The Development of Multi-level Governance for the Management of Polar Bears in Nunavut Territory, Canada

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Abstract

This thesis examines the complex social ecological system involving polar bear management in Nunavut and its conversion from a top-down system to a multi-level governance system. The interactions of the governance scale with the biophysical, economic and social/cultural scales are explored, with emphasis placed on the local levels of these scales. Co-management, as an instituted method of governance, is also examined to evaluate the incorporation of the Euro-Canadian and Inuit ideologies regarding polar bears.

The hypothesis that Inuit would gain power through the authority granted to them in co-management was supported. However, the hypothesis that individual polar bear harvesters and other Inuit involved in the formal governance system would adopt the Euro-Canadian ideology due to the influences of the market economy and historic power of the top-down governance system was not well supported. Instead, Inuit used the Euro-Canadian tools of science and the market economy, but resisted top-down management views and the commoditization of polar bears in the market economy. Traditional understandings of social relationships among humans and between humans and bears based on the social economy of subsistence were used to oppose Euro-Canadian views in co-management and in structuring the use of polar bears for economic reasons.

Résumé

Cette thèse compare le système socio-écologique, impliquant la gestion des ours polaire du Nunavut, et la conversion d'un système de gestion directionel (*« top-down »)* vers un système de gouvernance multi-niveaux . Les interactions des échelles de gouvernance avec les éléments biophysiques, économiques et socio-culturelles sont abordées, en mettant l'accent sur les échelles locales. La co-gestion, comme méthode de gouvernance, est également examinée afin d'évaluer l'incorporation des idéologies Euro-Canadiennes et Inuits en ce qui concerne les ours polaires.

Notre hypothèse de recherche stipule stipulant que les Inuits gagnent du pouvoir par l'acquisition d'une autorité accordée par la co-gestion. Toutefois, nos recherches n'ont pas corroboré l'hypothèse voulant que les individus chassant l'ours polaire et les autres Inuits impliqués dans le système formel de gouvernement adopteraient les idéologies Euro-Canadienne, en raison de l'influence du pouvoir du marché économique et historique présent dans le système de gestion directionnel. Au contraire, les Inuits utilisent les outils scientifiques Euro-Canadiens et l'économie de marché, mais résistent aux idées de gestion directive et la commercialisation des ours polaires dans l'économie de marché. La compréhension traditionelle des relations entre les Hommes, entre les Hommes et les ours polaires sur l'économie sociale de substistance a été utilisée afin d'opposer les idées Euro-Canadiennes de la co-gestion et pour rationaliser l'utilisation de l'ours polaire pour des raisons économiques.

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Contributions of the Authors

This thesis contains four manuscripts. All the manuscripts are single authored by Martha Dowsley with the exception of Manuscript 3 *"Time of the Most Polar Bears:" A Co-Management Conflict in Nunavut*. For this manuscript Martha Dowsley is the first author and George Wenzel is the second author. The collection of data and writing of the paper were conducted by the first author. Discussions between the two authors guided the paper's development and assisted with analysis of the data.

CHAPTER 1: INTRODUCTION

The management of renewable natural resources was, until recently, seen as being within the purview of biologists. Advancements in scientific knowledge of many species and the conditions required for their existence have however, proven inadequate to ensure their conservation (Freese 1997; Levin 1999; Alexander and McGregor 2000; Agrawal and Ostrom 2001). Although knowledge of renewable natural resources is crucial, understanding and managing the interactions of humans with the natural world and especially with each other are also vital components in our quest to use renewable natural resources in a sustainable fashion. This connection between social and ecological systems requires the input of fields such as political science, anthropology, economics and geography in order to develop appropriate governance structures to complement our biological understandings of renewable natural resources.

Following the realization that social and ecological systems are integrated, it is now also generally understood that we must examine these as complex rather than linear systems (Levin 1999; Holling 2001; Berkes et al. 2003). Within this view, sustainability is defined as using natural resources to meet the needs of the present generation without compromising the ability of future generations to meet their own needs, through developing and maintaining adaptive capacity and resilience to change (Holling 2001; Berkes et al. 2003). Resilience is the ability to withstand perturbations, while adaptive capacity is the ability to adapt to change. In order to use resources sustainably then, we must examine the social-ecological systems in which they are embedded in order to gain an understanding of the interactions between the various components and how change affects the systems.

Holling (1986) conceptualized social-ecological systems as an adaptive renewal cycle with periods of exploitation, conservation, release and

reorganization (see Figure 1.1). The release and reorganization stages, where the system shifts from Ω to α is termed the 'backloop'. This section of the cycle was understudied during the employment of the linear systems paradigm, which focused on maximization of growth, and thus tried to maintain systems in the exploitation (or growth) phase. The backloop is, however, essential for sustainability, and provides important opportunities for policy intervention. This part of the cycle is often much faster than the front loop, and is also the point (during reorganization) where a flip to another system might occur, causing the loss of resources from the original system (illustrated in Figure 1.1 as an exit arrow as the system enters the 'r' phase).

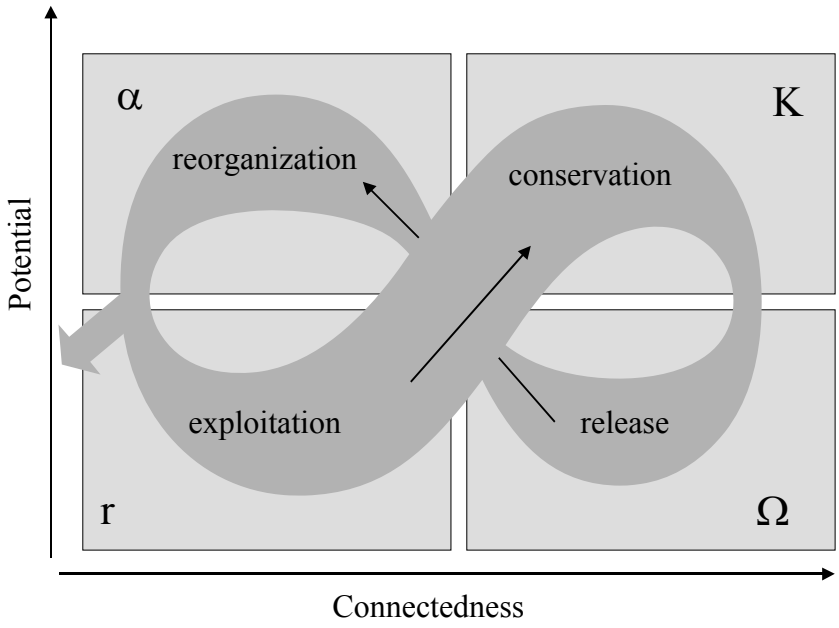

Figure 1.1 Holling's adaptive renewal cycle (modified from Gunderson and Holling 2001).

Adaptive cycles are found at different hierarchical levels of organization in both human and natural systems, with smaller, faster cycles operating at lower levels and larger, slower cycles operating at higher levels. This nested set of adaptive cycles is called a 'panarchy'. The recognition that adaptive cycles

operate at different levels encourages experimentation within the different levels and connections between the levels. These connections, particularly during the vulnerable backloop phase, allow for the outcomes of crises in lower levels to be incorporated into higher levels (a process termed 'revolt'), and for the outcomes of destructive changes to be dealt with through 'remembering' aspects of the higher levels in order to rebuild. Examples of revolts are well known from human social history, while an example of 'remembering' is the regrowth of the same tree species from seed banks after the mature trees have been destroyed by a forest fire.

Wildlife are a difficult natural resource to manage sustainably because they are fugitive resources, meaning they move across spatial and social boundaries, and thus cannot be managed based on their biology alone. Instead, their management also includes a key political component. Social science disciplines such as political science and geography, have been criticized for their lack of engagement on the topic of wildlife conservation (Young 2001; Giordano 2003; Agrawal and Ostrom 2006). Geography for example, is a useful lens to examine the various levels on the spatial and social/political scales which influence wildlife management (c.f. Campbell 2007).

Wildlife are classified as 'common pool' resources, meaning they are characterized by their subtractability (i.e. if one user removes a unit, there is one less for others to use) and by the difficulty of excluding other users (Ostrom 1990; Bromley et al. 1992). Such resources are often governed by common property regimes as a distinct form of group property rights falling between private property and open access. Again, geographers have been criticized for not engaging in common property theory (Young 2001; Giordano 2003), yet the spatial scale of common property issues makes them an excellent topic for geographic inquiry. This thesis addresses this gap in geographic research by examining the social components of a wildlife

management system, focusing on cultural, political and economic interactions. The primary theoretical framework used is common property theory.

A current focus of common property research is the development of multi-level common property regimes (Cash and Moser 2000; Adger et al. 2006; Cash et al. 2006; Young 2006). This focus is closely related to the paradigm shift from a linear systems view to a complex systems, or panarchy, view and seeks to improve on poor results from top-down and bottom-up systems of management (see Peluso 1993; Barrett et al. 2001; Bradshaw 2003 for discussions of failed management systems). Multi-level governance is considered more effective than either top-down or bottom-up systems because, while it recognizes the importance of local or community-based management, it aims to assign appropriate tasks to different levels of governance (Berkes in press; Cash and Mosher 2000). It links the local to the global on a scale consisting of different levels of governance, which may or may not be formal political units of government.

Figure 1.2 illustrates two perspectives of the governance scale. In top-down governance (Figure 1.2a) the various levels are perceived as subordinate to those above. In multi-level governance (Figure 1.2b) each level is seen as an adaptive cycle in a panarchy, tightly linked to those above and below it in a system that focuses on the appropriate assignment of tasks to various levels. As Holling (2001) explains, each level is protected by the more general, slower-acting upper levels and inspired by the faster-paced lower levels. Each level on the governance scale is assigned responsibilities relating to similar levels on other scales, most obviously the ecological scale in the case of wildlife management, but also the economic and socio-cultural scales. Multi-level governance is thus an integrated approach to managing complex socio-ecological systems (Lebel et al. 2005; Reid et al. 2006; Cash et al. 2006; Berkes in press). It allows multiple objectives to be met, provides space for the use of different knowledge systems, such as scientific and local or

traditional knowledge, and is meant to encourage learning and novel problem solving among participants.

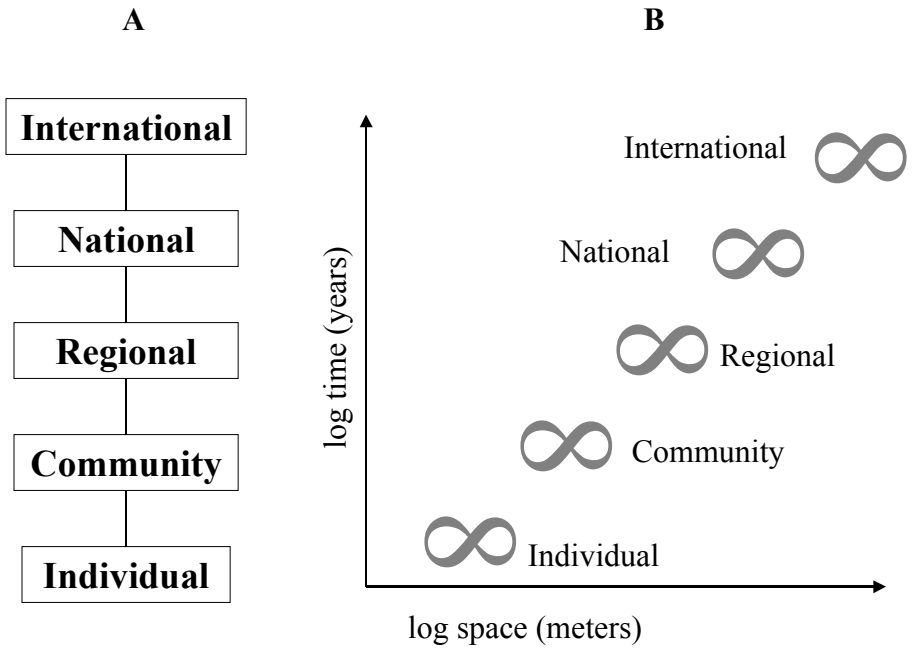

Figure 1.2. Two Perspective on the Governance Scale, a) Showing a Linear Hierarchical Perspective, and b) Showing a Panarchy Perspective (B is modified from Gunderson and Holling 2001).

Major recent events affecting social-ecological systems for managing natural resources worldwide are the paradigm shift from top-down management to cooperative or co-management of resources, and the global environmental effects of climatic warming. In northern Canada the finalizing of the comprehensive land claim of Nunavut in 1993 and birth of the new territory of Nunavut in 1999 established a nascent co-management system. At the same time, Nunavut's geographic position in the arctic makes it especially vulnerable to climate change (ACIA 2005). Thus, Nunavut is undergoing change in both its ecological and its resource management systems, making it

an ideal candidate for the examination of a complex social-ecological system that is adapting to change.

The common pool resource selected for analysis here is the polar bear (*Ursus maritimus*). Inuit have long engaged with this species in a physical sense through its position as a co-apex predator with food and trade values (Kemp et al. 1977; Wenzel 1991; 2005; Freeman and Wenzel 2006). Inuit have also interacted with the polar bear in an abstract sense through its use as a symbol of power and of the links between people and their environment (Wenzel 1983a; Randa 1986, Sandell and Sandell 1996). Internationally the status of the polar bear has recently been uplisted to vulnerable by the World Conservation Union (International Union for the Conservation of Nature Species Survival Commission (IUCN/SSC)) due to climate change-linked impacts on the population parameters of 3 of 19 world populations (Schliebe et al. 2006).

Polar bears have long been valued economically for their meat and fur and more recently for sport hunting. They also have non-empirical value as cultural resources for Inuit, Canadians in general, and many other people around the world. Most recently polar bears have taken on a new symbolic value as a flagship species for climate change concerns.

The case study of polar bear management allows focus to be placed on the interaction across levels on the governance scale because several levels from the local to the global are involved in polar bear conservation. As well, through this case study we can analyze the interaction between two different ideologies regarding polar bears. Examination of the governance system from a top-down perspective reveals a Euro-Canadian wildlife management paradigm, in which focus is on conservation of the species from a scientific perspective that seeks to maximize harvests and thus economic returns through time. Concomitantly a bottom-up perspective of governance is framed by an

Inuit cultural paradigm in which animals are seen as sentient and actively involved in human social, economic and environmental relations (Fienup-Riordan 1990; Stairs and Wenzel 1992; Nadasdy 2002; Wenzel 2005;).

Attempts to incorporate disparate ideologies has become the norm for natural resource management in northern Canada through the use of institutional systems of cooperative management (also known as co-management). The general development of co-management systems can be conceptualized as in Figure 1.3, whereby at some point in the theoretical past, little investment was made by either locals or higher levels of government (if any higher levels existed) (Cell 1). Local-level management then developed through time as resources were utilized and became embedded in local culture (Cell 2). Government management was eventually developed, possibly independently of local management. Finally, both forms of governance interact and attempt to develop co-management (Cell 4). As indicated by the axes in Figure 1.3, greater effort is required to develop management systems than to leave the resource as open access. The move from Cells 2 and 3 to co-management is even more difficult because it requires the construction of a new type of management system that considers both parent systems.

In reality, the success of co-management systems has been mixed, primarily due to the difficulty of marrying the disparate ideologies and the dominance of the top-down system and ideology (White 2006; Nadasdy 2003a).

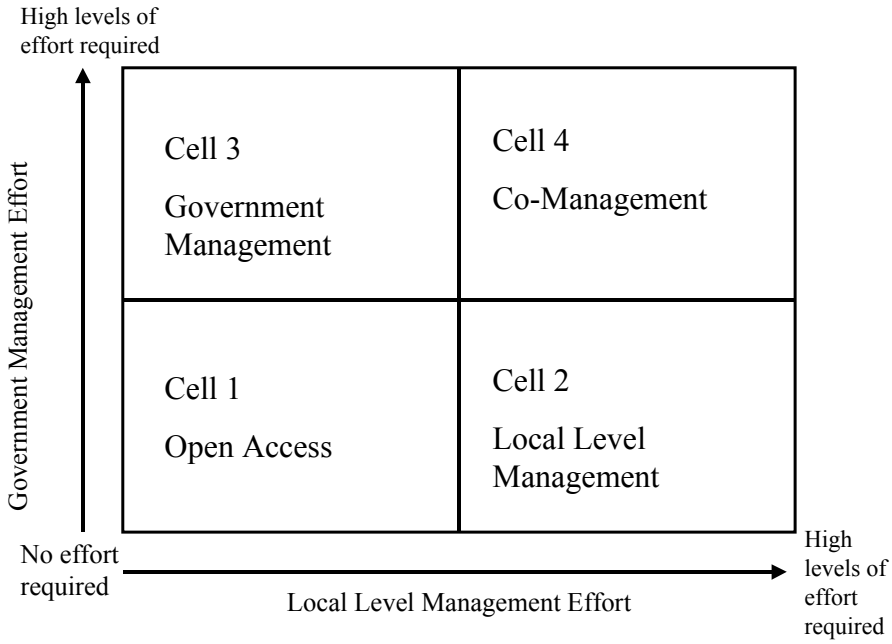

Figure 1.3. Schematic Illustrating Types of Management Related to Level of Investment Necessary from Local and Higher Forms of Governance (Modified from Acheson 1989: 369).

Despite these problems, co-management does increase the property rights assigned to the resource users (a key goal of decentralization and in some instances also of multi-level governance). Agrawal and Ostrom (2001) list four categories of property rights: 1) Withdrawal rights, 2) Exclusion rights 3) Management rights and 4) Alienation rights. Withdrawal rights allow the holder to harvest units of the resource. Exclusion rights include the right to decide who holds withdrawal rights and how to transfer withdrawal rights. Management rights allow the holder to make decisions about how the resource will be used and potentially modified. Finally, alienation rights allow the holder to sell or rent the other types of rights.

The Government of the Northwest Territories developed a Game Ordinance in 1949, which gave withdrawal and exclusion rights for the use of polar bears to residents of the territory (Clancy 1990). Canada ratified the International Agreement for the Conservation of Polar Bears and Their Habitat in December 1974 (Prestrud and Stirling 1994), which further secured withdrawal and exclusion rights for local hunters. During the 1970s, two developments increased the rights of local resource users. The first was the development of laws governing the sport hunting industry, while the second was the 1975 creation of local governance institutions for wildlife (Clancy 1990). These gave communities alienation rights, although harvest levels were constrained within the quota assigned to the community by the territorial government. Management rights to polar bears (the right to regulate internal use patterns and transform the resource) have only formally been granted with the advent of land claims and their instituted wildlife co-management boards. The gradual increase in local rights, which has culminated in the development of a co-management system in Nunavut, provides the situational backdrop for this thesis.

The political development of wildlife management in Nunavut can also be examined from the perspective of political ecology, which asks such questions as 'What is viewed as the 'proper' relationship between humans and their environment?' and 'Who decides this and why?' (Stott and Sullivan 2000). Geographical political ecology examines such questions at different levels and scales and recognizes the simultaneous and interrelated processes that occur in each (Zimmerer and Bassett 2003). Thus, geographical political ecology recognizes the complex social-ecological systems discussed by Holling (1986) and others (ex. Berkes et al. 2003) and focuses specifically on the human political aspects of the system.

This thesis is written from a critical-realist perspective (Eden 2001; Forsyth 2003; Zimmerer and Bassett 2003), in that it assumes there is an underlying

reality to the components of the natural world, but recognizes that "we can only ever know them through (imperfect and changing) cultural and social ways" (Eden 2001:82). From this perspective the importance of obtaining information from the natural world is assumed, while the interpretation and use of that information must necessarily be examined in order to improve the sustainable use of the resource. In the case of polar bear management then, we see two ideologies being used to interpret and shape the social aspects of the social-ecological system –the Euro-Canadian top-down perspective and the Inuit bottom-up perspective. Several questions then frame the thesis: What happens when a subsistence resource develops new values across the social-cultural scale? How does human interaction with the resource change with changing understandings of the environment and the resource? How does ideology relating to that resource change as a result of these interactions?

It is hypothesized that the advent of co-management (which increases authority of aboriginal people over natural resources), and the increasing recognition of scientific uncertainty due to climate change, will allow the aboriginal ideology and the related use of traditional knowledge to gain power in the management of polar bears. However, it is also hypothesized that the top-down ideology will become more pervasive among the individual participants in the system (including harvesters), due to the nature of historic power relations in top-down governance and the influence of the market economy.

To reiterate, in this thesis the primary theoretical framework of multi-level governance comes from common property theory and is embedded in the panarchy or complex systems concept, but ideas from economic anthropology and the institutional experiences gained through the process of co-management are discussed in the various manuscripts. The main ideas within the literatures of common property, with its current focus on multi-level goverance, co-management, and economic anthropology are explored in the next chapter. As well, throughout the thesis some dismantling of the governance system is

required for analysis of some key components, but a view of the integrated nature of the system is attempted.

Thesis Objectives

The main goal of the thesis is to examine the transition of top-down governance into multi-level governance in the context of multiple uses of polar bears and in an era of increased recognition of ecological uncertainty. Flowing from this are three supporting objectives:

1. To explore how the transition to multi-level governance affects interactions between the governance scale and the biophysical, economic and social/cultural scales.

2. To examine the interaction of two cultural paradigms regarding the interactions of humans and wildlife: Euro-Canadian and Inuit, and their different tools for knowledge generation, respectively western science and local experience.

3. To analyze how local-level governance institutions balance different uses of the resource within a cultural framework and in the context of the larger governance and economic systems.

Thesis Outline

Chapter 2 summarizes relevant literature regarding common property, co-management and economic anthropology, and identifies gaps in these literatures that are relevant to the main objectives. The second section of the chapter frames the selection of the polar bear as a common pool resource case study in Nunavut for the examination of multi-level governance.

Chapter 3 is the first manuscript (Dowsley in press, *International Journal of the Commons*). It analyzes polar bear governance systems in their historical contexts and assesses their transition from formal top-down and less formal local institutions into multi-level institutions. Examples are drawn from several systems, but particular emphasis is placed on Nunavut.

Chapter 4 is the second manuscript (Dowsley 2007, *Research and Practice in Social Sciences* 2(2): 53-74) which reports and discusses interview data collected from local Inuit in the Baffin Bay polar bear population area. This manuscript uses a novel approach of combining qualitative and quantitative analysis of the data to provide a contextualized data set that shows variation across the geographic study area. It aims to supplement traditional and scientific knowledge already collected to assist in co-management discussions. An earlier version of this manuscript (Dowsley 2005) contributed traditional knowledge to the co-management discussions held in the Baffin Bay area that are analyzed in the third manuscript.

Chapter 5 is the third manuscript (Dowsley and Wenzel in press, *Arctic*) which draws on several sources of Inuit knowledge to examine the interactions between Inuit organizations and the Nunavut territorial government in the co-management setting. It focuses on a specific case in which the various groups met in 2005 to discuss the possibility of reducing hunting quotas for two polar bear population areas, Western Hudson Bay and Baffin Bay. These two areas had received quota increases earlier in 2005 based on Inuit knowledge that the populations were increasing, but scientific data and interpretations suggested the populations were in decline.

Chapter 6, the fourth manuscript (Dowsley in prep), examines how polar bears are used economically in Nunavut communities. A broad definition of economics is employed to examine the decisions made at the local level of governance. This paper supports the others through its examination of

multiple uses of the resource and the cultural context of local level governance. It also directly examines the hypothesis that the top-down ideology regarding the resource will spread to the lower levels of governance as multiple uses and values are given to the resource by different levels on the social/cultural scale.

Finally, chapter 7 summarizes the findings of the individual manuscripts and discusses the original hypothesis regarding the interaction of disparate ideologies and the historic dominance of the top-down view of the resource in the management system. The chapter concludes with the contributions of the thesis to understanding the development of multi-level governance systems for the sustainable management of renewable natural resources embedded in complex social-ecological systems.

CHAPTER 2: LITERATURE REVIEW AND CASE STUDY SELECTION

The thesis examines the challenge of renewable natural resource management by drawing on several sets of related literature: common property theory and the current focus on multi-level governance, co-management, and economic anthropology. These four areas will be reviewed and gaps in the literature that pertain to polar bear management in Nunavut will be identified. The rationale for the selection of the case study species and geographic area will then be presented.

Common Property

Common property theory developed from neoclassical economics and game theory with the Prisoner's Dilemma and Hardin's Tragedy of the Commons (1968). In these theoretical situations logical choices lead people to choose sub-optimal solutions. One major criticism of them is that in real life situations humans can often improve their outcomes by communicating with others (Elardo and Campbell 2007). Common property theory then examines the coordination of groups to manage a shared resource, called a common pool resource, from which individuals draw units. Common pool resources are defined by two important characteristics, first, the removal of units subtracts from the total number of units, and second, it is difficult to control who has access to the resource (Ostrom 1990). The problem of low excludability makes private property regimes too expensive to enforce, but at the same time the subtractability of common pool resources requires some form of management in order to ensure the persistence of the resources into the future.

Classic examples of common property research include the examination of subsistence fisheries and irrigation systems (Ostrom 1990; Bromley et al. 1992), but the field also explores sustainable use of renewable resources for

the market (ex. marine fisheries, Rudd 2004) and is applied today to such diverse resources as credit institutions, geo-stationary orbits and Internet sites (Pretty 2003; Ostrom et al. 2002). It has thus moved from examining local institutions with few uses and a limited user group to regional and international institutions with multiple user groups and many uses of the resource (Ostrom et al. 2002; Dietz et al. 2003). Common property theory has proven important for examining human organization concerning the governance of shared resources and is a vital tool for developing systems for the sustainable use of renewable natural resources (Acheson 1989; Plummer and Armitage 2007).

In roughly the past two decades, governments have been supporting the creation of common property regimes as part of sustainable development projects and devolution of authority to local institutions (for example community-based conservation), albeit with mixed results (e.g. Morrow and Hull 1996; Edmonds 2002; Plummer and Armitage 2007). General rules and frameworks to assist in designing common property regimes have been developed (e.g. Bromley et al. 1992) and the results of implementation have been evaluated (e.g. Ostrom et al. 2002). Barriers to effective common pool resource management for institutions developed in a top-down fashion include lack of capacity in the community institutions (Bradshaw 2003), incompatibility of the institution with community history, culture and political ecology (Alexander and McGregor 2000, Morrow and Hull 1996) and lack of real community control in terms of power and authority (Goldman 2003). These issues are subsumed under three key topics in need of further investigation: the evolution of appropriate institutions, the social/historical context of institutions, and finally, the linkages of local institutions with other levels of government (Ostrom et al. 2002). There is also a need to examine systems that involve multiple-use resources (Edwards and Steins 1998).

Inuit and Common Property

The Inuit traditional property system provides an interesting example of common property. Historically, Canadian Inuit can be divided into eight regional groups based on linguistics, culture and ecological adaptation (Damas 1968; 1972; Usher and Bankes 1986). Each group has typically been further divided into bands that defined themselves by their common geographic territory and named themselves after it, adding the suffix *–miut* meaning 'people of'. The territorial claim was expressed through oral histories of the area as well as recent use. Permission was sought in using the resources of another group of people. Thus, although boundaries were fluid, geographic claims to territories were recognized.

One major difference between Euro-Canadian and Inuit views of common pool resources is that Inuit do not view land and resources as things separate from humans that may be owned. Rather humans interact with animals and manipulate that relationship to a certain degree, but animals are seen as partners in the relationship, rather than solely subject to human will (Wenzel 1983a; Usher and Bankes 1986; Stairs and Wenzel 1992). As a result of this perspective, rights to the land and resources were traditionally use rights rather than ownership rights (thus there was no right of alienation) (Usher and Bankes 1986). Nevertheless the traditional property system can clearly be considered a common property system in which groups of people held rights to resources.

During the twentieth century the increasing influence of top-down Euro-Canadian governance resulted in the granting of group user rights to Inuit and other northern aboriginal peoples in an effort to protect their land-based economies from encroachment by non-Native settlers (Usher and Bankes 1986). It was assumed that such rights would become unimportant as the north developed economically (Usher and Bankes 1986), however aboriginal interest in maintaining and expanding their legally recognized rights to common pool

resources continued and culminated in comprehensive land claims, for example, the Nunavut Land Claims Agreement (NTI 2000). The development of a formal governance system for wildlife management in the Canadian Arctic began in the mid-twentieth century as a top-down system, but soon began its transition to a multi-level system.

Multi-Level Governance

Multi-level governance is a concept based on common property theory that recognizes the complexity of social-ecological systems as outlined by Holling (2001) and focuses on the interactions of different levels and scales relating to the use of common pool resources. A scale is defined as a temporal, geographic or other dimension used to study a phenomenon, while a level is a unit on a particular scale (Berkes in press; Cash et al. 2006). In order to understand outcomes of environmental management systems in general, an examination of the governance scale and its interactions with various other scales is necessary. For example, international political and economic policies of the United States government are linked to the cultivation of marginal land to grow wheat in the 1970s, which resulted in severe soil erosion (Lockeretz 1978). Thus, events involving the political and economic scales resulted in an environmental problem. Figure 2.1 illustrates some scales and levels examined in this thesis. Each level is represented as a box, however it is understood that the scales are part of the panarchy of the complex social-ecological system and that adaptive cycles are housed in the boxes illustrating each level. The economic scale is discussed further below.

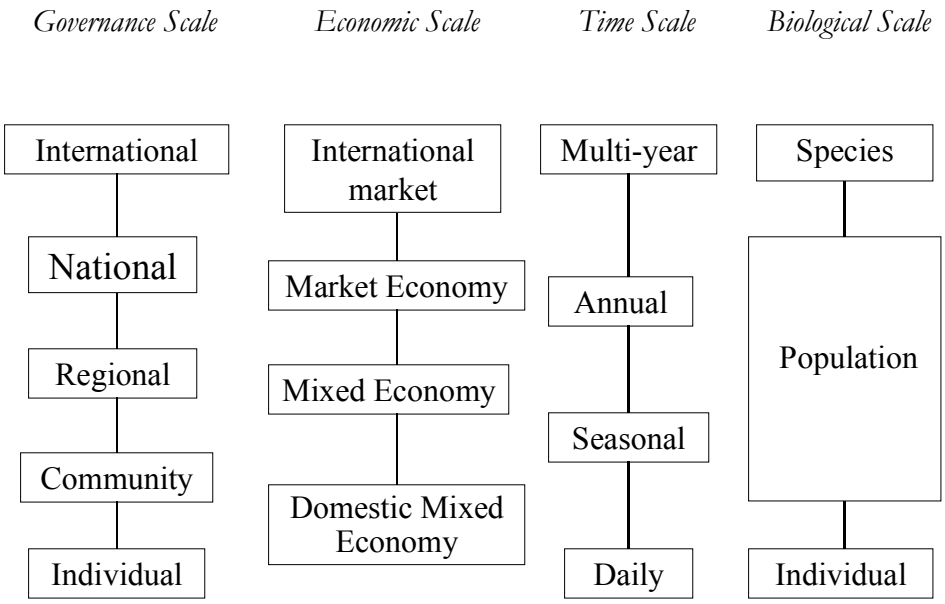

Figure 2.1. Scales and levels discussed in this thesis.

The connections and feedbacks between levels of a scale and across scales (not illustrated) create a complex system. Theory regarding such systems indicates that each level on a scale requires a different set of concepts that may or may not overlap with other levels (Dietze et al. 2003; Berkes in press). It is therefore difficult to scale up from community-based management or scale down from international institutions (Berkes 2006a). The local level of governance is, however particularly important since it is at this level that resources are harvested. For this reason we must examine the local level of governance in order to understand the functioning of the entire system. Some authors (ex. Agrawal and Gibson 1999; Brown 2002; Berkes 2004; 2006a) view the development of new multi-level governance structures from the ground up perspective, as the construction of new institutions. However, many top-down systems are unlikely to be dismantled for various reasons and therefore might be candidates for modifications into a multi-level system

rather than for replacement by bottom-up approaches for multi-level institutional development. Case studies of transformations from top-down to multi-level systems are lacking in the literature.

Many of the key topics in common property theory and the question of transforming top-down institutions into multi-level governance institutions are highlighted in situations involving two different cultural views of common pool resources. Co-management has become the form of governance chosen to deal with disparate viewpoints.

Co-management

Top-down management of renewable natural resources is considered inadequate for promoting sustainable use and conservation objectives at least in part because it uses reductionist scientific models and does not pay appropriate attention to politics, nor social and economic pressures (Pomeroy 1995; Agrawal and Gibson 1999; Goldman 2003). Co-management, or the sharing of management between governments and local organizations, takes many forms (see Berkes et al. 1991, Notzke 1995), but according to Berkes "the goal should be as much local solution as possible and only so much government regulation as necessary" (Berkes 2004:626). Advocates of various forms of co-management have argued that shared responsibility could increase stewardship and equity and make resource use more responsive to a variety of needs (Castro and Nielsen 2001). It is argued that local managers know their environment better than distant government officials; they can more easily see the repercussions of their decisions; and can act to create a more accurate and quick-responding system of management (Bradshaw 2003). This does not mean however that other levels of management are not necessary. For example, local institutions are insufficient to deal with wide ranging problems like pest or disease outbreaks (see Bradshaw 2003). Theoretically, co-management arrangements represent the best solution to the problem of

sustainable use of natural resources in that they combine local knowledge and ability to act, with the strengths of various higher levels of government. Co-management then fits in well with the concept of multi-level governance.

Support for co-management comes from both the top-down and bottom-up directions on the governance scale and has been instituted in modern aboriginal land claims across Canada including the Nunavut Land Claim Agreement (Notzke 1995; Pomeroy and Berkes 1997; NTI 2000), but these co-management systems have not been as effective as desired by either group. A major problem continues to be the interaction of indigenous and western views of natural resources and the management institution itself. Although traditional ecological knowledge is often included in co-management systems, it is generally only used as a form of data to supplement scientific information, rather than a knowledge system (Usher 2000; Nadasdy 2003a). Traditional ecological knowledge about wildlife populations for example, can be, and is in fact, tested empirically (Kendrick et al. 2005; Gilchrist et al. 2005), although much work can be done in this area in order to better integrate science and this type of traditional knowledge. The cultural aspects of traditional knowledge have, however proven more difficult to integrate into co-management systems (Nadasdy 2003a; Natcher et al. 2005; White 2006).

The considerable amount of time, money and energy that must be invested in developing co-management institutions and the often far-from-perfect outcomes have encouraged scholars to view the situation as an iterative process rather than a simple flow of information (Holling 2001; Cash et al. 2006). In order to further the development of co-management as part of multi-level governance, indigenous perspectives must be better understood by higher levels of government. One way to examine indigenous ideologies surrounding natural resources is through an exploration of how resources are divided among competing uses, in effect the study of the economics of resource use in a cultural setting.

Inuit and Co-management in Nunavut

Co-management is legislated in Nunavut through the Nunavut Wildlife Management Board (NWMB), which is an institution of public government under the Nunavut Land Claims Agreement (NTI 2000). While the designated territorial or federal Minister holds ultimate responsibility for wildlife management, the NWMB is the main instrument of wildlife management in the Nunavut settlement area. It may hold public hearings on any issue requiring its decision, and has typically done so, particularly in issues involving the setting of quotas for wildlife harvesting. It thus has a close relationship with lower levels of governance such as Regional Wildlife Organizations and community Hunters' and Trappers' Organizations. White (2006) found that although the NWMB makes a strong effort to incorporate traditional knowledge into its operations, its bureaucratic structure is at odds with Inuit culture. The incorporation of traditional knowledge is however, far and beyond that seen in non-land claim co-management boards in other areas of the Canadian Arctic (White 2006).

Inuit participation in wildlife management at the local level typically involves partnerships between the NWMB or responsible government departments, and community Hunters' and Trappers' Organizations. Independent researchers are also required to consult with Inuit communities and provide research results to them through the Nunavut Research Institute. Inuit participation often involves consultations, community-based monitoring and management programs. Examples include Memoranda of Understanding regarding the management of certain species including polar bears (Government of Nunavut 2005a), the Inuit Bowhead Knowledge Study, which was mandated by the Nunavut Land Claim Agreement (Hay et al. 2000), and an experimental community-based narwhal management program (Armitage 2005). Inuit have also commissioned their own studies and presented them to government, for example in conducting a cumulative impact study of hydroelectric

development during the planning phase of the Great Whale hydroelectric project in northern Québec (McDonald et al. 1997). This project was a joint effort between Inuit from northern Québec and Nunavut and Cree from Québec and Ontario.

The collection of traditional knowledge relating to observations of the environment for the purpose of wildlife management is clearly a useful approach to complement scientific studies, which often lack temporal depth and geographic breadth. Only a few studies have yet been carried out to collect and analyze traditional knowledge for this purpose (ex. Ferguson et al. 1998; Mallory et al. 2003; Gilchrist et al. 2005).

Inuit are more integrated in wildlife management than they have been in the past, yet critiques of their involvement suggest their observations of the environment could be better integrated into management and that their cultural understandings are at odds with the co-management system (Armitage 2005; White 2006). Further investigation into both Inuit traditional knowledge (Inuit *Qaujimajatuqangit* or IQ) relating to observations of the environment and IQ relating to cultural understandings of the environment are needed.

Economic Anthropology

The study of economics from an anthropological perspective provides a tool to evaluate the valuation of natural resources. While it does not pretend to capture non-empirical values, it gives some insight into the ideology of resource use.

Economic anthropology is a subfield of cultural anthropology, which examines economics as embedded in the larger society through its connections to politics, culture and other areas (Plattner 1989). Originally a purely descriptive field, economic anthropology developed into a more analytical and

theoretical field during the mid-twentieth century. At that time, discussions emerged surrounding the search for universal economic rules. The two most prominent schools of thought are the formalists who employ neoclassical economics in an attempt to explain all economies (ex. Firth 1968; Herskovits 1968) and the substantivists who employ a broader definition of economics to examine the unique forms of making a living that are employed in different cultural contexts (ex. Polanyi 1944, 1957; Dalton 1968).

The work of Karl Polanyi (1944; 1957; 1968) in historical and comparative economics has been particularly influential in the field (e.g. Isaac 2005: Stanfield et al. 2007). Polanyi started out as an economic historian. He observed the development of market capitalism in England and the resulting separation of the economy from social relationships (Polyani 1944). He believed the commoditization of goods, labour and land threatened to destroy social and cultural institutions in society, but that the rise of socialism and the welfare state helped to offset these negative consequences of market capitalism.

Polanyi then worked with anthropologists to study non-capitalist economies. He defined the formalist approach as assuming a scarcity of resources. This creates a view of economics as a system of choosing between alternatives to maximize efficiency (which could include utility or profits) (Polanyi 1957; Isaac 2005; Stanfield et al. 2007). Polanyi (1957) then used the work of Malinowski (1922) on the economy of the Trobriand Islanders of the South Pacific to develop the substantivist approach. The substantivists view economics as how humans make a living within their natural and social environments, which may or may not include choice nor maximization of anything. Polanyi felt that substantivism allowed for a comparison across cultures because it assumes a material need, but views the objective of the economy to be sufficiency rather than efficiency. Formalism thus focuses on

logic and theory while substantivism focuses on fact observed in different cultural settings.

Critics of formalism pointed out its ethnocentric focus on western market economies, which ignores the history of these institutions, as well as the histories and alternative futures of other economies that may or may not converge on the market system (Stanfield et al. 2007). The formalists countered that their measurement of utility is not limited to money as the unit, but refers to whatever is being maximized, and thus is not ethnocentric nor limited to a particular time in history, rather it is the tool that should be used in comparative economics and economic anthropology (Cook 1966; LeClair and Schneider 1968; Isaac 2005). Halperin (1994), a substantivist, replied to this that if everything is analyzed in the rational, maximizing way of the formalists, all cultures would appear the same and no comparisons could be made.

The debate can be seen as a divergence of viewpoints, with the formalists seeing differences between economies as one of degree, while the substantivists viewed it as a difference in kind (Cook 1966). The formalists focus on the individual and his/her choices, while the substantivists examine the system in which the individual is embedded (Cancian 1966). The tension between the two schools also speaks to wider tensions in social science such as between positivistic and interpretative approaches and between generalization and particularization (Isaac 2005). Economic anthropology then struggles to define its unit of study as well as to select the tools it should employ. Both the formalist and substantivist approaches have value and can assist in understanding the diversity of economic systems and the use and valuation of resources.

Inuit Economy

The Inuit economy has been used to examine economic anthropological questions since the field began with the work of Franz Boas on the central

Inuit (Boas 1888). As a cultural evolutionary view developed during the late 19th and early 20th centuries, studies of hunting and gathering economies, including those of Inuit, focused on primary production with hunting being seen as the theoretical economy of early humans (Lee and Devore 1968). Hunter-gatherers were seen as primitive and struggling to survive until Sahlins presented his paper on the "Original Affluent Society" in 1968. Inuit cultures however, served as an important counterpoint due to the harsh environment they inhabit, resulting in a conceptual scale of affluence that placed Inuit at the extreme lower end (Lee and Devore 1968). The assumption that Inuit live in the most extreme environment suggests that they should be more preoccupied with meeting needs and have less energy to devote to non-essentials than people living in other places. That is, they should be astute maximizers in the formal economic sense. However, some anthropologists, in particular Damas (1968; 1972), had already found a high level of variability amongst aspects of the economies of Inuit groups that spoke to the importance of history and social organization and suggested the environment was not so harsh as to force people into only one way to make a living.

The logical hypothesis that Inuit should be maximizers encouraged further examination of Inuit economy. In a cultural ecology study on energy flow, Kemp (1971) found that given choices in labour distribution between wage employment and hunting, Inuit households did not necessarily distribute their labour in such a way as to maximize returns from energy invested. Hunting was maintained despite the better returns from wage labour. No doubt Kemp's study was also influenced by the concurrent shift from studying hunter-gatherers as the theoretical economic ancestors to 'modern' market economies, to examining the effects of interactions between hunter-gatherers and other groups, in particular those groups using a market economy. Some researchers, such as Murphy and Steward (1956/1968) and Chance (1960), predicted the replacement of subsistence economies by the market. This evolutionary view has been overshadowed by evidence, such as Kemp's study, that shows the

persistence of many subsistence economies decades, and even centuries, after the introduction of cash and the market (Spencer 1969; Denbow 1984; Myers 1988; Wenzel et al. 2000). This persistence supports the substantivist view of multiple values being used in subsistence economies.

The continued use of subsistence systems has also forced researchers to reconsider their definition of subsistence. It is now considered that subsistence is a highly integrated social economy that does not just entail the actual acquiring of food, but also includes the social system that organizes the production, distribution and consumption, not only of food, but of other material and non-material goods (see Figure 2.1 *Economic Scale*) (Lonner 1980; Langdon 1986; Nadasdy 2003b). Subsistence economies such as that of the Inuit, then can serve as support for the substantivist school in economic anthropology, and are often studied using an interpretive, particularist approach (see for example Dahl 1989; Hovelsrud-Broda 1999; Wenzel et al. 2000). Today the Inuit economy, like many others originally based on hunting and gathering, utilize cash in a mixed economy (Wenzel et al. 2000). The term 'mixed' relates to the ways in which wage labour and the sale of wildlife products support hunting and subsistence. The previous examinations of Inuit economy from an energy flow perspective to the current particularist approach have left a gap in research employing both the formalist and substantivist approaches to examine mixed economic systems. Several questions remain including: do Inuit economic decisions make sense from the formalist perspective or can we only understand them from the substantivist perspective? Can employing both techniques draw a more complete picture of resource use?

Selection of a Case Study

Nunavut Territory is both a land claim and a territory, and has a majority indigenous population. In 2004-2005 Federal transfers to Nunavut increased

to over 800 million dollars and are expected to exceed 900 million by 2007-2008, which is calculated at over $30,000 per person in the territory (Dept. of Finance, Canada 2007). This is greater than any other province or territory in Canada (the second highest is the N.W.T. receiving over $20,000 per person). In 2005, 89.9% of the budget of Nunavut came from the federal government, up from 87.8% in 2004 (Simailak 2005). The balance of the budget is money generated within Nunavut.

Because Nunavut is poorly situated geographically to develop a manufacturing sector, the development of the natural resource sector has been encouraged (Grekin and Milne 1996; Myers 2000). However, non-renewable resource exploitation, in particular mining, suffers from boom and bust cycles and Inuit have made up only a small percentage of the workforce (Wenzel 1983b; Hobart 1982). One of the reasons Inuit have offered for not working in this industry, or quitting after a short time, was their desire to continue to work in the subsistence economy. The development of tourism addresses the desire of many Inuit for part time work that is situated close to home. Wildlife, Inuit culture and the extreme physical environment are major natural resources in the Arctic as a basis for tourism, and this industry has been encouraged by both the territorial and federal governments for several decades (Addison 1996).

Wildlife, as a key economic resource in Nunavut, is one type of common pool resource that firmly links local and higher levels on the geographic scale. While wildlife typically has a long history of local use throughout the world, it is a fugitive resource that generally ranges well beyond the jurisdiction of local institutions. It is very difficult for local governments to exclude other users and thus develop sustainable management institutions alone. Thus, cooperation between local governments and higher levels on the governance scale is necessary to determine property rights and develop management institutions. Wildlife management provides a good focus for common pool resource institutional research because of the multiple uses of wildlife

populations, the difficulty of controlling access to them, and their susceptibility to degradation.

The topics of rights to wildlife and appropriate use of animals are explored in other literature including biological conservation (e.g. Geist 1988), sustainable development (e.g. Matzke and Nabane, 1996, Stearman and Redford 1995), and tourism (e.g. Baker 1997). Rights to wildlife are highly political and relate to other resource rights such as those associated with land (Child 1996; Alexander and McGregor 2000; Wolmer et al. 2004). Wildlife management will be examined here in the context of the biological scale, but a focus will be placed on the governance scale and related social scales, in particular economics.

Humans use wildlife in multiple ways, including for subsistence and commercial hunting, cultural functions and inherent value (Leopold 1949; Geist 1988; List 1997; Hovelsrud-Broda 1999; Schultz et al. 2003). Traditional Inuit culture viewed wildlife and humans as integrated in one economic and social system (Usher and Bankes 1986; Stairs and Wenzel 1992). For Inuit, hunting was necessary to maintain relationships with animals. Respect for that relationship included the prohibition against taking more than was needed, as well as other restrictions on behaviour and thoughts regarding animals (Rasing 1994). Hunting levels then were controlled by the quality of the human relationship with animals including choices made by the animals to engage hunters, as well as respect paid by humans (ex. Wenzel 1983a). The Inuit subsistence economy, in which these understandings are based, has expanded to include commercial uses of wildlife. The interaction between the commercial and subsistence uses of wildlife and the affects on Inuit ideology relating to wildlife is explored throughout this thesis.

A new use of wildlife, sport hunting, is an economically important form of tourism and recreation in many countries (Baker 1997, Simiyu and Bennun

2000). Research into how best to manage sport hunting has been ongoing for over a decade (see examples in Robinson and Redford 1991 and Freese 1997), and has shown that it is less environmentally destructive than other forms of tourism (Baker 1997), can be used for sustainable development (Dietrich 1992) and can encourage conservation through economic incentives (Rasker et al. 1992; Lewis and Alpert 1997; Wilkie and Carpenter 1999; Freese and Trauger 2000,). As well, sport hunting generates considerably more money for the local economy per visitor than non-consumptive tourism (Milne et al. 1997; Baker 1997). The term 'conservation hunting' has emerged to highlight those sport hunting programs where conservation is promoted in such ways as through the inclusion of local governance in decision making and the use of scientifically-based quotas and returns of some profits to conservation programs (Freeman et al. 2005). One of the most sought after species for conservation hunting in the world is the polar bear (*Ursus maritimus*). Polar bear sport hunts generated over $800 000 for Nunavut communities in 2000-2001, more than all other tourist activities combined (Freeman and Wenzel 2006).

There are approximately 22 000 polar bears in the world (Lunn et al. 2002). Current polar bear population estimates for Canada are 12,700 bears in 13 sub-populations (4 of which are shared with Alaska or Greenland) (Taylor and Lee, 1995). Of the approximately 1000 polar bears harvested for all purposes internationally per year (excluding Russia), 700 are taken annually in Canada (Taylor and Lee 1995), the majority (450) in Nunavut. As the locus for a large percentage of all polar bear harvesting in the world, Nunavut is of primary importance for polar bear conservation.

Nunavut's economic position, focusing on the exploitation of both renewable and non-renewable natural resources, its aboriginal majority, and its mandated co-management governance structure make it an appropriate institutional case study for examining questions relating to economic anthropology, common property regimes, co-management and multi-level governance systems. Its

international importance for polar bear conservation supports the examination of this species as the case study common pool resource.

Theoretical Focus

The four related sets of literature discussed above provide several areas of investigation that relate to the hypothesis of the thesis. First, from common property theory there are gaps in understanding the evolution and social and historical contexts of governance institutions and how local institutions link to other levels of governance. There is also a need for further investigations into multiple-use resources. In multi-level governance the importance of the local level is stressed as necessary to analyzing the entire system, however case studies in the modification of top-down institutions into multi-level systems are lacking. Co-management studies have suggested that the system, which makes sense on paper, but does not perform well in reality, must be viewed as an iterative process rather than a static entity. Finally, in economic anthropology the formalist and substantivist schools have maintained separate views of economics yet both have proven useful in exploring the cultural aspects of resource use.

The case study of polar bear management in Nunavut allows for an examination of a common pool resource with multiple uses that was officially managed through a top-down governance system. The development of Nunavut as a land claim and territory institutionalized co-management and encouraged movement towards multi-level governance. In order to examine the hypothesis that the Inuit perspective will gain power in the management system both the local level and co-management levels of governance must be examined. The second part of the hypothesis that the top-down ideology will become more pervasive among participants in the governance system can also be explored through examination of the co-management level on the governance scale since it is here that the two ideologies regarding the resource

intersect. An examination of Inuit economic decisions relating to polar bears reveals some aspects of Inuit ideology regarding this resource and more broadly their understanding of human-environment relationships.

CHAPTER 3: MANUSCRIPT 1, DEVELOPING MULTI-LEVEL INSTITUTIONS FROM TOP-DOWN ANCESTORS

Martha Dowsley

Abstract

The academic literature contains numerous examples of the failures of both top-down and bottom-up common pool resource management frameworks. Many authors agree that management regimes instead need to utilize a multi-level governance approach to meet diverse objectives in management. However, many current operating systems do not have that history. This paper explores the conversion of ancestral top-down regimes to complex systems involving multiple scales, levels and objectives through the management of the polar bear (*Ursus maritimus*) in its five range countries. The less successful polar bear management systems continue to struggle with the challenges of developing institutions with the capacity to learn and change, addressing multiple objectives while recognizing the conservation backbone to management, and matching the institutional scale with biophysical, economic and social/cultural scales. The comparatively successful institutions incorporate these features, but reveal ongoing problems with vertical links that are partially dealt with through the creation of horizontal links to other groups. This case study suggests that it is possible to convert top-down institutions into multi-level governance structures, but that particular attention must be paid to the lower levels of the institutional scale. These lower, often less formal, levels also need different types of support than higher, more bureaucratic levels.

Introduction

Many authors have expounded on the problems with top-down management of natural resources (c.f. Baland and Platteau 1996; Acheson 2006). Such approaches may meet certain national and international objectives, but they have done little to promote equity for local people and as a result often fail to

meet conservation objectives (c.f. Peluso 1993). Community-based approaches were meant to improve the sustainable use of resources through improved equity, but many researchers find that the pendulum has swung too far in the other direction, favouring bottom-up approaches at the expense of upper levels of management and thus also failing to meet certain objectives, especially regarding sustainable resource use (Barrett et al. 2001; Bradshaw 2003; Schaik and Rijksen 2002). Failures in both top-down and bottom-up approaches to natural resource governance have taught us that institutions need to accommodate different levels (from the local to the global) and also different scales.

There is growing support for management that recognizes multiple scales, including biophysical, economic, and social/cultural scales and assigns appropriate authority to institutional levels which allows them to interact effectively with these other scales (Ostrom et al. 2002; Cash and Moser 2000; Berkes 2006a). As several researchers note, resource management systems need to better employ the law of comparative advantage, namely, that the division of labour according to relative ability improves outcomes (Barrett et al. 2001; Young 2002). By assigning the different levels of governance appropriate responsibilities (i.e. those that correspond to similar levels on the scales to be managed), outcomes should improve. This multi-level perspective allows for more objectives to be met and should lead to more efficient, equitable and sustainable resource use.

One of the main issues in the conservation discourse concerns how to construct multi-level regimes. The singular importance of the community level organization and its complexity has been recognized, and it is considered by some to be the starting place for regime formation (Agrawal and Gibson 1999; Brown 2002; Berkes 2004). However, many resource management regimes are already functioning, albeit often poorly, and are candidates for modification rather than dismantling for the construction of new regimes. Thus

the focus in this paper is to give an overview of how some ancestral top-down regimes have begun the transformation to multi-level systems and to suggest how they might be further developed. The discussion is based on the transformation of national and sub-national wildlife management regimes to deal with polar bears. This species became the subject of overt management from the top down in all five of the countries in which it is found through an international agreement signed in 1973. The international agreement drew attention to the need to manage the resource, but allowed much latitude in the development of governance among the signatory nations, several of which already had some form of management institution in place.

The paper will examine the interaction of the management regimes in the various range countries with the biophysical, economic and social/cultural scales. In reality these scales often overlap. However, for the purposes of analysis they will be considered separately. Each scale will be considered to consist of different levels from the bottom, or smallest units, to the top, or largest units. The paper will first examine the incorporation of multiple objectives into national polar bear management institutions. These may be from different scales as well as different levels on these scales. This leads to a discussion on the benefits of matching the institutional scale to other scales. Two examples are given, the first involving the biophysical scale and the second involving the economic scale.

Next I explore the historic development of the institutions through an evaluation of the strategy of taking small steps before large ones (Ostrom 1990; McCay 2002). This method allows for learning within the institution without paying high costs (such as economic or political) until they are understood to be necessary. The final section examines some linking problems that have arisen at the lower levels of the governance scales as the systems have evolved. Finally, the lessons learned from the conversion of top-down polar bear management regimes will be summarized.

I turn first to the initial development of the top-down polar bear management regimes.

The International Polar Bear Management Regime

Natural resource management regimes are often formed due to the perception of a crisis (Fikkan et al. 1993; McCay 2002). In the case of polar bear management a perceived crisis developed during the 1960s, which sparked the creation of an international level of governance involving all five polar bear range states – the United States, Canada, Denmark, Norway and the USSR.

The first formal polar bear management regimes were formed during the mid-twentieth century, before the international agreement, in order to control the commercial harvest of the species. They were primarily top-down institutions at the national or sub-national levels and only one country, the USSR, imposed a complete hunting ban (U.S. Department of the Interior and University of Alaska 1966). The formation of these early institutions was not sufficient to alleviate growing international fears about the conservation of the species, and many citizens and interest groups encouraged their countries to enter into negotiations to create an international conservation agreement (Fikkan et al. 1993).

At the time of the first international meeting in 1965, scientific research on polar bears was in its infancy and species population estimates ranged from 5000 to 20,000 animals (Delegation of Canada 1966). The total harvest of polar bears had increased throughout the twentieth century, and was approximately 1300-1500 animals per year by 1965 (Fikkan et al. 1993). Increased use of firearms, mechanized transportation, rising fur trade prices and increased access to the Arctic by non-local hunters were all given as reasons for the growing harvest (U.S. Department of the Interior and University of Alaska 1966). The fear about increasing harvests was not the

only issue for citizens of the range countries. Discussions around hunting ethics and harvesting rights also encouraged international cooperation.

The ethical discussion focused on hunting in Alaska and in Norway's Svalbard Archipelago. In Alaska, trophy hunting was carried out using small aircraft that chased bears towards waiting hunters (Fikkan et al. 1993). This hunting method accounted for 85-90% of the total harvest for Alaska between 1950 and 1972, while Native subsistence hunting made up the remainder (Lentfer 1976). In the Svalbard Archipelago, Norwegian trappers killed or wounded bears indiscriminately using set guns (rifles triggered by an animal touching the bait) (Fikkan et al. 1993). At the same time, sport hunters in the archipelago killed high numbers of swimming bears, which had no opportunity for escape (Stirling 1998). These methods were considered distasteful and unsportsmanlike by many people.

The question of harvest rights was a concern in three ways. First the polar bear countries did not want non-range countries to begin their own harvests in international waters (Fikkan et al. 1993). Second, polar bears were thought to belong to one international population, and therefore high harvests in any one area were a concern to all. Finally, in Canada, Denmark and the United States there was strong interest in recognizing the rights of indigenous people to continue hunting polar bears.

After several meetings between the five range countries, the International Agreement on Conservation of Polar Bears and their Habitat was signed in Oslo, Norway, in 1973 (Stirling 1998). The agreement prevents signatories from taking polar bears except where done traditionally by local people. The articles of the International Agreement are intentionally vague, allowing a wide range of interpretations by the range countries (Fikkan et al. 1993). The agreement also lacks provisions to ensure compliance. However, the countries are requested to conduct and share research on polar bear ecology and

management and to consult with each other on the further protection of polar bears. They meet every 3-5 years as the Polar Bear Specialist Group of the IUCN/Species Survival Commission. This group, arising in 1968 from the international negotiations, has developed a culture of peer pressure to encourage compliance among the signatory nations. Further incentives to conserve polar bears come from other international agreements and national laws, such as CITES (Convention on International Trade in Endangered Species signed in 1973, enacted in 1975) and the Marine Mammal Protection Act of the United States (1972), which both restrict trade in polar bear products from populations that do not meet conservation guidelines.

The International Agreement met the main objective of conservation. It aimed to match the governance scale to the biophysical scale of the resource, which was perceived to be a single, circumpolar population of polar bears. Objectives relating to the social/cultural scale, such as hunting ethics (a national concern in several countries) and the harvesting rights of local people, were also considered and included to varying degrees. Other objectives were dealt with at the national or lower institutional levels.

Multiple Objectives

The basis for common pool resource management is to ensure a flow of benefits into the future. This implies that the backbone of management regimes must be conservation, and the regime must be related appropriately to the biophysical scale. In the case of polar bears the hypothesis that polar bears belonged to one circumpolar population shared by all five nations was the impetus for international cooperation.

However, the International Agreement also allowed for countries to meet objectives on other scales. Fikkan and colleagues (1993) explored some of the international objectives of the polar bear range countries in attending the

international meetings and negotiating the agreement. They argue that the meetings and agreement were used as an opportunity to "lessen international tensions and improve circumpolar and international relations" (p. 96). As an example of the range of objectives held by the various countries, some of the political objectives attributed to Canada's participation include recognizing the rights of indigenous people, reassuring citizens that unethical American hunting in Alaska would stop, building Canada's conservation reputation, increasing its international presence in arctic affairs and strengthening its sovereignty over the Arctic Archipelago and surrounding waters. The period of negotiations for the agreement, and the agreement itself, were also used to meet certain national and regional within-country objectives.

In Alaska, polar bears were under state jurisdiction until, using the International Agreement as justification, the federal government placed polar bears under the Marine Mammal Protection Act (MMPA) in 1972 (Fikkan et al. 1993). By the time this occurred, the state had already passed laws on several issues of international concern. It had prohibited aircraft-assisted sport hunting, controlled harvest levels, and protected cubs and females with cubs (Lentfer 1976). Alaska was also promoting more Native involvement in sport hunt guiding to meet the objective of the recognition of Native rights. The move to federal jurisdiction overrode these developments, but met two objectives of main national lobby groups, Alaskan Native people and wildlife preservationists. Preservationists gained federal legislation promising protection for polar bears and banning aircraft assisted trophy hunting (although these were already met under the new state laws). The second lobby group, Native Alaskans, was granted the right of sole harvesters, but most uses of polar bears in the monetary economy were outlawed. The MMPA also removed all harvesting restrictions, in essence dismantling the state system, which had taken considerable effort to build, and which had been in line with the best conservation practices of the time. These federal laws lacked the

nuances of the state laws and resulted in a regime that met only a few higher-level objectives and left little room for change.

Canada was faced with similar objectives from its citizens, but handled the inclusion of multiple objectives in a way that provided more room for the maximization of benefits at different levels. At the international negotiations Canada had argued for the rights of indigenous people to continue to use polar bears within conservation guidelines and to allow them to use the resource according to their own objectives, including economic ones (Fikkan et al. 1993). In Canada polar bears remained under provincial and territorial jurisdictions and indigenous people were recognized as the resource user group. Further institutional development was left to the provinces and territories.

Denmark also incorporated several objectives into the Greenland management system. It limited hunting to Greenland residents and also implemented various regulations and protected areas, but stopped short of imposing harvest limits in order to meet local objectives of access and economic use. Placing socio-cultural and economic objectives ahead of conservation objectives proved to be the major weakness of the system and is further discussed below.

The final two nations, the USSR and Norway, chose to focus on only national and international objectives and banned polar bear hunting in 1956 and 1973 respectively (Fikkan et al. 1993). The ban in Russia is an example of how the use of narrow objectives in management leads to weak institutions. Although conservation was the objective of the hunting ban, economic change and the erosion of authority after the dissolution of the USSR has led to poaching and illegal trade of unknown levels (Lunn et al. 2002). Recent negotiations with the United States and Native Alaskans over co-management of shared populations shows promise of a new and more robust Russian system that will

provide better protection of the resource and also allow for other objectives to be met.

All five countries moved to reduce the harvest of polar bears and/or to implement other conservation measures. A second set of objectives from the social/cultural scale, most notably the rights of aboriginal people, were incorporated in the United States, Denmark/Greenland, and Canada. Only the latter two left space in their institutions for objectives on the economic scale to be identified by lower levels of governance. In general, the polar bear management institutions that were founded on conservation, but also included objectives from other scales, have been more sustainable as institutions because they promote conservation at all levels and engage resource users in the system through considerations of other scales, which leads to more equity and efficiency in resource use.

Matching Scales

Developing effective natural resource management institutions involves matching the authority of levels of the institutional scale to similar levels on a variety of other scales including the biophysical, social/cultural, and economic scales. It is expected that the most efficient management systems will involve nested sets of institutions, responsible for management at appropriate levels. Holling (2001 p.390) states that a level should be "allowed to operate at its own pace, protected from above by slower, larger levels but invigorated from below by faster, smaller cycles of innovation". In this view an institutional level is held to general rules and incentive structures managed by higher levels, but is responsible for manipulating rules and incentives of lower levels. To illustrate how different institutional levels can contribute to efficient scale interactions, I shall examine two examples of matching scales for polar bear management, one involving the biophysical scale and one the economic scale.

Mismatch between the biophysical scale of the resource and management institutions has been the subject of much discussion (Berkes 2002; Cash and Moser 2000). One of the main problems is that fugitive resources, such as polar bears, range over a large area and cannot be managed by a single community; rather they require a higher governance level to coordinate management (Barrett et al. 2001). The need for some type of coordination for polar bear management was recognized during the international discussions in the 1960s, when all polar bears were thought to belong to one circumpolar population. Under the international agreement the range countries were encouraged to improve research and monitoring in their own areas and report back to the group. One of the outcomes of the research and monitoring projects was the discovery that polar bears do not all belong to a single circumpolar population, but are divided into 19 discrete populations (Lunn et al. 2002). Monitoring and research has since moved to focus mainly on the population level.

Only one jurisdiction, the Northwest Territories of Canada (NWT) dealt with the original concerns over the conservation of polar bears by limiting the harvest through a quota system, which it instituted in 1968 (Macpherson and Jonkel 1970). To meet its need to set reasonable quotas, the NWT quickly developed a multi-level system for monitoring the resource. At the community level information on each harvested bear is collected for statistical analyses, while at the polar bear population level the territorial government conducts ecological research and population surveys. This system was inherited by Nunavut Territory, which became a separate territory from the NWT in 1999, but began developing new wildlife management systems after the Nunavut Land Claim was signed in 1993 (NTI 2000). In Nunavut, surveys on each polar bear population are carried out on a 15 year rotating schedule. The territorial Minister of the Environment and the Nunavut Wildlife Management Board (the co-management board instituted under the land claim) use the information to decide on the maximum number of animals that can be

harvested for each polar bear management area (which approximately match polar bear population areas). Regional Wildlife Organizations (RWOs), made up of community representatives, then divide the resulting quota amongst the communities.

In the past, community level Hunters' and Trappers' Organizations (HTOs) were consulted on decisions, but not legally provided with a place at the quota setting table. However, since 1993 the de facto system has been a series of negotiated agreements between the HTOs, RWOs, the Minister, and the co-management board. The co-management board has authority over non-quota limitations, while the Minister retains authority over the total allowable harvest to ensure conservation. Pressure from Inuit political organizations has recently caused a major change in the quota setting system.

Beginning in 2005, scientific data will now be used to set quotas for the first seven years of the 15 year management period, and Inuit *Qaujimajatuqangit* (Inuit traditional knowledge) will be used to modify these quotas for the next eight years or until new scientific data are collected on the population. In theory, the new system should be more accurate because it includes scientific procedures where accuracy can be quantified, but which are constrained in the frequency of their population estimates, and local knowledge which provides frequent, but less precise, observations of population trends.

Since 2005 HTOs and other Inuit groups have negotiated quota increases for several polar bear populations based on hunter perceptions of polar bear population growth (cf. Anonymous 2005). The increase in quotas has sparked discussion at higher institutional levels of "leaving the fox to guard the hen house", but of course the real test of this new system is whether the lower level institutions will report observed decreases in polar bear numbers and limit the harvest accordingly.

One such situation occurred before this new system became formally institutionalized. During the early 1990s a scientific population estimate of 700 bears in the M'Clintock Channel population area resulted in quotas of approximately 37 bears a year (Taylor et al. 2006). Inuit hunters reported a decline in the bear population during the late 1990s and preliminary scientific surveys supported their observations. The territorial government and co-management partners reduced quotas and then imposed a moratorium on harvesting in 2001 to allow scientific studies to be completed. The quota was reinstated in 2006 at only 3 bears per year, well below the maximum sustainable yield of 13 (PBTC 2006). The quota was a compromise by community Hunters' and Trappers' Organizations (HTOs), the territorial government and co-management partners in order to meet the need for natural population growth and the desires of hunters. This example illustrates that there can be a commitment at the local level to manage polar bears for long-term benefits.

Nunavut's new monitoring system is in fact a double feedback system. It links the monitoring system to the biophysical system twice, first at the territorial level through scientific surveys of polar bear populations, and second at the community level through population monitoring. This system provides institutional redundancy and hopefully strength, by using both a fast, though blunt, feedback loop at the local level and a slow, but more precise, feedback loop at the territorial level.

The second example of matching scales involves the economic scale. In the case of polar bear management in Nunavut territory, Canada, this scale involves two economies. At the local level, Inuit participate in a mixed economy, relying on both a subsistence hunting economy and the monetary economy through wage labour and the sale of renewable resource products. The remote location of these Inuit communities limits access to markets and

they therefore rely on territorial and national governments to facilitate market access as well as structure economic incentive frameworks.

The power of economic incentives is often given as a reason for resource collapse, but in the case of polar bear management in the Canadian territories, it has strengthened the management system. This is at least partially because conservation was originally given priority, but both the conservation and economic systems interact and strengthen each other. In order to offset the loss of fur trade income suffered by hunters through the implementation of the quota system, the NWT developed programs to increase economic efficiency in polar bear use (MacPherson and Jonkel, 1970, Stirling and Macpherson 1972). The two main economic uses are the sale of hides and the sport hunt industry. Individual hunters have the opportunity to sell their hides privately or through an international auction. The auction typically provides a higher return than private sales, but is difficult for hunters to access. The territorial governments of NWT and Nunavut facilitate the flow of hides to auction and the flow of cash back to the hunters.

Sport hunting of polar bears is coordinated at the community level and again supported by the territorial governments. Since 1970, communities may develop a sport hunt industry for non-natives using tags from their annual quota (Stirling and Smith 1980a). The HTOs have full authority over how to develop this industry, subject to certain regulations. When the sport hunt was first institutionalized, few Inuit communities chose to take part. Territorial government programs increased local capacity through the 1970s and 1980s, but it was not until the mid 1980s that HTOs developed sport hunting in earnest (Wenzel 2005). The impetus to develop the industry in the eastern Arctic came when the local mixed economy was destroyed through the European Economic Community's ban on seal products in 1983 and narwhal products in 1984. The proportion of the quota devoted to sport hunts varies by

community, but accounts for an average of about 20% of the total polar bear harvest of the NWT and Nunavut.

The government has played a coordinating role in the fur trade and the sport hunt by enacting legislation to support the industries and creating an economic framework. In the fur trade it has gone further, facilitating the trade and improving economic efficiency. In the sport hunt, initially there was government support in training and development, but in recent years the territorial government has been less involved than it was previously. In both cases the hunters were hindered by lack of access to markets. The territorial government formed a link between the bottom level of the economic scale (hunters) and the higher levels (national and international markets), which increased economic efficiency in resource use.

These examples of matching the institutional scale with the biophysical and economic scales illustrate how systems can operate more efficiently, while also improving equity for users and sustainability for both the resource and the institutions governing its use. The territorial institutions provided both individuals and communities with the opportunities to develop and meet their own economic objectives within the conservation framework of the quota system, and to experiment with a new management system involving two monitoring systems rather than just one. The understanding that developing harvest controls is necessary to ensure conservation forced the territorial governments to invest considerably in the entire management system and encouraged hunters to engage in the system through the development of the economic framework. This has strengthened links, both within the institution and between the institutional scale and other scales.

Institutional Evolution

An incremental approach to problem solving is advantageous since each change in rules affects interactions with other scales and incentive structures (McCay 2002). When inexpensive solutions do not solve problems, then more costly solutions can be employed. The evolution of the polar management institutions, from top-down towards multi-level institutions, illustrates this approach of taking small, inexpensive steps and examining the outcomes before taking large, expensive ones. In the Canadian territories relatively small changes in their quota systems have thus far proved sufficient to deal with problems, while in Greenland small steps did not prove sufficient to control harvest levels and a large step of quota implementation was eventually taken.

The first quotas in the Canadian Northwest Territories were assigned to communities based on the average number of hides they had sold in recent years (Macpherson and Jonkel 1970). The quota setting method was considered reasonable by the government because harvest levels had increased through the 1960s and there were some concerns about conservation. However, there was little scientific data to support a serious curtailment of the harvest, or to define quotas more precisely (Schweinsburg 1981). The early quotas were not strict. For example, communities were frequently able to increase their quotas by simply asking the territorial government (Macpherson and Jonkel 1970, Stirling and Macpherson 1972). The main benefits of these early quotas were to formalize the harvest system. The institution allowed for the collection of harvest statistics and improved communication with hunters regarding resource management.

Over the subsequent decades many incremental changes occurred in the system through protracted negotiations and development of the co-management system. Quotas in what was the eastern part of the Northwest

Territories (now Nunavut territory) are set for polar bear populations through a process involving both scientific and local information. The quota is flexible in that the number of tags available to a community increases or decreases based on past over- or under-harvests. The system maximizes the harvest based on biological parameters by favouring the harvest of males over females and protecting family groups, but allows the taking of cubs under certain restrictions to meet cultural objectives. Although scientific methods have played a key role in quota setting, social/cultural objectives have also been incorporated to some extent. Discussions about changes to the system and the cultural acceptability of the system to Inuit continue (Dowsley and Wenzel in press). Changes to the system can be dealt with using the small-step approach, however the question of the acceptability of the system itself is a deeper concern and could potentially result in a large step to a new system.

Greenland has recently taken the large step of implementing a quota system. During the 1970s and 1980s there was no strict harvest control. Changes in the polar bear management system tended to be low cost because conservation concerns were low compared to some other range countries, and the economic and cultural value of bear hunting was strongly defended politically (Fikkan et al. 1993, Rosing 1998). Various voluntary methods to report the harvest were employed, but reporting under each system degraded with time and had to be replaced with a new and stricter system, while harvest levels appeared to be rising (Born 2005; Rosing 1998). The relatively small, but incrementally more expensive adjustments did not create a regime to promote sustainability in either resource use or in the institution itself. Finally, a large change was undertaken when the benefits of instituting a quota system were seen to outweigh the political and financial costs, and the first quotas were introduced in 2006 (PBSG 2005).

The new quota system in Greenland increases the institutional investment at all levels and drastically alters the economic incentive structure for hunters. This

change in the system has also opened the door for two new opportunities to be explored. The first is the development of co-management plans with other jurisdictions over shared populations of polar bears, with the goal of improving conservation. The second arises from economic interests expressed by resource users. Without quotas there was little possibility of developing a sport hunt that could attract international clients, but now a sport hunt industry is possible and could improve economic efficiency in resource use.

The governments of Denmark and the Canadian territories made initial investments in their polar bear systems that they considered appropriate at the time. Small changes were subsequently implemented to adjust the systems. In the NWT, and later Nunavut, the gradual development of the quota system reduced hardship on hunters that might have resulted from a strict system vigorously enforced from the start. It allowed for linkages between scales and levels to develop so that feedback could guide further change. It also reduced initial costs by spreading costs out over a longer time period and avoided over-investing in expensive changes. The development of the management regime in Greenland first involved several relatively inexpensive changes (in terms of political capital, time investment and economic outlay), but when these were not successful, a major change in the system was undertaken that will hopefully provide a better set of pay-offs in the long term. Both Greenland and the Canadian territories have now developed harvest control systems necessary to meet conservation objectives while remaining alert to the changing dynamics of the entire system.

Building Relationships

Improving linkages between governance bodies is an important step in moving towards a multi-level system (Berkes 2006a). While vertical links are obviously important for successful governance, horizontal links are seen as ways to strengthen institutional levels through knowledge sharing and other

forms of support. Two examples, one from Alaska and one from Nunavut, reveal problems with ancestral top-down polar bear management systems that relate to weak vertical links. In an effort to overcome these problems, organizations representing the resource harvesters have developed new horizontal linkages.

The first example is from the American polar bear regime. In 1972 the Marine Mammal Protection Act (MMPA) granted sole user rights for polar bears to coastal dwelling Native Alaskans, but prohibited the sale of polar bear parts (except as manufactured handicrafts). Before the MMPA came into effect, nearly all polar bear hides taken by Native Alaskans were sold (Lentfer 1976). Thus, while Natives received recognition of their rights, they were dealt a serious economic blow. They also lost the economic opportunity to develop a sport hunt, which provides significant amounts of cash to many Canadian Inuit communities (Wenzel 2005).

During the 1980s, interest in modifying the MMPA was one factor that led Native Alaskans of the North Slope Borough to engage in negotiations with their Canadian counterparts, the Inuvialuit Game Council, regarding sharing management of the polar bear population they both hunted (Schliebe 1991). In 1988 the Polar Bear Management Agreement for the Southern Beaufort Sea (also known as the North Slope Borough/Inuvialuit Game Council (NSB/IGC) Agreement) was ratified. The two sides created a Joint Commission to set sustainable harvest limits (with outside technical assistance) and divide these between the two user groups. The system has been very successful from a conservation perspective even though compliance by the Alaskans is voluntary (Brower et al. 2002). The agreement also outlined various other economic and cultural objectives, in particular to reopen the American market for Alaskan polar bear skins and sport hunting in Alaska. An effort was made in 1993 to meet the economic objectives of the agreement when the US Fish and Wildlife Service, Alaska Region requested changes to the MMPA (Schliebe and Evans

1995). In 1994 the MMPA was modified to allow Canadian polar bear parts from the Southern Beaufort Sea population to be imported to the US, but did not meet the economic objectives of the Native Alaskans, in particular to develop sport hunting (Schliebe et al. 1998). Despite this setback the NSB/IGC agreement continues to function effectively as a conservation tool and to meet other cultural objectives as well.

The NSB/IGC agreement, as a protocol between indigenous groups, has had an enormous impact on co-management in the Arctic (Brower et al. 2002; Johnson 2002). In terms of polar bear management, several new links were formed and the entire system for management of Alaskan polar bear populations has improved. In 1994 the Alaska Nanuq Commission (ANC) was formed to link all Alaskan polar bear harvesters for management and research projects. The ANC later became an equal partner with the U.S. Fish and Wildlife Service in the development of the US/Russia Polar Bear Treaty (signed in 2000). During negotiations for the treaty, the ANC and the USFWS insisted on the inclusion of the Chukotka Native peoples of Russia as equal partners with Russia. The ANC has been working with its counterpart in eastern Russia to implement the treaty through an enforceable native-to-native agreement. The horizontal link between users of the Southern Beaufort Sea polar bear population, formalized through the NSB/IGC agreement, and the institutions that arose in the wake of that agreement, have made remarkable progress in adjusting the top-down regime of the United States, and promoted equity not just for Alaskan Natives, but Russian indigenous groups as well. The horizontal link forged by the NSB/IGC agreement shows that hunters can choose to limit their harvests and can do so through social rather than legal incentives. Perhaps most importantly, the NSB/IGC agreement demonstrates that while economic objectives are not irrelevant, failure to meet them has not impeded other developments in management.

The second example of a weak vertical link, which has encouraged the formation of horizontal links, comes from the Canadian territorial institutions. It should be expected that in the case of top-down regimes, links and institutions at the lower levels will be weaker than upper level institutions and links, because the original investments in governance focused on upper levels. Even in community-based natural resource management cases, lower level institutions and their linkages have generally been poor (cf. Agrawal and Gibson 1999; Baland and Platteau 1999). Lower levels on the institutional scale often function under fundamentally different types of relationships than their upper level counterparts. For example, they often use social pressure rather than formal incentives (as seen in the NSB/IGC case), and utilize different forms of knowledge to make decisions (Young 2006). Therefore, the development of governance at lower levels requires not just more input from upper levels, but very different types of assistance than those given to higher levels. It should come as no surprise then that low-level links are weak in Nunavut's polar bear management system.

In Nunavut Territory the lowest-level formal institution for polar bear management is the Hunters' and Trappers' Organization (HTO) of each community which represents all local hunters. HTOs are responsible for developing rules and managing wildlife harvesting amongst their members (NTI 2000). Each HTO has the right to decide how and when to distribute the hunting tags that make up its polar bear quota and to decide if it will hold a sport hunt. The sport hunt uses tags from the community quota and represents the potential for an increase in the monetary return per bear for the community on the scale of 1000% (Dowsley 2004). Sport hunts are held in most communities, and decisions regarding the level of sport hunting, disbursement of profits, employment opportunities and cultural concerns are on-going (Dowsley 2004; Wenzel 2005). The HTOs have developed a wide range of rules for local hunting (NTI 2000; Anonymous 2005). In most communities, a lottery system is used to distribute tags to hunters, a minimum eligible age is

set, and hunting is open to both men and women. Some communities have tag holding periods of one or two days, after which point the tag passes to the next person whose name is drawn in the lottery.

Since their inception in the 1970s, HTOs have become important players in the wildlife management system, slowly assuming more responsibilities as their capacity increased. This capacity has not increased uniformly across all HTOs. For example, in the community of Pond Inlet, HTO meeting minutes are posted in public places and summarized on public radio (Anaviapik 2006), while in nearby Qikiqtarjuaq communications are poor. In 1999-2000, a federally sponsored community based narwhal management program was implemented which involved both Pond Inlet and Qikiqtarjuaq hunters. Both HTOs received the same information and training from higher levels of government, but Qikiqtarjuaq hunters harvested, wounded, and lost narwhal to such an extent compared with other communities that federal authorities had to temporarily close their hunt (Armitage 2005). Reasons for the failure of the Qikiqtarjuaq HTO to successfully implement the new narwhal management system included lack of communication and lack of social cohesion and sanctioning within the community. The lack of communication between HTOs and their constituents was also apparent in the community of Arviat on the coast of Hudson Bay, where Tyrrell (in press) received incorrect information from informants regarding who was responsible for setting polar bear hunting rules. Tyrrell was told that the territorial government set rules such as requiring women to enter the lottery draws for tags and mandating that hunters abide by short tag-holding periods, when, in fact, these rules are the result of local HTO decisions.

The lack of communication between hunters and their representative organization was one in a long list of HTO weaknesses exposed in a report commissioned in 2004 by the Nunavut land claim organization, Nunavut Tunngavik Inc. (NTI) (Younger-Lewis 2004). One outcome of the report was

that NTI developed a wildlife secretariat in 2005 to build capacity at the HTO level for wildlife management (NTI 2006). That this development should come as an outside intervention by NTI rather than from within the wildlife co-management structure suggests the system is not yet functioning fully as a multi-level institution. Furthermore, Armitage's analysis of HTOs with regards to narwhal management underscores the need to examine the social incentive systems operating at the community level and seek ways to build upon these.

The nature of links along the institutional scale changes dramatically from upper, formal structures to local, less formal, but highly contextualized, relationships. Institutional design or rehabilitation must recognize these differences and work at the lower levels to promote appropriate behaviour patterns rather than merely enact rules. Further, assumptions about the existence of local norms for monitoring and enforcement need to be investigated rather than assumed. And, finally, community-level resource management institutions are often new, non-traditional forms of governance. They require extra capacity building compared to higher levels of the institutional scale where government staff engage in a variety of institutional arrangements as a matter of course.

The weak vertical links between institutional levels in the United States and Nunavut left holes in the management systems that user groups are attempting to address. Both situations illustrate that the original top-down institutions did not adequately deal with the needs of lower levels. The different set of incentives and interactions operating at lower levels need to be further considered in institutional development. More, and potentially quite different, efforts are required to develop lower levels of governance and improve their links to other levels and scales.

Modifying Top-Down Systems: Lessons from Polar Bear Management

The polar bear management institutions illustrate the importance of developing multi-level regimes rather than focusing on one level. Top-down regimes have been most successful in promoting equity, efficiency and sustainability where the upper levels limited their own authority to similar levels on the social, biophysical and economic scales (such as securing harvesting rights, coordinating harvesting, and developing economic frameworks), and assisted in institutional development at lower levels to allow for devolution of appropriate responsibilities. Through an examination of the transformation of the top-down regimes into multi-level regimes several lessons emerge.

Carlsson and Berkes (2005) stress the importance of viewing resource management systems as iterative processes. The polar bear case studies show that, while management of the resource has been iterative, so has the structuring of the whole management system. In Nunavut changes in management of the resource occurred in small steps over time through advancements in science and through inclusion of different objectives (most notably those from the local level). Further, as harvesters gained a stronger voice in management, a new co-management system developed as part of land claim negotiations, which transformed the Nunavut system into a multi-level institution. Information feedback from small steps in development of the management system in Greenland eventually led managers to take the more drastic step of implementing harvest controls. We should not expect the management institutions themselves to stabilize because objectives change with time and each change in the system alters its interactions with other scales. For example, in Greenland the new quota system restricts harvests, but opens opportunities for new economic uses of the resource.

The second lesson concerns local level institutions. The examples show that even the evolving multi-level institutions that were relatively successful, in terms of sustainability of resource use, efficiency of economic use and equity,

have weaknesses at the local level. Relationships among participants at the lower level of the institutional scale are much more nuanced and multifaceted than the bureaucratic, rules-based relationships among participants at the higher levels. The culturally foreign nature of wildlife management systems is often an obstacle for aboriginal peoples (White 2006). Local social norms are not necessarily compatible with the management system, and although certain forms of interaction can be learned and used in the management setting, these interactions may continue to be at odds with other relationships among participants. The high specificity of local relationships and objectives should be recognized and examined in the development of local institutions and in interactions between the different institutional levels.

Horizontal linkages proved very useful in the case study examples for filling in gaps left by the formal resource management institutions. The power of these horizontal linkages is not just in the support they give to lower levels of the institutional scale (as in the wildlife secretariat developed by NTI), but also in their ability to create new links and instigate change in the whole system as seen in the Alaska case study.

The case study of polar bear management illustrates that top-down institutions can be transformed rather than dismantled to create multi-level institutions. However, the transformation is a long and, at times, jarring process as a new system emerges from the old. Unlike the creation of completely new systems, the history of the top-down ancestral institutions provides a basis for participants to make changes and observe their effects on the entire system. The value of these lessons may well outweigh the baggage of historical institutional failings; moreover, they serve as a reminder of the struggles and successes of previous participants. Polar bear management institutions in none of the five member countries have yet fully transformed into a multi-level institution, but most are well on their way.

Bridge Between Manuscripts 1 and 2

Manuscript 1 focused on common property theory and some of the key topics in need of further investigation outlined in Chapter 2, namely institutional evolution, social and historical context, and linkages between local and other levels of governance. Polar bears are a multiple use resource and the institutions that accommodate multiple uses have been more successful in monitoring and managing the resource. We have seen that lack of capacity in local institutions can impede effective resource management. In Nunavut the local institutions were designed from a top-down perspective and did not always communicate well with their constituents. Part of the problem at the community level was the incompatibility of the local institutions with existing relationships among harvesters and weak links to higher levels of governance. We also saw how horizontal links between local institutions and other institutions helped to overcome vertical linkage problems in both Alaska and Nunavut.

This manuscript also partially addressed the first thesis objective: To explore how the transition to multi-level governance affects interactions between the governance scale and the biophysical, economic and social/cultural scales. The examples from Alaska, NWT/Nunavut and Greenland illustrated different approaches taken by the top-down systems to dealing with the recognition of rights of Native harvesters, economic concerns and biological concerns. While all three systems are converging on the need for quotas to control harvest levels and open economic opportunities (such as the sale of hides and development of sport hunting), the role of local people in governance is still developing.

Manuscript 1 also began our examination of the two-part hypothesis. It touches on the first part (that aboriginal ideology and the use of traditional knowledge would gain power in resource management) by examining the

changing role of aboriginal people in management. In Alaska, Native people received sole user rights in the 1970s, but lost access to the market. They are however, relatively free to manage their harvest according to their own views of the resource. Meanwhile in the NWT, Inuit gained power during the 1970s and 1980s through devolution of authority to HTOs, and later through the Nunavut Land Claim Agreeement (which instituted co-management through the Nunavut Wildlife Management Board). One outcome of this is the use of Inuit *Qaujimajatuqangit* in recent quota setting decisions that in different cases resulted in both quota increases and decreases and suggests community monitoring can be an effective conservation tool.

The second part of the hypothesis is that the top-down ideology will become more pervasive among the individual participants in the social-ecological system due to the historic top-down governance structure and the influence of the market economy. In the western Arctic, the North Slope Borough/Inuvialuit Game Council (NSB/IGC) Agreement provides us with evidence that top-down approaches to wildlife and the strong influence of the market economy may not trump Inuit social and cultural relationships. One of the objectives of the agreement was to reopen the American market to Alaskan polar bear hides. Despite the failure to achieve this goal, the agreement continues due to social and cultural objectives that have been met. In fact, the agreement has been very influential at higher levels of governance as well. It led to the development of the Alaska Nanuq Commission, which in turn opened negotiations with Russia (where essentially no management had occurred for nearly 50 years), and empowered Chukotka Native groups in Russia to participate in the US/Russia Polar Bear Treaty. Economic considerations may have aroused interest in the North Slope Borough in developing the NSB/IGC agreement, but other objectives, especially social and cultural ones have kept the agreement going and expanded its influence far beyond its original intent.

The influence of top-down ideology and economic models regarding polar bear use in Nunavut has only been touched upon in Manuscript 1. We saw that the bureaucratic style of governance and professional relationships that were instituted as part of the top-down approach to natural resource management have not yet become well established at the local level. Community social interactions and lack of experience with these structures appear to be impeding its development. The relative importance of these two factors, as well as the influence of the market economy, have not yet been assessed. The other manuscripts examine this issue further.

The rest of the thesis examines only the Nunavut system of governance. Thus we have moved from the general concept of multi-level governance outlined in Figure 2.1 to the specific governance scale used in Nunavut (see Figure 4.1).

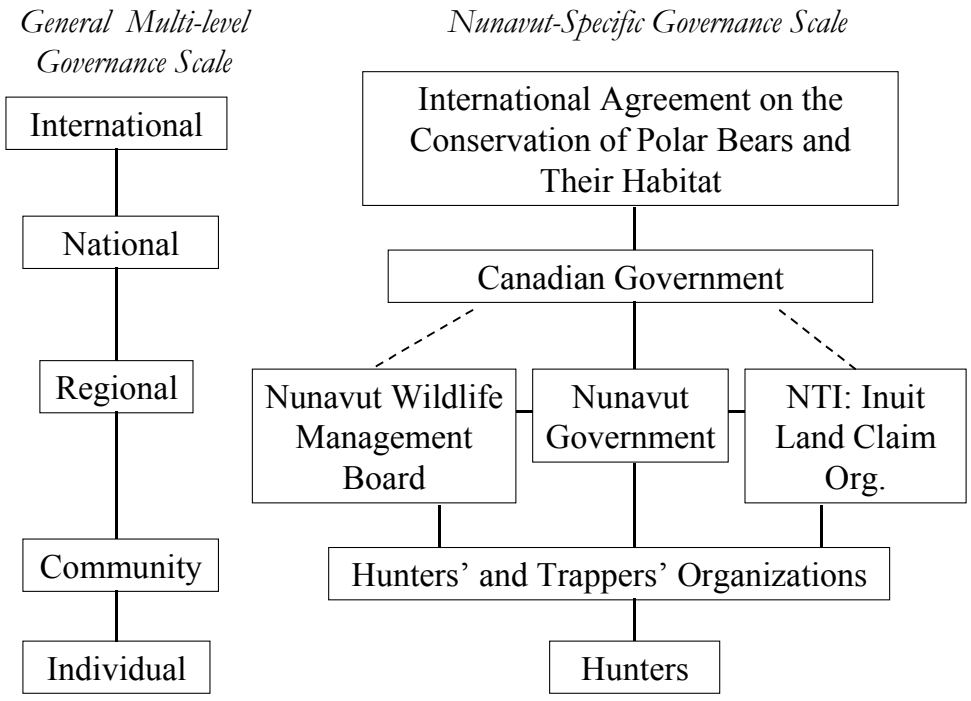

Figure 4.1. The general concept of a multi-level governance scale (from Figure 2.1) modified to the specific case of polar bear management in Nunavut.

Manuscript 2 begins our examination of the second thesis objective: To examine the interaction of Euro-Canadian and Inuit cultural paradigms regarding the interactions of humans and wildlife and their different tools for knowledge generation. It briefly explains the current management situation in two polar bear population areas, Baffin Bay and Western Hudson Bay and then reports on traditional knowledge gathered from the Baffin Bay communities on the status of polar bears and issues relating to climate change. This manuscript adds to the collection and use of traditional knowledge in management through its dual analytical approach, as well as the presentation of an earlier version of the work at co-management meetings in the Baffin Bay area. These meetings are analyzed in the third manuscript, which focuses on the central level of the governance scale, involving co-management.

CHAPTER 4: MANUSCRIPT 2, INUIT PERSPECTIVES ON POLAR BEARS (*URSUS MARITIMUS*) AND CLIMATE CHANGE IN BAFFIN BAY, NUNAVUT, CANADA

Martha Dowsley

Abstract

Scientific research has demonstrated negative effects caused by climate change on three of 19 polar bear populations worldwide (Stirling et al. 1999; Aars et al. 2006). As a result, the status of polar bears has been uplisted by the IUCN/SSC to vulnerable (Schliebe et al. 2006). At the same time, Inuit hunters in many areas of the Canadian Arctic have reported increased sightings of polar bears and have received hunting quota increases (Aars et al. 2006). One of the areas where quotas were increased in 2005 is the Baffin Bay polar bear population. Computer modelling simulations indicate a decline in this population (Aars et al. 2006). This paper analyzes interviews conducted during the spring of 2005 in the three Canadian Baffin Bay communities using both quantitative and qualitative techniques. All three communities reported similar environmental changes, but provided significantly different information on polar bear population trends and interpretations for observed changes in polar bear behaviour. A north-south gradient was identified, with more polar bears and bear sign being encountered in the north-western part of Baffin Bay. The research technique of combining qualitative and quantitative analysis allowed for the inclusion of individual experiences in keeping with other studies involving traditional ecological knowledge (TEK) and more specifically *Inuit Qaujimajatuqangit* (IQ), but also quantitatively compared communities to gain a more detailed perspective on the Baffin Bay polar bear population throughout its territory.

Introduction

In Canada's most northern territory of Nunavut, wildlife management is conducted using a co-management system involving both scientific studies and Inuit *Qaujimajatuqangit* (IQ), which includes both traditional or local ecological knowledge (TEK or LEK) based on observations of the environment and non-empirical cultural understandings of the natural world (see Keith 2005; Usher 2000; Wenzel 1999, 2004). Recently, the struggle to integrate these two knowledge systems has been further complicated by the new problem of climate change; a challenge which itself includes both scientific and cultural dimensions. This paper examines IQ on polar bears and climate change in Baffin Bay.

Inuit living in Nunavut retain the right to harvest wildlife, and some species, such as the polar bear, are managed under a quota system. Canada is home to 13 populations of polar bears and each is studied according to a 15-year rotational scientific inventory to evaluate status and estimate appropriate rates of harvest in order to maintain healthy polar bear populations (Aars et al. 2006). The Nunavut hunting quota for each population is based on the scientific information and on consultation with Inuit. The quota is then distributed among the communities that hunt in a given population area (Government of Nunavut 2005a).

The Baffin Bay polar bear population is shared between Nunavut and Greenland (see Figure 1). In 2005 Nunavut used IQ to increase the polar bear total allowable harvest (TAH) from 64 to 105 for the Nunavut communities that hunt this population (Government of Nunavut 2005a). In February, 2005 the Federal-Provincial-Territorial Polar Bear Technical Committee of Canada, which coordinates research on polar bear populations in Canada, received information indicating that the Greenland harvest had increased from 68 per year (average harvest from 1993-1997) to 185 per year (average of 2003 and 2004) (Born 2005). In 2006 Greenland instituted a quota system to reduce its

harvest to approximately 100 animals. The estimated combined harvest of Nunavut and Greenland then is 200 animals per year, which continues to be well above what population modeling suggests is sustainable (approximately 88 bears) (Taylor et al. 2005). Co-management discussions between Nunavut and Greenland are on-going.

Simulation modeling suggests the Baffin Bay population has declined from 2074 ± 266 bears during the study period 1994-1997 (Taylor et al. 2005) to ~1700 in 2004 due entirely to legal over-hunting (that is, no climate change parameters were used in the model) (Dowsley and Taylor 2006a). During 2004 and 2005 undocumented information from both Greenlandic and Nunavummiut hunters was to the effect that the Baffin Bay population of bears was increasing. Hunters in other polar bear population areas have made similar reports, notably in Western Hudson Bay, where scientific information on the bear population is much greater and clearly indicates a decline (Stirling et al. 1999; Stirling and Parkinson 2006). Biologists and wildlife managers hypothesize the paradox in Western Hudson Bay to be due to changes in the distribution and behaviour of polar bears caused by climate change, and extrapolate this hypothesis to Baffin Bay (Stirling and Derocher 1993; Stirling and Parkinson 2006). While the IQ from both areas needs to be collected and examined, Baffin Bay was selected for this study due to the lower total information available on it in the published literature.

Inuit *Qaujimajatuqangit* and similar indigenous knowledge systems have been used in other investigations relating to the arctic environment and wildlife and have demonstrated that TEK is a detailed and holistic worldview that stresses observation of the natural world (Ferguson et al. 1998; Huntington et al. 1999; Krupnik and Jolly 2002; Omura 2005). Frequently, studies which record such knowledge focus on non-statistical information, such as compiling composite maps, time lines, migration routes, reproductive behaviour etc. (Ferguson and Messier 1997; Ferguson et al. 1998; Keith 2005; Kendrick et al. 2005; Krupnik

and Jolly 2002). A few studies, such as Mallory and colleagues in 2003 and Gilchrist and colleagues in 2005, examine IQ from different Inuit communities to examine species population trends. This paper follows their lead in that it reports on a study that examined IQ of the polar bear population of Baffin Bay using both qualitative and quantitative techniques with the goal of drawing a more complete picture of Inuit understandings of polar bears status in the area, climate change observations and possible linkages between the two in order to add to the discussions regarding the relationships between scientific information, Inuit observations, climate change and polar bears.

Previous reports of IQ relating to polar bears have mainly investigated Inuit hunting techniques and polar bear denning behaviour (Keith 2005; Van de Velde et al. 2003; Wenzel 1983a). This paper focuses on changes in polar bears and climate observed by Inuit over the past 10 to 15 years in three communities. Quantitative and qualitative methods were used to reveal both statistically significant differences in responses and to allow for the expression of observations as they were reported by Inuit research participants. Parallel analyses allowed for a consideration of Inuit observational knowledge and also allowed respondents to express a deeper Inuit *Qaujimajatuqangit*, or cultural, context for TEK data. The use of quantitative analysis was not to question the validity of participant knowledge. The observations given are assumed to be true in keeping with the author's experiences and those of other arctic researchers (Ferguson and Messier 1997; Krupnik and Jolly 2002; Kendrick et al. 2005.). Rather, quantitative analysis was employed to examine geographic differences across the polar bear population under study in order to develop a more detailed understanding of the population status and behaviour and its relationship to climate change.

Methods

The data were collected using a semi-directed interview format that has proven useful to other researchers working with aboriginal groups in the North American Arctic (Ferguson and Messier 1997; Huntington 1998). The questions were developed after consultation of the Igloolik Oral History Archive, government wildlife managers and Inuit hunters. Survey participants were recruited through two means: 1) consultation with the Nunavut Department of Environment and local Inuit organizations, and 2) recommendation by earlier participants.

Forty-eight interviews were conducted from April to June 2005 in the Baffin Bay communities of Pond Inlet, Clyde River and Qikiqtarjuaq (see Figure 4.2). The majority of participants were men (n = 40) who engaged in harvesting activities on either a part time or full time basis, or else were recently retired from harvesting. Participants ranged in age from late 20s to early 80s, with most over age 50. Interview participants were generally unprompted with regards to possible explanations of their observations. This was done to allow them to express their own views. Participants were asked two sections of questions. The first was regarding polar bear population, behaviour and health, the second was regarding climate change and any linkages to changes in polar bears. Due to the semi-structured design of the interviews, some participants were asked supplemental questions or they offered further explanation for their answers. When themes were revealed in these discussions they were coded into new variables for the quantitative analysis. These are labeled as sub-questions of the main questions. For example Question 3 was renamed 3a followed by groups of responses that are coded as questions 3b, 3c, 3d etc.

Quantitative analysis was completed using SPSS (SPSS© for Windows version 11.0.1). Responses to questions were broken down into their smallest units and coded into a data table. The results are provided as frequency tables.

To analyze these results, I tested for age effects using an ANCOVA categorical regression approach entitled 'optimal scaling' (SPSS© for Windows version 11.0.1), but no significant differences were found. Fisher's exact test (2-sided) (SPSS© for Windows version 11.0.1) was used to look for categorical differences in participant responses based on community and sex. No significant differences were found based on sex. For those questions for which a significant difference was found between communities ($p < 0.100$), figures present the responses of the different communities and the observed significance is given. In the discussion section possible causes and implications for significantly different responses are examined.

The semi-directed nature of the interviews allowed participants to expand on their answers and express information that was not specifically queried, but which they considered important. In the results section, qualitative comments are provided where they help to further explain the responses. Where differences between communities were found to be statistically different the qualitative data are divided by community.

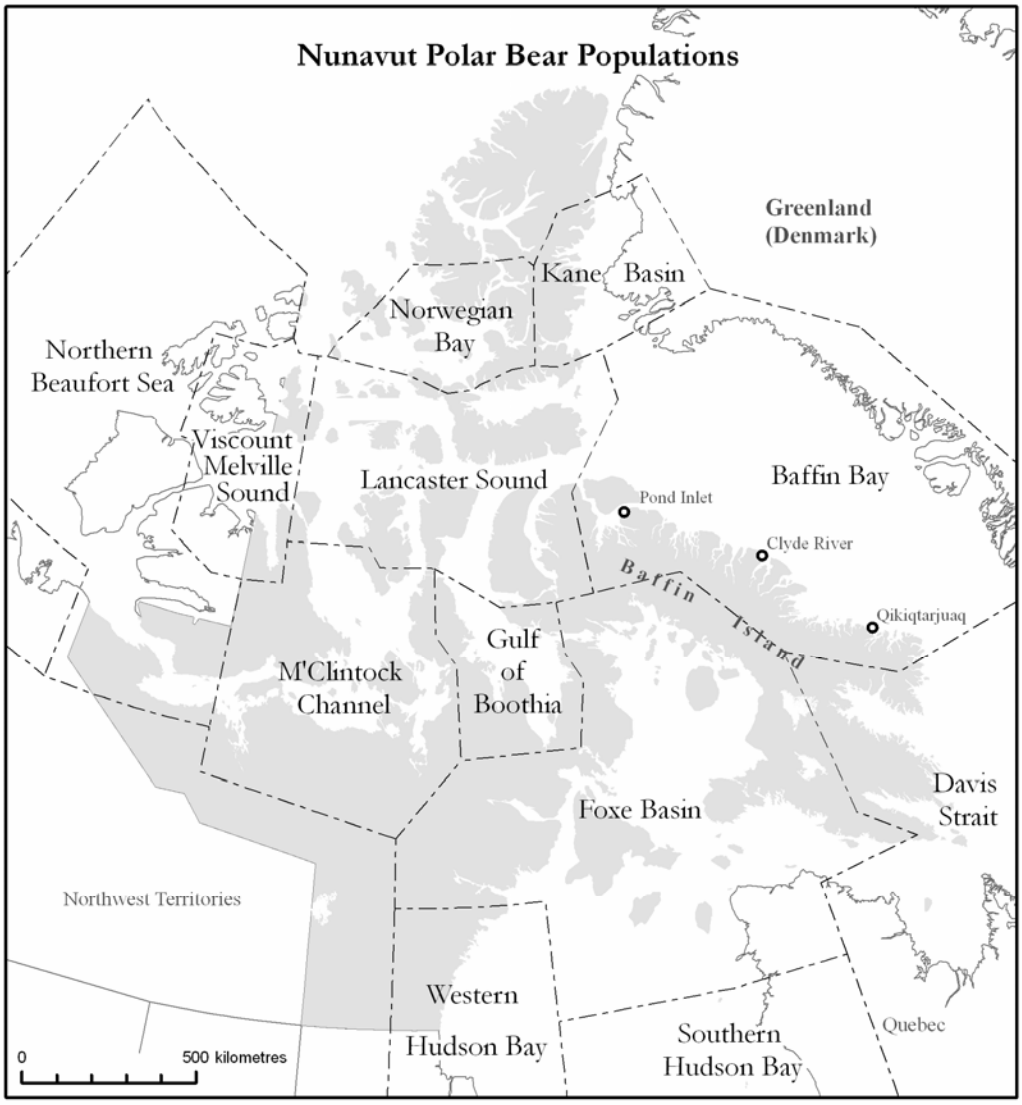

Figure 4.2. Nunavut Polar Bear Population Areas and the Study Communities in the Baffin Bay Population Area.

Results

The results are divided into two sections, the first reports the results for questions relating to polar bear population dynamics and behaviour while the second examines climate change and possible connections between climate change and polar bears. The responses to questions are given in frequency tables and qualitative comments are provided. For the questions where a

significant difference between communities was observed, charts illustrate the results by community and qualitative comments from each community are shown.

Section 1 Polar bear population dynamics and behaviour

Question 1 'Has The Bear Population Increased, Decreased or Stayed the Same Over the Past 10-15 Years?'

The responses to Question 1a were significantly different between communities ($p = 0.01$) (Figure 4.3). All Pond Inlet participants reported an increase, but only 60% of Qikiqtarjuaq participants made the same observation. Over half of participants who stated an increase offered the type of observation they had made to reach this conclusion (coded as Question 1b) (Table 4.1), but no significant difference between communities was found in these observations.

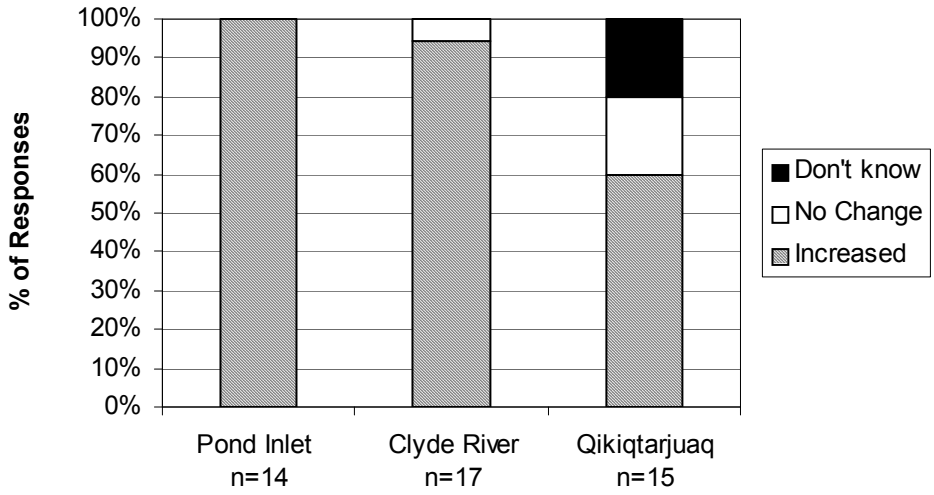

Figure 4.3. Responses to Question 1'Has The Bear Population Increased, Decreased or Stayed the Same Over the Past 10-15 Years?' by Community ($p = 0.01$).

Table 4.1. Explanations Offered by Participants Regarding Question 1b 'How Do You Know the Polar Bear Population Has Increased?' (n = 28).

Response	Response Percent
Bears are less afraid of people now	3.57
More polar bears are coming to our town	21.43
Elders say there are more bears	3.57
I've seen fewer tagged bears and more signs	7.14
I've seen more bear tracks and/or signs	64.29
Total	100

Comments:

Pond Inlet

"There were not many bears around Pond Inlet when I was growing up. We used to have caches of muktuk and seal. The polar bears only bothered them once in a while. Now there are lots of polar bears! I never suspected there would be polar bears in the western fiords and now there are. There are fewer seals there, but the bears are probably looking for food over there."

Clyde River

"There are too many bears. Before, when we went dog teaming for hunting we didn't come across many bears. We were getting 45 a year anyway. The government says that's too many. We should be able to get more now since we were able to get that when they were scarce."

Qikiqtarjuaq

"I don't know. The polar bears are usually at the floe edge and the sea. But this year they are not really down at the sea. They are more by the land. Probably there is not enough to harvest there [not enough food at floe edge]. And there are walruses by the floe edge so the seals are probably more close to land."

"I can't answer, but I think they increased, but it could be due to change of weather or the polar bears are following their prey. We say they have increased because the weather got warmer and probably the polar bears have come nearby the communities. They are coming more to the community."

Question 2 'Are there more, the same or fewer bears around town now than 10-15 years ago?'

Responses to question 2 showed a significant difference between communities ($p = 0.021$). The responses are given in Figure 4.4. All Pond Inlet participants reported an increase, but only half of Qikiqtarjuaq participants reporting an increase.

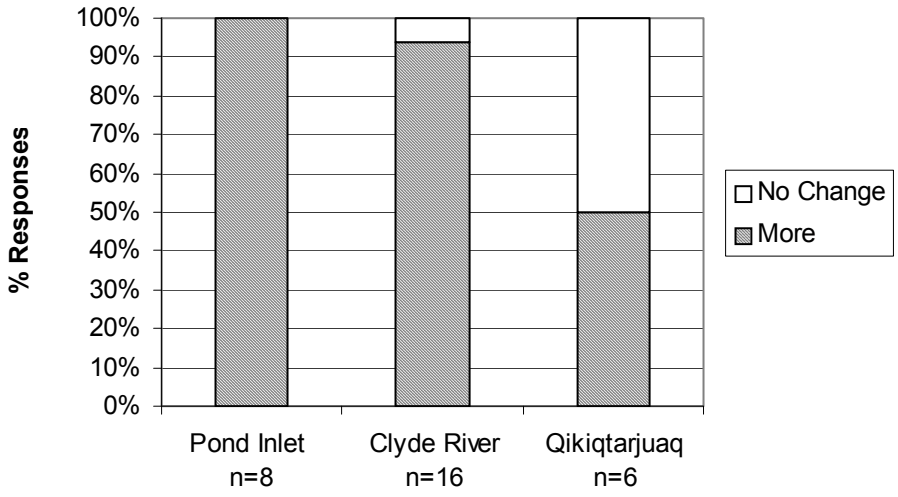

Figure 4.4. Question 2 'Are There More, Fewer or the Same Number of Bears Coming to Town Now Compared to 10-15 Years Ago?' and Community ($p = 0.021$).

Comments:

Pond Inlet

Eight people responded to this question. All said more bears are coming now. Even though many people used the presence of bears in town during the fall as an indication that their population had increased, some respondents gave more textured answers:

"It seems to be that more are coming to the community. When the polar bears are hunting they are not so careful because of the noises they always hear. Even dogs' barking damages their ears. So polar bears are not as successful at hunting so they come to the community to find food."

"They started coming to town in the 1960s, early 1970s. Polar bears can think like a person, they won't forget things right away. If they come and find food around here, people chase them away and the polar bear will come again the next year. They will remember where they found food. If a bear is chased away from town, it will come back at night when things have quieted down."

Clyde River

"More are coming to town, because there are more bears, not because they are extra attracted to town. It's a different bear almost every time, but skinny ones keep coming back."

"In the fall they seem to be hungry, they've been lying around for a long time. The town bears are also more likely to be young ones."

Qikiqtarjuaq

"Back then we only saw them (around the community) when there was no ice. Now even in the winter they come around."

Question 3 'Is there more, less or the same amount of damage to cabins, meat caches and other equipment?'

Responses to question 3a showed no significant difference between groups of respondents (Table 4.2). Participants were then asked a follow up question: 'If there is more damage, why is that?' or in some cases they explained their answer to 3a unprompted. The responses to the follow-up are broken down into three themes: 3b changing bear behaviour, 3c bear numbers, and 3d changing human behaviour. These themes are phrased as questions here, but were not asked of the participants. Questions 3c and 3d showed significant differences between communities and the responses are illustrated in Figures 4.4 and 4.5). Pond Inlet felt that increased damage was caused by more bears and not by the presence of more people or more things being left out. The other two communities gave mixed responses.

Table 4.2. Responses to Question 3a 'Is There More, Less or the Same Amount of Damage Caused by Bears Now Compared to 10-15 Years Ago?' (n = 29).

Response	Response Percent
More	93.10
Same	3.45
Don't know	3.45
Total	100.00

Table 4.3. Responses to Question 3b 'Is This Increased Damage Caused by a Change in Bear Behavior?' (n = 26).

Response	Response Percent
No	57.69
Yes	42.31
Total	100.00

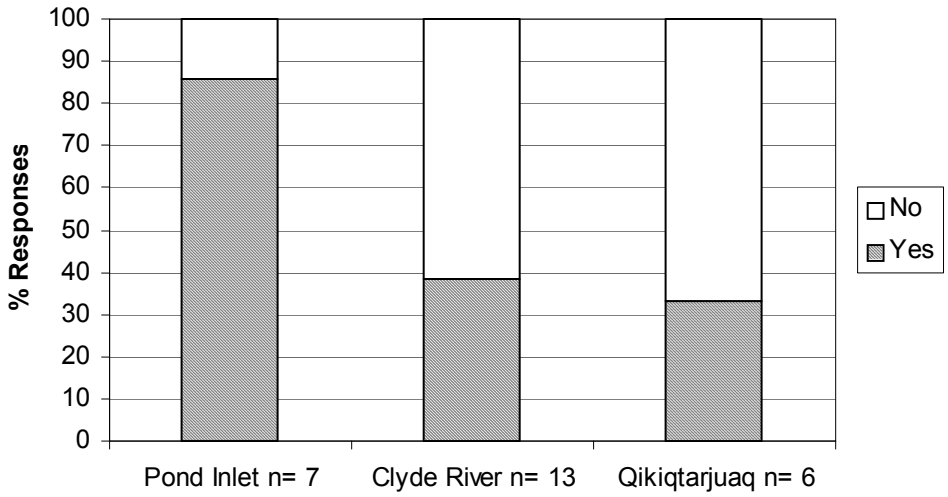

Figure 4.5. Question 3c 'Is the reason for increased damage that there are more bears?' ($p = 0.092$).

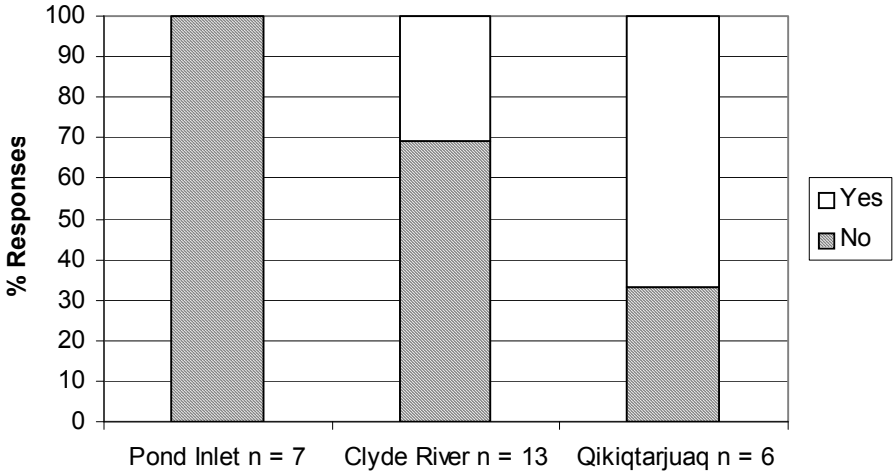

Figure 4.6. Question 3d 'Is the Reason for Increased Damage That There are More People and More Things Left Out?' ($p = 0.043$).

Comments:

Clyde River

"There seems to be more damage, but you have to take into consideration that we're leaving more stuff out on the land than 15 years ago. But if you leave meat caches they are pretty much guaranteed to be gone."

"We used to cache 4 or 5 seals in a row, covered them just with gravel. Used to never be touched. But now it disappears even if we put rocks on it. Polar bears don't like to use their claws and scratch them (wear them down), so they stayed away from the gravel. They wouldn't dig it. Now they do."

Qikiqtarjuaq

"The bears are more hungry. There is a problem with the ice. The rough ice makes it hard for them to find seals, but there is the same number of seals."

"The only change I've noticed is when I was growing up the polar bears would scare easily and run away. Even when they were around shacks they didn't break windows or do damage, but now they are not afraid. They used to avoid communities before and now they don't."

Questions 4 'Is there more, less or no trend in skinniness of polar bears over the past 10-15 years?'

Participants were queried about bear condition in question 4. There was no significant difference between communities. The results are given in Table 4.4.

Table 4.4. Responses to Question 4) 'Is There More, Less or no Trend in Skinniness of Polar Bears Over the Past 10-15 Years?' (n = 24).

Response	Response Percent
More skinny	45.83
No trend	54.17
Total	100.00

Section 2 Climate Change and Polar Bears

The responses to questions 5, Have there been any changes in the sea ice over the past 10-15 years?, 6 'Is there any evidence of climate change in this area?' and 7 'Could climate change contribute to what you have observed about polar bears?' are summarized in Table 4.5. No significant differences were found between communities for these questions.

Table 4.5. The Percentage of Total Responses to Questions 5, 6 and 7.

	Yes	No	Don't know	n =
Q 5 Have there been any changes in the sea ice over the past 10-15 years?	83.33	13.33	3.33	30
Q 6 Is there any evidence of climate change in this area?	63.64	27.27	9.09	33
Q 7 Could climate change contribute to what you have observed about polar bears?	41.67	25.00	33.33	12

Question 5

In question 5 the participants discussed a number of different environmental features when asked the general question "Have there been any changes in the sea ice over the past 10-15 years" (Table 4.5) and then general follow up questions such as "how do you know?", or "what has changed exactly?". Tables 4.6 to 4.10 summarize the information on specific sea ice features discussed. The number of responses varies. In some cases a low number of responses may indicate that although the respondents thought about that aspect of the environment they had not noticed changes and therefore did not say anything because they were specifically asked about changes. Most interviews were translated and it is also likely that the translators sometimes prompted participants with a list of ice features, which solicited negative or uncertain responses.

Table 4.6. Responses in Which the Location of the Floe Edge Over the Past 10-15 Years was Discussed (n = 21).

Response	Response Percent
The location is the same	14.29
The floe edge is closer to land	76.19
Don't know	9.52
Total	100.00

Comments:

"The floe edge is closer to the land and there are hardly any icebergs. That's why the floe edge is close by. The icebergs keep the ice from going anywhere. They are like plugs."

Table 4.7. Responses in Which the Thickness of the Sea Ice Over the Past 10-15 Years was Discussed (n = 14).

Response	Response Percent
It is thinner	85.71
It is variable	14.29
Total	100.00

Comments:

"The salt water doesn't freeze as hard as before. Every year we chip the ice at seal breathing holes, today it is not as hard, not as brittle. Now in June the bottom of puddles [on the ice] is not slippery, it's not melting from the top, it's melting from everywhere through the ice, like the inside of a bone. Today the ice is also thinner. People used to say when the leads opened they looked tapered going down in them because of the thickness. They no longer look tapered."

"I went bear hunting all the way to the DEW line on Durban Island [south of Qikiqtarjuaq] and the ice there was moving up and down. That was 4 years ago in March. It was not like that there when I was growing up. It was solid."

Table 4.8. Responses Involving the Number of Icebergs Grounding Around The Community Over the Past 10-15 Years (n = 33).

Response	Response Percent
Fewer icebergs are grounding	81.82
No trend	18.18
Total	100.00

Comments:

"The icebergs are like nails, they hold the ice in. Since there are fewer icebergs there (around Button Point near Pond Inlet) the ice edge is closer."

"When I'm flying to and from Clyde River [from Pond Inlet], there are not a lot of icebergs and the floe edge is closer to the land. In the Clyde River area, way back, when there were lots of icebergs, the floe edge was further out. Recently there are strong winds from the south so the icebergs left and the floe edge came in closer. The icebergs come from Greenland (between Greenland and Ellesmere Island) and they go into Clyde and the coast just north of it. The current is from the north and from Lancaster Sound coming east… The ice changes in Baffin Bay mean less ice patches so the bears come to land to hunt. Because polar bears can swim, but when they are tired they go to land."

Table 4.9. Responses Involving When the Sea Ice Breaks Up Recently Compared to 10-15 Years Ago (n = 13).

Response	Response Percent
It is occurring earlier now	61.54
It is occurring about 2 weeks earlier now	30.77
Same time	7.69
Total	100.00

Table 4.10. Responses Involving The Timing of Sea Ice Freeze-up Recently Compared to 10-15 Years Ago (n = 8).

Response	Response Percent
No trend	25.00
It is occurring later now	12.5
It is occurring about 2 weeks later now	62.5
Total	100.00

Question 6

The breakdown of responses to question 6 'Is there any evidence of climate change in this area?' is given in Table 10. Over 60% of respondents answered yes.

Comments:

"Yes, it has affected our area. In the past we could hunt for different animals further. Now we can't go further, we have to hunt nearby on the ice." [This comment seemed to refer to the difficulty of traveling on the ice.]

"I am experiencing it. In winter there are usually cracks from the points of land and I can put my [fishing] net under water. But now there are hardly any cracks so I can't fish for char any more."

Question 7

The breakdown in responses to question 7 'Could climate change contribute to what you have observed about polar bears?' is given in Table 10. Participants did not strongly agree on any one answer to this question.

Comments:

"No, because polar bears can go and follow the seals further, so they won't have trouble hunting. Also the snow covers the [seals'] breathing holes but polar bears can still hunt, it's just for people."

"Seems like yes because polar bears are getting skinnier. If it gets warmer it will affect polar bears. They like to be cold."

"Yes, it could affect the polar bear's food, even with small amount of temperature change, the food will change. These days some livers [of seals]

don't look good. Also the shedding of the seal fur, molting is this time of year usually. Now you sometimes find ones that are molting in other times of the year."

"There is more rough ice, more thin ice. But it won't affect polar bears' hunting."

"It may be. There are not enough icebergs and the denning areas have less snow and it is melting in summer. The bears are more hungry. There is a problem with the ice. The rough ice makes it hard for them to find seals, but there are the same number of seals."

"Maybe the ice in the sea is melting and the bear have no where to go. It is very noticeable, they will go to land. There are no icebergs for them to go to."

Discussion

There was a significant difference between community responses to some questions in Section 1 (Polar Bear Population Dynamics and Behaviour) regarding polar bear numbers and interpretations of the causes of increased polar bear damage of human goods. A north-south gradient was discovered, with Pond Inlet (the most northern community) and Qikiqtarjuaq (the most southern) having different answers while Clyde River was intermediate between the two.

The results for Section 2 (Climate Change and Polar Bears) concerning climate change did not show any significant differences between groups of participants, suggesting all areas are experiencing similar changes in climate. There is a general consensus that the sea ice is thinner now, open water season is longer (earlier break-up and later freeze-up) and there are fewer icebergs now than in the past. As a result of the decrease in icebergs, the floe edge is

closer to the land. Interview participants did not have a clear idea of how, or if, this was affecting bears.

Most respondents (93.1%) in all communities stated that there is more damage caused by bears today than 10-15 years ago. Pond Inlet participants attributed the increased bear damage to an increased polar bear population, while the other communities did not agree as strongly that this was the cause of the increased damage. The gradient of responses to interpretive questions may represent a gradient in communications between the communities, since people from Clyde River interact with both of the other communities while Pond Inlet and Qikiqtarjuaq interact with each other less due to their geographic locations. If one or a low number of people in a small community come up with a hypothesis it might quickly spread to the rest of the community as well as to visitors. The variable, and at times conflicting, explanations for bear behaviour, even within the same community suggest that IQ may not converge on a single perspective, especially when there are geographical differences in experiences.

A significant difference between communities was also observed regarding the number of polar bears. Only 60% of respondents in Qikiqtarjuaq felt the bear population had increased over the past 10-15 years, compared to over 90% of respondents in the other two communities. Likewise, only 50% of respondents in Qikiqtarjuaq felt more bears are coming to town today than 10-15 years ago, whereas once again over 90% of respondents in the other communities thought more bears were coming. Scientific studies on polar bears in the area offer hypotheses to explain this difference.

The Baffin Bay polar bear population borders on the Lancaster Sound polar bear population to the northwest. The boundary between these two populations is relatively leaky compared with boundaries between other polar bear populations, such as the boundary between Baffin Bay and Davis Strait to the

south (Taylor et al. 2001a). The Lancaster Sound ecosystem is relatively productive (Welch et al. 1992), and the bear population is well managed and productive, and therefore could serve as a source of immigrants to Baffin Bay (Schweinsburg et al. 1982; Taylor and Lee 1995; Taylor et al. in press). Pond Inlet hunters utilize the boundary area between Baffin Bay and Lancaster Sound for a variety of harvesting activities, whereas Clyde River and Qikiqtarjuaq hunters spend the majority of their time in Baffin Bay only. It is possible that the Pond Inlet area is experiencing more polar bears due to changes affecting one or both populations that increase the density of polar bears in the boundary area and northern Baffin Bay.

Studies of polar bear movements in Baffin Bay also show a weak differentiation between sub-groups of bears in north and south Baffin Bay due to the currents and movement of pack ice (Dunlap and Tang 2006; Taylor et al. 2001a). Changes in the environment that affected polar bears in only one of these areas would thus be noticed in the either the north or south part of the bay (by either Pond Inlet or Qikiqtarjuaq respectively), but not necessarily both. Clyde River is located near the boundary of these two groups and would likely report mixed observations.

Recent studies of the ice in Baffin Bay suggest changes are occurring. Stirling and Parkinson (2006) report a significant trend to earlier break-up in the sea ice of Baffin Bay between 1979 and 2004, resulting in break-up occurring roughly 2.5 weeks earlier than during the 1970s, which agrees with the observations of the participants in this study. Other studies indicate an increase in the extent and density of the pack ice (Parkinson 1995; Laidre and Heide-Jørgensen 2005). Inuit hunters do not typically venture out onto the pack ice so changes to this ice, and interpretations for observed changes in wildlife are not expected in studies of TEK/IQ.

Baffin Bay polar bears spend the summer open-water season on the west side of the bay, in Nunavut (Taylor et al. 2001). If the bears are suffering from climate change effects on the ice they will be forced onto land for longer periods and suffer reduced condition due to a longer fasting period in the summer and a shorter hunting period in the spring (Stirling and Derocher 1993; Stirling and Parkinson 2006). Such a change in condition has been measured scientifically in the polar bears of Western Hudson Bay (Aars et al. 2006), but has not yet been observed in Baffin Bay. It is expected that should such changes in condition occur, they will appear first in the Nunavut side of Baffin Bay, but Inuit observations on condition reported in this paper were mixed. The Western Hudson Bay studies used large sample sizes and statistical analysis to measure condition. Observations by Inuit hunters are on a much smaller sample size, are by visual inspection only and take place over the course of the year when individual bears vary greatly in condition. As a result it is not expected that Inuit observations would pick up small, though possibly statistically significant changes in condition.

The question remains as to why many Inuit have observed more polar bears in the Baffin Bay area when population modeling suggests a decline. Stirling and Parkinson (2006) suggest more bears are in poor condition due to the trend to earlier spring break-up and thus they seek out food near humans, increasing the encounter rate between the two species. While Inuit participants in this study stated more polar bears were coming to town, the majority also stated that they felt the population had increased because of general signs of bears everywhere, not just near the community, which does not support Stirling and Parkinson's argument. Another possibility is that the scientific population estimates under-represent the actual population in Baffin Bay. If that is the case, the population may not be in an over-harvest situation, but might, in fact, be stable or growing despite the increased harvests by both Nunavut and Greenland hunters. Current scientific information and Inuit knowledge are insufficient to resolve this apparent paradox.

This study illustrates the usefulness of applying 2 analytical perspectives to better understand information provided in semi-directed interviews. The quantitative analysis revealed an important gradient in the responses of different communities regarding polar bears, while the qualitative information added context and detail. In this study IQ was useful in developing multiple perspectives and was a very good source of information for directly observable events. The value of interpretations of the events is less clear, but may become more so in the future.

Bridge Between Manuscripts 2 and 3

Manuscript 2 addressed a gap in the literature by using TEK/IQ observations of the environment to assess polar bear population status, behaviour and geographic variation, as well as climate conditions and possible links between climatic changes relating to sea ice and polar bear population and behaviour. This manuscript partially met the second objective of the theis by comparing IQ to scientific observations and analysis of the Baffin Bay polar bear population.

Manuscript 3, "Time of the Most Polar Bears: A Co-Management Conflict in Nunavut", uses the information discussed in Manuscript 2 as background information for an analysis of the interaction between local and territorial governance levels through the co-management system. This system also involves the territorial government's official co-management partner, the Nunavut Wildlife Management Board and the Nunavut land claim organization, Nunavut Tunngavik Inc. (see Figure 4.1). Manuscript 3 sets out to meet part of objective 1 by exploring how the transition to multi-level governance through the use of co-management affects interactions between the governance scale and the biophysical, and social/cultural scales. It also addresses objective 2 by examining the interaction of two cultural paradigms regarding the interactions of humans and wildlife: Euro-Canadian and Inuit, and their different tools for knowledge generation, respectively western science and local experience.

Manuscript 3 brings together the differences between science and IQ in data collection and interpretation and examines the management outcomes of attempting to incorporate the two sets of data. It also examines the deeper meanings of IQ as a knowledge paradigm and its interaction with the co-management system. In this way Manuscript 3 addresses the first part of the hypothesis that the advent of co-management and the increasing recognition of

scientific uncertainty due to climate change will allow the aboriginal ideology and the related use of traditional knowledge to gain power in the management of polar bears. It also touches on the second part of the hypothesis that the top-down ideology will become more pervasive among the individual participants in the system (including harvesters), due to the nature of historic power relations in top-down governance and the influence of the market economy.

CHAPTER 5: MANUSCRIPT 3, "THE TIME OF THE MOST POLAR BEARS": A CO-MANAGEMENT CONFLICT IN NUNAVUT

Martha Dowsley and George Wenzel

Abstract

Beginning in the 1990s, Inuit Traditional Knowledge (Inuit *Qaujimajatuqangit*) has taken on a substantial role in polar bear management in the Canadian territory of Nunavut through its direct use in quota setting procedures. This paper examines the co-management conflict that has arisen due to an increase in January 2005 of hunting quotas for Inuit living in the Baffin Bay and Western Hudson Bay polar bear population areas. The quotas were based on Inuit observations and the conclusion that there were polar bear population increases. Scientific information suggests that climate change has concentrated polar bears in areas where humans are more likely to encounter them, but that the populations are in decline due to over hunting and climate change effects on demographic rates. During consultations with wildlife managers and through other interviews in 2005, Inuit indicated their lack of support for quota reductions. Discussions with Inuit reveal two categories of problems that, though couched in the polar bear management issue, involve the co-management system and the integration of Inuit and scientific knowledge more generally. The first relate to direct observations of the environment by both Inuit and scientists and the synthesis of such information. The second relate to Inuit conceptualizations of human-animal relationships and the incorporation of scientific studies and management into that relationship. These problems reveal that differences between Inuit *Qaujimajatuqangit* and scientific knowledge are not fully understood and accounted for within the co-management system and that the system does not effectively integrate Inuit cultural views into management.

Introduction

> "There have been more polar bears these days. There were some by these houses, and also by cabins. We always need a 'watch person' while berry picking. We always hear polar bears are decreasing, but that's not true. We like berry picking and walking in summer, but we need rifles to protect ourselves. If you are going to talk about the past, there were fewer then than there are today. This is the time of the most polar bears." (Participant in Clyde River community consultation, Dowsley and Taylor 2006a:71)

Indigenous or Traditional Knowledge has become an integral part of wildlife management in northern Canada. It has provided historical and ecological information on many species (see Ferguson et al. 1998; Huntington et al. 1999; Gilchrist et al. 2005), served as a red flag to draw attention to changes in particular species (Mallory et al. 2003) and has proven useful in population monitoring for some harvested species (Moller et al. 2004). However, Traditional Knowledge, or Inuit *Qaujimajatuqangit* in Nunavut, is not merely observations of the environment; it is a paradigm for viewing the world and the place of humans in it (Usher 2000; Wenzel 1991; 2004). This knowledge is not restricted to traditional knowledge in the meaning of 'old knowledge passed down from previous generations'. Rather it also includes knowledge acquired by the current generation. Usher (2000) describes four categories of such knowledge, which he calls Traditional Ecological Knowledge (TEK): 1. Knowledge about the environment, 2. Knowledge of the use of the environment, 3. Environmental values, and 4. The knowledge system itself. The first two categories of knowledge have been used, as in the examples mentioned above, to improve wildlife management. This paper explores the ways in which all four categories of knowledge influence how Inuit approach the Nunavut co-management system for polar bears (*Ursus maritimus*).

Co-management systems have been the subject of much recent academic inquiry (Nadasdy 2003a; Moller et al. 2004; Natcher et al. 2005; White 2006). Carlsson and Berkes (2005) stress that these systems should be viewed not as static entities, but rather as iterative processes that function as a space for discussion and problem solving. With this in mind, particular attention will be paid here to Inuit understandings of human-polar bear interactions, since indigenous perspectives are often poorly understood and therefore have been undervalued in co-management situations (Nadasdy 2003a; Natcher et al. 2005).

In January 2005 the Nunavut hunting quotas for two polar bear populations, Baffin Bay and Western Hudson Bay (see Figure 4.2), were increased based on Inuit *Qaujimajatuqangit*. Scientific and harvest data suggest that these populations are in decline (Aars et al. 2006; Stirling and Parkinson 2006; Dowsley and Taylor 2006a; 2006b). However, Inuit support for a decrease in quotas is mixed. In order to better understand this conflict in the co-management system, Inuit observations and interpretations are explored here using information gathered through interviews and the minutes of meetings between the Government of Nunavut (GN) and Inuit communities in the Western Hudson Bay and Baffin Bay polar bear population areas in November and December, 2005 (Dowsley and Taylor 2006a; b).

Polar Bear Management In Nunavut

In 1973 Canada signed the International Agreement on the Conservation of Polar Bears and their Habitat (Lentfer 1974). Within Canada, polar bears fall under the jurisdiction of the range provinces and territories, including the Northwest Territories, from which the territory of Nunavut was created in 1999. In the Inuit-majority territory of Nunavut, the government has adopted Inuit *Qaujimajatuqangit* (IQ) as a guiding philosophy in the Bathurst Mandate

and Clyde River Protocol (Government of Nunavut 1999a; 1999b; Wenzel 2004).

The Nunavut Land Claim Agreement mandates a co-management system to conserve polar bears and other wildlife for future generations, while allowing Inuit to harvest these species at sustainable rates (NTI 2000). A quota system is in place to control hunting within sustainable limits, and various other regulations protect reproductive females and cubs. Adult females unaccompanied by cubs can be taken in a ratio of 1 female per 2 males harvested. GN Department of Environment biologists intend to survey each of Nunavut's 13 polar bear populations on a 15 year rotation. This inventory has two main components, first to delineate the population (Taylor et al. 2001a) and second to determine demographic parameters sufficient to assess status and sustainable harvest levels (Taylor et al. 2002; Taylor et al. 2005).

The scientific information is then used to develop Total Allowable Harvest (TAH) recommendations which are sent to the government's co-management partner, the Nunavut Wildlife Management Board (NWMB), for their initial decision regarding the TAH levels. The Minister of the Environment may accept or reject the NWMB first decision. If the Board's first decision is rejected, the NWMB provides their final decision to the Minister, who may accept, reject or modify that decision (NTI 2000 Article 5 Part 3). The TAH for a polar bear population area is then given to the appropriate Regional Wildlife Organization for allocation among the Hunters' and Trappers' Organizations of the affected communities, who then allocate tags to hunters.

The community organizations, the Minister of the Environment, and the Regional Wildlife Organization also sign a Memorandum of Understanding on how the polar bear population will be managed for the following 15 year interval until the next survey. This document includes how the quota was set, other government regulations and local hunting rules. Memoranda of

Understanding are not legally binding on any of the signatories, but are formally accepted as a final decision by the NWMB.

In 2005, Inuit *Qaujimajatuqangit* was directly incorporated into Memoranda of Understanding on polar bear management for Western Hudson Bay, Baffin Bay and several other populations. For the first seven years of the 15-year survey cycle, the TAH will be set using a Conservative Harvest Rate, based on the calculations of the biologists as outlined above. Harvesting at the Conservative Harvest Rate is expected to allow population growth. For the next seven years, or until the next population survey is completed, the Guided Harvest Rate, based on IQ perceptions of trends, will be used to set the TAH. The Guided Harvest Rate is determined as "the number of bears that can be taken without reducing the population below the target number" and must be in agreement with the conservation principles of the Nunavut Land Claim Agreement (Government of Nunavut 2005a 1.1). The target number of a population is based on previous estimates of population size. Harvest levels are supposed to maintain the population, or in the case of a reduced population, are supposed to allow for population growth back to the target number.

In 2004, IQ from the Baffin Bay and Western Hudson Bay polar bear population areas indicated an increase in polar bear sightings which was believed to have been caused by population growth, and the NWMB identified an increase for the TAH. The increase was accepted by the Minister of the Environment in January 2005, raising the combined quota for the three Baffin Bay communities from 64 to 105 bears/year and for the five Western Hudson Bay communities from a total of 47 to 56 bears/year (Government of Nunavut 2005a; b). These increases were based on IQ rather than scientific estimates of population size. Nunavut was criticized by the Canadian Polar Bear Technical Committee (PBTC 2005) and by the Polar Bear Specialist Group of the IUCN/SSC for raising quotas based on traditional knowledge without supporting scientific evidence (Aars et al. 2006). In 2005 and 2006 Nunavut

decided not to reduce quotas due to a lack of community support (PBTC 2006).

According to the MOU, if "new research indicates that the population has declined below 90% of the target number for any reason, a moratorium on harvesting will be implemented until the population is projected to have recovered, or until a new population estimate shows that it has recovered to its target number." (Government of Nunavut 2005a 5.7.1). The Baffin Bay target number is 2074, based on the last mark-recapture survey conducted from 1994-1997 (Government of Nunavut 2005a; Taylor et al. 2005). Harvest data from Nunavut and western Greenland, which also harvests from the Baffin Bay population, were used in population projections using the computer population modelling program RISKMAN (Taylor et al. 2001b) and suggest the population had fallen to about 1550 polar bears (a decline of 25%) by the time of the 2005 consultations (Dowsley and Taylor 2006a).

The Western Hudson Bay target number was set at 1400 in 2005 using IQ (Government of Nunavut 2005b). This is an increase from 1997 scientific population estimates, and the previous target number of 1200 animals (Lunn et al. 1997). The population estimate was raised in the 2005 agreement because community consultations revealed that Inuit harvesters felt there were more bears than the surveys indicated, and they estimated 9 more bears could be harvested per year. If this information is correct, a population of 1400 animals is needed to support such a harvest level. Thus, 1400 was set as the new population target, and quotas were set on the assumption that this was indeed the population size. Since then, Canadian Wildlife Service data for Western Hudson Bay estimate a population of 977 ± 108 bears (Aars et al. 2006), a decline of 18.5% from the 1997 estimate of 1200 and 32% less than the target number of 1400.

According to the scientific calculations both populations have dropped below 90% of the target populations. The GN is therefore in a position to impose a hunting moratorium in both Baffin Bay and Western Hudson Bay. However, given the cultural value of bear hunting, safety concerns raised by community residents, and the political climate in Nunavut, the GN is reluctant to act without the support of the community Hunters' and Trappers' Organizations.

Scientific Research

Research conducted by the Canadian Wildlife Service in Western Hudson Bay has shown that spring breakup of ice now occurs significantly earlier than 30 years ago (Stirling et al. 2004). This forces polar bears onto the land earlier in the year, reduces their critical spring seal hunting season, and prolonging their summer fast (Stirling et al. 1999). As a result, the condition of adult female polar bears in Western Hudson Bay has declined significantly (Stirling et al. 1999). The resulting decrease in population productivity renders recent population projections, and the quotas based on them, inaccurate since they were developed using higher productivity estimates than is now the case (Stirling and Parkinson 2006).

Stirling and Parkinson (2006) report a significant trend towards earlier breakup of ice in Baffin Bay on the order of 6-7 days per decade since 1979. The effects of changing ice conditions in Baffin Bay on polar bears have not been scientifically studied, but Stirling and Parkinson (2006) hypothesize that similar climate change-induced stress could be affecting the Baffin Bay population as well.

What is known with more certainty is that the Baffin Bay population faces the problem of over-hunting. Nunavut shares the Baffin Bay polar bear population with Greenland. In 2005 a Greenland harvest report was published containing data from 1993 to 2004, which showed an increase in the harvest levels (Born

and Sonne 2006). According to RISKMAN projections, by the end of 2005, the combined hunting pressure from Nunavut and Greenland had reduced the Baffin Bay population to the point that both Greenland and Nunavut were harvesting above the sustainable yield independently (Dowsley and Taylor 2006a). Greenland initiated a quota system in January 2006, and discussions between Greenland and Canada on the Baffin Bay harvest are on-going (Lønstrup 2006).

Methods

In order to achieve consensus for management actions in Nunavut, both Inuit and scientists must agree on what is happening to the polar bear populations and why. The lack of Inuit support for quota reductions in Baffin Bay and Western Hudson Bay indicates that Inuit perceptions of the situation differ from the scientific understandings.

In order to examine Inuit understandings, data were collected using two methods. The first was through interviews conducted during the spring of 2005 in the three Baffin Bay communities of Nunavut (Pond Inlet, Clyde River and Qikiqtarjuaq) (see Figure 2) (Dowsley 2005; 2007). In each community 15 to 17 community members were interviewed using a semi-directed approach (Ferguson and Messier 1997; Huntington 1998; Fox 2002). The participants were mainly senior (over age 40) and retired hunters recommended by Inuit organizations, GN personnel and earlier participants in the study. Other participants were 8 female elders and 5 experienced hunters under the age of 40 (the youngest was 28). A total of 48 interviews were completed. Participants were asked three sets of questions. The first concerned changes in polar bear population size, behaviour and health, the second set was on observed changes in the sea ice environment and possible relationships between such changes and polar bears. The last set involved questions about the management system. The number of respondents who

discussed each topic varied because they were asked to discuss changes rather than answer individual questions.

The responses were analyzed using both qualitative and quantitative methods. As part of the quantitative analysis, responses were categorized by community and gender of respondents. Fisher's exact test (2-sided) (SPSS© for Windows version 11.0.1) was used to look for differences within the categories using an observed level of significance less than 0.100. The information gathered from these interviews is available both as a report from the Government of Nunavut (Dowsley 2005), and, in a more condensed version, as a journal article (Dowsley 2007). The information will be summarized here to allow for a discussion of its interaction with the Nunavut co-management system.

The second method was to analyze minutes recorded at co-management consultations held between GN representatives, Inuit organizations and community Hunters' and Trappers' Organizations (HTO) in November and December, 2005 in both Baffin Bay and Western Hudson Bay communities (Dowsley and Taylor 2006a; b). These meetings focused on an explanation of the scientific concerns regarding hunting levels and climate change. Four meetings were held in the Baffin Bay communities, one with each HTO and one general meeting for the community at large in Clyde River. As part of the Baffin Bay meetings, the interview report (Dowsley 2005) was presented and comments solicited. In Western Hudson Bay, one meeting was held in Rankin Inlet (see Figure 5.1) involving HTO representatives from the 5 hunting communities. Canadian Wildlife Service data were presented to the Western Hudson Bay communities explaining the scientific perspective. The minutes of all 5 consultations were analyzed qualitatively to gain an understanding of IQ from Usher's 4 categories relating to the polar bear management situation. In the results and discussion section IQ from Usher's first two categories are explored first (Knowledge about the Environment and Knowledge about the Use of the Environment), followed by IQ from the

second two, more abstract, categories (Environmental Values and the Knowledge System itself).

Figure 5.1. Map of Nunavut (shaded area) showing the location of the study communities of Pond Inlet, Clyde River and Qikiqtarjuaq on the shore of Baffin Bay and Rankin Inlet on the western shore of Hudson Bay. (Courtesy Jay McConnell, Dept. of Environment, Government of Nunavut).

Results and Discussion

IQ Categories 1 and 2 -Observations of the Physical Environment and Animals

Climate Change and the Sea Ice

The sea ice is a key habitat component for polar bears because it serves as a platform for hunting and is critical habitat for prey species. Changes in ice conditions, including the amount and quality of land fast ice, and the timing of breakup and freeze-up were reported during the Inuit knowledge study (Dowsley 2005). No significant differences were found within the categories of community or gender of respondents for these topics.

The main change in ice reported during the Baffin Bay Inuit knowledge survey was a decrease in the amount of land fast ice (Dowsley 2005; 2007). A total of 16/21 survey participants reported that the floe edge has receded in the past 10 to 15 years. More participants chose to discuss icebergs, with 27/33 stating that there has been a decrease in the number of icebergs grounding near their community. Several participants linked the two observations, for example:

> "The floe edge is closer to the land and there are hardly any icebergs. That's why the floe edge is close by. The icebergs keep the ice from going anywhere. They are like plugs." (Qikiqtarjuaq participant, Dowsley 2005:16).

Finley and colleagues (1983) also report that grounded icebergs, which drift down from the north along the west coast of Baffin Bay, are important for maintaining the land fast ice of northeastern Baffin Island.

Scientific studies from both Western Hudson Bay and Baffin Bay report the date of spring breakup is now significantly earlier than it was approximately

30 years ago (Stirling and Parkinson 2006; Gagnon and Gough 2005). Stirling and Parkinson (2006) report the breakup in Baffin Bay is occurring between 2 and 3 weeks earlier than it did in the early 1980s. In the community interviews the timing of spring breakup in Baffin Bay was reported by 12 of 13 people to be earlier now than 10 to 15 years ago (Dowsley 2005; Dowsley 2007). Four of the respondents specified breakup as being about 2 weeks earlier from 2000-2005 than it was 10-15 years previously. The others did not specify a time.

A change in the timing of fall freeze-up has not been as apparent to either Inuit or scientists. Scientific studies in western Hudson Bay report a non-significant trend for time of freeze up from 1975 to 2000 (Stirling et al. 1999). However, Gagnon and Gough (2005) found statistically significant trends towards later freeze up in the northern and northeastern regions of Hudson Bay. Data are not available for Baffin Bay. Only 8 people chose to discuss freeze-up in the Baffin Bay interviews when asked to discuss changes in the sea ice. Six of the eight reported freeze-up was later than during the early 1990s (Dowsley 2005; 2007). The low number of responses about freeze-up suggests that it is more variable or changes are more difficult to judge than other aspects of the sea ice.

Changes in Polar Bears

In the interviews, Inuit reported numerous changes in polar bears over the past 10-15 years, mainly involving human-bear interactions and the condition of bears (Dowsley 2005; Dowsley 2007). There was more variability between the Baffin Bay communities on this topic than there was on the climate-related observations. There were significant differences ($p < 0.10$) between communities for four topics, two concerning polar bear population size and human-bear encounters and two involving the reason for increased damage caused by bears. No significant differences were found based on the gender of respondents.

Polar Bear Population

During the Inuit knowledge survey in the Baffin Bay area, Inuit knowledge varied significantly between communities on whether there was any change in the population of polar bears ($p = 0.010$) (Dowsley 2005; 2007). In the northern community of Pond Inlet all 14 respondents indicated a population increase. In the central community of Clyde River 16/17 respondents reported an increase. In the most southern community of Qikiqtarjuaq 9/15 reported an increase. The other 6 respondents in Qikiqtarjuaq reported either that they did not know or that no change was observed. No respondents in any of the communities reported a decrease in the bear population.

Interview participants were asked if there were changes in the number of bears coming around town over the last 10-15 years. Again, there was a significant difference in responses between communities ($p = 0.021$). In Pond Inlet, all 8 respondents stated an increased number of bears were coming into the community. In Clyde River 15/16 gave the same response, while one person indicated no change. In Qikiqtarjuaq 3/6 stated there was an increase while the other 3 indicated no change.

The differences in community responses to questions regarding polar bear population levels and changes in the number of bears coming to the community indicate a north-south gradient along the coast of Baffin Island. Two biogeographic features may explain this gradient. First, there is a weak differentiation between sub-groups of bears in northern and southern Baffin Bay due to currents and movements of the pack ice (Dunlap and Tang 2006; Taylor et al. 2001a). The split between the northern and southern areas occurs in the Home Bay area, just south of Clyde River and north of Qikiqtarjuaq. Second, the Lancaster Sound polar bear population, which borders on the Baffin Bay population in the vicinity of Pond Inlet, is a productive population and may contribute immigrant bears to the Pond Inlet hunting area or to the north Baffin Bay group in general (Taylor and Lee 1995; Taylor et al. in

press). Thus, it is possible that changes that affect the northern part of Baffin Bay might not be as obvious to observers in the southern areas. This could explain the difference between observations made in Qikiqtarjuaq and the two more northern communities.

Condition of Polar Bears

The condition of polar bears varies throughout the year, depending on available food resources. In Western Hudson Bay progressively earlier spring break up of ice over the past 25 years has resulted in significantly poorer condition of both male and female polar bears when they come on shore (Stirling et al. 1999; Stirling and Parkinson 2006). Early spring break up was also associated with increased human-polar bear encounters in Churchill, Manitoba (Stirling et al. 1999). Stirling and Parkinson (2006) hypothesize that polar bears are increasingly coming around humans due to food stress in both Western Hudson Bay and Baffin Bay. If this is correct then the condition of these polar bears is expected to be less than bears encountered on the land.

During the interviews in the Baffin Bay communities, 11/24 of interview respondents felt polar bears are skinnier now than 15 years ago and there was no significant difference between categories of respondents (Dowsley 2005). The remaining 13 respondents indicated that there was no trend. When asked specifically to compare bears that come to the community versus other bears, 5/10 participants reported that 'town' bears are skinny while four participants reported there was no pattern and 1 said they were fat.

These data suggest that the polar bears Inuit are encountering around human habitation are not obviously in poorer conditions than other polar bears. This does not necessarily refute the hypothesis put forward by Stirling and Parkinson. The weight loss they discuss for bears in Western Hudson Bay is not necessarily of the magnitude that would be noticed by an observer or hunter encountering many fewer bears across a long time period. Annual and

internannual fluctuation in condition may mask the trends in weight loss observed through scientific analysis in Western Hudson Bay.

Property Damage by Bears

When asked about the amount of property damage caused by polar bears, 27/29 respondents said polar bears are causing more damage now than 15 years ago (Dowsley 2005). The other 2 respondents indicated no obvious change. There was no significant difference between categories of respondents. Destruction of meat caches were reported in Pond Inlet and Clyde River, while damage to cabins and tents were mentioned in all three communities.

Respondents were asked what had caused the bears to be more destructive. For this question, there was a significant difference between communities regarding the interpretation of the bears' behaviour as being related to bear population size ($p = 0.092$). Six of seven Pond Inlet respondents stated the increase in the polar bear population was the reason for increased damage, while Clyde River and Qikiqtarjuaq respondents did not feel as strongly about this explanation (5/13 and 2/6 respectively). There was also a significant difference between communities regarding humans as the cause of increased bear damage ($p = 0.043$). In Qikiqtarjuaq 4/6 respondents stated that the cause of increased bear damage was that there are more people now and more human objects around for bears to get into. In Clyde River 4/13 agreed with this while 9/13 said this was not the reason. All Pond Inlet respondents (7/7) stated that the cause of increased damage was not that there are more people or more human objects on the land.

Some of the disagreement between Inuit and scientists regarding the polar bear population size may also result from a time lag for IQ between making sufficient observations and then synthesizing that information into an understanding of cause and effect. Omura (2005) discusses the timely

formation of Inuit knowledge when he points out that while science focuses on the strategy, or big picture, Inuit focus on the tactics, or particulars of events, and try to avoid generalizations. When this is combined with the lower precision (compared to scientific studies) of observations of trends within naturally fluctuating systems, it is expected that the result will be fewer strong conclusions.

This is not to say that no Inuit have connected changes in the sea ice with the changes they have observed in polar bears. In the Inuit knowledge survey 12 people discussed possible links between polar bears and climate change (Dowsley 2005; 2007). Three did not think there was a link and four respondents were uncertain. Five respondents felt climate change could be contributing to what they had observed about polar bears, for example:

> "The bears are more hungry. There is a problem with the ice. The rough ice makes it hard for them to find seals, but there is the same number of seals." (Qikiqtarjuaq participant, Dowsley 2005:11)

In summary, Inuit observations of the sea ice environment are fairly consistent with each other and with scientific information. There was more variability between interview participants regarding polar bear population, behaviour and condition, and the meaning of the observations. There is high variability in the environment and it is difficult to assess how climate change is affecting polar bears.

Discussion of IQ

The collection and interpretation of IQ (and TEK/TK more generally) involves several cautions. The first is the individual nature of traditional knowledge. Second is that Inuit focus on the tactics, or particulars of events, and try to avoid generalizations. Finally, traditional knowledge is almost always derived

from local-level observations and may not always translate well into discussions of wildlife populations at the larger geographic scale.

Traditional Knowledge in general, or IQ more specifically, is not a single unified body of knowledge, catalogued and accepted by everyone as universal truth. There is much variation in life experience, analysis of observations, and ability to integrate various pieces of information among Inuit, just as there is among other people.

The Baffin Bay consultations provided an example of the problems that arise due to the individual nature of TEK (Dowsley and Taylor 2006a). It involved the claim by some Inuit participants that a loss of sea ice due to climate change would not affect polar bears' hunting success or population distribution as they are perfectly capable of hunting in the open water. Thus, the argument concluded, scientists' belief that bears are being concentrated on land was incorrect. While it has been reported that polar bears hunt in open water (Furnell and Oolooyuk 1980, Smith and Sjare 1990), these reports note that polar bears bring their prey out of the water to feed. Similarly, other Inuit reported the use of a feeding platform during the consultations in Clyde River and Pond Inlet. For example:

> "In 1969 we used to go by ship to Alexander and Grise Fiords, when my father worked for the RCMP. When we were in the middle of the ocean, going by boat, we used to see polar bears in the water where there was no ice. And when they caught seals they would take them to the ice to feed themselves in summer." (Pond Inlet community consultation, Dowsley and Taylor 2006a:42).

This example demonstrates the importance of vigilance in collecting and verifying traditional knowledge as discussed by Ferguson and Messier (1997)

and Fox (2002). It also illustrates the usefulness of viewing co-management as an iterative process of knowledge sharing between all participants.

The individual nature of IQ should also be recognized and accommodated by the co-management system more generally. The transformation of individual observations and conclusions by Inuit politicians into an 'official' group opinion occurred often during the consultations and allowed these elected officials to demonstrate a unified front to wildlife managers and add weight to their concerns (Dowsley and Taylor 2006a; 2006b). In doing so, the textured nature of the original reports can be lost. For example, although the majority of Baffin Bay interview participants reported the polar bear population had increased, there was a significant difference ($p = 0.01$) between the proportion of people in Qikiqtarjuaq who reported more bears, and the proportion of people who reported more bears in Clyde River and Pond Inlet (Dowsley 2005; 2007). Biogeographic differences between northern and southern Baffin Bay may be affecting bears differently in the two areas.

Once a group opinion has been expressed, it may also be difficult to modify. Inuit generally try to avoid contradicting other people, because other people's words are assumed to be true (Ferguson and Messier 1997; Fox 2002). Therefore, people may try to add their own knowledge to a discussion without openly contradicting the observations and conclusions of someone else. For example, although 16/17 interview participants in Clyde River reported an increase in polar bears during the interview study (Dowsley 2005; 2007), an elder reported an opposing view during the consultations:

> "I think that there's a decrease in polar bears, but I don't want everyone to believe that because Inuit Knowledge says there is an increase. Sometimes we hardly see them anywhere. From Inuit Knowledge I know if we don't see a polar bear it's because they are moving around a lot. Inuit Knowledge is saying more polar bears are

being seen." (Clyde River consultation participant, Dowsley and Taylor, 2006a:56).

Closely related to the individual nature of TEK is that Inuit tend to be cautious about over generalizing or simplifying their knowledge and prefer to admit ignorance over speculating on topics (Gilchrist et al. 2005; Dowsley 2007). Often information is shared as anecdotes of individual events rather than as generalizations (Omura 2005). Omura points out that while science focuses ideologically on the strategy, or big picture, Inuit knowledge ideologically focuses on the tactics employed in particular situations. This difference needs to be recognized in order to hold more effective discussions between people using the different knowledge systems.

Finally TEK is almost always formed from a local geographic focus. Traditional knowledge of wildlife can be useful at the population level as a source of information on population trends which can be ascertained, for example, from body condition of harvested animals (Lyver and Gunn 2004) or movement patterns in migratory species such as caribou (Kendrick et al. 2005). However, TEK (as well as scientific information) has at times, proven less reliable in discussions of animal population size or distributions. In several studies, when asked about possible declines in wildlife populations, Inuit reported that the species had declined in the local area, but that this represented a shift in distribution rather than a decline in population (McDonald et al. 1997; Johannes et al. 2000; Gilchrist et al. 2005). In some instances further scientific studies indicated there had been a change in distribution (Johannes et al. 2000), while in others a decline in population was concluded (Hammill et al. 2004; Gilchrist et al. 2005). Problems in data collection and synthesis, or the geographic or time scale of the observations may explain the incorrect conclusions that were initially offered by either scientific researchers or Inuit observers (Johannes et al. 2000; Gilchrist et al. 2005).

The disagreement in Western Hudson Bay over the population of polar bears may provide an example of either incomplete data collection and synthesis among Inuit observers, or data collection that is too narrowly confined in geographic area on the part of scientific research. The scientific studies by the Canadian Wildlife Service indicate a significant decline in the body fat of female bears in the fall (Stirling et al. 1999), as well as a population decline. A representative from the land claim organization, Nunavut Tunngavik Inc., summarized Inuit views of the situation as follows:

> "The elders don't know the exact population, but they say the population is stable…We will tell you when we are concerned. We'll tell you when there is a problem." (Dowsley and Taylor 200b:44).

A scientific population survey of a much larger geographic area in Western Hudson Bay in the fall of 2007 will examine the Inuit view that the distribution of bears has shifted. The alternative possibility is that IQ has not yet noticed a decline in bear condition or population in Western Hudson Bay. The amount of body fat on polar bears varies throughout the year, with bears at their lowest weight in early spring (Stirling et al. 1999). Inuit in Western Hudson Bay harvest polar bears throughout the year, with a male to female ratio of 2:1 and may not yet have made sufficient observations of the condition of bears in any one season to notice a decrease in the amount of fat on females in the fall.

In discussions about possible population declines of other species (Johannes et al. 2000; Gilchrist et al. 2005), Inuit recognized that local harvesting rates were quite high, or local disturbance of animals had caused the animals to leave. In the case of thick-billed murres (*Uria lomvia*) in western Greenland, most of the Inuit hunters interviewed did not consider the lack of alternative habitat for the species outside the local area, and/or the cumulative effects of many settlements, including their own, harvesting or disturbing the birds (Gilchrist et al. 2005). Instead, most interview participants concluded the declines were

caused by local disturbance or non-local over harvesting. These conclusions were explained by Gilchrist and colleagues as a lack of knowledge of the regional movements of the species and an ignorance of harvest levels relative to productivity. An underlying reason for this apparently narrow geographic focus in the synthesis of harvest and movement data comes from IQ categories 3 and 4 (discussed further below) and relates to the Inuit view of animals as sentient beings.

If these cautions are noted, the arguments relating to IQ Categories 1 and 2 are relatively easily understood by non-Inuit and can be discussed by scientists and managers. They work within the scientific paradigm and can be addressed either within the present co-management system or with slight modifications to that system. If they were the only arguments used, one would expect a solution could soon be reached. These arguments do not, however, fully explain the reluctance of the Inuit to take immediate action regarding the scientific evidence that the Western Hudson Bay and Baffin Bay polar bear populations are declining. The participants in the consultations and interviews frequently offered another type of argument, either directly or indirectly, as to why they did not want to lower quotas. This has to do with a cultural view of animals that differs greatly from that of Euro-Canadians.

IQ Categories 3 and 4-Environmental Values and the Knowledge System

Inuit Qaujimatuqangit from categories 3 and 4 was used to discuss the polar bear situation in Western Hudson Bay and Baffin Bay and to argue against quota reductions or against the structure of the management system itself. These arguments reveal an underlying conflict in the co-management system: that it has not effectively incorporated Inuit cultural traditions. Inuit participants made several statements against the co-management system itself during the community consultations:

"As Inuit, we have rights. You're just here telling us things. We have rights and a voice. We can do something about that. The elders know [about the polar bears]. Even though I'm young, I believe them, I don't believe you." (Clyde River community consultation participant, Dowsley and Taylor 2006a:67).

"Ever since we abided by the government we have been following things we don't like. They impose it on the settlements. We used to follow our own thoughts and we were conservation minded. If we work together we won't be over-killing wildlife." (Western Hudson Bay consultation participant, Dowsley and Taylor 2006b:52).

These statements reflect a strong interest in participating in wildlife management, but in a culturally appropriate way. Omura (2005) and Fienup-Riordan (1999) points out the desire among Inuit and Yup'ik Eskimos to maintain their own perspective rather than following non-indigenous ways. This is manifested in many aspects of life and interactions with non-Inuit, and serves to strengthen Inuit identity in the face of much outside influence in their lives (Omura 2005).

For Inuit, hunting plays a key role in cultural identity (Condon et al. 1995), and is essential for the development and maintenance of human-animal relations and also human-human relationships (Stairs and Wenzel 1992; Nuttall 2000). Directly from the relationship between hunter and prey (as food provider), comes the necessity to share that food with other people in order to fulfill one's relationship obligations to the hunted species and to other humans who also share food. In this way, hunting ties people to each other as well as to animals. Furthermore, the IQ principles of Nunavut stress that animals and land are not owned and therefore people must show respect for them and avoid disputes over them (Wenzel 2004).

For northern hunters, animal-human relationships are most obviously expressed through hunting and, in order to be successful hunters, humans must have a proper attitude towards animals (Fienup-Riordan 1990; Stairs and Wenzel 1992). One key aspect of this relationship, not generally shared by Euro-Canadian ideology, is that all animals are understood to be sentient (Wenzel 1991; Fienup-Riordan 1999; Zavaleta 1999; Natcher et al. 2005). Inuit *Qaujimajatuqangit* principles include several references to proper behaviour in relation to animals, including recognizing that there are consequences of one's actions, one should harvest without malice, and one should avoid unnecessary harm (Wenzel 2004). Two related themes, arising from this cultural construct, appeared in the interviews and consultations: the recognition of polar bears as sentient and deserving of respect, and the incorporation of new information into traditional understandings of the relationship between humans and polar bears.

Polar bear hunting holds a special importance to Inuit (Wenzel 1983a; Sandell and Sandell 1996). This was expressed at the Clyde River community consultation:

> "We have many problems and there are many youths who want to catch their first polar bear. There are many people. Sometimes there are people in their 50s who never caught a polar bear. It's very important to get your first bear. It brings you up in your life." (Clyde River community consultation participant, Dowsley and Taylor 2006a:70)

Inuit traditions dictate that one should show proper respect to polar bears in thought, word and deed in order to avoid a negative response from bears (Wenzel 1983a; Sandell and Sandell 1996). These negative responses may be anything from avoidance of the disrespectful hunter to an attack on one's person or property (Wenzel 1983a; Dowsley unpublished data). The

importance of proper communication between humans and polar bears is illustrated in a case of hunting near Clyde River, reported by Wenzel (2004), in which the Inuk hunter emphasized the importance of watching the bear for signs of how to proceed with the interaction, and the subsequent understanding that successful completion of the hunt was a result of acting on the information communicated by the bear.

Some Inuit consider the human-polar bear relationship to be threatened by the very existence of the quota system. Wenzel (2005) discusses how the establishment of quotas was seen by Inuit in the Clyde River area as bragging about hunting ability by predicting the number of bears that would be harvested, and acting outside the human-bear relationship by limiting the harvest to fewer bears than might present themselves. Fighting over hunting tags, which can result from a quota system, was also seen as inappropriate. Such behaviour is predicted to cause polar bears to leave the area and go to where there are respectful hunters. This belief was apparent during the Baffin Bay consultations when the high rate of harvest on the Greenland side of the bay was discussed with the HTO of Qikiqtarjuaq (Dowsley and Taylor 2006a). One HTO board member there stated:

> "A few years back when I was also doing a survey [in Greenland] and I asked what kind of animals they had, Greenland seemed to respect polar bears more because it is not for money and they even cut up the hide and share it to make clothes. They are not hunting for money but for food and clothes." (Qikiqtarjuaq consultation participant, Dowsley and Taylor 2006a:34)

The implication of this statement is that Greenland is able to harvest more polar bears because Greenlanders (Kalalliit) have been more respectful by sharing, and not fighting over money or tags, thus the polar bears have moved there from Nunavut. The scientific reports that concluded a drop in quota was

necessary because there were fewer bears for Nunavut hunters could be interpreted as supporting this understanding. This also explains some of the reluctance of Baffin Bay Nunavummiut to judge Greenland's recent large harvests negatively as an over-harvest, and turns the concern inwards to encourage consideration of the things Nunavummiut are doing wrong in their relationship with polar bears.

Suggestions for improving the relationship between humans and polar bears were also offered during the Baffin Bay interviews and consultations. Current management rules are considered by some Inuit to be damaging to good human-polar bear relations, and a removal of quotas was seen as potentially restorative:

> "It's not right for animals to be chased away with a rifle [when there is no available hunting tag]. It must be recognized that this is wrong. We should try going back to Inuit knowledge for 4 or 5 years and see the effect." (Pond Inlet HTO board member, Dowsley and Taylor 2006a:42).

The second, and closely related theme from IQ categories 3 and 4 is the incorporation of new knowledge into traditional views of human-animal relationships. Among northern aboriginal groups traditional views of wildlife as sentient means the animals may disappear and reappear according to their own way (Fienup-Riordan 1999). This view was expressed in this study specifically for polar bears and caribou (Dowsley 2005; Dowsley and Taylor 2006a). Traditionally hunting was thought to only influence the population by the manner in which it was carried out. Disrespectful hunting would drive animals away, while respectful hunting could draw animals towards humans (Fienup-Riordan 1999). Given this cultural belief, the scientific perspective that the level of hunting influences population size is a difficult concept.

Northern aboriginal groups are now in the process of expanding their views of human-wildlife relationships to include this understanding of hunting levels (Zavaleta 1999). Many interpretations of the relationship between hunting and wildlife populations have been offered in this and other studies. For example, Gilchrist and colleagues (2005) found that only 2 of 10 expert thick-billed murre hunters in Upernavik, Greenland cited over hunting as the cause of decline in the murre population. Other hunters cited shifts in distribution. Further scientific studies showed over hunting to be the leading cause in the decline. A similar process of partial integration of the concept of over hunting was observed in Nunavut concerning polar bear populations. During the Baffin Bay interviews, 4/16 interview participants stated that they liked the quota system the way it is (Dowsley 2005). Some hunters recognized the connection of hunting to population size:

> "I like the idea of the quota. If we don't have a quota and there are more hunters we'll have fewer polar bears. The population will go down." (Pond Inlet participant, Dowsley 2005:19).

Other participants made remarks throughout the interviews that illustrate a more complex integration of the quota system into traditional views. For example, in Qikiqtarjuaq, when asked why a polar bear might attack a particular person, an elderly woman discussed wildlife regulations as if breaking them would upset bears:

> "I don't really know. Maybe it is that we are not supposed to say bad things about polar bears. When a man's property is damaged he might get mad. We are told polar bears have minds like humans. The man might threaten to kill that polar bear. The polar bear also knows there are seasons when humans can't kill polar bears and if a man kills one out of season the polar bears might get mad." (Qikiqtarjuaq interview participant, Dowsley unpublished data)[1].

Conclusions

Science and traditional knowledge are not diametrically opposed either generally or in the case of understanding polar bears. There are many areas of overlap, particularly with regard to Categories 1 and 2 of traditional knowledge. In evaluating population size or distribution of species, coarse change is noted in traditional knowledge, but finer changes are, or seem to be, not as easily detected (Gilchrist et al. 2005). This may explain a lack of agreement between scientific observations of declining polar bear condition in Western Hudson Bay and the observations of harvesters. In the discussions of polar bears and climate change, there was much variability in IQ around the synthesis of information provided by observations. This variability suggests that IQ knowledge holders have not yet had sufficient time to make observations or connect the environmental changes to changes in polar bears. Continued monitoring using both large scale scientific studies and smaller scale local observations will likely result in a consensus over time if communication and cooperation between the two sets of observers is maintained or improved.

Developing co-management as an iterative process is also necessary to address the issues regarding IQ categories 3 and 4. Communication has helped scientists to incorporate IQ into their research, and Inuit are also recognizing the role of science. For example, the land claim organization, Nunavut Tunngavik Inc. (NTI) acknowledged the benefits of science, in this comment on climate change:

> "While it is unusual for Inuit to predict years ahead into the future, scientific knowledge can help to anticipate change and prevent being so suddenly faced with it…Thought must be given to future challenges and opportunities" (NTI 2005:4).

Incorporation of science into Inuit understandings of the relationship between wildlife populations and hunting were highly variable among individuals in this study. Views of this relationship ranged from the cause and effect understanding espoused by Euro-Canadians, to a combination of traditional Inuit and Euro-Canadian views. A dialogue must be encouraged between Inuit, scientists and managers on cultural understandings of polar bears because this is a very complex and individual aspect of management that can affect levels of the governance system well above the individual hunter. Co-management has the conservation of wildlife populations as the tangible management goal, but it also has the social goal of developing a governance system that builds trust and allows for problem solving among participants (Natcher et al. 2005). If group cohesion does not develop among co-management participants, effective management may fail to occur (Ostrom 1992; Natcher et al. 2005).

1. Note that regulations regarding hunting seasons have been rescinded because the quota system and a 2:1 male to female harvest ratio adequately protect the populations.

Bridge Between Manuscripts 3 and 4

Manuscript 3 addressed the lack of examples in the common property literature of the conversion of top-down systems into multi-level systems by examining a case study situation where top-down and bottom-up perspectives met through co-management. Manuscript 3 examined the interaction of different categories of IQ with science and the Euro-Canadian wildlife paradigm. Local understandings differed from higher levels mainly in how the resource was viewed. From the territorial government perspective polar bears were seen as a renewable resource to be managed, while the local perspective was that polar bears are sentient beings with a social relationship to people.

In the case study presented in Manuscript 3 the power of IQ in the Nunavut co-management system was manifested not only in quota increases that went against scientific recommendations, but also in delaying management changes as more harvesting information and science became available because it did not agree with IQ. Manuscript 3 also provided some information to allow for an evaluation of part of the second section of the thesis hypothesis that the top-down ideology will become more pervasive among the individual participants in the system (including harvesters), due to the nature of historic power relations in top-down governance. The top-down perspective, based on scientific observation, that hunting levels can reduce wildlife populations was not pervasive among interview participants in either this case study or in the one reported by Gilchrist and colleagues (2005). While part of this is the more narrow geographic focus of IQ and TEK more generally, TEK from Usher's (2000) categories relating to the view of animals as sentient is apparently also involved.

The relationship of Inuit to polar bears is explored further in Manuscript 4 through the economic use of polar bears in the sport hunt industry and the Inuit subsistence hunt. Several Nunavut communities are used as case studies,

including the Baffin Bay communities. This final manuscript serves to highlight local views of the resource and how these perceptions are manifested in consumptive use. It thus addresses part of objective 1 by exploring the interactions between governance and the economic and social/cultural scales. It also addresses objective 3, to analyze how local-level governance institutions balance different uses of the resource within a cultural framework and in the context of the larger governance and economic systems. Finally it addresses the second part of the hypothesis regarding the influence of the market economy of local views of polar bears.

CHAPTER 6: INUIT ECONOMIC VALUATIONS OF POLAR BEARS

Martha Dowsley

Abstract

Inuit and other indigenous groups in the Arctic rely on a mixed economy based on the use of wildlife and wage labour. Polar bears (*Ursus maritimus*) are a common pool resource that contributes to both the subsistence and monetary aspects of the Inuit economy. After quotas and a sport hunt were developed for this species in the Northwest Territories (N.W.T.) during the 1960s and 1970s, Inuit community hunting organizations were faced with decisions about the distribution of their quota between Inuit and sport hunters. Sport hunting is much more profitable financially than subsistence hunting. However, the proportion of the polar bear quota devoted to the sport hunt has become relatively stable at approximately 20% across Nunavut (which separated from the N.W.T. in 1999). This ratio suggests local Inuit organizations are not using a neoclassical economic model based on profit maximization for polar bear use. This study examines three local-level hunting organizations and their institutions (as sets of rules) governing the sport and Inuit subsistence hunts. Modifications to 2 of the 3 sport hunt institutions reflect attempts to maximize individual returns from this pool of bear tags, and thus do demonstrate rational resource use in the neoclassical sense. The allocation of the balance of the quotas to Inuit subsistence hunting appears to reflect system maintenance goals within a broader socio-economic framework. These goals include reproducing the ability to hunt bears in order to reproduce relationships between bears and people. Retaining bear hunting as a general skill in the community requires resisting the commoditization and privatization of polar bears in order to reproduce the larger socio-economic system and insure flexibility of resource use into the future. Thus, the division of the polar bear quota represents the

immediate need for cash, and various longer-term system maintenance goals, both of which are necessary to maintain the mixed economy.

Introduction

Many Inuit communities rely on a mixed economy, using labour both to acquire cash and to harvest wildlife, and transforming each product into the other through the purchase of hunting equipment and the sale of goods and services relating to wildlife use (Smith and Wright 1989; Wenzel 1991; Reeves 1993). Increasingly, wage labour supports harvesting activities. Harvesting in turn supports dietary and other household needs as well as allowing for social and cultural reproduction (Dahl 1989; Wenzel 1995; Hovelsrud-Broda 1999). The dual roles of wildlife harvesting for the subsistence and market economies cannot be separated, since animals are used for food and the byproducts of the hunt (such as skins and tusks) are sold, or transformed for sale as carvings and crafts (Wenzel 1989; Reeves 1993). Wildlife is however, generally seen as a common pool resource that is (or should be) accessible to all (Usher and Bankes 1986), while cash is relatively scarce and often difficult to access.

Declining prices in markets for wildlife products (eg. seal skins and narwhal tusks) during the 1980s contributed to the development of the sport hunting industry in northern communities as a new use of wildlife for the monetary economy (Wenzel 2005). In the eastern Canadian arctic territory of Nunavut, polar bears have become the most lucrative sport hunted species (Freeman and Wenzel 2006). Communities receive approximately $20,000 per bear, an increase of over 1000% of the sale of a polar bear hide in the fur trade. Despite this high return, only approximately 20% of polar bear hunting tags in Nunavut are allocated to sport hunting (Dyck et al. 2006; Peacock et al. 2007). The high demand for hunts, as evinced by waiting lists lasting several years (Wenzel 2005), suggests that the constraining factor on the number of sport hunts is not the ability to sell hunts, but rather the number of tags available.

Each Nunavut community has a non-profit Hunters' and Trappers' Organization (HTO) which represents the community wildlife interests to higher levels of government. The HTO receives hunting tags for polar bears that make up its annual quota. The HTO then decides on the division of tags between sport and Inuit hunting and distributes the tags to individual hunters. In some communities the HTO also acts as the outfitter for polar bear sport hunts, while in others the HTO or individual hunters sell tags to private sport hunt outfitters.

This paper examines the role of polar bears in the Inuit mixed economy. Two questions will be addressed in order to assess the use of polar bears from both a formalist (neoclassical) economic perspective and a substantivist (or culturally specific) perspective (see Wood 2007). First, from the standpoint of formal neoclassical economics, do the HTOs behave in a rational manner in terms of maximizing profits from those polar bear tags that they assign to the sport hunt? Second, from the substantivist perspective, why do the HTOs behave in an irrational manner, according to neoclassical economics, when deciding the number of tags to allocate to the sport hunt? In addressing these questions we seek to increase our understanding of how the mixed economy operates under modern political and economic constraints.

Data were gathered to answer both questions through informal discussions and semi-directed interviews with hunters, elders, board members of Hunters' and Trappers' Organizations and Nunavut Department of Environment staff in the Nunavut communities of Pond Inlet, Clyde River, Qikiqtarjuaq, Arviat and Igloolik from 2003 to 2005 (see Figure 6.1). In addition, minutes from co-management meetings between communities and the Department of Environment regarding polar bears were examined (Dowsley and Taylor 2006a and b). Data regarding the sport hunt industry in Resolute Bay and Clyde River were collected by G. Wenzel (Wenzel 2005).

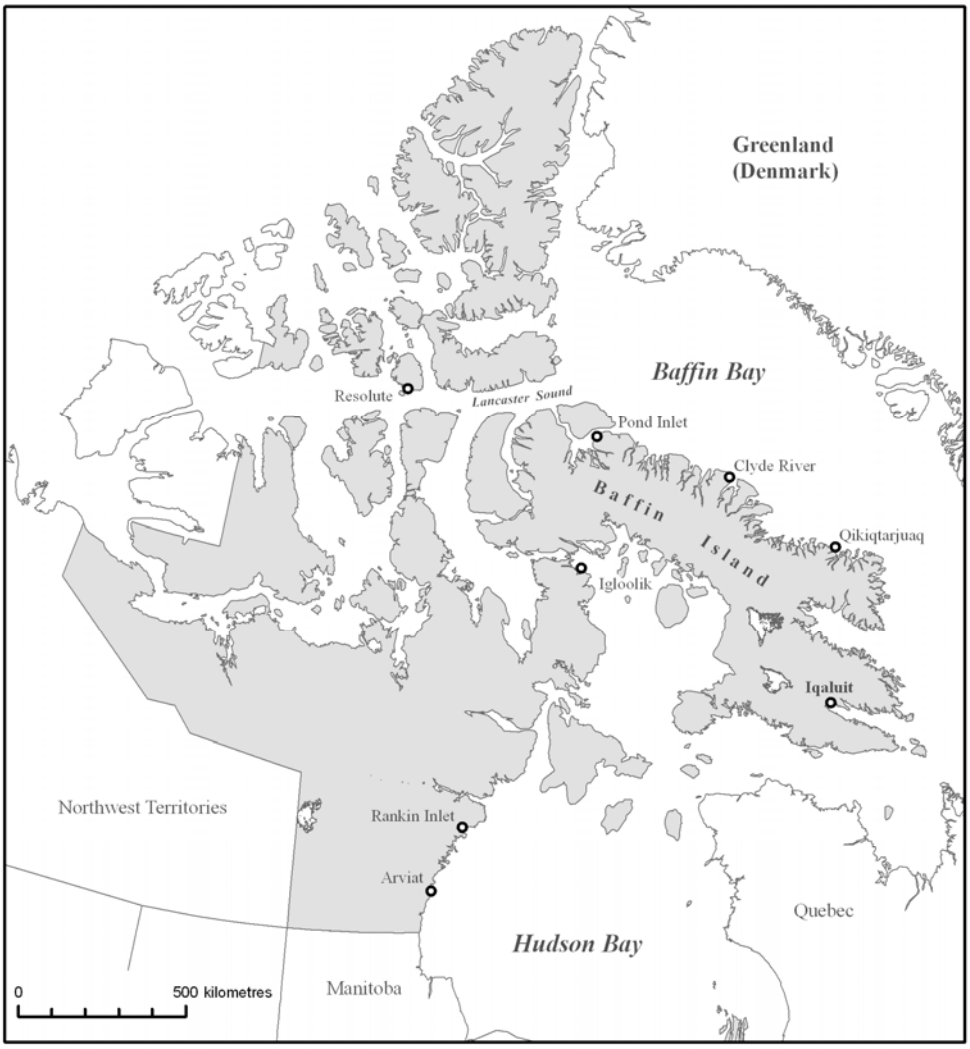

Figure 6.1. Nunavut Territory with main settlements and study communities labeled.

Three case study communities in Nunavut (Resolute Bay, Clyde River and Qikiqtarjuaq) will be used to examine the first question. These communities were selected due to the high polar bear populations around the communities, the resulting high quotas in Resolute Bay and Clyde River and their popularity with sport hunters. Qikiqtarjuaq provides an important counterpoint as a community with a smaller quota, but a shared resource management history with Clyde River (Davis 1999; Dowsley and Wenzel in press). These three

communities devote some of the highest percentages of community quotas to sport hunting (about 50% as opposed to the territory average of about 20%) and have been involved in the industry longer than many other communities. Their selection then was deliberate in order to examine communities with a well developed infrastructure and long experience with sport hunting, and therefore represent communities that should be best able to use their bear quotas efficiently.

The Northern Mixed Economy

Subsistence economies are socioeconomic systems involving food as the central circulating good (Damas 1972; Wenzel 2000). Production and distribution are based on social networks rather than the sale of goods and labour (Stairs and Wenzel 1992). Several decades ago the introduction of the market economy to subsistence-based societies was predicted to result in the demise of subsistence systems (Murphy and Steward 1956/1968; Chance 1960). However, the persistence of these systems as social economies continues today in many cultural contexts, including among northern indigenous groups (Denbow 1984; Myers 1988; Spencer 1969; Wenzel 1995, 2000). Today the influx of money has modified the Inuit economic system into a mixed economy which involves not only food, but the circulation of other goods including hunting equipment and money, and maintains forms of sharing as an important distribution mechanism (Wenzel 2000).

An important feature of the mixed economy is that the production of money is not seen as the goal of the economy. Rather, the goal comes from the earlier subsistence structure, which is to facilitate wildlife harvesting and related social interactions in order to provide security and psychological returns (Lonner 1980; Condon et al. 1995; Wenzel 2000). Thus, participants in mixed economies use money as a tool, but do not necessarily adopt the structures and values of market economies (Peterson 1991).

The social aspects of the mixed economy are considered important to identity by many northerners (Jolles and Kaningok 1991; Kruse 1991; Condon et al. 1995), and even urban-dwelling northern indigenous people maintain aspects of the social economy through sharing a wide variety of goods and services (Fogel-Chance 1993). Harvesting however, is, in itself economically rational in the neoclassical sense in that it produces food more cheaply than purchasing food (Smith and Wright 1989, Condon et al. 1995; Kishigami 2000; Wenzel field notes 2007).

Inuit have adapted to many changes in their traditional economy over roughly the past two centuries as a result of contact with non-Inuit and the market. For example, foreign products such as sugar, tea, and rifles were integrated into the subsistence distribution system by the 1940s (Wenzel 1995). More important than simply adopting new foods and technologies, Inuit have modified the physical and social aspects of production, distribution, and consumption to deal with changing relationships between hunters and their environment that have resulted from centralization of human settlements, market forces, and formalized wildlife management.

The advent of centralized settlements (which developed in the 1950s in the eastern Canadian Arctic) changed the distribution of hunters on the land and necessitated longer travel times to harvesting areas (Wenzel 1991). The concurrent adoption of new technologies such as snowmobiles and rifles resulted in a hunting system that requires cash input to purchase supplies and equipment. Polar bears rose in importance in the fur trade of all the Arctic nations by the mid-twentieth century due to increasing ease of hunting them and the high value of the skins. Scientists believed that polar bears were a nomadic species consisting on a single circumpolar population. International and national conservation concerns resulted in various management initiatives including the introduction of a quota system in the Northwest Territories

during the late 1960s. Early quotas for individual communities were partially set based on fur trade records, which served as a proxy for harvest records (Wenzel 2005). The economic status of a given community was also considered and quotas were sometimes adjusted based on monetary need (Scheweinsberg 1981). At Clyde River, on Baffin Island, the quota was set at 45 bears per year. This number roughly corresponded to the population of hunters in the community at the time, allowing each continued access to the resource on an annual basis (Wenzel 2000). Income from polar bear hides and other hunt byproducts, most notably seal skins, allowed every hunter monetary access to hunting equipment, maintaining the relatively even distribution of capital in a way that was similar to earlier economic structures (Wenzel 2000).

To gain an understanding of how the market and subsistence aspects of this mixed economy developed and interacted in the Canadian Arctic from the 1970s to the mid-1980s, I will examine the cost of the snowmobile, which replaced dog teams as the standard form of transportation for hunters by the mid-1970s. In Resolute Bay, wage labour was readily available and the average adult income in that community in 1976 was $4907 (this was 75% from wages, 15% from wildlife products and 10% from transfer payments) (Kemp et al. 1977). As an illustration of the purchasing power of Inuit at the time, a snowmobile cost about $1500, and depreciated at about $500/year (Kemp et al. 1977). Other communities, including Clyde River and Qikiqtarjuaq, had much less access to wage employment. In 1972 at Clyde River the fur trade in seal skins and polar bear skins provided an average annual income of $1400.00 per hunter (this is excluding any wage labour) (Wenzel 1981). Of that, $922 was the average annual return per hunter for polar bear hides. By 1980 income from wildlife products at Clyde River rose to $2500 and some polar bear hunters were able to sell two or three hides a year and could earn up to $4000-$6000 a year from wildlife products (Wenzel 2005). Using these data as an approximation for other arctic communities, a snowmobile in the 1970s cost an Inuk between 30% and 60% of his annual

income, and the sale of a polar bear skin could greatly affect that percentage, basically raising the income of a hunter to that of a full time wage labourer.

Several aspects of this mixed economy were disrupted by the mid-1980s. In 1983 and 1984, market crashes in sealskins and narwhal ivory upset the balance of the system resulting in hunters requiring outside inputs of cash and/or equipment to support their hunting (Wenzel 2000). In Qikiqtarjuaq and Clyde River the economic returns from hunting were further reduced through the reduction of polar bear quotas by 55% and 67% respectively in 1985, although compensation was paid to the communities for several years (Davis 1999). By the mid-1980s full time hunting no longer paid for itself. In the community of Holman, NWT the average income in 1984 from the sale of furs (fox, seal and polar bear) was $4534, while the price of a snowmobile was $3725 (Smith and Wright 1989). Similar changes in prices occurred in Clyde River (Wenzel 1989). Whereas in the 1970s a hunter might pay as little as 30% of his annual income to purchase a snowmobile, by 1984 he was paying approximately 82%.

With the necessity to raise funds for hunting equipment through other means than the sale of hunt byproducts, economic production units above the level of individual hunter (and of course, his wife who prepared the skins for sale) became necessary in order for the system to function (Bodenhorn 2000; Wenzel 1995). Hunters had the time to pursue animals according to the physical conditions and prey availability, but they required hunting equipment that had to be purchased. Full-time employees had the necessary funds to purchase such equipment, but were limited in their hunting time to weekends and vacations. Wenzel (1983b, 1995) found the Clyde River Nunavummiut to be engaged in regular exchange of hunting equipment, food and cash across several households within the extended family, or *ilagiit* level of social organization. For example, by the mid-1980s, he found that demand sharing, whereby socially dominant men may demand support for hunting from their

subordinate kinsmen through equipment donation, long-term loans or by the sharing of cash, had increased pressure on members of the wage earning younger generation beyond what had previously been experienced (Wenzel 1995; 2000). Wage employment of female relatives has also become increasingly important to support hunters (Smith and Wright 1989; Wenzel 2000).

The development of formal conservation systems to control harvest levels of some species, coupled with human population growth also affected the social organization of northern mixed economies (Sejersen 2001; Bodenhorn 2000; Caulfield 1993). In the case of polar bears, the limited number of hunting tags available in each Nunavut community resulted in changes to the type of person who engages in the hunt. Whereas hunting was traditionally a job assigned to men, some HTOs now have large female memberships as well. This is, at least in part, an adaptation to the restricted number of polar bear tags. The more members of a household that are members of the HTO, the better chance the household has to receive a tag and thus harvest a bear. Men in some communities complain about the undermining of their gender role, but women rarely hunt alone (Tyrrell in press, Dowsley field notes). Instead they are accompanied by male relatives, and the products of the hunt enter the same distribution systems, regardless of which household member was the tag holder.

A second, and potentially more problematic outcome of the increasingly limited access to bears is that the high demand for tags has been dealt with in some communities through a lottery distribution system coupled with a short tag holding period of one to a few days. If a hunter is unsuccessful in that time, the tag is returned to the lottery and assigned to someone else. The time demands of work and school, and the pressure to be successful in a short time mean that few people accompany the hunter, generally only a competent male hunting partner. There are therefore fewer opportunities for less experienced

hunters to participate in a hunt than in the past (see for example the hunt described by Wenzel 1983a). Often inexperienced people will only hunt bears if they receive a tag themselves. In the long term this could result in fewer well-trained and experienced hunters. From a conservation and economic perspective this system is also less than ideal because it encourages hunters to be less selective for males and/or larger bears than they would be if less pressed for time. Under a short tag-holding period a hunter does not want to pass on a bear when the chances of finding another animal that better fits his selection criteria are low. Large male bears are desirable two reasons, first, the pelts of larger animals fetch more in the fur trade and second, the flexible quota system encourages the taking of males in order to maintain reproductive females in the population. If a community harvests too many females in a given year the number of tags they receive the following year is reduced.

The mixed economy has undergone important changes since the 1970s. Not only have market influences caused hunt byproducts to lose value relative to the cost of necessary hunting equipment, but the social aspects of the economy have changed as well. The need for wage employment has reduced the opportunity for many men to be full time hunters and affected the distribution of capital, straining traditional economic relationships. Concurrently, developments in wildlife conservation and a growing human population have reduced the availability of polar bear hides as saleable hunt byproducts. These changes encouraged the development of a sport hunt industry whereby hunters could greatly increase their income from wildlife. For example, by 1984 guiding sport hunters for a variety of species (though polar bears were the most lucrative) brought in an average annual return of $7000 per full time hunter in Holman (Smith and Wright 1989).

Development of the Polar Bear Sport Hunt Industry

Polar bear harvests and the sale of polar bear hides in the fur trade across the arctic increased through the mid-twentieth century (Schweinsburg 1981; Prestrud and Stirling 1994; Wenzel 2005). We now know that some populations were over-harvested by the late 1960s (Stirling 2002). In 1967 the Northwest Territories developed a quota system to control the growing harvest, but recognized the importance of polar bears to the monetary sector of the Inuit economy. Partly to reduce the economic burden of limiting the harvest, Canada sanctioned the development of polar bear sport hunts in 1970. During that decade polar bear sport hunts were sporadic and most NWT communities did not participate (see Figure 6.2) (Stirling and Smith 1980a; 1980b). Problems with infrastructure and capital investment may have limited the industry in some communities. For example Stirling and Smith (1980a) report that, because the use of dog teams (as opposed to mechanized transport), is mandatory for the sport hunt, the lack of sled dogs in some communities resulted in their not being granted sport hunt licenses by the government. However, as this aspect of infrastructure developed, other government officials interpreted the low number of sport hunts offered by HTOs as relating primarily to relations with the market economy. It also became apparent that Inuit were not making rational use of bears in the neoclassical sense. For example, officials reported:

> "The higher fur prices received in 1973-74 probably contributed to reducing the sport-hunt in the N.W.T. Although each sport-hunt, whether successful or not, brings $3500 into the settlement, most native hunters preferred to harvest their quota of bears themselves." (Smith and Jonkel 1976:72).

> "To many Inuit hunters in 1974-75, the effort involved in servicing a sport-hunt and the consequent reduction of individual freedom while out on the sport-hunt did not justify the financial gain. In 1975-76

with the reduction in prices received for polar bear hides more tags were allotted to the sport hunt" (Stirling and Smith 1980b:138).

The sport hunt industry grew more rapidly after the loss of income from the sale of hunting byproducts from other species in the mid-1980s, (see Figure 6.2). Throughout that decade the Canadian government also developed infrastructure and training programs as part of a larger focus on promoting tourism in the north (Myers and Forrest 2000; Wenzel 2005). This improved the quality of service and access to communities for sport hunters and other tourists. The increase in polar bear sport hunts offered after the seal skin and ivory market crashes of the early 1980s suggest it was a deliberate effort by Inuit to offset monetary losses, rather than a desire to commoditize the polar bear harvest. Despite the growth in sport hunts through the 1980s and early 1990s, only about 20% of tags are allocated to the polar bear sport hunt in Nunavut today.

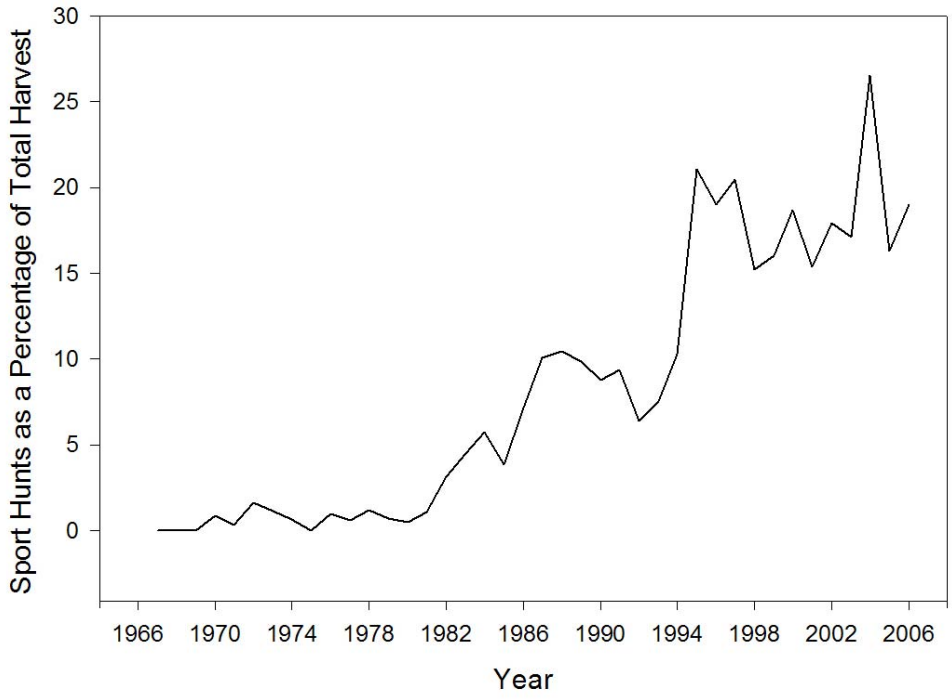

Figure 6.2. Sport hunts as a percentage of total polar bear harvest in the Northwest Territories (including Nunavut) from 1967 to 1999, and in Nunavut from 2000-2006. (Data from Nunavut Department of Environment).

Before a further examination of why sport hunting levels are maintained at this low level, I will address whether Inuit as a group, through the HTO, behave in a rational manner according to neoclassical economics, when participating in the market through the polar bear sport hunt industry.

Do HTOs Act Rationally in the Sport Hunt?

Each community Hunters' and Trappers' Organization (HTO) is allocated an annual number of tags for polar bear hunting within the local bear population area. Any adult in the community can be a member of the HTO, and, as a group, the HTO membership decides whether or not to hold a sport hunt and subsequently decides how many tags to devote to that activity. The local outfitter receives roughly $19 000 for a sport hunt package (which includes the labour of a dog team guide and assistant, food, equipment etc.). Hunt regulations require that sport hunters be accompanied by Native guides and use non-mechanized transport to pursue bears.

The considerable money available to Inuit through the polar bear sport hunt has required community-level institutional development through the HTO to decide on the level of sport hunting and to distribute the profit in an equitable manner. Each HTO has a different arrangement with regards to assigning tags to the sport hunt and access to monetary benefits from sport hunting. The situation results in diverse outcomes for individual HTO members, both in monetary terms and in accessibility of bear tags for personal use. The opportunity costs and financial benefits to individual hunters will be examined through case studies of three communities: Resolute Bay, Clyde River, and Qikiqtarjuaq (formerly Broughton Island). Analysis will focus on the 2001-2002 and 2002-2003 hunting seasons.

Resolute Bay (*Qausuittuq*), is situated on Cornwallis Island (74°41'N, 94°54'W) in the Lancaster Sound polar bear population area. The adult Inuit

population (and therefore potential hunters) is approximately 90 (all human populations taken from Statistics Canada 2001 census). With 35 bear tags per year, Resolute Bay possesses one of the highest polar bear quotas in Nunavut. Since the 2000-2001 season 20 of these tags have been used for sport hunting each year. Resolute has five dog team owners (thus able to serve as sport hunt guides) and one private outfitter. In 2003-2004, polar bear sport hunting brought in $380,000 to this community.

Clyde River (*Kangiqtugaapik*) is located on the east coast of Baffin Island (70°27'N, 68°38'W.), in the Baffin Bay polar bear population area. Pond Inlet and Qikiqtarjuaq, as well as several west Greenland communities also hunt this bear population. However, the area around Clyde River has a high density of bears (Harington 1968), and was particularly hard hit by the seal skin market crash of the early 1980s (Wenzel 1991; Davis 1999). As a result it has generally received the highest quota on Baffin Island. In 2001, Clyde River's adult population was 390, and from 2001 to 2003 bear quotas at Clyde were 21 animals annually. Three private outfitters ran at total of 10 hunts in 2001, and the HTO took over outfitting in 2003 and ran 8 hunts. Sport hunting in 2003-2004 provided Clyde River with $190,000.

Qikiqtarjuaq (formerly Broughton Island) is located on Baffin Island (67°33'N, 64°03W) southeast of Clyde River and has an adult population of 340. The sport hunt in this community is organized and outfitted by the HTO. There are four dog team owners who act as guides. The quotas in 2001-2002 and 2003-2004 were 21 tags each year, of which 10 were used annually for the sport hunt. In 2003-2004, the Qikiqtarjuaq HTO decided to initiate a fall sport hunt (when bears are on the land rather than the ice) and two hunts were carried out. The community plans to continue to offer fall hunts. In 2003-2004, Qikiqtarjuaq took in $200,000 from sport hunting.

Costs of Conducting a Sport Hunt

One of the main costs of conducting a sport hunt is a loss of access to bears for community hunters. The severity of that loss depends on the number of tags allocated to the sport hunt and the population of potential Inuit hunters.

Resolute Bay, receives 35 bear tags, and has 90 potential hunters who, if there were no sport hunt, would have a 39% chance of receiving a bear tag in any year. This level of access is expressed as the estimated frequency in years of receiving a tag for personal use, here 1 in 3 years (see Table 6.1). The current level of sport hunting in the community reduces the number of Inuit hunting tags to 15, and subsequently a hunter's chance of getting a tag to one every 6 years. Clyde River had 390 potential bear hunters and 21 tags during the study period, giving each hunter one tag every 19 years. With a sport hunt at the 2001-2002 level of 10 tags, a hunter's chance of receiving a tag were reduced to one in 36 years.

Qikiqtarjuaq had 340 potential hunters and 21 bear tags. If no sport hunt existed, each hunter would receive one every 16 years. With the 2001-2002 sport hunt level of ten tags, eleven subsistence tags were assigned by lottery, allowing each eligible Inuk a tag only once every 31 years. The very low chance of an Inuk hunter receiving a tag in a given year has become a concern in Qikiqtarjuaq. In order to allow more people to go bear hunting the HTO board has instituted a 24-hour tag holding period. If an Inuk hunter does not get a bear in this time, the tag is returned to the general lottery.

	If no Sport Hunt		With Sport Hunt	
Community	Inuit tags /hunter population	Estimated frequency in years	Inuit tags /hunter population	Estimated frequency in years
Resolute Bay	35/90	1/3	15/90	1/6
Clyde River	21/390	1/19	11/390	1/36
Qikiqtarjuaq	21/340	1/16	11/340	1/31

Table 6.1. Frequency of individual Inuit hunters receiving bear tags for subsistence hunting under 2001-2002 quotas and sport hunt levels.

Distribution of Monetary Benefits of the Sport Hunt

The loss of access to bears affects all Inuit hunters in the community. In order to offset these losses, HTOs have developed mechanisms to direct some sport hunt income to Inuit hunters who are not earning wages by working on the sport hunt. If the sport hunt is to function in a rational manner, each HTO member must receive more money through these mechanisms than he or she would receive through the fur trade**.**

The basic monetary value of a polar bear, through selling the pelt in the fur trade, is estimated at $1000.00 (prices fluctuate due to the use of auctions, but data collected by both the author and G. Wenzel support this estimate). If all hides are sold in the fur trade and the money divided by the number Inuit hunters in the community, a base line measurement emerges of how much each person receives per year. Of course, no hunter receives this income as a yearly payment, but rather as a lump sum whenever he or she harvests a bear and sells the hide. However, given the different cycles of payments in various distribution mechanisms employed by the case study communities, it is easiest to make all monetary comparisons at the annual level (see Table 6.2). A similar calculation has been made to estimate the financial return per person if all tags were assigned to the sport hunt and the income from those sport hunts

(estimated at $20 000 each) were evenly distributed among all members of the HTO. These two calculations then provide a range of monies that could accrue to HTO members from the use of polar bears.

The federal government rule that stipulates non-mechanized transport of sport hunters essentially limits guiding to dog team owners. Further, the cultural tendency in many communities (including two of the case studies) to hire close relatives as assistant guides results in very limited sport hunt employment possibilities for most people. It is possible then to calculate how much money on average is distributed to an Inuk who is neither a dog team owner, nor close relative of such, and thus has basically no chance of employment in the sport hunt industry. The mechanisms whereby HTO members receive monetary benefits from the sport hunt are explored below and the amounts from two hunt years are compared to the baseline fur trade value of bear hides as well as the maximum economic value that could occur if the entire quota were assigned to sport hunting (see Table 6.2).

Resolute Bay

Resolute Bay's sport hunt is privately outfitted, and neither the HTO nor the community at large receives money from the hunt. There is, however, a mechanism to distribute cash benefits to Inuit hunters: the 20 tags assigned to the sport hunt are first allocated to Inuit through a lottery system. The sport hunt outfitter then purchases these tags from their holders for a price of $2500 each. This cash provides monetary benefit to individuals for their loss of access to polar bears, and is more money than a hunter receives from selling a bear hide in the fur trade (see Table 6.2). With 90 potential Inuit hunters in the community, each hunter receives the payment on average every 4.5 years, or a yearly payment of $555.56. If the remaining, fifteen non-sport hunt bears are harvested by the remaining 70 Inuit and the hides sold through the fur trade, an additional $15,000.00 enters the system, for a yearly payment to each Inuk hunter of $214.29. In total, a hunter not employed by the sport hunt receives

an annual payment of $769.85, under the 2001-2002 sport hunt levels and rules (although no one person would receive both types of payment in any one year). This system provides considerably more than the $388.89 each hunter would receive if no sport hunt occurred, but is only about 1/10th of what he or she would receive if all tags were used for sport hunting and the income evenly distributed. The Resolute HTO did not change their rules for sport hunt participation or monetary distribution between 2001-2002 and 2002-2003, so payment remained the same.

Clyde River

If the Clyde River quota of 21 polar bears was filled only by Inuit hunters and the hides sold on the fur trade, annual payment to each of the hunters would be $53.85 ($21,000/390). At the other end of the financial spectrum, if all polar bear tags were used for sport hunting and the income evenly divided amongst HTO members, they would each receive $1076.92 per year.

At Clyde River the HTO members vote annually on the number of tags to be used for sport hunting. These tags are then removed from the pool and sold to private outfitters. The HTO uses the sport hunt tag fees for equipment purchases to facilitate hunting in the community**.** In 2001-2002 the HTO received $21,000 for 10 tags, resulting in an in-kind payment worth $53.85 per Inuk hunter ($21,000/390 potential members). Combined with potential fur trade cash from the remaining 11 Inuit-hunted bears ($11,000/390), each individual would receive a total payment of $82.06. This is a much lower payment than in Resolute, and Clyde River also pays a much higher opportunity cost in terms of accessibility of bear tags. Continuing the sport hunt though is rational since each hunter receives more money through it than just from the fur trade.

In response to the low return (though the Resolute payment is not known to Clyde hunters), the HTO redesigned its sport hunt institution in 2003 to

increase monetary benefits to members and reduced the sport hunt by 2 tags. That year the HTO also took over all outfitting, resulting in profits of $80, 000. Employment opportunities, however, were not redistributed. The in-kind payment to the HTO members was thus increased to $205.13 per person ($80, 000/390). Combined with the $13,000 fur trade value of the remaining 13 Inuit hunted bears ($33.33/member), this would give annual benefits of $238.46, which is a substantial increase from the previous system.

Qikiqtarjuaq

In Qikiqtarjuaq the fur trade could provide a maximum of $61.76 per person annually, while if all polar bear tags were used for sport hunting and the income distributed evenly among a potential HTO membership of 340, each member could receive $1235.29.

In reality, Qikiqtarjuaq assigns 10 of the 21 bear tags to the sport hunt in each of the two study seasons. The HTO is the only outfitter and the assignment of assistants to the sport hunt is open to all hunters, giving a hypothetically even chance of employment. The average Inuk hunter then, would be assigned as a helper once in 34 years and earn $4000 for his/her labour, or a yearly payment of $117.65. A member also receives the benefit of utilizing equipment purchased by the HTO with profits from the sport hunt, which amounted to approximately $80,000 in 2001-2002, or $235.29 per person per year. If the remaining 11 bears were all harvested and the pelts sold (for a total of $11,000), an additional return of $32.35 would accrue to each HTO member. Thus, the total payment to each hunter in 2001-2002 would be $385.29.

Over the years there have been a number of unsuccessful sport hunts from Qikiqtarjuaq. These are blamed at least in part to the rough sea ice in that area, which can make sighting and pursuing bears difficult. Unsuccessful sport hunters have made requests to the HTO for second hunts at reduced prices. HTO discussions have also touched on what some perceive as the unfair

advantage of dog team owners, who usually receive sport hunt employment. These concerns have led the community to initiate a fall sport hunt. According to sport hunt rules, a hunter may pursue and kill a bear using non-mechanized transport, i.e. from a dog sled or by foot. The Qikiqtarjuaq HTO has interpreted this rule to mean a guide may transport a sport hunter by boat to an appropriate hunting area, where the sport hunter can then pursue the bear on foot. Every adult in the community owns or has access to a boat, opening the possibility of fall guiding employment to all. Two fall hunts were conducted in 2003, with 'boat guides' being selected by lottery, and paid the same wage as winter dog team guides. The initiation of the fall hunt, with the new opportunity to work as a guide increases the average hunter's income from the sport hunt by $44.12 ($7500 in wages/340 people x two fall hunts).

	Average return per person, fur trade only	Average return per person, sport hunt only	Average return per person 2001-2002	Annual return per person 2002-2003
Resolute Bay	$388.89	$7777.78	$769.85	$769.85
Clyde River	$53.85	$1076.92	$82.06	$238.46
Qikiqtarjuaq	$61.76	$1235.29	$385.29	$429.41

Table 6.2. Average Income to HTO members if all polar bears hides sold in the fur trade, all tags devoted to the sport hunt, and in two seasons with sport hunting.

Resolute Bay, with the highest return per HTO member from the sport hunt, did not change its rules between the two study seasons. The move by the Qikiqtarjuaq and Clyde River HTOs to modify their sport hunt institutions in order to increase payoffs to individual Inuit hunters suggests that the HTOs

behaved rationally in the market economy by attempting to increase profits to their stakeholders. The biggest increase in payoffs was in Clyde River where hunters have the smallest chance to get a bear tag with or without the sport hunt. Clyde River hunters also received the smallest return from the 2001-2002 sport hunt arrangements of the three communities. The case study communities were not aware of the payoffs in other communities, so this suggests that it was the scarcity of the sport hunt-devoted tags that increased pressure to maximize their use, rather than a desire to emulate one's neighbours. The complementary ranking of the three communities in the amounts received by HTO members and the degree to which they modified their institutions suggests there is a shared awareness across communities concerning acceptable returns for polar bears used in the sport hunt relative to the social costs of modifying the institution.

The apparent neoclassical economic rationality of the Clyde River and Qikiqtarjuaq HTOs in increasing returns to Inuit hunters from the sport hunt through using the HTO as the only outfitter may not lead to economic maximization in the long term. This is because private outfitters are able to invest in their business and are thus able to provide better service than the HTOs. HTO outfitting is done as a side task in addition to the regular workload of the only full time employee, the secretary-manager, who in any case may not have training in outfitting, and receives no extra pay for performing outfitting duties. Thus, secretary-managers have little incentive to improve the outfitting business. We have seen that the HTOs act in an economically rational manner in the design of sport hunt institutions, so we can assume they are aware of this economic inefficiency. The reasons for not remedying it appear to be related to the same cultural politics as those involved in the division of tags discussed in the next section.

Why Do HTOs Not Devote More Tags to the Sport Hunt?

The allocation of the majority of the polar bear quota for Inuit subsistence hunting across Nunavut reflects goals within a culture-specific socio-economic framework (Wenzel 1995). The goals, which will be discussed below, include maintaining and reproducing the ability to hunt bears, and through this activity, maintaining relationships with bears and with other people. Reproducing both hunters and relationships requires retaining polar bears as a common pool resource and resisting commoditization and privatization in order to reproduce the socio-economic system and insure flexibility of resource use into the future.

Reproducing Hunters

Training children and young adults in hunting is done overtly through their inclusion in discussions and activities related to the hunt. For example, Wenzel (1983b) describes how, during a polar bear hunt near Resolute Bay, children were actively taught tracking and observation of the bears and included in discussions of hunting strategy. Although this type of training is seriously curtailed by time commitments of school and jobs, it continues in various ways, of which I offer two examples. First, in 2007 at Resolute Bay, time constraints imposed by formal education were overcome when five polar bear hunting tags were used for a school trip to hunt bears (M. Taylor, personal communication). The second example comes from Igloolik where I observed that young men often asked a more experienced man to accompany them on their polar bear hunts. The selection of a mentor was not constrained by a close kin relationship and one man in particular was asked by several young hunters to help. In joining one such hunt with this man and his son (who was in his late 20s and had received a 24-hour tag), I observed the man to take a leadership role in navigation and searching, but he encouraged his son to shoot a seal from the floe edge, which the man then retrieved by boat. The son was also fully involved in attempting to repair a broken skidoo and in searching for bears. Several hunting skills were practiced on this bear hunt, and the son

readily admitted the vital role his father played in conducting the trip and in training him.

Through the interviews in various communities, Inuit indicated the need to train young people in hunting and to allow people of all ages the psychological benefits of harvesting a bear. These were given as reasons for restricting the allocation of tags to the sport hunt and for asking the government to increase the quota. In Pond Inlet private sport hunt outfitters have responded to the concern regarding training future hunters (and no doubt their own concerns regarding future sport hunt guides) by including young people in sport hunts. Sport hunting relies on experienced hunters to work as guides and assistants, therefore training young people in hunting and guiding will also benefit the industry by producing skilled workers. In most communities, sport hunt guiding contracts are awarded to competent dog team owners who then may pick an assistant or have one assigned to them by the outfitter. Rarely do other Inuit accompany the sport hunting party. At Pond Inlet the sport hunt is outfitted privately by two companies, both of which take a 'student assistant' as well as a dog team guide and assistant. When I asked a dog team guide and outfitter why he did not pick his son as the student assistant, he replied "I'm trying to teach the other kids how to hunt so I try not to pick from my family. That's the only way to teach them."

It is not only young people that benefit from training. Teaching is a prestigious activity in itself. Wenzel (1983b) observed experienced hunters accompanying those with less experience to help get a bear. These mentors did not receive any form of material payment, nor did the Igloolik man who served as a mentor to other young men as well as his own son, although some meat was probably received in both cases. Wenzel attributed the motivation of the teachers to the desire to behave *Inumariit* (as a 'real' Inuk). Sport hunt guides and outfitters likely attain similar prestige for including young people, which may also generate social capital in support of the industry. Training

future hunters in general and being non-kin selective in hiring student assistants for the sport hunt then serves several purposes, including preventing the resource from becoming de facto privatized by a decreasing pool of people with the necessary skills to access the resource.

Reproducing Relationships

While this discussion has touched on the physical aspects of training hunters, there are psychological aspects to their training as well (although it is not clear whether these are transmitted in sport hunt guide training). Among Eskimo cultural groups (ie. Inuit and closely related groups such as the Alakan Yup'ik and Inupiat), animals are considered sentient beings that are aware of hunters' intentions (Stairs and Wenzel 1992). Maintaining proper relationships with animals and with other people is believed to allow the animals to return after they have been harvested (Fienup-Riordan 1990). Thus, the subsistence economy is perpetuated by the relationships of the participants. Indeed the success of a hunter is attributed to his understanding that equity exists between people and animals and to his respectful relationship with other beings (Stairs and Wenzel 1992). This relationship includes the intention to use an animal for food and to share that food with other people. In fact, the harvested animal does not belong wholly to the hunter, rather it remains common property, subject to customary rules of distribution (Wenzel 1983a; Caulfield 1993; Sandell and Sandell 1996; Bodenhorn 2000). This ideological aspect of Inuit culture ties together the production, distribution and consumption aspects of the subsistence economy to create a social network that extends to non-human participants.

Polar bears are viewed as particularly intelligent beings and hunts for them are carried out in a more serious tone than hunts for other animals (Wenzel 1983a). In discussions with elders and hunters I was told that polar bears resemble people more than other animals do because of their ability to build 'snow houses' and stand on their back feet, and they are anatomically similar

to humans when skinned. The similarities between polar bear and Inuit hunting techniques is also considered evidence of this close relationship, as is the strong curiosity of bears and their ability to solve problems. The intelligence of polar bears is also extended into the non-empirical realm. It was expressed in all the communities I visited that polar bears had a particularly strong ability to understand people's thoughts and intentions. I was cautioned several times to avoid any hopes of seeing a polar bear during my visit, as this could cause a bear to appear unexpectedly and cause me or others harm. When a bear arrived in Qikiqtarjuaq I was only half-jokingly told it was perhaps my questions or thoughts about bears that had drawn it to the community.

The special intelligence and awareness attributed to polar bears is also expressed in concerns about offending them and thus upsetting the human-bear relationship. In Clyde River discussions among HTO members regarding the ethics of harvesting under a quota system, counting bears for management purposes and developing a sport hunt have been on-going since the early 1970s (Wenzel 2005). Counting bears through scientific studies and then stating how many bears could be harvested is considered by some to be arrogant, while refusing to hunt an animal that presents itself after the quota has been filled is considered disrespectful to the hunter-bear relationship of sharing. The idea of killing a bear for sport also goes against traditional values. The possible outcome of these offensive behaviours is that polar bears would stop interacting with the community and go elsewhere. However the necessity to comply with the quota system and the need for income, especially for hunters, has resulted in the limited community acceptance of these potentially damaging behaviours.

Resisting Commoditization

Concerns over the disruption of human-bear relations can also been framed as resistance to the commoditization of a common pool resource.

Commoditization has been shown to change subsistence economies by encouraging privatization of resources and the decline of sharing institutions as goods are sold anonymously on the market (Peterson 1991). Subsistence based societies are often aware of the threats to the social economy. In fact, some studies have shown a conscious choice by hunters not to maximize their harvest for the market, but rather to minimize this aspect in favour of continued subsistence production (Coates and Morrison 1988; Rich 1960). Inuit view wildlife as a common resource that cannot be owned by any person (Wenzel 2004). Many wildlife products are sold, but often not with the goal of maximizing profits. Rather goals include prestige, providing for non-harvesters and to obtain cash to continue harvesting (Caulfield 1993; Kishigami 2000).

Even in the polar bear sport hunt aspects of sharing are maintained. Visiting hunters rarely want to keep the meat of the animals, which allows the Inuit guides to distribute the meat in the community either through kinship networks, gifts to elders or through generalized sharing at feasts or through radio announcements inviting people to come and collect some meat. These networks are the same as those used for Inuit-hunted polar bears and other animals (Collings et al. 1998). Generosity in selecting non-kin to work on the sport hunt may also be considered a sharing of economic opportunities. Resistance to commoditization may best be illustrated by the choice of the HTO as sport hunt outfitter in some communities. Private companies are able to increase economic efficiency and pay offs to the community members through specialization of labour and increased effort in business development compared to the HTO. The drawback of privatization is the exclusion of the majority of people from participating and the potentially high profits accruing to the business owner(s) from a resource that is seen as belonging to all.

Conclusions

At the heart of the Inuit economy is the understanding that the relationships between people and between animals and people are maintained through sharing. These include sharing meat, labour, knowledge, equipment and cash (Damas 1972; Dahl 1989; Condon et al. 1995; Wenzel 2000). Therefore complete commoditization of wildlife is not desirable. However, cash has become a necessity in the mixed economy and wildlife is one of the few resources available for sale. The partial commoditization that has resulted is still very much embedded in the social aspects of the economy, through the sharing of meat, distribution of profits or fees, and training and employment opportunities.

Maintaining polar bears as a common pool resource in the face of harvest level constraints and economic pressures to fully commoditize the hunt serve to maintain flexibility in resource use by resisting privatization and the concomitant loss of hunting skills in the community. Ideologically it also preserves and reproduces the social relationship with bears. Should the relationship be sufficiently weakened, some Inuit expressed fear bears will leave and not return, essentially destroying hopes of any future interactions.

The division of tags between subsistence and sport hunting illustrates the complexity of the mixed economy. The construction of sport hunt institutions indicates that HTOs, representing Inuit hunters, can behave rationally in a neoclassical economic sense, although the social aspects of the economy may preclude long-term maximization of profits. Meanwhile the continuation of Inuit subsistence hunting is rational in a broad sense over the long term given the ideological context and history of rapid economic change Inuit have undergone in the last few decades combined with the uncertainty of the future. By dividing the tags between sport and subsistence hunting Inuit are optimizing the use of the resource and hedging their bets against future uncertainty.

CHAPTER 7: CONCLUSIONS

This thesis examined the complex social-ecological system involving polar bear management, focusing on Nunavut as a geographic case study area. The first manuscript gave an overview of the various systems used in different countries or regions and examined their transition to multi-governance systems. The other manuscripts focused on lower levels of the governance scale because these are seen as problematic and requiring greater attention in the conversion to multi-level governance. Manuscript 2 reported on previously unrecorded Inuit *Qaujimajatuqangit* (IQ) or traditional knowledge about changes in the sea ice and polar bears in the Baffin Bay area in order to add to our body of knowledge of polar bears in that area. Manuscript 3 explored the use of IQ in the co-management setting for polar bears. The final manuscript used two views of economics, the formalist and substantivist schools, to examine how and why Nunavut Inuit divide their polar bear quotas between sport and subsistence hunting.

Major Contributions of Each Manuscript

Within the common property literature, authors of conceptual papers, as well as case studies, often explore the construction of multi-level governance systems from a bottom-up perspective, such as through community-based management (McCay and Jentoft 1996; Brosius et al. 1998; Berkes 2002; Berkes 2006b). Manuscript 1 (Chapter 3) provided much-needed case studies in the conversion of top-down management systems into multi-level systems. It showed that top-down systems can improve linkages between governance levels and across scales. It also displayed the importance of history and some of the ways in which lower levels of governance can work around weaknesses in the top-down systems. Though all the polar bear management systems had some barriers to overcome before they can be truly considered multi-level

systems, several did show changes in their management systems that suggest top-down systems can be converted into multi-level governance systems.

Manuscript 2 (Chapter 4) used both quantitative and qualitative techniques in the analysis of semi-directed interviews to gain a contextualized regional overview of climate change impacts on the sea ice environment and their possible connection to changes in the polar bear population of Baffin Bay. The combination of methods has not been attempted before for the examination of IQ. It proved to be helpful in gaining an understanding of Inuit experiences with the physical environment and polar bears in that area. The manuscript revealed the while changes in the sea ice were similar throughout the study area, changes in polar bears were not. Interpretations of observed changes varied across the study communities as well.

Manscript 3 (Chapter 5) examined Nunavut's co-management system and found two problems with the integration of IQ. The first was that when direct observations of the environment by both Inuit and scientists did not agree, a course of action was difficult to arrive at, which delayed any management action. The second problem was that Inuit conceptualizations of human-animal relationships differed greatly from those of Euro-Canadians in higher levels of governance and from scientists. This essentially prevents the co-management system from working as envisioned by either cultural group. The system cannot concurrently manage wildlife-human interactions based on both paradigms. These problems reveal that differences between *Inuit Qaujimatuqangit* and scientific knowledge are not fully understood and accounted for within the co-management system and that the system does not effectively integrate Inuit cultural views into management.

Manuscript 4 combined formalist and substantivist approaches from Economic Anthropology to examine the economic uses of polar bears in Inuit

communities. This method allowed for behaviour that is considered rational neoclassical maximizing to be discussed in comparison to seemingly non-rational behaviour. Substantive examination of the 'non-rational' behaviour showed it to be wise use of resources in the social economy, which is meant to ensure a future flow of both physical and psychological benefits from the resource. Thus, Inuit are optimizing the use of polar bears in both formal and substantive ways in order to allow for short term and long term economic use.

Thesis Hypothesis and Objectives

The main goal of the thesis was to examine the transition of top-down governance into multi-level governance in the context of multiple uses of polar bears and in an era of increased recognition of ecological uncertainty. It asked such questions as: What happens when a subsistence resource develops new values across the social-cultural scale? How does human interaction with the resource change with changing understandings of the environment and the resource? How does ideology relating to that resource change as a result of these interactions?

The hypothesis of the thesis was that the development of co-management, which increases Inuit authority over natural resources, and the increasing recognition of scientific uncertainty due to climate change, would allow the Inuit ideology and the related use of traditional knowledge to gain power in the management of polar bears. It was also hypothesized that the top-down ideology would become more pervasive among the individual participants in the system, due to the nature of historic power relations in top-down governance and the influence of the market economy.

The three supporting objectives were:

1. To explore how the transition to multi-level governance affects interactions between the governance scale and the biophysical, economic and social/cultural scales.
2. To examine the interaction of two cultural paradigms regarding the interactions of humans and wildlife: Euro-Canadian and Inuit, and their different tools for knowledge generation, respectively western science and local experience.
3. To analyze how local-level governance institutions balance different uses of the resource within a cultural framework and in the context of the larger governance and economic systems.

The first objective was met through its inclusion of all four manuscripts. Manuscript 1 used various polar bear management system as examples of the interactions between scales and the links that have formed between scales as the management systems have developed towards multi-level governance. Manuscripts 2 and 4 focused on the local level of the governance and social-cultural scales in the relatively more developed multi-level governance system of Nunavut, and explored their relationships to the biological and economic scales. Local governance systems (both formally through the HTOs and informally through cultural mechanisms) had more authority and power to interact with these scales than was seen in the other polar bear management case studies from Manuscript 1. Manuscript 3 incorporated the first objective through its discussion of the co-management system and the interaction of the governance system and the social/cultural scale.

The second objective was also met through all four manuscripts. In Manuscript 1 the development of connections between higher levels of governance and the local level were examined. The incorporation of Inuit/indigenous paradigms into management in various forms was examined in the United States, Canada and Greenland (and to some extent in Russia). However, Nunavut as Canada's key management system for polar bears,

incorporates indigenous viewpoints to a much greater extent than was seen in other countries. In Manuscript 2 traditional knowledge regarding polar bear and climate change was compared across the communities that utilize one polar bear population in Nunavut. The environmental observations agreed across communities and with other published literature. Scientific estimates of population trends differed from local observations. Local observations also showed a gradient across the polar bear population area, which might be explained by biogeographical variation discussed in the scientific literature. Interpretations of polar bear behaviour were difficult to assess and may require more research.

The observations however were useful in co-management discussions examined in Manuscript 3, where scientific concerns about population declines were used by the territorial government to discuss the quota levels. This manuscript illustrated the relatively smooth interaction of scientific and traditional knowledge from Usher's (2000) first two categories of knowledge (knowledge of and use of the environment), compared to some of the difficulties of using both Euro-Canadian and Inuit knowledge systems (Usher's second two categories: environmental values and the knowledge systems) to make management decisions. The final manuscript looked at Inuit valuation of polar bears from an economic perspective and found that the cultural paradigm (including Usher's second two categories), prevented profit maximization in the market economy, but may, in fact, create a more robust long term economic strategy in both the market and social economies.

The final objective of the thesis was to examine how local-level governance balances different uses of the resource within a cultural framework and in the context of the larger governance and economic systems. This objective was met in Manuscripts 3 and 4. Both discussed the Inuit perspective on polar bears and other animals as sentient beings that are embedded in the Inuit social economy. In Manuscript 3 use of quotas was generally accepted, but

frequently challenged in co-management settings based on cultural views. Cultural understandings of bears were also used to argue against suggestions or decisions made by higher levels of governance. When actions undertaken by the higher level of governance failed to produce the desired results, these cultural understandings were evoked as explanation. The necessity of using polar bears in the market economy was explored in Manuscript 4. Here again the necessity to interact with higher levels on the governance scale and to link to other scales, specifically the economic scale, caused conflict in how best to interact with polar bears from an Inuit cultural perspective.

The hypothesis of the thesis was tested throughout the four manuscripts. The development of co-management in Nunavut certainly did increase Inuit power over decision making. IQ from the first two categories discussed by Usher were openly discussed and incorporated in co-management settings to the extent that Inuit observations caused further scientific examination of the Western Hudson Bay population. The scientific community is struggling to understand climate change affects in the Arctic and is increasingly recognizing its own fallibility in understanding ecological interactions. This context may have helped empower Inuit through the need for more information on the ecological system.

The second part was that the hypothesis that top-down ideology would become more pervasive among individual participants in the governance system, including harvesters, was not as strongly supported. In the first manuscript the case study of Alaska showed that social and cultural relationships amongst aboriginal groups were able to overcome the failure to access the market economy for polar bear products. In the third manuscript Inuit ideology was used in co-management to argue against the top-down perspective and scientific evidence about how best to conserve polar bears. Most Inuit interviewed subscribed to the traditional Inuit view that polar bears are sentient and respond quite differently to humans than the Euro-Canadian and scientific

perspective espoused. Finally in the last manuscript, the reluctance of the study communities to commit more polar bear hunting tags to the sport hunt industry illustrated their adherence to the social-ecological system with its long term focus and psychological goals. While the market economy was used, it was not the main focus of polar bear use.

This thesis examining the polar bear governance system has shown that multi-level governance, specifically the use of co-management, empowers Inuit through the devolution of authority to lower levels of governance. Inuit have become more exposed to Euro-Canadian perspectives through the development of natural resource management, but they have resisted both Euro-Canadian ideology and the full penetration of the market economy into their lives, while also beginning to learn about science as a system for knowledge generation.

As a whole this thesis contributes to our understanding of complex systems of renewable resource management in a bi-cultural setting. It accepted the top-down history of official polar bear management systems, but used a bottom-up approach to examine resource use and the creation of knowledge at the local level. Barriers to effective conversion to multi-level governance were explored and the underlying problems of co-management were examined. The case study of polar bear management underlines the complexity of relationships between governance and other scales relating to wildlife management.

Future Research

Future research at the local level could involve horizontal political links between communities and an examination of the internal politics of HTOs. At the local level methodologies for the collection and analysis of IQ could be tested and potentially improved. At the regional level, Inuit associations such as NTI and Regional Wildlife Boards should be further studied. These groups

have somewhat vaguely defined roles in co-management and in the general structure of Nunavut's government, and are thus able to create their own roles to some extent. Coming from an Inuit cultural paradigm regarding wildlife, the interaction of these groups with the territorial government and with higher bodies such as the Government of Canada might reveal news ways of dealing with the problem of two different paradigms concerning animal-human interactions.

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Appendix 1: Ethics Approval Form

McGill

Research Ethics Board Office
McGill University
845 Sherbrooke Street West
James Administration Bldg., rm 429
Montreal, QC H3A 2T5

Tel: (514) 398-6831
Fax: (514) 398-4853
Ethics website: www.mcgill.ca/rgo/ethics/human

Research Ethics Board I
Certificate of Ethical Acceptability of Research Involving Humans

Project Title: Polar bear in Nunavut: outfitted hunting and common pool-common property issues

Applicant's Name: Martha Dowsley **Department**: Geography

Status: Ph.D. student

Supervisor's Name (if applicable): Prof. G. Wenzel

Granting Agency and Title (if applicable): SSHRC (PI- Prof. G. Wenzel)

This project was reviewed on April 7, 2004 by

Expedited Review ___
Full Review ✓

Lynda McNeil, Research Ethics Officer
Signature/Date 04/07/04

John Galaty, Ph.D.
Chair, REB I

Approval Period: April 7, 2004 **to** April 6, 2005

REB File #: 118-0404

cc: Geography Dept.
Prof. G. Wenzel

Appendix 2: Nunavut Research Institute Licence

Nunavummi Qaujisaqtulirijikkut / Nunavut Research Institute
Box 1720, Iqaluit, NU X0A 0H0 phone:(867) 979-7279 fax: (867) 979-7109 e-mail: sicnri@nunanet.com

SCIENTIFIC RESEARCH LICENCE

LICENCE # 0501706R-M

ISSUED TO: Martha Dowsley
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Montreal, Quebec
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TEAM MEMBERS: M.Dowsley, G.W.Wenzel

AFFILIATION: McGill University

TITLE: Polar Bear and Inuit" A Multiple-Use Resource and It's socio-Economic Implications in Nunavut

OBJECTIVES OF RESEARCH:
The purpose of this research is to understand how Inuit have changed their views and management of polar bears since the introduction of sport hunting and conservation concerns. The first question in this research is whether polar bears were once viewed by Inuit as subsistence-cultural resources available to all local people with few rules governing their use. The introduction of sport hunting and the increasing interest in conservation of polar bears by outsiders has led to more strict management of polar bears. The type of management can be and can exclude outsiders from using the resource. The main goal of this research is to learn how Inuit have changed their view of polar bears based on the new use of polar bears in sport hunting and how Inuit management of polar bears has evolved. The second question is to understand how Inuit and government balance these outsider interests in polar bears. The two main interest groups are sport hunters and conservationists. If either of these groups gains to much influence, the current management of polar bears could be threatened. This project will explore how Inuit and government rules reflect the interests of these two outside groups while trying to maximize Inuit use and benefit from polar bears. The main objective is to create a framework to understand the evolution of polar bears management. Other researchers have studied common property management in other situations and have developed a framework to explain why some forms of management work better than others. I used their framework to study Native people's resource management in the Amazon Basin as part of my Master's work. I would like to test and possibly modify the framework to explore the multiple uses of polar bears by Inuit. It is hoped that this project will be useful in several ways. First, this project will record the history of changes in polar bear use since the introduction of the sport hunt. Second it will provide information to Inuit about potential benefits and costs related to changing the current management situation. Native peoples around the world are struggling to maintain control over their traditional resources and to use these resources in new ways to support their livelihoods. This research will provide a framework for studying natural resource management that is focused on Native people. I hope that other groups will be able to learn from the experiences of the Inuit and that this will help them to manage their resources in a way that is culturally acceptable and sustainable.

DATA COLLECTION IN NU:
DATES: February 01, 2006-December 01, 2006
LOCATION: Qikiqtarjuaq, Pond Inlet, Resolute Bay, Grise Fiord, Clyde River, Igloolik, Arviat

Scientific Research Licence 0501706R-M expires on December 31, 2006
Issued at Iqaluit, NU on September 14, 2006

Mary Ellen Thomas
Science Advisor