CHAPTER 13

UNPACKING SOCIAL LEARNING IN SOCIAL-ECOLOGICAL SYSTEMS:

CASE STUDIES OF POLAR BEAR AND NARWHAL MANAGEMENT IN NORTHERN CANADA

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As northerners search for appropriate responses to rapid environmental change and look for tools to guide nature-society interactions along sustainable trajectories, social learning (*i.e.,* learning at collective levels) provides a promising frame of reference. First, it can help organizations, governments, and communities adapt in basic ways to changing social and environmental conditions. Additionally, and perhaps more importantly, it is a way for such groups to generate positive change through collective expressions of human agency. Moreover, in the face of uncertain futures, it can illuminate legitimate endpoints and help craft means for reaching those endpoints.

This chapter provides a social learning analysis of the Nunavut Wildlife Management Board's (NWMB) responses in two recent management crises. The NWMB is a co-management board created under the terms of the Nunavut Land claims agreement. The chapter examines the board's introduction of community-based management (CBM) of narwhal in five communities, and a subsequent problem that arose when the fishery was closed in one of those communities. It also reviews the NWMB's polar bear mandate and considers the board's response in a crisis engendered by the recognition that one population of bears, the M'Clintock Channel (MC), was 50 per cent smaller than estimated. (For ease of reference, a list of acronyms is provided at the front of the book.)

The first part of the chapter contextualizes our work in a general way in the growing literature on social learning in resource and environmental management. Part two summarizes our theoretical framework. The third part presents the narwhal case study, and the fourth presents the polar bear case. The cases were chosen because, while subject to different legislative regimes, they involved

the same co-management authority (the NWMB), comparable resource types (large marine mammals), and similar management crises (relating to population estimates and harvesting levels).

Part five of the chapter is a comparative analysis of the cases. The analysis describes evidence of social learning processes, using constructs from the theory. It also identifies systemic and institutional features that enabled or inhibited such learning, relying on a grounded or inductive approach. Part five provides a largely theoretical exploration and is based principally on secondary documentation from selected sources (mostly NWMB and government records). Nevertheless, it provides a good starting point for more detailed intensive case studies of social learning dynamics in co-management boards created by other northern land claims agreements. The chapter concludes with a review of the implications for management, and considers policy and practice reforms that could encourage social learning for sustainability in the North.

SOCIAL LEARNING PERSPECTIVES IN RESOURCE MANAGEMENT

Discussions of social learning often start with reference to the politics and epistemology of John Dewey, who argued that public policy decisions should be viewed as a series of experiments. He argued that, guided by the principles of scientific inquiry and bounded by democratic debate, experimental politics would yield progressive social improvement (Dewey and Sidorsky 1977). In the planning literature, Freidmann's (1987) transactive model built on Dewey's notion of learning by doing, and elaborated the dynamics of interpersonal relations and the institutional arrangements conducive to learning at collective levels. In the organizational development literature, Argyris and Schön (1978), Senge (1990), and others examined social learning ideas in the context of corporate governance. Their work advanced systems thinking in social contexts, presented innovative and coherent theoretical constructs, and furnished rich empirical evidence of key ideas. As discussed below, our analysis is founded on concepts from this literature. Further important contributions to the social learning literature have been made in sociology, psychology, politics, and other disciplines. Excellent reviews of the literature can be found in Argyris and Schön (1978), Friedmann (1987), Levitt and March (1988), and Parson and Clark (1995).

In resource and environmental management, seminal publications by Holling (1978), Walters (1986), and Lee (1993) applied notions of learning by doing to large-scale management interventions. Nelson and Serafin's (1996) civics approach modelled resource management functions (*e.g.,* planning, assessment, monitoring) as mutual learning processes. Webler *et al.* (1995) helped focus attention on the learning outcomes of deliberative public involvement programs. Recently, social learning studies have identified properties that enable or hinder learning by international institutions in the management of global environmental risks (Haas 2000), described participatory agent-based modelling as a forum for social learning and for fostering changes toward sustainability in the water sector (Pahl-Wostl 2002), and illuminated connections between social capital and social learning (Fien and Skoien 2002). Yet other research has applied social learning frameworks in analyzing policy changes (Brown 2000; Fiorino 2001), multilateral negotiations (Eckley 2002), sustainability indicators (Shields *et al.* 2002), international development initiatives (Dyck *et al.* 2000), and non-formal education (Krasny and Lee 2002).

In addition, social learning is an important part of the emerging framework of social-ecological resilience (Gunderson and Holling 2002; Walker *et al.* 2002; Folke *et al.* 2002; Berkes *et al.* 2003). In resilience thinking, society and nature are viewed as interconnected, complex, adaptive systems. The core concept of resilience explicitly includes as a defining characteristic the capability for learning (along with capacity for adaptation, ability to absorb change, and capacity for self-organization).

THEORETICAL FRAMEWORK

As noted earlier, our analysis is founded on concepts from the organizational development literature, specifically the theory of action framework of social learning (Argyris 1977; Argyris and Schön 1978; Argyris 1993). We adopted this framework because it accommodates human agency, links individual and social learning, and describes a process for generating innovative change. Without providing a comprehensive summary of the theory, the ensuing discussion introduces constructs that form our analytic framework.

Learning is viewed as a process of detecting and correcting error, and occurs under two conditions. The first is when intentions match outcomes of action, and the second is when intentions and outcomes do not match. Single-loop learning occurs when matches happen, or when mismatches are corrected by changing one's strategy or behaviour while preserving basic values and norms. Double-loop learning occurs by correcting mismatches by first changing or supplementing existing values and norms, and then changing strategies or behaviour (Figure 13.1). Learning occurs at both individual and social levels, but individuals are the agents for social collectives. Therefore, social learning does not occur until individuals encode what they have learned in social memory. The media of social memory include public maps (*e.g.,* legislation, regulations, licences, bylaws, informal rules) and private images (*i.e.,* mental models of self in relation to others and in relation to the social collective). The key processes of the double-loop social learning dynamic are:

- detecting the mismatch between intention and outcome;
- investigating the source of the mismatch;
- developing alternatives for avoiding future mismatches;
- identifying conflict over competing visions or goals;
- resolving that conflict;
- implementing the preferred alternative;
- evaluating the results;

- modifying practice and theory accordingly, including fundamental goals, norms and assumptions; and,
- embedding the modified practice and theory in the images and maps of social memory.

Following a summary of both case studies, the theory of action framework of social learning will be utilized to explore and highlight the type, form, and direction of learning in narwhal and polar bear management regimes in Nunavut. Preliminary observations on policy implications and questions for further research will also be offered.

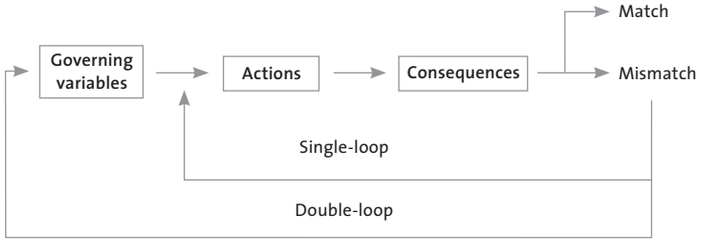

Figure 13.1 Double- and single-loop learning. Governing variables are underlying values of the system that can be inferred from observing the actions of organization agents. (Argyris 1993)

COMMUNITY-BASED MANAGEMENT OF NARWHAL

Background and Context

Narwhal have long been important to eastern Arctic Inuit communities both as a food source (especially the muqtuk) and for the prized tusks of the male narwhal. The balance of the animal would historically have been used for dog food, but these days is used less intensively or is discarded. There is no suggestion in the literature that Inuit harvesting had a significant effect on the sustainability of the resource, and the narwhal was not a major target of European whaling between the 1850s and the First World War, which focused instead on the bowhead whale.

Nevertheless, the federal government introduced community quotas for narwhal harvesting in 1977 (SOR/76-471, Narwhal Protection Regulations), apparently out of a concern that Inuit harvesting levels were increasing primarily to secure the tusk as a source of ivory. The regulations replaced an earlier approach that provided an individual quota for each Inuk. The consensus, however, is that there was no real scientific basis for the community quotas, which were set more or less arbitrarily. The ability of communities to harvest up to the level of the quota was highly variable, dependent on such factors as ice conditions and migration routes. In some years, for example, some communities had no opportunity to harvest any narwhal, whereas in other years the narwhal were close to the community but harvesting ended when the quota was reached, even though the community had not satisfied its needs. Moreover, quotas could not be carried over from one year to the next, and neither were they transferable to other communities. Inuit dissatisfaction was compounded by an appreciation that the narwhal populations of the eastern Arctic were shared with Greenland and yet there were no (or much laxer) restrictions on narwhal harvesting by hunters in that jurisdiction (Bankes 2003).

In 1993, the NWMB was established under the terms of the Nunavut Final Agreement (NFA), a comprehensive land claims agreement. The NFA not only treated the NWMB as central in the management of wildlife, it had as one of its informing imperatives the transfer of responsibilities and control to local communities. Soon after the NWMB was established, it was faced with several requests from communities to vary narwhal quotas. The NWMB found it difficult to evaluate these requests on an *ad hoc* basis and resolved instead to find a more principled way to deal with narwhal management issues. The NWMB also wanted to use this as an opportunity to return control of harvesting to the communities. A three-year community-based management system was therefore introduced in 1999 in the communities of Repulse Bay, Arctic Bay, Qikiqtarjuaq (formerly Broughton Island), and Pond Inlet. Kugaaruk (formerly Pelly Bay) was later added to the project. The NWMB (2002) described community-based management (CBM) as:

> … a system of wildlife management characterized to date by a removal of formal annual quotas and a transfer of initial management responsibility away from the NWMB and Government, directly to a community.

The CBM project was explicitly framed as an experimental process, and included an internal review at the end of its initial three-year period. The project was spearheaded by the NWMB, but it had the support of the organizations that would be key to implementation: the Hunters and Trappers Organizations (HTOs) for the individual communities, the regional wildlife management organizations (RWOs), the Nunavut Tunngavik Inc. (NTI), and the federal Department of Fisheries and Oceans (DFO).

NWMB played an important role of gatekeeper and standard setter by establishing and applying the criteria for communities to participate in CBM. These requirements were for: (i) communities to establish a reporting system for all narwhal struck, landed, and lost; (ii) hunters to obtain and complete a narwhal tag for all narwhal landed; and (iii) HTOs to make bylaws or rules to regulate hunting by members. The objectives of the rules had to be to ensure effective management and conservation, ensure education and proper training of harvesters, minimize loss and wastage, ensure humane and effective hunting practices, and maximize the safety of hunters (NWMB 1999a).

To assist communities in securing eligibility for CBM, the NWMB developed a series of briefing notes as well as draft narwhal hunting rules that could be adapted and adopted by HTOs as they saw fit, subject to NWMB approval of the final product. HTOs, therefore, were expected (s. 5.7.3 of the NFA) to regulate

harvesting practices and techniques among members and to allocate and enforce the community's entitlement to quota stocks. By the same token, RWOs were expected to assume similar responsibilities for sharing regional entitlements among communities, especially for shared wildlife stocks (s. 5.7.6). To aid in their enforcement responsibilities, HTOs and RWOs were expected to develop bylaws to discipline members (s. 5.7.12). The NWMB was expected to provide adequate funding for the operation of HTOs and RWOs (s. 5.7.13).

As to the remaining actors, NTI was the key entity on the Inuit side of the claim responsible for representing Inuit interests. DFO was responsible for administration of the *Fisheries Act* and the Marine Mammal regulations. While much of the implementation of the CBM model was, by its very nature, left to the communities, one of the things that the Fisheries Minister did was relax the quota requirements of the regulations. In addition, DFO had to make narwhal tags available on demand. Finally, while each of the NWMB, HTOs and RWOs, and DFO had an individual role to play, they also worked collectively, along with NTI, to prepare communities for the adoption of CBM by visiting communities and conducting workshops to discuss CBM requirements.

The Management Crisis

Within a year of its trial implementation, the outcome of the CBM process became a matter of significant concern to NWMB, DFO, some community members, and at least one environmental non-governmental organization (NWMB 1999b; 2000a; 2000b; World Wildlife Fund 2001). Estimated total annual mortality from 1999 to 2001 exceeded historic quotas for all communities for which data were available (with the exception of Pond Inlet in 2001) (Tables 13.1 to 13.3).

Important concerns related to waste of the resource (suggested by the high struck/lost levels), low levels of utilization of the meat, increased commercialization of the narwhal hunt (for the tusk), harvesting methods (shooting by rifle before harpooning), and the overall sustainability of these harvest levels (evidenced largely by comparison with the more or less arbitrary former quota levels). As well, some DFO officials were concerned that an increased harvest was inconsistent with Canada's position in ongoing discussions with Greenland as to management of the shared population that neither party should alter its management approach pending the outcome of these discussions. Finally, DFO representatives noted that struck/loss reporting was not always satisfactory (thereby undermining one of the key premises for DFO's support for lifting quotas) and that hunters were not always providing sampling information to assist in determining stock affiliation. In October 2000, DFO decided to close the Qikiqtarjuaq narwhal fishery, relying on the minister's power to issue emergency orders (s.5.3.24).

The closure created significant conflict among the organizations involved in the CBM project, but it did not result in a return to the centrally controlled, rigid quota system previously enforced by the DFO, nor the discontinuation of the community-based experiment itself. Rather, the 'crisis' provoked by the situation in Qikiqtarjuaq provided motivation for the NWMB, DFO, and Nativak

Table 13.1
1999 HARVESTING DATA

Community	*Historic Community Quota*	*Struck & Landed*	*Struck & Escaped*	*Struck & Sunk*	*Estimated Total Hunting Mortality*
Pond Inlet	100	130	14	16	146–160
Qikiqtarjuaq	50	81	30	25	106–136
Repulse Bay	25	156	68	30	54–63
Arctic Bay	100	101	?	?	?
Kugaaruk	10	0	?	?	?

Table 13.2
2000 HARVESTING DATA

Community	*Historic Community Quota*	*Struck & Landed*	*Struck & Escaped*	*Struck & Sunk*	*Estimated Total Hunting Mortality*
Pond Inlet	100	166	21	10	176–197
Qikiqtarjuaq	50	137	79	40	177–256
Repulse Bay	25	49	9	5	54–63
Arctic Bay	100	101	?	?	?
Kugaaruk	10	30	?	?	?

Table 13.3
2001 HARVESTING DATA

Community	*Historic Community Quota*	*Struck & Landed*	*Struck & Escaped*	*Struck & Sunk*	*Estimated Total Hunting Mortality*
Pond Inlet	100	63	5	27	90–95
Qikiqtarjuaq	50	89	8	9	98–106
Repulse Bay	25	100	38	21	121–159
Arctic Bay	100	134	20	4	138–158
Kugaaruk	10	41	18	8	49–67

HTO (Qikiqtarjuaq) to identify their different goals and agendas, the sources of management conflict, and the mechanisms required to resolve those conflicts.

A subsequent review of the closure order (required by s. 5.3.24 of the NFA), along with the formal evaluation of the CBM project, identified a need for an enhanced and diversified knowledge base concerning narwhal. As stated above, the actual harvest and struck/loss levels led to conservation concerns, yet the foundation for these concerns was not completely clear. It was difficult, for example, to allege (at anything other than an intuitive level) that the harvest was unsustainable, simply because harvest levels under CBM were so much higher than those under the old quota rules. Those quotas were set more or less arbitrarily and not on the basis of population estimates and recruitment rates. In addition, it soon became apparent that there were major gaps in the knowledge base for narwhal. The DFO acknowledged, for example, that its estimates of narwhal populations were based on aerial surveys conducted in areas of known whale concentrations. Some of these surveys were dated, and in any event, they did not account for narwhal that were submerged and beyond view at the time of the survey, narwhal that were outside the survey area, or narwhal that were missed by observers because of ice conditions or because of poor visibility. Moreover, hunters generally believed that the stocks were larger than estimated by DFO and also believed that narwhal reproduced more frequently. Similarly, it emerged that while DFO science was based on the idea that all narwhals in the Baffin Region belong to a single stock, more recent research suggested that there were a number of different stocks or aggregations that made up the Baffin Bay narwhal population. All of this led the NWMB to conclude that it was essential to improve the state of knowledge of narwhal and that this endeavour must include the development of traditional knowledge (*Inuit Qaujimajatuqangi*t [IQ]) studies of Baffin narwhal.

The closure order review and the evaluation also identified a need for better communication between DFO and local communities. There had, of course, been extensive consultation between DFO and the NWMB and the communities before the introduction of CBM. DFO had also communicated its concerns about the high struck/loss rates for narwhal. Nevertheless, the actual issue of the closure order came as a shock to the community, which felt that it had responded to DFO concerns by requiring that all narwhal be harpooned before they were shot.

Subsequent to the review and evaluation, in spring 2002, the NWMB decided to continue with CBM for another year, at which time a final review and determination of the future of the CBM process would be made. The changes in CBM that occurred, or are currently being considered, include community adoption of informal or pseudo quotas, and possible adoption of five-year rolling quotas. These are thought to be more suited to the needs of long-lived populations for which the harvest may be highly variable due to natural conditions, including migration patterns and ice conditions (NWMB 2001).

The final results of the narwhal CBM system have not yet been determined. Yet it is valuable from both theoretical and practical perspectives to explore the learning processes and enabling conditions evident in the initial iterations of the system described above. However, before doing that, we turn our attention to the NWMB's polar bear mandate, and to its response during a management crisis concerning the M'Clintock Channel (MC) bear population.

MANAGEMENT OF POLAR BEARS

Background and Context

Polar bear management in Canada and internationally is coordinated by a network of government agencies and co-management bodies, and is closely linked with academic and government research programs. The two important interagency organizations involved in polar bear management in Canada are the Federal-Provincial Polar Bear Technical Committee (PBTC) and the higher-level Federal-Provincial Polar Bear Administrative Committee (PBAC). The shape of the polar bear management network has been strongly influenced by Canada's obligations under the International Agreement for the Conservation of Polar Bears and their Habitat. This 1973 agreement between Canada, the United States, the former Soviet Union, Norway, and Denmark was spurred by international concern about rapidly increasing harvests of polar bears. The agreement is widely recognized as a success and is considered to have been instrumental in the establishment of effective polar bear conservation regimes and research programs throughout the Arctic (Fikkan *et al.* 1993; Prestrud and Stirling 1994). Complementing the PBTC and the PBAC at the international level is the IUCN's Polar Bear Specialist Group (PBSG). The PBSG was originally formed in 1965 and continues to be an active forum for international coordination of conservation efforts.

At the domestic level, the legal regime for harvesting polar bears varies from jurisdiction to jurisdiction. In Nunavut, the regime is based upon the territorial *Wildlife Act* (Government of Northwest Territories 1988) and regulations (Government of Northwest Territories 1990; 1992) as modified by the NFA. In other words, it is a territorial responsibility rather than a federal responsibility, although the federal Canadian Wildlife Service maintains an active research program on at least one population harvested in Nunavut and, through the PBTC and PBAC, a strong role in management decisions nationwide. The current *Wildlife Act* of Nunavut was inherited from the Northwest Territories, but a Bill to replace that Act was introduced in the Nunavut legislature in 2003 (Government of Nunavut 2003). The new Bill contains a series of provisions designed to enhance the role of traditional knowledge. Within the Government of Nunavut, responsibility for the *Wildlife Act* falls to the Department of Sustainable Development (DSD). In the post-NFA environment, there is an allocation of responsibilities between the NWMB and DSD that is similar to the allocation of responsibilities that we have already noted in the context of narwhal. The minister responsible for DSD has the authority to exercise the exceptional powers of disallowance and emergency decisions already described in the context of the narwhal fishery.

Under the current system in Nunavut, a person may not hunt without a licence and a tag, and tags are issued for a particular polar bear management zone designated under the regulations (Figure 13.2). The number of tags issued for a particular area constitutes an overall quota, but that quota is sub-allocated to individual communities. This sub-allocation is based upon historical practice and negotiations, and recorded in polar bear management agreements between DSD and the relevant HTOs. Communities may "lend" or "trade" their quota to other communities with quota in the same management zone. Quota calculations have long been designed to achieve a target of maximum sustained yield and encourage preferential harvesting of males. A single community may have quota entitlement with respect to a number of different populations, but tags are issued and may only be used with respect to a specific population. Quotas and variations to quotas are determined annually on the basis of actual harvesting numbers and are confirmed by the NWMB. Tags are issued to HTOs, and the HTO allocates tags within its community. An HTO may issue a tag to a non-resident for a sport hunt. Further, it decides what proportion of its community allocation sports hunters may harvest.

Sport hunting of polar bears (largely by Americans and Europeans, guided by experienced Inuit hunters) provides important economic opportunities for Nunavut communities, but sport hunter interest in that hunt is in large measure dependent upon the ability of the prospective hunter to be able to import the trophy to his or her home jurisdiction if the hunt is successful. While polar bears are listed in the Convention on International Trade on Endangered Species Appendix II, and trade therefore requires the issuance of import and export permits, the United States (U.S.) took additional measures in 1972 through its *Marine Mammal Protection Act* (MMPA) to further restrict the import of trophies to the U.S. Congress amended the MMPA in 1994 to allow for the issuance of permits to authorize the import of sport-hunted trophies, but only where the Secretary of the Interior is able to certify that certain conditions can be met, including that: (i) the exporting jurisdiction (Canada) has a monitored and enforced sport hunting program consistent with the purposes of the international agreement, and that (ii) Canada has a sport hunting program based on scientifically sound quotas ensuring the maintenance of the affected population stock at a sustainable level. The U.S. Fish and Wildlife Service (US FWS) has interpreted these conditions as requiring, among other things, the existence of a management agreement signed by all user groups where the harvesting of a particular population is shared by more than one community or jurisdiction and prescribing "scientifically sound quotas" (US FWS 1997).

In 1997, following extensive review of the Canadian regulatory scheme, the US FWS agreed to list (*i.e.,* approve) five of the twelve (now thirteen) identified Canadian polar bear populations: Southern Beaufort Sea, Northern Beaufort Sea, Viscount Melville Sound (subject to a harvesting moratorium), Western Hudson Bay, and M'Clintock Channel (MC). Two additional populations were subsequently defined and added in 1999. With the exception of Gulf of Boothia,

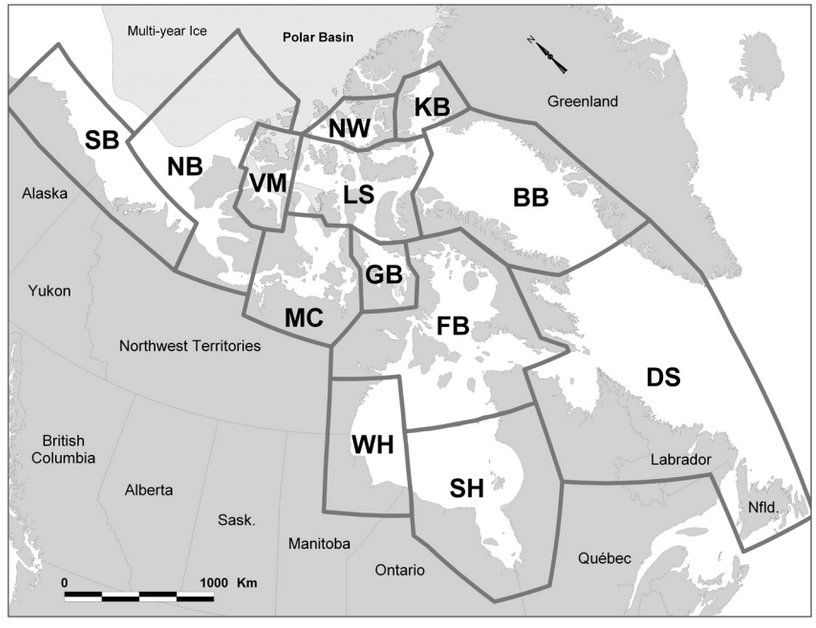

Figure 13.2 The thirteen polar bear management zones in Canada, which are based upon the boundaries of discrete populations of bears.

(Legend: BB = Baffin Bay, DS = Davis Strait, FB = Foxe Basin, GB = Gulf of Boothia, KB = Kane Basin, LS = Lancaster Sound, MC = M'Clintock Channel, NB= Northern Beaufort Sea, NW = Norwegian Bay, SB = Southern Beaufort Sea, SH = South Hudson Bay, VM = Viscount Melville Sound, WH = Western Hudson Bay)

(Source: Dean Cluff, NWT Resources and Economic Development.)

the only populations that remained unlisted were those that Nunavut shares with Greenland or another Canadian province, and for which there did not exist a joint management agreement. The authorization for the MC population was subsequently revisited and withdrawn following the events described below (US FWS 2001a, 2001b).

The Management Crisis

The communities of Talyoak, Gjoa Haven, and Cambridge Bay hunt the MC population, which was originally surveyed between 1972 and 1978 as part of a more geographically extensive population study (Furnell and Schweinsburg 1984). At that time, this study area was thought to represent a single "Central Arctic Islands" bear population, but subsequent research has demonstrated otherwise. That study area and the population estimate were subsequently subdivided into the MC population and portions of three other populations: Gulf of Boothia, Lancaster Sound, and Viscount Melville Sound (Taylor and Lee 1995; Taylor *et al.* 2001). Accounts of the partitioning of the population estimate and the setting of a quota for the MC population differ.

The formal account in the US FWS's rule-making process suggests the following. First, while the existing estimate for the combined MC/Gulf of Boothia population had been 1,081 bears, this was adjusted to nine hundred for each of the discrete populations to take account of the known bias of non-representative sampling. Second, consultations with Inuit hunters resulted in a reduction of the original estimate from nine hundred to seven hundred (US FWS 2001b) (This is consistent with the account of the IUCN PBSG (Lunn *et al.* 2002; 26).) In later discussions (2000) within the NWMB, Government of Nunavut officials acknowledged logistical difficulties with the survey and suggested that the original raw estimate of the MC population was revised upward based on community consultations, perhaps setting "the stage for the possible problem we are seeing today" (NWMB 2000a, per Atkinson). In any event, all accounts agree that the estimate information was problematic (although in fairness, Furnell and Schweinsburg (1984) were very candid about the limitations of their sampling and estimation procedures), and that all subsequent quota determinations were based on the lower figure of seven hundred. And it was on that basis, and in recognition that there was a community agreement in place, and that hunting had been at a two-male-to-one-female harvesting ratio for several years, that US FWS accepted the population for listing.

A new study of the MC population was initiated in 1998, and early results (NWMB 1999b) were not encouraging, as researchers were having difficulty finding enough bears for the survey. By 2000, Government of Nunavut biologists were presenting revised estimates of between 238 and 399, with 288 as the best preliminary estimate. The Government of Nunavut subsequently revised its current best estimate to 367 (US FWS 2001a). Whatever the number, it was clear that there had been a dramatic decline in this population if indeed the original survey was accurate. It was also clear that the current quota of thirty-two bears was not sustainable. These results were communicated to the NWMB and also to the US FWS.

The US FWS responded by initiating an emergency rule-making procedure to revoke the listing of the MC population on the grounds that the population was no longer being managed at a sustainable level. US FWS clearly regarded a quota cut (which the NWMB had decided upon), rather than a moratorium on harvesting, as an inadequate response to the problem, especially in light of the premise that the historical baseline for the population was nine hundred bears, from which there had been a precipitous decline. The discussions within the NWMB took a somewhat different course.

First, the NWMB considered a range of possible outcomes, based on the data presented by DSD. One option was to reduce the quota, thereby allowing some limited hunting to continue but delaying rebuilding of the population. Another option was the imposition of a moratorium on harvesting. Following discussion, the board adopted a two-year proposal to reduce the quota to twelve bears for the 2000/2001 harvest year followed by a complete moratorium for 2001/2002 – effectively a quota of six bears per year for each of the two years. In reaching this conclusion, the board rejected the advice of its director of wildlife that a moratorium "was probably the best option" (NWMB 2000d), and seemed to be persuaded by the importance of proceeding incrementally and with the concurrence of the communities, recognizing that an immediate moratorium might produce hardship and resentment.

Second, there was much discussion within the NWMB as to how this crisis had occurred (NWMB 2001, 39, per Koonoo; NWMB 2000d, 5). Was it the result of last-minute changes that had been made to the results of the survey in the mid-1970s? If so, what had occasioned those changes? Was it possible that original estimates were completely wrong, in which case a target of returning to 700–900 animals was not realistic? Was the decline due to the fecundity of the MC population being lower than that of the adjacent Gulf of Boothia population? Was it due to over-hunting? What were the implications of climate change on ice conditions, and therefore on bear-seal interactions? Had there been an out-migration of bears from this area? Would the problem have been identified earlier had greater attention been paid to traditional knowledge and the observations of hunters?

Third, whether coincidentally or not, the Government of Nunavut at about this time proposed to change the manner in which it determined quotas for given populations by adopting what it described as a risk-based model rather than a maximum sustained yield model. In brief, the new approach contemplates that communities would be more directly involved in selecting appropriate harvest targets in light of possible scenarios. Such scenarios would be generated by computer models such as RISKMAN (developed by a Government of Nunavut polar bear biologist), which allow managers and stakeholders to evaluate the outcomes of different harvest strategies given available quantitative population data and known or estimated uncertainties within that data (*e.g.,* McLoughlin *et al.* 2003).

Fourth, members of the NWMB were concerned to explore the consequences of the US FWS decision for affected communities. The community most seriously affected was Gjoa Haven, since it had no alternative population from which to harvest. This led to suggestions that other communities might be prepared to loan Gjoa Haven quota rights to the Gulf of Boothia population (NWMB 2001, Meeting 30). In the end, the healthy state of the Gulf of Boothia population allowed DSD and the NWMB to increase the quota for that population and to give Gjoa Haven a quota of three (Government of Nunavut 2002).

Fifth, members of the NWMB expressed a variety of other concerns. Some of these concerns related to the costs of ongoing polar bear research needed to support harvesting based on maximum sustained yield models, especially in relation to other priorities, while other concerns related to the perceived complexity of both the current flexible quota system of the management agreements as well as the Government of Nunavut's new proposals. Throughout, board members emphasized the need to take account of traditional knowledge in making further assessments of this population.

Finally, it is clear that all of the discussion within the NWMB occurred within the shadow of the MMPA and concerns as to the U.S. reaction. This was a consistent theme in the NWMB minutes: there are constant references to the MMPA and US FWS decision making, and also concerns that a misstep by the board in this one case might trigger distrust of its role in managing other populations.

DISCUSSION AND COMPARATIVE ANALYSIS

As both case studies illustrate, efforts to manage narwhal and polar bear reveal a complex array of institutional, organizational, socio-cultural, and ecological challenges. Framing the complex management milieu associated with both species, for example, are numerous value conflicts associated with resource use and protection, quotas and the mechanisms with which they are established, and the roles of Westernscience and traditional knowledge. In the exploration of these issues, therefore, a number of questions will be addressed: To what extent has the NWMB's management of narwhal and polar bear exhibited evidence of learning? What type of learning has taken place (*i.e.,* single-loop and/or double-loop learning)? What mechanisms, and systemic and institutional features, enabled or inhibited that process of learning? And finally, what are the implications for planning, management, and the policy reforms required to encourage social learning for sustainability in the Canadian North?

The CBM project was a management innovation, and provides evidence of the double-loop learning dynamic. Key double-loop processes (identifying and resolving normative conflict, and modifying precepts of theories-in-use) were evident in implementation of the project, including the NWMB's response to the Qikiqtarjuaq crisis. These processes were not easy, nor are they complete. At their heart, however, is an effort to bridge different management paradigms and knowledge systems that have come into conflict, and which require communities, regional wildlife organizations, the NWMB, and the DFO to test their management norms and modify key assumptions. In addition, the NWMB's review of the CBM project reflects the evaluation phase of the double-loop learning dynamic, and indicates an internal commitment to and monitoring of its past decisions. As well, the review was done in a participatory or community-based manner, which was conducive to incorporating fresh perspectives and diverse values into the existing management system.

In contrast, the NWMB's response in the MC polar bear crisis, while involving some attention to conflict identification, was essentially a short-term single-loop adaptation. Like other organizations in the larger polar bear management network, the NWMB has struggled with key double-loop processes (identifying and resolving normative conflict, and modifying the precepts of its theories-in-use), and has relied on the single-loop dynamic (in seeking to increase effectiveness). This is apparent in how the board responded to the MC population crisis. The response (which arguably was quite reasonable) was a case in which value and normative conflict were identified (at least by the NWMB) but not resolved. As well, it is a case in which the NWMB relied on a single-loop response to derive a short-term solution to a pressing problem. The board engaged in fundamental learning processes, *e.g.,* detecting key errors linked to the 1973 estimates, investigating likely sources of the errors, developing response options (*i.e.,* reducing quotas or instituting a moratorium), and discussing the consequences of the various options (with a focus on the effects of the US FWS delisting). It also began discussions suggesting it was identifying sources of normative conflict (*e.g.,* its questioning of maximum sustained yield models and its critique of the quota systems), but in the end, it did not engage fully in the double-loop dynamic.

Differences between the cases can be found in the political, legal, and institutional conditions that shaped the learning processes described above. The CBM project and the Qikiqtarjuaq crisis fit squarely within the mandate of the NWMB and within the context of the NFA, both of which resulted from the resolution of profound historical and value conflict. That is, CBM was forged in a context that favoured sweeping political and social change, particularly in a direction toward community-based governance models. Further, the NWMB created a non-threatening environment in which it was possible to work through the new rules and to discuss how change should be managed. Additionally, the NWMB was committed to seeing CBM succeed – not only because of its application to the management of other cetaceans, but also because of its potential application to other quota species, such as walrus and polar bear. And perhaps most importantly, the introduction of CBM was explicitly couched as an experiment. The key players at all levels recognized from the outset that there would need to be adjustments as CBM was put into practice. As well, the time-limited nature of CBM's introduction anticipated the need for a review. The NWMB was also quite explicit in treating the process as an opportunity for learning, and in a sense it set explicit learning goals by requiring communities that wished to participate to develop a set of bylaws or hunting rules that met certain minimum standards. The reporting system required as part of the CBM process, and which offered the potential to obtain records not only of those animals taken but also a record of those animals that were struck and either escaped or sank, implies a commitment to monitoring and experiential learning. Therefore, all the key players recognized that this was a collaborative experiment from which all parties had to see some gains. But this also meant that there was a strong, shared commitment to making CBM work.

In contrast, the NWMB's polar bear mandate and its response in the MC crisis were grounded firmly in an established legislative and policy regime, few aspects of which were meant to encourage major social and political change. Moreover, the MC crisis was influenced strongly by decisions taken under foreign legislation, namely the U.S. *Marine Mammal Protection Act.* Consequently, the planning and decision-making environment during the MC crisis was not conducive to evaluating long-standing goals, identifying alternatives, and discussing points of conflict (particularly those that spanned value systems). From a resource management perspective, this highlights both the potential and the limitations

of enabling legislation and policy. In the narwhal case, the legislative and policy regime created a safe and legitimate climate for management innovation, experimentation (and failure), and double-loop learning. In the polar bear case, the regime (although it shared important components with narwhal governance) encouraged incremental adjustments in existing technologies and end points, and single-loop learning.

Another essential difference in the cases was the extent to which the NWMB's polar bear and narwhal mandates were based in traditional or scientific knowledge systems. Relatively speaking, scientific research plays a larger role in polar bear management than it does in narwhal management. This is due to the strong scientific capacity found at most levels of the polar bear management network, including the NWMB. For most of the past four decades, sustainability of harvest has been the major conservation concern, and a comprehensive system of assessing populations and assigning (and monitoring) sustainable quotas has been operating for over twenty years now. Considered from a strictly experimental perspective, such efforts would reflect a relatively high degree of adaptiveness because quotas are adjusted regularly to compensate for changes in the harvest or apparent changes in the population detected during subsequent surveys. These attributes have facilitated important and adaptive single-loop processes in Canada's polar bear management system, but the very efficiency of the system could now be preventing organizations in the network (such as the NWMB) from engaging in the double-loop dynamic. Polar bear management has an enviable track record in the wildlife management field, and given that the network of practitioners is grounded in orthodox wildlife science, acceptance of diverse values and goals has been difficult. Hence, the network's capacity for profound double-loop learning has been constrained.

Yet other important differences between the narwhal and polar bear cases relate to the nature and degree of risk the NWMB faced in engaging in double-loop processes. Overall, higher levels of risk affecting polar bear management likely reduced the board's willingness to engage in double-loop processes. For example, polar bear scientists and managers have deeply embedded values and very strong personal and professional affiliations with their science and with the overall management network (and often for very good reasons since the standard of their work is extremely high). Due to the 1973 international agreement and individual biologists' successful leverage of that to start and maintain research and management programs, polar bear scientists have significant vested interests in the institutional network they created. They form a powerful epistemic community with no parallel in the narwhal management network. For polar bear scientists and managers, therefore, there was likely a higher level of political risk than for their narwhal counterparts in adopting fundamental change in research strategies or management approaches. Similarly, there were various socio-cultural risks in the polar bear case that were not present in the narwhal CBM project. In fact, there were likely socio-cultural risks associated with *not* experimenting with new narwhal management approaches, given the past management problems and concerns expressed by Inuit over their rights under the land claim.

CONCLUSIONS

As illustrated in both the narwhal and polar bear cases, the process of learning may take many forms – depending on the organizations, the individuals, and the management context. For managers, practitioners, and researchers concerned with issues of learning and sustainability, therefore, it is important to elucidate those mechanisms and/or conditions that serve to impede or foster the learning process, and in particular double-loop learning processes. What can we learn from the narwhal and polar bear cases to help guide resource management policy and practice in northern Canada? The review of the two cases has revealed three broad mechanisms and/or conditions that have played a fundamental role in shaping the learning process:

1 *The emergence of an enabling political and institutional framework*: Foremost, the two cases reveal the importance of an institutional framework that permits – through legislative means and new management mechanisms – greater opportunity to directly address conflicts over competing visions or goals, and an arena in which to resolve that conflict. In the case of narwhal CBM, the NFA has resulted in the distribution of authority among a greater number of interests, and led to the creation of new management entities (*e.g.,* NWMB) that provide a more favourable forum for conflict identification and resolution than under the previous management regime. As a result, there are strong connections between the NFA and the double-loop learning process evident in CBM. Although the same basic institutional conditions apply in the polar bear case, there are several complicating factors, including extra-territorial pressures exerted through the US MMPA, and as illustrated, the status accorded to the scientific community. However, the existence of the NFA institutional framework, and the process of on-going socio-political change, is likely to exert further influence on the current polar bear management approach.

2 *A willingness to experiment and receptivity to risk*: As is evident in the comparison of the polar bear and narwhal cases, opportunities for double-loop learning appear to be in many respects a function of perceptions about risk. Although connected in part to the emergence of an institutional and political framework in which conflict identification and resolution is more likely to be addressed, issues of ecological, social, political, and scientific risk permeate the two cases in different ways. In the narwhal case, there are

arguably fewer risks involved, and therefore, greater willingness to experiment and challenge management norms. In the case of polar bear management, the political and scientific risks are perceived to be more significant, and serve to dampen a willingness to experiment with new management models and opportunities for double-loop learning. At the level of both individuals and organizations, the degree of 'entrenchment' of interests further mediates perceptions of risk. As illustrated, there is a greater disconnect between the individuals involved in the narwhal CBM process and the outcomes of the management strategy. The same cannot be said of polar bear management where individuals, their careers and the management outcomes create a much tighter loop.

3 *A shift in the dominant management worldview or model and the corresponding integration of different knowledge sources and frameworks*: In the case of narwhal management, an institutional framework that encouraged conflict identification and resolution, along with a greater tolerance for risk, has contributed to modifications of the dominant management worldview. This modification of the management worldview, moreover, included requirements for the integration of different knowledge sources and frameworks. The creation of opportunities in which different perspectives can be expressed, and in ways that are closely connected to the management process, is fundamental to the modification of theories-in-use, and serves to encourage a 'check' of basic management goals, norms, and assumptions. This has begun to occur in the narwhal case and has contributed to the double-loop learning process that is characteristic of the CBM process. In contrast, the predominant discourse of polar bear management remains positivist and science-oriented.

The circumstances that have shaped opportunities for double-loop learning in the narwhal and polar bear management cases as outlined above, while illuminating, represent preliminary insights into the connections between management conflict and the learning process. In an effort to further identify preconditions for double-loop learning in complex management circumstances, and continue the development and elaboration of a set of principles managers and practitioners can utilize as a reference, much research remains to be done. For example, the preliminary conclusions highlighted above deserve additional research. Rephrased as propositions, these conclusions provide a useful starting point for further, and comparative, analyses of polar bear, narwhal, and other similar cases. The outcomes of this type of research should result in the development of a detailed and empirically tested set of principles to encourage social learning in complex management contexts.

There are many other outstanding questions, some of which are specific to the case studies, while others have more general implications. Where single-loop learning has been dominant to date – as in the case of polar bear management – when and how does a need for double-loop learning become apparent? Does a crisis in respect of one population (the MC population) really constitute adequate grounds to propose an overhaul of the system? It may be possible to achieve key environmental or conservation objectives in the context of a single-loop learning process. In the long term, nevertheless, a failure to meet the critical social objectives that shape sustainability (*e.g.,* equity, empowerment, participation) will likely serve to undermine management efforts. Therefore, if change is desired, how could the adaptive strengths of existing management networks be preserved during a period of double-loop learning, and not be abandoned simply for the sake of change? What kinds of change would actually be beneficial?

A key theme in many of these questions is the issue of learning across scales (see also Berkes *et al.,* this volume). For example, at what level is social learning most prevalent? Are the procedures established by the NFA (and other land claims agreements) more important than the particular powers accorded to co-management institutions when it comes to social learning? With respect to narwhal CBM, is the learning that has occurred confined to Nunavut-based managers? Does it extend to the DFO Winnipeg office? Does it extend to the head office? Will the double-loop learning process evident in the case of narwhal extend to the management of other resources in the region, or to other regions? Important questions at the scale of the individual also require further analysis, for example, to what extent is personal chemistry important in social learning? The contributions of individuals in the polar bear case suggest that it can be significant, but under what specific circumstances? How important is staff continuity, or board member continuity, when institutions such as claims-mandated co-management boards have only recently been established? And finally, how can the lessons that emerge from these different learning processes be constructively transferred?

As these two cases illustrate, there are many questions that require further analysis. Understanding the processes and structures associated with learning in complex management contexts remains a significant challenge – as does the identification of transferable lessons from one context to another. In the long term, however, the concern with social learning will likely prove central to the development of the management capacity necessary to guide nature-society interactions along sustainable trajectories.

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