

Keep It Simple and Be Relevant

The First Ten Years of the Arctic Borderlands Ecological Knowledge Co-op

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Interest in traditional ecological knowledge among resource managers and scientists in northern Canada and Alaska is growing (Urquhart 1998; Eamer 2000). This increased interest has led to more and more requirements for its use in many management, planning, and assessment processes (Berkes 1998; Canada Department of Justice 1998, 2002, 2003). This has prompted initiatives to interview elders and hunters and document their knowledge (Gwich'in Elders 1997; McDonald, Arragutainaq, and Novalinga 1997; Sherry and the Vuntut Gwitchin First Nation 1999), to examine methods of incorporating traditional ecological knowledge into resource management decision making (Huntington 2000; Usher 2000), and to examine and critique ways in which traditional and science-based knowledge are compared or synthesized (Krupnik and Jolly 2002; Nadasdy 2003).

This chapter describes and discusses the Arctic Borderlands Ecological Knowledge Co-op, a program that focuses on ecological monitoring from science-based and local knowledge sources. The Borderlands Co-op has operated for ten years in the western North American Arctic. During that time, it has faced challenges, adapted, developed its programs, and expanded geographically. Because of its longevity and its broad base of support, other organizations that are starting or expanding community-based and cumulative impacts monitoring initiatives in the Arctic look to the Borderlands Co-op for advice and assistance.

In the Canadian part of the Arctic Borderlands region, several comanagement

regimes are operating, with direct participation of indigenous representatives in making decisions and advising local, regional, territorial, and national governments on many aspects of resource management (e.g., Bailey et al. 1995). The Borderlands Co-op builds on and collaborates with these research initiatives and management regimes but has no management authority itself. Key elements of the program are cooperative decision making in all aspects of the program's development and organization; involvement at the community level in direction and implementation of the program; and ongoing communication and discussion about the use of multiple information sources in ecological monitoring.

The Borderlands Co-op is, above all else, a collaboration. The term *we* in this chapter should be interpreted as "we, the people who are involved with and working to maintain and improve this program." This includes people representing community, comanagement and government councils and agencies, and researchers (see the acknowledgments section at the end of this chapter). Information on the Borderlands Co-op and the people and organizations involved is available on the program's Web site (<http://www.taiga.net/coop>). A discussion on the contributions of communities to coproduction of knowledge through the Arctic Borderlands Ecological Knowledge Co-op is available in a paper coauthored by Gary Kofinas of the University of Alaska Fairbanks and by the four initial participating communities (Kofinas et al. 2002).

The Borderlands Co-op focuses on strengthening the role of local indigenous knowledge in environmental assessment, planning, and management, and in exploring ways to bring local and science-based knowledge together to improve understanding of ecological conditions and trends.

Traditional knowledge studies in the region have documented a wealth of knowledge of place, way of life, culture, and spirituality (e.g., Nagy 1994; Gwich'in Elders 1997). Some studies have been conducted to document elders' and hunters' knowledge about animals of concern to management (e.g., Byers and Roberts 1995; Smith 2004). The Borderlands Co-op's community-based monitoring program differs from these studies. The program is not based on in-depth traditional knowledge interviews with elders. Instead, structured interviews, conducted by local residents of each participating community, focus on what the community's most active hunters, fishers, and berry pickers of all ages have observed over the preceding year. Interviewers also ask for interpretations of what people have seen, which are based on personal experiences and traditional knowledge. We use the term *local knowledge* to encompass this blend-

ing of observation and interpretation. The program documents and reports, annually, observations of indigenous people about the land, how it is changing, and how conditions and changes affect their lives. This work complements in-depth traditional knowledge studies, much as science-based monitoring complements science-based research.

The program operates in a diverse, multijurisdictional setting, bridging both geographic scales and organizational levels. Participants include community residents and representatives of boards, committees, government agencies, planning and assessment processes, and research projects—each with its own defined jurisdiction, and none covering the entire region.

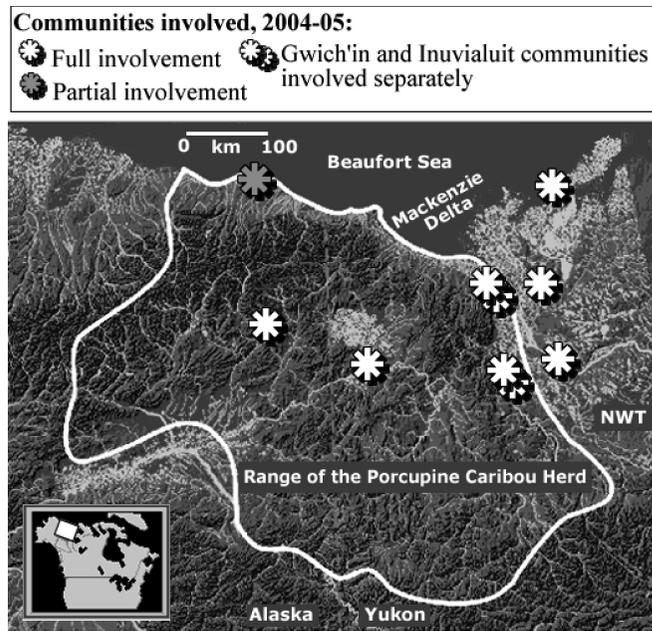
The Borderlands Co-op itself works at several scales. Interview-based monitoring is conducted in communities in the Arctic Borderlands region. Results from the community-based monitoring program are summarized on the scale of each community and the land used by community residents for hunting, fishing, trapping, and berry picking. Information is also acquired from other monitoring and research programs at a range of scales, from local (climate station records) to regional (Porcupine caribou herd populations) to global (greenhouse gas levels in the atmosphere). This information is tracked, summarized, and presented in the context of its significance to the Arctic Borderlands region. Meetings of the Borderlands Co-op provide a forum for sharing and comparing information and for discussing the implications of global issues (such as climate change) to the region and the significance of local observations (such as observations on caribou distribution) to the region and its resources.

The Arctic Borderlands Region

The Arctic Borderlands Ecological Knowledge Co-op operates in the range of the Porcupine caribou herd (250,000 square kilometers) and adjacent marine and coastal areas, extending into the Mackenzie Delta (figure 10.1). This area is complex in terms of jurisdictions and is ecologically very diverse. The region contains tundra, taiga and coastal landscapes, mountains, large wetlands complexes, several major rivers, and one of the world's largest river deltas, the Mackenzie Delta. It contains internationally important wilderness and wildlife habitat. The Arctic Borderlands encompasses part of northern Alaska and, in Canada, parts of two territories: the Yukon and the Northwest Territories.

The human population is predominantly indigenous—Iñupiat (Alaska),

Figure 10.1
Arctic Borderlands Ecological Knowledge Co-op region.
(From base map from U.S. Fish and Wildlife Service, Fairbanks, Alaska.)



Inuvialuit (Canada), and Gwich'in (Canada and Alaska)—and the area includes five major land claimant groups, each with its own governance and resource management structures. The communities range in size from fewer than two hundred people to about a thousand, with the exception of Inuvik, which has more than three thousand residents, of which about two thousand are indigenous. A total of ten communities, two of which are in Alaska, participated in the program in 2004–05.

Caribou have always been a key resource for people in the region. For most of the communities, the Porcupine caribou herd (named after the Porcupine River, a tributary of the Yukon River) is a major part of the diet and of the traditional culture. For the communities with coastal homelands, harvesting marine mammals is also important. Fishing, trapping, and berry picking are traditional activities for all of the communities. The economies of the communities are a mix of subsistence activities and wage economies. Oil and gas exploration and development are becoming increasingly important in some of the communities; indigenous and national, state, and territorial governments are important employers. Tourism currently provides limited job opportunities to local residents.

Although most of the Arctic Borderlands is sparsely populated and little

developed, the region is not without its environmental stressors. The migratory Porcupine caribou herd's calving grounds are primarily in a narrow section of the coastal plain in Alaska (Griffith et al. 2002), a wilderness area with petroleum reserves; thus the herd has become the subject of a high-profile, bitter, and protracted dispute regarding its ongoing protection. Increased oil and gas exploration and preparations for pipeline development are taking place on the winter range of the herd in the Canadian side of the region. Levels of persistent organic pollutants and mercury (from atmospheric transport) in fish and marine mammals have raised concerns about the safety of traditional foods over the past fifteen years (Braune et al. 1999; Indian and Northern Affairs Canada 2003). The Arctic Borderlands is predicted by climate models to be among those regions that will experience the most severe impacts from climate change (Taylor and Taylor 1997; Zhang et al. 2000). Temperatures are measurably warming now, and the extent of permanent sea ice is decreasing. Changes in snow conditions in the Arctic Borderlands may now be contributing to the observed decline in population of the Porcupine caribou herd (Griffith et al. 1999).

Development of the Arctic Borderlands Ecological Knowledge Co-op

The Borderlands Co-op grew from a meeting of researchers, government managers and scientists, indigenous leaders, and community representatives in Dawson City, Yukon, in summer 1994. The purpose of the meeting was to come up with a plan to improve ecological monitoring in the range of the Porcupine caribou herd. Although the working relationships among the organizations represented at the meeting were fairly well established, it was clear that a rift existed between many scientists and community representatives in terms of the value and credibility of different types of information. All too often, the results of such a meeting are to respectfully acknowledge these differences and proceed with strengthening the science-based program, while perhaps increasing communications efforts but also leaving the communities frustrated and sidelined. At this meeting, people decided to tackle this issue head-on by developing a monitoring program that would strive to improve our collective understanding of ecological conditions and trends by using local observations, traditional ecological knowledge, science-based research and monitoring, and government records.

Meeting participants developed a set of guidelines for implementing this new program:

- Go slow.
- Keep it simple.
- Be relevant.
- Focus on the long term.
- Economize.

These guidelines have successfully stood the test of time and have been useful in implementing the monitoring program over the past ten years. Every year we review the guidelines to help keep us on track.

It was also decided at the founding meeting that this program would be developed and managed cooperatively, with major decisions being made by consensus at meetings, and with Environment Canada (a federal government department) leading but not “owning” the program. Environment Canada has maintained this lead role, providing staff time and core funding. Over the years this arrangement has evolved into a more formal model, with a not-for-profit society, set up and managed by the program’s participants, administering the program. The goals of this not-for-profit society are as follows:

- To monitor and assess ecosystem changes in the range of the Porcupine caribou herd and adjacent coastal and marine areas
- To encourage use of both science-based studies and studies based on local and traditional knowledge in ecological monitoring and ecosystem management
- To improve communications and understanding among governments, indigenous and nonindigenous communities, and scientists with regard to ecosystem knowledge and management
- To foster capacity-building and training opportunities in northern communities in the context of the above-listed goals.

The gradual acceptance of the methods and results of the Borderlands Co-op cannot be separated from the organizational development. Control and ownership at the community and regional level are integral to the program.

In a 1996 workshop that was to become the first “annual gathering” of the

Borderlands Co-op, participants developed a list of about seventy potential indicators of ecological change for the region. Information was available for about half of these indicators from research and monitoring projects and programs and from other sources, such as transportation and census records. At this workshop, discussion also focused on how to document the communities' knowledge about ecological conditions and changes. A pilot project was started over the following year, based on interviews with people who were active hunters, trappers, berry pickers, and fishers.

Since then, a gathering has been held each year in one of the participating communities or in the regional centers of Whitehorse and Inuvik. These gatherings allow participants to discuss and make decisions about the Borderlands Co-op's programs. Each year an action item list is prepared, and each year the previous year's action item list is reviewed. Directors are elected, financing is discussed, reports are presented, indicators are reviewed, observations are compared, and the directions, goals, and operations of the program are argued over, fine-tuned, and reaffirmed. Decision making is by consensus. Most of the decisions taken at the gatherings are general ones regarding the directions, scope, and priorities of the program, with the details and follow-up being left to staff and directors. Key decisions, such as approval in principle of the information-sharing protocol, are made by consensus at a gathering and followed up with fine-tuning by the staff, a review, and a formal motion at a board teleconference.

The membership requirements have been kept flexible. As illustrated by table 10.1, the annual coming and going of individual participants presents challenges in maintaining the focus and continuity of programming. However, the relative stability in representation from the various boards, agencies, and processes provides evidence of support by these organizations.

When the not-for-profit society was formed in 1999, the consensus of the members was that the directors should make few decisions and that the main direction for the program should come annually from the broader membership. In subsequent gatherings, the members directed that the board should be more involved in operating the program, and there has been some evolution toward strengthening the role of the directors and formalizing structures and policies. Borderlands Co-op members are sensitive to the need to keep the participation in the program balanced between community and agency representatives and to keep all jurisdictions and land claim groups involved. The

Table 10.1

Borderlands Co-op membership

Scale of Representation or Primary Interest	Participant Affiliation	Number of Participants		Breakdown of Participation by Scale (average)
		7th Gathering	8th Gathering	
Community and traditional lands	Community monitor	4	4	36%
	Unaffiliated community member	2	3	
	Renewable Resource Council or Hunters and Trappers Committee	8	4	
	First Nation government	0	2	
Region (as defined by the planning or management process represented)	Regional wildlife or fisheries comanagement process	8	5	27%
	Land use planning or environmental assessment process	3	4	
Region (as defined by government agency jurisdiction)	Government agency (e.g., oceans, parks, refuges, environment and wildlife agencies)—federal and territorial, United States and Canada	8	11	25%
Various, depending on field of research	Researcher working in the Borderlands area	5	4	12%
Total participants		38	37	

Note: Participation at an annual gathering constitutes membership in the Borderlands Co-op. This table shows the breakdown, by scale, of participation at two annual gatherings. The Seventh Annual Gathering was in one of the participating communities (Fort McPherson), and the Eighth Annual Gathering was in a regional center (Whitehorse). In addition to these full-time participants, at the Fort McPherson Gathering interested local people attended portions of the gathering, and at the Whitehorse gathering interested government employees and college students dropped by the proceedings.

2004-05 board of fifteen directors includes representatives from each of the participating communities as well as people who were elected based on their strong interest and past involvement with the program, rather than on the basis of their affiliation.

Components of the Borderlands Co-op's Program

Three core features of the Borderlands Co-op Program involve the selection of indicators, community-based ecological monitoring, and mechanisms to ensure that research results are available to local communities in forms that they can use.

Indicators

The potential indicators identified at the First Annual Gathering in 1996 ranged from basic environmental measurements (such as temperature and the length of the ice-free period) to measurements of potential stresses (such as the number of airplane flights) and community and ecological measurements (such as the amount of time people spend on the land and the calving success of caribou). In developing these indicators, we have worked primarily with established data sets, in some cases requesting from the data holders additional data collection or manipulation to make the information more suitable for assessing conditions and trends. Most of the indicators are based on results of science-based monitoring (such as temperature records and animal population estimates) or on government records (such as community population census figures and airport flight records). The presentation of the data and the interpretive text accompanying each data set are developed or reviewed by the data holder.

Indicators follow a standard format that allows easy access to a wide range of information about the region (see box 10.1). Other examples of indicator titles include summer temperatures in the Arctic Borderlands, precipitation in Old Crow, snow depths at Eagle Plains,

Box 10.1

Anatomy of an Indicator

What is happening?

Usually a graphical presentation of the data, accompanied by a simple description.

Why is it happening?

Concise explanation of the factors affecting the conditions and trends observed.

Why is it important?

Significance of this indicator, in ecological and human terms. This section can also point out the relevance to policy and management and describe the actions being taken.

Technical notes

Information about the data set, including methods, frequency of measurement, references, and contact information.

Peel River Ferry operational period, Porcupine River break-up dates and ice-free period, early plant growth in caribou calving areas, salmon in the Porcupine River system, beluga abundance, caribou calving habitat use, mercury levels in marine mammals, airplane flights by community, community populations, development permits issued, carbon dioxide emissions, fur prices, marine oil spills, numbers of park visitors, and Dempster Highway traffic.

Each year at the annual gathering, the indicator set is reviewed and discussed by the general membership. The participants provide guidance regarding what indicators are most useful in assessing and communicating conditions and trends. For example, discussions at the 2003 and 2004 annual gatherings focused on what indicators could be developed that would help assess impacts related to recent and proposed oil and gas development in parts of the Arctic Borderlands.

The indicator set largely reflects what information is available; in 2004, we began a strategic assessment to select key indicators and identify gaps. Developed indicators are all available on the Borderlands Co-op Web site (<http://www.taiga.net/coop>) and are periodically printed and distributed to Borderlands Co-op participants.

Community-based Ecological Monitoring

Interviews with local experts are conducted annually by community monitors who are selected jointly by the Borderlands Co-op and each local participating organization (for example, the Hunters and Trappers Committee). A training and planning session is held each year with the community monitors to review the program and contract duties and to practice interview techniques. The first task for each community monitor is to develop (in consultation with the local organization) a list of knowledgeable, experienced people who have been active on the land over the past year. This list represents the community's selection of their local experts. The target is to interview twenty local experts in each community each year.

Prior to each interview, the community monitor reviews the basics of the program and discusses how the information will be used. An "informed consent" form with this information is signed, and a copy is left with the local expert. Interviews are anonymous (specific responses are not connected with names). In 2004, to provide an opportunity for better recognizing the local experts, interviewers asked people whether they wished to be recognized by name or photograph in the reports and posters. Each local expert receives an honorarium in the form of a coupon for gasoline at the local store. Gas prices

are high in the region, and purchasing gas for snowmobiles and vehicles is often a factor limiting people's ability to get out on the land.

The interviews are conducted using an interview form developed by Gary Kofinas that is revised annually by Borderlands Co-op participants. The form has a mix of closed and open-ended questions. Here is an example of a "closed" question:

- How did the lakes freeze up this year?
 - A quick freeze-up
 - A slow freeze-up
 - Or just an average year?

And an example of an open-ended question:

- What kind of a year was it for cranberries?

Tape recorders are used only as an optional aid for note-taking for an open question that prompts people to discuss their main observations and concerns about environmental conditions and changes. If the person interviewed prefers not to be recorded, the interviewer takes notes on this question instead. A map is used for each interview to mark the areas being discussed. Questions are reviewed and adapted each year with the help of the community monitors and must be tailored to some extent to each community to reflect the differences in traditional areas and use patterns. The end product is always a compromise among several often-conflicting goals:

- Keep the questions simple, and keep the interview interesting and not too long.
- Make the interview form easy for inexperienced interviewers to use.
- Be comprehensive.
- Document information in a way that can be compared across areas and years.
- Ask questions in ways that are relevant to the people interviewed and that draw out observations and interpretations that reflect their traditional knowledge.
- Cover topics that will elicit observations from male and female experts of a range of ages.
- Adapt to needs for specific information for understanding issues that arise.
- Be consistent from year to year.

Figure 10.2

Excerpt from the 2003 Community Monitoring Report. (From Allen et al. 2003.)



Berries

Old Crow

- The berry blossoms started growing because of hot weather and early showers last spring. Then it rained, got damp, then it snowed. This killed and froze the berry blossoms resulting in hardly any berries last summer
- The few that grew were very small and had an unpleasant flavor. This includes all berries.
- People did not get enough to meet their needs.
- This also created problems for the animals because there were no berries to feed on. As a result the animals turned to grass and roots along the rivers to eat.

Fort McPherson

- This year was a very bad year for berries.
- Elders reported this resulted from extreme temperature changes this summer.
- There was an abundance of cranberries at Rat River. These were under shrubs, willows, and trees.

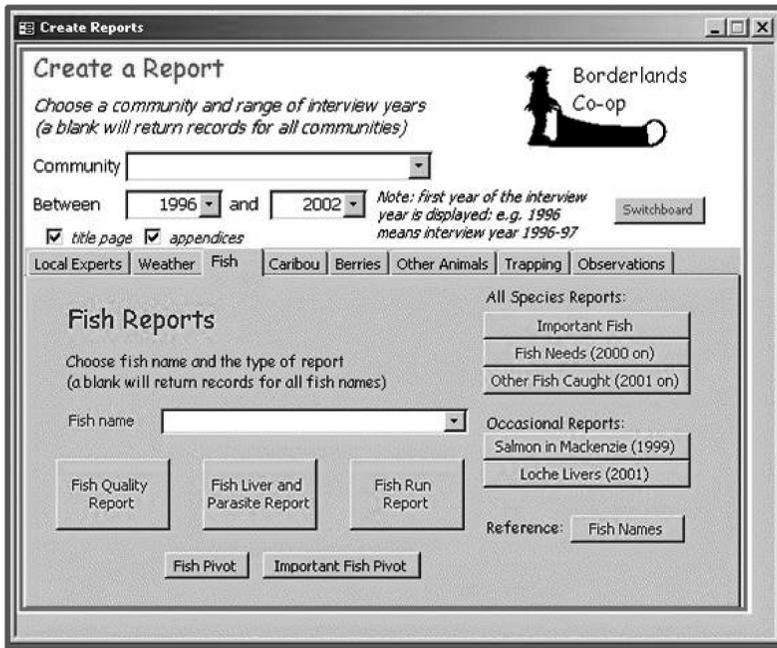
Observations about fish, berries, caribou, other animals, weather, and environmental conditions are documented. Many of the questions draw out observations about changes and interactions among environmental, economic, and community conditions, and the effects of these on people's ability to hunt, trap, fish, and collect berries.

Each community monitor prepares his or her own summary report on the interview results and presents it at the annual gathering. The community monitors' reports, along with added observations from the annual gathering, are reviewed by the local organizations and then compiled into an annual community report coauthored by all of the community monitors and widely distributed (e.g., Allen et al. 2003; Tetlich et al. 2004). A copy of the report is mailed to each person who was interviewed in each community. This annual reporting by the community monitors to all contributors is crucial to the profile and success of the program. It allows people to see how their information is being used in developing a regional picture, and it reinforces community ownership of the results. Figure 10.2 shows an excerpt from a community summary report.

The current information management system has taken years to develop,

Figure 10.3

Database interface for creating reports.

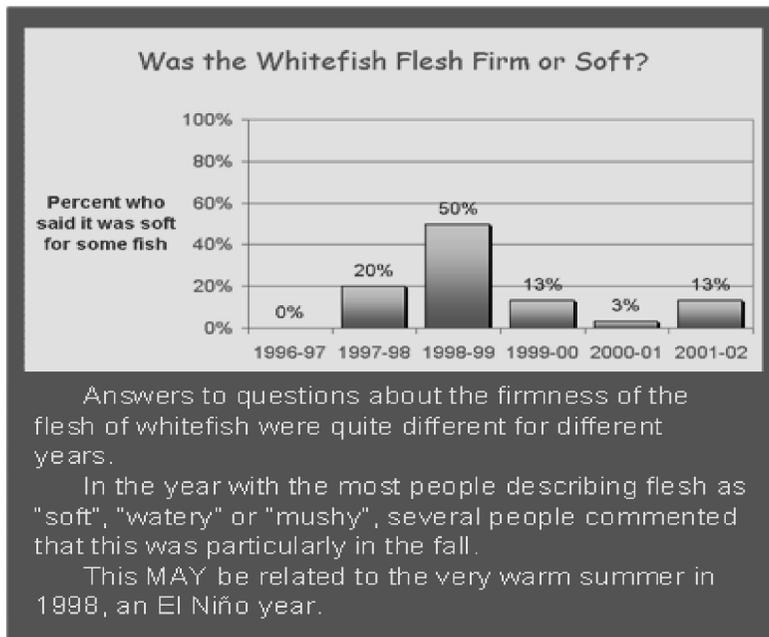


and work remains to be done on summarizing and interpreting the results. Information management is complicated by the broad scope of the interviews, the range of question types, and the variations in questions from year to year. The main characteristics of the current system include the following:

- The results from the interview forms and the community monitors' summary reports are stored in a customized relational database. This database is not publicly available; access to these "raw" results is based on the Borderlands Co-op's information-sharing protocol.
- The database has an interface that allows a user without database expertise to produce customized queries and reports by topic area, year, community, or keyword, or based on a word search (figure 10.3). Examples of types of data reports that can be produced follow:
 - Observations on fish quality for Fort McPherson, arranged by year and fish species

Figure 10.4

Example of a chart summarizing responses to a closed question. This chart is from a poster report for Whitefish in Aklavik. Other information that helps interpret the chart, including the number of people interviewed each year, is included on the poster.



- Observations on any topic that references the place name "Peel River"
- Observations about the status, changes, and effects of different types of human activity for all communities in a selected year
- A report quantifying, by community and year, how many of the people interviewed met their needs for caribou in each season.
- Reports produced through the database contain documentation to link responses to specific questions and to assist the user in interpreting results.
- Maps that accompany each interview are digitized and linked to the database by each map reference code (for example, for each sighting of muskoxen or each marked location of increased stream bank erosion). Analysis of the spatially referenced results started in 2003 and is ongoing.
- Summaries are prepared on a topic basis for display and distribution. This work is currently done by Environment Canada staff and by contractors.

We are working toward a system in which resource managers in each community or comanagement region will have access to the database and will produce summaries to meet specific needs. The primary format used for summaries is large posters. Simple bar and pie charts are used where appropriate to show results from closed questions (figure 10.4). The main part of these posters consists of tables and text boxes summarizing and providing samples of the types of comments recorded in the interviews. The poster layout can be selected to allow comparisons across years, to scale up from the community level to the regional picture, and to examine topics in depth. The next step for us is to produce these materials in other formats (paper reports and Web versions).

- An information-sharing protocol, finalized in 2004, provides guidance for accessing and referencing results at the data and summary levels. This protocol reflects the desire of the Borderlands Co-op members to share information and to respect and recognize the local experts in each community.

Making Use of Research Results

One long-standing complaint from communities is that researchers come into the region, work for a bit, and then leave, but the communities do not receive the results of the research. Increasingly, researchers are reporting back to the communities, but it remains difficult for all parties to keep track of and find relevant information from past studies. Because of the importance of the Arctic Borderlands to wildlife, and because of the history of major petroleum-related development proposals, much research has been conducted in the region. To address needs for better access to and better understanding of research results, the Borderlands Co-op took the following steps:

- Worked with the Wildlife Management Advisory Council (North Slope) to develop an online database of information sources for the region and a literature review of coastal zone science and management. This database is accessed by resource management offices in the communities and regions.
- Produced a summary of what is known about contaminants from atmospheric transport in the region. This summary was presented at public meetings and distributed as presentation overheads and in a print version. (These products can be viewed at <http://www.taiga.net/coop/reference>.)

While this component of the Borderlands Co-op's program was stressed by participants at meetings in the first few years, it has not been a high priority in later years. As many of the agencies and organizations involved with research in the Arctic Borderlands now report back directly to the communities through meetings and reports, the need for communicating results through a separate process may be less than it was when the program began.

Putting It Together

Each annual gathering starts with an overview of the Borderlands Co-op's programs and a discussion of the relationships among the different program components. The following examples illustrate ways these program components have been used.

Providing Direction for Research and Making It Relevant

Local experts from the community of Old Crow, Yukon, observed that the lakes in Old Crow Flats were drying up. Scientists followed up on (and confirmed) these observations with remote-sensing studies and ground-truthing. Further assessment work will track this trend to see whether it continues and will look at the ecological implications (Jim Hawkings, Environment Canada, personal communication).

Following Up on Community Concerns

In the first three years of the community-based monitoring program, local experts in three communities identified an unusual number of diseased-looking livers from one species of fish (*Lota lota*, burbot or loche). There was concern that these fish might be contaminated and unsafe for human consumption. The Borderlands Co-op, through a partnership with a government department, followed up with a testing and analysis program. Experienced local fishers submitted "good" and "bad" livers for analysis. It was determined that contamination was not the source of the problem (Gary Stern, Fisheries and Oceans Canada, personal communication). This was communicated through the annual gathering and community meetings. In recent years, the incidence of reporting of diseased livers has dropped, and concern is rarely expressed. The community-based monitoring program continues to track this issue.

Assessing Conditions and Changes in a Region to Support Management Decisions

The Borderlands Co-op's indicator series, community-based monitoring program, and Web-based database of information sources are incorporated into the implementation section of the Wildlife Conservation and Management Plan of the Wildlife Management Advisory Council (North Slope), a comanagement council set up under the Inuvialuit Final Agreement land claim settlement. The Borderlands Co-op is a member of the implementation team for this plan and receives funding to provide information to the council in support of their assessment and management activities.

Specific action items undertaken by the Borderlands Co-op include assessing ecosystem health through ongoing monitoring and synthesis of information, especially related to climate change; tracking and reporting on the health of harvested fish and wildlife and on unusual sightings; maintaining the database of information sources to provide access to past research results; and producing educational materials on the effect of local pollution on wildlife and the environment (Wildlife Management Advisory Council [North Slope] 2003). In 2005 the council began work on a summary of what has been learned about the Yukon North Slope through the Borderlands Co-op's community-based monitoring and indicators.

Improving Understanding of Conditions and Trends of Ecosystems

The Porcupine caribou herd has been the subject of extensive research and monitoring over the past twenty-five years (Griffith et al. 2002; Russell, Kofinas, and Griffith 2000). The communities who are users of the herd hold knowledge based on centuries of observations. Caribou hunters observe and interpret the conditions they encounter each year while going about their activities on the land (Kofinas et al. 2004). These sources of information and interpretation are often at different temporal and spatial scales and inform one another. Examples include the following:

- Science-based methods provide estimates of herd size and calf survival and information on how snow conditions affect these (Griffith et al. 2002); local observations and traditional knowledge provide understanding of how caribou movements and feeding patterns are influenced by

snow conditions and how these conditions affect the body condition of the caribou (Kofinas et al. 2004).

- Science provides regional trend information on climate variables (Whitfield and Russell 2004); local knowledge provides information on trends and quality of snow and forage in some key habitat areas.
- Harvest study records provide (often poor) records of total harvest (Hanley and Russell 2000); the community-based monitoring program provides information on whether each community has met its seasonal needs for caribou.

Conclusions: Some Lessons Learned

The development of this program has not been a steady progression. There have been difficulties obtaining support, financing, agreement on direction, and acceptance of the results. Nonetheless, the years have seen a steady growth in support and success of the Borderlands Co-op. Here is some of what we have learned:

- Keeping things simple and relevant to local concerns and needs, though not always easy, is crucial to the success of community-based programs.
- Developing a core set of people dedicated to the program is crucial. We have been fortunate to have strong supporters who are community leaders, elders, government managers, and academic scientists.
- Frequent reporting on the program and the results is very important. To reach all participants and interested parties, we use multiple means of communicating—newsletters, inexpensive photocopied reports, results posters, a Web site, and presentations at meetings.
- The organization of the program cannot be separated from its methods and results. Establishing a balance of power and ownership that communities, agencies, and councils are comfortable with is essential. For us, this is constantly evolving—as the profile of the program has risen, the need to structure and define the management of the program has grown.
- The community-based monitoring program presents significant challenges for data management and results interpretation. We did not sufficiently address this at the start, but we now have a system that allows us to access the results efficiently and to develop useful summaries that recognize the constraints and limitations imposed by the methods.

- One rather simple way of tackling the issue of multiple scales is to experiment with ways of displaying the information. We have found it helps to structure posters in a way that allows comparisons among communities and over time. This promotes discussion about impacts, issues, and trends at the regional scale.
- In this type of program, being independent from the management regimes has strong advantages. People are more open and relaxed about providing information and discussing its implications.
- Attention must be given to balancing the need for consistency and quality control with the need for local participation and ownership. At the outset, we recognized that involvement and control at the community level were essential for this program—although this has meant some inconsistencies in the documenting of local knowledge (with annual review of the methods, separate interviewers in each community, and often new people each year). This is part of the program and needs to be acknowledged when summarizing and interpreting results.
- The tension between science and traditional knowledge remains a part of the program. Results do not always agree; people remain entrenched in their views and traditions. This difficulty needs to be revisited periodically and examined openly.

Acknowledgments

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board members, elders, and local experts from the communities of the Arctic Borderlands.

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