University of Alberta

An Exploration of Non-timber Forest Product Potential in a Sub-arctic Aboriginal Setting.

by

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A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Science

in

Agricultural and Resource Economics

Department of Rural Economy

Edmonton, Alberta

Fall, 2002

0-612-81450-5

ABSTRACT

Aboriginal peoples have had a long history of utilizing non-timber forest products. While the type of products used is well document, little is know about the quantities collected and if these products could be sold and marketed as a means of income generation for Aboriginal peoples. This thesis examines three main components of the economic development for a potential NTFP in a sub-arctic aboriginal setting. The first part of this thesis examines the cultural and institutions implication of the collection of such a product in the Gwich'in Settlement Area (GSA). The second part of this thesis focuses on research inventorying the species of fruit bearing plants within the major vegetation types and to quantify the total annual supply of berries available to the Gwich'in People in the GSA. The third part of this thesis examines market demand for the potential products in a southern market.

ACKNOWLEDGEMENTS

I would like to thank my thesis committee, Dr. Peter Boxall, Dr. Jim Untershultz, Dr. Vic Adamowicz, and Dr. Ross Wein for their comments, suggestions and help in improving the quality of this thesis. I would to express my sincere gratitude to Dr. Peter Boxall for all the help thoughtout this process and for putting my mind at ease when it needed to be.

I would also like to thank all the people I have met and have had help from in Inuvik. This includes the staff of the Gwich'in Renewable Resource Board including Peter Clarkson, Jennifer Walker-Larsen, Bobbie Jo Greenland, Sheldon Bernard, and John Edwards.

My gratitude also goes out to Sunterra Market Place and Urban Fare for allowing me to run my surveys at the stores. I would also like to thank Ara Murray for assisting me in the survey work.

I would like to acknowledge the financial support of those who made this thesis possible. This includes the Sustainable Forest Management Network, The Gwich'in Renewable Resource Board, the Department of Resources, Wildlife, and Economic Development of the Government of the Northwest Territories, and the Canadian Circumpolar Institute for a Northern Scientific Training Program Grant. I would also like to acknowledge the Aurora Research Institute for the granting of a Scientific License.

Finally I would like to thank my Mom for supporting and believing in me and never giving up on me even when I had my doubts. Thanks!

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CHAPTER 1
Introduction

A growing literature highlights the extent of collection and use of non-timber goods from forested areas in Canada (e.g. Mohammed 1999; Mater Engineering Ltd. 1993). The importance of these forest products has long been recognized in the developing world (e.g. Mendelson and Balick 1995). Such products are now called non-timber forest products (NTFP) in the literature. Mohammed (1999) classifies NTFPs as foods, decorative and aesthetic items (e.g. wreaths), environmental products (e.g. biofuels), health and personal care products, manufacturing goods, and landscape and garden products.

Duchesne et al. (2000) estimate the total value of such products shipped in Canada during 1997 to be in the order of $240 million. However, their figures do not include values of products not traded in markets, for example those collected for personal use or those traded through underground economies. Using their figures, $220 million was credited to the maple syrup and mushroom industries; most of the remaining $21 million was attributed to foods such as wild berries. Duchesne et al. (2000) estimate the potential for NTFP harvest in Canada at $1 billion.

The magnitudes of the dollar values from the sale of NTFP discussed above for Canada result in frequent claims that the collection of marketable NTFPs represents viable economic opportunities for many rural communities in North America (e.g. Mohammed 1999; Brubacher 1999). In many cases, however, these claims are based upon the observation that such markets exist in Europe; or that local cottage industries have developed in which small amounts of products are sold to tourists (e.g. Hendrickson 1997, Marquardt and Caulfield 1996). Of course strong markets do exist for products such as maple syrup (Chapeskie, 1997), mushrooms (e.g. Schlosser and Blatner 1995), certain berries (e.g. blueberries), and crafts made from barks, conifer boughs and other parts of trees (1997). But the assertions of consultants and others seem more related to the fact that since residents of forested areas currently collect NTFPs, and that markets exist elsewhere, that there should be considerable economic opportunities for collectors of NTFPs. These claims for many of these products in Canada remain untested.

The wild berry industry represents one of the areas in which potential may exist for expansion of the economic opportunities. This potential can be realized in international markets as well as at the cottage industry level. High production levels of berries are generally achieved through intensive management of production sites. The fact that these plants are managed to generate high levels of production and quality raises the issue of whether the product really deserves the "wild" designation and thus whether these products are truly NTFPs.

Brubacher (1999) outlines the argument that NTFPs collected by members of First Nations' communities can be viable options for employment and income generation. Aboriginal opportunities may be unique in that through centuries of traditional knowledge they have access and considerable experience in collecting NTFPs. One important element of this economic potential is alternative trade options such as fair trade and associated labeling schemes, which exist if the products are collected, produced and marketed appropriately. Wild berries and value added products collected and produced by First Nations could be a component of this potential development.

A foundation of the potential for this industry is the fact that berries are widely collected from forests by Aboriginal People. The literature on aboriginal bush food use, for example, contains descriptions of the types and amounts of berries collected (e.g. see Berkes et al. 1995; Tobias 1995). Collection of NTFP such as berries provides relatively low wages to harvesters (Mohammed 1999). Few First Nations, however, have developed businesses around the collection, processing and distribution of berry products. Those that have generally service small local tourism markets or have formed cooperatives to sell products to international markets. Examples of co-operatives are the Iroquois Cranberry Growers, and the Kagiwiosa Manomin Cooperative (Mohammed 1999).

One avenue for economic opportunities open to First Nations in the NTFP sector is the non-local or Southern Canadian market for wild berry products. In particular, urban food store chains and specialty stores may offer prospects for value-added wild berry products such as jams and jellies. Few, if any studies explore this potential market.

Objectives of the Research

This research examines the question of whether there is a market for NTFPs derived from wild fruits which are collected by First Nations people at the northern extent of the boreal forest in Canada. In order to position this question appropriately in an economic context, information is required on the supply and demand of wild fruit products. This requires knowledge on the utilization of wild fruits by the local indigenous people, the indigenous institutions surrounding fruit collection and the abundance of these fruits in the forests in which these people reside. These issues are more specifically related to three areas of NTFP extraction. The first is that researchers must better understand the traditional ecological knowledge held by the indigenous people in their utilization of NTFPs in traditional areas. There is little information on the use of plant based NTFP in the sub-arctic boreal forests and this must be addressed to fully understand whether NTFPs can provide opportunities for economic development.

The second area involves investigating the supply of NTFPs. In examining this issue, the distribution and abundance of NTFPs must be understood. However, supply and production issues are not merely biological relationships. For example, institutional and cultural constraints must be considered. These include issues such as property rights and the importance of wild fruits in local aboriginal culture. There are also economic issues surrounding the processing and preparation of NTFPs for sale in formal markets.

One way to frame this issue is to consider a production function for a First Nations jam product. A production function can be defined as, "a description of the way in which factors of production are combined to produce goods and services" (Norton and Alwang 1993). Thus, a production function describes, for a given technology, the different output levels that can be obtained from various combinations of inputs of factors of production. In this case, the quantities of jams supplied will be a function of cultural and physical inputs and constraints. The important cultural features can be viewed as the institutional constraints such as property rights issues and cultural constraints such as the significance of wild fruits to the local aboriginal population. The physical inputs will include such factors as the ability of the landscape to produce fruits to meet both cultural and market demands.

Finally, the demand for wild fruit preserves is addressed by examining potential for their sale in large markets that exist in non-local areas. To date much of the interest in NTFP markets has involved local tourism markets (e.g. Mohammed 1999) and little research has involved the non-local potential.

The Study Area and the People

The research involves NTFP collection by a Dene people called the Gwich'in. The Gwich'in number about 7,000 people and they are scattered among 15 villages and small towns throughout northeast Alaska and the northwest portions of the Yukon and Northwest Territories. Specifically this research will examine the Gwich'in people who reside in the Gwich'in Settlement Area (GSA) in the Northwest Territories (Figure 1). The GSA is located at the southern part of the Mackenzie Delta Region. It encompasses a 57 000 km^2 landscape that reaches from the town of Inuvik to the upper reaches of the Arctic Red River and the Peel River. Within this area, there are four communities, Inuvik, Tsiigehtchic, Fort McPherson, and Aklavik.

For the residents in the GSA, resource issues are dealt with by the Gwich'in Renewable Resource Board (GRRB). This recognizes the fact that, wildlife, fish, and forests are important to the Gwich'in economy and lifestyle, and thus the board works with each of the four communities in the GSA to ensure that these renewable resources are managed in a sustainable manner (www.grrb.nt.ca). This is accomplished in each of the four communities through local Renewable Resource Councils (RRC). The RRC's from each community elect members to the council in order to address issues concerning renewable resources for their communities. Approximately once a month the RRC's of each community meet with members of the GRRB to ensure that issues surrounding their

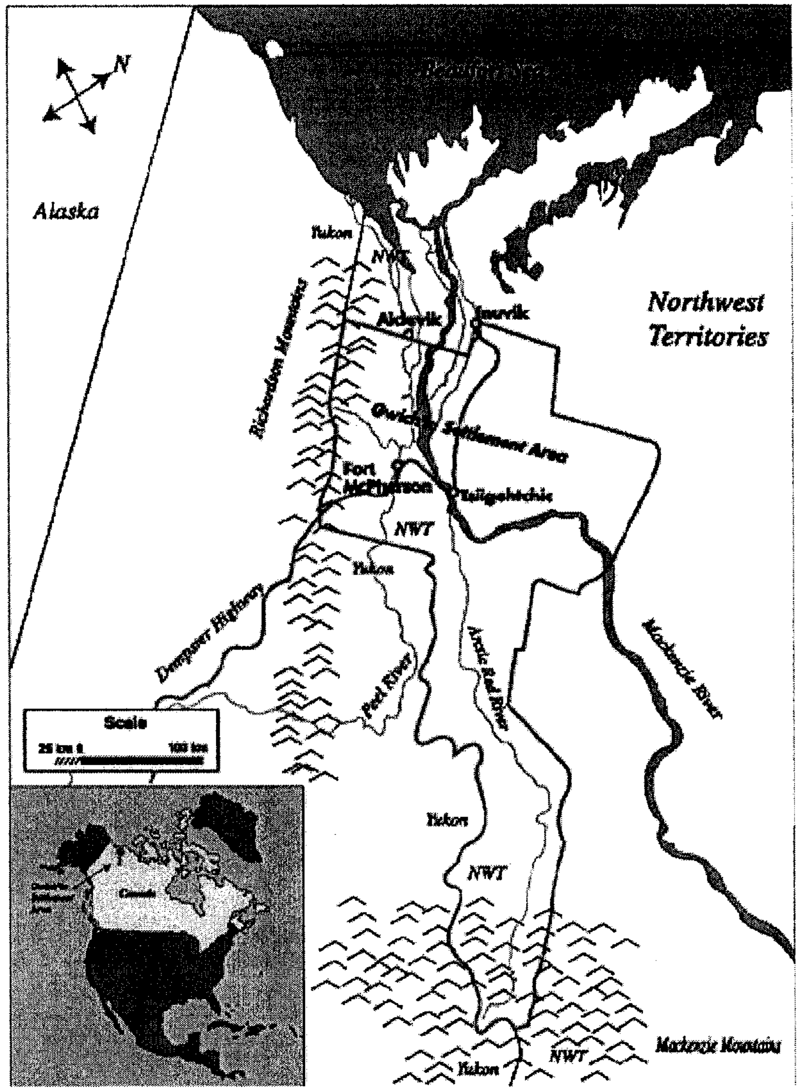

Figure 1. Location of the Gwich'in Settlement Area.

resources are dealt with. This ensures that all the community needs and issues are addressed.

The word Gwich'in means 'people of the caribou' and as a result the Gwich'in are renowned as hunters. Their dependence on wild caribou for subsistence is well documented (Gwich'in Renewable Resource website http://www.grrb.nt.ca/). However, less known is their use of plant foods collected from the boreal forest in the GSA. Thus, the first stage of the project involved an examination of the extent of use of local berries in the Gwich'in diet and the levels of interest in collecting fruits from forests and selling them both locally and to southern Canadian markets. The research then focused on estimating the distribution and abundance of sources of the most sought after fruit species, and estimated the amounts of fruits actually collected by the Gwich'in in the major communities in the GSA.

Once insight was gained into the supply of fruits and their collection by local people, attention turned to whether a southern market exists for products made from the most frequently collected fruits. It also evaluated the efficacy of marketing options such as identifying the product's region of origin or whether the product was produced by peoples of Aboriginal origin. These marketing features could be communicated through vehicles such as product labels or other advertising schemes. Thus, the value of such attributes could be ascertained through the estimation of price premiums and/or the probabilities of purchase, as is frequently done in the marketing literature.

To examine the potential for marketing northern fruit products, information on the demand for jams was required. This information allows an assessment of the feasibility of introducing new products into the jam market. A choice experiment (CE) was developed that focused on consumer preferences for jam products made from wild and domestic berries. The experiment was designed to examine of the importance of different label attributes and berry species in the jam purchase decision.

Thesis Organization

The next chapter presents a literature review. In this review, NTFPs will be examined. It begins with a general review of NTFPs, leading to discussion on their use in developing countries, followed by the Nordic countries, and finally concluding with issues of NTFPs and First Nation peoples. Chapter 3 is concerned with the cultural and institutional constraints of the production function. It involves the examination and exploration into the use of wild edible plants by the Gwich'in. In this chapter the use of berries by the Gwich'in is determined, where the Gwich'in people went to collect berries, how the Gwich'in used the berries, and tried to gain an understanding of the total annual amount of berries collected. Chapter 4 is concerned with the physical constraints of the production function. It presents results of the research on inventorying the species of fruit bearing plants within the major vegetation types in the GSA and to quantify the total annual supply of berries available to the Gwich'in People in the GSA. Chapter 5 examines market demand for the potential products. Using an in-store (choice experiment) survey, potential consumers were surveyed about their views over a potential product originating from the GSA. Chapter 6 presents the conclusions and implications of this research and also limitations and future research possibilities.

CHAPTER 2
A Review of Literature on Non-timber Forest Products

Introduction

At the northern extremes of the boreal forest, traditional forestry may not be a sustainable industrial enterprise. At such northern extremes, the forest is only of marginal productivity, and with the severe climate, forests grow slowly and there is very limited potential for timely replacement of harvested trees. The northern latitudes also have little potential for the development of agriculture (Saastamoinen and Lohinivia 1989). In these areas, the development of marketable NTFPs may offer a viable alternative for income generation. These NTFPs could encompass a wide range and variety of products originating from forest including, conifer boughs, wild rice, medicinal herbs, fruits, and mushrooms (Duchesne et al. 2000).

This chapter reviews some of the literature surrounding NTFPs. It starts with a general review of NTFPs, leading to discussion on their collection and sale in developing countries. This is followed by examining the literature on NTFPs in Nordic countries and concludes with NTFP collection by North American aboriginal peoples.

Much of the literature involving non-timber forest product is concentrated on tropical forests (Bawa and Godoy 1993), and it appears that the bulk of the literature is concerned with potential for income generation. Research in this area includes articles by Bawa and Godoy (1993), Chopra (1993), Arnold and Ruiz (2001), and Pattanayak and Sills (2001).

This literature suggests that in many developing countries the collection of NTFPs can be a significant income generator. Research has discovered that wild plants account for a large share of household income among poor households, and that income from the collection of non-timber forest products seems to be lower amongst high income families than lower income families (Bawa and Godoy 1993).

Chopra (1993) estimates that the total value of non-timber forest products from a tropical deciduous forest in India varies from $4 034 to $6 662 per hectare, and that this has a significant impact upon the welfare of communities which use NTFP's for subsistence. Grunatilake et al. (1993) estimate that in the communities surrounding the Knuckles National Wilderness Area of Sri Lanka, 16% of all income is derived solely from the collection of NTFPs. Shiva (1993) estimates that approximately 50 million people in India rely on the collection of forest products.

Not only are the NTFPs used just for income generation but they are also used as ways to mitigate the risks associated with potential shocks or losses in the growing and harvesting of agricultural crops (Pattanayak and Sills 2001),

Most of the studies that have done in depth research into NTFPs such as edible fruits in Northern Regions have originated from Nordic countries (Norway, Finland, Sweden and Greenland). Wild fruits collected from forests are an important aspect of trade in the Nordic countries. Authors such as Kangas (1999), Raatikainen (1983), Salo (1985), and Rosi et al. (1984) describe both the quantities and the species of fruits which Nordic people pick and prepare for markets. It is important to note that the Nordic countries have well developed markets for their NTFPs. The goods developed from NTFPs for sale range from unprocessed berries, jams and preserves to alcoholic liqueurs.

As an example of the use of NTFPs by Nordic people, Marquardt and Caulfield (1995) describe the history and progression of the country food market in Greenland. The Greendlandic government has been encouraging local country foods as a strategy for sustainable development. The goals of the strategy are to promote the use of culturally valued foods on a sustainable basis and to provide economic opportunities for local hunters. It is believed that this would promote indigenous hunting practices, offsets the needs for government subsidies, and encourage the consumption of nutritious and culturally valued foods.

Another country in which NTFPs play a role is Finland. The majority of Finnish people pick berries throughout the year (Rossi et al. 1984). Kangas (2001) estimates that between 65%-90% of the population of Finland collects berries. It has been estimated that 72% of the bilberries picked in commune of Pihtipudas in Finland were for home consumption, while 24% of the berries picked were sold at various markets through out the land. In the Lapland area of Finland the picking of wild berries holds special position to the people (Saastamoinen and Lohinvia 1989). Wild berries are a traditional source of food and an established export product. Berries are also used in the domestic commercial food industry.

In Finland, berry picking is an open access resource, free for all citizens to collect and sell (Kangas 2001). The people who collect the berries get extra tax-free income when the berries are sold and marketed, and collecting them is also a popular leisure activity (Saastamoinen and Lohinvia 1989). Although it would seem that the majority of these pickers just collect for leisure, the potential for economic opportunities remains high. Of all the berries that are harvested, the cloudberry (*Rubus chamaemorus*) is the most sought after species. This fruit is collected not only for domestic and household use, but also for commercial sales and exports.

Salo (1985) estimated that in Eastern Finland, those active in berry collecting who sold the berries, sold on average 24.6 kg of lingonberries (a species of *Vaccinium* found in Europe which is similar in flavour to *Vaccinium vitis-idaea* found in Northern Canada (Porslid and Cody 1980)), which amounted to 73.3% of the berries collected. Rossi et al (1984) estimated that in Central Finland, those who collected berries, approximately 43% of the berries collected, specifically lingonberries, were sold. Similar numbers were found by Saastamoinen and Lohiniva (1989) in the Rovaniemi region of Finnish Lapland. They estimated that of the three most popular berries collected, cloudberry, blueberry, and lingonberries, approximately 43% of collected berries were sold.

NTFP use by North American Aboriginals

The use of NTFPs by aborginal people appears to have significant social, cultural and nutritional significance. However, most of the research on this involves the harvest and use of meat from wild animals. Rarely is the collection and use of wild fruits and other plants mentioned in detail. Johnson et al. (1995) estimate that foods derived from wild animals comprised between 95%-97% of aboriginal diets from the boreal forest, and that plants foods (especially berries) were only used occasionally. Others, such as Kuhnlein and Turner (1991), emphasize that, aboriginals in northern latitudes are even less dependent on plants for their diets. What is apparent in the limited literature is that ethnobotanical works emphasize the description of the plants, and there is little quantitative information on the extent of use by aboriginal population groups (Kuhnlein and Turner 1991). Thus, plant foods appear to be a somewhat minor component of North American aboriginal diets.

What is known is that both meat and the plant foods collected (country foods) are of considerable importance in the northern native economy (Usher 1976). Country foods have nutritional, social, economic, and cultural values associated with them that cannot be replaced by a substitute and cannot be measured easily through market forces. (Marles et al. 2000)

Examples of the importance of meat in the country food diets of Aboriginal people is described in a number of articles. Mackey and Orr (1981) stress the importance of country foods to the local population in Makkovik (n=333), Labrador Canada. The importance of country foods to these residents continues to be important not only to the economy but also to their health and well being. During the period of the study (one year/food cycle in length) it was estimated that Makkovik residents harvested approximately 28 397 kg of country mammals, birds, and fish and that 832 kg of berries were collected from their surrounding environment. It was estimated that 44% of the population had a per capita volume of country foods (meat, fish, and birds) close to or above the national average per capita consumption for all meat, fish, and poultry.

Tobias and Kay (1993) documented NTFPs collected from the Cree-speaking Metis of Pinehouse in Northern Saskatchewan. Their findings were based upon a one-year study of the total resources harvested (fish, mammals, bird, berries, and firewood) by the residents of the community. They found that 84.5 tonnes of edible meat (0.342 kg/day for each of the 676 residents) were collected. Another part of their study was to assess and assign a dollar value to the harvest for the residents.

The authors used replacement cost methods[1] and found that the bush harvest accounted for one-third of the village income. This last statement supports the argument that the Native bush harvest has both cultural and an economic value to its use.

Similar results were found by Berkes et al. (1984) in a study conducted with the Native economies in the Hudson and James Bay Lowlands in Ontario. Their study was done to assist the Omushkego Cree in developing a community and regional economic plan that would consider the traditional native economy. Aboriginal residents from eight communities (these included Moose Factory, Moosonee, New Post, Fort Albany, Kashechewan, Attawapiskat, Peawanuck, and Fort Seven) were interviewed. Berkes et al. (1984) found that the residents from the communities harvested 687 000 kg of edible meat in one year. The estimate of the replacement value of the bush meat was $7.8 million in 1990. If one were to include other products (such as fur, fuelwood, and berries) the traditional economy would account for $9.4 million for the region (or approximately $8400/household/year) which totals one-third of the cash economy.

While these studies document the economic importance of country foods other studies suggest that country foods have key nutritional significance. For example, Wein and Freeman (1995) examine the frequency of use of traditional foods by three Yukon First Nations from the communities of Haines Junction, Old Crow, Teslin, and Whitehorse. The authors found that the daily diets of individuals included traditional

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[1] Replacement cost methods involves the documentation of the quantity and range of the resources taken from the forest and then to calculate a replacement cost for these resources. The underlying premise of the calculation is to determine "how much it would cost [a hunter] to feed his family by buying the equivalent food at the store?" (Usher 1976:112). To calculate replacement costs conversion factors, based on participant observation, field measurements and detailed monitoring of harvesting activities, are used to convert live game weights into edible weights. The prices used are often the average price per kilogram of a comparable type of meat in the nearest store. This approach to valuation is controversial (Haener et al. 2001).

foods 1.14 times per day. Measured by frequency of use, it was found that traditional foods (especially moose, caribou, and salmon) remain extremely important in the contemporary diets of these aboriginal people. In another paper Wein et al. (1996), examined the use of and preference for traditional foods among the Inuit from Sanikiluaq, on Belcher Island, N.W.T. They found that traditional foods were consumed 1171 times annually for an average household (or 3.2 times daily) and that the Inuit of Sanikiluaq (both the adults and juveniles) rated traditional foods very high in terms of preference.

For aboriginal people residing in the sub-arctic and arctic regions there is very little detailed information in the literature on their use of plant foods. There are edible plant foods in such regions, and these were known as far back as 1930's when Porsild (1937) identified plants and edible plants from the Arctic regions. He also published a further study on the aboriginal use of plants in the Arctic region, but stressed that plant use by the indigenous people was minimal (Porsild 1953). Since then, Mackey and Orr (1981), Berkes et al. (1984) and Tobias and Kay (1993) describe the total amounts of wild berries collected. Mackey and Orr (1981) estimated that the local population in Makkovik Labrador harvested NTFP's amounting to three tonnes of wild berries and 682 cords of fuelwood were collected. Berkes et al. (1984) found that in the Native communities in Hudson and James Bay areas berry harvests were seasonally significant and that 39% of households collected berries. Berkes et al. found that during their study period over 1100 liters of berries were collected by residents of Attawapiskat, a community with a population of 1214.

As to the social importance of the collection of NTFPs, and especially wild fruits, Jarvenpa (1976) and Brumbach and Jarvenpa (1997) describe berry collection by the

Chipewyan, a Dene group residing in Northern Saskatchewan. Jarvenpa (1976) mentions that from late July to early September families form berry-picking parties. He describes this activity as the only activity in which men, women and children form cooperative harvesting units, although he suggests that teams consisting solely of females are more common. These teams sought blueberries, low bush cranberries, raspberries and saskatoon berries that are canned in large quantities as a food reserve for the winter. Brumbach and Jarvenpa (1997) mention that the Chipewyan do not consume a lot of locally procured plant foods, and that while berry picking is largely the domain of women and children, it involved memorable summer outings.

Thornton (1999) discusses the cultural importance of berries to the Tlingit of Southeastern Alaska. Not only did berries comprise an important nutritional component of their diet, but they also held an important symbolic element at feasts. At any winter ceremony, the most important food to be served was berries. "Gifts were distributed among guests as thanks for their attendance and participation in the healing and bolstering of the clan" (Thornton 1999). Of all the gifts awarded, berries were the most celebrated gift to receive. The berries were linked symbolically to the negotiation of status between host and guest, the raising of spirits, and to represent the landscape from which people came from (Thornton 1999).

Very little information exists on the use and importance of plants by the Gwich'in First Nation. Andre and Fehr (2001) describe the plant species used by the Gwich'in for foods, medicines, shelters and tools; and the Gwich'in Social and Cultural Institute (1995) describe the traditional uses of plants in Gwich'in territorial parks. Both of these studies shed some light on the fact that plants were valued, collected and utilized by the Gwich'in for many uses including foods, dyes, medicines and tools.

CHAPTER 3
Gwich'in Use of Non-Timber Forest Products

Introduction

The first part of this study involved the examination and exploration of the use of wild edible plants by the Gwich'in. It examined this issue by exploring the cultural inputs of the economic inputs of the production function. Thus the focus was on the institutional constraints such as property rights issues and cultural constraints such as the significance of wild fruits to the local aboriginal population. The objectives were to ascertain the use of berries by the Gwich'in, where the Gwich'in people go to collect berries, how the berries are used and to try and gain an understanding of the amount of berries the Gwich'in collect. This information is important because of the lack of literature on the subject. If one were to believe the literature the Gwich'in survived on just meat alone.

Methods

Interviews with Gwich'in Pickers

During the summer of 2000, 24 Gwich'in were interviewed to ascertain their knowledge on the use and collection of non-timber forest products in the area. Six members from each of the four communities (Aklavik, Inuvik, Tsiigethchic, and Fort McPherson) were contacted and the interviews took place in person. The people who were interviewed were selected based upon their knowledge of berries and that they are (or were) active harvesters of plants in the region. The majority of persons interviewed tended to be both female and elders within each community.

People were interviewed about their knowledge about berries and other NTFPs that grow in the region; what and how much of these they collect; what kind of processing (if any) did they do with the berries they collected; any levels of interest in producing marketable products. A list of the guiding questions can be found in Appendix A. These interviews were done to gain initial knowledge about the use of berries in the area, and to guide the development of more quantitative surveys.

Formal Telephone Survey

From the interviews done in 2000, a representative telephone survey was designed and administered in the spring and summer of 2001. The survey was administered by members of the GRRB. A copy of this survey can be found in Appendix B. The same issues were addressed as in the interviews, but in the survey the concentration was on gathering information to estimate the annual harvest levels of plant NTFPs from the four communities.

It was decided to survey 10-15% of the Gwich'in households in each community. The sample size was determined based on the NWT census data. A summary of these data can be found in Table 1. A total of 50 Gwich'in households were contacted for this survey. The number of households surveyed varied from community to community; five (13% total) households were interviewed from Tsiigehtchic, eight (16%) from Aklavik, 11 (7%) from Inuvik, and 26 (12%) were contacted from Fort McPherson. For various reasons, the percentage of Gwich'in households surveyed in Inuvik did not achieve the

Table 1. A summary of 1996 census data on the population and number of households by cultural ethincity and community in the GSA.

Community	Total Population (1996)	Gwich'in Population (% total pop)	Inuvialuit Population (% total pop)	Non Aboriginal Population (% total pop)	Total Occupied Household Dwellings	Number of Gwich'in Households (% total hholds)
Aklavik	727	165 (22.6)	400 (55)	65 (9)	218	49 (22.4)
Inuvik	3296	460 (13.9)	1210 (36.7)	1370 (41.5)	1135	158 (13.9)
Tsiigehtchic	162	125 (77)	10 (6)	10 (6)	49	38 (77.5)
Fort McPherson	878	710 (80.8)	35 (3.9)	85 (9.6)	264	213 (80.6)

(www.stats.gov.nt.ca Date accessed Aug. 31 2001.)

desired total. However, it was still deemed representative of those Gwich'in residing in that community by the GRRB staff.

The survey was administered during the spring and early summer, prior to the major NTFP plant harvesting periods, in order to make sure the required number of people, were contacted. It was discovered during the interviews, that many of the people interviewed provided various measurement units for amounts of NTFPs collected. To estimate household collection levels, a standardized number of volume measurements were used to convert collection amounts to common units. This information is presented in Table 2.

Results and Discussion

Collection of Non-timber Forest Products

The interviews solicited information on the types of NTFPs collected by Gwich'in pickers. Wild berries were by far the most common products collected. This observation is supported by authors such as Johnson et al. (1995) and Kuhnlein and Turner (1991), who estimate that of the plant foods collected berries were the most frequently plant food collected and consumed.

Mushrooms were not reported to be collected by any of the 24 interviewees. This is supported by information presented by Andre and Fehr (2001) who claim that fungus is not commonly used or collected as a food source by the Gwich'in. When fungus is collected, Andre and Fehr (2001) claim that the Gwich'in use it for medicine, tobacco, mosquito repellent, and for mothballs.

Table 2. The measured volumes of containers commonly used by Gwich'in pickers to collect berries.

Size of container	Amount of berries (liters)
Small ziplock bag	1.85
Large ziplock bag	3.70
Lard pail	2.00
Ice cream pail	4.00
Jugs	2.00
Egg box	25.00

The other main plant NTFP collected was Labrador tea. The interviewees either reported the picking of Labrador tea as a leaf product or as an "other" category. Labrador tea is not used as a food source but it is used in teas. It is said that Labrador tea helps prevents colds and that many elders suggest drinking one cup per day (Andre and Fehr 2001).

The Species of Wild Berries Collected

Based on the in-person interviews it was found that there are approximately seven species of berries collected in the region (Figure 2). The common names, scientific names, and both the Gwichya and Teett'it dialect names of the berries are listed in Table 3. For these berry pickers, cloudberries, cranberries and blueberries were the most popular species picked. All of the 24 (100%) pickers interviewed collected cloudberries and blueberries; 23 (96%) collected cranberries.

As for the remaining berry species (crowberry, red and black currant, and raspberry) many people did not go out of their way to pick them. During one interview, it was said that,

> "They don't taste as good as the yellowberries (the other berries) but you always just get some in your pail when you pick berries."

This comment would be the case for the crowberries. As for currants and raspberries people did want to collect them but they grew in extremely small patches. One interviewee stated that,

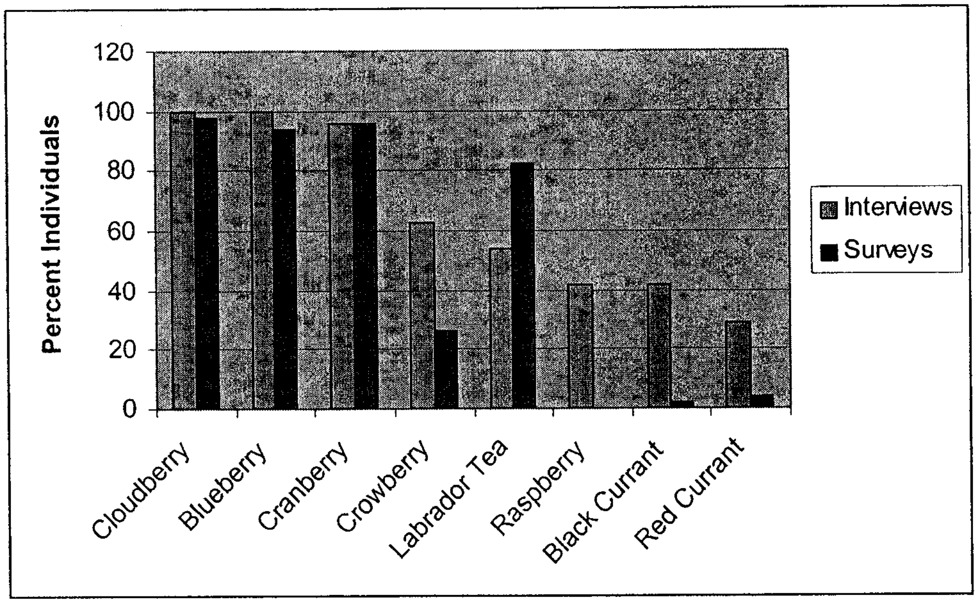

Figure 2. Percentage of individuals who collect various berries in the GSA.

Table 3. The common English names, Gwich'in names, and Latin names of wild berries species found in the GSA. (Adapted from Andre and Fehr 2001, and Porsild and Cody 1980)

English names	Gwich'in names	Latin names
Cloudberry (Yellowberries)	Nakàl (G) Nakal (T)	*Rubus chamaemorus*
Cranberry (Lingonberry)	Natl'at	*Vaccinium vitis-idaea*
Blueberry	Jàk zheii (G) Jak na or Jak naalyuu (T)	*Vaccinium uliginosum*
Crowberry (Blackberry)	Dineech'ùh (G) Dineech'uh (T)	*Empetrum nigrum*
Buffaloberry (Soapberry/Mooseberry)	Dìnjik jàk (G) Dinjik jàk (T)	*Sheperdia canadensis*
Black currant	Deetree jàk	*Ribes hudsonianum*
Red currant	Eneeyù' (G) Nee'uu (T)	*Ribes triste*
Rose hips	Nichìh (G) Nichih (T)	*Rosa acicularis*
Juniper	Deetreè jàk (G) Ts'ìivii ch'ok (T)	*Juniperus communis*
Bearberry (Stoneberry)	Dàn daih (G) Dandaih (T)	*Arctostaphylos uva-ursi*
Red Bearberry (Bird's eye)	Dzhii ndeè (G) Shis jak (T)	*Arctostaphylos rubra*
Labrador tea (Muskeg tea)	Lidd maskeg/maskig (T)	*Ledum palustre*

G indicates the name in the Gwichya dialect
T indicates the name in the Tee'it dialect

> "Raspberries are good but it is are hard to find a lot of them, and when you do find a patch you don't tell anyone about it....although you must share your berries after you pick them with those who can't get in the land anymore."

The same can be said for both species of currants. As will be discussed in the next chapter, both black and red currants grow in very limited numbers, and in assessing production levels in botanical surveys, no raspberries were encountered. The scarcity of these berry species in the GSA points to the reasons why the Gwich'in do not collect these types of berries in great amounts.

Where Berries are Collected

When the interviewees where asked, "Where they go to collect berries?" the answers ranged over the dominant vegetation types in the region (Figure 3). The most popular areas to collect berries were bog/peat areas and the foothills/mountains: while white and black spruce stands and burnt areas were the least popular to pick in. A large number of interviewees indicated the "other" category when asked where they picked. The majority of interviewees who selected this category included their fish camps as a location for berry collection. It is interesting that they do not associate a vegetation type with their fish camps. Also provided in selecting the "other" category were statements such as:

> "In the old days, we used to fly in to lakes to fish and pick berries when they were in season."

It also follows that access to these remote sites may not be that easy. White spruce stands in upland areas are located on hummocks and exist far off any major access

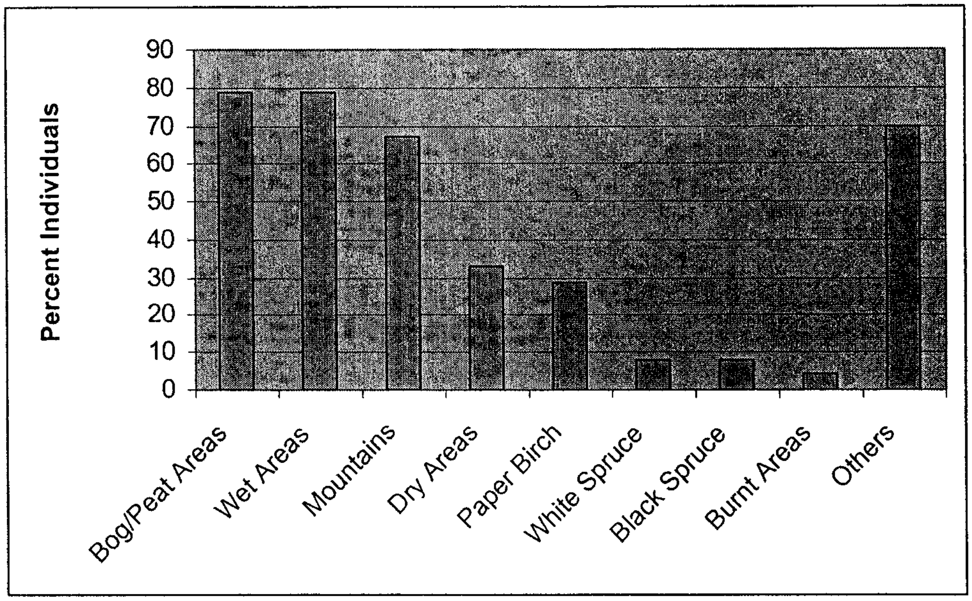

Figure 3. The distribution of vegetation types where Gwich'in collected berries in 1999.

corridor. These sites are not convenient to travel to and therefore are not efficient berry sites to pick in.

The least popular location for berry collection was in burnt areas. Although no specific reason was given, two interviewees stated that:

> "No berries grow in those (burnt) places", and
>
> "There are no fires around here and that is why we don't pick there."

How Berries are Prepared for Eating

The most popular ways to use the collected berries was to clean and serve the berries fresh or in others (Figure 4). This other category includes desserts such as trifles, muffins, itsu[2] and medicines. Jams and pies then followed, with the least popular methods of using berries were jellies and teas. It should be noted that many interviewees stated that berries might not be used right away and could be stored and brought out for special occasions and holidays. For example one person stated that,

> "At Christmas we take our berries which we haven't used and make trifle and other desserts from them."

Although the use of wild berries as medicines was not a part of this study, many interviewees stated that berries and other plants collected were used as remedies or medicines. Certain tree species for example were collected for this use. Black spruce cones were collected and boiled and used to treat colds, coughs and bronchitis. Young white birch trees were collected and boiled and the tea was used to treat ulcers or for other stomach problems.

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[2] Itsu is a traditional food that is produced from mixing fish and berries.

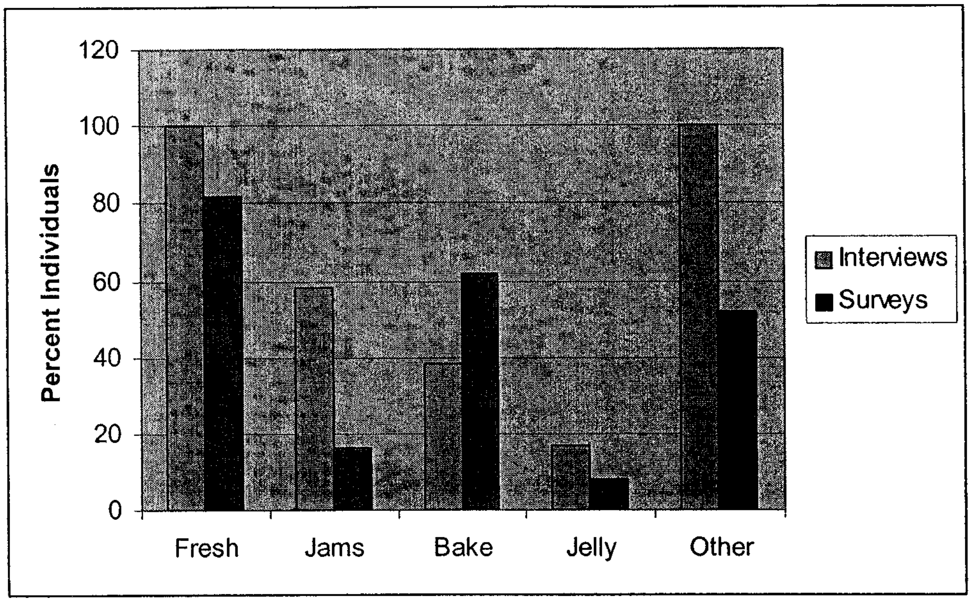

Figure 4. The percent distribution of food types in which the Gwich'in used the berries they collected in 1999 and 2000.

Certain berry species were also said to have medicinal purposes. Crowberries were considered good for a "bad stomach", and cranberry juice was considered good for kidney problems and to help stop coughs (Andre and Fehr 2001, Gwich'in Social and Cultural Institute 1995).

Another important issue, which was uncovered in the interviews, was that berries played an important role culturally. Many of the interviewees stated that at holidays, gatherings and other special occasions berries were served. An example of this importance for First Nations people can be found in an article by Thornton (1999). He examined the use of berries by the Tligit, a First Nations People from southeast Alaska. The Tligit collected berries for trade, and comprised an important and symbolic element in ceremonial feasts. At feasts, the most important food to be served was berries, and it was berries, received as a gift were the most celebrated.

Interest in Selling Berries and Berry Products

About 29% of interviewees said they would be willing to sell the berries they collect; the other 71% said they would not. Specific reasons provided by several interviewees for the lack of interest in selling berries were:

> "You must not sell berries...they aren't meant to be sold or collected in those amounts. You should only take what you need."
>
> "If you have any extra berries, you must give them away to people who can't get in to the land any more."
>
> "Picking berries is hard work...it is not worth it to pick them and sell for money."

From the 29% who said they would be willing to sell berries, the majority of people would be willing to sell to a local market as long as there were enough berries produced in a given year. It became apparent that many interviewees gained the impression given that sales of berries or berry products may be a proposed business venture to be run by an "outsider". In other words the people thought that if products were to be produced it would not be a Gwich'in business venture.

As informal discussions took place many interviewed warmed to the idea of a berry product, which could be collected, produced and marketed by the Gwich'in people. The majority of these informal interviews took place with members of the Renewable Resource Councils (RRC). These RRCs meet generally once a month. It was at these meetings where the discussions in berry selling took place. As the members of the RRC's heard the idea many thought that it could possibly be an economic opportunity for community members to participate in, and many thought that the income generated would be useful. The one concern that was always brought up was the question of whether there would be enough berries for people to collect for themselves if such an enterprise took place.

Some issues became apparent from comments made in the interviews and personal knowledge gained through spending two summers living in the GSA. One was that it appears that the Gwich'in pickers have a system of informal property rights regarding berry patches. Many of these patches reside around individual or family fish camps, and thus certain patches are picked by specific families (and indeed specific family members) every year. If another person not in the fish camp party wants to pick in these patches[3] permission must be asked.

Also when picking berries, it is "polite" practice not to pick every berry in the area. This is done to ensure that there are still enough berries for other pickers and also for the animals that use the berries. Thus, many Gwich'in believe in only picking enough berries for themselves and family members. Remaining berries should be distributed to those in the community who cannot get out on the land anymore such as elders (Andre and Fehr 2001, Gwich'in Social and Cultural Institute 1995).

Telephone Survey Results

The results of the telephone survey suggested that 45% of Gwich'in households in the GSA collected cloudberries, 29% collected blueberries, and 24% pick cranberries (Figure 2). These percentages are different than those for the interviews done in 1999 because the interviews only involved pickers, while the telephone survey involved a randomly drawn sample of households.

For the three most popular berry species collected there were differences in household participation in picking across the four GSA communities (Figure 5). In Inuvik, just over 60% of households surveyed collected cloudberries, and about 90% collected both cranberries and blueberries. For Akalvik, 100% of households surveyed

[3] It is often the case that "berry patches" are owned by family groups. An example of this is noted by Thorton (1999). He states that the berry patches of the Tlingit were treated as hereditary property by matrilineal clans, and that if another family wished to collect berries in another families patch, permission had be to asked and given. Also, Kuhnlein and Turner (1991) note that the ownership and stewardship of particular harvesting sites by individuals, families, and village groups was widely recognized in North American aboriginal culture and that proprietorship carried on for many successive generations.

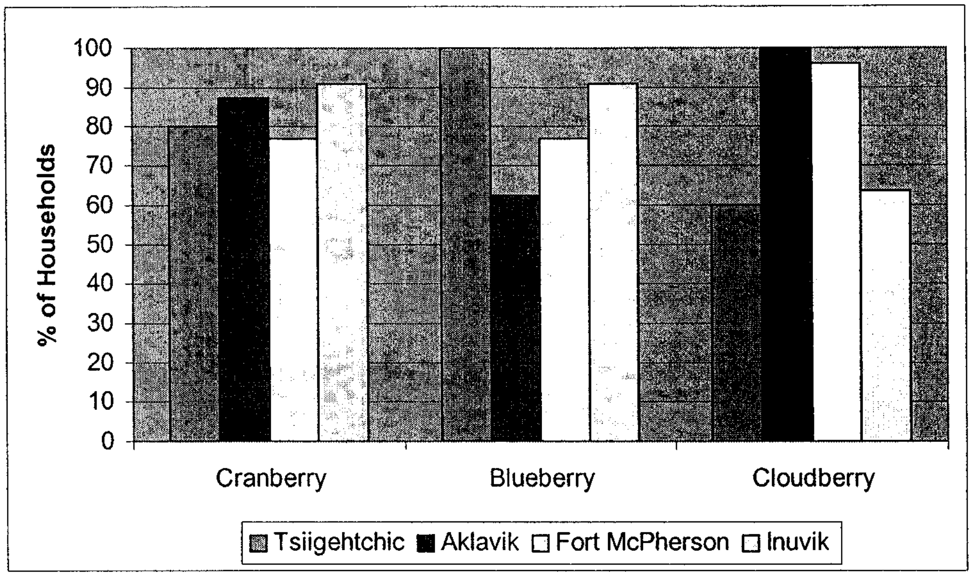

Figure 5. The types of edible fruits collected by Gwich'in households from each of the four communities in the GSA.

collected cloudberries, while over 80% picked cranberries, and about 60% picked blueberries. For the community of Tsiigehtchic, 100% of those surveyed collected blueberries, 80% picked cranberries, and only 60% collected cloudberries. In the last community, Fort McPherson, just under 100% collected cloudberries, and just under 80% collected both blueberries and cranberries.

Information was also gathered on the amount of Labrador tea collected by the communities. It was found that on average households from surveyed from the community of Inuvik collected 9.2 liters of tea. Aklavik households collected 1.65 liters, Fort McPherson households collected 8.3 liters, and that those surveyed from Tsiigehtchic collected 18.4 liters of Labrador tea.

The most popular method stated by the Gwich'in to prepare berries was to clean and serve the berries fresh (Figure 4). This was followed by using the berries in baking and "other" uses such as the preparation of itsu.

During this survey we also revisited the question of, "Would you be willing to sell the berries you collect?" We also asked respondents "Have you ever sold the berries they had picked in the past?" During this survey only one person of the 50 people surveyed would be willing to sell the berries they collect. Although as with the year 2000, when at the Renewable Resource Council meetings, and through informal discussions with Gwich'in, they became more interested in the idea once it was known that this project could be run by the Gwich'in themselves. For the second question asked, 14 of the 50 Gwich'in responded that in the past they had either sold or traded their berries for other goods. The comments received by the telephone surveyors were similar to those in the year 2000. Such comments included, "You never sell your berries…only give them away if you have too much."

"If we needed meat, and had lots of berries, we would trade our berries for meat."

One of the key factors of this survey was to elicit and gain knowledge on the total quantities of berries collected by Gwich'in in the GSA. After analyzing the interviews from 2000 and the surveys from 2001, it was decided to concentrate further effort on the 3 most commonly picked berries in the GSA. These were cloudberries, cranberries and blueberries. There are 49 Gwich'in households in Aklavik, 158 Gwich'in households in Inuvik, 38 Gwich'in households in Tsiigehtchic, and 213 Gwich'in households in Fort McPherson (Table 1). Using the data from Figure 5 and Table 3, the number of Gwich'in households that picked berries was determined. From this the total amount of berries collected per community and for the entire GSA was estimated (Table 4).

The results indicate that for the year 2000, Gwich'in households in Aklavik collected a total of 1445 L. of berries (513 L were cranberries, 137 L were blueberries, and 784 L were cloudberries.). For Inuvik, a total of 4986 L were collected. (2714 L of cranberries were collected, 1378 L of blueberries were collected, and 894 L of cloudberries were collected.) In Tsiigehtchic, a total of 570 L were collected. (191 L of cranberries were collected, 254 L of blueberries were collected, and 125 L of cloudberries were collected.) In Fort McPherson a total of 8354 L of berries were collected. (982 L of cranberries were collected, 2457 L of blueberries were collected, and 4915 L of cloudberries were collected.) This information was used to estimate the total quantity of berries collected by the Gwich'in in the GSA. This amounted to a total of 15344 L of berries being collected by Gwich'in in the GSA, with 4400 L of

Table 4. Estimates of total quantities of three most commonly collected wild berry species by Gwich'in households in each of the four communities.

Community	Avg. quantity of berries collected by surveyed households (litres)			Total qunatity of berries collected by community (litres)			
	Cranberry	Blueberry	Cloudberry	Cranberry	Blueberry	Cloudberry	Total
Aklavik	12	4.5	16	513	137	784	1435
Inuvik	18.9	9.6	8.9	2714	1378	894	4987
Tsiigehtchic	6.3	6.7	5.5	191	254	125	571
Fort McPherson	6	6	24	982	2457	4915	8355
Total				4400	4226	6718	15344

cranberries being collected, 4226 L of blueberries collected, and 6718 L of cloudberries collected.

It is interesting to compare these estimates with three other studies that provide estimates of the total quantity of berries collected by Nordic countries and aboriginal people. Rossi et al. (1984) estimate that of the berry pickers in central Finland, 86% of the families picked cranberries. The average amount collected was 17.6 liters/person, which totals between 9-44% of the total cranberry yield. The authors also estimated that 79% of the pickers collected bilberries, which amounted to 5.6 liters/person, which totaled between 5-21% of the entire bilberry berry yield. Salo (1985) estimated that in eastern Finland the amount of wild berries, which were collected, was 49.4-56.4 kg/person.

Tobias and Kay (1993) they noted that the residents of Pinehouse Sk. (Cree speaking Metis) collected a total of three tonnes of berries during 1983 to 1984. Although Pinehouse has only 676 residents, the total amount collected is around one third of that collected by the 1500 Gwich'in residents in 2000[4]. Mackey and Orr (1987) study of the residents of Makkovik, Labrador, found that for a population of 333 residents, 832 kg of berries were collected over a one-year period between July 1980 and June 1981. When comparing this to Gwich'in numbers, it would appear that the 125 Gwich'in residents of the community of Tsiigehtchic collected larger quantities of berries than the residents of Makkovik. Finally a study done by Berkes et al. (1994) estimate that in the community of Attawpiskat, whose population was 1214 collected approximately 1100 L of berries. Once again this number does not come close to the amount the Gwich'in

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[4] This represents the total Gwich'in population in 1996 from Table 1.

collect. This information suggests that wild berries are a more important food source for the Gwich'in in the GSA then for other aboriginal people.

Conclusion

While not definitive, the research reported in this chapter sheds light on some of the production relationships surrounding wild berry use by the Gwich'in. The Gwich'in appear to collect considerable quantities of berries and have considerable knowledge on where berries grow. However, the questions of supply of the berries required for the development of a market in wild berry products are complicated by the "informal" system of property rights held by the Gwich'in with berry patches. The collection of berries, while not complicated in terms of the need for capital investment, probably requires high amounts of labour. Whether the Gwich'in are willing to invest additional labour in collecting berries beyond amounts required for traditional use is an open question.

CHAPTER 4
The Supply of Wild Berries in the Gwich'in Settlement Area

Introduction

As mentioned in Chapters 2 and 3 it is evident that First Nation Peoples have a long tradition of using plants found in their regions. Such uses included medicines, tools, shelter and foods. In particular, Gwich'in bush food diets include wild fruits and berries. The previous chapter outlined a number of the cultural features surrounding the collection of these berries. It also provided information in the traditional knowledge of the Gwich'in regarding berries and their collection. However, it is apparent after examining the botanic literature is there is a lack of knowledge concerning the biology and levels of productivity of the plants that produce edible berries that grow in this area of Northern Canada.

This chapter presents results of the research conducted to inventory the species of fruit bearing plants within the major vegetation types in the GSA and to quantify the total supply of berries available to the Gwich'in People in the GSA. This information is a key requirement for development of a sustainable forest management plan in which the use of non-timber forest products is to be incorporated. It is important information that is required in examining the development of economic opportunities involving NTFPs so that the physical supply side of the production function can be understood.

This component of the research effort had five objectives. These were: 1) to determine the amounts and geographical extent of the various vegetation types in the GSA 2) To identify the various species of fruit bearing plants that grow in each vegetation type 3) To derive measures of the abundance of these plant species in each vegetation type 4) To determine the weight of fruit collected from the selected plant species 5) To derive estimates of the total production of fruit from selected fruit bearing species for the years 2000 and 2001.

Methodology

The Study Area, Ecosystem Types and their Composition

The GSA encompasses two distinct ecosystem types: the Mackenzie Delta and the forested uplands. Located within these two ecosystems are five vegetation types. These are Paper Birch (*Betula papyrifera var. papyrifera)* forests, White Spruce (*Picea glauca)* forests, Black Spruce (*Picea mariana*) forests, peatlands and the foothills/tundra areas. The Gwich'in Renewable Resource Board (GRRB) has conducted extensive inventories of these vegetation types in the GSA. At the time of the study, approximately 85% of the entire GSA had been mapped. This information was examined using a Geographical Information System (GIS) and the composition of the surveyed GSA in terms of the dominant vegetation types was determined. The results are shown in Table 5. The dominant vegetation type is Black Spruce forest, comprising over 65% of the area surveyed to date. Foothills/tundra areas and White Spruce forest are the next most common vegetation types, each comprising 13.8% and 10.4% of the surveyed area. Paper Birch forests and Wetlands comprise the remainder of the surveyed GSA.

Most of the area within the GSA is inaccessible for the collection of wild berries by residents. The most accessible areas are along the Dempster Highway and the few watercourses and roads that connect with it. In order to develop estimates of the levels of supply of available fruit, a 1 km buffer was established along each side of the Dempster

Table 5. The amount and percent composition of vegetation types in the Gwich'in Settlement Area (GSA) and of a 1 km^2 buffer along the Dempster Highway in the Gwich'in Settlement Area.

Vegetation types	Thousands of hectares (% total)	
	In surveyed GSA	In Dempster Highway Buffer
Black Spruce	1332.25 (65.3)	18.05 (74.0)
Foothills/tundra	281.46 (13.8)	0.27 (1.1)
White Spruce	212.39 (10.4)	2.35 (9.6)
Peat/bog	133.82 (6.6)	1.98 (8.1)
Birch	78.56 (3.9)	1.74 (7.1)
Total	2038.48 (100.0)	24.39 (99.9)

Note that at the time these estimates were generated that only 85% of the GSA had been surveyed and mapped.

Highway using the GIS. The location and amounts of the five vegetation types were determined within this buffer. The results, shown in Table 5, provide a different pattern of vegetation types than exhibited in the entire GSA. Black Spruce forests still dominate the vegetation cover, but Peat/Bog areas and Paper Birch forest comprise relatively larger portions of this accessible forest.

Determination of Percent Cover, Production Levels, and Weights of Berries

Early in the study the location of suitable areas for estimating fruit production levels were determined. Initially this involved informal discussion with GRRB biologists and other staff. However, interviews with Gwich'in pickers in 2000 also assisted in this initial determination (Figure 3). Subsequent to these discussions with local people, trips were taken by vehicle along the Dempster highway from Inuvik to the Yukon/Northwest border where various vegetation types were examined for fruit bearing plants.

Based on observations of these vegetation types the study area was divided into four main areas along the Dempster highway. The first area was established from Inuvik to approximately 30-km south down the highway. The next section was from that 30 km point to the ferry crossing at the Arctic Red and Mackenzie rivers. The third section was from the ferry crossing at the Arctic Red and Mackenzie rivers to the second ferry crossing at the Peel River. The final section was from the Peel River to the Northwest Territory/Yukon border. Within each of these sections, six randomly selected transect lines were placed, in each of the vegetation types. This amounted to two transect lines per vegetation type in each area of study except in the last section from the Peel River to the Northwest Territory/Yukon border. For this section, the only vegetation type in this section of the study area was the foothills/tundra area. It should be noted that in only this section was the foothills/tundra vegetation sites were located. The transects were 100m in length, and were placed in a vegetation type that was at least 200m in diameter. Each transect was located with a minimum distance of 100m from the highway to avoid dust contamination. The UTM coordinates of these sites are identified in the Appendix C.

During the summer (mid to late June), and after the full leaf expansion, the areal cover in terms of percent cover of each fruit bearing plant species was estimated on nested plots of 1, 2, and 5m^2 at every 5m point along each transect line. The smaller quadrats were used to determine the percent cover for the soil surface and uniformly distributed species such as lowbush cranberry (called cranberry below). The larger quadrats were used to assess the percent cover for the more non-uniformly distributed shrubs such as blueberry. For the shrubs, the height and width of each bush was measured to provide an estimate of volume.

In the late summer (late July, early August) these transects were revisited to obtain estimates of the actual quantities of berries produced. In 2000, all sites were revisited and on six 1m^2 plots all the berries on each plant were counted. In 2001, the same transects were revisited, but the number of plots assessed was increased from 6 to 20 to lower the standard error of the mean production estimate. For the prostrate berry species such as cranberry, crowberry, and bearberry, the number of terminal shoots was counted. For cloudberry the number of plants was counted. For shrubs such as blueberry and prickly rose, 20 randomly located shrubs were selected, measured for cover and height, and all of the berries on the shrub were counted.

In addition, approximately 100 berries were collected for each of the fruit bearing species. This allowed for a "wet" weight measurement of the fruit. The wet berries were then dried for 48 hours at 100 C to determine the water content and their "dry" weight.

To estimate the maximum production potential of fruit from the plants the maximum and average number of berries found on the terminal shoots in the study were multiplied by the number of terminal shrubs, which were then multiplied by the wet and dry weights of the berries. This procedure provided both an estimate of the actual weight (g/m^2) of berries produced in a year and an estimate of the maximum production of fruit in a year.

Once the production levels of fruit were understood in selected plots, these estimates were "inflated" to estimate fruit production levels (in g/m^2) by vegetation type. This knowledge in turn, permitted estimation of the total production of various fruits for the surveyed GSA and those parts of the GSA that are accessible for picking.

Results and Discussion

<u>Presence of Fruit-Bearing Plants in Each Vegetation Type</u>

A total of seven different berry species were found in the White Spruce vegetation type. These forests contained the highest number of fruit- bearing species. The Black Spruce and Paper Birch vegetation types had six different species. The peat/bog and foothills tundra vegetation types had the least diversity of fruit-bearing species with only four species found.

Cranberries, blueberries, and crowberries were found in each one of the five vegetation types. The next two most commonly found berries in the region were prickly rose (which was be found in Paper Birch stands as well as Black and White Spruce stands) and cloudberries, which were found in Black Spruce stands, Peat/Bog areas and in the Foothills/Tundra vegetation type. Red and black currant species were only found in the Paper Birch stands. Buffaloberry, juniper berry, and bearberry were unique to White Spruce stands, while red bearberry was only found in the Black Spruce stands.

The Abundance of Fruit-Bearing Plants by Vegetation Type

Table 6 shows the abundance of each of the species in terms of percent cover found in the five vegetation types. Cranberry and cloudberry plants were most abundant in the Foothills/tundra vegetation types. Collectively these two plant species on average contributed to over 66% of the ground cover in this vegetation type. In Peat/Bog areas, these same two species only contributed to about 22% of ground cover. Cranberry plants were also important ground cover in White and Black Spruce stands. However, the percent cover estimates for cranberry were about a third of that in the Foothills/tundra estimates and about one sixth of those in the Black Spruce stands.

Cloudberry, while important groundcover in the Foothills areas, was also numerous in the Peat/Bog areas. The estimates of its ground cover were similar between the two years (Table 6). While found in the Black Spruce vegetation type, cloudberry plants were not numerous and were mostly associated with the low lying wet areas in the spruce stands.

Blueberry shrubs were most common in the Peat/Bog and Black Spruce vegetation types. In the former this species contributed over 14% of the groundcovers while in the latter, blueberry comprised about 10%. The species was found to a lesser

Table 6. Estimates of the percent cover of 11 edible fruits bearing species by vegetation type in the Gwich'in Settlement Area for the years 2000 and 2001 (n=6 transects/vegetation type)

Berry Species	Mean % cover (± standard error)									
	Black Spruce		White Spruce		Paper Birch		Peat/bog		Foothills/tundra	
Cranberry	12±1	17±1	6±1	5±0.7	7±1	7±1	12±1	9±1	Not measured	38±1
Blueberry	10±1	5±1	5±1	4±0.7	Tr.	Tr.	14±1	11±1		1±Tr.
Cloudberry	Tr.	1±Tr.	0.0	0.0	0.0	0.0	9±1	9±1		28±2
Crowberry	3±Tr.	3±Tr.	Tr.	1±Tr.	Tr.	0.0	5±1	4±1		10±1
Red currant	0.0	0.0	0.0	0.0	Tr.	Tr.	0.0	0.0		0.0
Black currant	0.0	0.0	0.0	0.0	1±Tr.	Tr.	0.0	0.0		0.0
Prickly rose	Tr.	0.0	3±1	Tr.	1±Tr.	1±Tr.	0.0	0.0		0.0
Buffaloberry	0.0	0.0	Tr.	0.0	0.0	0.0	0.0	0.0		0.0
Juniper berry	0.0	0.0	4±1	2±Tr.	0.0	0.0	0.0	0.0		0.0
Bearberry	0.0	0.0	8±1	4±Tr.	0.0	0.0	0.0	0.0		0.0
Red bearberry	0.0	Tr.	0.0	0.0	0.0	0.0	0.0	0.0		0.0

extent in the White Spruce and Foothills vegetation types. Very few blueberry shrubs were located in the birch stands.

The Paper Birch vegetation type had the lowest percent cover of fruit-bearing species. The reason for this observed difference between the birch stands and the foothills/tundra, and peat/bog areas is that the berry species may have less competition in terms of water absorption and direct access to sunlight. In the birch stands there is more competition for water and the sunlight does not penetrate the leaf cover as easily.

As seen from Chapter 3, the most commonly collected berries by the Gwich'in are cloudberries, blueberries and cranberries. This suggests that the foothills/tundra and Peat/bog areas are important vegetation types to the Gwich'in, as it is these areas which produce the berries most frequently collected. Each community appears to exhibit slightly different preferences for the berries collected (Figure 5). These differences can possibly be attributed to the location of each community in the GSA. Cloudberries tend to be highly concentrated in the foothills/tundra regions, which are located closer to the communities of Aklavik and Fort McPherson while cranberries and blueberries are produced more in the areas surrounding Inuvik and Tsiigehtchic. This is not to say that the Gwich'in in Tsiigehtchic prefer one berry species to another, but the apparent preferences we observed are likely more indicative of the accessibility of certain berry species.

Wet and Dry Weights of the Different Berry Species

Fruit production and sales is commonly measured by weight. Thus, estimates of the production of wild berries in terms of weights per unit area would be valuable information in understanding the supply of fruit available. In order to provide these estimates the weights of fruits need to be calculated first. Table 7 shows the wet and dry weights of the different berry samples collected, along with the percent dry weight found in the fruits.

The fruit with the highest dry weight was juniper berry (44%), followed by crowberry (40%), blueberry (30%), and all other fruits having a dry weight of 25% or less.

Wild Berry Production Level in g/m^2 by Vegetation Type

The production of fruits by weight for each vegetation type for the two years of study is shown in Table 8. As with the percent cover (Table 6), the most productive vegetation types were the Foothills/Tundra areas, followed in order by the Peat/Bog, White Spruce, Black Spruce, and Paper Birch stands.

Table 8 displays two estimates of production. The differences between these estimates are illustrated with the Black Spruce vegetation type. During the year 2000, the Black Spruce stands produced an estimated average of 176.9 g/m^2 of cranberries, 64.8 g/m^2 of crowberries, 29.5 g/m^2 of blueberries, and 27.2 g/m^2 of cloudberries, with just traces of black currant and prickly rose being found. Fruit-bearing plants in this vegetation type had the potential to produce a maximum of 294.8 g/m^2 of cranberries, 129.7 g/m^2 of crowberries, 132.9 g/m^2 of blueberries, and 27.2 g/m^2 of cloudberries. For the next year of study (2001), however, the same sites studied actually produced 176.4 g/m^2 of cranberry, 6.4g/m^2 of blueberries, and 123.9 g/m^2 of crowberries, with just traces of black currant and prickly rose being found. No cloudberry plants assessed were found

Table 7. Wet and dry weight of individual berries weights (g), and dry mass (%) of wild fruits collected in the Gwich'in Settlement Area.

Berry Species	Wet Weight (g)	Dry Weight (g)	% Dry Mass
Cranberry	0.14	0.03	18
Blueberry	0.37	0.11	30
Cloudberry	1.93	0.49	25
Crowberry	0.27	0.11	40
Black Currant	0.26	0.02	6
Prickly Rose	1.01	0.23	23
Buffaloberry	0.13	0.02	17
Juniper Berry	0.19	0.08	44
Bearberry	0.64	0.16	25

Table 8. Actual and estimated mean wet weights (± standard error) of edible fruits collected from plants in various vegetation types in the Gwich'in Settlement Area during two years (2000 and 2001).

For the Year 2000

Berry Species	Wet weight (g/m^2)									
	Black Spruce		White Spruce		Paper Birch		Peat/bog		Foothills/tundra	
	Actual	Maximum	Actual	Maximum	Actual	Maximum	Actual	Maximum	Actual	Maximum
Cranberry	176.9±39.2	294.8±65.3	170.6±73.1	284.4±121.1	62.2±28.0	103.68±46.8	106.8±36.5	177.0±60.9	Not Measured	
Blueberry	29.5±13.4	132.9±59.4	28.1±8.5	103.3±20.5	Tr.	Tr.	74.7±20.1	305.7±61.2		
Cloudberry	27.2±9.6	27.2±9.6	0.0	0.0	0.0	0.0	122.8±33.2	122.8±33.2		
Crowberry	64.8±22.6	129.7±45.2	66.4±26.4	132.1±52.7	3.6±3.6	6.5±6.5	70.6±38.6	141.2±77.2		
Red currant	0.0	0.0	0.0	0.0	Tr.	Tr.	0.0	0.0		
Black currant	Tr.	Tr.	0.0	0.0	Tr.	Tr.	0.0	0.0		
Prickly rose	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	0.0	0.0		
Juniper berry	0.0	0.0	48.77±20.59	81.28±34.31	0.0	0.0	0.0	0.0		
Buffaloberry	0.0	0.0	Tr.	Tr.	0.0	0.0	0.0	0.0		
Bearberry	0.0	0.0	Tr.	Tr.	0.0	0.0	0.0	0.0		

For the Year 2001

Cranberry	176.4±16.2	293.3±27.0	96.6±22.1	161.0±37.0	52.2±21.3	87.0±35.5	127.8±44.4	212.9±73.9	348.9±27.0	581.5±45.0
Blueberry	6.4±3.1	57.3±26.0	2.1±0.6	38.1±15.3	0.0	0.0	7.9±2.1	61.1±13.8	0.6±0.2	7.7±3.5
Cloudberry	0.0	37.4±5.3	0.0	0.0	0.0	0.0	0.0	58.3±26.8	0.0	198.6±16.3
Crowberry	123.9±68.2	165.5±91.0	57.4±27.4	76.6±36.5	0.0	0.0	114.9±41.1	153.2±54.8	203.7±75.1	271.6±100.2
Red currant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Black currant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prickly rose	0.0	0.0	Tr.	Tr.	16.7±5.8	45.1±10.5	0.0	0.0	0.0	0.0
Juniper berry	0.0	0.0	Tr.	Tr.	0.0	0.0	0.0	0.0	0.0	0.0
Buffaloberry	0.0	0.0	Tr.	Tr.	0.0	0.0	0.0	0.0	0.0	0.0
Bearberry	0.0	0.0	Tr.	Tr.	0.0	0.0	0.0	0.0	0.0	0.0

to be producing fruit. The same site in 2001 had the potential to produce a maximum of 293.4 g/m^2 of cranberry, 57.3 g/m^2 of blueberries, and 165.5 g/m^2 of crowberries, and 37.4 g/m^2 of cloudberries. Similar patterns are found for the White Spruce and Paper Birch vegetation types.

As for the foothills/tundra area, the only measurements that were taken were those from the year 2001. In that vegetation type, the actual number of berries produced were 348.9 g/m^2 of cranberries, 0.6 g/m^2 of blueberries, and 203.7 g/m^2 of crowberries. The surveyed sites had the potential to produce a maximum of 581.5 g/m^2 of cranberries, 271.6 g/m^2 of crowberry, 198.6 g/m^2 of cloudberry, and 7.7 g/m^2 of blueberry. Cloudberry actual and potential production appears highest in this vegetation type.

The annual differences in production of these three berry species illustrate the importance of vegetation type and weather patterns in the supply of fruit in the GSA. Cranberry production in Black Spruce vegetation types was similar in each of the two years of study (Table 8). However, in White Spruce and Paper Birch stands cranberry production in 2000 was greater than that of 2001. A similar pattern was found for the production of blueberries. Cloudberries show the most variable pattern of production within the two years studied. While the abundance of cloudberry plants were roughly similar between the two years (Table 6) the production of cloudberry fruit in 2001 was nil (Table 8). The estimated mean maximum weight of fruit that could be potentially produced, however, was larger in the Black Spruce type in 2001 than in 2000.
This annual difference in production can possibly be attributed to the weather differences between the two years. Table 9 shows the average annual temperature and precipitation for the Inuvik region. In the year 2000 the region experienced normal to near normal

Table 9. Average weather conditions for the Inuvik region

	Temperature (^{0}C)				
	May	June	July	August	September
Maximum	4	17	20	16	8
Minimum	-5	5	8	5	0
Mean	0	11	14	11	3
	Precipitation				
Rain (mm)	7	20	34	39	15
Snow (cm)	15	2	0	4	11
Total (mm)	19	22	34	44	24

(http://www.theweathernetwork.com/weatherstatistics/static/C02194.htm Date accessed June 14 2002) temperature levels, but experienced above normal precipitation levels. In 2001, the region experienced near normal temperatures, but experienced below normal precipitation levels. (http://weather office.ec.gc.ca/saisons/index_e.html/ Date accessed June 11 2002.) The difference in the precipitation levels in the 2 years may be the cause of the lack of cloudberry production in 2001. Salo (1985) also offers other possible factors influencing berry production. The preceding growing season can influence the next season growth, the thickness of the snow blanket, spring frosts, and successful pollination can all influence berry production. Cloudberries tend to grow in bog areas, usually with sphagnum moss (Johnson et. al. 1995). Thus, with the lack of precipitation in 2001 the plants would not be able to produce fruit easily. These observations point to caution in utilizing only a single years worth of information to estimate wild fruit production as the estimates maybe subject to considerable annual variation.

Estimates of Fruit Production in the Entire Gwich'in Settlement Area

Estimates of wild fruit production in terms of g/m^2 for each vegetation type (Table 8) were used to determine the total level of production in the entire GSA and accessible portions of the GSA. These total estimates involved taking the g/m^2 of each fruit in each vegetation type and multiplying them by the total area of that vegetation type in the GSA or the accessible GSA (Table 5). Tables 10 and 11 provide these total estimates for the actual and maximum potential production of each type of fruit. It is noteworthy that for the total berry production levels in the entire GSA cranberry, blueberry, and crowberry were the most abundant berries. Cloudberries (when present) were next most abundant but not as abundant as the other three. For the accessible GSA

Table 10. Estimates of the production of wild edible fruits in the entire Gwich'in Settlement Area by year.

Type of Fruit	Thousands of Tonnes			
	2000		2001	
	Actual	Maximum	Actual	Maximum
Cranberry	2782.51	4629.05	3595.74	5983.56
Blueberry	613.51	1871.42	92.48	874.26
Cloudberry	378.86	378.86	0	1065.11
Crowberry	1016.73	1477.70	105.11	3152.84
Juniper berry	103.43	172.68	0	0
Prickly rose	0	0	13.12	35.43

Table 11. Estimates of the production of edible wild fruit in accessible areas[1] of the Gwich'in Settlement Area.

Type of Fruit	Thousands of Tonnes			
	2000		2001	
	Actual	Maximum	Actual	Maximum
Cranberry	39.84	64.48	37.64	62.61
Blueberry	7.46	32.47	2.20	11.60
Cloudberry	7.34	7.34	0	7.95
Crowberry	14.76	29.37	26.04	34.78
Juniper berry	1.14	1.90	0	0
Prickly rose	0	0	29.6	78.01

[1] This is defined as the 1 km buffer along each side of the Dempster Highway within the GSA.

Note: Red and black currant, buffaloberry, and bearberry were encountered but not in great numbers.

zone, a similar patterned followed. It is interesting to note that although crowberries are available in abundant quantities, they are not a preferred species by pickers (Figure 2). On the other hand, cloudberries, which grow at a less abundant level, are more highly sought by pickers than crowberries.

Few studies report estimates of wild berry production. Most of the research in this area comes from Finland and Sweden. Raatikainen (1983) estimated that 24 million kg or 21.9 kg per hectare of land of bilberry (a *Vacinium* spp. similar to blueberries) grew in Pihtipudas in northern central Finland. Raatikainen et al. (1984) also tried to estimate the berry species per forest type for all of Finland. The authors found out that, "coverage was dependent on vegetation type, on the tree development, as well as on weather conditions." (Raatikainen et al. 1984). They estimated that bilberry yield (on average) was 4.3 kg/hectare of forest area. This amounted to 150-200 million kg of bilberry yield and that about 60% of the crop was collectable. For Sweden, the average yield per hectare for bilberries was 255 million kg, and cloudberries averaged a yield of 75.7 million kg (Salo 1995). The combined crop of all edible berries in Sweden was estimated at 500 million kilos and this estimate was similar for Finland.

Conclusions

This research sheds light on the levels of the productivity and abundance of the wild berry species collected by the Gwich'in. This information adds knowledge to the supply of wild berries in the GSA. We now have the actual and potential bio-physical input of the production function for berries. The findings suggest that at a landscape level, the most productive vegetation type is black spruce stands, followed by the foothills/tundra areas, white spruce, and peat/bog areas. The least productive vegetation type for wild berries are the paper birch stands. Black spruce, with a total of 1332.25 thousands of hectares is the most predominant vegetation type in the GSA while the foothills/tundra area is the most productive vegetation, but contributes the least amount of hectares in the GSA with 281.426 thousands of hectares.

There are two important limitations to note from this research. The first limitation is that only approximately 85% of the GSA had been successfully mapped using GIS at the time of study. Thus, the numbers obtained could underestimate the total production. Another important limitation is that between the years 2000 and 2001 the production of the berries was highly variable. Authors such as Salo (1984) and Raatikainen et al. (1984) note that variations in berry production depend greatly on weather conditions. This was the case for cloudberry production in the GSA for the present study. In the year 2000, the plants flowered and produced bountiful fruit while; in the year 2001 the plants flowered but produced no fruit.

CHAPTER 5
Potential Markets for Gwich'in Non-timber Forest Products

Introduction

The main objective of this chapter is to examine whether the collection and preparation of wild berries can be a market NTFP opportunity for the Gwich'in. This question is key in investigating the potential for NTFPs to improve economic development in the GSA. This research examines the potential market demand for product sales in a non-local southern market, investigates preferences for berry products and determine if a price premium exists for products derived from First Nations producers. We take as given the potential for a local tourist market in Inuvik for jams made from wild berries[5].

This aspect of the study involved the application of a questionnaire survey to a sample of shoppers in two commercial food stores in Edmonton. The survey examined the shoppers' knowledge and preferences of wild berries and also included a stated preference experiment in which respondents were asked to choose among sets of hypothetical jam products which differed by the price and type and origin of fruit as well as who produced the jam. The econometric analysis of this stated preference information is founded in consumer theory and this theory is discussed and applied to the NTFP.

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[5] Another market segment area to consider would be a "local" tourism market. A brief survey was administered to tourists in the area. (See Appendix E for Tourist Survey.) For the local tourist market it was found that, the majority of tourists coming to the GSA originated from Canada. On average the tourists coming to the area planned on spending between $500-$900, and planned on bringing back souvenirs from their trip. For the tourists, country foods (such as jams) are not a popular choice. This does not reflect the lack of interest in purchasing such a product, but is most likely due to the fact that there do not currently exist such products for sale. When surveyed further, the majority of tourists would be willing to purchase locally made jams made from berries that grow in the area. The majority would purchase approximately 2 jars of jam, and that the most popular species of fruit used to make the jam would be cloudberries. This is indicative of a potential local market for a product produced by the Gwich'in from fruits originating from this area.

Since a non-local market in the southern areas of Canada currently does not exist for Gwich'in NTFPs, investigating the potential for a market in a formal manner involves the examination of intentions to purchase NTFPs. The procedures used to examine these behavioral intentions involve the use of stated preference methods. Stated preference methods involve the establishment of hypothetical markets and allow researchers to pose hypothetical questions concerning market scenarios which do not currently exist (Carson 1999, Adamowicz et al 1998). Applying this theory in hypothetical purchase situations involves the collection of stated preference information from a sample of consumers. This requires a researcher to collect hypothetical purchase data in a survey administered through the mail, by telephone, or in-person. Regardless of the mode of administration a survey must be designed to collect this data on consumer preferences. The outcomes from the application of stated preference methods involve purchase intentions rather than the assessment of actual behavioral outcomes. The most popular SP method is contingent valuation. However, stated choice or choice experiments are frequently used to examine choice behavior in the marketing, transportation, and health economics literatures (Louviere, Hensher and Swait 2000).

The choice experiment method asks respondents to make hypothetical choices among products or alternatives defined by their attributes. This approach has a number of advantages (Adamowicz et al. 1998), but a key advantage is that the introduction of new products or new product attributes can be accomplished in a straightforward manner. By analyzing the product choice responses, researchers can estimate the relative importance or weight of each attribute in determining respondents' choices. These methods are founded in consumer theory and choice behavior.

Theory of Consumer Choice Behavior

Ben-Akiva and Lerman (1985) suggest that, "a specific theory of choice is a collection of procedures that defines the following elements: a decision-maker; a set of alternatives; attributes of these alternatives, and a decision rule." The decision-maker in this case can be an individual, a group of people, a household unit, or an organization. In this present research, the decision-maker will be the person or head of household who purchases jam. It is this decision-maker who faces the alternatives and must make a choice from the relevant choice set. In order to make a relevant choice the alternatives must be feasible, and known to them. It is from this set of alternatives that an individual decision-maker considers a subset of alternatives called the choice set.

There are two types of choice sets: continuous and discontinuous. An example of a continuous choice set can be seen when asking the question, "How much of good A, B, and C will you purchase?" The answer to this question elicits a continuous response since the consumer will provide quantities of the good chosen. An example of a discontinuous choice set can be seen when asking the following question, "Given the following choices A, B, and C, which one would you choose?"

Each alternative in the choice set has a specific set of attributes that are known to the decision-maker with certainty. The decision-maker will then consider all the attributes of each alternative and make a choice of an alternative. A consumer's decision is made by considering the attributes of each alternative, and choosing that alternative that provides the decision-maker with the highest level of utility.

It is assumed that each consumer wishes to maximize their utility given the alternatives of the choice set and their budget. Utility can be described as a measure of satisfaction that provides economists with a measure to describe consumer's preferences (Varian 1987). It is thought that individual *n* facing a choice between alternatives *i* and *j* will choose the alternative that provides the greatest utility. Thus, individual *n* will choose *i* over *j*, if and only if, $U_i > U_j$, where $i \neq j$.

Random utility theory can be used to establish an empirical framework to examine observed or intentional discrete choices of consumers. Following Train (1986) a discrete choice can be defined as one in which a decision-maker faces a choice between a set of alternatives with the following criteria: 1) the number of alternatives in the choice set is finite; 2) the alternatives are mutually exclusive; and 3) the set of alternatives is exhausted (all possible alternatives are included).

Let U_i be the utility of product *i*. This utility has two components; a systematic element V_i, and a second element, ε_i, which is random. The element V_i, represents attributes of the product which are known and observable to the researcher, while ε_i, represents unobservable or random idiosyncrasies of tastes (Louviere et al. 2000). Therefore, a given consumer's utility function has the form $U_i = V_i + \varepsilon_i$. V_i represents the systematic element of utility and is assumed to be a function of the attributes of the alternative *i*. In most studies using this theory and for computational convenience, V_i is assumed to be a linear function of its *K* attributes:

$$Vi = \sum_{k=l}^{K} \beta_k X_i^k \tag{1}$$

where X_i represents a vector of *K* attributes associated with alternative *i*, and β_K represents a vector of parameters or taste weights.

A key assumption is that a consumer will choose alternative i over alternative j if $U_i > U_j$, therefore $V_i + \varepsilon_i > V_j + \varepsilon_j$. If analysts observe a consumer choosing i over other products including j, this implies the utility of i is greater then the utility of the other product alternatives. Thus, the probability of the consumer choosing product i can be represented by $Pr\{ V_i + \varepsilon_i > V_j + \varepsilon_j;\ \forall j \in C\}$, where C represents the choice set of alternatives. McFadden (1974) shows that if the random terms are assumed to be independently distributed Type-I extreme value variates, this probability takes the form:

$$P_n(i) = \frac{exp\ Vi}{\sum_{j \in C} exp\ Vj} = \frac{exp\ (\mu \sum_K \beta_k X_{ki})}{\sum_{j \in C} exp\ (\mu \sum_K \beta_k X_{kj})} \qquad (2)$$

where μ is a scale parameter which is typically set equal to 1. This model is commonly known as the conditional logit model. The parameter vector (β_k) can be estimated using maximum likelihood techniques (Louviere et al. 2000).

Following Ben-Akiva and Lerman (1985), "a maximum likelihood estimator is the value of the parameters for which the observed sample is most likely to have occurred." For a multinomial choice model the following likelihood function provides the basis for estimating the parameters:

$$L^* = \prod_{n=1}^{N} \prod_{i \in C} P_n(i)^{Yin} \qquad (3)$$

where N represents the sample size of consumers used in determining the parameters, Y_{in} = 1 if consumer n chose alternative i, or 0 otherwise.

Design and Administration of the Survey

The survey employed to examine consumers' preferences for various jams included a stated preference tool called the choice experiment (CE). For this study, the choice experiment (CE) focused on consumer preferences for jam products made from wild and domestic berries. The experiment was designed to examine the importance of prices, different label attributes and berry species in the jam purchase decision.

In designing the CE the first step was to select a relevant set of jam product attributes that could be used to examine preferences. The attributes selected for this research were price, the type of fruit used to make the jam, geographical origin of the fruit, and the type of organization preparing the jam. The levels that were chosen for these attributes reflected the current market conditions and were related to the research questions. Embedded in the selection of attributes were characteristics such as the variety of berries that were thought to represent Gwich'in and First Nations' opportunities (types of berries) and some information on current markets (e.g. commercial jam products). The species of berries examined were cloudberries, cranberries and blueberries. These berries were examined because they are grown in the GSA and are actively collected by the Gwich'in (see Figure 5).

A summary of the attributes and their levels used in the CE can be found in Table 12. (A copy of the survey can be found in Appendix D.) For the "geographical origin of the fruit" and the "type of organization preparing the jam" attributes, one of the levels used was, "unknown". This was chosen because an informal survey of labels on commercial varieties of jams sold in three large grocery stores in Edmonton revealed that most of the commonly purchased brands had no information on these attributes. Table 13 shows some of these results. The commonly purchased Canadian brands are shaded in

Table 12. The attributes and their levels used in the choice experiment of jam preferences.

Attributes	Levels
Price	\$3.00, \$3.50, \$4.50, \$5.50, \$6.50, \$7.00
Type of fruit	Blueberry, Cloudberry, Lingonberry
Geographical origin of fruit	Northern Canada, Scandinavia, Unknown
Type of organization preparing jam	Commercial organization such as Kraft, First Nation community, Unknown

Table 13. A summary of information on labels on selected popular brands of jam from Edmonton food stores. Shaded rows identify the most commonly purchased Canadian brands.

Brand	Type of berry	Amount	Price	Price/ml	Where made	Where grown
Danish Orchards	Blueberry	375 ml	\$3.99	\$0.0106	Denmark	Denmark
	Strawberry	375 ml	\$3.99	\$0.0106	Denmark	Denmark
Kraft	Blueberry	250 ml	\$3.19	\$0.0128	Canada	Unknown
	Strawberry	250 ml	\$2.99	\$0.0120	Canada	Unknown
Robertsons	Strawberry	250 ml	\$3.69	\$0.0147	Canada	Unknown
E.D. Smith	Blueberry	250 ml	\$3.19	\$0.0128	Canada (On.)	Unknown
All Fruit	Blueberry	250 ml	\$3.99	\$0.0160	Canada (B.C.)	Unknown
	Strawberry	250 ml	\$3.99	\$0.0160	Canada (B.C.)	Unknown
Last Mountain's	Blueberry	454 ml	\$4.29	\$0.0094	Southey (SK.)	Canada
St. Dalfour	Blueberry	225 ml	\$4.99	\$0.0221	Cedex (France)	France
	Strawberry	225 ml	\$4.99	\$0.0221	Cedex (France)	France
Cascadian Farms (organic)	Blueberry	284 ml	\$3.29	\$0.0116	U.S.	U.S. (Oregon)
Ikea	Cloudberry	388 ml	\$5.75	\$0.0148	Sweden	Unknown
	Lingonberry	388 ml	\$3.75	\$0.0097	Sweden	Unknown

the table. Inspection of these brands shows that there is little to no information available on the source of the berries or where the jam was produced.

Since jams are goods with which most consumers have had considerable past experience, a number of challenges exist in understanding jam preferences. First, while consumers may have favourite brands or fruit species, they may seek variety in one or more of the jam attributes; in particular with the type of fruit. Second, jam may be a product that is frequently purchased and consumers may have a high degree of brand loyalty. Finally, consumers may not be familiar with the types of wild berries of interest in this study, and thus many of them may not have been exposed to products made from these fruits in past purchase decisions.

To address the first two concerns, the design of the choice experiment required respondents to consider their next five purchases (e.g. jars) of jam. This aspect of the design allowed respondents to continue to seek variety in jam purchases if they wished. However, the respondent was provided with three alternatives for their purchases: what they currently buy (or status quo) and two hypothetical products described in terms of levels of the four attributes described in Table 12. This design feature allowed respondents to continue to purchase some of the products they typically purchase, including jams made of fruits not described by the fruit attribute. Note this choice set design uses both continuous and discontinuous elements. The continuous aspect involves "how many jars" of each alternative jam product (for a total of five) an individual would purchase. The discrete or discontinuous part requires a respondent to choose among three specific alternatives of jam categories.

Finally, in case respondents were not familiar with cloudberry and lingonberry jams, they were presented with commercially available samples of these jams for tasting. The jam products were produced by companies in Scandinavia and were purchased at Ikea, a large Swedish furniture and specialty food store in Edmonton. Respondents were also required to complete a short series of questions along with the choice experiment. These questions asked respondents to rate the taste of Swedish cloudberry and lingonberry jams and to provide other information on their knowledge of berries and past purchases of jam and other berry products.

Given that the presentation of the choice set involved two new jam products, their corresponding attributes and levels (Table 12) form a large universe of all possible combinations (full factorial) to use in the choice experiment. For this experiment, three of the attributes contained three levels, and the final attribute contained six levels. Since this universe is large, experimental design methods were used to sample from this universe (a fractional factorial) to construct orthogonal choice sets with two alternatives. The experimental design program in SPSS was used to develop the sample of choice sets. Application of this procedure resulted in a sample of 49 choice sets.

Expecting a respondent to complete choices for all 49 choice sets was deemed burdensome, so the sample of 49 was blocked into seven versions where only seven choice sets were presented to a respondent. An example choice set is shown in Figure 6.

Respondents were solicited through in-person interviews in two specialty food stores (Sunterra Market and Urban Fare) in Edmonton. To ensure familiarity with the products, subjects were asked to taste samples of cloudberry and cranberry jams. After

	Product 1	Product 2	The jam you usually buy at the price you usually pay ↓
Type of Berry	Cloudberry	Lingonberry	
Where the berries are grown	Northern Canada	Sweden	
Who makes the jam	Unknown	First Nations Community	
Price:	$4.50	$3.00	
Number of jars you would purchase of each product (total of 5):	_____ jars	_____ jars	_____ jars

Figure 6. A sample choice set from the choice experiment used to examine jam preferences among a sample of Edmonton food shoppers.

tasting the products, the subjects were asked to complete the CE in the store in front of the researchers. This personal interview setting allowed the researcher to answer questions that arose about the jams or the CE. It also allowed the collection of detailed information on the attributes of the jam that they typically purchase. This allowed the complete coding (i.e. type, brand, price etc.) of the third choice option or status quo available in each choice set.

Respondents were also asked about their purchases of berry products. They were asked about the kinds of berry products they purchase, the frequency of purchases, and how important berry product characteristics are to them. The final set of questions the respondents were asked to answer included demographics. Respondents were asked about their age, household income levels, and if the respondents had children aged sixteen years or under living in their households.

The final sample included 140 people (70 at each store) who agreed to taste the jam and complete the questionnaire and choice experiment. The administration of the choice instrument was constructed to ensure that 20 respondents completed each of the seven versions. In this administration, however, a random assignment of versions across the sample in each store was ensured.

The choice data were entered into digital files, and with the exception of the price variable, the levels of the attributes were described using "effects codes." Effect-coded variables have advantages over dummy variables in that they are uncorrelated with the grand mean or intercept of the choice model (Louviere et al. 2000). Effects-coding involves the construction of variables that assess levels of qualities specified as attributes directly in the indirect utility function. For the 3-level attributes used in this study, two variables were constructed for each attribute and were coded 1, 0, or -1 depending on the level of attribute in the design (Louviere et al. 2000; Boxall and Macnab 2000).

Following Boxall and Macnab (2000), an example of effects coding for this study is; consider a three level attribute (eg. The type of berries, cloudberry, cranberry, and blueberry), which is effects coded as α_1 and α_2. The impact of this of this attribute on the consumer' utility would be assessed by levels: the marginal utility of the first level is α_1, the second level is α_2, and the third level is $-(\alpha 1 + \alpha_2)$. Thus for this study cloudberries were coded as (1,0), cranberries were coded as (0,1), and blueberries were coded as (-1,-1). Note that the coefficient on the third attribute is the negative sum of the coefficients on the other two levels (Boxall and Macnab 2000). For the category of "other" berries, (principally strawberries and raspberries) in which all currently purchased jams were found, the coding used was (0,0).

Prior to econometric analysis, coding of the status quo or typical jam purchased choice was performed. The brand, origin of berry (if known), type of berry, price, and per unit quantity purchased was solicited from each respondent during the preliminary discussion preceding completion of the choice task. Accordingly, for each respondent, the attributes of the jam they currently buy for the status quo in each of the seven choice sets were coded using this information. An alternative specific constant (ASC) for this status quo choice was also included in the vector of choice parameters to be estimated. The status quo ASC captures the effect of other characteristics of the typical jam purchases that are not described by the other attributes. The addition of the status quo ASC has been shown to be influential in appropriately estimating choice parameters (Haaijer et al. 2001). For this study, the price of the typical purchase or status quo jam was coded as an average jam price for 250 ml. All other relevant price levels were estimated at the 250 ml level.

Estimation of the taste weight parameters was performed using the maximum likelihood procedures in LIMDEP (Greene 1999). Since, five purchase choices were allocated by respondents among the alternatives in each choice task, the various components of the likelihood function were weighted according to the number of purchases indicated in each choice set.

Results and Discussion

Respondent Characteristics

About 15% of those surveyed indicated their annual household income was in the lowest federal income tax bracket of \$0-\$29 590 (Table 14). About a quarter of the sample indicated an income between \$ 29 591 - \$ 59 180. Over half of the sample (54%) indicated their income was greater than \$59 181, which is the highest in the federal income tax bracket. This large proportion of high-income households in the sample is not surprising due to the fact that the two stores where the respondents were interviewed were specialty food stores.

Out of the 140 individuals surveyed, 44% indicated that they had a least one child living at home. Out of those who indicated that they have children, 61% indicated on having one child living at home, 32% had two children living at home, 15% had three children living at home, and two people indicated having 4 or more children at home (Table 14).

Table 14. Information on the characteristics of respondents surveyed at two specialty food stores in Edmonton.

Household Income Level (%)		
$0-$29 590	$29 591-$59 180	$59 181+
21	43	76
(15)	(25)	(54)

Number of Children Respondents Had (%)						
0	1	2	3	4	5	6+
66	41	21	10	1	1	0
(47)	(29)	(15)	(7)	(0.01)	(0.01)	(0)

% Total	
Respondents with Children	Respondents without Children
74	66
(53)	(47)

Age of Respondents (%)					
Under 20	20-29	30-39	40-49	50-59	60+
3	14	27	48	27	21
(2.1)	(10)	(19.3)	(34.3)	(19.3)	(15)

The mean age of the respondents was between 40-49 years. Only 2% of the sample were under 20 years of age and 15% were over 60 years of age.

Knowledge, Use and Ratings of Jams

Over 82% of respondents reported that they often purchase berries and/or berry products. About 45% of them estimated that they purchase these about once a month. Only 16.5% of respondents claimed they make more frequent purchases. Regarding the types of berry products purchased, about 78% of the respondents claimed they buy jams, 74% buy fresh berries, 26% buy jellies, and about 9% purchase pie fillings. The percentages for jam purchases may be under-estimated because many jams on the market now are called "spreads" or "sauces."

Respondents familiarity with "specialty" berries was assessed and the results of this assessment are shown in Table 15.[6] Respondents were most familiar with cranberries, although the specific variety of cranberry (*Vaccinium vitis-idaea* or *Viburnum trilobum,* which is the more familiar cranberry used in juices and sauces) was not identified in the assessment. Gooseberries were the next most familiar berry variety; with over 80% claiming they had heard of them and about 60% indicating they had tasted them. Huckleberries were next, followed by the two berries of interest, lingonberry and cloudberry. More respondents were familiar with lingonberries than with cloudberries. Over 40% of respondents had heard of and tasted lingonberries, while only 30.7% had heard of cloudberries and even fewer (18.6%) had tasted them. These findings support

[6] Since it was assumed that respondents were familiar with strawberries and raspberries, knowledge of these berries was not addressed.

Table 15. Knowledge of various varieties of wild berries by shoppers in two specialty food stores in Edmonton.

Type of berry	% respondents[1]	
	Have you heard of it	Have you tasted it
Cloudberry	30.7	18.6
Lingonberry	47.1	40.0
Cranberry	97.9	95.7
Gooseberry	81.4	61.4
Huckleberry	74.3	55.7

[1] N=140

the use of the taste tests to generate knowledge of the two berry products prior to the administration of the choice experiment.

The distribution of the ratings of tastes of the two jam samples is shown in Figure 7. The taste ratings of cloudberry jam were clearly higher than those for lingonberry jam. Over 75% of respondents liked the taste of cloudberry jam; 60% rated the taste as "moderately or extremely liked". While 65% of respondent liked the taste of lingonberry jam, only 45% rated the taste as "moderately or liked extremely".

Choice Model Results

The parameter estimates and other information for the three choice models are displayed in Table 16. For these models, Model 1 reflects the preferences of the "average" consumer in the sample. A quadratic specification was attempted for the price variable, but the quadratic term was not statistically significant. Models 2 and 3 include some interaction terms for respondents who were in the high income category (Model 2) and for those who had at least one child in their household under the age of 16 (Model 3). All interaction terms were initially attempted. The final selection of interaction terms are those that were statistically significant for at least one parameter level in a given attribute. "Product" based attribute interactions for both high-income households and households with children were significant. "Label" based attributes were only significant for the high-income households.

For Model 1, the first parameter, status quo represents the ASC on the typical jams purchased. This parameter is large relative to the other parameters, and is positive and highly significant. This indicates the strong preferences of the respondents for the

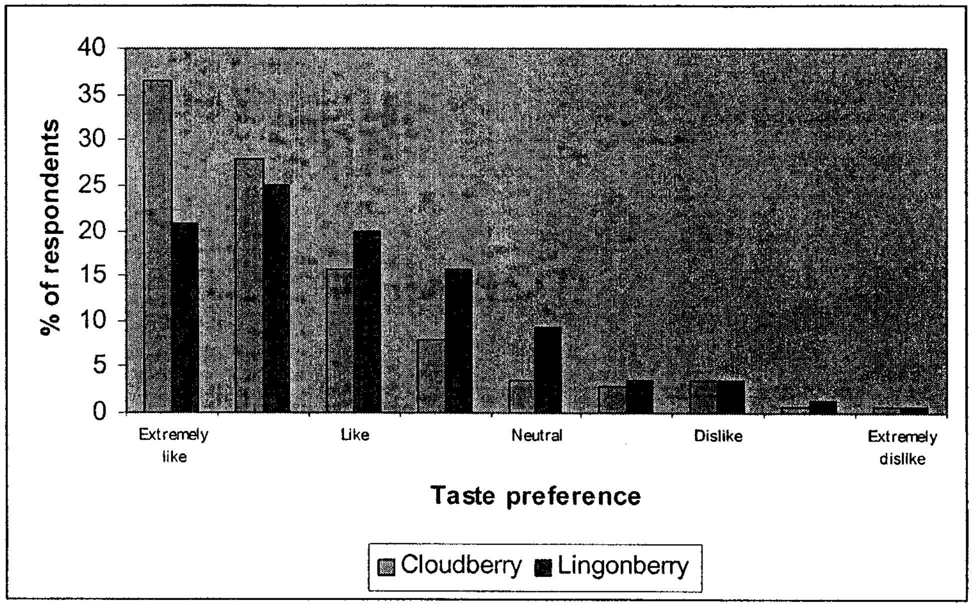


Figure 7. The percent distribution of ratings of taste of two specialty jams by respondents in a sample of Edmonton food shoppers.

Table 16. Parameter estimates for the choice models used to examine jam purchases by Edmonton shoppers in two stores.

Variable	Parameter (standard error) Model 1	Model 2	Model 3
Status Quo ASC	1.37453*	1.37550*	1.44997*
	(0.07803)	(0.07843)	(0.08620)
Price	-0.28270*	-0.28590*	-0.28329*
	(0.01860)	(0.01871)	(0.01865)
Cloudberry	0.29777*	0.15847*	0.23168*
	(0.03994)	(0.05778)	(0.05997)
Cranberry	-0.25221*	-0.25191*	-0.12769*
	(0.03936)	(0.05627)	(0.05574)
Blueberry	-0.04556	0.09344	-0.10399
Northern Canada	0.25836*	0.17262*	0.25394*
	(0.04024)	(0.05712)	(0.04030)
Sweden	-0.18181*	-0.11278*	-0.17811*
	(0.03930)	(0.05412)	(0.03947)
Unknown	-0.07655	-0.05984	-0.07583
Commercial Brands	-0.46083*	-0.47640*	-0.46456*
	(0.04061)	(0.05322)	(0.0407)
First Nations	0.60347*	0.50120*	0.60332*
	(0.03922)	(0.05404)	(0.0393)
Unknown	-0.14264	-0.02480	-0.13876
Interaction Variables			
High Income x Cloudberry		0.28312*	
		(0.07082)	
High Income x Cranberry		-0.00691	
		(0.07865)	
High Income x Sweden		-0.14506*	
		(0.07250)	
High Income x Northern Canada		0.16139*	
		(0.07711)	
High Income x Commercial Brands		0.01510	
		(0.06318)	
High Income x First Nations		0.21608	
		(0.07163)	
Households with children x Status Quo ASC			-0.12469
			(0.06454)
Households with children x Cloudberry			0.12799
			(0.08033)
Households with children x Cranberry			-0.23527
			(0.07792)
Log likelihood at convergence	-3936.523	-3919.226	-3930.328
Rho squared	0.26589	0.27180	0.26974

*Parameter is significant at the 5% level.

typical jams that they buy. The price parameter is negative, signifying as expected that respondents do not prefer to pay high prices for jam when the other attributes are held constant.

The other parameters in Model 1 suggest an interesting pattern of preferences relevant to the objectives of this study. First, the cloudberry jam parameter is positive, while the lingonberry jam parameter is negative and smaller in magnitude than the cloudberry one. Since the berry attribute was effects coded, the remaining berry level parameter (blueberry) is not estimated directly, but can be calculated by taking the negative sum of the other two berry parameters (see Boxall and Macnab 2000). The result is shown in Table 16, and suggests that blueberry jams are not as preferred as cloudberry jams, but are more preferred than lingonberry jam. Thus, the ordinal ranking of the three berry species for the average respondent would place cloudberries first, followed by blueberries, then lingonberries. The ranking of cloudberry higher than the lingonberry in the choice experiment is consistent with the results of the taste rankings shown in Figure 7.

Second, the parameters on geographical source of the berries suggest that jams made with products from Northern Canada provide more utility than jams using the same fruits from Sweden. The remaining parameter on unknown source is intermediate between the other two. This suggests that jam made with berries from an unknown source would be preferred over those from Sweden. It would appear that the average consumer in the sample is either not aware of or are not concerned with where jams are processed. The jams we surveyed in food stores only indicate a country or region where the jam was processed and not a specific location except for Empress Jams and a few other specialty jams (Table 13).

Finally, the parameters on the jam producer suggest that jams made by First Nations producers rank higher than those from commercial or unknown producers. This indicates that respondents would be more willing to buy jam from a First Nation producer than a commercial one. This provides the first empirical evidence that there may be an economic opportunity for First Nations in the wild berry product market. This must be tempered, however, with the finding that the status quo, or typical jam purchases, is rated very high. These consumers may exhibit strong habit persistence yet some in this target market group may be receptive to purchasing First Nations jams made with specialty berries.

The parameter estimates for Models 2 and 3 suggest a similar ordinal ranking for the attributes as Model 1. The interaction between the cloudberry parameter and the high income dummy variable is highly significant, suggesting that cloudberry preferences are particularly strong among high income respondents. For households with children, the cloudberry parameter is not significant at the 5% level but it is at the 10% level, and the coefficient on cranberries is negative and significant. This suggests that respondents with children would prefer not to purchase a cranberry product. For the attributes relating to labeling factors, significant interaction terms were uncovered for respondents with high income levels. These respondents clearly prefer products originating from Northern Canada and of First Nations origin.

Market Share and Price Premium

Market Shares

The choice parameters in Model 1 were used to estimate an average respondent's probability of selecting various jams currently available in the market on their next jam purchase. To do this, the equation 2 is used, and for each jam in the market, the typical values of their attributes are used in their corresponding X matrices.[7] The price of each alternative was adjusted for constant volume by assuming a purchase of 250ml (i.e. the size of jar). The choice set in this model included four commonly produced jams available at both Sunterra Market Place and Urban Fare. These products included Allfruit, E.D. Smith, Robertsons, and Kraft strawberry jams. At these store there were also other types of jams available for purchase. These types of jam included different fruit combinations such as guava-strawberry and watermelon and strawberry mixes. To deal with these types of jams, a "generic jam" category was included which was included to capture these other types of jam available to the consumer. An average price was factored in for this category, and all prices were adjusted to the 250 ml level. When the analysis was complete the probabilities of purchasing the commercial brands of jams and the generic jam were summed and were incorporated into a new category called the "typical purchase" of jam. The same procedure was followed for the currently available blueberry jams. This information was used to simulate the current by creating alternatives (i.e. varying attribute levels) for the Canadian jams typically purchased, Swedish cloudberry and lingonberry jams and Canadian blueberry jams.

[7] For example, the Ikea cloudberry jam used in the taste ratings is a product made with cloudberries from unknown sources in Sweden at the price paid from the store.

The estimated probabilities of purchasing currently available jams at current market prices for the average consumer are shown in Figure 8. Also portrayed for comparative purposes are the probabilities of purchase for the high income respondents and respondents with children. The results for the average consumer are described first.

As expected, for the average respondent the jam typically purchased has the highest chance of being purchased at about 82%. Generic blueberry jam probability of choice is much lower at 5%. The two Swedish products' probabilities of purchase are less than the respondents' typical jam – cloudberry jam has a 7% and lingonberry has a 6% chance of being purchased. The probabilities of purchase for these two Swedish products are quite similar which seems inconsistent with the finding that cloudberry jam would be preferred over lingonberry jam. However, the current actual price of lingonberry jam from Ikea is almost half that of cloudberry jam (Table 13). The lower price increases the probability of purchase of the lingonberry product.

These patterns are similar to those for high-income respondents and those with children. High-income respondents are more likely to purchase their typical jams on their next purchase than the average respondent (Fig. 8). They are less likely to purchase lingonberry jams. However, respondents with children (Fig. 8) are less likely to choose typical jams and more likely to choose blueberry and cloudberry products. These results suggest that high-income respondents are less likely to seek variety, but that those respondents with children are more likely to seek variety in jam purchases. Perhaps having children in a household imparts a desire to expose children to different types of jam products.

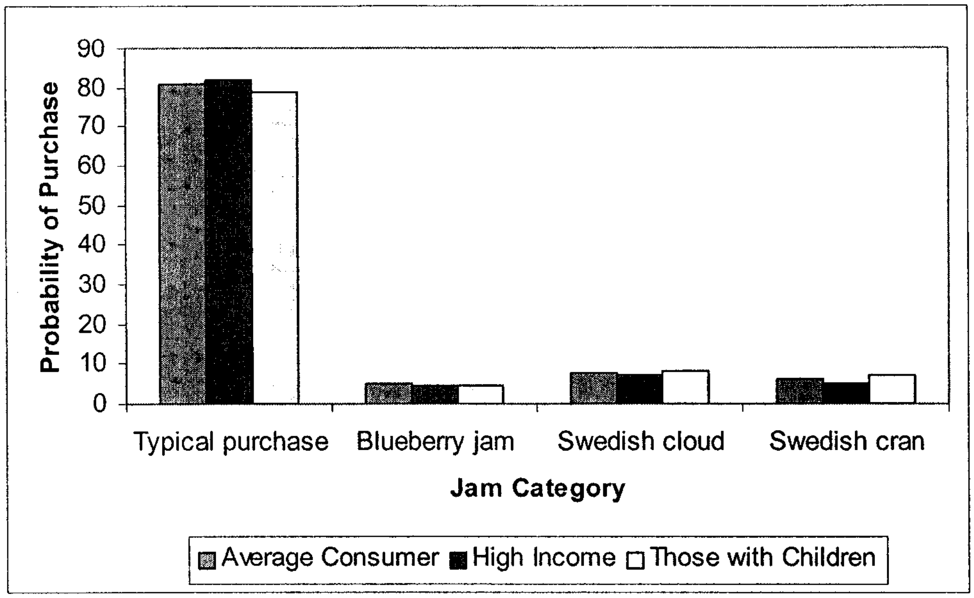


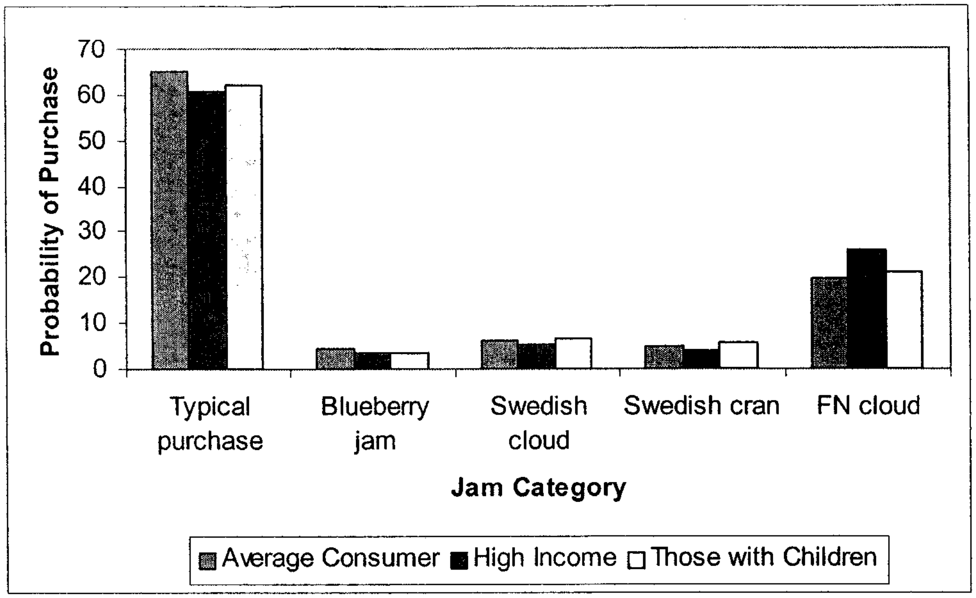
Figure 8. Distributions of the probability of purchasing various jam varieties at the current market levels.

Next the introduction of various Gwich'in jam products into the current market was simulated. To do this we assumed the creation of a label that highlights the source of the fruit from Northern Canada and that the jam is produced by a First Nation. Gwich'in cloudberry and lingonberry products are introduced separately. Figures 9a and 9b portray the distributions of purchase probabilities where the prices of the two Gwich'in jams are assumed to be equal to that of the same Swedish products. The distributions of the probabilities of jam purchases were developed for the average consumer (Model 1 in Table 16), high-income respondents (Model 2), and respondents with children in their household (Model 3).

For the average respondent, the chance of either new jam being bought on the next purchase occasion is around 20% for a Gwich'in cloudberry jam and 17% for a Gwich'in lingonberry jam. For high-income respondents the chance of purchase is higher at 26% for Gwich'in cloudberry jam and 20% for lingonberry jam. For the respondents with children the chance of purchase is about 21% for the Gwich'in cloudberry jam and 19% for a Gwich'in lingonberry jam. The associated chances of purchase for the other jams fall for each respondent group but the typical purchase still remains relative high and would still dominate the market. For example, the chance that the typical jam alternative is purchased when Gwich'in cloudberry jam is introduced into the market falls from 81% to about 65% for the average consumer.

Price Premiums

Since the associated probabilities of purchase of the First Nation products are higher than their Swedish counterparts, there is evidence for the existence of a market



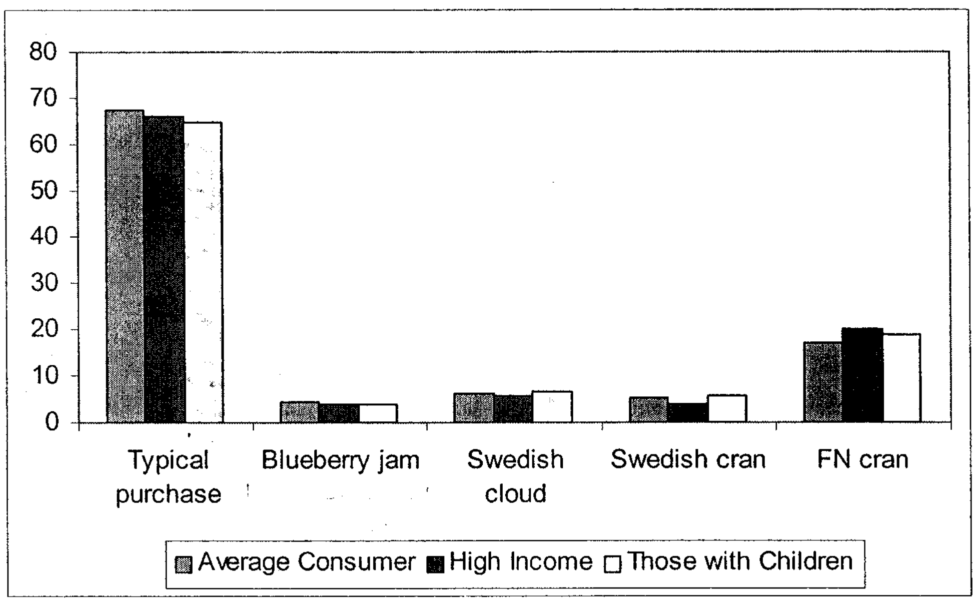


Figure 9. The estimated probabilities of market segments of Edmontonians shopping at specialty stores buying various types of jams on their next purchase occasion. The top figure (Fig.9a) shows estimates for the introduction of Gwich'in cloudberry jam. The bottom figure (Fig.9b) shows estimates for the introduction of Gwich'in cranberry jam.

price premium. To estimate the premium, one must seek the price of the First Nation product that equates the probability of its purchase to that of the similar Swedish product. The difference between this price and the current Swedish price, if greater than 0, is the premium. Using the first model (just with "average" consumers, and no interaction effects) and the goal seek procedure in Excel a price of $7.58 for a 250ml jar of Gwich'in cloudberry jam ($30.32 for 1 liter jar) equates the probability of purchase of this product with that of the Swedish product. Since the Ikea Swedish cloudberry product costs $7.40 for a 388ml jar ($19.07 for a 1 liter jar), the estimated price premium is about $3.88, or about 52% of the product price. The same method applied to lingonberry jam of northern First Nation origin resulted in a similar premium of $6.57 ($26.28 for 1 liter jar) or about 36% of the product price (Figure 10a and 10b).

Using the same methods for the high-income respondents, a price of $10.03 ($40.12 for a 1 liter jar) could be charged for a jar of Gwich'in cloudberry jam to equate the probability of purchased being equal to that of the Swedish product. This amounts to a premium of $6.33 for the Gwich'in product. For Gwich'in lingonberry jam, a price of $8.56 ($34.32 for 1 liter jar) could be charged to the high-income consumers to equate the probability of purchase to that of the Swedish product. This amounts to a $6.15 price premium (Figure 10a and 10b).

For those consumers with children, and using the same methods as described above, a price of $8.46 ($33.84 for a 1 liter jar) could be charged for a jar of Gwich'in cloudberry jam, and a price of $7.06 ($28.24 for 1 liter jar) could be charged for lingonberry jam (Figure 10a and 10b). The associated price premiums are $4.76 and $4.65.

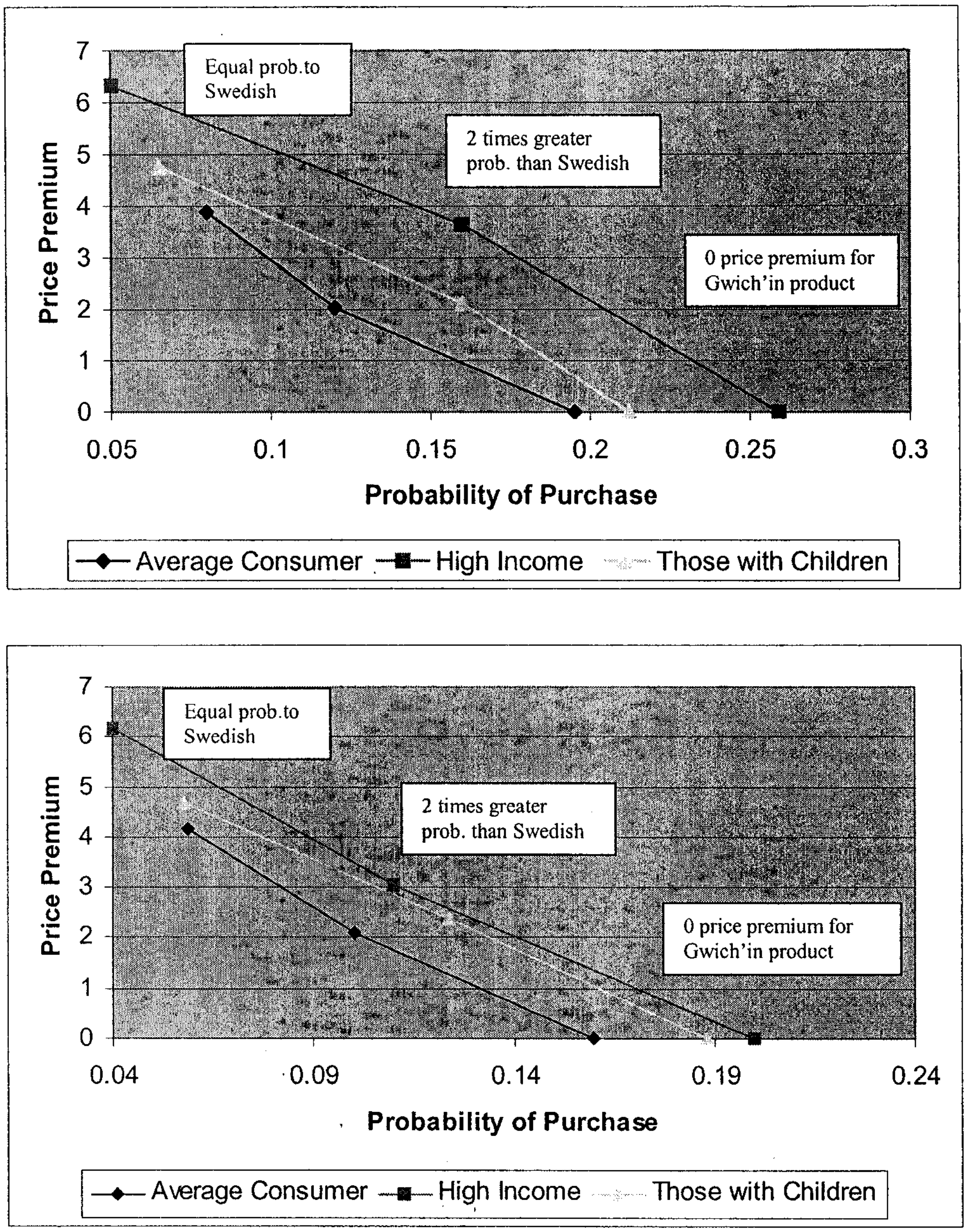


Figure 10. The relationships between price premia and probability of purchase. The top figure (Fig. 10a) shows the probability of purchase and price premiums associated with Gwich'in cloudberry jam. The bottom figure (Fig. 10b) shows the probability of purchase and price premiums for Gwich'in cranberry jam.

At first glance, one may question the market potential of a product with a price of \$7.58 for a 250 ml jar being sold in a market with competing products available at lower prices (see Table 13) to the average consumer. However, the target market for the First Nations products would be a specialty market where quantities are limited and the product may command higher prices. In reality, consultant reports suggest that, profit margins for wild berry preserves are high. For example, Mitchell and Associates (1997) claim wild berry preserves can be produced for \$0.29 per 57ml jar and sold for as much as 2.99-4.10/jar, or \$0.0525 - \$0.0719/ml. These numbers are considerably higher than those for common brands of jam shown in Table 13. Converting the Mitchell and Associates (1997) estimates to the same quantities used in the present study results in prices that range from \$13.13 to \$17.98 for a 250ml jar.

To further understand the potential demand for First Nations' jams we evaluated price premiums at various probabilities of purchase relative to the Ikea products. These were assessed at three points: the first where the probability of purchase was equal to that of Swedish products; the second at twice this probability; and finally at the point of a premium of \$0, or where the prices of the two products were equal. This was done for the average respondent (Model 1, Table 16), for the high-income respondents and those respondents with children. The premiums and associated probabilities of purchase are graphed in Figure 10a and 10b.

Note that it is the high-income consumers who would be most likely to purchase a Gwich'in cloudberry or lingonberry jam, but that these consumers would also be willing to purchase such products at higher prices than the average consumers or those with children. High-income consumers would have more disposable income to purchase higher cost specialty goods. The average consumer is the next group who would purchase such products, followed by those consumers with children. Consumers with children often have less disposable income to spend on specialty goods and thus one would expect the results shown in Figure 10a and 10b.

Conclusion

These results suggest that there would be demand for Gwich'in jams and that these jams have the potential to charge a significant price premium to the Swedish jams and capture a similar market share, or charge a similar price to Swedish jams and hold a market share greater than Swedish jams. The choice of pricing strategy would be contingent upon the market entry strategy chosen by the Gwich'in producer. While this would not replace the more conventional jams current on the market, it would appear that for a certain segment of shoppers (those of a high income group) a product of aboriginal origin would be sought after. Caution should be used in interpreting theses results however. The main issue of concern is that of the potential of respondents to over-state their purchase intentions. There is often an "emotional aura" surrounding a new product (Greenhalgh 1986) which consumers focus on just one attribute of the product. Another factor which could have lead to the over-stating purchases of the results was giving consumers an opportunity to taste the jam right before the y completed the choice experiment. Although this was done to ensure that consumers were familiar with the products being examined, it could have lead to consumers over predicting of its purchase.

CHAPTER 6
Summary and Conclusions

This study concentrated on economic and biological issues surrounding the development of marketable NTFP products by an aboriginal people residing in the Canadian sub-arctic region. First the study determined the extent of use of plant-based NTFPs by the Gwich'in First Nations People. The second objective was to estimate the annual biological supply of the most commonly used NTFPs in the Gwich'in Settlement Area (GSA). Finally, the third objective was to investigate potential for selling NTFPs in a non-local market in a southern urban center.

The first section of this study, discussed in Chapter 3, shed light onto the issues of plant use by the Gwich'in people. Using interviews with key members of the various Gwich'in communities it was apparent that wild fruits and berries were used both as a food source and medicines. Wild berries were also an important part of foods served at feasts and at holidays for the Gwich'in people. Using surveys of randomly selected Gwich'in households, it also became evident that berries were collected in large amounts, and that the type of berries collected depended on proximity to certain vegetation types. The three most popular berry species collected were cranberries (lingonberries), blueberries and cloudberries.

Also explored in this chapter was the interest in selling berries and products derived from berries (e.g. jams). It was apparent that at first, the notion of selling wild berries was not well accepted by the Gwich'in. Many felt that it would not be worth the time or effort involved to collect berries for such a business. However, as informal discussions took place, the idea of wild berry products collected, produced and sold by the Gwich'in people and not "outsiders", was more accepted.

From this information we conclude that the Gwich'in do utilize and collect berries in numbers greater than the literature suggests for Canadian Aboriginal people. Through the personal interviews and community surveys it became apparent that berries hold a significant dietary and cultural role in the Gwich'in lifestyle. Also, it became apparent that the Gwich'in have informal property rights over the use of berry patches. While no "formal" rights are apparent, it became noticeable that often ownership of patches was associated with locations to family fish camps. This information are key components of the production function constraints discussed in Chapter 1.

Chapter 4 portrays results from the next section of this study and examines the biological aspects of the production function. This aspect of the research involved estimation of the distribution and abundance of edible wild berries in the GSA. Within the GSA, five main vegetation types exist and include, white and black spruce stands, paper birch stands, peat/bog areas, and foothills/tundra locations. Within representative samples of these vegetation types, measurements of the ground cover of fruit bearing plants and their production of berries were taken over two separate years. Biological production levels were estimated for the entire GSA and for what was deemed to be those areas of the GSA that were easily accessible to residents. It was discovered that over the two years of study levels of berry production showed great variability. This was indicative of how different weather conditions can affect the berry supply. Also, although the foothills/tundra area comprised a small proportion of the total landscape in the GSA, this vegetation type had the highest production levels of the three most commonly collected berries.

This chapter suggests that at the landscape level, the potential for the production of berries is high. Caution should be used when examining these numbers though. The production of berries tends to fluctuate year to year based on certain weather characteristics described in this chapter. Thus, while the production of berries can be high in one year, there is also the possibility that the berry production for the following year can be extremely low. It also appears that at the landscape level the total biological production levels meet and exceed the needs and demands of the Gwich'in.

The final component of this study, reported in Chapter 5, examined the market demand potential for a wild berry jam produced by a northern First Nation. For the Southern market, a choice experiment was designed to provide a "snapshot" of the potential demand for First Nations jam products. The analysis of the survey results indicated that First Nations jam products would be highly preferred to equivalent products of international origin. A small but significant portion of consumers shopping at specialty urban food stores would be willing to purchase jam products of northern First Nation origin. Consumers with higher income levels in particular, show a strong preference for a good produced in Northern Canada and one produced by members of a First Nations community.

This result must be tempered, however, with the finding that consumers still have high preference for the commonly purchased commercial jams and exhibit strong habit persistence. Thus, our results do not support the idea that First Nations jams made with specialty wild berries can supplant the dominant market share that current commercial brands using more familiar fruits have. However, supplementing mainstream commercial brands may not be feasible due to supply constraints. Our results do support the idea that First Nations jam products can displace competing international brands in niche markets for cloudberry and cranberry (lingonberry) jam. Further, once consumers purchase these products the first few times, the strong habit persistence exhibited by the survey respondents may help maintain the captured market share.

This information suggests that if these First Nations jam products are developed there is potential for a small non-local southern urban market share for northern jam products. Consumers responded to price as expected and showed preference for cloudberry jam, products grown in Northern Canada and jam produced by First Nations businesses. This information suggests that the successful cloudberry market in Scandinavia could be duplicated in Canada. First Nations' communities may be in a good position to capitalize on this niche market potential.

From the information presented in this study there appears to be the demand for a First Nations product originating from Northern Canada. Although the market share of such a product would not dominate the market, there is likely a niche market for such a product. For the Gwich'in, the GSA is capable of producing berries in sufficient numbers. It would also appear that the production of berries in the GSA exceeds the Gwich'in demand for the berries collected for personal use. There seems to be some interest from the Gwich'in in collecting berries to turn into a marketable product. The Gwich'in are concerned about who would benefit from such a business opportunity. If the Gwich'in were to be the beneficiaries, then the interest in pursuing such an opportunity is higher than if an "outsider" were to pursue this opportunity. Before we can conclude that the potential exists for such a product the following issues need to be addressed before a definite answer can be made on the economic potential.

This study briefly touched on the role that wild berries play culturally for the Gwich'in. If a product were to be developed, would the collection of wild berries for commercial use interfere with the collection of berries for personal or ceremonial uses? Often berry patches are closely associated with family fish camps, which implies that there may be an "informal" system of property rights surrounding the exploitation of berry patches. If one wished to collect berries close to another family's fish camp, permission should be asked and the amount collected should only be for personal use. Furthermore, under these conditions one should never "pick a patch dry." Thus, if such a product would be developed, the question becomes, "Who owns the berries and who owns the right to certain berry patches?"

Along with the property rights issues addressed above, what would be the costs involved in securing "formal" private property rights. The Iroquois Cranberry Growers (a First Nations Cooperative) began their cranberry patch with 34 acres and it now encompasses 64 acres. It was been estimated that for a large scale commercial field to be purchased, that an initial investment of $1 million would be needed and that the first crop would not be collected until after three years (Brubacher and Associates 1999). These estimates may not be directly relevant in the Gwich'in context, but other types of costs may be. These would include transportation costs to access remote patches that are not "owned".

These considerations lead to the question of, that if a product was to be developed, where would the jam be produced? Would the production take place in the

Inuvik area, or would the raw berries be shipped to a southern jam producer? If berries collected by Gwich'in were shipped to a southern market area, would the jam be labeled as originating from Northern Canada, and would the jam be labeled as a Gwich'in product? Also, issues surround the costs of labour. The method currently used by the Gwich'in for berry picking is to collect the berries manually. This method is extremely time consuming. The question then becomes one of, "How would you pay the people who collect the berries?" Would the people be paid by the hour, or would they be, paid by the pound? The latter would probably make more sense, due to the fact that this would accommodate those who wished to pick with full time jobs or those who still wished to pursue a more traditional lifestyle.

Furthermore, what type of business structure would be established to market the jam? Would it be a privately operated company, a community business, or a co-operative? The question of who would benefit from such enterprises is key in establishing the structure of the business. Many of the Gwich'in who attended the RRC meetings in the study area felt that a community or solely Gwich'in owned business would be the best business structure. They felt that such a business would be successful if it benefited as many Gwich'in people as it could.

From a landscape dynamic level, for the two years of the study, fluctuations in the amount of berries occurred. It appeared that this was caused by the difference in the annual precipitation levels. This then leads one to ask the question "is the supply of berries reliable enough to sustain an industry?" It has been generally recognized that a supply of between 10 000 to 500 000 pounds of fruit (berries) would be needed to sustain a commercial operation (Brubacher and Associates 1999). However, for a specialty market a much smaller quantity would be needed. One company, Crofter Foods, would produce a product for a sale with as little as 250 to 500 pounds of fruit (Brubacher and Associates. 1999).

The other issue that was not examined in this thesis, is the issue of the environmental impacts of increasing the local efforts to collect berries. This is an important consideration in any discussion of developing business opportunities around the collection of NTFPs. This consideration is frequently mentioned, but little research to date has addressed this subject in the forests of North America. Furthermore there are important environmental impacts such as the health effects of pollutants in the arctic. The Arctic Monitoring and Assessment Programme (AMAP) issued a study of Arctic Pollution issues in 1997. One of the things to consider would be the accumulation of pollutants in a potential berry product of sub-arctic origin. It is known that radionuclides, and heavy metals (including cadmium and mercury) tend to accumulate in the food webs of the arctic (AMAP 1997). Thus, if a product such as a cloudberry jam were to be collected, there may be an increased risk of accumulating higher levels of such pollutants with the consumption of such products.

There are also some issues regarding the study of the non-local southern markets for jams. These surveys were administered at two "high end" specialty food stores in the city of Edmonton. Thus, while the surveys produced results that indicated that a jam produced by members of a First Nations community with fruit grown wild in northern Canada would command a premium price over similar international brands, the question remains of whether similar results would be found at more popular grocery stores?

There is previous research on examining the potential for stated preference surveys to over-estimate the probabilities of purchase of "new" goods. The issue is that, as long as respondents believe that the new good will be produced there is an incentive to always answer, "yes – I would purchase it." This phenomena is known as the "warm glow" effect. One reason for this is that a respondent will always be able to purchase or not purchase the product at a later date. Carson et al. (2000) claim that the reason for this response is that respondents will encourage companies to produce the good. The respondent might not realize that if the product is produced that the price of the product might be higher than originally thought. Thus, respondents who say they would purchase a product in a stated preference survey may not (Greenhalgh 1986).

A further reason for respondents to overstate their purchase proclivities for new products is that respondents often find that there is an "emotional aura" surrounding a new product. These respondents may only consider one attribute of the new product (such as choosing only a First Nations product) without examining any other attributes of the product (e.g. its price). There is also the chance that consumer might be too "sensitive" or "rational" in answering stated preference surveys. An example of this occurs when the different prices presented to respondents are viewed. Some respondents would only choose the most expensive product because they view it as "the product, which has the better quality", or some might always choose the least expensive product, because they view it as, "they judge it to be the better value" (Greenhalgh 1986).

These issues and limitations suggest the need for further research on the potential for NTFP's in the arctic and sub-arctic regions to be economic. Future studies include estimating the variability of levels of production of wild berries. Questions to be examined here include the possibilities of "semi" domestication of the berry species and the environmental impacts of harvesting berry crops annually. Other research efforts could focus on the total economic costs involved in creating a NTFP business in the arctic and sub-arctic areas. Finally research on understanding the potential social and cultural impacts of such a business being developed around a traditional hunting and gathering activity are required. Berries are both important culturally and socially to the Gwich'in People and if this importance were to be used to develop a business, would it change the traditional use and importance of berries to the Gwich'in?

Despite the fact that this study has some limitations and areas for future research important knowledge was gained. It is evident that berries are used and are important to the Gwich'in both from a dietary and a cultural aspect. The Gwich'in collect berries in amounts, which are relatively high in number when compared to other First Nations Peoples, or Scandinavian countries. The physical production of berry species in the area has high potential but fluctuates year to year. This production appears to be beyond the current Gwich'in needs. There is potential for a market for First Nations product, but it will be a small, segmented and specific market share. While if such a product were to be introduced into a southern market, it would not dominate the market, a specific consumer group would certainly be interested in such a product.

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Appendix A: Year 2000 Personal Interviews With Gwich'in Berry Pickers

Non Timber Forest Products in the Gwich'in Settlement Area

Name: ________________ Date: ________________
Community: ________________

Q1) What type of plants or products (eg. berries, leaves and mushrroms) do you collect for food from the bush?

Cloudberry	Blueberry	Cranberry	Crowberry	Red Currant
□	□	□	□	□
Black Currant	Raspberry	Leaves	Mushrooms	Others
□	□	□	□	□

If leaves, mushrooms, and/or others, would you describe what they were?

____
____
____

Q2) What areas do you go to pick the plants/berries mentioned above?

White spruce	Black spruce	Paper birch	Bog/peat areas	Burned areas
□	□	□	□	□
Wet areas	Dry areas	Mountains	Other	
□	□	□	□	

If others, would you describe the area?

____
____
____

Q3) How much of each do you collect each year?

Berry/plant type	Amount
Cloudberry	________________
Blueberry	________________
Cranberry	________________
Crowberry	________________
Red currant	________________

Black currant	______________________
Raspberry	______________________
Other	______________________

Q4) How do you prepare the berries you collect?

Jams	Jellies	Teas	Serve fresh	Other
☐	☐	☐	☐	☐

Q5) Approximately what month, and what time during the month do you collect berries?

Berry/plant type	**Month/week**
Cloudberry	______________________
Blueberry	______________________
Cranberry	______________________
Crowberry	______________________
Red currant	______________________
Black currant	______________________
Raspberry	______________________
Other	______________________

Q6) What methods do you use to store the berries you collect?

Freeze them	Can them	Dry them	Other
☐	☐	☐	☐

Q7) Who do you go berry picking with?

Just yourself	With family	With friends	Other
☐	☐	☐	☐

Q8) If you had the opportunity to sell the berries you pick, would you be willing to?

Yes	No
☐	☐

Reasons for your answer

____

____

____

Q9) How would you feel about selling berries?

Q10) Are there any reasons why you wouldn't sell berries?

Q11) If you would be willing to sell your berries, who would you sell them to?

Tourists	Local people	Southern market	Others
☐	☐	☐	☐

Q12) If you were to sell your berries, how would you like them sold?

Retail (eg. the Northern)	Wholesale (eg. Staton's)	Craft fairs	Sell them yourself
☐	☐	☐	☐

Sell them as a community	Sell them with groups	Other
☐	☐	☐

Q13) Have you ever traded for berries?

Yes	No
☐	☐

Comments:

Q14) Have you ever traded away berries?

Yes	No
☐	☐

Comments:

Q15) Are there any berries that are used for anything other than for foods ? (eg. medicines or dyes)

Yes	No
☐	☐

Comments:

Appendix B: Year 2001 Telephone Survey of Gwich'in Berry Pickers

Non Timber Forest Products in the Gwich'in Settlement Area

Name: ____________________ **Date:** __________________________

Community: ______________________________

1) How many people live in your household?

____

2) How many members of your household collect plants or berries from the bush for food?

____

3) If YES to berries, ask what kind and how much of each (volume will be much easier for people to guess than weight – they will usually know what kind of container they use to pick)

Berry Type	**Amount**
___ **Cloudberries (Yellow Berries, Knuckle Berries)**	______________
___ **Blueberries**	______________
___ **Cranberries**	______________
___ **Crowberries (Black Berries)**	______________
___ **Red Currant**	______________
___ **Black Currant**	______________
___ **Raspberries**	______________
___ **Other**	______________

3a) If YES to plants, ask what kind and how much of each

Plant Type	**Amount**
___ **Labrador Tea**	______________
___ **Mushrooms**	______________
___ **Other**	______________

4) How do you use/prepare the berries you collect ?

___ **Jams**

___ **Jellies**

___ **Itsu**

___ **Clean and serve fresh**

___ **Other**

____

____

____

5) Do you collect berries every year ?

___ **Yes** ___ **No**

6) Have you ever sold the berries you have collected ?

___ **Yes** ___ **No**

7) If you had the chance, would you be willing to sell your berries that you have collected ?

___ **Yes** ___ **No**

Reasons ____

____

8) In general, has the amount of berries or plants/products you pick changed over the years ? What was the Difference.

___ **More** ___**Less** ___**Same**

Comments ____

____

____

Appendix C: UTM Location of all Berry Sites

Vegetation type	Site number	UTM
Black Spruce	1	08 W 0555797 7581340
	2	08 W 0555955 7581266
	17	08 W 0539600 7474139
	15	08 W 0519811 7482023
	12	08 W 0548817 7505403
	7	08 W 0563777 7556431
White Spruce	4	08 W 0569303 7577761
	5	08 W 564351 7564534
	14	08 W 0533606 7474829
	13	08 W 0533845 74752525
	10	08 W 0563984 7544012
	6	08 W 0564351 7564538
Paper Birch	18	08 W 0525495 7476485
	16	08 W 0551073 7480619
	11	08 W 0564165 7544548
	9	08 W 0563982 7544007
	8	08 W 0563782 7556431
	3	08 W 0555679 7581293

Vegetation type	Site number	UTM
Peat/bog areas	24	08 W 0551954 7520422
	23	08 W 0553329 7524291
	21	08 W 0510236 7482431
	22	08 W 0566122 7578989
	20	08 W 0525436 7476691
	19	08 W 0565223 7578807

Foothills/tundra areas	25	08 W 0498685 7465310
	26	08 W 0497388 7462398
	27	08 W 0493769 7459066
	28	08 W 0493769 745066
	29	08 W 0489607 7458146
	30	08 W 0484931 7458054

Appendix D: Southern Market Survey
(One of seven versions)

A Survey About your Preferences for Berries

1) Do you often purchase fresh or frozen berries or products produced from berries (e.g. jams, jellies etc.)?

Yes ☐ No ☐ → If **No** please go to question 2

→ If YES: How often do you buy berry products?

Several times a week	Once a week	Once a month	Several times per year
☐	☐	☐	☐

What kinds of products do you buy?

Jams	Jellies	Pie Fillings	Fresh Berries	Others
☐	☐	☐	☐	☐

2) Have you heard of or tasted any of the following types of berries or products made from these berries?

Berry Type	**Heard of?**		**Tasted?**	
	Yes	No	Yes	No
Lingonberry	☐	☐	☐	☐
Cranberry	☐	☐	☐	☐
Cloudberry	☐	☐	☐	☐
Gooseberry	☐	☐	☐	☐
Huckleberry	☐	☐	☐	☐

Please answer the following questions about the products you have tasted.

3a) Overall, how much did you like this first product?

1	2	3 LIKE	4	Neither like nor dislike	6	7 DISLIKE	8	9
☐	☐	☐	☐	☐	☐	☐	☐	☐

3b) Overall, how much did you like the second product?

1	2	3 LIKE	4	Neither like nor dislike	6	7 DISLIKE	8	9
☐	☐	☐	☐	☐	☐	☐	☐	☐

4) How important are the following characteristics when purchasing jam?

a) Price

1	2	Important	4	5	6	Not Important	8	9
☐	☐	☐	☐	☐	☐	☐	☐	☐

b) Who makes the jam

1	2	Important	4	5	6	Not Important	8	9
☐	☐	☐	☐	☐	☐	☐	☐	☐

c) Where the berries are grown

1	2	Important	4	5	6	Not Important	8	9
☐	☐	☐	☐	☐	☐	☐	☐	☐

5) Do you usually purchase jams?

Yes ☐ No ☐ → If **No** Thank you for your Assistance

If YES: Please consider carefully the following purchase situations. If you were to buy 5 jars of jam within 6 to 8 months, how would you allocate the following purchases?

a)

	Product 1	Product 2	The jam you usually buy at the price you usually pay
Type of berry:	Cranberry	Cranberry	
Where the berries are grown:	Unknown	Northern Canada	
Who makes the jam:	Kraft	First Nations Community	
Price:	$4.50	$3.50	
Number of jars you would purchase of each product (total of 5):	______jars	______jars	______jars

b)

	Product 1	Product 2	The jam you usually buy At the price you usually pay
Type of berry:	Cloudberry	Cloudberry	
Where the berries are grown:	Northern Canada	Sweden	
Who makes the jam:	Unknown	First Nations Community	
Price:	$4.50	$3.00	
Number of jars you would purchase of each product h(total of 5):	______jars	______jars	______jars

c)

	Product 1	Product 2	The jam you usually buy at the price you usually pay
Type of berry:	Cranberry	Cloudberry	
Where the berries are grown:	Sweden	Sweden	
Who makes the jam:	First Nations Community	First Nations Community	
Price:	$3.00	$7.00	
Number of jars you would purchase of each product (total of 5):	______jars	______jars	______jars

d)

	Product 1	Product 2	The jam you usually buy at the price you usually pay
Type of berry:	Cloudberry	Cloudberry	
Where the berries are grown:	Unknown	Northern Canada	
Who makes the jam:	Unknown	Unknown	
Price:	$5.50	$5.50	
Number of jars you would purchase of each product (total of 5):	______jars	______jars	______jars

e)

	Product 1	Product 2	The jam you usually buy at the price you usually pay
Type of berry:	Cloudberry	Cranberry	
Where the berries are grown:	Sweden	Northern Canada	
Who makes the jam:	First Nations Community	Kraft	
Price:	$7.00	$5.50	
Number of jars you would purchase of each product (total of 5):	______jars	______jars	______jars

f)

	Product 1	Product 2	The jam you usually buy at the price you usually pay
Type of berry:	Cranberry	Cranberry	
Where the berries are grown:	Sweden	Northern Canada	
Who makes the jam:	Unknown	Unknown	
Price:	$6.50	$3.00	
Number of jars you would purchase of each product (total of 5):	______jars	______jars	______jars

g)

	Product 1	Product 2	The jam you usually buy at the price you usually pay
Type of berry:	Cranberry	Cranberry	
Where the berries are grown:	Northern Canada	Sweden	
Who makes the jam:	Kraft	Unknown	
Price:	$6.50	$5.50	
Number of jars you would purchase of each product (total of 5):	______jars	______jars	________jars

6a) Would you mind writing down the kind of jam you usually buy

____

6b) Would you mind writing the down the label who the jam you usually buy

____

6c) Would you mind writing down the price you usually pay for that jar of jam

____

6d) Would you mind writing down the amount of jam that is in the jar of jam you usually buy

____

7) What is your age?

Under 20	20-30	30^{+}-40	40^{+}-50	50^{+}-60	60^{+}-70	Over 70
☐	☐	☐	☐	☐	☐	☐

8) What is your approximate income?

$0-$29 590	$29 591-$59 180	$59 181+
☐	☐	☐

9) How many children under the age of 16 live in your household ?

____

Appendix E: Year 2001 Tourist Survey

A few questions about your trip

Date:_______________

Q1) Where are you from?

Canada	USA	Europe	Other
☐	☐	☐	☐

Q2a)How many of you came up here?

1	2	3	4	5	6 or more
☐	☐	☐	☐	☐	☐

Q2b) Did you come as a…

Family	Group tour	Business Group	Other
☐	☐	☐	☐

Q3a) How long to you plan to spend up here?

1 day	2 days	3-5 days	Up to 1 week	Up to 2 weeks	Other
☐	☐	☐	☐	☐	☐

Q3b)Where are you staying?

Campground	Hotel	Trailer/RV	Other
☐	☐	☐	☐

Q4a) How did you get up here?

Drive	Fly
☐	☐

Q4b)What are your reasons for coming?

Vacation	Business	Other
☐	☐	☐

Q5)How much are you planning to spend while you are here? (eg. Lodgings, trips, souvenirs, ect.)

Less than $100	$100-$199	$200-$499	$500-$999	More than $1000	I choose not to answer
☐	☐	☐	☐	☐	☐

Q6)Have you bought or are planning to buy anything to take home?

Souvenirs	Local crafts	Country foods	Carvings	Other	No
☐	☐	☐	☐	☐	☐

Q7) Did you find products of interest locally that you would be willing to take home

Yes ☐ **No** ☐

If **YES** could you please list them

____

____

If **NO** what would you have like to have found

____

____

Q8) Have you heard of or tasted any of the following types of berries or products made from these berries?

Berry Type	**Heard of?**		**Tasted?**	
	Yes	No	Yes	No
Lingonberry	☐	☐	☐	☐
Cranberry	☐	☐	☐	☐
Cloudberry	☐	☐	☐	☐
Gooseberry	☐	☐	☐	☐
Huckleberry	☐	☐	☐	☐

Q9)If you had the chance would you be willing to buy some locally made jam from berries that grow in this region?

Yes	No
☐	☐

If YES how many jars would you buy?

1	2	3	4	5	6 or more
☐	☐	☐	☐	☐	☐

What kind of jam would you buy?

Blueberry	Cloudberry	Cranberry	Raspberry	Currant
☐	☐	☐	☐	☐

Thank you for your time!