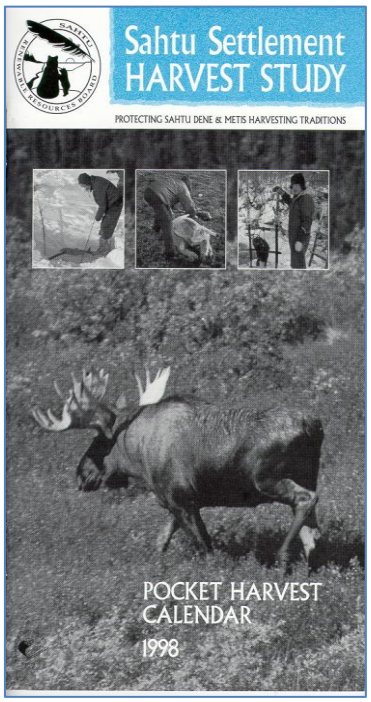

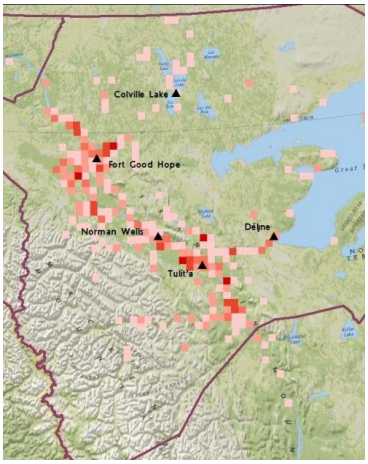

REVIEW AND ASSESSMENT OF THE SAHTÚ SETTLEMENT HARVEST STUDY, 1998-2005

July 23, 2013

DRAFT REPORT PREPARED FOR THE ʔEHDZO GOT'ĮNĘ GOTS'Ę́ NÁKEDI (SAHTÚ RENEWABLE RESOURCES BOARD)

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EXECUTIVE SUMMARY

This technical report presents the findings of a review of methods commonly used in harvest surveys in the north of Canada, as well as findings from a review and assessment of the Sahtú Settlement Harvest Study in particular. The work was done at the request of the ʔehdzo Got'ı̨nę Gots'ę́ Nákedı (Sahtú Renewable Resources Board [SRRB]). Included in this report are recommendations for maintaining and using the existing harvest study data, bringing the initial study to completion, and considerations for future harvest study work in the region.

The Sahtú Settlement Harvest Study (SSHS) was a claim-mandated survey conducted between 1998 and 2005 in the Sahtú Settlement Area. In the context of the 'first wave' of harvest studies done in the north, it appears that the Sahtú study was designed and executed in a way that make it as robust as other studies done at the time. It was well-planned and carried out very carefully, with as much quality control as possible and good overall support in the communities. No immediate or significant concerns or issues that could affect data integrity were identified during the course of this review. While data integrity does vary (by species, by year, and likely also by community), this variation should be no greater than for comparable studies, nor should it invalidate the resulting information. Some of the specific weaknesses identified for the SSHS included problems with harvester recall – especially when there were backlogs of data and when the study switched to quarterly interviews in its last two years. The omission of some very productive or 'super'-harvesters was also identified as a weakness that could influence the accuracy of the data – possibly resulting in under-reporting of harvests for some species. It is expected that a more careful analysis of the data – including some verification tests – will reveal that it has the type and magnitude of errors characteristic of other studies done in the Canadian north over the last 25 years.

The data resulting from the SSHS have yet to be finalized. To date, the only products from the study have been spatial data or mapped products, and bi-annual reports of draft harvest numbers. Completion of the study requires calculating total estimated harvests for the region. These figures can then be used to calculate Sahtú 'basic' or 'minimum needs levels', as outlined in the Sahtú Dene and Métis Comprehensive Land Claim Agreement (1993). Bringing the Sahtú harvest study to completion is a priority recommendation of this analysis that will require a significant dedication of resources. We would also strongly recommend that a statistical analysis be done that can indicate the variance associated with the total estimated harvests.

Despite being in an incomplete state, the Sahtú harvest study data are an important tool for communities and Renewable Resource Councils, as well as biologists and other resource professionals. Broad trends and indications of harvesting and species distribution patterns are apparent and help to inform decision-making. The data are perhaps especially valuable considering recent increasing levels of development in the region, and there is some current interest in initiating a new study in the area. The Sahtú harvest study can be seen as having established a baseline, or 'best estimate' of what harvesting levels were like at the time it was conducted. Because data collection stopped in 2005, there is a concern that the numbers are now becoming out of date – for example, the barren-ground caribou herd no longer winters near Délı̨nę, so harvesting patterns have changed in that area. Other ecological and environmental changes such as climate warming and shifting fire regimes can influence animal distribution and mean that recent harvesting patterns may not be well-represented by the older data. In addition, data accessibility is a concern due to the nature of the database used.

ACRONYMS USED IN THIS REPORT

SSHS	Sahtú Harvest Study
SSA	Sahtú Settlement Area
SRRB	Sahtú Renewable Resources Board
GIS	Geographic Information Systems
GRRB	Gwich'in Renewable Resources Board
GMNL	Gwich'in Minimum Needs Level
GSA	Gwich'in Settlement Area
IHS	Inuvialuit Harvest Study
ISR	Inuvialuit Settlement Region
HTO	Hunters and Trappers Organization
HTC	Hunters and Trappers Committee
NWHS	Nunavut Wildlife Harvest Study
NWMB	Nunavut Wildlife Management Board
HMP	Harvest Management Plan for the Porcupine Caribou Herd in Canada
PCH	Porcupine Caribou Herd
IP	Implementation Plan for the Porcupine Caribou Herd Harvest Management Plan
PCMB	Porcupine Caribou Management Board
RRC	Renewable Resource Council
CBMN	Community Based Monitoring Network
RWO	Regional Wildlife Organizations
TOR	Terms of Reference
ENR	Environment and Natural Resources
GNWT	Government of the Northwest Territories
CV	Coefficient of Variation
SLUPB	Sahtú Land Use Planning Board
SDMCLCA	Sahtú Dene and Métis Comprehensive Land Claim Agreement
UA	University of Alberta
NLCA	Nunavut Land Claim Agreement
MNL	Minimum Needs Level
ABEKC	Arctic Borderlands Ecological Knowledge Co-op
YTG	Yukon Territorial Government

TABLE OF CONTENTS

TABLE OF FIGURES

INTRODUCTION

The ʔehdzo Got'ı̨nę Gots'ę́ Nákedı (Sahtú Renewable Resources Board [SRRB]) is the main instrument of wildlife and forestry management in the Sahtú Settlement Area (SSA). As a regional co-management board, it represents beneficiaries of the Sahtú Dene and Métis Comprehensive Land Claim Agreement (1993) as well as non-beneficiaries and the non-Aboriginal population of the Sahtú Settlement Area. The Board works together with ʔehdzo Got'ı̨nę in the five communities of the Sahtú Region to maintain Dene and Métis harvesting traditions, and keep the land and animals healthy for future generations.

The Sahtú Settlement Harvest Study (SSHS) was an important project required under the land claim agreement. The objective of the study was to count the number of animals, fish, and birds harvested by Sahtú Dene and Métis hunters, trappers, and fishers for five years. The study data are confidential, and can be of great value as a community data set to protect Sahtú Dene and Métis rights. The data can also be of value for researching other topics, such as for species at risk, and for environmental assessments. Results have already been used, for example, by the Mackenzie Valley Environmental Impact Review Board in its assessment of a hydrocarbon development in the Sahtú region. They are also being used for the drafting of the Sahtú Land Use Plan.

In November 2012, the SRRB contracted Kristi Benson and Janet Winbourne to conduct an assessment of the Sahtú harvest study. Their main responsibilities included a review of the study methodology, and an assessment of the Sahtú data – including both the numerical or textual data, and the mapped or spatial information. As part of this work, a limited review of the relevant literature was conducted. In addition, a number of harvest study professionals and academics were interviewed, including those with expertise in the Sahtú Settlement Area. The objective was to identify 'best practices' in current harvest data collection and use in the north, as a means of informing the discussion of how well the Sahtú Settlement Harvest Study met its objectives, how it compares to other harvest studies, and the relative strengths and weaknesses of these surveys for the consideration of future work. A more detailed scope of work is provided in Appendix A.

This report details the findings of this review, and includes considerations as to how the Harvest Study data can be maintained and used in the future. The report concludes with a series of recommendations for meeting both short-term and longer term harvest study objectives for the ʔehdzo Got'ı̨nę Gots'ę́ Nákedı.

METHODS

This project had two main objectives:

I. Conduct a review of relevant harvest survey methods; and
II. Review and assess the state of the Sahtú Settlement Harvest Study and resulting data.

I. Establishing best practices for harvest surveys

Literature review

The author conducted a limited review of online sources, academic journals, periodicals, government reports, and other grey and/or unpublished literature pertaining to harvest survey methods and critiques. Due to the volume and age of existing material, efforts were mostly focused on recent work and information relevant to the Canadian north.

Expert interviews

Ten experts were interviewed for this review, including academics working to develop new harvest survey methods in the Canadian North and Alaska; resource professionals who collect and/or use harvest data; and professionals with experience directly related to the Sahtú Settlement area. The questions and interviewee list were developed in consultation with the Board. A list of interviewees and their affiliations is included in Appendix B.

The objectives of the expert interviews were to:

- ***identify any new models or methods for harvest data collection;***
- ***discuss the strengths and weaknesses of the various approaches; and***
- ***explore options for information storage, sharing and use of the data.***

Interviews averaged 1.5 hours in length and were for the most part conducted on a one-to-one basis, over the telephone, using a semi-structured interview format. Two interviews were conducted in person, and one interview involved both contractors as interviewers. There was additional follow-up with several interviewees through emails and phone calls. Questionnaires were tailored according to the specific expertise of the interviewee, but a generic format is included in Appendix C. Results were recorded through type-written notes during the interviews, and interviewees were asked to review their information as it was used in the report.

The objectives of the Sahtú interviews were to:

- ***identify any strengths or weaknesses specific to the Sahtú Harvest Study;***
- ***discover any factors that could influence the integrity of the Sahtú Harvest Study data;***
- ***determine information needs for resource management in the Sahtú Settlement Area; and***
- ***develop recommendations for future harvest data collection in the Sahtú Settlement Area.***

An additional five experts were contacted for specific information but not interviewed. They included harvest study experts in Inuvik, Whitehorse and Iqaluit, as well as the database developer for the SSHS and the executive director of the SRRB.

Information resulting from the literature review and the interviews was reviewed for themes, points of difference or convergence, as well as relevant suggestions and insights specific to the Sahtú Harvest Study. This information was compiled and summarized to form the ***Results and discussion.***

II. Sahtú Settlement Harvest Study data review and assessment

The second main focus of this work was to assess the state of the data that resulted from the Sahtú harvest study (1998-2005). The study design and methods, spatial or Geographic Information System data (GIS), and the numerical data (harvest totals) were reviewed and assessed separately.

Analysis of study design and methods

Background information on study design and initiation came from documentation found on the SRRB HarStudy server, as well as the expert interviews conducted with Sahtú resource professionals. A Methods Report, drafted by coordinator Ed McLean at the initiation of the SSHS, was discovered early on and provided most of the required details. Various aspects of the overall study were considered, including the survey frame, methods for identifying harvesters, how data was collected, possible sources of error, factors influencing data interpretation, and participation levels.

Analysis of data management system and GIS

A review of how the SSHS data was entered, managed and stored was conducted. Assessing the spatial or mapping component of the Sahtú Harvest Study included a brief review of the GIS files available and the preparation of a series of maps for initial review by SRRB.

Analysis of Sahtú harvest data

The objective of the Sahtú Harvest Study data review was to determine the status of the data, including its state of readiness for use.

The assessment of the Sahtú harvest study data involved a cursory review and analysis of some database records. With roughly 60,000 records in the database, it was not possible to review each individual record, so a sample was checked for errors or inconsistencies. As part of this assessment Joe Hanlon (SRRB Program Coordinator) reviewed a total of 100 data sheets from the SSHS – 20 randomly-chosen samples from each participating community. In each instance, the hard copy of the survey form was compared to the record in the database. To identify 20 random forms per community, a random number generator on a computer was used. If the random number selected a record that didn't have any harvesting associated with it, then the next record that had harvesting activities was used. During the assessment, a number of missing sheets were identified. When a missing data sheet was noted, another record was assessed. A separate assessment of the missing sheets was conducted.

Beyond this data-checking, harvest study results for two species (barren-ground caribou and moose) were considered at a higher level of detail to provide examples of some of the findings about the SSHS data overall. This includes some observations from other researchers who have worked with the data.

Limitations

The literature review was restricted to North American models of harvest surveys, and Canadian models in particular, as they tend to have similar parameters, challenges and strengths. For the most part, Alaskan models were not reviewed or included as part of the review. The discussion here is restricted to Aboriginal and Métis subsistence use of fish and wildlife, as resident and non-resident harvesting is generally characterized by different parameters, and those data tend to be collected through other

survey and reporting methods. Early in the review and assessment, it was found that the most relevant and current information was coming from the expert interviews. As a result, more time and effort was diverted to that part of the project than in a more extensive literature review.

RESULTS AND DISCUSSION

I. Establishing best practices for harvest surveys

In this section we present a brief background to what types of harvest surveys have been used most often in the north of Canada. There is a limited amount of information available regarding recent developments in harvest survey methods in the literature; most published reports and critiques are set in the late 1980s and mid-1990s. Because of this, we have relied most on information provided by the expert interviews, as well as professional reports and other 'grey literature' sources. We provide a comparison of four past harvest surveys (including the Sahtú Harvest Study), and discuss the strengths and weaknesses of these models and the type of information they produce. We then introduce some new trends in harvest surveys, to indicate some of the 'best practices' that are emerging today.

A background to harvest surveys and methods

The objective of harvest studies – also called harvest surveys – is to estimate the harvest of fish, wildlife, and plants by Aboriginal or subsistence harvesters. Because of this singular focus, these surveys are distinct from Traditional Ecological Knowledge studies, oral history documentation, or Traditional Land Use and Occupancy studies that document more contextual, long-term, and 'rich' information about cultures and landscapes.

Harvest studies attempt to estimate the harvest of fish, wildlife, and plants by Aboriginal harvesters.

Harvest surveys also differ from resident and non-resident hunter surveys in their methods and scope, as the circumstances of recreational hunting are different from those of subsistence or Aboriginal harvesting. While both types of survey are used to gather information through self-reporting of harvests, surveys that are conducted with recreational hunters tend to rely on only a small sample of hunter reports and on mailed questionnaires (Usher and Wenzel 1987; Usher and Brooke 2001).

In contrast, subsistence harvest surveys usually attempt a census or complete coverage of a population, and use in-person interviews to record information. For recreational surveys, lower sampling rates are usually enough because they focus on only one or a few species (e.g., deer, fish, waterfowl), and because there is usually a legal harvest limit per hunter, there isn't much variation in harvest levels (Usher and Brooke 2001). Also, because the legal hunting season is generally short, a single survey following the season can be undertaken without risk of hunters failing to remember their harvests. Subsistence harvesting tends to target a greater number of species and takes place throughout the year.

While subsistence harvest information for fish and wildlife has been collected in northern Canada for at least 70 years, targeted harvest studies, or 'Native harvest surveys', came into common use in the 1970s as a result of the James Bay and Northern Quebec land claims settlement. The settlement provided the basis for establishing 'guaranteed levels of harvesting' for Inuit and Cree (Usher and Wenzel 1987; Berkes 1990; Usher and Brooke 2001).

The harvest surveys in the Inuvialuit, Gwich'in and Sahtú regions all stemmed from land claim agreements settled in the mid-1980s and early 1990s.

There was a flush of this type of work in the 1980s and 1990s that established somewhat standardized methods for harvest data collection in the north (see Usher *et al.* 1985). Harvest surveys were initiated in the eastern Arctic (Nunavut) in the 1980s, and in the Inuvialuit Settlement Region, Gwich'in Settlement Area and Sahtú Settlement Area starting in the late 1980s, and continuing until as recently as 2005.

These harvest studies shared two common objectives – the identification of a baseline of resource dependence, known as 'basic' or 'minimum needs levels', and to provide information for resource management. However, the information produced by harvest surveys is also of interest to other types of research encompassing the social sciences, economics, nutrition, government planning, and impact assessments.

Harvest survey data was most often used to try and establish a baseline of Aboriginal resource use, known as a 'basic' or 'minimum needs level'.

Traditionally, harvest study methods relied on multi-year, repetitive surveys, conducted at monthly intervals, for all species, with a goal of census coverage (a 100% sample of the population) (Usher and Brooke 2001). The results are annual estimates of the harvest of each species for each community, based on twelve monthly estimates. Since the early 1990s, the surveys also generally provide the locations of kills (Usher and Brooke 2001).

The majority of harvest surveys in Canada have focused on five main pieces of information:

- ***Harvester profile;***
- ***Species categories;***
- ***Date of harvest event;***
- ***Location of harvest; and***
- ***Quantity of species harvested.***

Additional parameters that are common to these surveys are: voluntary participation; a setting in remote, small northern communities; and the use of local interviewers and overseeing bodies. These factors are also important factors in the choice and success of this methodology, and have helped this model to become the standard one for harvest surveys in Canada – referred to as the 'Canada model' (Usher *et al.* 1985; Usher and Wenzel 1987).

In Alaska, subsistence surveys are also very common, but a different survey model is generally used. The chief differences as compared with the Canada model are:

- the surveys are usually stand-alone and non-repetitive (many years may pass between surveys in any particular village), and are intended to establish baseline conditions;
- the survey is normally done annually, not seasonally or monthly (meaning the recall period is at least a season and as long as a year);
- the survey coverage objective is seldom 100% – a random sample is normally used, and in larger communities, a stratified sampling approach is used to minimize survey costs;
- a broader range of questions is included, such as household demography, employment, income, harvesting gear, and country food sharing; and
- the reports are narrative as well as data reports, providing more context and analysis of harvesting activities and data than the Canada model (Usher and Brooke 2001).

Most of the initial harvest survey programs following the standard methods of the Canada model wrapped up in the last 10-15 years. As a result, most published critiques or reviews of the methodology date from the late 1980s and 1990s; there is relatively little new information in the literature. However, as the Sahtú Harvest Study follows the Canada model, it is relevant to assess the work in that time period and context.

Generally, reports resulting from 'Canada model' harvest surveys are a compilation of data tables with very little contextual or qualitative information; this is considered one of the weaknesses of this method.

Today, many harvest surveys are adopting new or different methods of collecting data. A new phase for harvest survey appears to be underway in northern Canada–several studies have been initiated recently in Nunavut, and parts of the NWT and Yukon. Various elements characteristic of the 'Alaska Model' are being included in some of these new efforts, as well as methods that come from more participatory approaches, involving harvesters and local communities in the study design and execution.

Why harvest survey data?

Harvest survey data produce what is known as a measure of 'production', or:

> *... the number of animals struck (or shot, trapped, netted, snared, as appropriate) and retrieved. Unless the survey is suitably specialized (and often this is not feasible for the primary purpose at hand), struck and retrieved is both the quantity that harvesters commonly assume is being asked and the quantity they are most likely to be willing and able to recall (Usher and Wenzel 1987: 152).*

Most harvest surveys tend to record what is known as 'kill data' or the number of animals struck and retrieved.

This is significant because while resource managers generally want to estimate total mortality on a population, and economic analysts want to know peoples' consumption, harvest surveys generally do not result in either measure, but instead an approximation of production (in an economic sense). In most cases this number is closer to the number of animals *used* than the number *killed* (Usher and Wenzel 1987). Biological details (e.g., species, genus, age) for large mammals, and harvest locations for all species are also usually recorded.

Resource managers in the northern territories stress that without knowing what harvest or mortality levels are in an area, it makes it very difficult to manage peoples' actions – which is the real task of a resource manager.

The type of data produced by harvest surveys is for the most part interesting to three main disciplines or agencies in the NWT: Aboriginal organizations (for specific claims and compensation purposes; see Wenzel 1997); wildlife managers and resource professionals; and for use in socio-economic and environmental assessments. However, to meet the objectives of each discipline requires collecting slightly different information in a slightly different manner. As a result, harvest studies are usually designed to meet the objectives of primarily just one user group. In the north, this has most often been biologists and resource managers (Parlee pers. comm. 2012).

This fact is reflected both in the literature as well as the interviews conducted for this assessment: resource and wildlife managers need an estimate of local harvesting levels to achieve their management objectives. This is perceived as a continuing management problem in the north, where low population densities and huge geographic areas present a particular challenge to biologists – it is extremely difficult to estimate a herd or population level without data from harvest studies.

Because basic or minimum needs levels are based upon harvest study data, the information can influence management of all species. For example, if harvest levels are at or below a basic or minimum needs level, other sources of mortality on that population would have to be reduced. This has already occurred with barren-ground caribou in the Sahtú – in 2006 resource managers had to eliminate other harvests to meet the Sahtú Dene and Métis needs (Popko pers. comm. 2012).

In regards to development applications and environmental assessments, resource managers say that harvest survey data are extremely useful because they indicate traditional land use activity. Maps showing things such as historical and contemporary use areas, harvesting areas, and travel routes are valuable for biologists and renewable resource councils alike (Popko pers. comm. 2012). As a result, the data are important in compensation and assessment situations, and have been used in various other ways, including land use planning projects and species at risk assessments (see Kowalchuk and Kuhn 2012). Of particular use is harvest data sets that span long time series, as they can indicate many factors of interest to Aboriginal managers, such as changes in harvesting patterns, relative quantities of foods harvested, and species of special importance in the sustenance economy (Usher 2002).

It can be extremely useful to have at least several years of harvest survey data at hand to indicate areas that are important for traditional land use activity – a map of harvest locations can be especially valuable in decision-making.

Some additional characteristics of the harvest can also be useful in resource management, such as indications of hunter preferences for a particular age or sex of big game species. For example, knowing whether hunters select for big cows or bulls and at what time of year they are shooting them can make a significant difference to a wildlife population (Popko pers. comm. 2012).

Strengths and weaknesses

While many of the experts interviewed for this assessment agree that the data produced by harvest surveys can be very useful for managing people and land use, they also urge caution in how the data are interpreted and used. It is important to recognize that the surveys suffer from numerous potential sources of error (Usher *et al.* 1985; Usher and Wenzel 1987; Berkes 1990; Usher and Brooke 2001).

In the end, harvest surveys can only indicate what people were doing on the land at a particular point in time.

One of the main weaknesses of harvest surveys is that they provide only a very narrow 'snapshot in time' of actual land and resource use. As such, they may fail to reflect the complexity and variability of indigenous resource use over time (Natcher pers. comm. 2012). Because the studies usually average less than ten years in duration, they are strongly influenced by circumstances at that particular point in time. However, none of results of the first wave of the Canada model have been presented in any kind of a socio-economic or ecological context to indicate the numerous potentially influencing and complicating factors.

Overall, experts stress the importance of having a long history to harvest surveys, to help address the challenges posed by variations in both abundance and harvesting patterns.

The relatively short duration of harvest surveys may have the greatest implications for the calculation of minimum needs levels (MNL), as when they are based on a small data set, it can result in somewhat arbitrary levels. Harvesters' resource use is adaptive; if a certain species is in decline or perceived to be low one year, harvesters will usually redirect their efforts to other species, adjusting their harvesting patterns to what the land will provide and to meet their needs (Usher 2002; Natcher 2009). In addition, regulations such as set domestic harvest levels or quotas can impact customary harvesting patterns – a factor seldom explained by studies that only present harvest numbers or quantitative data.

Harvest survey data are most reliable when collected over the long term.

There are additional sources of weakness that tend to characterize the Canada model and influence the resulting information. Challenges involved in interpreting the data can include: assessing how comprehensive the survey was; assessing how representative the participants were; and assessing how accurate the data are (Usher *et al.* 1985; Usher and Wenzel 1987). The following error categories were identified during an analysis of the past harvest study conducted by the Nunavut Wildlife Management Board (NWMB), and are expected to exist to some degree in other surveys of the same type:

- ***Survey frame*** *(did the survey sample fully represent the hunter population?);*
- ***Coverage and non-response bias*** *(are there significant differences in harvesting between participants and non-participants?);*
- ***Measurement issues and response error*** *(are the survey responses valid? Do they measure the true harvests of responding individuals?) (NWMB 2004: 6).*

There are no easy answers to problems such as response error, non-response bias, interviewee fatigue, low or declining response rates, recall failure, and measuring accuracy in reporting. However, the situation in most northern communities also helps to overcome many of these challenges to some degree, as community members tend to know who's harvesting what (this is especially true for large mammals), who is or is not participating, and who the 'super-harvesters' or 'super-households' are (Usher and Wenzel 1987; O'Donoghue 2012).[1]

Non-response bias = do the people participating in the harvest survey differ in some way from those not participating?

Nonetheless there are still several important potential influences on the reliability and/or accuracy of the data. Non-response bias refers to the question of whether those who chose not to participate in the survey might in some important way differ from those who did – for example, they were the top harvesters, or did not harvest at all – and have a significant influence on harvest estimates. Generally, very little attention is paid to the problem of non-response bias in the literature, and instead, reported

[1] Recent research into subsistence patterns has provided new information on the specialized roles that particular households and subgroups perform in rural communities in regards to country food harvests and distribution. While most households do participate in subsistence activities and sharing networks in rural communities, a small subset of households tend to be extremely productive in subsistence activities. The relatively few highly productive households, termed 'super-households,' may produce most of a community's food supply, distributing it along sharing networks. There are indications that this trend is becoming more prevalent today (Wolfe 1987; Natcher pers. comm. 2012).

harvests are commonly projected to estimated totals, making the assumption that a representative sample was obtained (Usher *et al.* 1985; Usher and Wenzel 1987).

Harvest survey data are strongest when the rates of participation in the study are very high.

Harvest data are strongest when the survey manages to achieve total census coverage, or very high response rates from eligible harvesters. In the Nunavut study, it was determined that the potential for non-response bias was small when response rates were high and intentional non-response rates were low – but the numbers varied by community (NWMB 2004).

> *Generally response rates of less than 75% were considered to be problematic. Caution is recommended when several months during a study year have rates below 75%, when any month drops below 50% or when rates for the active or intensive strata are consistently below 75% (NWMB 2004: 129).*

High rates of intentional non-response can increase the potential for non-response bias. Generally rates of over 5% were considered to be high and a potential problem in the Nunavut study (NWMB 2004).

In practice, field researchers familiar with the communities have good subjective assessments of whether non-response bias affects harvest survey results – again, this is especially true in small northern communities (Usher and Wenzel 1987). As a result, non-response bias can be less of a concern in small, relatively homogeneous communities, as long as researchers are aware of it and communicate to readers how they dealt with it (Usher and Wenzel 1987).

Response bias = the issue of whether the harvest survey responses are valid and if they measure the actual harvests of the individual harvesters.

Response bias or error (an indication of whether the survey responses are valid and measure the true harvests of responding individuals) can be caused by poor questionnaire wording; recall failure by the harvester; bias from the interviewer; or harvester strategizing. Interviewer training and trust is extremely important in minimizing these challenges, and problems need to be resolved as soon as they become apparent. Recall failure is suspected to be low for most species and in most northern communities, but does vary by species. Recall tends to be especially unreliable for groups of species such as waterfowl, fish and small mammals, and less so for large mammals.

Response bias, non-response bias, and strategic bias can all impact the accuracy of harvest survey data.

Strategic bias in the north has tended to be based on a fear of individual prosecution and/or of the imposition of quotas resulting from the collective data from the harvest survey, but reasons may also include income tax, social welfare programs, and harvesting support programs. It is not systematic, but restricted to certain species and situations. While it is important to account for this type of error when applying statistics to the results, there are no straightforward technical solutions to the problem (Usher *et al.* 1985; Usher and Wenzel 1987). Overall, it is thought that the influence of strategic bias has been to produce an underestimate of the harvests of certain species. Similarly, in Alaska, where land claim scenarios have resulted in significantly different management institutions and regulatory settings than in the Canadian north, researchers report there can be issues with under-reporting harvests (Natcher pers. comm. 2012).

Challenges associated with assessing the accuracy and reliability of harvest survey data need to be considered in regards to data interpretation and use.

Because it can be difficult to determine to what extent issues of response bias and/or non-response bias influence a harvest survey data set, it can be challenging to determine the accuracy of the results (Usher *et al.* 1985). In some cases there has been evidence that harvesters were known to not report accurate numbers, but there is as yet no means of providing a measure of error on the resulting inaccuracy (Urquhart pers. comm. 2012).

Apart from the potential sources of error that create problems in harvest surveys, there are also criticisms of the gathering and use of the data on socio-cultural or political grounds. Some critics argue that harvest surveys have most served biologists (to assess predation on populations) and while they are embedded in land claim agreements, there is less evidence that the data have been used to benefit Aboriginal people. There are criticisms that the intent of harvest surveys is not clear to community members or harvesters, and that the numbers that are being collected are often not shared. Some researchers feel that there has been a disconnect between the data acquisition and use, and the holders of that information throughout the north. This can have important implications for data accuracy.

Another broad criticism of harvest surveys is that the narrow focus on gathering quantitative data means that other important information – such as socio-economic data – has been overlooked. Recent considerations of harvest surveys point out the failings of these social surveys to account for the broader social, political and cultural contexts in which the work is taking place. Without an understanding of the economic or regulatory settings, it can be difficult to assess how factors such as the availability of wage employment or harvesting quotas can influence harvesting activities; “Failing to appreciate the complexity and the context in which subsistence harvesting is situated, data interpretation is at best speculative,” (Natcher pers. comm. 2012).

Overall, there has been a lack of economic, cultural and other ecological data gathered by harvest surveys, such as the influence of trade, barter and sharing networks or climate change on harvesting patterns. For example, in some communities, researchers are seeing a concentration of harvesting carried out by only a few individuals (‘super-harvesters’). Without data that shows how food is shared, there could be a misperception that some of these individuals are wasting meat (Natcher pers. comm. 2012). Despite these shortcomings, harvest studies across northern Canada are thought to have made a major contribution to knowledge about harvest practices in the north, and are substantially more rigorous than historical harvest estimates done until the 1970s (Parlee pers. comm. 2012).

Past harvest surveys: comparison of four northern studies (1988–2005)

The Sahtú harvest study methods are compared with the following three Canadian studies in Table 1:

- ***Gwich’in Harvest Study 1995-2004 (Gwich’in Renewable Resources Board 2009);***
- ***Inuvialuit Harvest Study 1988-1997 (Joint Secretariat 2003);***
- ***Nunavut Wildlife Harvest Study 1996-2001 (Nunavut Wildlife Management Board 2004);***
- ***Sahtú Settlement Area Harvest Study 1998-2005 (Sahtú Renewable Resources Board, In prep.).***

A brief discussion of some of the differences between the studies and their respective results follows the table.

Table 1: Summary of characteristics of four northern harvest surveys spanning 1988-2005.

	GWICH'IN	INUVIALUIT	NUNAVUT	SAHTÚ
Study objectives	i) Provide harvest statistics to calculate Gwich'in Minimum Needs Level ii) Information for management of fish and wildlife	i) Provide basis for sound rational wildlife mgmt. ii) Calculate compensation regime that may be required as result of development in ISR iii) Determine Inuvialuit subsistence wildlife usage and requirements	i) Document the current levels and patterns of Inuit use of wildlife resources for purpose of determining basic needs level and assist NWMB in establishing levels of total allowable harvest ii) Contribute to sound management and rational utilization of wildlife resources in NSA	i) Determine the Sahtú Minimum Needs Level of Dene and Métis to protect harvesting traditions ii) Provide information for management of fish and wildlife
Study duration	Initial 5 years: *1995 - 2000* Additional 4 years: *2001-2004*	Initial 10 years: *1988 – 1997*	Initial 5 years: *1996 -2001*	Initial 5 years: *1998-2003.* Additional 2 years: *2004-2005*
Communities involved	4 communities: *Aklavik; Fort McPherson; Inuvik; Tsiigehtchic*	6 communities: *Aklavik; Inuvik; Paulatuk; Tuktoyaktuk; Holman (Ulukhaktok); Sachs Harbour*	28 communities in 3 regions: *Baffin; Keewatin; Kitikmeot*	5 communities: *Colville Lake; Déljne; Fort Good Hope; Norman Wells; Tulít'a*
Sampling approach	Census	Census	Census (smaller communities) & stratified random sample for larger communities – groupings based on subjective harvester activity levels (*e.g. intensive, active, occasional, non-hunter*)	Census
Approx. % harvesters participating	At end of any given month about 50-60% of harvesters had contributed. As backlogs were covered over 30-60 days, total participation for a given month reached approx. 80-90%.	For 1989-92, coverage consistently exceeded 90% and rarely fell below 80%. *Note*: Usher (1996) has some doubts that the sustained rates achieved by the ISR were real – suggesting they may be an artifact of *inflated* hunter lists.	Approx. 80%	Response rates appear high for all years of the study, averaging between 90-98% for all eligible harvesters reporting annually.

	GWICH'IN	INUVIALUIT	NUNAVUT	SAHTÚ
Data collection methods	In-person recall interview by community-based interviewer Standardized approach used in all communities Interview is open ended *(i.e., conversational without formal set of questions)*	In-person recall interview by community-based interviewer Standardized approach used in all communities Interview is open ended *(i.e., conversational without formal set of questions)*	In-person recall interview by community-based interviewer Standardized approach used in all communities Interview is open ended *(i.e., conversational without formal set of questions)*	In-person recall interview by community-based interviewer Standardized approach used in all communities Interview is open ended *(i.e., conversational without formal set of questions)*
Frequency	Monthly	Monthly	Monthly	Monthly for five years, then quarterly
Definition of harvester	Any Gwich'in beneficiaries who hunt, fish or trap Also includes non-beneficiaries who harvest and who live with a beneficiary Exclude Gwich'in covered under IHS	Native individuals 16 yrs of age or older who reside in the Inuvialuit Settlement region Predominantly Inuvialuit beneficiaries (as defined by Final Agreement). At request of HTCs and IGC, extended to include resident Dene/Métis	Nunavut beneficiaries 16 yrs of age or older who hunt, fish or trap "*Provider*" non-beneficiary harvesters who are married to beneficiaries are not included	Eligible harvesters are Sahtú Dene, Métis, or a non-participant of the land claim who provides for a Sahtú Dene-Métis family; currently live in the Sahtú; are at least 16 years of age; do any hunting, fishing, and/or trapping; do not have to be registered with the Sahtú Enrollment Board
Definition of harvest	Struck and retrieved Includes all types of harvest *(domestic, trade, commercial, nuisance)* Does not include wounding loss	Killed and recovered Includes all species harvested for *"subsistence use"* , including furs and unsalable pelts used for domestic purposes *Note:* IHS results may include commercial fur, fish and ungulate harvests (Usher 1996) Does not include wounding loss	Killed, gathered, or caught and retrieved Includes all types of harvest (*if hunter sells the meat or skin, will note this in comments section*) Does not include wounding loss	Killed and retrieved by an eligible harvester Includes for any purpose (*e.g. personal use, trade, commercial, etc.*) Does not include wounding loss

	GWICH'IN	INUVIALUIT	NUNAVUT	SAHTÚ
Information collected	**Activity** in last month *("Did you hunt, fish or trap last month?" -- harvested; hunted but did not get anything; did not hunt; could not contact; moved; remove- doesn't want to participate; remove- doesn't hunt; other)* If harvested -- **what** animal *(if caribou specify herd)*; **where** killed *(place name + UTM coord.)*; **how many**. **Age** *(adult, juvenile, calf)* and **gender** collected for only moose, Dall's sheep, caribou and bear Collect information on harvests outside settlement boundaries General **comments** section	**Activity** in last month *(hunted; hunted but no catch; did not hunt; out hunting; out of town; could not contact; didn't want to be interviewed; moved; other)* If hunted – **what** animal; **when** *(first and last day of the hunt for given animal)* and **where** killed *(place name + UTM coord.)*; **how many**. **Age** *(adult, immature, calf/cub)* and **gender** collected for only muskox, moose, sheep, caribou and bear Harvester indicates the actual days out on land General **comments** section	**Activity** in last month *(hunted; did not hunt; hunted but not successful; still out hunting; moved; out of town; could not contact; did not want to be interviewed; other)* If hunted – **what** animal *(if caribou specify herd)*, **when** *(date)* and **how many** killed **Where** killed *(place name + UTM coord.)* collected for only some *(caribou, muskox, walrus, narwhal, beluga, char lake trout, king and common eider animals and their eggs)* **Gender** *(caribou, muskox, walrus, narwhal, beluga, char lake trout, king and common eider)* and **age** (*caribou: adult, yearling, calf)* collected for only some Collect information on harvests outside settlement boundaries General **comments** section	**Activity** in last month *(went out harvesting and was successful; went harvesting but not successful; did not go harvesting; could not be contacted – still out harvesting; could not be contacted – other reason; harvester moved; deceased; does not want to participate; does not harvest; other)* If harvested for each animal – **what** animal; **how many** of each; and **where** killed (*place name + grid coordinates).* **Age class and sex** of animals was also recorded for: *moose, barren-ground and woodland caribou, muskox, Dall's sheep, mountain goats, black and grizzly bears, white-tailed deer*. **Age classifications** include *adult, juvenile, unknown.* Collect information on harvests both inside and outside Sahtú Settlement Area boundaries. Harvester indicates total number of days spent out on the land harvesting General **comments** section

	GWICH'IN	INUVIALUIT	NUNAVUT	SAHTÚ
Species covered	Any animal harvested *(no formal species list; a general list provided as recall aid only)* Some species groupings	73 fish and wildlife species *(incl. 14 species of fish; 36 species of birds; 4 species of marine mammals; 19 species of terrestrial mammals)* Some species groupings	64 fish and wildlife species *(incl. 14 species of fish/shellfish; 28 species of birds; 7 species of marine mammals; 15 species of terrestrial mammals plus egg and down collection)*	Any species of animal, fish and bird *(incl. 9 species of large mammal; 20 species of small mammal; 38 species of birds; 13 species of fish)*
How harvest location reported	Based on 1:250,000 scale NTS maps Harvest location reported as **place name** and 10x10km UTM ***grid*** block	Based on 1:250,000 scale NTS maps Harvest location reported as **place name** and UTM ***point*** location	Based on 1:250,000 scale NTS maps Harvest location reported as **place name** and UTM ***point*** location	Based on 1:250,000 scale NTS maps Animal and bird harvest locations reported as **place name** and 10x10km UTM ***grid*** block. Fish harvests reported as **place name** and on 2x2km UTM ***grid***
Database design	Use commercially available software *(Filemaker Pro* for Mac) Contracted out design of database management system	Use commercially available software *(Paradox* for PC) Database management system developed by Study Coordinator	Use commercially available software *(FoxPro* for PC) Contracted out design of database management system	Had database developer in-house create custom application using *FireBird*, an open-source relational database management system Database developer in-house also designed database management interface – *Harvest Study Manager*
How total harvest estimated	Proportional projection *(assumes small group of harvesters not participating equal to those that do)*	Proportional projection *(assumes small group of harvesters not participating equal to those that do)*	Proportional projection *(assumes small group of harvesters not participating equal to those that do)*	Not yet complete, however proportional projection is recommended

Gwich'in Harvest Study 1995–2004

Five years of harvest surveys were required under the Gwich'in Comprehensive Land Claim Agreement (1992). The Gwich'in Renewable Resources Board (GRRB) continued the study for a total of nine years, however, only data collected during the first six years (1995-2001) were found to be suitable for calculating the Gwich'in Minimum Needs Level (GMNL) (GRRB 2009). The last three years of data (2001-04) were excluded because of low response rates; these data did provide additional information on harvest locations and the age class and sex of harvested animals.

The Gwich'in Harvest Study (GHS) data are used in the calculation of minimum needs levels for all species or populations of wildlife other than migratory birds. The report presents the study results in tables of the following figures:

- Hunter response rates, number of months recall, and total monthly and annual harvests by community;
- Total harvest, mean annual harvest, and number of harvesters getting each species for the Gwich'in Settlement Area.

The results report notes that there are some issues to consider in the statistical analysis, such as reporting of tundra swan harvests, analysis of caribou by species or herd, effects of the grizzly bear moratorium and restrictions on fishing Rat River Dolly Varden char on reported harvests and harvest levels (GRRB 2009). The magnitude of these potential effects was not quantified.

Wildlife that was harvested and sold commercially on a small scale was included in the GHS and used in the calculation of the GMNL. Examples of small scale commercial harvests include furs that were trapped and sold locally or non-locally through fur auctions, and fish and caribou that were sold locally. In all of these cases the harvesting was conducted by one or a few self-employed hunters. There were no large scale commercial harvesting operations in the Gwich'in Settlement Area (GSA), 1995-2004 (GRRB 2009).

Inuvialuit Harvest Study 1988–1997

The Inuvialuit Harvest Study was one of the first harvest surveys conducted in Northern Canada and one of the most comprehensive to date. It was designed on the same basic principles as those under the provisions of (or in anticipation of) other land claims agreements, and ran for ten years. While the Inuvialuit Final Agreement (1984) did not specifically require a harvest survey, it did establish a co-management system for wildlife and environmental management, and provided for harvester compensation in the event of adverse effects from development activities. As the co-management bodies require harvest information and data, a continuing harvest survey was determined to be the best method of obtaining the required information (Joint Secretariat 2003).

Hunters were asked to report the total number of animals of each species harvested for subsistence use or commercial sale, but the study was not intended to collect information on large-scale commercial harvests. Community, commercial and research harvests are itemized in a separate appendix of the report. Similar to the Gwich'in harvest study, the data are presented in tables in the report, including:

- Estimated harvest, selected species, other harvested species reported; and

» Hunter response rates, number of hunters harvesting selected species for each year, and a ten-year summary.

Three main sources of non-response bias were identified, including: harvester refusal to participate, incomplete coverage by field workers, and survey avoidance. Each possible source of error is likely to have resulted in some under-counting, but the degree was not quantified.

Nunavut Wildlife Harvest Study 1996–2001

The Nunavut Land Claims Agreement (1993) required that a harvest study be conducted in all three regions in Nunavut for a period of five years. The Nunavut Wildlife Harvest Study was a massive undertaking with over 6,000 harvesters participating in 28 communities (NWMB 2004). Response rates varied widely between communities, however, and it is estimated that up to 33% of harvesters did not want to take part. Commercial harvests of all furbearers, and harvests sold for local consumption (including local Hunter and Trapper Organizations or stores) were kept in the database with the subsistence harvest data. Like the Gwich'in and Inuvialuit studies, results are presented in a final report, with data tables showing monthly harvest estimates by species, with annual totals and 95% confidence intervals. Monthly hunter response, recall periods, and the number of hunters harvesting each species are also included. The results are summarized for annual and five year periods.

A review of the Nunavut study was conducted and several sources of strategic bias were identified; all resulted in some level of under-reporting and under-counting (NWMB 2004). An example of some specific problems which were thought to have led to measurement error include under-reporting of certain resources such as eggs, eider down and shellfish. In addition, commercial harvests were reported inconsistently. Overall, fieldworkers and participants reported that hunters were generally truthful in their responses. Due to these potential sources of error, community feedback was sought on the data, and the harvest estimates were compared to other sources of data for further verification of the results.

> *The ultimate question asked during the analysis of Harvest Study data was: how reliable are the harvest estimates? Do they provide an accurate record of the harvesting levels and patterns of Inuit over the study period? At the conclusion of the data analysis the answer to this question is in some cases yes and in other cases no. The size and complexity of the NWHS resulted in data reliability issues that differ not only among communities but also among the years of the study and among the species (NWMB 2004:7).*

As a result, the final report published for the Nunavut study differs from the other harvest surveys summarized here in that the data tables for each community are accompanied by a 'Community Results Discussion' in the final report. The study results are organized in the report by community, as follows:

» ***Annual data tables***
- Monthly harvest estimates
- Monthly hunter response
- Recall period between harvest and interview
- Number of hunters harvesting each species

» ***Five-year summary tables***
- Annual harvest estimates and five-year mean (with footnotes)
- Annual hunter response
- Recall period between harvest and interview

- Number of hunters harvesting each species

» ***Community Results Discussion***

The 'Community Results Discussion' sections describe the reliability of harvest estimates specific to each community, expanding on the information presented in the tables. Each section contains community feedback and other sources of harvest data for comparison purposes. Select species in the tables are footnoted and refer readers to related comments and data found in this discussion section. An independent assessment of the Nunavut harvest study was conducted in 2008, and a summary is provided here as an example of the socio-political context surrounding northern harvest surveys and implications for data interpretation.

An example from Nunavut

Since the completion of the Nunavut Land Claim Agreement in 1993, the Nunavut Wildlife Management Board was tasked with carrying out the harvest survey, among other resource management activities. During an assessment of recent land claims institutions and the management of harvester activities in Nunavut, authors Suluk and Blakney surmised that the communities were engaging in 'creative acts of resistance' in order to avoid the increasing demands for local information and participation in research (2008). They cite conflict between the joint management bodies and the 'Institutions of Public Government' and their methods as fueling some of these acts of resistance.

In regards to the harvest survey specifically, the authors concluded that harvest data collection is problematic and as a result there are numerous irregularities with the harvest study data. For example, the authors found that recorded harvests are often based on after-the-fact 'guesstimates'; that the categorization of hunters as 'intensive', 'active' or 'occasional' was inaccurate; and in some communities, 'occasional' hunters were not surveyed. While the assumption was that excluding 'occasional' hunters did not affect results, it was found that they actually had high harvest capacities. Funding issues exacerbated these problems, but the authors state that the full range of contextual factors that has led to today's problems and current conditions include: "...harsh policies, tough regulations, stiff penalties, dismissal of Inuit Qaujimajatuqangit [traditional knowledge], imposition of southern knowledge systems, and the disempowerment of local people through bureaucratic and financial strangulation," (Suluk and Blakney 2008: 68). It is possible these conditions exist in other areas of the north, and potentially exert an influence on all types of research, including harvest surveys.

A separate review of the Nunavut harvest data concluded that: "Results are considered sufficient to identify relative differences over space and time, but not necessarily to establish clear year over year trends (especially for management purposes) as it is assumed that confidence intervals will not be sufficiently tight for this purpose. Most suggested the data will certainly be good enough for their primary intended purpose which is to establish Basic Needs Levels," and, "Other harvest surveys ... have shown that where census coverage is intended and high reporting rates are achieved, the resulting estimates for most key species are at least as reliable as animal population and similar survey information routinely used by wildlife managers, at least with respect to sampling error. Measurement error arises from those aspects of survey design or limitation – questionnaire design, interview format, recall error, and response bias – that cause the respondent's answer to vary from the 'true' answer. Unlike sampling errors, these types of error may be difficult or impossible to quantify. But even allowing for these additional sources of error, a properly designed and executed harvest survey should provide much better than 'order of magnitude' results," (Usher and Brooke 2001:16).

Sahtú Settlement Harvest Study 1998-2005

The Sahtú Settlement Harvest Study (SSHS) was also a claim-mandated survey, required to produce five years of data to calculate minimum needs levels and for use in resource management. The methods chosen for the Sahtú study were based on the previous three surveys summarized here, and the study therefore produced comparable data. For the first five years the study was conducted on a monthly basis. It was then continued for an additional two years, but the interview schedule was changed to quarterly, and the list of participating harvesters was reduced.

The Sahtú study data are likely influenced by the same sources of error mentioned for the other studies, and the magnitude of those effects will be similarly challenging to assess. To date, the SSHS has not been finalized – no statistical analysis of the results has been completed and no final report produced. Only interim, draft results are available, published in reports produced on a bi-annual basis during the course of the study. More in-depth assessments of the Sahtú harvest study data and methods, as well as detailed recommendations to bring the study to completion, are the focus of following sections of this report.

Current harvest surveys: a look at emerging methods

New harvest surveys emerging in several areas of the north in recent years attempt to address the characteristic challenges and weaknesses of past harvest surveys and the Canada model. These new studies are driven by the recognition that there is a continued need for the data – perhaps even a growing need, as development applications increase across the north – and that past studies may not have addressed the needs of communities and Aboriginal agencies very well. In this section we introduce four approaches to gathering harvest survey data that are currently underway in the north.

The May Gatherings, Northern Tutchone Region, YT

Heralded as a uniquely successful example of how harvest data collection and use can take place in the north, the 'May Gatherings' are a locally-developed platform for sharing information and management considerations for select species in parts of the Yukon Territory (Natcher pers. comm. 2012). The process arose out of a desire of the Selkirk First Nations to implement self-governance and develop their own wildlife act in a way that was rooted in their culture (O'Donoghue 2012).

The annual May Gathering is a coming together of three First Nations each spring to discuss fish and wildlife issues. The process arose to revive a traditional gathering that took place at river camps in the spring, as that is typically a hard time of year to move on the land. There, families would visit, gaff jackfish, and talk about how their winter had gone. After four or five families had reported their observations and experiences, the headman would re-assign them to areas for the coming winter. As a result, everyone knew where each family would be, resource competition was lessened, and areas that were known to be low for wildlife could be rested. People would part ways but then get together again the following May. The May Gathering is an annual custom that has been revived for the past 12 years as part of the traditional government (Urquhart pers. comm. 2012).

Approximately 100-150 people take part in the Gathering each year. A typical meeting agenda consists of presentations on harvest results and wildlife population status from the regional biologist together with local First Nation staff. This is followed by observations from citizens and discussions about harvest responses where required. The entire Northern Tutchone region is divided into three management areas and participants talk about what's known about wildlife populations in each area. The focus is on big

game species such as moose and caribou, but other species are also discussed (Urquhart pers. comm. 2012). Aside from information on harvesting and population levels, observations on wildlife health and a range of other topics (e.g., industry, development) may also be discussed. Hunters and the biologist then talk about interpreting the information that has been presented – *Is the harvest is too high? Is more information needed? Do harvesting areas need to be rotated?* It takes about three days to get through the whole process and has evolved over the years to include a balance of more cultural activities as well, such as contests and dancing. Following the Gathering, a technical report is prepared that includes all the data and is only distributed to the First Nations. A document including some information on resolutions that came about as a result of the meeting is prepared for other audiences (O'Donoghue pers. comm. 2012).

Harvest data from each of the three First Nation communities is gathered by various means and with varying levels of consistency and success. Some of the information has been collected through regular household surveys, there are annual mail-in surveys, and informal interviews are conducted – methods vary depending on the level of resources and support available. The communities are also collecting harvest information on other species such as salmon, as part of other processes (O'Donoghue pers. comm. 2012). Most recently, there has been a decision to work with focus groups of harvesters instead of door-to-door surveys in this area, as there has been ongoing difficulties to get information consistently through conventional survey methods (Urquhart pers. comm. 2013).

As with other harvest surveys methods, a possible weakness of the May Gathering may be the fact that there is no rigorous way to measure the accuracy of the information. However, it is felt that due to good levels of trust and very restricted sharing of the harvest data, some of the parameters that would lead to accurate reporting are in place. For example, the Yukon Territorial Government responded to hunters' concerns over publishing moose survey details by only reporting harvest data for very broad geographical regions that cannot be used to pinpoint areas of high moose density O'Donoghue pers. comm. 2012; Urquhart pers. comm. 2013). It is thought that approximately 60-70% of the harvests are being reported – an estimate that parallels that found in other jurisdictions (O'Donoghue pers. comm. 2012).

The information that results from the May Gatherings is useful to resource managers, the First Nation communities, and Renewable Resource Councils, especially in helping to inform decisions on developments that might increase access to areas (e.g., mining). It is felt that the May Gathering has been successful because the idea originated with the Selkirk First Nation and is based on Tutchone traditions. There is little to no bureaucratic involvement; other than the one YTG biologist, the Gathering is a wholly Tutchone gathering. Perhaps most importantly, the process itself is empowering in that each First Nation will stand up in a public place and report what they hunt, despite long traditions of secrecy. This increased willingness to report harvests has replaced a reluctance to participate in resource management processes (based on the negotiation phase of the land claim), as well as a reluctance to report shooting cow moose because of perceptions in the non-Aboriginal community. In the context of the May Gathering harvesters feel comfortable reporting truthfully; "Some say you get people to report harvests because it gets them feeling they are taking some responsibility, and are involved in the resource management in some way," (Urquhart pers. comm. 2012).

An important strength of the process comes from the format of having over 100 people engaged in the Gathering – rumours and innuendo are dispelled whether around other communities' activities or outfitter harvests. The result is that there ends up being a collective agreement for how the land should be used the coming year. Now that the Gathering has been going on for years, children are also being

introduced to the process at an early age – they are present in the room, amongst the elders, learning about resource stewardship (Urquhart pers. comm. 2012).

The harvest results provided at the Gathering are one component involved in wildlife management in the Yukon. In estimating total mortalities of a species like moose, biologists also factor in the harvests of outfitters and resident hunters; all three are then totalled for each moose management zone. This information can be compared with other sources of information (e.g., surveys) done by the Yukon Territorial Government. In most zones, the total harvest is well below what is thought to be sustainable, and it appears that harvesting isn't posing a threat to the moose populations. This ability to provide a complete rendition of the harvest is very important to resource managers; the harvest component is not available in any other parts of the Yukon at this point (O'Donoghue pers. comm. 2012).

The May Gatherings indicate that while the harvest data they produce may not be as accurate as with some other methods, they are sufficient for management purposes and perhaps most importantly, a cooperative, long-term, Tutchone-based form of stewardship is now informing resource management and empowering people.

It is worth considering how well a public forum such as the May Gathering would work on a more sensitive species or when conservation concerns arise. Co-management tends to work best when there are a lot of animals, but the question of how well it will work when harvest restrictions are necessary remains (Natcher pers. comm. 2012). There have not yet been situations in which issues such as overharvesting have had to be addressed in the forum.

Recently, similar gatherings were also organized in the southern NWT as a means of discussing caribou management issues (Snortland Pellissey, pers. comm. 2013). No results were available at the time of report preparation.

Porcupine Caribou Harvest Data Collection, YT and NWT

There are eight main groups of hunters in Canada who harvest the Porcupine Caribou Herd (PCH). Although there have been a number of data collection programs for the various user groups over the years, the programs ran intermittently, operated in different years, used different methodology, had varying hunter participation rates, and generally were never coordinated (Cooley and Branigan 2012).

The Harvest Management Plan for the Porcupine Caribou Herd in Canada (HMP) states that "The Parties are committed to the annual collection and reporting of rigorous and verifiable harvest information, required of all harvesters at all times," (Porcupine Caribou Management Board 2010a:23). The accompanying Implementation Plan (IP) assigns the task of collecting and reporting harvest data to the eight Parties to the plan; by signing on to the HMP and IP, all Parties have agreed to an integrated approach and a minimum standard in the quality of data (Cooley and Branigan 2012).

The overall objective of the program is to annually estimate the total number, by sex, of Porcupine Caribou harvested in Yukon and NWT. There are methods built in to help interpret the reliability of that estimate, which allows an assessment of the total harvest of the herd. The harvest estimates are then incorporated into computer population models (Cooley and Branigan 2012).

While some of the methods used in the PCMB model are the same as those used in former harvest surveys, there is progress in several areas such as:

- All Parties are collecting at least some harvest data. For the 2010/11 season, Parties submitted some sort of estimate for all Canadian User Groups for the first time ever;
- A working version of the generic database has been produced. This database will be designed to minimize data entry errors and will automate most of the mathematical calculations needed to produce the estimate;
- There is greater flexibility in community choices of methods and data use;
- Additional questions are asked regarding harvester observations about animal behaviour, condition and other environmental variables; and
- Other sources of data provide a means of verifying the accuracy of the information (Cooley and Branigan 2012).

Nonetheless, there are also several continuing challenges:

- Participation rates may be low and further communication to encourage hunters to report is needed;
- The harvest database needs to be finalized and tested;
- Most communities still need to consistently 'stratify' their hunters and calculate the variance in their estimates in order to formally calculate a total estimated harvest. This may be facilitated by the automated features in the harvest database;
- Further public communication is needed on the use and limitations of the supplementary data (check station and enforcement field check data); and
- Implications of the *Access to Information and Protection of Privacy Act* to data sharing arrangements need to be clarified (Cooley and Branigan 2012).

The Porcupine Caribou Harvest Management Plan (HMP) was agreed to and signed by the following eight Parties with authorities and responsibilities for Porcupine Caribou Herd management across the Canadian range: Gwich'in Tribal Council, Inuvialuit Game Council, Vuntut Gwitchin Government, Tr'ondëk Hwëch'in Government, First Nation of Na-Cho Nyäk Dun, Government of the Northwest Territories, Government of Yukon, Government of Canada (Porcupine Caribou Management Board 2010b).

Information for all users comes from four sources: Yukon mandatory reporting by licensed hunters; NWT resident hunter reporting; PCH user community interviews; and non-PCH user community Aboriginal harvests, requiring slightly different sampling methods. For the PCH user community interviews, a draft report describes the interview methodology chosen for the community information in detail (see Cooley and Branigan 2012). A copy of the survey form is included in Appendix D.

Gwich'in Harvest Study, Gwich'in Settlement Area, NWT

Within the Implementation Plan of the Porcupine Caribou Harvest Management Plan, the Gwich'in Renewable Resources Board (GRRB) is one of the organizations with a responsibility to collect harvest data from Gwich'in harvesters and provide relevant data to the Porcupine Caribou Management Board (PCMB). As part of this program, the GRRB has recently initiated a harvest survey that is collecting information not just on the Porcupine caribou, but also on all other caribou harvested by Gwich'in harvesters (which may include Mountain woodland caribou, Boreal woodland caribou, Cape Bathurst

caribou, Bluenose West caribou), as well as Dall's sheep, moose and muskox. Four communities take part in the study (GRRB 2012).

The study methods for the new Gwich'in survey are very similar to the original harvest study conducted in the area, however there are some significant differences. Instead of on a monthly basis, harvester interviews are now conducted just twice a year (in June and November); interviews are done by community interviewers in person or over the phone using a list of active harvesters prepared and checked by the local RRC and updated as new information comes in; and information on animal condition, environmental observations, behaviour, and how well needs are being met have been added to the questionnaire (GRRB 2012).

The GRRB facilitates and coordinates the study by training interviewees in each community, and corresponding with RRCs who collect completed questionnaires and send to the GRRB for data entry, storage, and analysis. The GRRB also sends entered data back to the RRCs for verification before it is considered finalized (Callaghan pers. comm. 2013).

In addition to submitting Porcupine caribou harvests to the PCMB, the GRRB collects information on harvests for all types of caribou, Dall's sheep, moose and muskox, through interviews done twice a year in four communities. Harvest data from the study is contrasted to information from voluntary reporting at check stations. The study also collects other ecological and social information.

The study relies on a secondary source of data to provide a way of verifying the accuracy of the information. For a twelve month period in 2011-2012, Gwich'in Porcupine caribou harvest data was obtained by community interviews of participating Gwich'in harvesters. Additional records were obtained through voluntary reporting of harvests for two months in the late summer and early fall at a check station run at the Dempster Highway Peel River ferry crossing. Interview data was analysed to calculate community and overall reported and estimated harvest amounts. Check station data supplied to the GRRB was compared with interview data from the overlapping data collection period for Gwich'in harvesters and station usage by all groups was examined. The results are written up in a recent report (GRRB 2012).

Some of the challenges encountered by the GRRB work are similar to those from earlier survey models, including:

- Interviewer training and turn-over;
- Incomplete questionnaires;
- Confusion about who reports what harvest when harvesting as a group (some harvest may get reported twice or not at all) or from community hunts;
- Ensuring active harvester lists are complete;
- Harvester burnout or disinterest in participating; and
- A need for ongoing funding to keep study running over multiple years (GRRB 2012).

The harvest data collection programs run by the GRRB and recommended by the analysis team for the overall Porcupine Caribou HMP are attempting to separate out 'key' harvesters from other harvesters (defined as 'active'). In many communities, it is common for a few individuals to take significantly more

caribou than the average harvester, as they are helping to supply community members who do not or cannot hunt with meat (or may be selling the meat). If the assessment of 'active' versus 'key' harvesters is generally accurate, then estimates of the total harvest taken based on the response rates of the two groups of active and key harvesters can be refined. Efforts are underway to best incorporate this type of stratification into the overall harvest estimate for the PC herd – a level of analysis that was not attempted by the older Canada model harvest surveys, and which may ultimately provide a better level of accuracy in the data (Callaghan, pers. comm. 2013).

The Inuvialuit are also conducting a new harvest survey in conjunction and cooperation with the PCH program, but details were not available in time for this report.

Community Based Monitoring Network, Nunavut

Three communities in Nunavut are piloting a new harvest study that relies on harvesters recording information on hand-held computers. The information includes wildlife sightings, harvests, and environmental observations. It then goes into a database, and is used in resource management.

Since January 2012, small groups of harvesters in three Nunavut communities—Sanikiluaq, Arviat, and Cambridge Bay—have been participating in a new study overseen by the Nunavut Wildlife Management Board. Instead of using interview methods common to past harvest studies (including the Nunavut Wildlife Harvest Study, see above), the Community Based Monitoring Network (CBMN) study trained participating harvesters to use specially designed hand-held computers to record wildlife sightings, harvests, and other environmental observations while out on the land. When harvesters return from the land, data clerks in each of the communities transfer the information contained in the hand-held computers into a regional database, where it may be used to improve local, regional, and Nunavut wildlife management practices (NWMB 2013).

The project began with a one-year trial in select communities to test the methods and get feedback from participants before deciding whether to expand the CBMN to more areas. The NWMB is currently evaluating the program in discussion with participating harvesters, community members, and other organizations, before deciding whether to continue or expand the CBMN.

The idea to establish the CBMN Pilot Study grew out of discussions with local community members, Regional Wildlife Organizations (RWOs), Hunter and Trapper Organizations (HTOs), and other stakeholders, and through lessons learned during the Nunavut Wildlife Harvest Study. The NWMB wanted to find a reliable way to include harvester knowledge and information when addressing wildlife management issues, such as: identifying important harvesting areas; documenting species distribution, movement, and health; and requirements for further research. The CBMN Pilot Study will help to assemble information that is needed to address concerns affecting wildlife and Inuit harvesting rights (NWMB 2013).

Further benefits of the CBMN Pilot Study have included contributions to the economies of the three pilot communities by creating employment and training opportunities for harvesters and data clerks. One of the goals of the project is to provide the communities with the necessary tools and skills to manage the CBMN independently in the future. Communities have full access to their own data, which they can use to manage local wildlife issues. The study also seeks to improve communication between

communities, regions, government, and other wildlife management agencies, while promoting stewardship and co-management.

Secure storage of the information contributed by Inuit harvesters has been an important component of the Pilot Study. NWMB has engaged participating harvesters on issues related to secure storage of data throughout the study, and the harvesters have had an opportunity to define who should have access to which data, how it should be stored and displayed, and what will happen to it after the study is over. These and other issues are laid out in a Memorandum of Understanding (MOU) on data sharing signed by the harvesters, data clerks, and the NWMB.

Following final meetings with participating harvesters and data clerks, and public information sessions in each of the communities, the project team will prepare a final report summarizing and presenting all data collected, reflecting on the successes and challenges of the CBMN Pilot Study and providing recommendations for the future (NWMB 2013).

Summary regarding possible 'best practices'

In several years' time, it will become clearer whether the new harvest data collection programs, such as the four outlined above, have been successful at addressing the challenges that characterized past harvest surveys. The adoption of a more adaptive framework – one that continually tries to improve upon the weaknesses of the former studies – will mean that a new responsiveness and flexibility should be incorporated into future work. Many factors can be 'adaptive' so that the study can be adjusted to respond better to community needs. And while some aspects of harvest surveys may become *less rigid* in new models – for example, the frequency of interviews and the target species – there are also possibilities that the resulting data can be *more accurate* than in the past.

It is likely that time will show that no one model will prove to be the best in all situations, but depending on culture, geography, information needs, species, and resource settings, successful future studies may 'piece together' numerous methods that are better-suited to each particular situation; "There are a number of little pieces of the puzzle ... and parts could be replicated along with a locally endorsed and generated harvest survey," (Natcher pers. comm. 2012).

Nonetheless, some common ways in which many of the new harvest survey programs are improving upon the initial work done under the 'Canada model' include:

- ***Methods rooted in tradition and/or community needs*** *(help increase success of studies through improved participation rates; ensure process and resulting information that results are relevant to the communities);*
- ***Inclusion of more qualitative considerations*** *(e.g., socio-economic indicators or contexts can help interpret harvest activities and data);*
- ***Seasonal, bi-annual or otherwise time- and species-restricted interviews*** *(avoid interviewee fatigue by doing fewer sessions and concentrating on fewer species);*
- ***Increased dialogue and transparency*** *(both between users and/or communities through public meetings, and between 'data providers' and end users);*
- ***Comparisons to other data sources*** *(help determine validity and accuracy of harvest survey results); and*

» ***Increased longevity/duration*** *(continuing to do harvest surveys over longer periods, and/or in areas that already have historic harvest data can greatly improve the quality and utility of the data).*

These topics are covered more fully in the context of future harvest study work considerations in the Sahtú in the ***Recommendations*** section at the end of this report.

II. Sahtú Settlement Harvest Study data review and assessment

This section of the report provides a detailed review and assessment of the Sahtú Settlement Harvest Study. Three aspects of the study were considered: i) Study methods and objectives; ii) Data management system and GIS; and iii) Harvest study data. In each of the three corresponding sections of this report, a brief introduction or summary of information is presented, followed by an interpretation or analysis of the findings. Analysis sections are italicized, indented and presented in a blue font to indicate these are the opinions of the author.

13.5.6 A Settlement Area Harvest Study shall be conducted in order to provide necessary information for the Board and government to effectively manage wildlife...

13.5.8 When the study described in 13.5.6 has been completed, the Sahtú Minimum Needs Level for a species or population of wildlife shall be equal to one half of the sum of the average annual harvest by participants over the first five years of the study and the greatest amount taken in any one of those five years (SDMCLA 1993: 49).

Study design and methods

The SSHS was initiated as a requirement of the Sahtú Dene and Métis Comprehensive Land Claim (Volume 1, Section 13.5.6, 1993). As noted above, the objective was to estimate total harvests of animals, birds and fish for all Sahtú Dene and Métis hunters, trappers, and fishers over a five year period. The results of the SSHS were intended for use for two main purposes:

» To provide information on harvesting in order to ensure effective management of fish and wildlife in the Sahtú by the SRRB and government; and

» To determine the Sahtú Basic Needs Level of Dene and Métis so that harvesting traditions can be protected.

The 'Basic Needs Level' is described as follows in the SSHS bi-annual reports:

> *In the future, it may be required to limit harvesting to allow a fish or wildlife species to recover from the effects of things like disease, habitat loss, and/or over-harvesting. This limit is called the Total Allowable Harvest. To date, the Sahtú Renewable Resources Board has not set a Total Allowable Harvest for any species in the Sahtú.*
>
> *Until a Total Allowable Harvest has been set, harvest by Sahtú Dene and Métis is* ***NOT*** *limited under the terms of the Land Claim Agreement. However, if a Total Allowable Harvest ever has to be set, the Sahtú Renewable Resources Board, in conjunction with territorial and/or federal governments, is responsible for deciding how many of the animals*

are available for the Dene and Métis people to harvest. This is called the Sahtú Needs Level. The Sahtú Needs Level will only be set or adjusted after consultation with the affected RRC.

If the Sahtú Needs Level is less than the limit set (Total Allowable Harvest), Dene and Metis needs will be covered first. However, if the Sahtú Needs Level is higher than the total number of animals available to harvest, the Dene and Metis will get no more than the total number of available to be taken.

*The Sahtú Needs Level can never be set below the **Basic Needs Level**, which is the number of animals required to feed all Sahtú households each year. The information collected from the Harvest Study will be used to determine the **Basic Needs Level**. The harvest information collected for the Study will **NOT** be used to set unnecessary quotas (see SRRB In prep.).*

Terms of reference (TOR) for conducting a Sahtú Harvest Study were laid out in the land claim agreement (Schedule I to Chapter 13, SDMCLCA 1993:65). Following instructions in the TOR, the study was designed by members of a Harvest Study Working Group – made up of three beneficiary appointees from the Sahtú Districts and three appointees from government (GNWT and Canada). After piloting the study with harvesters from three Sahtú communities, the study design received final approval from the SRRB in 1998. After that point, it was coordinated by the SRRB in cooperation with local Renewable Resource Councils (RRCs). Dedicated staff was hired (a harvest study coordinator and assistant); the staff then hired and trained community interviewers, and the study was initiated in Tulít'a, Norman Wells, Fort Good Hope, and Colville Lake in spring 1998, and in Délı̨nę the following January.

Lists of eligible harvesters were developed in conjunction with RRCs in each community. For five years, participating harvesters were interviewed by local community interviewers in door to door interviews on a monthly basis. Harvesters were asked to report numbers and locations of animals, fish, and birds harvested in the past month. An example survey questionnaire is in included in Appendix E, and a sample harvester registration form is in Appendix F. Interviewers for the SSHS were provided with documentation about the animals they were asking about – photographs, and a species list with English, common, and Dene Language[2] names. This list included a total of 80 species of birds, fish and mammals and is provided in Appendix G. It was also included in SSHS reports with reported annual harvests.

The methods chosen for the Sahtú Settlement Harvest Study were sound, rigorous and comparable to harvest survey standards at that point in time.

Reported harvests were recorded on a survey form, then entered into a database after it was developed in the fall of 1999 (see following section for further descriptions of the SSHS data management system). Kill locations were documented on a system of ten by ten kilometer grids (and two by two km grids for fish).

The study was projected to wrap up in 2003, but was then continued on a reduced interview schedule for another two years. During that period, harvesters were interviewed on a quarterly basis only, and the list of participating harvesters was reduced. The objective of continuing the study was to keep collecting information for the board, RRCs and communities to use (Snortland Pellissey pers. comm. 2012).

[2] Linguists refer the Dene Language spoken in the Sahtú area as North Slavey, a language in the Athapaskan family. There are four dialects: K'ashogot'ı̨nę (Fort Good Hope/Colville Lake), Káalogot'ı̨nę (Willow Lake), Shúhtagot'ı̨nę (Mountain) and Sahtúgot'ı̨nę (Bear Lake).

Analysis

As Table 1 indicates, the main characteristics of the Sahtú Harvest Study were comparable to other studies done at that time. Overall, the methods chosen for the first five years of the Sahtú study were well-researched, suitable and rigorous, and would have produced information that was as accurate and reliable as those other surveys, and will meet the information needs outlined in the land claim agreement. It is possible that the change in methods in the last two years of the study would have resulted in different levels of data reliability and accuracy for that time period. Statistical advice should be sought for whether those years of data will need to be treated differently in an analysis and reporting of the results.

Data management system and GIS

The SSHS data is stored in a free relational database management software called Firebird (for a full assessment, see Appendix H). The database is organized around a harvest trip – in other words, a single harvest trip is the node around which other types of information (who, what) is linked (Figure 1). The interview table records each separate harvest trip taken by each participant. The harvester's name, date of birth, and other relevant information are contained within a harvester table. Other tables hold information about what was harvested. Therefore, most queries or questions flow through the Harvest Trip records to link different pieces of information. Unsuccessful harvest trips are also recorded, as are instances when the harvester did not go out on any trips.

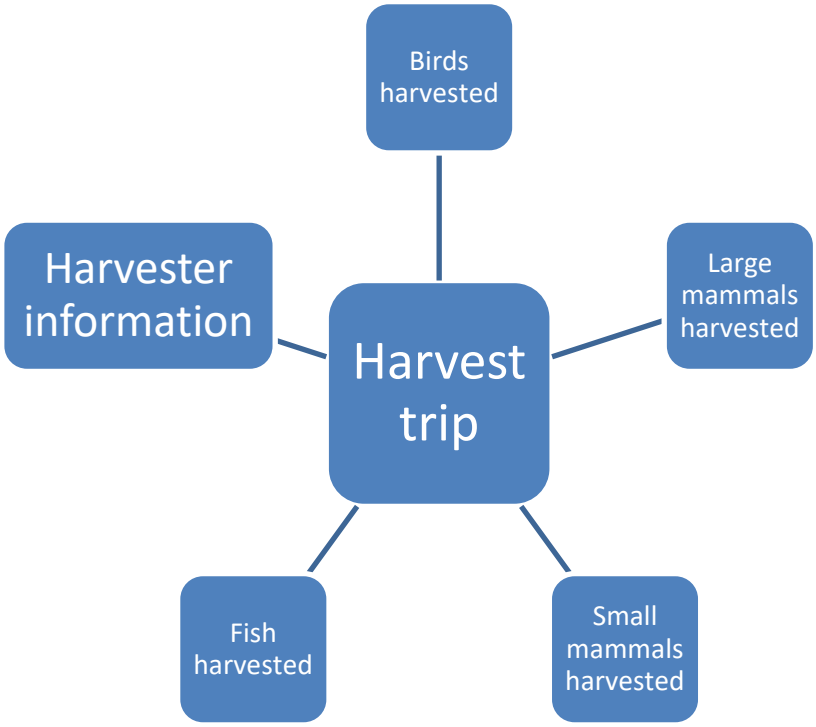

Figure 1. Generalized diagram of Sahtú Settlement Harvest Study Database

Therefore, by linking tables through queries, the following types of questions can be answered:

» *How many hares were harvested by young female harvesters during the winter of 2001?*

» *What percentage of the total moose harvest during the fall months was by Colville Lake hunters?*
» *How many successful hunting trips resulted in the harvest of both large mammals and birds?*
» *How many hunting trips under two days were successful, compared with those over four days?*
» *How many bulls were harvested within 25km of each community, compared with further away?*

Analysis and recommendations

The Firebird program is technical and suited only for experienced and trained database developers or technicians. It is not for casual or even competent end-users. The database can be used and updated through MS Access as well as through a linking program. Although Access is, as a part of the MS Office suite, more user-friendly and likely intuitive for Windows users, the linking function is not preserved when the files are moved around from one computer to another, and is not easily set up using the standard Access software. Also, the database is structurally complicated, and casual use through MS Access could overwrite records and cause issues.

For the Geographic Information System (computerized mapping component), a separate GIS file or database of SSHS was not a part of the original database plan. Instead, the ten kilometer by ten kilometer grid code reference stored in the database is linked to an essentially empty map file of squares. This system allows for many possibilities in map-making and spatial statistics and analysis. However, most currently-used SSHS spatial files, such as the shapefiles being used by the Sahtú GIS Office and the Sahtú Land Use Planning Board, are a small exported sub-set of the SSHS data attached to the grid for easy use and display. The creation of a dynamic, comprehensive, query-driven tool (or a comprehensive set of exported shapefiles) may be of use in the future, although currently the GIS system, including the exported shapefiles in use by various GIS offices, has proven adequate. Further details on the SSHS GIS capacity are included in Appendix H.

Harvest study data

The characteristic strengths and weaknesses of many harvest surveys were described in Section I. In this section of the report, we identify and describe what we found in regards to strengths and weaknesses that are specific to the Sahtú harvest study data. The information presented here results from our review of the Sahtú harvest data and methods, as well as the expert interviews.

Analysis

Survey frame

» ***How well did the survey sample represent the harvester population?***

The SSHS seems to have had very good communication, publicity, participation and support overall, but particularly in the early years of the study (e.g., 1998-99). However, it was reported by those interviewed as part of this project that there were always some harvesters that declined to take part, including several 'major' or 'super-harvesters' that never registered with or reported to the study, fearing prosecution or simply not supporting the study objectives. It is difficult to know the magnitude of the resulting influence on the data set.

Within the sample of participating harvesters, it is possible that there could be a slight bias towards information from people that harvest less than others. It was pointed out during the

expert interviews that people who harvest part-time tend to be the easiest to contact for the monthly interviews. The full-time harvesters – who are harder to contact as they are out of town a lot – are necessarily more difficult to interview, but do tend to harvest significantly more than others. It is possible that this effect has influenced the SSHS data, but a number of supporting methods (e.g., community verification sessions, comparisons to other data sources, etc.) could help determine the extent of this influence.

Overall, women were not very well-represented in the harvester list. This is in part due to the fact that there was no emphasis on foods traditionally harvested by women in the species list. For example, information on berry and plant harvesting was not recorded. Also, most often, men reported a household's total harvest, including the harvesting done by women.

Coverage and non-response bias

» ***Are there significant differences in harvesting between participants and non-participants?***

Past coordinators report that the study achieved a good cross-section of the harvester population in the first five years, and that family representation was thought to be good. However, as mentioned above, out of each community, one or two very productive harvesters did not take part; this would result in a possible under-estimate of total harvests in the area.

Measurement issues and response error

» ***Are the survey responses valid? Do they measure the true harvests of responding individuals?***

Past study coordinators feel that the results of the SSHS are fairly representative of the harvesting that was taking place in the Sahtú during the period of the study; "We did manage to cover the majority of harvesting that was happening in the communities at that time," (Snortland Pellissey pers. comm. 2012). No reasons for harvesters to strategically bias their answers were identified; there were no species-specific or other resource management issues identified that were likely to have created biases in reporting or the study results. For the most part, harvesters were said to have had good recall of both their harvest numbers as well as locations. No major issues were reported in regards to harvester reporting, community interviewers, or the conduct of the survey.

There were however differing levels of acceptance in the different communities. One resource manager felt that because there was not as good a trust established with harvesters in Colville Lake, the data for that area may be less reliable than for the other communities. There was reportedly a greater reluctance to participate in the SSHS amongst Colville Lake harvesters, based at least in part on that particular political setting. However, it was also acknowledged that generally, "... the hunters are pretty good – commitment to conservation of wildlife is very high on their agenda, and compared to any other region in the country, you get a lot of support from the elders in the communities for any wildlife concerns," (Popko pers. comm. 2013).

On a couple of occasions, it became apparent that reported harvests were falsified. This was a result of an action either on the part of the harvester or the interviewer. However, due to a rigorous data-checking procedure, as well as the coordinator's local knowledge of seasonal harvesting activities, it was felt that these were isolated incidents and unlikely to significantly influence the data.

One weakness identified for the SSHS was recall failure when data backlogs occurred – this happened when a harvester couldn't be contacted for several consecutive months, and became even more likely when the study switched to a quarterly interview schedule. It was felt that when harvesters were out on the land, and an interviewer was unsuccessful at interview attempts for two or three months at a time, harvesters were more likely to give inaccurate numbers or 'guesstimates' of their actual harvests. This tended to occur seasonally, for example when harvesters were out for extended periods hunting caribou or ducks and geese (Janet Bayha pers. comm. 2013).

In 2004 and 2005, when the SSHS changed to quarterly interviews, the study coordinator at the time felt that harvester recall failure began to be a bigger and more consistent problem, as harvesters had a harder time remembering their activities over the three month period (Janet Bayha pers. comm. 2013).

In addition, in the later years of the study, interviewee fatigue began to influence harvester participation. Past coordinators report that harvesters grew weary of the monthly census and some were declining to take part towards the end of the study and/or reporting that they had not harvested anything. It is likely that the study was most successful at achieving census coverage of harvesters in its first two to three years, and that the last two to three years only achieved a sample or representative portion of the harvesting population. This was identified as a possible weakness in the SSHS data – one that could result in an underestimate of actual harvest amounts for several years – and will need to be considered in any statistical analyses.

Overall, the study coordinators worked closely with the RRCs in each community. Good communication and a strong incentive for good study results helped ensure data reliability. Harvest study staff regularly visited the communities to make presentations and report on the study results and progress. There was also good communication directly between staff and harvesters that also helped to ensure reliable information. For example, if a harvester had missed the interviewer, he would often call the office for follow-up. In addition, coordinators did data checks by calling harvesters to confirm their activities and harvests (Janet Bayha, pers. comm. 2013).

Response rates

» ***What were participation levels like in the Sahtú Harvest Study?***

The intent of the SSHS was to interview every eligible harvester in the Sahtú Region. However, not all eligible harvesters participated in any given month. A calculation of the number of participating harvesters in a month relative to all possible eligible harvesters in the community that month is known as the 'response rate'. This figure must be calculated for each community, for each month of the study, using the following formula:

The 'response rate' indicates how many harvesters participated in the harvest study each month, out of the total harvesting population in the community.

$$R\,(\%) = \frac{\text{Number of harvesters interviewed}}{\text{Number of eligible harvesters}} \times 100$$

Initially, the software designed to manage the SSHS data could use updated harvester and survey lists to calculate response rates, however the software no longer functions in this regard. While some of the calculations are included in the bi-annual reports, it appears that they have not been calculated consistently and it is strongly recommended that these calculations be done again.

Notes from early harvest study coordinators detail the process of engaging communities and harvesters in the study, and while Délįnę did not begin participating until 1999, overall, it was stated that harvester participation was good in each community after that point. According to the existing SSHS reports, the response rates remained high in each of the communities, for each year the study took place. The draft response rates are presented in Figure 2. It appears that the response rates remained over 80% for the duration of the Sahtú Harvest Study. Generally, researchers consider response rates exceeding 80% to be very good.

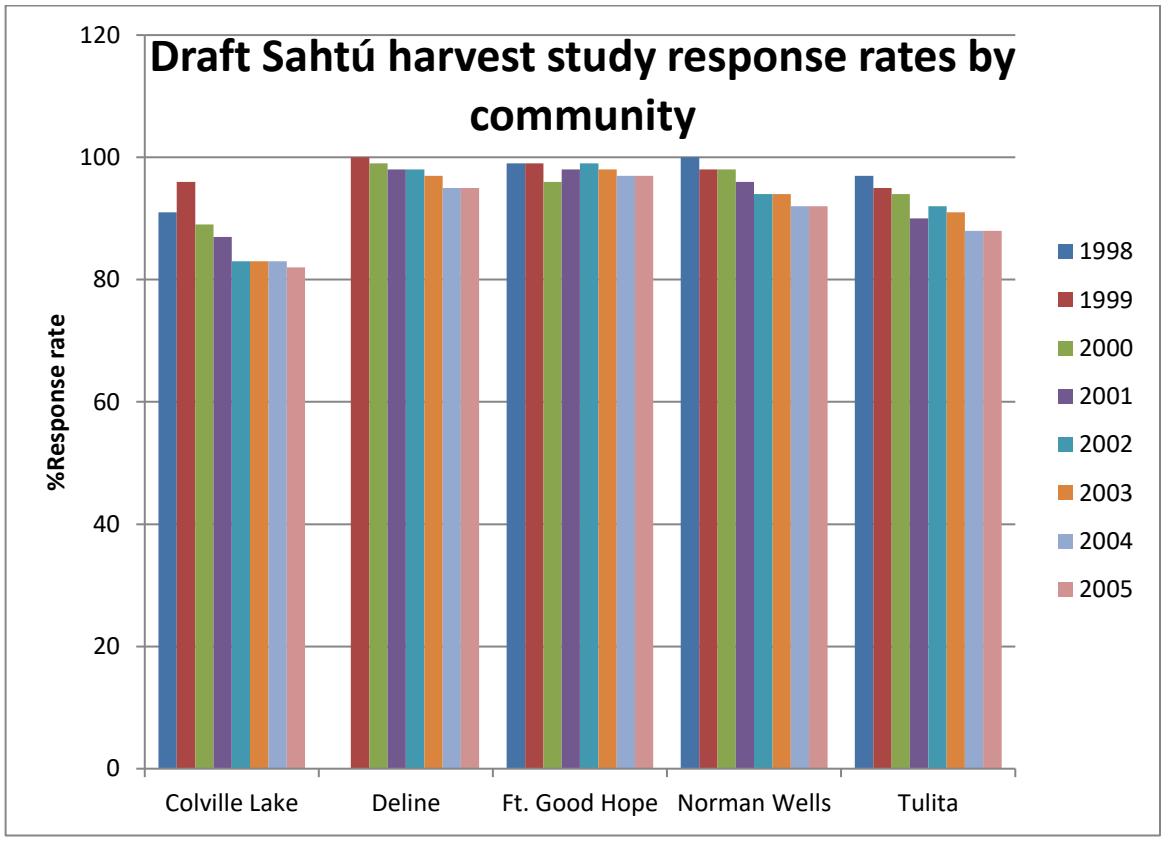

Figure 2: Draft response rates for the Sahtú harvest study, 1998-2005.

It is important to re-iterate that the response rates shown in Figure 2 are draft only, and should be re-calculated and confirmed in a final results analysis and/or report.

Data entry

» ***How was information handled?***

Data resulting from the harvest survey interviews was recorded on a standardized survey form by community interviewers (included in Appendix E). When these forms were submitted, each was checked by a harvest study coordinator. If data was missing, or information seemed unclear or

unexpected for some reason, the coordinator would then make a follow-up call to either the harvester or the interviewer to confirm as necessary. There were also random checks done to make sure that a harvester did get interviewed and to check if the harvest amounts were recorded correctly during the interview. The harvest study coordinators generally knew what to expect each month and could recognize when numbers looked unexpectedly high or low, or if harvests were reported in the wrong season, for example. On a monthly basis the coordinators would go through each list that would come in, to look for these potential sources of error. It was described as a careful process, leaving little chance for error to occur between the survey forms and the data entry (Snortland Pellissey pers. comm. 2012; Janet Bayha pers. comm. 2013).

"The data should generally be in good shape and there is generally good confidence that the [Sahtú harvest study] information should be correct," (Snortland Pellissey pers. comm. 2012).

To verify the impressions of the harvest study coordinators, 100 survey forms were compared against the harvest study database as part of this review. Of these, two records contained differences between the interview data sheet and the database. These differences were both updates to incorrectly written grid block numbers and as such are evidence of careful data-entry, rather than errors. During data-checking, but outside of the 100 samples, a single error was noticed by chance – the community of the harvester was inputted incorrectly into the database. Within the sampled data sheets, there were essentially no errors. A single error out of 101 datasheets could suggest an error incidence of approximately 1%, but further assessment may be warranted, as the sample size is small (i.e. 100 records out of 40,000 – 60,000). Reviewing a sample of 1000 records would give a better indication of the rate of error in the database. Minor errors in recording harvest comments (such as using 'good' instead of 'very good') were also noted but not considered relevant to data consistency.

As mentioned, some missing forms were identified during the data-checking process. This was concerning to the study team and an effort was made to identify if a pattern existed in missing forms which may impact data quality. A hard copy form should exist for each incidence of harvest activity. Eleven missing forms were identified and a search for the forms was also undertaken by Joe Hanlon. Of the 11 missing forms, an intense search found six filed in a way that indicated that the harvester was interviewed outside of their 'home' community. The remaining five forms are likely from interviews conducted outside of the home community as well, but remain outstanding. The issue of missing forms was dismissed as a data-entry concern at this point, and should be resolved with further data-checking.

Spatial data

» ***How accurate and reliable is the mapped information?***

Former harvest study coordinators felt that the spatial data resulting from the SSHS was likely to be quite accurate. Harvesters were generally good at recalling where their harvests had occurred, and locations were recorded on a map grid at the time of the interview. There were no indications that harvesters did not report locations accurately. Reviews of the spatial data did not identify any problems.

Some resource managers have been using the SSHS data in their work and find it to be of use and value. The 10 x 10 km grid scale is accurate for most planning needs and the harvest patterns can provide clear indications of areas that are important to harvesters. Further details are provided in later sections of this report.

Qualitative data

» ***Are there other types of information documented by the study that can be used?***

Relatively little qualitative data was recorded during the SSHS and questions were not asked consistently enough to be able to indicate any overall trends or patterns. Comments were only recorded when harvesters mentioned things they had noticed, and these generally focus on animal health – there were many notes about when animals appeared to be 'fat', 'good' or in 'very good shape'. There were also quite a few comments that include information about disease – most of these observations are for fish and caribou.

The comments are included in the Harvest Trip database, and must be linked to the animal tables to determine which species is being referenced. In all, there were 2,822 records with a comment; out of 62,273 records, this is about 4.5%.

Status of data and/or readiness for use

Total estimated harvest:

The total number of animals harvested by all harvesters in an area. This number comes from a statistical analysis and calculations based on reported harvests in the database.

Reported harvest:

The number of animals reported as harvested during the harvest study. This number is lower than the total estimated harvest and should be used with caution.

To date, the data resulting from the Sahtú harvest study have only been compiled in bi-annual reports with reported harvests – no total estimated harvests have yet been calculated, nor have calculations been done to establish Minimum Needs Levels for any species.

To meet the stated objectives of the Sahtú Harvest Study, it is important that some further calculations are done to the raw harvest numbers. The results presented in bi-annual reports to date do not represent total estimated harvests for the communities or for the Sahtú; these figures only represent the harvest numbers reported to the study over its duration.

To calculate total estimated harvests by all eligible harvesters, it is necessary to estimate how many animals were taken by eligible harvesters that were not interviewed. This calculation is done using a projection based on the response rates.

It is then useful to do further statistical analyses that can provide an estimated 'variance' or margin of error, which can indicate the reliability of the harvest estimates. This work was done for each of the other three harvest studies presented here to bring them to completion and to calculate the Minimum Needs Levels. It can provide important insights into the strength or reliability of the total harvest estimates. This process is explained in the final report of the Gwich'in Harvest Study as follows:

"Variance was used to produce two indicators of the reliability of the annual harvest estimates:

• The margin of error provides a range in which the true harvest is likely to lie and the confidence that the true value falls within this range. Margins of error were calculated at 95% confidence and are reported with total harvests;

• The coefficient of variation (CV). A large margin of error is not necessarily indicative of an unreliable estimate. The margin of error is in the units of the reported species, so what is large for one may be small for another. The CV, expressed as a percent, is unitless and provides a better indicator of the reliability of the annual total harvest across species. Generally, annual total harvests whose CVs are greater than 33.3% are considered unreliable. The total harvest tables indicate cases where the CV of an annual total harvest exceeds 33.3%" (GRRB 2009:26).

It is important to proceed with these calculations to bring the Sahtú harvest study to completion. Not only is this work required under the land claim, it would prove very useful to resource managers and Sahtú organizations to have final, reliable harvest estimates with a measure of accuracy. Because this work has not yet been done, there are instances in which the draft Sahtú harvest numbers are being used in comparison with adjusted, finalized numbers from other areas in the NWT, without a caveat to explain that these are not total estimated harvests. Without the necessary statistical calculations, it is probable that the actual harvests in the Sahtú are being underestimated when used this way.

"To reconstruct and evaluate historical harvest statistics of any type, it is necessary to determine: 1) the accuracy of the data; 2) the completeness of the data; and 3) the representativeness of the data. If all three characteristics of the data set are known, it is possible to estimate, by projection, the total harvest within precisely specified confidence limits. In practice, it is seldom possible to be so precise about the data set, but the use of a common set of conventions will nonetheless yield a reliable evaluation of its validity," (Usher and Wenzel 1987:154).

Harvest totals and spatial data

*Harvest trends and patterns cannot be assessed for significance until final estimated harvest totals are available (see following section on **Completion of the Sahtú Harvest Study**). Nonetheless, some of the resource professionals currently using the SSHS data provided observations on the data, and those comments are summarized here.*

*One resource manager that has consistently worked with the results from the SSHS reported that harvesting levels recorded in 1999 seemed high in comparison to other years. He noted, "it's immediately apparent for every community and every species, the first year with all five communities participating was a banner year for harvest of **everything** – more lake trout, more caribou, more [of] everything appears to be harvested in 1999," (Veitch pers. comm. 2013). He felt that this was likely an artifact of the early promotion and education done in the communities; "There was a lot of enthusiasm from both the interviewers and the interviewees early on," and by the second year of the study, the numbers had "smoothed out," (Veitch pers. comm. 2013).*

In addition to some year to year variation that is likely to be apparent in the harvest totals, there is also an expectation that the data will be more accurate for some species (namely for big game species like caribou, moose, and muskox) and less accurate for species like birds, fish and small

mammals. This is likely in part due to recall failure, but also has to do with whether or not the information is committed to memory in the first place (e.g., harvesters generally remember the numbers and locations of moose harvests, but may not even make exact counts of fish, grouse or rabbits). This is not unique to the SSHS but common to most harvest surveys.

To indicate some of the ways in which results from the Sahtú harvest study may vary between species, two cases are presented below for consideration – barren-ground caribou and moose.

Barren-ground caribou harvests in the Sahtú – challenges for data interpretation

According to the experts interviewed for this assessment, the SSHS data for barren-ground caribou harvests are likely going to be among the most difficult to interpret. The number of barren-ground caribou harvests reported to the SSHS from the communities between 1998 and 2005 are shown in Figure 3. In 1998 Délı̨nę was not yet participating in the study, so their harvests could not be included for that year. It is important to note that these numbers are draft and have not been adjusted for response rates, nor are we able to provide a measure of accuracy at this point. As a result, the data likely underestimate total barren-ground harvests by Sahtú Dene and Métis for this period.

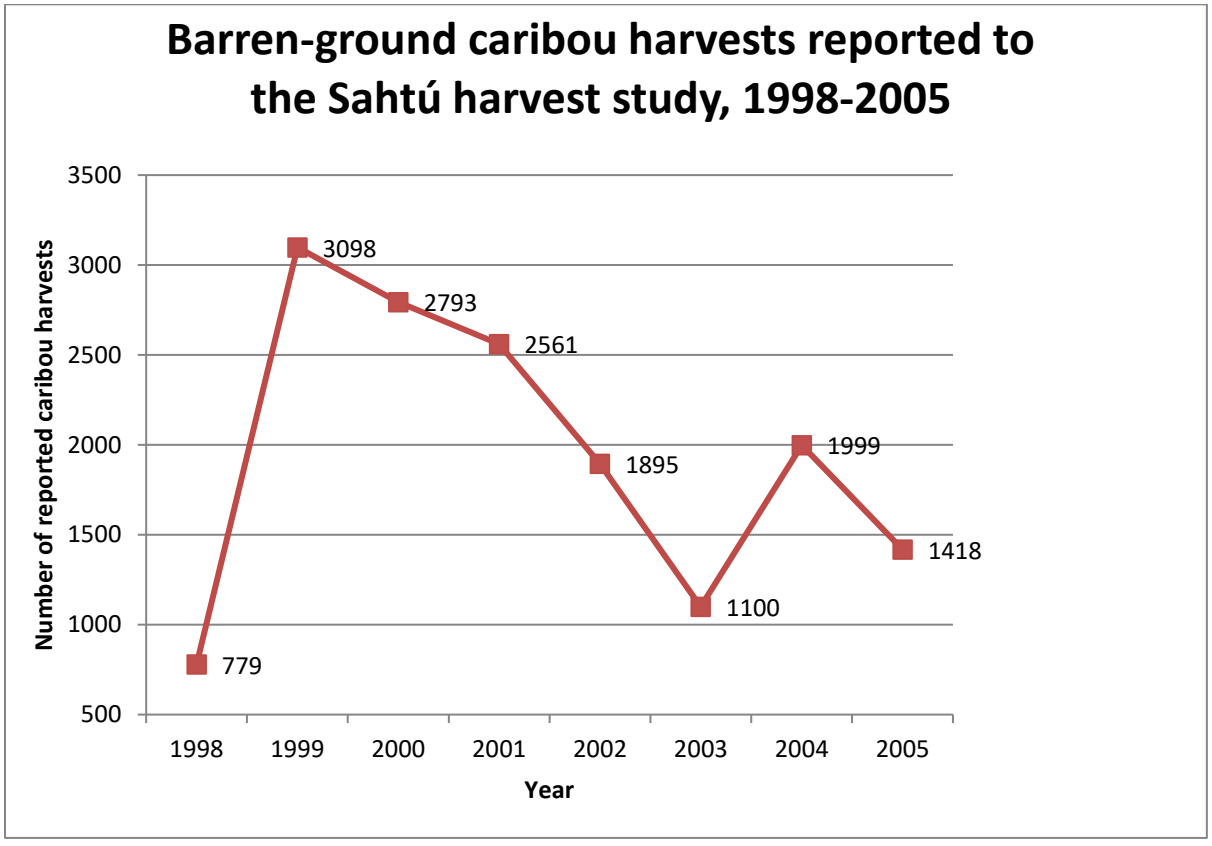

Figure 3: Graph showing caribou harvests reported to the Sahtú harvest study over seven years. In 1998, only four communities were taking part in the study, so data for Délı̨nę could not be included for that year.

The SSHS data show that on average, between approximately 780 and 3,100 barren-ground caribou were reported as harvested to the Sahtú harvest study per year. These numbers will possibly increase by 10-20%once adjusted for response rates. Even with these adjustments and with variance estimates

complete, it is likely the trend will indicate an overall declining trend in caribou harvest levels for the period of the harvest study. However when presented in the context of a longer timeframe, the results can appear quite different, as discussed below.

Numerous resource professionals indicated that although barren-ground caribou were thought to be in an overall decline in the region, Sahtú communities may have actually experienced an *increase* in caribou availability during much of the harvest study. Walter Bayha stated that from 1983 to 2005 the caribou remained closer to Délı̨nę than usual (pers. comm. 2013). For several years in particular, there were unprecedented increases in both the total number of caribou taken and in the amount of time the caribou wintered near Délı̨nę. Harvest amounts reported in other communities also increased, as harvesters travelled to the Délı̨nę area to hunt. Figure 4 shows caribou harvests recorded during the period of the SSHS in the context of harvest estimates dating back to the 1940s.

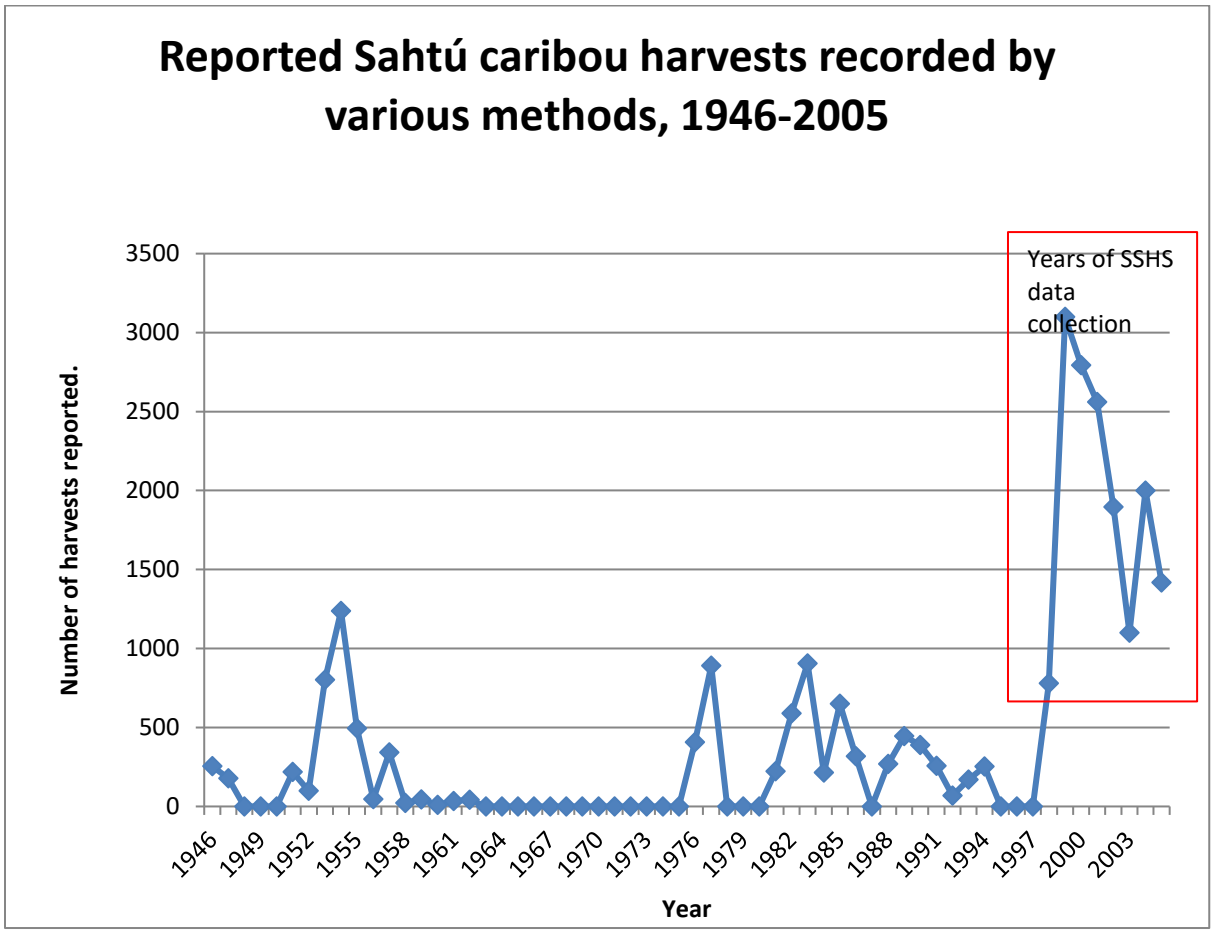

Figure 4: Barren-ground caribou harvest estimates for the Sahtú, 1946-2004 (data provided by Alasdair Veitch, ENR). Years for which no data are available are recorded as nils. These data are draft and have not been adjusted for all communities' participation. They do not therefore represent total harvests in the Sahtú.

The data for 1946 to 1963 come from an appendix in J.P. Kelsall's work (1968) in which harvests are reported from Fort Rae (Behchokǫ̀), Yellowknife, and Fort Franklin (Délı̨nę) only. There is no explanation of where the data came from, except that for Yellowknife in 1955-56 the reported harvest of 866 was

extrapolated from a 20% hunter return, and for Fort Franklin in 1962-63 – a reported harvest of 41 caribou – it was only 20% complete. It is unclear whether data for the other years are considered complete. It is also unclear if the data for Yellowknife (generally under 1,000 caribou per year from 1951 to 1963) include harvests for Resident Hunting Licence holders or just represent subsistence harvests.

The data for Fort Franklin/Délı̨nę from 1976-77 until the time of the harvest study are from Renewable Resource Officers in the Sahtú. The information came from the hunters when they renewed their General Hunting Licence each year. It is thought that these data are a reasonable reflection of what was actually going on each year (Veitch pers. comm. 2013). Similar data were collected for moose from Renewable Resource Officers in the Sahtú, and it was found that those numbers were closely mirrored by the data collected during the SSHS.

There are numerous other factors to consider when assessing the data seen in Figure 4, for instance: the data were not collected by comparable methods from year to year; not each community's harvest is represented each year; and there are 24 years that are missing data. While it is possible that there is a significant degree of error in the absolute numbers each year, the overall pattern is likely reliable. The numbers indicate that for several years of the SSHS, there is a spike in reported caribou harvests.

As a result, calculating a Minimum Needs Level based on just the Sahtú harvest study data could give a falsely high indication of what average barren-ground harvesting patterns are like from year to year. Experts generally feel that it would not be possible for the herd to support the level of harvest reported during the years of the harvest study on an annual basis.

Because the barren-ground caribou over-wintered close to Délı̨nę for several years of the harvest study, there is a spike in the number of harvests reported for those years. Some fear that if the Minimum Needs Level is calculated based on those numbers, the herd would not be able to sustain such high harvesting levels over the long term.

> *With land claims it's going to be very difficult to match those harvesting levels as a Basic Needs Level. Like 1,600-1,700 caribou [harvested in Délı̨nę] every year – you'll never be able to get that. In all the years of my grandfather, I don't think they ever saw numbers like that. You'll see that in [the mapped] data – it's all red right around Délı̨nę. I don't think that's ever going to happen again. When that becomes legal it's going to be a <u>huge</u> issue. That can't happen; we'll never match it (Walter Bayha pers. comm. 2013).*

It is suspected that if the harvest study had continued after 2005, the number of caribou harvested per year would be similar to the 1970s-1980s.

In recent years, hunters from Délı̨nę have had to leave the Sahtú and head to the Hottah Lake area in the Tłı̨chǫ region to hunt Bluenose-East caribou (Veitch pers. comm. 2013). It is thought that caribou harvest levels in the Sahtú today are very low in comparison to the years of the SSHS.

The spatial data recorded for barren-ground caribou harvests during the Sahtú Harvest Study are shown in Figure 5. The map in Figure 5 does indicate concentrations of harvesting right around the community of Délı̨nę, but also Colville Lake during the period of the harvest study. These results could be mapped by individual years, to see if there are some years in particular for which harvesting is more

concentrated at Délı̨nę (i.e. to further narrow which years the caribou over-wintered in a way that influenced customary harvesting patterns).

While it is generally felt that the spatial data resulting from the SSHS are accurate, when used as in Figure 5 (i.e., with a gradient showing estimated harvest amounts) it is important to consider that these numbers have also not been adjusted for response rate, and so the totals could be under-estimating Sahtú Dene and Métis harvests by roughly 10-20%.

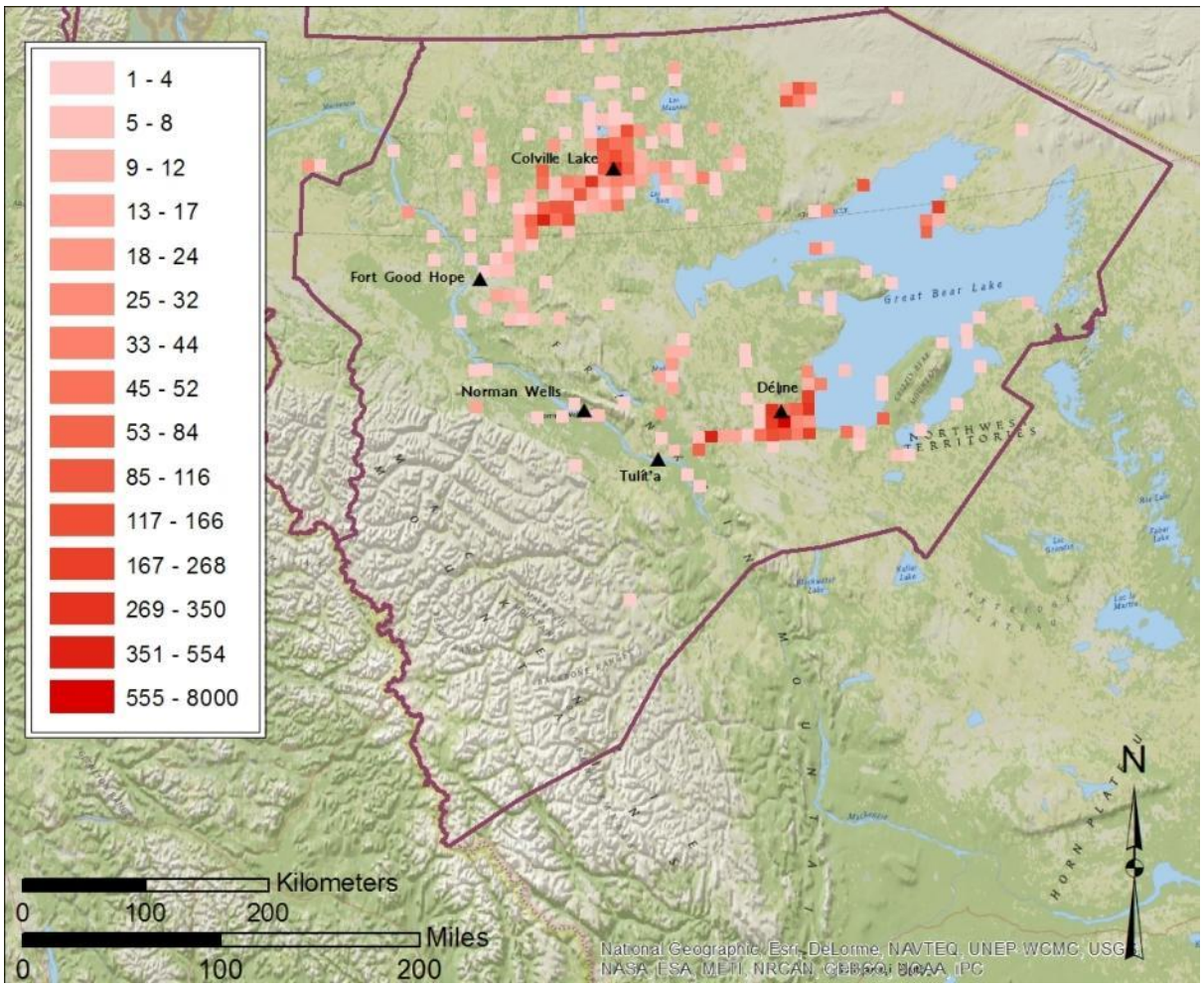

Figure 5: Locations of barren-ground caribou harvests in the Sahtú Settlement Area as reported by the Sahtú Settlement Harvest Study (1998-2005). This map is based on draft numbers, and does not represent the total estimated harvest of Sahtú Dene and Métis. The information on this map is confidential; do not copy or distribute. Contact the Sahtú Renewable Resources Board for conditions of use.

Moose harvests in the Sahtú

Some of the resource managers interviewed for this assessment felt that the best data in the Sahtú data set are likely those for moose. These harvest numbers are described as consistent from year to year for the duration of the study. Moose harvests, as reported to the SSHS, are shown in Figure 6. In 1998 Délı̨nę was not yet participating in the study, so their harvests could not be included for that year. Again,

it is important to note that the numbers are draft and have not been adjusted for response rates, nor are we able to provide a measure of accuracy at this point. As a result, they likely underestimate total moose harvests by Sahtú Dene and Métis for that period.

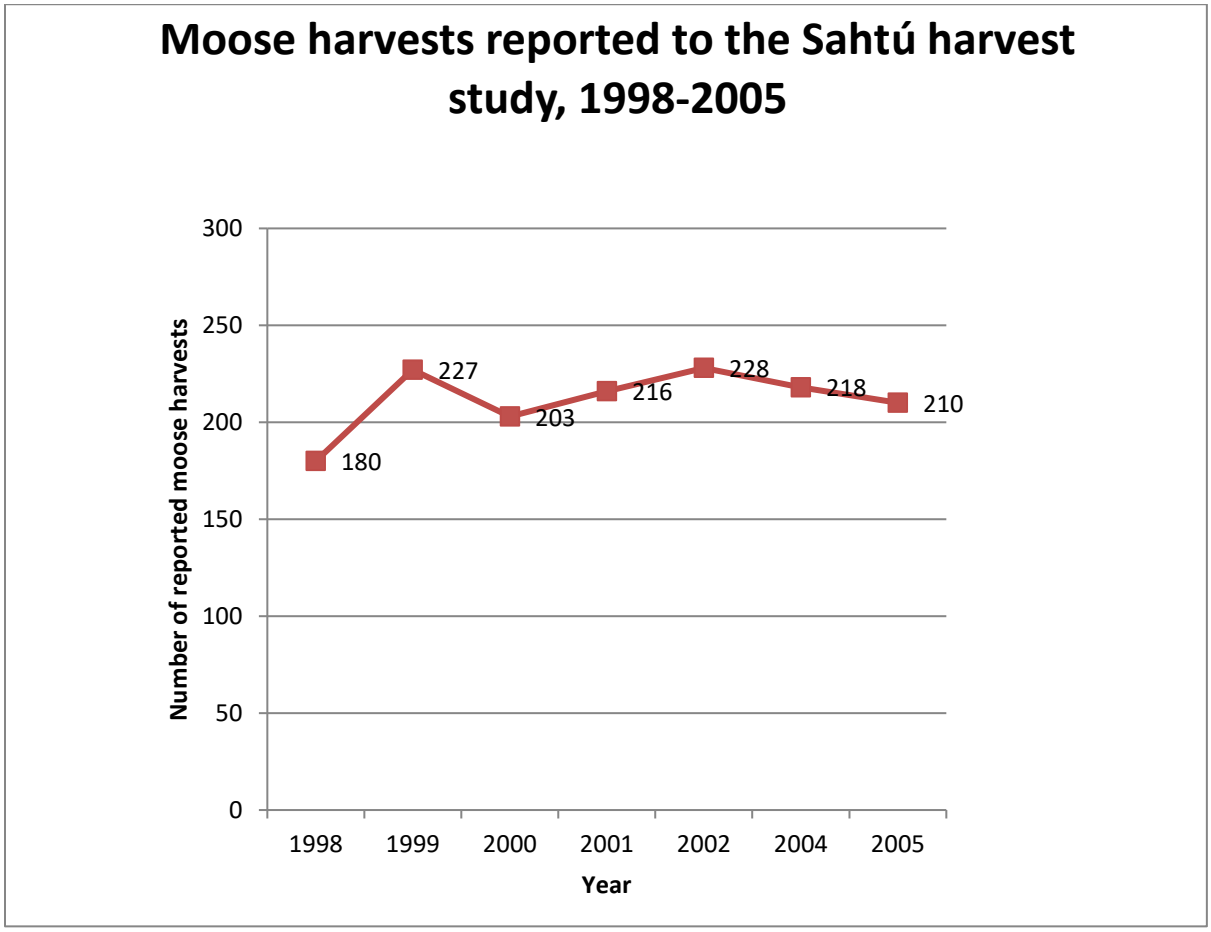

Figure 6: Graph showing moose harvests reported to the Sahtú harvest study for seven years. Because Délı̨nę did not start participating in the study until 1999, only data for four communities could be included for 1998.

The SSHS data show that roughly 210-220 moose are taken in the Sahtú Settlement Area per year. While the graph in Figure 6 only includes seven years of data (compared to the roughly 60 years of data shown in Figure 4 for caribou), the harvest study results are remarkably consistent from year to year. These data were also informally verified by Alasdair Veitch, through regular calls to the RRC officers; the RRC officers had a good idea of harvesting activities and numbers in the communities, and the numbers they estimated were very similar to the results from the SSHS (Veitch pers. comm. 2013).

Sahtú harvest study spatial data for moose are shown in Figure 7. It is precisely the type of spatial information that is mapped in Figure 7 that resource managers find especially valuable when considering development applications. While the accuracy of the harvest numbers may not be as high as is desirable, the pattern indicated by the colour gradient does indicate areas that are consistently important to both moose and the people who harvest them.

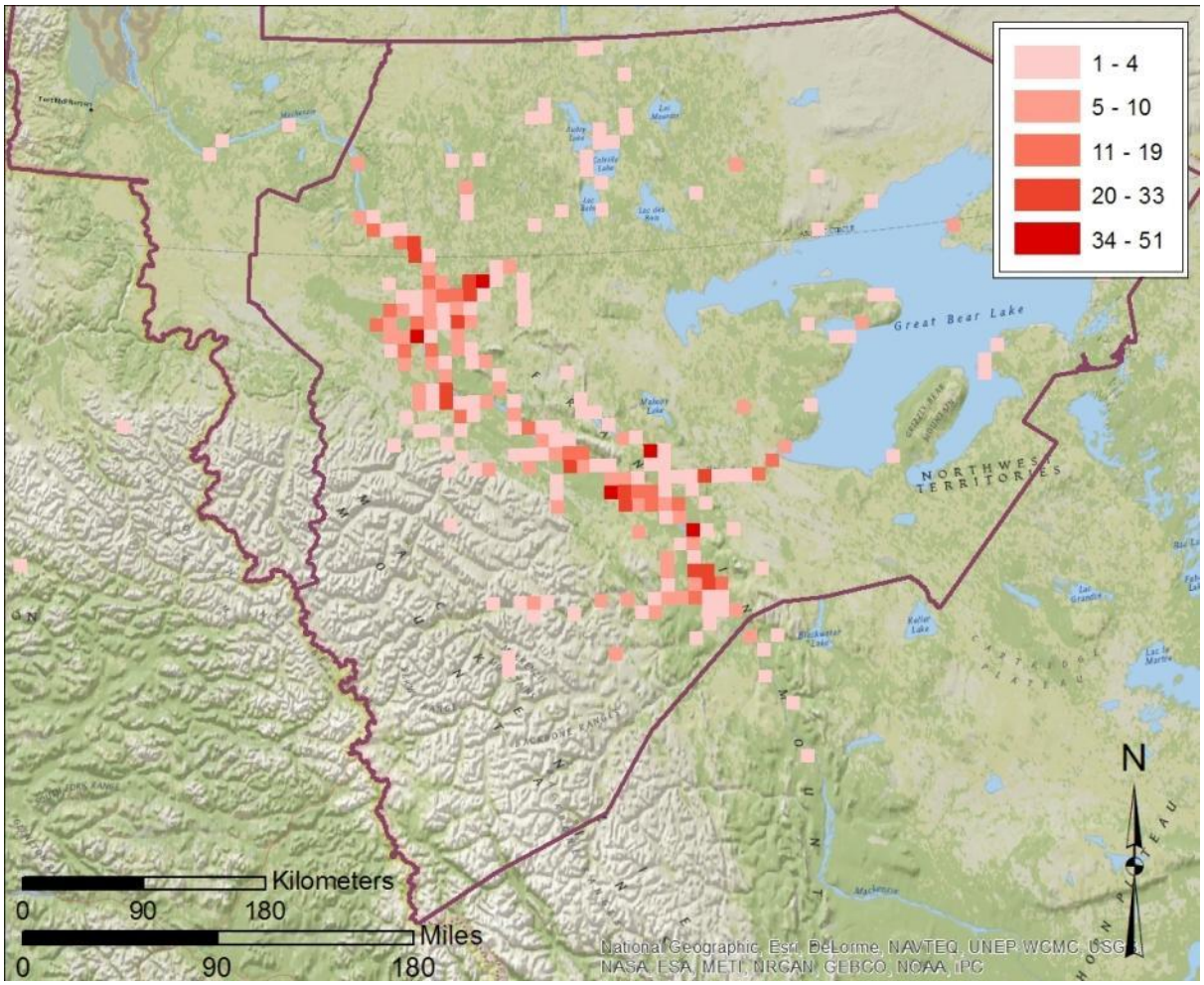

Figure 7: Locations of moose harvests in the Sahtú Settlement Area as reported by the Sahtú Settlement Harvest Study (1998-2005). This map is based on draft numbers, and does not represent the total estimated harvest of Sahtú Dene and Métis. The information on this map is confidential; do not copy or distribute. Contact the Sahtú Renewable Resources Board for conditions of use.

RECOMMENDATIONS

I. Immediate next steps: completion of the Sahtú Settlement Harvest Study

During the interviews conducted for this assessment, there was a very clear message that people would like to see the Sahtú Settlement Harvest Study completed. It is problematic to use or reference the data in its draft form, yet many consider it to be an extremely useful tool and valuable source of information to have at hand. With high response rates and good participation in the communities, as well as stringent data management protocols, the information likely has relatively good levels of reliability and accuracy. To finish the study there are three main steps: i) Preparation of a draft report; ii) Verification

of the results; and iii) Completion of the final report. Until a final report is prepared and approved, summary data can remain available to agencies on an interim basis and with appropriate disclaimers.

i) Draft report preparation

To prepare a draft results report from the Sahtú harvest study data will require a number of steps. We have briefly outlined those steps here. Appendix J includes an estimated cost for item.

Data checking

The random sample of harvest records reviewed for this assessment indicated that there are likely minimal errors in the harvest study data as entered in the database. However, further effort should be spent assessing and correcting the data before any numerical calculations are done. We recommend a minimum sample of 1000 data sheets be reviewed and checked. Depending on the outcome of that review, it is possible that more effort will need to go into data checking and correction.

Response rate calculation

Response rates can be calculated by two different means: a database developer or programmer could repair the functions in the original software so that the totals could be automated; or a database manager could extract the necessary information manually or with queries.

Calculation of total estimated harvests, Minimum Needs Levels, and variance

Once the data are cleaned and response rates determined, the total estimated harvests can be calculated. It is recommended that the board get statistical advice on all stages of this work. Because the data collection methods changed in the last two years of the study, a rationale for using or not using all years of data in calculations will need to be developed, as will the appropriate statistical analyses. The total estimated harvests can then be used to calculate Minimum Needs Levels. As outlined in the previous section, we would recommend that statistical analyses are also done to provide an indication of the margin of error, or coefficients of variation around the data.

Draft report writing

Much of what would be included in a final results report for the harvest study has already been summarized by the first Harvest study coordinator, Ed McLean. There is a detailed 'Methods Report' that has been drafted, and this could be edited and turned into a draft results report with a minimal amount of extra work.

ii) Verification of SSHS results

In the initial Methods Report prepared for the Sahtú study, there are proposed steps to be taken during the course of the SSHS to provide a 'reality check' on the data. These include getting monthly RRC input on harvest summarizes, and a comparison of the harvest data with other data sets (e.g., ENR fur export data). We would also suggest that reviews of the draft results report could provide a useful third check on the accuracy and reliability of the data. The draft harvest study results report could be submitted to the SRRB, RRCs, and relevant resource professionals for review in its entirety, and presentations of the data made to the communities in dedicated workshops. These workshops could achieve three goals:

provide an update on the work done on the harvest study to date; document feedback on the accuracy and reliability of the initial SSHS results; and provide a forum for initiating conversations around future possible harvest survey work.

While the data from the SSHS now date back 8-15 years, and many specific observations on population and/or harvesting trends for a particular year may no longer be available, it is expected that there will nonetheless be interesting community insights into both the harvest survey program as well as the data. Audio-recording the sessions would be desirable, in case very specific information is provided. This information could then be included with the final draft of the results report.

"Getting contextual information is critical and has been one of the big failings in these types of studies – they are usually just reduced to numbers, confidence intervals, etc. … Without providing this context the numbers are absolutely meaningless to community members," (Natcher pers. comm. 2012).

A similar process was undertaken by the Nunavut Wildlife Management Board at the conclusion of their harvest study – the study coordinator visited each community to present the five-year preliminary results and to obtain feedback on the results and on the study in general. The consultations were important for both promoting the study and verifying the study results. As noted earlier, feedback from the community visits and from other wildlife management organizations were detailed in a section of the final report accompanying the data tables for each community. The rationale behind the Nunavut work was detailed as follows:

> *The purpose of [the Community Results Discussion] section is to assess the strength of the data collected by the NWHS for the purpose of establishing current harvesting levels, and determining basic needs levels, as required by the NLCA. Inevitably, due to survey limitations, the harvest levels actually reported to the survey are incomplete. It is therefore necessary to estimate 'the amount harvested in any one year' (NLCA, 1993, Article 5.6.21) for the purpose of calculating a BNL, on the basis of reported harvests. It is crucial that these estimates of total harvests be credible to Inuit beneficiaries, to the NWMB, and to wildlife management agencies. This credibility depends on a clear statement of survey methods, along with an assessment of both the qualitative and statistical integrity of data (NWMB 2004:35).*

Professionals and academics interviewed during this assessment supported the idea of doing a series of community sessions to provide not just verification, but a regional context for the harvest study data.

iii) Preparation of final report

Following completion of the preceding two steps, a Sahtú harvest study final results report could be prepared. This report could include monthly and annual harvest estimates for each community and for the Sahtú Settlement Area, presented with an estimated variance and the qualitative information gained through the community sessions. There could be additional analysis of the data if comparisons to other data sets are also done.

iv) Calculation of Minimum Needs Levels

Once the harvest data have been adjusted for response rates and the annual estimated totals calculated, it is then quite straightforward to calculate 'Sahtú Minimum Needs Levels' for each species, following the formulas included in the Methods Report.

II. Considerations for a future Sahtú harvest survey

As noted above, biologists, resource managers, and past harvest study coordinators in the Sahtú stress that the data from the harvest study is very useful – the spatial data is thought to be especially valuable, even if there is some inaccuracy associated with the annual harvest totals. Spatial data are proving to be a highly effective tool for indigenous peoples in negotiation over land ownership or tenure and in resource management questions – at least in part because it means information is brought to the table in a format that is broadly understood; "Mapping is one of the most efficient ways of achieving this exchange of knowledge about the land," (Chambers *et al.* 2004:22).

"For the Sahtú, they should get the study wrapped up, then consider doing something in the near future again, and repeating it every five years – maybe in a scaled-down version. It was very expensive, and they don't have the funding like it was before, but they do need the data. ... It would be good to be selective on the species of concern – you could generate the list in the communities – and this can change over time, but have something focused like that and repeat it every few years. We need a current, ongoing database," (Popko pers. comm. 2012).

The SSHS information can be used by the RRCs and communities to demonstrate land use patterns and provide evidence of areas that are important for Sahtú Dene and Métis land use and harvesting. Some people feel it is more important than ever to have a new harvest study in the region, as development applications, proposals, and exploration reach new levels of intensity.

> *I think they should continue [the harvest study]. They should've stopped for two years, compiled the data, and continued again. It's such an important thing, but it's been such a long time. The industry's hitting us really hard now. If you start now and compare the data to the first one there will be such, <u>such</u> a change. That would be good for the RRCS to see and to wake up the communities. It will be good for the leadership to see, and for the future of the kids – compare the previous data, do at least one year or two years right now – that would show such a big difference in all the communities. Tulíta's getting the biggest impact, but Délı̨nę has its share too. People are saying they have to go such a long ways to get food; there's too much disturbance around the communities. … This kind of data can be a really important tool to explain to industry why they need to restrict some areas from development (Janet Bayha pers. comm. 2013).*

New approaches to harvest surveys are addressing some of the former weaknesses inherent in the study design of the Canada model, and data are being used in ways beyond the usual estimates of 'production' and calculations of basic needs levels. In the NWT, harvest study data have been used as a non-invasive way to track a population of animals or act as a parallel source of data to that from aerial surveys. For example, in Lutsel K'e harvest survey data showed that a decline in caribou harvesting paralleled caribou

population declines (Parlee pers. comm. 2012). However, this type of pattern or trend can only be relied upon as an indication of broader population trends when factors are not complicated by harvest limits – specific regulatory settings can complicate this relationship.

In the southern Yukon, where there are some specific conservation concerns, harvest surveys are considered the best way to get information necessary to make allocation decisions. For example, in situations where the allowable harvest may be as low as ten animals, very precise harvest numbers are necessary. The information is also necessary for sharing arrangements – allocation of a resource between First Nations requires precise numbers (Cooley pers. comm. 2012).

Collecting harvest data can be an ideal way to include and benefit from indigenous knowledge in a scientific study (Bell and Harwood 2012).

The data that results from harvest surveys is also used in valuation assessments and for compensation purposes (see Wenzel 1997), though there are various challenges associated with placing a dollar value on 'country foods'. There is a large body of literature that addresses this topic, dating back to the 1960s (see Usher 1976, Guyot 2006, among others).

It's important to point out that keeping track of harvesting information and sharing it with others is not a new concept for the Sahtú Dene. Walter Bayha remembers that when he was a child, his grandfathers regularly got together to talk about what they were harvesting, where they were harvesting, and how much they were getting; "In my grandfather's time that information was gold," (pers. comm. 2013). As a Renewable Resource Officer, Walter developed a program around the General Hunting Licence (GHL) that documented harvesters' information.

> *The licensing system expired at certain dates, so it had to be validated and you'd get a new sticker on your licence every year. That's the time we'd collect whatever the hunters would tell us. It was an opportunity – we'd sit like this and talk about how well they did and it was like what my grandfathers would do and the hunters liked it – they didn't mind me writing it down, putting a little sticker on it. People had a great time. If you can do it in a way that the people will appreciate it, it's not a problem. I really appreciated them telling me, and they appreciated me telling them what other hunters told me. Then eventually they got together and talked about what information had been shared ... (Walter Bayha, pers. comm. 2013).*

"The use of harvest data to calculate or track changes in wildlife populations is common practice in many parts of the world. It is considered one key way in which traditional ecological knowledge can inform wildlife management; indeed the number of animals harvested is a measure embedded in many indigenous resource management systems..." (Parlee pers. comm. 2012).

It was stated that the program was successful because it built on something that was already a Dene tradition – talking about harvesting and sharing harvesting information (Walter Bayha, pers. comm. 2013). Other resource managers interviewed for this project consider the decades of information documented by the GHL program to be reliable and of value. Records remain on file in ENR offices today.

In the following section, we present some considerations for a possible future harvest study in the Sahtú. We briefly describe three main aspects of a new study: i) What type of information to collect; ii)

How to collect the information; and iii) What to do with the information. The scope is too large to discuss each topic in detail as part of this assessment, but there has recently been work done in other areas that could assist the board in making these decisions. In particular, we would suggest the following four documents are consulted for further consideration of future harvest studies:

- Bell, R.K. and L.A. Harwood. 2012. Harvest-based monitoring in the Inuvialuit Settlement Region: steps for success. Arctic 46 (4): 421-432.
- Lavallée, M. 2010. Yukon First Nation wildlife harvest data collection and management: lessons learned and future steps. Contextual analysis of the wildlife harvest workshop held November 5-6, 2009, Lake Laberge, Yukon. Master's thesis. University of Saskatchewan, SK. 76 pp.
- Rettie, W. J. 2011. Porcupine Caribou Herd. A review of the design of the harvest reporting program [Report to the Senior Officials of the Parties to the Porcupine Caribou Management Agreement, included as Appendix 9 of the Harvest Management Plan for the Porcupine Caribou Herd in Canada]. 20 pp.
- Usher, P., and L. Brooke. 2001. Assessment of Options for Collecting Statistical Data on Wildlife Harvesting in Nunavut. Report prepared for Government of Nunavut. Unpublished. 64 pp.

These reports could provide a methodological framework for future harvest surveys that would produce data that would be compatible across much of the Yukon, NWT, and relevant areas of Nunavut. Each document is included in the sources provided with this report. Further information on the planning process undertaken for the new Nunavut study is detailed below.

An example from Nunavut

During the course of the Nunavut Wildlife Harvest Study it became clear that the data were anticipated to be extremely valuable for purposes other than establishing basic needs levels. Agencies and departments of the federal and territorial governments expressed interest in using the data for wildlife management, implementation of other provisions of the Nunavut Land Claim Agreement, and policy and program development purposes. Given the high level of interest in continuing some form of harvest data collection after completion of the original study, these agencies and departments of government collaborated to: develop a terms of reference; assess the scope and nature of future needs for harvest and other related data; and advise on appropriate and cost-effective methods for collecting them.

A contract was issued to interview representatives from relevant Inuit organizations, wildlife management organizations, institutions of public government and other government agencies about:

- The uses they may have for statistical data on wildlife harvesting in Nunavut on an ongoing basis (e.g. . managing specific stocks, measuring the economic value of country food, using harvest effort as a measure of cultural integrity, etc.);
-The specific types(s) of harvest data required on an ongoing basis to meet their needs;
-What commitment, both financial and administrative, they are willing to commit to a process to obtain the harvest data they require; and
-What role they feel they should play in managing a harvest data collection process.

The results of this study are available in a technical report (Usher and Brooke 2001).

While the referenced reports and publications can provide important direction in the design of a methodologically rigorous and useful harvest survey, it is most important to establish study objectives and a collaborative study design that meet the specific needs of the Sahtú Settlement Area. Accordingly, the first steps must be:

» ***Determine who the end users of the information will be, what kind of information they need, and what they will be able to contribute financially to the project;***

» ***Design the study according to three principle drivers: a participatory methodology that involves the harvesters and communities; a framework that provides for reliable data and rigorous data collection methods; and the specific information needs identified for the Sahtú.***

Conducting a comprehensive harvest survey – for example, one that attempts full census coverage for all species, provides information that is interesting and relevant to a variety of user groups, and is done over a long time – is a very expensive proposition. Invariably, compromises have to be made in order to design a study that is feasible (both logistically and financially) and will produce accurate, reliable data over the long term. There will need to be considerable effort spent in developing funding strategies for such future work, but it is not possible to explore this topic fully here.

i) What type of information to collect

As a criticism of past harvest studies has been that their focus on counting the number of harvested animals is too narrow, a future harvest study in the Sahtú could be designed with a broader scope. It can include the collection of rich, comprehensive, and contextual information. Some common topics that harvest surveys may include are:

» *Harvester demographics (ethnicity, age, gender, etc.);*
» *A measure of effort, or catch per unit effort (e.g., time and gear, plus investment or costs of harvesting);*
» *'Kill' or 'production' by species (numbers of animals struck and retrieved);*
» *Species information (age class, gender, health, disease, biological samples);*
» *Harvest locations, dates and seasons;*
» *Environmental or behavioural observations;*
» *Traditional ecological knowledge;*
» *Socio-economic data (rates and types of employment, barriers to harvesting, food-sharing and distribution networks, etc.).*

Some other topics that new harvest surveys could explore include: species population dynamics in relation to harvesting pressure; harvesting strategies in relation to resource abundance, scarcity, climate or climate change; and the historic effects of variable harvests on the social, economic and cultural life of northerners (Usher and Wenzel 1987; Snortland Pellissey pers. comm. 2012).

Because past harvest surveys have been based on biological models, they have tended to exclude social and cultural data (e.g., on sharing, use, employment, etc.). As a result, they have generally collected information that can be used by biologists to produce predation models, but have had limited use outside of that context (Parlee pers. comm. 2012). Expanding the research scope could address some of

the weaknesses identified for past harvest surveys, especially the criticism that they have mostly focussed on collecting quantitative data.

The literature review and interviews done for this assessment indicate that both northern Aboriginal and academic communities have concerns that using solely quantitative methods to estimate harvest amounts and patterns cannot account for the diverse social, cultural and spiritual values inherent in caribou and other wildlife (Parlee pers. comm. 2012).

> *As hunting, especially in Aboriginal populations, is very much a socio-cultural activity, further analysis and research should be done at the community level. As the villages, towns, and communities of the NWT continue to evolve, changes in hunting patterns will inevitably occur. An understanding of the importance of Aboriginal hunting now can only serve to aid in our understanding of it in the future* (Parlee pers. comm. 2012).

Socio-economic variables that can be considered in future harvest studies include:

- ***Employment status;***
- ***Wage rate;***
- ***Hunting technology;***
- ***Household(s) supplied;***
- ***Hunting party size;***
- ***Hunting costs subsidization;***
- ***Targetted species;***
- ***Other game seen; and***
- ***Trip expenses (Parlee pers. comm. 2012).***

Numerous academics and resource management professionals also strongly suggest that for future harvest surveys, data should be collected for every hunting trip taken, not only those that were successful. By having this information, a better understanding can be gained of hunting behaviour and effort. The information surrounding when an animal is not caught is just as important as the information about when an animal is caught, as effort and time are still being spent (Parlee pers. comm. 2012). Some researchers and resource managers would like to see harvester effort measured in some way. 'Catch per unit effort' can be a useful indicator, however, it can also be confusing to interpret. For example, some people will just hunt for four days, while others will go out and build a cabin, and hunt at the same time. Some do a variety of activities like fishing, recreation and hunting at once. A survey can capture the number of days people went out, but it may not be as straightforward or as useful as some other types of information (Veitch pers. comm. 2013).

New harvest surveys can also better represent local values by emphasizing topics such as identifying and understanding habitat issues, well-being, or food security and safety. The primary focus could shift from harvest statistics to contextual information. The same questions could still be asked, but the survey then becomes embedded in a bigger picture of what people are doing on the land (Parlee pers. comm. 2012).

> *I would like to see harvest studies be part of a larger process of engagement of people who are on the land in some of these decisions, without creating enormous bureaucracy. If you can do innovative things like a weekly call-in on the radio, together with a May Gathering or cultural equivalent, some forums of knowledgeable users, periodic surveys of harvesters, and so on. This would be a more comprehensive approach to engaging community, and exchanging information in both directions, to get at resource management* (Natcher pers. comm. 2012).

For many of the topics, the most interesting results will be seen when trends are tracked over longer periods of time. In the ISR, harvest data has been collected in several ways since the 1960s. Comparisons of the different data sets now indicate that there have been some significant shifts in harvesting patterns over the decades: total country food harvests have declined by almost half; there appears to be an increasing reliance on 'super-harvesters' amongst households; and the harvest of marine foods has declined notably – marine fish harvests are now roughly one-fourth what they were in the 1960s – but caribou harvests appear to have more than doubled in the same time frame (Usher 2002). These changes could become more pronounced with impacts of climate change, possibly requiring adaptation and compensation to reduce vulnerability (Ford *et al.* 2007; West and Ross 2011).

"If you did [a harvest survey again] now, harvest locations, distribution and numbers would be very different. The species might differ too – people used to be very reliant on the barren-ground caribou, but that's not happening as much now. That goes back to the other gap – [you need] not just numbers but locations of harvests – so you can figure out which populations are being harvested." (Popko pers. comm. 2012)

There are practical limits to how much information can be collected through a harvester survey, however. For example, long interviews increase interviewee fatigue and can discourage participation. There are also issues that arise if more sensitive topics are included (e.g., employment, wage and/or income information). The question remains:

» ***Is it possible to expand the study so that it produces reliable and accurate information on a variety of topics without jeopardizing the biological or species 'kill' data that is considered so important?***

An example from the Inuvialuit Settlement Region

Harvest studies can have much greater utility than solely providing kill statistics. Harvest-based monitoring is one such example. Several types of concerns have been raised by communities in the ISR and are addressed through harvest-based monitoring studies, including the following:

1) Concern about stock trends and abundance, and therefore, harvest sustainability;

2) Concern for species health and well-being, mainly due to changing habitats;

3) Concern regarding disturbance of fish and marine mammals by activity and its impact on subsistence harvesting opportunities and resource (food) quality; and

4) Concern about the impact of external pressures, political pressures, and scientific findings on sub-sistence lifestyles and harvesting opportunities (Bell and Harwood 2012).

However, harvest-based monitoring is only one tool, and is best used in conjunction with others; "Harvest monitoring alone, without frequent analysis and the addition of the latest local information and use of the latest scientific tools, cannot expect to contribute answers to complicated questions such as possible impacts of anthropogenic noise or global climate change on the stocks being studied," (Bell and Harwood 2012: 425).

Species Information

Of the harvest studies that have recently been initiated in the north, few (if any) attempt to collect species information as comprehensively as in past, land claim-mandated studies. Overall, territorial resource managers tend to be most interested in big game (especially moose, caribou and sheep), but the species list should also be dependent on community interests; "... it depends on the First Nation and their specific interests. Lots are interested in collecting fish and bird information; northern communities are interested in marine mammals. The methods will differ slightly for the different species," (Cooley pers. comm. 2012). The Nunavut assessment revealed the following:

> *The wildlife agencies require a core list of species for management purposes. The minimum or core list would likely include large ungulates, bears, wolves, wolverines, all marine mammals, char, trout, and waterfowl. It was suggested that harvest data might be useful in connection with the forthcoming Species at Risk Act. Although as a general principle, a mass harvest survey cannot be relied on to provide reliable data for rarely harvested species, it should be possible to obtain reliable harvest data by means of harvest surveys, for species or populations at risk that are taken in any significant numbers, as is the case with some beluga or caribou populations. Reducing the list does not provide much savings in survey time, response burden, or data input (Usher and Brooke 2001:22).*

There are arguments both for and against reducing the species list used in a harvest survey, ranging from balancing information needs against interviewee fatigue, as well as accommodating specific regional interests.

Overall, most of the people interviewed for this assessment felt that harvest data collection is not very useful in the management of small game, fish, or waterfowl. Nonetheless, important data has resulted from harvest surveys that include or focus on these species (see Berkes 1990, Natcher *et al.* 2007). In the Yukon, there is some interest amongst First Nations to record subsistence use of furbearers; this would potentially involve a different reporting method, and a study conducted in different seasons than existing programs for reporting caribou and fish harvests. The exact species of interest would depend on each community, but may include marten, lynx, beaver, wolverine, and wolves (Cooley pers. comm. 2013).

When deciding on the species to record in a survey, it is also important to consider the implications that reducing the list of species could have for interpreting the data.

> *In Alaska a few years ago, the Alaska Department of Fish and Game wanted to know about black bears, so they were going to do a black bear specific survey. The community said it was a mistake because everything is so inter-related. They said the black bear harvest was really high one year, because the salmon return failed – so more bears were coming into camps, and there were more nuisance bears because there were no fish. So if you were to look at those numbers without looking at other species you'd have a very incomplete picture. With caribou or moose, you need to know what is the relationship with wolves when the numbers are going down (Natcher pers. comm. 2012).*

Some specific considerations are outlined below by species groupings.

Wildlife – General

Additional considerations for a species list could include:

- Species at Risk;
- Species of conservation concern;
- Species of other resource management interest.

As different species are of varying interest in the communities, the species list could vary, focusing on those species that are of particular interest to each Sahtú community (e.g., it may be more important to collect information on lake trout in Délı̨nę than in Tulít'a). While this would perhaps be problematic for territorial resource managers – who prefer to be able to estimate harvests over large regions and total harvests of herds and/or populations – it would increase the likelihood that the study and results are of greater interest to the harvesters, communities, and RRCs.

In addition to recording harvest numbers and locations, other species questions could include observations about numbers of predators (e.g., asking whether numbers of wolves are increasing, the same or less); questions about snow, weather or travel conditions (e.g., freeze-thaw events); health and body condition of animals (e.g., *Are animals fat, normal or skinny?*) (see example survey form in Appendix D).

Wildlife – Big game

Another suggestion that arose during the expert interviews was to narrow the focus of a future harvest study to big game species that are important to harvesters, such as caribou (woodland and barren-ground) and moose.

> *... caribou and moose – that's certainly where we should be trying to continue getting harvest data. Thirty years ago, people used to come in to renew their harvest licence. I was an officer and had to record their harvest when they did that. Even that – an annual question to each hunter – is useful. While we didn't get every hunter, we got the primary ones. They'd also bring in fur, carcasses. We'd ask them questions and got pretty good information at zero cost... you don't need to know for every squirrel or mallard duck, but you could get these basics, focussed in on the species of management concern (Popko pers. comm. 2012).*

After the Sahtú harvest survey data collection phase was over in 2005, a harvest survey for moose was designed in Fort Good Hope with the RRC. For that study, it was proposed that ten regular moose harvesters be interviewed four times each year about their harvests and other observations (e.g., predation and snow conditions). The questions were developed in collaboration with harvesters in the community.

> *The idea was to take some of what was good with the previous harvest study and modify it a little bit. The old one was just numbers – there was nothing about the condition of the animals, etc. It was talked about by the working group and while they didn't want to add more questions, from a wildlife perspective 50 pregnant animals versus 50 skinny ones is a big difference (Veitch pers. comm. 2013).*

While the health of big game can be monitored through a harvest survey, the Community Based Wildlife Health Monitoring program does already record information on barren-ground caribou and moose health in collaboration with the Sahtú communities. In addition, if added to a harvest survey, health questions could exacerbate interviewee fatigue. Nonetheless, it could also function as a way for people to flag issues of concern. For example, if harvesters are seeing a trend, like 'moose are skinnier', it could indicate that further specific study is warranted. Harvesters could then also cooperate to provide biological samples, help design the study, and assist on further work and monitoring.

There may be some additional interest in documenting information about muskox in the Sahtú, as the increases seen in both range and numbers in the last 20-30 years is thought to be influencing caribou numbers (Veitch pers. comm. 2013).

"The [Sahtú] communities thought the study was useful, and overall, would consider a new study useful, as it's a tool. It was intended to protect harvesters and harvesting. It's pure information from the harvesters, where they're harvesting, where the animals are, etc. ENR people don't see the day to day thing the harvesters do, so that's why I think this was such an effective tool and effective study. I'm sure people would want to start it again. You could make it different, or design it for how they want it – the communities might have a better idea. ... I really do hope that they start the study again, but revamp it so it's more interesting to the harvesters," (Janet Bayha pers. comm. 2013).

Wildlife – Furbearers

There may be interest in recording furbearer harvests in the Sahtú; wolverine was mentioned in particular during the interviews. A new wolverine harvest study may show that harvest locations, and wolverine distribution and population are very different from in the past. There may also be a way to check or verify this data through ENR records.

Fish

There may also be some interest in collecting information on fish in the SSA, due to the importance of fish and fisheries issues in parts of the region. While long term studies on loche livers are ongoing in Fort Good Hope, other fish monitoring programs are more sporadic (e.g., contaminants work at Kelly Lake). Regular involvement of harvesters and reporting of fish harvests could inform this research as well as other projects, such as work underway to examine historical trends on salmon in the Mackenzie River (Popko pers. comm. 2012). However, it would be useful to try new methods to ensure greater accuracy in fish harvest reporting. In regards to fish harvests in particular, it is sometimes best to collect and assess information community by community, as averaging several communities can mask the significant differences between them (Berkes 1990).

Plants

During the past harvest study in the Sahtú, some harvesters expressed an interest in the collection of information on plant harvests – especially wood and berries.

Climate change

Climate change was also brought up as a topic that should be added to the harvest study list during the past survey. The Arctic Borderlands Ecological Knowledge Co-op (ABEKC) also documents this type of information however, so any future data collection should be developed in cooperation with that research program.

Traditional Ecological Knowledge

There is some interest in collecting traditional and ecological knowledge through a harvest survey. The new PCMB and Gwich'in studies have incorporated some questions on these topics (see example form in Appendix D). In the Sahtú, past interviewers found that many elders enjoyed the interviewer's visits and have very valuable knowledge gained over a lifetime of harvesting that they would like to pass on to younger generations. Unfortunately, due to the methods and schedule of the former study, it wasn't possible for interviewers to spend that length of time with participants and it felt like some opportunities were lost.

Sahtú species list

The species list (Appendix G) is a valuable resource which should be verified, updated and published on the SRRB website. The names should be separated by community or dialect. The species list could be used to create a poster or other product for distribution across Sahtú communities, schools, and homes. The posters could pair the names of the animals with relevant and appropriate photographs showing the animal in context, and be used as a teaching tool. It is recommended they are well-designed and eye catching to promote their use. A pronunciation guide may also be included for all dialects, or using an online format complete with audio clips (see Nuu-chah-nulth Language Project: Sea Creatures http://westcoastaquatic.ca/seacreatures/). The SRRB may wish to undertake the following steps to make full use of the species list:

-verify the species names in all appropriate dialects with speakers/linguists;
-verify the spellings, as appropriate;
-gather photographs from land-users or SRRB photo archives;
-get quotations from graphic designers and have posters or other products created;
-print and distribute to promote harvest study;
-consider online applications.

Recommendation: conduct a survey of regional resource professionals, Renewable Resource Council members, and harvesters in the Sahtú communities to determine information needs and inform what information should be collected in a future harvest study. Check the results of this survey against other research programs (e.g., ABEKC, DFO, ENR) to coordinate efforts and minimize redundancy of efforts.

ii) How to collect the information

Several of the people interviewed for this assessment gave the example of the May Gatherings held in the Northern Tutchone region of the Yukon each year as a successful model of how harvest information can be recorded, shared and used in a new way. Some of the factors that make the May Gatherings a success include:

- *The harvesters are empowered to make the decisions themselves;*
- *The process ends up being a collective agreement for how the land should be used the coming year;*
- *The regional biologist has a respectful relationship with the communities;*
- *There is intergenerational involvement; and*
- *The process is rooted in cultural traditions.*

Some of these influences are not tied to the specific methodology, and could be transposed onto other study methods in the right circumstances.

While data gathering methods depend on factors such as budget, the size of the community, and the specific information being documented, it is possible that some of the following methods would be of value, and a successful strategy may involve more than one:

- *Seasonal focus groups with small numbers of knowledgeable harvesters and community members;*
- *Annual regional meetings with harvesters, resource managers and others present;*
- *Individual or paired interviews;*
- *House to house surveys or phone surveys;*
- *Voluntary reporting using handheld devices (e.g., harvesters upload their own data to a database using a smart phone or tablet);*
- *Regular meetings and information sharing done over radio or the internet;*
- *Mail-in surveys or reporting to an office.*

"For small communities, you could get a collective group, at a strategic time of year, and go back and figure out who got what after the hunting season is over. Any indicator, if you repeat it, will show a trend – even if you only get 80% of the reported harvest, that's fine as long as you get 80% each year. The survey has to be easily repeatable. Door to door surveys are fraught with problems – they are too onerous, it's difficult to find someone in the community to do it well over the long term. They are also culturally inappropriate – there is a strong cultural component to vote against exactly what's been done in that regard. I like the 'collective guess' better," (Urquhart pers. comm. 2012).

A methodology that combines a few different ways of collecting information, and tries to target both quantitative (numbers) and qualitative (contextual) information is likely to prove more successful than past methods with a more restrictive approach. It is also likely that other suitable suggestions will come from further discussions in the communities.

A past harvest study coordinator suggested that it would be useful to have a committee of experts advise on what type of information should be collected, not just initially but on an ongoing basis. She felt that this was a weakness of the former study and it would have been beneficial to create a dialogue between this committee and the harvesters – whose feedback should have been shaping the study on a regular basis (Janet Bayha pers. comm. 2013). In addition, it was observed that if the harvesters had felt that their input was valued and did shape the study, there may have been greater participation in the program. A process like this would create a more adaptive harvest study – one more able to change

according to changing development pressures and information needs – but may also hamper the ability to establish more long term data sets.

A new harvest survey in the Sahtú could involve getting at different types of information in different ways. For example, there could be seasonal interviews done for some species like caribou and moose; small group workshops could investigate specific topics like trends in caribou health or impacts of climate change to document more TK; and there could be annual gatherings to share information and identify management priorities.

In the past, the Sahtú study was considered particularly successful in how each community had their own representative, so that communication could be in their own language, and people were known to one another. This situation – known to be comfortable for the harvesters – was thought to help encourage consistency and reporting (Janet Bayha pers. comm. 2013).

Conversely, there were also examples given from other harvest studies in which results from one community did not seem accurate. It was later revealed that because an interviewer did not feel welcome at all the households on the list, he/she approximated the harvests based on personal knowledge. It is widely acknowledged that conventional harvest survey techniques can be culturally inappropriate. Specifically, it can be uncomfortable for an interviewer to go into households and ask people to talk about things that they don't want to talk about.

Sampling strategy

Past harvest surveys relied on a census approach most often, with an objective of documenting the harvests of each eligible harvester in a community. Today, there are arguments both for and against a census-type survey, as depending on the size of the community (and other variables) it can be equally effective to record information from a selection or stratified sample of harvesters (see PCMB 2010). Calculations done on these results then enable them to be applied to a region or population. Usher and Brooke (2001) identified further considerations on how best to sample and/or stratify a harvester population, as this can be more complicated that it initially sounds. For example, someone identified as a super-harvester of one species, may not be as productive for other species. The authors point out that as a result, "... if response rates fall much below 80% there may be concerns about the adequacy of the coverage achieved, especially if reliable estimates are needed at the community... level," and "in the case of the [Inuvialuit Harvest Survey], coefficients of variation were found to exceed 33.3% in a few of the sample cases examined, a rate above which Statistics Canada does not consider data suitable for release,"(Usher and Brooke 2001: 19-20).

Some of the methods mentioned in the previous section, such as interviews with small groups of people or focus groups, can result in accurate harvest numbers when a community is small (e.g., 300 rather than 1,600 people). In small communities people generally have a good idea of what their neighbours are doing (especially in regards to large prey), but there could be some social or cultural reluctance to this method. Similar methods are being used in some areas of the Yukon where there are few resources to conduct a more comprehensive survey and there have ongoing challenges getting consistent harvest information in household surveys (Urquhart pers. comm. 2013). There, it appears that if there are a few really knowledgeable people on the land, and they know where people are spending their time, involving that select group in a harvest data collection program may be adequate. Researchers imply

that if the right people are involved in this type of process the results can be very similar to a broader survey sample.

In Carmacks, YT harvest study organizers are attempting another method in which several knowledgeable elders will be invited to small, occasional group meetings to discuss the community's moose harvest. The results of these gatherings will then be compared to those from the more intensive house to house census methods. It is expected that the meetings could produce results similar to the survey, for some species and in some circumstances, but no results are available at this time (O'Donoghue pers. comm. 2012).

Timing and duration

"There's no problem doing a one-year survey; once a month or even seasonal recall is a bit demanding on harvesters' time... you could do it once a year or even every three years. Then, you could target the survey according to specific concerns, or just do the whole thing [all species]," (Natcher pers. comm. 2012).

Most opinions on when and how long to do a harvest study for are curbed by funding realities – harvest surveys as done in the past required a lot of resources. The optimal timing and duration of a harvest survey are also influenced by the species list, as well as other external factors. Nonetheless, the value of the information is increased over a longer time – a large, long-term, and current data set is the most desirable. The SSHS data set is somewhat aged now, as data collection stopped eight years ago. In that length of time there can be large shifts in wildlife populations and ranges. For example, moose distributions can change markedly in response to forest fire, and caribou can change migration routes and seasonal habitats, meaning that what were once good areas of habitat and important areas for harvesting may no longer be.

The strength and reliability of wildlife data can also grow over time, becoming not just a way to track trends in harvesting but also possibly to monitor wildlife populations, once the data are shown to be sound. While harvest survey data may not stand alone as a sole source of data for monitoring wildlife population trends, they can be cross-checked and used alongside other data sets. Perhaps most importantly, the process can involve local users and knowledge holders in a meaningful way.

Some of the experts interviewed for this project indicated that the timing is right for re-initiating a study in the Sahtú. The results from the first study now form a useful point of reference or baseline of information and it will be interesting to compare any new data to this baseline. If a new study is started in the SSA, in the future, harvesters could comment on barriers to harvesting, information sharing, and other topics in regards to both sets of data. It was suggested that a new harvest study could be done in 'single year snapshots' (i.e., repeat the harvest study every five years) (Natcher pers. comm. 2013).

Other resource professionals agreed with this approach, indicating that it is better to have seven years of data spread out over a 20 year period than a single seven-year stretch (Veitch pers. comm. 2013). An intermittent approach could also avoid interviewee and interviewer fatigue. Because caribou population surveys are conducted every three years, it was felt there was some logic to doing the harvest survey on a similar schedule. It would be helpful for resource managers to know the numbers of caribou being removed from the population around the years they are able to estimate the recruitment to the population. One possible challenge identified with a three year schedule is that it would be most likely

that the community interviewer and coordinator would be different people each time (Veitch pers. comm. 2013).

Another consideration for the timing and/or duration of a harvest study is the use of the estimates for compensation purposes. The requirement for doing Minimum Needs Level (MNL) calculations can be met with the 1998-2003 data, but more current harvest estimates could be useful in the case of assessing the impacts of development as well as supporting or countering the earlier data. It is felt that a weakness of the MNL is that it is a static figure. It would be better if understandings of the MNL incorporated a greater degree of flexibility. For example, the MNL should change according to population, who the hunters are feeding, and with wildlife changes. There could be two options in this regard: a static MNL versus a rolling five year average. It was suggested that the average is better, but requires continuous data collection. Situations in the Yukon were cited in which community growth is also complicating the scenario, and the best thing to accommodate changing needs levels is this type of rolling average – a strong argument for continuing to collect harvest information over the long term (Urquhart pers. comm. 2012).

Seasonal data collection

According to past harvest study coordinator Janet Bayha, a continuing challenge in a new SSHS would likely be reporting problems related to recall failure. She suggested that a harvest survey done on a seasonal instead of monthly basis, timed to harvesters' activities on the land, might be a better approach. Some of the main seasonal patterns are seen around fall hunts, fish runs, and waterfowl migrations, when harvesters may go out on the land for two to three months at a time. She said it is important to get harvesters at that point, when they have been very active and remember everything accurately (Janet Bayha pers. comm. 2013).

> ***"[The SRRB] could have an intensive harvest study conducted every five years to inform a 'rolling' Basic Needs Level. There's no balance in nature; everything's fluctuating all the time, so we need adaptive management," (Popko pers. comm. 2012).***

Bayha also said that when she worked on the SSHS, she saw regular seasonal 'spikes' in the data – for example, people will get 10-30 geese when they migrate through – then for the rest of the year harvests for those species will be close to zero. She mentioned these patterns for waterfowl, fish, caribou and moose in particular, and noted that furbearers like mink and marten are only harvested during the winter months. Based on these observations, she felt it was not beneficial to ask about those species in the other seasons, and suggested that the species list could change with the seasons (Janet Bayha pers. comm. 2013).

Spatial data or scale

The level of detail used to record harvest locations can be contentious – biologists generally want to know spot locations of harvests, but harvesters prefer more vague references. In the Yukon and in other areas, there remains an "enduring conflict between the level of detail you think you want versus the level people are willing to divulge, versus what you really need," (Urquhart pers. comm. 2012).

For the initial SSHS, a 10 x 10 km grid was used for all species other than fish; fish harvests were reported using a 2 x 2 km grid. Resource managers indicated that this scale generally met their needs, and struck a balance with what harvesters seemed to be comfortable with (i.e., pointing out a grid block for their harvest, rather than giving a more accurate coordinate). There are circumstances in which more

precise spatial data are desirable, such as in considering the location of an all-weather road, but no real problems were identified with this system during this assessment, and it would likely be an appropriate scale at which to collect information in future survey work.

There are concerns about publishing some harvest locations however. Resource managers in both the Yukon and NWT said that one of the worst problems with security around harvest data is its publication in government documents. They said that the problem is that hunters are mobile and are attracted to areas that show a large harvest – they will drive 200-300 km if it looks like hunting is good in another area. As a result, "it is not in the best interests of local people to show that they're doing well with hunting in a certain area, as this invites outsiders to compete with them," (Urquhart pers. comm. 2012).

In the NWT, ENR Wildlife Management Supervisor Richard Popko says he has become hesitant to put a dot on a map that will be public. He cited the example of their long-term Dall sheep study area; once an article was published in the local paper about the field survey, seven rams were shot in the area the following summer. In the preceding year, the harvest for the entire NWT was less than five. Popko has become very cautious about publicizing point data as a consequence; detailed information such as satellite collar data is no longer released to the public (Popko pers. comm. 2012).

"The level of detail (10 km^2 grid) provided by the current NWHS system of geographical location of kills appears to be satisfactory to all parties. Only fishing locations might require greater detail, where there could be confusion between bodies of water (and hence possibly fish stocks) within a grid square. For critical fisheries, this more detailed information can be obtained on a case by case basis, or by specific monitoring program," (Usher and Brooke 2001: 24).

Communication and study promotion

The success of harvest surveys is highly dependent on communication and education about the study and why it is being done. Meaningful collaboration with harvesters and good trust go a long way to ensure a study's success. It is often found that when a lot of effort is put into pre-survey visits and promotion to explain that it is the communities' data, people are more inclined to participate. Nonetheless, even truly collaborative projects require fairly high continual investments in promotion.

Lessons in new modes of communication can be learned from recent projects in Alaska, Nunavut and the Yukon (see PCMB harvest survey materials, Yukon River Drainage Fisheries Association newsletter 2012, and Wolfe *et al.* 2011). Study promotion has now expanded well beyond promotional materials such as newsletters and harvest calendars, and includes regular radio broadcasts, podcasts, and various ways of networking through social media. However, there are still many improvements that could be made in communicating the results back to the communities and the harvesters.

Harvest study experts indicate that incentives to participate have been more successful than dis-incentives for poor cooperation – the message being that voluntary participation and empowerment result in better information than stiff penalties and coercion. There are lessons to be learned from the past harvest study in the Sahtú – for example, both the study calendar and the prizes were really popular. There was also a contest for harvest photos in the community and in the school; "Something that the communities really liked was all the pictures and how we involved the children in the school.

That was a good thing too... the bad thing is we didn't do lots of feedback to the communities; we should've had more feedback to the communities," (Janet Bayha pers. comm. 2013).

Two-way communication between harvesters participating in the study and those compiling the data could be improved through other events like harvester lunches. Inviting harvesters, youths and elders to an event such as an appreciation lunch would also enable some of the intergenerational information-sharing that there was never time to incorporate during the past study.

> *Community feedback and interaction are really important. If it was one of [the harvester's] changes that would be adopted, then their interest would be held. Maybe they had a better idea than we did, of how to do it, but we didn't know because we didn't have their feedback. We took their comments, but they'd talk a lot when we'd go visit them – information on what animal, why they come around, what time – that's what they want us to share with the school kids, how to respect animals, etc. All that stuff should've been recorded. You could have monthly interviews, then quarterly feedback to the communities and connect the findings – ask them what they want them to be used for, what to do, what to collect. Show the data for the months, talk to them about why this happened, why there was a spike or a downfall, link some stories to it … and it's coming from each community. It would be so unique if we put it into a book and gave it to the schools for their studies and research – a product from the communities would be very interesting for the schools (Janet Bayha pers. comm. 2013).*

There were also suggestions that it would be useful to coordinate workshops on good harvesting practices, or events such as tournaments – to get people to sight their rifles accurately, use good firearm techniques, and improve their butchering skills. There are indications that wounding loss is a significant issue – it is thought that many animals are being crippled and wounded through poor practices – and hunter education is an important means of addressing that source of mortality. This issue is not restricted to the Sahtú, and there have been more conservation education programs in the past. A desire was expressed to re-establish those programs to reduce wounding loss, especially for young hunters; "We need to get the good hunters involved with the department in promoting respect for wildlife, to do it right, to not be wasteful, to only take what you need," (Popko pers. comm. 2012).

> *Recommendation: review harvest study protocols as laid out in Usher and Brooke 2001, Bell and Harwood 2012, and Rettie 2011 (in PCMB 2010). Design new work based on those suggestions, but adapt to incorporate specific needs identified in collaborative process (e.g., consult potential Sahtú harvest survey participants to determine effective and more culturally-appropriate ways of collecting information). Once a realistic survey frame or population to sample is decided upon, consult with statisticians for advice on whether that survey will produce accurate and reliable results and what type of calculations can be done with those results. A statistician's opinion on the survey design will ensure the study is rigorous enough to meet future information needs. StatsCan can provide this type of advice for harvest surveys and have a published manual on survey techniques (see Statistics Canada 2010 for an introduction to survey methods).*
>
> *During RRC and community consultations to develop the study design, the SRRB should also consider reviewing or developing further data-sharing agreements and protocol in collaboration with community organizations and harvesters. For example, it may be necessary to develop specific policies in regards to sharing spatial data for sensitive topics, such as big game species. Communities could provide advice on what level of 'buffering' is appropriate for sensitive data. It*

would be advisable to develop a standard written disclaimer to use on all maps containing SSHS spatial data. Due to the information management system construction, the spatial data will not be adjusted for participation or response rates in the communities, meaning that harvest estimates will remain draft in the future, and do not represent total estimated harvests in the region. This needs to be clear in all publications of mapped data. Alternately, the board could get advice on how the spatial data could be adjusted to reflect total estimated harvests, once those calculations are complete.

iii) What to do with the information: managing, storing, sharing and using data

A continuing challenge with long-term data sets such as those resulting from harvest surveys is that the data need to be stored over many years and endure many software changes. There are accounts of data being difficult to retrieve or even lost due to a lack of system maintenance and upgrading. As a result, the information storage (i.e., database management system) for a new harvest survey should be considered early on in the project design phase. Currently, there are new databases under construction by the PCMB and the NWMB. The NWMB is planning a multi-user database of some type with restricted access – the program might involve both hand-held devices as well as kiosks for inputting information, but no further details were available at the time of writing. The PCMB has contracted a custom database as well. Either of these data models may suit the SRRB's specific information storage and access needs in the future and may become available for use depending on specific licensing or proprietary arrangements.

Other communities (e.g., in the Yukon) are using on-line databases, with appropriate access restrictions, to store harvest data and other land-use information. This allows easy access for managers with the benefit of a single storage component for the data. Data management is also streamlined. However, the cost for hosting and management must be weighed against increased ease of use. Online database availability also fits well with mobile data-gathering, as described above (i.e., with the use of smart phones or tablets for hunters to input data). Past harvest data collection programs have often used 'Filemaker' for data storage, and there are researchers that continue to promote using user-friendly Filemaker systems for communities to enter and query data, as well as run preliminary results summaries (Natcher pers. comm. 2012).

Any future harvest survey in the Sahtú will need a new information storage system; much could be learned from recent research and development done as part of other studies. It would also be useful to explore whether the existing SSHS data could be extracted from the HarStudy database and included along with any new data. To ensure that the existing harvest study information remains current and accessible in the database, a software package including the appropriate files and a plain-language instruction sheet should be created with a copy of the database, and kept together near the original database. The original database should have a README file describing the file type and with indications of how to use the copy. The original database should be updated every three to five years to prevent file type obsolescence, but should not be accessible otherwise to the casual user. Data entry, including the addition of harvest estimates based on response rates, should only be undertaken with a copy of the database. Once a wave of data entry is complete, the database should be inspected prior to the archiving of the previous master file and switch to the new file. To ensure data integrity, the data entry process should be overseen by a qualified database developer.

The HARVEST_LOCATION_NAME table has place names associated with any particular grid block. Most grid blocks do not have any names. It is unclear where the names came from, but possible sources include National Topographic System GIS data using a spatial join, or other traditional/local place names projects or maps. These names are variably separated by commas and semi-colons. The spelling of both local and Dene language names likely needs updating, if these names will ever be of use. Capitalization is also inconsistent, and it appears that a standard Athapaskan orthography was not used. The names may have only been used during the data entry process to assist the data entry team. Unless the names are verified, it is recommended that these names are not used for other purposes. It does not appear that legacy eight-bit fonts such as Win-Mac or Vowel-First Dene are used in this table, however, they appear to be used in other related documents such as reports. The use of these fonts means that any Dene language place names or other Dene language words will be unreadable in the near future. All files with legacy fonts that are worth keeping /archiving should be transliterated.

Comparisons to other data sets

There are suggestions that harvest survey data – no matter how well the study is designed – will remain challenged by some level of inherent weaknesses in regards to reliability and accuracy. One solution is to develop a 'correction factor' based on independent samples from the same population. While this may not always be feasible, some of the new and emerging studies are currently attempting this, and/or building a 'test' or comparison to other data sets into their methodology. For example, in the PCMB study, secondary data sets from field officer inspections and check stations along the Dempster Highway are used to provide a level of verification of the harvest data. This information cannot yet be used to calculate a correction factor, but nonetheless provides a useful 'check' on the harvest information reported to the study.

Other NWT data sets that could potentially be used for comparisons with Sahtú harvest study data include the Canadian Wildlife Service migratory bird survey, resident hunter harvest surveys, fur export records, past harvesting records, and/or the results from carcass collection programs.

Current and future use of SSHS information

As noted above, estimated total harvests have not been calculated from the harvests reported to the Sahtú Harvest Study for any species. To date, only spatial data and bi-annual reports containing reported harvest numbers have been available. Nonetheless, the results have already proved useful in several applications. Here, we give examples of how the Sahtú harvest study data set has been used by three different user groups – Environment and Natural Resources biologists, Sahtú Land Use Planning Board staff, and academics at the University of Calgary. Currently, the sharing of data from the Sahtú harvest study is limited through a data-sharing agreement. Requests to share data are handled by the SRRB on a case-by-case basis. A revised data-sharing agreement was drafted and piloted in 2012-2013. The form is considered suitable for SRRB needs at this time (see Appendix I).

Environment and Natural Resources, GNWT

ENR biologists are likely the professionals most familiar with the Sahtú harvest study data set. In particular, they have been using the data for big game like caribou and moose to inform decision-making. According to biologists and resource managers, the spatial aspect of the harvest study data is important. They report that the harvest location information has been the most enlightening from a wildlife management perspective. While acknowledging inaccuracies, they say that the numbers can still indicate very important patterns both in harvesting and animal distribution when considered in

relation to each other. For example, a particular location that consistently has high moose harvests every year can indicate a 'hotspot' when compared to areas with few to no harvests, whether or not there is an order of magnitude error in the data set (see Figure 7). This information is then useful if facing a development application such as a road.

> *I used the harvest location information year after year. For example, if one square is showing about 50 moose harvested, well, that could be 40 moose or it could be 60 moose – we don't know – but it is still an important area. When they're constructing an access road, the first place I would go is to get the GIS analyst to show me the moose harvests in that area. While the absolute number could be out, people were quite good with where they were harvesting, so after seven years we're able to pick out where the hotspots are (Veitch pers. comm. 2013).*

The harvest study numbers were also indicative of other trends in harvesting, such as the age or sex of caribou being harvested. Resource managers find this type of information very useful in regulatory settings, and it is not provided by any other sources of data in the Sahtú area at this point in time.

Recent work incorporating harvest data and population data in modelling indicates that in the future, biologists may be able to use past harvest information to model historic population levels – providing a better understanding of long term population trends. For example, in the Yukon there is an attempt being made to relate harvest information to the distribution of caribou, using data was reported to the Arctic Borderlands Ecological Knowledge Co-op program, plus the radio collar data. Researchers are trying to make a link with the harvest level in the community and where the caribou are. There are ideas that it may be possible to then cast that backwards to historic distribution, to try to get a better understanding on the years for which there is no data (Cooley pers. comm. 2012; see also Sutherland 2005 and Anadón *et al.* 2008).

It is expected that there is some inaccuracy in the actual harvest numbers reported to the Sahtú harvest study – this is common for this type of survey. However, resource managers feel that the data can still show relative numbers, as well as important harvesting distribution patterns in the mapped data.

Also in the Yukon, the harvest data collection program is attempting to build in options for First Nations to look at things such as harvesting effort, body condition, monitoring, important travel routes, and land use areas. A harvest study database that includes this type of information, used in conjunction with a land registry, can be even more useful in the review of land assessments and applications in the future.

Sahtú Land Use Planning Board

The Sahtú Land Use Planning Board (SLUPB) is mandated to develop and implement a land use plan for the SSA. Protecting lands used for harvesting is an important component of the plan and the Sahtú harvest study data has been used extensively in plan development. Many draft maps made to assist with the land use planning process and containing Sahtú harvest study data are located on the SLUPB website (http://www.Sahtúlanduseplan.org/website/web-content/index.html). An example from that site, showing barren-ground caribou habitat and harvesting areas is included in Figure 8 on the following page.

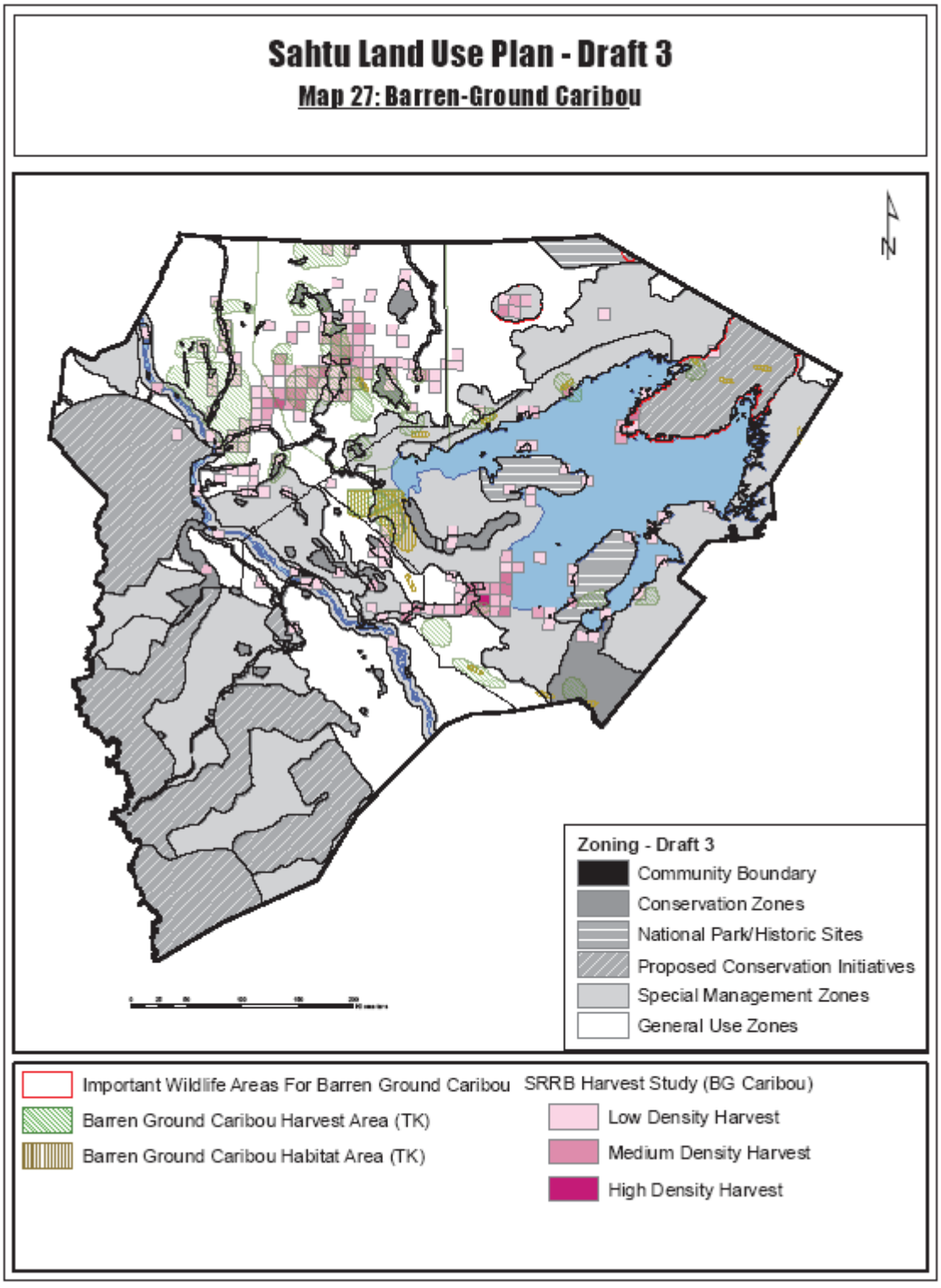

Figure 8: Map showing barren-ground caribou habitat and data from the Sahtú harvest study. Downloaded from the SLUPB website http://www.Sahtúlanduseplan.org/website/web-content/index.html.

University of Alberta

In 2009 a team from the University of Alberta (UA) partnered with the SRRB to look at the caribou and moose data from the SSHS in novel ways (Parlee pers. comm. 2012). As part of this work, harvest data from the Sahtú was analyzed to learn more about patterns of harvest, particularly for barren-ground caribou (Bluenose-West, Bluenose-East and Cape Bathurst herds). The researchers looked into three main questions for the 1998-2005 period of the Sahtú harvest study:

- *If caribou declined during the time of the harvest study, did harvests decline at the same rate?*
- *If caribou harvest is declining, are people hunting other species?*
- *With increased wage employment, are people hunting less?*

Data on the quantity, location and number of hunting days (harvest effort) was analyzed to understand more about the extent to which harvesters and/or households substituted for other kinds of traditional foods (e.g., moose and fish) during times when fewer caribou were harvested. The integration of other socio-economic data from the region into the analysis was part of an effort to explore patterns between harvesting and employment status, weather conditions (temperature), and population and mobility. A summary of the draft results of the analysis is presented here, however, the information is not finalized but currently in preparation for publication.

Hunting Trends

Hunting trip information for each Sahtú community was assessed to determine if there were any trends or changes over the years the data were collected. Table 2 includes some descriptive statistics about big game hunting trips. It shows that the average number of days spent on the land was five, with some trips as long as 31 days. The data indicate that trips were widely varied in their duration, purpose, and the amount of meat obtained. Out of three different meat sources reviewed, hunters spent the most time pursuing barren-ground caribou. Overall, the initial analysis showed that the number of days spent on the land per harvested animal appeared to be decreasing over time. This means that hunters are taking less time to achieve the same harvest levels.

Table 2: Descriptive statistics for big game hunting in the Sahtú data set (information provided by Parlee pers. comm. 2012).

	Average # of trips	Min	Max
Days on Land	5.0	1	31
Number of Harvested Animals	3.0	1	30
Distance Travelled (km)	55.9	1	603
Number Harvested/Number of Days on the Land	1.6	0.03	20

Proportional harvests – big game

The University of Alberta researchers also assessed the relative proportion of big game species (woodland caribou, barren-ground caribou, and moose) (Figure 9). The vast majority of big game species hunted were barren-ground caribou, which fluctuated between less than 80% of the hunt to more than 90%. It is important to note that the results presented here are not adjusted for response rates (i.e., they are not estimated total harvests for the Sahtú, but only the number of harvests reported to the study) and are therefore likely to underestimate the total harvest in the SSA.

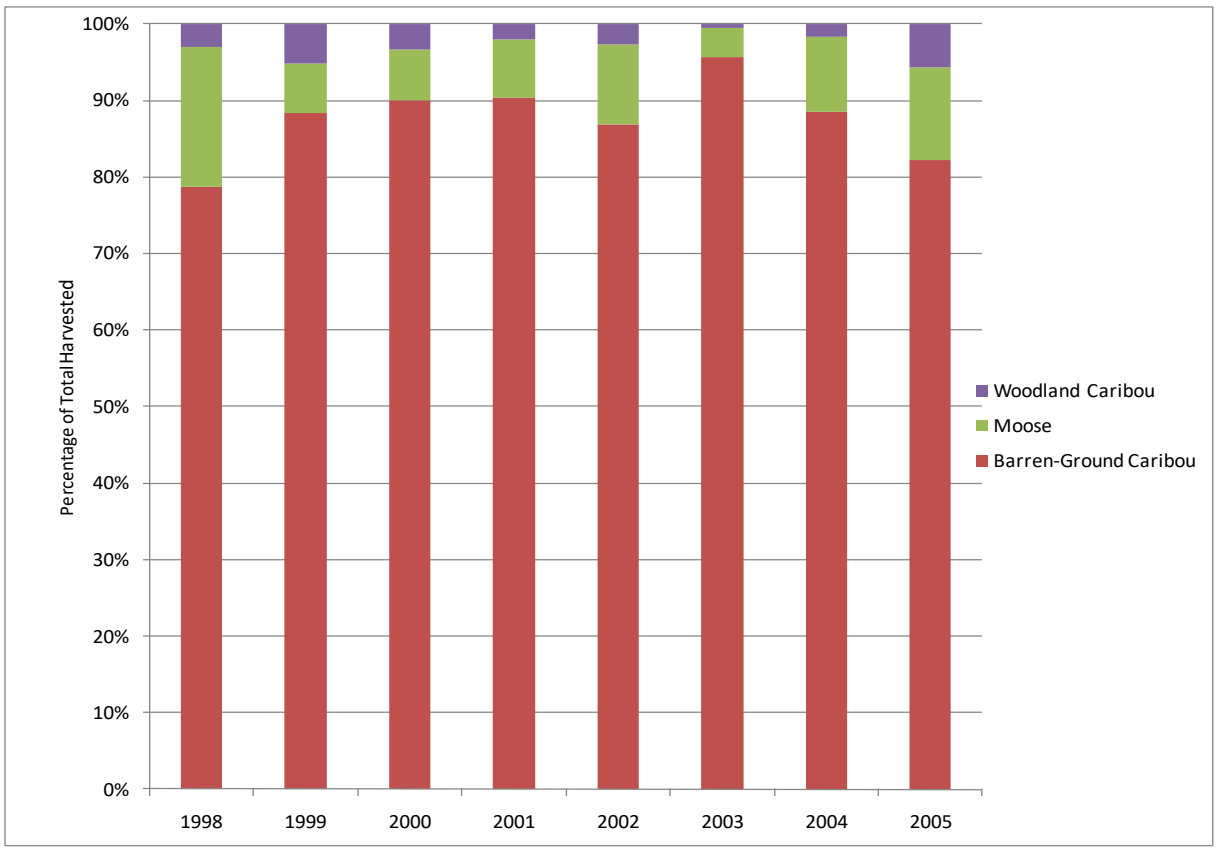

Figure 9: Proportional harvests of three big game species (moose, woodland caribou, barren-ground caribou) reported to the Sahtú harvest study, 1998-2005. The reported harvests are draft and have not been adjusted for response rate. They do not represent the total harvest by Sahtú Dene and Métis during the period of the harvest study.

Impacts of external variables – climate, population, wage employment

The UA researchers hypothesized that many factors likely influence harvester behaviour and success. For example, climatic factors are thought to influence caribou population dynamics and range as well as the capacity of harvesters to travel long distances safely. The UA team correlated the average number of days on the land and temperature (from a federal government temperature data set), but found no visible patterns that were attributable to the weather.

Two other factors potentially having a large impact on harvest activities are community population and the wage rate. Mineral exploration as well as oil and gas exploration was significant during the study period, and it was suspected that both the number of harvesters and the amount of time harvesters have to allocate toward harvesting would be affected. Statistics for the community of Délı̨nę were assessed by the UA team to determine if any pattern was noticeable (Figure 10).[3]

The assessment found that most wage rates remained at around the same level or increased over the duration of the SSHS, and population did vary between communities. No visible relationship was found between the amount of hunting and those two variables.

[3] Wage rates for the community of Colville Lake were not available as Statistics Canada suppresses data where less than 250 people reside.

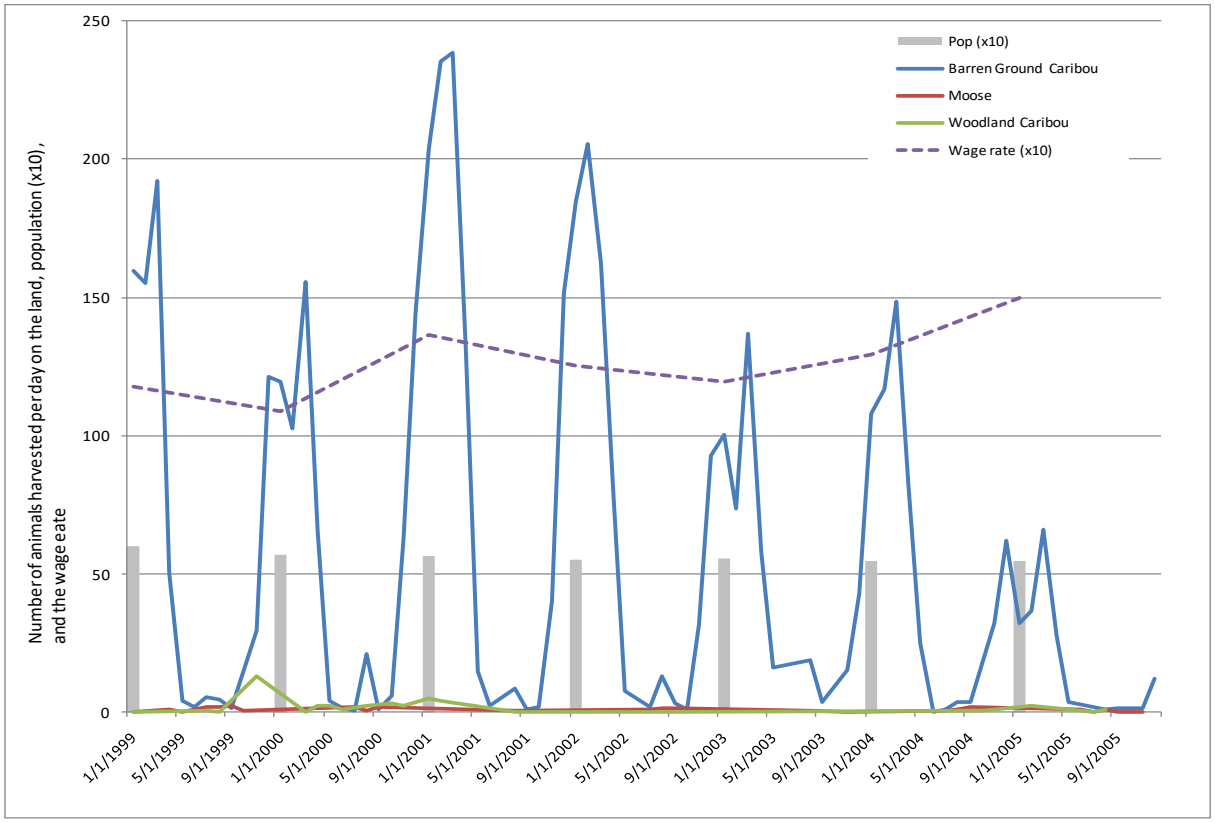

Figure 10: Trend of number of days on land per harvested animal, the population in tens of people, and the wage rate in tens of dollars for the community of Délı̨nę.

UA Summary

Overall, the analysis by the University of Alberta team revealed few to no patterns between harvesting in the Sahtú data set and the chosen variables. It did appear that the average number of days spent on the land per animal decreased for three of the five communities. However, as no statistical analysis was done, it is not known whether this change is significant. Researchers concluded that the number of animals harvested decreased over the period on which the analysis was based. Again, because finalized numbers were not used (i.e., harvest levels adjusted for response rates); because no measure of error or level of confidence is provided for the harvest levels; and because no statistical analyses were done, these conclusions should only be considered preliminary. They should also be considered in the context of the longer trends in caribou abundance and harvesting discussed earlier and indicated in Figure 4.

Ideas for further use of harvest study data

The preceding examples from ENR, the SLUPB, and the University of Alberta were intended to help explore the idea of potential uses for harvest study data, as future use of both the harvest study tabular and spatial datasets will only be limited by the type of information collected. With just the existing information already housed in the SSHS database, an interactive map product could be created to look at changes in hunting patterns in relation to, for example, road development and use, hunting patterns,

and technology change. Much more complex questions could be asked of the existing data than have been to date (see example questions in ***Data management system and GIS*** section of this report).

With both the historic data set and a new or current data set gathered ten years later, there are many additional topics that could be examined. During the interviews conducted for this assessment, some interest was expressed in other possible uses of the data including the following:

- *Harvester demographics (What is happening with the average age of harvesters today? Are more or less youth involved in these activities than in the past?)*
- *Household statistics (Are there more or less households that participate today? What are the quantities of food like?)*
- *Species information and monitoring (Are there changing observations of behavior, abundance and/or health?)*
- *Assessment of animal's characteristics such as sex or age*
- *Assessments of effort (Does it take more or less time to harvest animals now? Are people having to travel further to harvest in certain years or at certain times of the year?)*
- *Assessments by game management zones, herd ranges, or bioregions*
- *Assessment of distribution of harvesting vs. known distribution of herds*
- *Assessment of average distances travelled for harvesting main species like caribou*
- *Assessment of community use of regions and species (Which areas are important to harvesters from Colville Lake? Where do people from Délı̨nę hunt? What species are harvested most by the different communities? Has this changed over time?)*
- *Assessment of use of areas or resources by age and gender (Are there differences between where and what different age groups or genders harvest?)*
- *Assessments of hunting patterns (Are peoples' hunting patterns changing? What are some of the external driving factors, such as fuel prices, changes in technology, or levels of development?)*
- *Mapping of resource use by season.*

Recommendation: Consult with other agencies currently conducting harvest studies for advice and potential sharing arrangements for recently developed software and information management systems. Explore avenues for importing existing data from the HarStudy database into a new information management system. Identify all possible user groups with interest in the data (e.g., SRRB, RRCs, ENR, DFO, Canadian Wildlife Service, SLUPB, etc.) to explore future potential data uses.

CONCLUSIONS

This review and assessment of the Sahtú harvest study indicates the following:

- The SSHS was conducted using methods that were appropriate for this type of work at the time the study was conducted;
- The study was planned and carried out carefully, in a manner that would produce results that are at least as reliable and accurate as other studies done in the north during that time frame;
- No major problems with the study methods or resulting information are expected;

- The study, as outlined in the Sahtú and Dene Land Claim Agreement (1993), remains incomplete: no total estimated harvests have been calculated, nor have the Minimum Needs Levels been estimated for any species;
- The information resulting from the SSHS can be strengthened by the application of statistics, community input, and comparisons to other data sets;
- There is interest in conducting further harvest survey work to meet continuing information needs in the Sahtú;
- Current harvest surveys are using a combination of new and different methods and are collecting a wider diversity of information than past models. As a result, potential future information uses are broader than previous work could enable;
- To ensure local relevance and interest, the design of a future harvest survey should be developed in collaboration with harvesters, communities and other potential user groups with an interest in using the information.

Many of the challenges or weaknesses identified for harvest surveys in this report are likely going to continue to be difficult to resolve in any future work, such as: accuracy and reliability (the methods need to be repeatable and reliable, but can never provide a complete picture of all harvesting); longevity (the data set is never complete but is improved over the length of time the work is conducted); interviewee fatigue (providing information is always a burden, at least in part); response bias and non-response bias; under-estimates of total mortality (e.g., due to wounding loss), and so on. Nonetheless, as long as the limitations of this type of work are recognized openly, experts indicate that the information will continue to be important and of value.

Based on these conclusions, we recommend that the Board arrange for the completion of the study as outlined in this report, and that they initiate a dialogue in the communities about future harvest study project planning.

ACKNOWLEDGEMENTS

We would like to express our appreciation to each of the harvest study experts interviewed for this project. Their time and interest was greatly valued, and their information forms the backbone of this report.

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APPENDIX A – SCOPE OF WORK

At the initiation of the project, the contractors met with the executive director of the Sahtú Renewable Resources Board via teleconference to clarify the scope and objective of this review and assessment. An initial scope of work was agreed upon, recognizing that later tasks in the scope were dependent upon findings of earlier stages of the review, and that a large degree of flexibility would need to be built into the study protocol. Regular communications – via email and teleconference – were maintained between the contractors and the executive director as the project progressed. The original scope of work included the following:

1. Literature review: research and review past and present standards for harvest studies, and indicate how the Sahtú harvest study methods compare to other methodologies. Research best practices, determine if best practice documents exist. Create if required. Review how harvest studies have been used outside of land claim context.
2. Interviews: engage relevant persons in both the participating communities and the academic community for input on the strengths, challenges and weaknesses of the Sahtú harvest study. Ms. Winbourne will conduct interviews with agencies and academic experts. SRRB will co-ordinate interviews with community members that either worked on the harvest study or were involved at some level, including some interviewers and RRC members. Necessary steps include:
    a. Develop interview materials and methodology with SRRB
    b. Develop interview list with SRRB
    c. Conduct 12-15 semi-structured interviews over the phone or in person using a short survey questionnaire and compiling results in notes only (note that time estimates presented here exclude SRRB's work.) Conduct 2-3 in-depth, longer interviews with key personnel.
3. Information compilation: review, assess and compile information resulting from Tasks 1 and 2.
4. Analysis of GIS data:
    a. Assess data structure and management system and compare with modern standards
    b. Assess accuracy of digitized spatial results, and if time permits, correct minor digitizing issues
    c. Assess cleanliness of data (e.g. projection, topology, etc.)
    d. Assess data integrity
    e. Make management suggestions and proposals for future work based on this analysis.
5. Analysis of harvest study data:
    a. Assess accuracy of data entered in database by reviewing a sub-sample of interviews in comparison with database records
    b. Assess readiness or state of data for use
    c. Assess data integrity (e.g. response rate by community, impressions of interviewers, etc.)
    d. Make management suggestions and proposals for future work based on this analysis.
    e. If time permits, assess and clean data for moose and caribou, and pilot ways to use moose and caribou harvest data.
6. Prepare recommendations related to the Sahtú harvest study based on preceding 5 Tasks:
    a. Indicate the strengths and weaknesses of the existing methods and data, for future use of the information in resource management

   b. Indicate what, if any, work needs to be completed to ready the data for use
   c. Provide an indication as to the value of this type of information for resource management
   d. Make management suggestions and proposals for future work based on this analysis.

7. Work with the SRRB to assess previous protocols relating to access to information requests (such as data-sharing agreements and requests for spatial data), and make suggestions for handling future requests.

8. Prepare two deliverables: a technical report for managers, and a plain language booklet for participating communities, aimed at RRCs. *[Note: during the course of the project, this task was modified to include a single comprehensive report]*

9. Presentation to board via telephone in February, have monthly check-in teleconferences with SRRB.

While the initial scope of work proposed doing several interviews with former Sahtú harvest study interviewers from each community, during the course of the work it was decided to not do these interviews for two reasons: 1) a series of community workshops to verify the SSHS data are proposed that can serve as a more thorough documentation of this information; and 2) there was not enough time remaining in the contract to complete all of the required tasks. Fostering dialogue in the communities about the harvest study, and providing an opportunity for harvester feedback is considered a top priority for future work. The proposed community workshops are detailed more in the ***Recommendations*** section of this report.

APPENDIX B – LIST OF EXPERTS INTERVIEWED FOR THIS ASSESSMENT

Janet Bayha, former Sahtú Settlement Harvest Study Coordinator, Tulít'a, NWT

Walter Bayha, former member of Sahtú Harvest Study Working Group; Sahtú Renewable Resources Board Member, Délı̨nę, NWT

Dorothy Cooley, Harvest Coordinator, Yukon Environment, YTG, Whitehorse, YT

David Natcher, Director, Indigenous Land Management Institute, University of Saskatchewan, Saskatoon, SK

Mark O'Donoghue, Northern Tutchone Regional Biologist, YTG, Whitehorse, YT

Brenda Parlee, Assistant Professor of Resource Economics and Environmental Sociology, and Native Studies Faculty, University of Alberta, Calgary, AB

Richard Popko, Wildlife Management Supervisor, ENR, Sahtú Region, GNWT

Jody Snortland Pellissey, former Sahtú Settlement Harvest Study Coordinator, Yellowknife, NWT

Doug Urquhart, Independent Consultant – facilitates May Gatherings, YT

Alasdair Veitch, former Wildlife Management Supervisor, ENR, Sahtú Region; former Sahtú Harvest Study Working Group member; former Sahtú GIS Project Supervisor; retired certified biologist

Additional contacts:

Kristen Callaghan, Biologist, Gwich'in Renewable Resources Board, Inuvik, NWT

Deborah Simmons, Executive Director, Sahtú Renewable Resources Board, Tulít'a, NWT

Calvin Pittet, Sahtú Settlement Harvest Study database developer, GNWT

Ian McDonald, former Gwich'in Harvest Study Coordinator and author of Gwich'in Harvest Study Final Report, Whitehorse, YT

Sarah Spencer, Terrestrial Wildlife Management Biologist, Nunavut Wildlife Management Board, Iqaluit, NU

APPENDIX C – GENERIC QUESTIONNAIRE USED FOR EXPERT INTERVIEWS

1. Harvest studies – past and present

- Can you tell me what kind of harvest data has been collected in your area in the past and if there is any being collected today?
- What species?
- What kind of spatial information?
- What methods? (e.g., census vs sample of population? Door to door monthly interviews? Focus groups? Mail-in surveys? etc.)

2. Strengths and weaknesses

- Can you describe the main successes and challenges you've encountered with this methodology and with your studies in particular?
- What worked well and didn't work well?
- How have you been able to use the information based on its strengths and weaknesses?
- What would you say could be regarded as "best practices" in this field today?

3. Information use and storage

- How are the data being used beyond monthly and annual totals?
- Can you tell us how you are storing the data?
- What kind of plan do you have for ensuring that the information remains up to date and available for use in the future?
- Do you have a protocol in place for handling information requests? Can you tell us how it works?

4. Further work and research

- How else would you like to see the data being used or be used in the future?
- Do you have plans for data collection or use that differs from what you've already described?
- What do you think are the key questions/knowledge gaps that need to be addressed in your region?
- Are harvesting surveys as they've been conceived to date the best way of addressing the priority questions?
- Are you aware of any other work in this field that you think we should look into?
- Are there other people you think we should speak to?
- Is there anything in the literature that you can direct us towards?

5. Specific questions for individual experts

APPENDIX D – AKLAVIK INUVIALUIT HARVEST DATA COLLECTION FORM

Aklavik Inuvialuit Harvest Data Collection
Harvest Dates: 01 Jun 2012 to 31 Oct 2012

	Date	Initials
Entered:	_____	_____
Checked:	_____	_____

(office use only)

Harvester Name:	Harvester ID: AKHTC	User Group: Inuvialuit Gwich'in Other	Interview Date:	Interviewer Name:

Decline to Participate: Yes — Why? _____

Did you attempt to hunt in this period? Yes ☐ No ☐ — If no why not? _____

If yes were you successful? Yes ☐ No ☐ — If no why not? _____

Did you get meat from others? Yes ☐ No ☐ — If yes from who? _____

Involved in a community hunt? Yes ☐ No ☐ — If yes do not include in data below.

Complete Table: Ensure Map code is entered and subzone if in Yukon. Use Age and Sex codes in bottom corner. If the harvester hunted with others only report the animals he/she shot.

Date	Place Name	Map Code Subzone	Transport	Species	How Many / Age / Sex	Condition	Hunting Party Names	Have you reported this elsewhere? Where?
31 Aug	Arctic Circle	29392 154	Truck	Caribou Porcupine	2 / A / M 1 / J / F	Poor\fair\mixed\ good\excellent	George Clooney George Jones	Yes, check station

Species		Age Codes	Sex Codes
Caribou – Porcupine	Moose	A - Adult	M - Male
Caribou – Bluenose-West	Dall's Sheep	J - Juvenile	F - Female
Caribou – Woodland	Muskox	C - Calf	U - Unknown
		U - Unknown	

Continue to record harvest information using codes on previous page.

Date	Place Name	Map Code Subzone	Transport	Species	How Many / Age / Sex	Condition	Hunting Party Names	Have you reported this elsewhere? Where?

Final Questions: Circle harvester choice or N/A if not applicable. Questions are for harvester observations during June 01, 2012 and Oct 31, 2012

Questions about caribou

1. Based on your observations this harvest period how many caribou did you see compared to normal?
   Less Same More
2. How available were caribou to your community?
   Close by and easily found \ not close required lots of effort to get \ not at all available
3. Did you meet your needs for caribou this harvest period?
   Yes No
4. If no what prevent your caribou needs from being met?
   Abundance Availability (too far away) No means to hunt
   Other? _____
5. If you hunted less caribou, what did you hunt instead or did you buy food to replace the caribou?
6. Did you notice anything unusual about the caribou? (signs of disease, lots of calves, no calves

Questions about muskrat, beaver and otter

Based on your observations this harvest period, compared to normal :

7. how many muskrats have you seen? Less Same More
8. how many beavers have you seen? Less Same More
9. how many Otters have you seen? Less Same More
10. Why do you think that is? Circle the species to which this applies:
    muskrat beaver otter all

Questions about weather and environment

11. Please describe any unusual, extreme or rare weather event that you observed during this harvest period and what month(s) this occurred.
12. Did you notice anything unusual? (e.g. predators, fire, insects, erosion rare/new animals) Where?
13. Anything else to add or you would like to know?

Thank you for participating in this survey. Please sign here:

_____

My signature indicates that this information is accurate and was given by me. I give permission to AHTC to use the information provided. All information provided becomes property of AHTC.

Interviewer Initials (as witness of signature): _____

APPENDIX E – SAHTÚ HARVEST STUDY QUESTIONNAIRE (1998–2005)

SAHTU SETTLEMENT HARVEST STUDY

Harvester Record

Harvester Identification Number: ☐☐☐☐

Community ☑:
☐1 Deline ☐3 Norman Wells ☐5 Colville Lake
☐2 Tulita ☐4 Ft. Good Hope

Interviewer Name: _____ **Interviewer #:** ☐☐☐☐ **PAGE** ☐ **OF** ☐

Interview Date: ☐☐ *Day* ☐☐ *Month* ☐☐ *Year*

Interviewed for Month of ☑: ☐ *Jan* ☐ *Feb* ☐ *Mar* ☐ *Apr* ☐ *May* ☐ *Jun* ☐ *July* ☐ *Aug* ☐ *Sept* ☐ *Oct* ☐ *Nov* ☐ *Dec*

Interviewed for Year of: ☐☐☐☐

Harvester Activity Code ☑:

☐1 Went out harvesting & was successful (*got something*)

☐2 Went out harvesting but was unsuccessful (*didn't get anything*)

☐3 Did not go harvesting

☐4 Harvester could not be contacted – still out harvesting *(ask when back?)*

☐5 Harvester could not be contacted – Other (*if out of town, ask when back?*)

☐6 Harvester moved *(when? where?)*

☐7 Harvester dead

☐8 Harvester does not want to participate

☐9 Does not harvest or stopped harvesting

☐10 Other (*Write in details*) _____

Name of animal, fish, or bird species harvested?	*Where harvested?*		*How many?*	For all big game *(e.g., Moose, Caribou, Muskox, Dall's Sheep, Mountain Goats, Bears, Deer)* record numbers taken by sex and age class **ADU=** *Adult; JUV=* **Juvenile** *(calf, lamb, yearling, cub);* **UNK = Unknown**								
				# of Males			# of Females			# Unknown		
	Place Name	Map Grid Block Number	**Total #**	**ADU** *bull ram*	**JUV** *calf lamb yrling cub*	**UNK AGE**	**ADU** *cow ewe*	**JUV** *calf lamb yrling cub*	**UNK AGE**	**ADU/ UNK SEX**	**JUV/ UNK SEX**	**UNK AGE & SEX**

Last month, how many days ***in total*** *did you spend out on the land hunting, fishing, and trapping?* ***Total # of days on Land:*** ☐☐

HARVESTER'S COMMENTS? *(E.g., Animal Condition? Animal numbers? Other observations made while out harvesting?)*

APPENDIX F – SAHTÚ HARVESTER REGISTRATION FORM

SAHTU SETTLEMENT HARVEST STUDY

Harvester Registration Form

Community ☑: **Interviewer Name:**

☐₁ Deline ☐₃ Norman Wells ☐₅ Colville Lake
☐₂ Tulita ☐₄ Ft. Good Hope

Interview Date: ☐☐ *Day* ☐☐ *Month* ☐☐ *Year*

Harvester's Last Name: **Harvester's ID #:** *(if available)* ☐☐☐☐

Harvester's First Name: **Harvester's Sex** ☑ ☐ Male ☐ Female

PART 1- ASK ALL

First, I just want to ask you a few questions to make sure this Study is right for you. Please answer "**Yes**" or "**No**" to each of the following questions ☑…

Do you do any hunting, fishing, or trapping at any time of the year?	☐ NO	☐YES
Are you 16 years of age and over?	☐ NO	☐ YES
Do you currently live in the Sahtu region?	☐ NO	☐ YES
Are you a Sahtu Dene, Sahtu Metis, or a Non-beneficiary of the Land Claim who provides fish and game for your Sahtu Dene-Metis family (e.g., non-aboriginal)?	☐ NO	☐ YES

Year of Birth-
If answered "**YES**" to *16 years of age and over*, ASK →

What year were you born? ☐☐☐☐

Dene/Metis or Other-
If answered "**YES**" *to Dene, Metis, or Other*, ASK →

Are you ☑ ☐ Sahtu Dene or Metis
☐ Non-aboriginal providing for your Dene-Metis family

IF YOU ANSWERED "**NO**" TO ANY QUESTION IN PART 1, THIS STUDY IS NOT FOR YOU → [*Code as "B" on your harvester list, get signature, & then remove name from list*]

INTERVIEW FINISHED

IF YOU ANSWERED "**YES**" TO **ALL** THESE QUESTIONS IN PART 1, YOU ARE **ELIGIBLE** TO TAKE PART IN THE HARVEST STUDY → [*Code as "A" on your harvester list and get the harvester's signature*]

CONTINUE

PART 2- ASK ELIGIBLE HARVESTERS-

Who is the one person in your house that does most of the harvesting? ☑ (ONLY ***ONE*** PERSON PER HOUSE)

☐ Person being interviewed *(CONTINUE)*

☐ Someone else (WRITE IN NAME BELOW & THEN FINISH. ADD ANY ***NEW*** NAME TO YOUR OFFICIAL LIST)

Are there any other adult harvesters aged 16 years plus living in your house? (ADD ANY ***NEW*** NAMES TO YOUR OFFICIAL LIST. CONTACT THESE NEW PEOPLE FOR REGISTRATION)

Are there any children under 16 living in your house who harvest? (WRITE IN NAME & YEAR OF BIRTH FOR EACH UNDER-AGE HARVESTER & THEN FINISH)

Child Harvester's Full Name (*first & last*)	Year of Birth

APPENDIX G – SAHTÚ HARVEST STUDY SPECIES LIST

Standard Names	Common/Local Names	Scientific Names	Dene Language Names (Délı̨nę, Tulít'a & K'asho Got'ine Districts)
LARGE MAMMALS			
Black Bear		*Ursus americanus*	saht'ea/sah dénı̨tłé/bədəzi
Grizzly Bear	Brown Bear	*Ursus arctos*	sahcho/sahsho
Barren-Ground Caribou		*Rangifer tarandus groenlandicus*	ekwę́wá/ʔekwę́ wá gow'ı̨ ɂədə́
Woodland Caribou	Mountain Caribou	*Rangifer tarandus caribou*	tǫdzí
Dall's Sheep		*Ovis dalli*	do/doge
Mountain Goat		*Oreamnos americanus*	shúhta do
Moose		*Alces alces*	ı̨ts'é/ʔı̨ts'ę́
Muskox		*Ovibos moschatus*	gokw'i əjiré/gokw'i ɂejire ɂəjire yǫ́né
White-tailed Deer	Deer	*Odocoileus virginianus*	
SMALL MAMMALS			
Beaver		*Castor canadensis*	tsá / sá
Muskrat	Rat	*Ondatra zibethicus*	tehk'áe/dzę
Mink		*Mustela vison*	tehwá
Weasel	Ermine	*Mustela erminea*	nǫba
Northern River Otter	Otter	*Lontra Canadensis*	nábə́ə/rábə
Marten	Sable	*Martes Americana*	nǫhwhə/zo
Fisher		*Martes pennanti*	nǫhwhəcho/zosho
Wolverine		*Gulo gulo*	nǫ́gha
Marmot	Gopher	*Marmota flaviventris*	tsele

Arctic Ground Squirrel	Gopher	*Spermophilus parryii*	dléa/sele
Red Squirrel	Gopher	*Tamiasciurus hudsonicus*	dléa
Red Fox	Cross, Silver, Black Fox	*Vulpes vulpes*	nǫ́gére dekwo/depoi yehfe defo
Arctic Fox	White, Blue Fox	*Alopex lagopus*	nǫ́gére dek'ale
Coyote		*Canis latrans*	dígatsele/belé lı́ę́
Wolf		*Canis lupus*	díga/bele
Cougar	Mountain Lion	*Felis concolor*	shúhta ɔewódzi
Lynx	Cat	*Lynx lynx*	nǫ́da
Porcupine		*Erethizon dorsatum*	ch'ųą/ch'ǫ
Snowshoe Hare	Rabbit	*Lepus americanus*	gah
Arctic Hare	Rabbit	*Lepus arcticus*	gahcho/gahsho
BIRDS			
Ruffed Grouse	Chicken	*Bonasa umbellus*	dih/ɔehseré
Sharp-tailed Grouse	Chicken	*Tympanuchus phasianellus*	ʔehtale/etsele
Spruce Grouse	Chicken	*Dendragapus Canadensis*	dih/ɔehtále
Rock Ptarmigan	Chicken	*Lagopus mutus*	k'áhba'cho
Willow Ptarmigan	Chicken	*Lagopus lagopus*	k'ahba
American Widgeon	Whistling Duck	*Anas americana*	zashishi
Bufflehead		*Bucephala albeola*	tutsele
Canvasback		*Aythya valisineria*	dahgare cho
Barrows Goldeneye		*Bucephala islandica*	
Common Goldeneye		*Bucephala clangula*	
Ring-Necked Duck		*Aythya collaris*	nǫ́hta
Harlequin		*Histrionicus histrionicus*	
Mallard		*Anas platyrhynchos*	chuho/túriw'élé
Common Merganser	Fish Duck, Pie Duck	*Mergus merganser*	kw'ole/fole

Red Breasted Merganser	Fish Duck	*Mergus serrator*	kw'ole
Northern Pintail	Long Tailed Duck	*Anas acuta*	nagorak'ale/chįhdúwe/yéhxąi
Northern Shoveler	Spoon Bill	*Anas clypeata*	dayéchare
Oldsquaw		*Clangula hyemalis*	ąįléa
Greater Scaup		*Aythya marila*	daįhgare
Lesser Scaup		*Aythya affinis*	daįhgare tsele
Black Scoter	Black Duck	*Melanitta nigra*	tənakeo
Surf Scoter	Black Duck	*Melanitta perspicillata*	chuk'ə
White-Winged Scoter	Black Duck	*Melanitta fusca*	tənakeo/yawileho dé
Blue-Winged Teal		*Anas disors*	chutsele
Green-Winged Teal		*Anas crecca*	chutsele/fík'ǫne
Brant Goose		*Branta bernicla*	dat'é/gogaht'ə
Canada Goose		*Branta canadensis*	xah
Greater White-Fronted Goose	Yellow legs, Speckle Belly	*Anser albifrons*	dahk'é
Snow Goose	Wavy, Blue, Grey Goose	Chen caerulescens	gogarek'ale/gogah
Trumpeter Swan		*Cygnus buccinator*	
Tundra Swan		*Cygnus columbianus*	degao
Arctic Loon		*Gavia arctica*	bedárega/w'ihbé
Common Loon		*Gavia immer*	tútsi/túsi
Pacific Loon		*Gavia pacifica*	p'įbe
Red-Throated Loon		*Gavia stellata*	yanǫ́hɔa
Yellow-Billed Loon		*Gavia adamsii*	tútsio/túsi
Sandhill Crane		*Grus canadensis*	deleho/dəleho
Snowy Owl		*Nyctea scandiaca*	bə́hdzįga/bə́hdzi dek'ale

FISH			
Arctic Char	Red Fish, Silver Trout	*Salvelinus alpinus*	łuedédele/luge dedélé
Sucker	Longnose, White Sucker	*Catostomus catostomus* *Catostomus commersoni*	dehdele
Arctic Grayling	Grayling, Blue Fish	*Thymallus arcticus*	t'áe/t'áa
Broad Whitefish		*Coregonus nasus*	łúé wá
Lake Whitefish	Crookedback, Humpback	*Coregonus clupeaformis*	łu
Burbot	Loche, Lingcod	*Lota lota*	nǫhkwə́/nǫ́hfə
Walleye	Pickerel, Dore, Perch	*Stizostedion vitreum* *Perca flavescens*	ʔéhch'íą/t'á
Chum Salmon	Dog Salmon	*Onchorhynchus keta*	geo sahba
Bull Trout/Dolly Varden Char		*Salvelinus malma* *Salvelinus confluentus*	dehgá sahba
Cisco	Herring, Least Cisco, Arctic Cisco	*Coregonus autumnalis* *Coregonus sardinella*	łuehya/lugeya
Inconnu	Coney	*Stenodus leucichthys*	Siho/sih
Northern Pike	Jackfish	*Esox lucius*	ɂǫ́hda
Lake Trout	Trout	*Salvelinus namaycush*	sahba

APPENDIX H – GIS AND DATABASE DETAILS

(Prepared by K. Benson)

Early records indicate that the SSHS coordinator originally proposed a comprehensive database system to input, store, and analyze harvest data. The ***Methods Report*** indicates the following:

> *"All Study data will be managed using a relational database system called the **Harvest Study Data Management System** - a computer system designed to store, organize and analyze harvest data collected for this Study.*
>
> *This user-friendly system will be a custom design developed by a computer programmer in close cooperation with the Harvest study coordinator. The System will be built to work on a commercially available database software package like FoxPro or Access. The System will have Windows-based point and click screens for ease of use.*
>
> *Automated push-of-a-button functions will be timesavers, assisting in monthly management tasks such as:*
>
> - *Management of the official harvester list (e.g., help prepare updated **Monthly Harvester Lists**, track harvesters with backlogged months outstanding; random draw of prize winners);*
> - *Quality control (e.g. , simplified data entry screens for ease of use, "smart" data entry fields to reduce keypunch errors during data entry, "sort & clean" features to help deal with missing/duplicated files and to update the master file when backlogs are cleared);*
> - *Analysis and reporting (e.g. , preparing data for export to GIS project; preparing **Monthly Community Harvest Updates** with tally of harvest counts and details on harvester participation in the Study, calculation of recall period for backlogged interviews);*
> - *Management of Community Interviewers (e.g., assists with payroll calculations and provide monthly reports on interviewer performance).*
>
> *In most cases, all data will be represented in the database as numerical codes (i.e., a caribou will appear in data file as a number code rather than as the word "caribou"). This allows for ease of organizing, sorting, and analyzing harvest information collected."*
> (Methods Report V.1, 1998:34-35)

Records indicate that after a competitive process in 1998, a Yellowknife-based computer consultant was hired to create this database, to be completed in early 1999. Work appears to have stalled mid-1999 and a database programmer was hired by the SRRB near the end of 1999 to work on the project in-house (as well as handle other computer/networking tasks within the SRRB). Although the original intent of the SSHS co-ordinator was to have a Windows-based software such as MS Access or Visual Fox-Pro, the complexity of the data and size of the potential database led the programmer to select a database program called 'Firebird'. Firebird is an open-source relational database producing files with a .gdb suffix. The software is free to download, but is command-line controlled – in other words, to see, query, or modify the data, commands must be typed in to the computer using a programming language. According to product literature, "Firebird is a powerful, open-source relational database system, with

high performance and extensive support for powerful SQL features with close adherence to the SQL standards." [4]

A free graphical user interface is also available, 'FlameRobin' - another cross-platform open-source project. FlameRobin is not command-line, but opens and views/modifies the Firebird database with a basic user interface (Figure A-1).

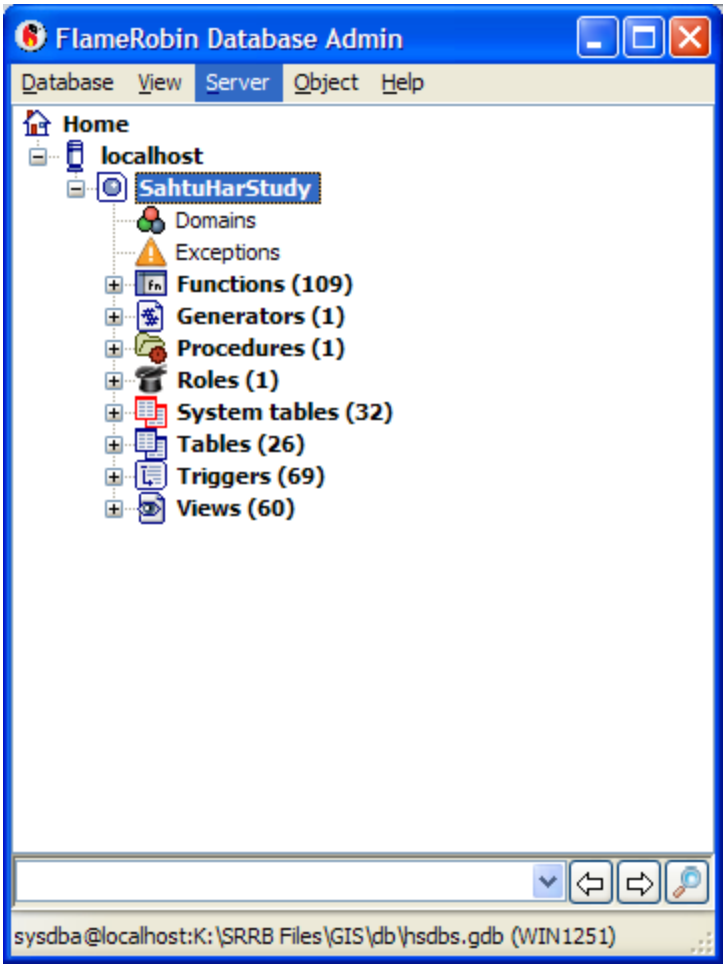

Figure A-1: FlameRobin Database Administrator.

The final harvest study database file (hsdbs.gdb) is 233MB. A reasonable portion (30 MB) of the size of the database relates to the storage of distance calculations: each ten by ten kilometer grid and each 2 by 2 kilometer 'fish' grid has an associated distance to each Sahtú community. The database does not appear to be compacted and may be versioned. The database developer did not anticipate that the SRRB would make use of the database through either the command-line Firebird software or through FlameRobin; instead a custom-coded software called the Sahtú Harvest Manager was created using Visual Basic. It appears that the Sahtú Harvest Manager was completed in 2001; an example of the system's graphical user interface is shown in (Figure A-2).

[4] For more information or to download Firebird, see http://www.firebirdsql.org/#get-started

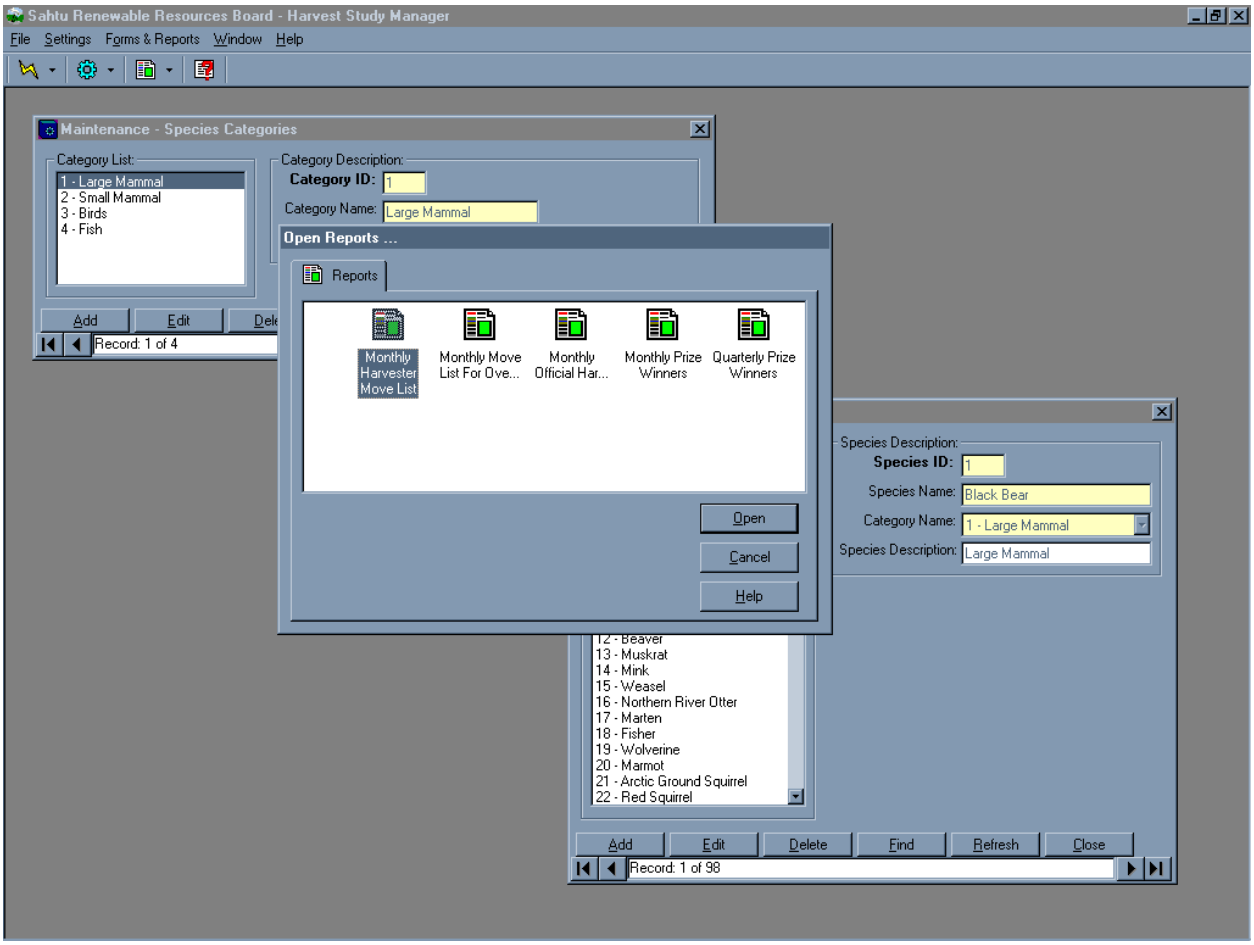

Figure A-2: Sahtú Harvest Manager

Additionally, the SSHS database was set up to be useable by SRRB in MS Access using a linking function called ODBC. In other words, a user could open an MS Access database window, link to the Firebird database, and use the MS Access functions to view, query, and modify the data in the Firebird database. Some queries and table views were created in Access. Apparently, these queries related to sharing data with other organizations such as SLUPB and CWS. At this time, the data remains in the original Firebird database. The database is password protected. The passwords were provided to the SRRB during this project.

The database is organized around a harvest trip – in other words, a single harvest trip is the node around which other types of information (who, what) is linked. The interview table records each separate harvest trip taken by each participant. For example, imaginary harvester #45 has a record in the HARVEST_INTERVIEW_TABLE for a five-day trip he took on March 27, 2001 – this harvest trip[5] is called 12345 in the database. There is a record in the BIRDS_HARVESTED table, showing that during trip #12345 there were 15 grouse killed. By linking the BIRDS_HARVESTED and HARVEST_INTERVIEW_TABLE, we can see that the 15 grouse in the one record in the BIRDS_HARVESTED table was harvested by #45 on March 27, 2001. There is also a record in the

[5] Column named HARVESTINTERVIEWID

SMALL_MAMMAL_HARVESTED table showing that 20 rabbits were harvested during trip #12345.[6] We can also link the small mammal table with the harvest interview table to find out when and who harvested these rabbits. If we want to know who Harvester #45 is, we must check in the HARVESTER table. The harvester's name, date of birth, and other relevant information are contained within the HARVESTER table. Therefore, most queries or questions flow through the Harvest Trip records to link different pieces of information. Unsuccessful harvest trips are also recorded, as are instances when the harvester did not go out on any trips.

There are also numerous tables relating to the running of the SSHS study, such as recording prizes and interviewer information, plus tables with information for the Harvest Study Manager software. Other tables include internal database instructions and linking tables such as species codes and species groups. A series of derived tables (called "Views" in the Firebird software) were created by the database developer for use in the Access database and Harvest Study Manager. These views include:

- All species harvested (separate table for fish, birds, small mammals, large mammals)
- All species harvested by grid block by community by month (separate table for fish, birds, small mammals, large mammals)
- All species harvested by grid block by community by year (separate table for fish, birds, small mammals, large mammals)
- All species harvested by grid block by month (separate table for fish, birds, small mammals, large mammals)
- All species harvested by grid block by year (separate table for fish, birds, small mammals, large mammals)
- All species harvested by grid block (separate table for fish, birds, small mammals, large mammals)
- Grand total (separate table for fish, birds, small mammals, large mammals)
- All species harvested by month by community (separate table for fish, birds, small mammals, large mammals)
- All species harvested by month by region (separate table for fish, birds, small mammals, large mammals)
- All species harvested by year by community (separate table for fish, birds, small mammals, large mammals)
- All species harvested by year by region (separate table for fish, birds, small mammals, large mammals)

Geographic Information System

All harvests were recorded spatially during the harvest interviews using a grid block number (ten by ten km for bird and mammal harvests, two by two km for fish). Each grid block had an ID number that was recorded by the interviewer and added to the database.

[6] Note that intermediate tables are also required for some of these queries, for example, as animals are coded numerically, the SPECIES table is needed to interpret the numbers.

A GIS polygon coverage (older format GIS file) was available for both the normal grid and the fish grid. The grid files were converted to polygon shapefiles.[7] The polygon shapefile could be linked in a one-to-many relationship with the tabular data *(i.e*. any table with GridBlock ID in the SSHS database). Additionally, the SSHS database can be manipulated using various queries to compile derived tables for linking in a one-to-one relationship suitable for cartographic purposes. For example, for the purposes of this assessment, a query was drafted to select all types of caribou harvest (barren-ground, woodland, general caribou). The results were grouped by community and grid block, producing a table that had each community's total caribou harvest for each grid block. This table was then linked to the grid block polygon shapefile to produce intensity maps of each community's harvest.

The SRRB database developer created a tool linking the SSHS database to ArcView 3.x with a series of queries and macros to allow a user to input desired parameters (*i.e.* "Moose") and have a map display the results of the query(ies). The tool developed to link the SSHS database to ArcView 3.x would allow a user to input desired parameters (i.e. "Moose") and have a map display the results of the query(ies). However, these tools no longer function, due in large part to the ten-year gap between their creation and today and exacerbated by the introduction of ArcView 8.0 in the early 2000s, which was a substantial departure from ArcView 3.x, and included the introduction of .mxd files to replace obsolete .apr projects.

[7] Note: the polygon coverage was not a "grid" file type, nor was the coverage converted to a modern "grid" or raster file. However, the database uses the term "grid" and "grid block" to refer to the ten by ten kilometer block of land, so this report maintains this wording. No GIS files of the file type "grid" were used or encountered.

APPENDIX I – TEXT OF THE SRRB DATA SHARING AGREEMENT

The Sahtú Renewable Resources Board (SRRB) agrees to make available to

of (the User) the following data subject to the conditions listed below.

Type of data or name of datasets (Data) requested:

Purpose for which the Data are to be used:

Scope of Agreement:

This Data Release and Usage Agreement (Agreement) is between the SRRB and the User, and it gives the User certain limited rights to use SRRB Data. All rights not specifically granted in this Agreement are reserved to the SRRB. The SRRB retains exclusive title and ownership of the Data and, unless otherwise noted, of the component parts of the Data, and hereby grants to the User a personal, nonexclusive, nontransferable permission to use the Data based on the terms and conditions of this Agreement. From the date of receipt, the User agrees to reasonable efforts to protect Data from unauthorized use, reproduction, distribution, or publication.

Conditions:

1. The User agrees that the Data will not be published or released in whole or in part to any individual or organization without prior written consent from SRRB. This restriction applies to all reorganizations of the Data, in whole or in part, and to integrations of the Data with information from other sources. This restriction extends to both digital and hard copy Data formats.
2. The User acknowledges that SRRB is the owner of the Data and agrees to clearly acknowledge the source of the Data supplied by SRRB whenever such Data are used in any report, publication, document or public communication.
3. The Data provided may only be used in reports or presentations directly related to the purpose described above.
4. SRRB makes no warranties as to the accuracy of the Data or its suitability for the User's purpose. SRRB does not guarantee exclusivity of use of the data.
5. If this Agreement includes Sahtú Harvest Study Data (SSHS Data), the User acknowledges that the SSHS Data have not been verified, and only include harvests reported by study participants. SSHS Data have not been adjusted for response rates and do not represent total estimated harvests for any species or region. The User agrees that any use of the SSHS Data must recognize this caveat and provide a disclaimer to that effect.

6. The User must attach documentation of community approval for use of the SSHS Data, or datasets containing traditional knowledge.
7. SRRB reserves the right to make changes, corrections, additions and/or deletions to the Data and is under no obligation to supply the User with updates.
8. In supplying the Data SRRB makes no endorsement of any interpretations of the Data made by the User.
9. It is understood that the User will destroy all electronic or paper copies of the Data (excluding products generated from the data such as reports, maps, documents or public communications) at the termination of this agreement. The term of the agreement commences with the signing of the agreement and remains in effect for length of agreement (normally one year) or until terminated by the SRRB or the User. The agreement may be extended with the written approval of the SRRB.
10. The User will provide plain language documentation of how the Data was used, including challenges and successes, and copies of technical reports, delivered to the SRRB and affected communities.
11. This agreement shall be interpreted according to the laws of the Northwest Territories.

Further condition(s), if appropriate

By signing this agreement and accepting the data, the User agrees to be bound by the above conditions.

_____

User Date

_____

For the Sahtú Renewable Resources Board Date

APPENDIX J – DRAFT BUDGET FOR COMPLETION OF SAHTÚ SETTLEMENT HARVEST STUDY

	Number of days	Cost per day	Estimated total
Final data checking	15	$ 300	$ 4,500
Response rate calculation	10	$ 500	$ 5,000
Calculation of total harvests and estimates of variance	20	$ 500	$ 10,000
Draft report preparation	10	$ 500	$ 5,000
Community verification sessions	20	$ 500	$ 10,000
Final write-up (quantitative and qualitative results/interviews)	25	$ 500	$ 12,500
Comparison of SHS results to other known estimates	5	$ 500	$ 2,500
Honoraria (10 per community, two days per community)	100	$ 200	$ 20,000
Workshop room rental	10	$ 400	$ 4,000
Workshop meals	10	$ 250	$ 2,500
Interpretation	10	$ 500	$ 5,000
Printing report	1	$ 500	$ 500
Flights and hospitality for workshop sessions*	1	$ 8,400	$ 8,400
SRRB flights and hospitality for workshop sessions*	1	$ 6,000	$ 6,000
Workshop facilitator local	10	$ 300	$ 3,000
Equipment rental	10	$ 200	$ 2,000
Sub-total			$100,900
SRRB Administration			$10,090
Total			**$110,990**

**** Breakdown of costs for travel:***

South-Norman wells	*$2400*
Each flight leg in Sahtú (6 anticipated)	*$200*
Hotel/billet	*$200*
Per diem	*$120*