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The Distribution, Abundance, and Utilization of Wild Fruits by the Gwich'in in the Mackenzie River Delta

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The Distribution, Abundance, and Utilization of Wild Fruits by the Gwich'in in the Mackenzie River Delta

"Developing sustainable non-timber forest products business opportunities: Is there a First Nations advantage?"

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EXECUTIVE SUMMARY

This project examines the abundance and aboriginal use of botanical non-timber forest products in the Gwich'in Settlement Area in the Northwest Territories. The Gwich'in people mostly collected wild fruits, the most frequent of which were cloudberries, blueberries and cranberries (lingonberries). The amounts of these fruits they collected were estimated to be greater than other published accounts of northern aboriginal peoples in North America. Biological inventories of the amounts and distribution of the wild fruits were also conducted over two years in representative ecosystems in the Gwich'in Settlement Area. The inventory results suggest that considerable amounts of these fruits can be found, although the between year supply may vary considerably. For example, estimates of cloudberries production in one vegetation type varied from 122 g/m^2 in the year 2000 to 0.0 g/m^2 in 2001. Our study suggests that wild fruits are an important component of Gwich'in diets and are an important component of their traditional land use.

ACKNOWLEDGEMENTS

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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). 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. 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. 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 NTFPs 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). 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. One potential reason for the lack of aboriginal NTFP businesses may be the relatively low wages paid to harvesters (Mohammed 1999).

Objectives of the Research

This research project examined 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 demand and supply of wild fruit products. Addressing these issues 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 related to three areas of NTFP extraction.

The first is that researchers must 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. One way to frame this issue is to consider a production function for a jam product of First Nations origin where the quantities of jams supplied will be a function of cultural and physical inputs and constraints. Some important features can be viewed as 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. There are also economic issues surrounding the processing and preparation of NTFPs for sale in formal markets.

Finally, the demand for wild fruit preserves of aboriginal origin requires investigation. In this project, this issue was 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. This aspect of the research project is reported in Boxall et al. (2002) and will not be discussed further in this report.

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. 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 (http://www.grrb.nt.ca/). This is accomplished in each of the four communities through local Renewable Resource Councils (RRC). The RRC from each community elects members to the council in order to address issues concerning renewable resources for their communities. Approximately once a month the RRCs of each community meet with members of the GRRB to ensure that issues surrounding their 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.

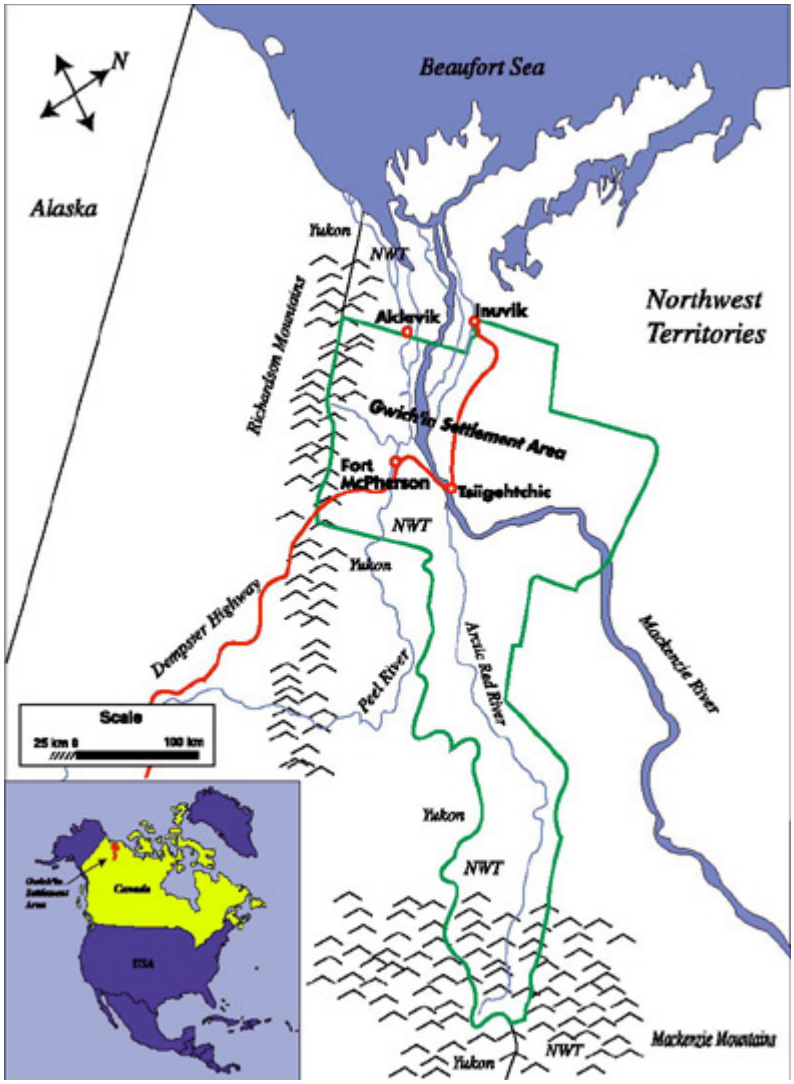

Figure 1. Location of the Gwich'in Settlement Area.

PLANT-BASED NTFP USE BY BOREAL ABORIGINAL PEOPLES

The use of NTFPs by aboriginal people in North America appears to have significant social, cultural and nutritional significance. However, much of the published research involves examination of the harvest and use of meat from wild animals that reside in forests. 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 aboriginal people in northern latitudes are less dependent on plants for their diets than aboriginal people living in southern latitudes. What is apparent in the limited North American literature on aboriginal plant use is emphasis on the description of plants and their use. There is little quantitative information on the extent of use by aboriginal population groups (Kuhnlein and Turner 1991). Plant foods appear to be a somewhat minor component of northern North American aboriginal diets.

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 commercially available substitutes, and the economic value of country foods cannot be measured easily through market comparisons (Marles et al. 2000).

Examples of the importance of meat in the country food diets of Aboriginal people are described in a number of articles. Mackey and Orr (1981) examine country food use to the local population in Makkovik, Labrador. During the period of the study (one year/food cycle in length) it was estimated that Makkovik residents harvested approximately 28,397 kg of 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 residing in Pinehouse, 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. 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. 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 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.

There is little detailed information in the literature on the use of plant foods by aboriginal people residing in the sub-arctic and arctic regions. 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

[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).

1953). We could only locate the studies by Mackey and Orr (1981), Berkes et al. (1984) and Tobias and Kay (1993) in which the total amounts of wild berries collected were described. Mackey and Orr (1981) estimated that the people of Makkovik harvested 832 kg of wild berries. 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. Tobias and Kay (1993) mention that three tonnes of wild berries were collected by the Metis in their northern Saskatchewan study.

There are number of important studies in the anthropological literature on the social and cultural significance of the collection of NTFPs, and especially wild fruits. For example, 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 members of 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.

GWICH'IN USE OF PLANT-BASED NON-TIMBER FOREST PRODUCTS

Methods

During the summer of 2000, 24 Gwich'in people were interviewed to ascertain their knowledge on the use and collection of plant based NTFPs 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 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.

Based on the interviews, a representative telephone survey was designed and administered by aboriginal employees of the GRRB prior to the major plant NTFP harvesting periods in the spring and early summer of 2001. 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 exact number of households was determined based on NWT census data. A total of 50 Gwich'in households were interviewed and the sample varied from community to community; five (13% total) households were interviewed in Tsiigehtchic, eight (16%) in Aklavik, 11 (7%) in Inuvik, and 26 (12%) were contacted in Fort McPherson. For various reasons, the percentage of Gwich'in households surveyed in Inuvik did not achieve the desired total. However, it was still deemed representative of those Gwich'in residing in that community by the GRRB staff.

Results and Discussion

Collection of Non-timber Forest Products

Wild berries were by far the most common plant products reported collected by the 24 people interviewed and the 50 households surveyed. 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 collected and consumed. Mushrooms were not reported 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. The other main plant product 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.

The Species of Wild Berries Collected by Interviewees

Based on the interviews and surveys 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 the Appendix. 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 of them (96%) collected cranberries.

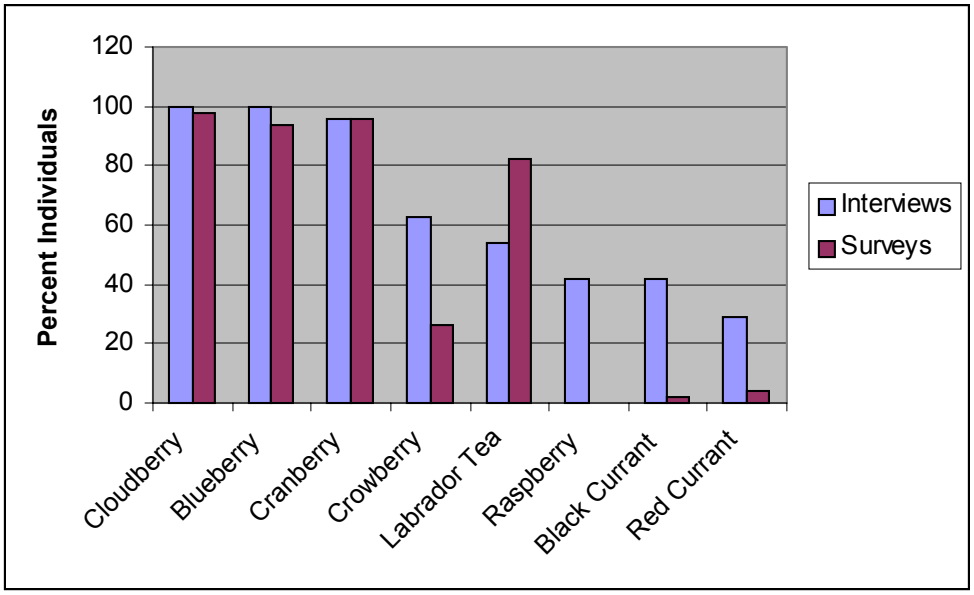

Figure 2. Percentage of individuals who collect various berries in the GSA.

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 hold 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: "Raspberries are good but it is 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. Both black and red currants grow in very limited numbers, and in assessing production levels in botanical surveys (see next section), 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.

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 because the interviews only involved well-known 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 3). In Inuvik, just over 60% of households surveyed collected cloudberries, and about 90% collected both cranberries and blueberries. For Aklavik, 100% of households surveyed 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 about 78% collected both blueberries and cranberries.

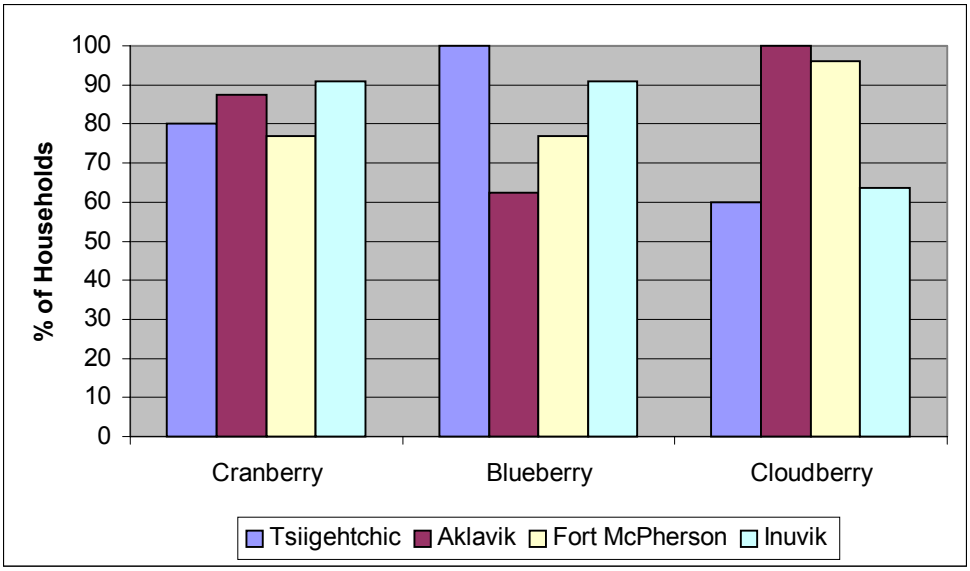

Figure 3. The percentage of Gwich'in households from each of the four communities in the GSA collecting three types of edible fruits

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

How Berries are prepared for Consumption by Interviewees

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 the berries which we haven't used and make trifle and other desserts from them."

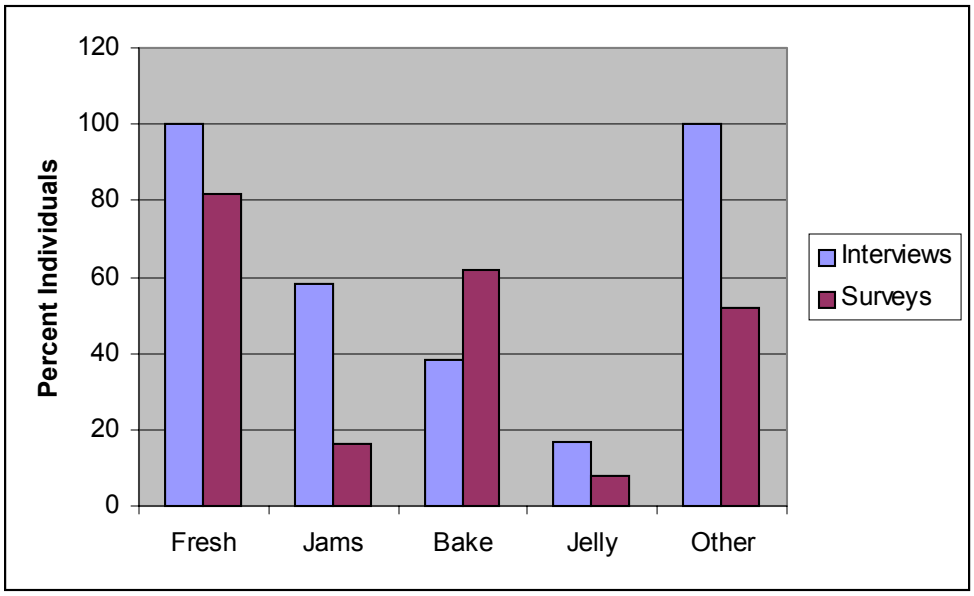

Figure 4. The percent distribution of food types in which the Gwich'in used the berries they collected in 1999 and 2000.

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. 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).

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

Another important issue uncovered during the interviews, was that berries played an important cultural role. 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 Tlingit, an aboriginal group found in southeast Alaska. The Tlingit 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 and only one of the 50 households surveyed said they would be willing to sell the berries they collect. Examples of the reasons stated by people 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."
- "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."

In the telephone survey respondents were also asked if they had ever sold the berries they had picked in the past. Only 14 of the 50 Gwich'in responded that in the past they had either sold or traded their berries for other goods.

For the 29% of interviewees who said they would be willing to sell berries, the majority 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 had gained the impression given that sale 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 in the interviews, however, many participants warmed to the idea of selling a berry product which could be collected, produced, and marketed by the Gwich'in people.

Informal interviews also took place with Gwich'in members of the Renewable Resource Councils (RRC) at their monthly meetings. As the members of the RRCs considered the notion of selling berry products 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.

Other Issues and Observations

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).

Total Quantities of Plant based NTFPs Collected by the Gwich'in

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 three most commonly picked berries in the GSA which were cloudberries, cranberries and blueberries. Based on NWT census data, there were 49 Gwich'in households in Aklavik, 158 in Inuvik, 38 in Tsiigehtchic, and 213 Gwich'in households in Fort McPherson. Using this information, and the data shown in Figure 3, the number of Gwich'in households that picked berries was determined. From this the total amount of berries collected per community and by Gwich'in in the entire GSA was estimated (Table 1).

[3] It is often the case that "berry patches" are owned by family groups. Thornton (1999) notes an example of this. 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.

Table 1. Estimates of total quantities of the three most commonly collected wild berry species by Gwich'in households in each of the four communities

Community	Quantity of berries collected per surveyed households (litres/hshld)			Total quantity of berries (litres) collected by each community			
	Cranberry	Blueberry	Cloudberry	Cranberry	Blueberry	Cloudberry	Total
Aklavik	12	4.5	16	513	137	784	1434
Inuvik	18.9	9.6	8.9	2714	1378	894	4986
Tsiigehtchic	6.3	6.7	5.5	191	254	125	570
Fort McPherson	6	6	24	982	2457	4915	8354
Total				4400	4226	6718	15344

The results indicate that for the year 2000, Gwich'in households in Aklavik collected an estimated 1434 litres of berries, most of which were cloudberries. For Inuvik, a total of 4986 litres were collected, but most of these were cranberries. In Tsiigehtchic, a total of 570 litres of berries were collected; blueberries were the most popular species of berry collected. In Fort McPherson a total of 8354 litres of berries were collected, half of which were cloudberries. 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 litres of berries being collected by Gwich'in in the GSA during 2000. Of this total, 6718 litres of cloudberries were collected. Similar quantities of cranberries and blueberries were collected over the GSA.

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 annual amount collected was 17.6 liters/person, which comprised about 9-44% of the total cranberry yield in the forests. The authors also estimated that 79% of the pickers collected bilberries (about 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) noted that the Metis residents of Pinehouse 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

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

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 the 1,214 people in the community of Attawpiskat collected approximately 1,100 litres of berries. Once again this quantity is much less than the amount the Gwich'in collect. This information suggests that wild berries are a more important food source for the Gwich'in in the GSA than for other aboriginal people.

THE SUPPLY OF WILD BERRIES IN THE GWICH'IN SETTLEMENT AREA

Introduction

This section of the report presents summaries of the inventory of the species of fruit bearing plants within the major vegetation types in the GSA. The goal of this aspect of the project was 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 2. 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 Highway using the GIS. The location and amounts of the five vegetation types were determined within this buffer. The results, shown in the third column of Table 2, 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.

Table 2. 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 GSA[1]

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)

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

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.

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

Presence of Fruit-Bearing Plants in Each Vegetation Type

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 3 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 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.

Since the most commonly collected berries by the Gwich'in are cloudberries, blueberries and cranberries, the information presented in Table 3 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. However, each community appears to exhibit slightly different preferences for the berries collected (Figure 3). 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 for example, but the apparent preferences we observe could be indicative of the accessibility of certain berry species to the members of various communities.

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

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. Murray (2002) displays the results of calculating the wet and dry weights of 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.

The production of fruits by weight for each vegetation type for the two years of study is shown in Table 4. As with the percent cover (Table 3), 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 4 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

Table 3. Mean % cover (± standard error) of 11 edible fruits bearing species by vegetation type in the Gwich'in Settlement Area for the years 2000 and 2001

Berry Species	Vegetation type									
	Black Spruce		White Spruce		Paper Birch		Peat/bog		Foothills/tundra	
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
Cranberry	12±1	17±1	6±1	5±0.7	7±1	7±1	12±1	9±1		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

Not measured

Table 4. Actual and estimated maximum 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

123.9 g/m^2 of crowberries, with just traces of black currant and prickly rose fruits found. No cloudberry plants assessed were found 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.

For the foothills/tundra area, the only measurements 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 4). 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 was similar between the two years (Table 3), the production of cloudberry fruit in 2001 was nil (Table 4). 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. Murray (2002) shows the average annual temperature and precipitation for the Inuvik region. In the year 2000 the region experienced normal to near normal temperature levels but experienced above normal precipitation levels. In 2001, the region experienced near normal temperatures, but experienced below normal precipitation levels. (http://weatheroffice.ec.gc.ca/saisons/index_e.html/ Date accessed June 11 2002.) The difference in the precipitation levels in the two years may be the cause of the lack of cloudberry production in 2001.

Salo (1985ab) 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 may be 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 4) 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 2). Tables 5 and 6 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 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 Gwich'in pickers (Figure 2). On the other hand, cloudberries, which grow at a less abundant level, are more highly sought by pickers than crowberries.

Table 5. 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 6. 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.

Comparing these estimates to those in other boreal areas is difficult as 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 1995a). The combined crop of all edible berries in Sweden was estimated at 500 million kilos and this estimate was similar for Finland.

SUMMARY AND CONCLUSIONS

This report summarizes research conducted on some of the supply and production issues surrounding the development of plant-based NTFP products by the Gwich'in First Nation, an aboriginal people residing in the Canadian sub-arctic region. The study determined the extent of use of plant-based NTFPs by the Gwich'in First Nation and estimated the annual biological supply of the most commonly used plant-based NTFPs in the Gwich'in Settlement Area (GSA).

Using interviews with key members of the various Gwich'in communities it was apparent that wild fruits and berries are the most commonly used plant based NTFPs. These fruits are 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 larger amounts than by other aboriginal people reported in the literature. That the types 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 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 research we conclude that the Gwich'in utilize and collect berries in amounts greater than the literature suggests for northern 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, often utilization of patches was associated with family fish camps.

These property rights may be a key component of the production function associated with supplying wild fruit products to NTFP markets. 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? For example, our formal and informal interviews suggested that 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 marketable wild fruit product would be

developed, the question becomes, "Who owns the berries and who owns the right to certain berry patches?" If such rights could be acquired within the cultural milieu of the Gwich'in, would there be considerable economic and social costs involved in securing such "formal" property rights?

Some of the biological aspects of the wild fruit production function were also examined in this research. This involved estimation of the distribution and abundance of edible wild berries in the GSA which sheds light on the levels of the productivity and abundance of the wild berry species collected by the Gwich'in. The findings suggest that at a landscape level, the most productive vegetation type for the desired fruit species are black spruce stands, followed by the foothills/tundra areas, white spruce, and peat/bog areas. The least productive vegetation type for wild berries is 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. It was discovered that over the two years of study the levels of fruit production showed great variability. This was indicative of how different weather conditions can affect the supply of berries.

This information suggests that at the landscape level, the potential for the production of berries is high. It appears that the total biological production levels in the GSA during the years of favourable weather exceed the current needs and demands of the Gwich'in. This suggestion is proposed with caution, however. The production of wild berries tends to fluctuate annually and is related to weather characteristics. 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.

This then leads one to ask the question "is the biological supply of berries reliable enough to sustain a small industry?" It has been reported that a supply of between 10,000 to 500,000 pounds of fruit (berries) would be needed to sustain a commercial operation (Brubacher 1999). However, for a specialty product that is supplied to more limited markets, 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 1999).

Other aspects of a fruit product business enterprise require investigation. For example, if a wild fruit product were to be developed, where would it be produced? Would production take place in the GSA, or would raw berries be shipped to a southern jam producer? This decision may be influenced by the costs of labour. The manual methods currently used by the Gwich'in for berry picking is extremely time consuming. 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? Our research suggests that 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 meetings with the researchers 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.

An important issue not examined in this project is the environmental impacts of increasing local efforts to collect berries. This is an important consideration in any discussion of developing business opportunities around the collection of NTFPs, but little research to date has addressed this subject for NTFPs in the forests of North America. Future research should assess the effect of increasing annual harvest levels of wild berries on their future biological production. This will be a necessary requirement to assess the sustainability of NTFP business enterprises.

There may also be important environmental human health impacts associated with consuming products derived from arctic and sub-arctic ecosystems. One of these issues involves the health effects of accumulated pollutants in the arctic as documented by the Arctic Monitoring and Assessment Programme (AMAP 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 products such as a wild berry jams were to be considered there may be an increased risk of accumulating higher levels of such pollutants with their consumption.

These issues and limitations suggest the need for further research on the economic potential for NTFP's in the arctic and sub-arctic regions. 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?

It is evident that berries are used and are important to the Gwich'in both from a dietary and a cultural perspective. The Gwich'in collect berries in amounts which are higher than those reported for other northern aboriginal peoples, or by citizens of Scandinavian countries. The

physical production of berry species in the study area we examined has high potential to generate surplus beyond current Gwich'in needs, but this production may fluctuate from year to year. Thus, there may be potential for enough fruit to generate products for a market, but this potential is likely to represent a small share of the current market.

References

Andre, A., and A. Ferh. 2001. *Gwich'in Ethnobotany: Plants used by the Gwich'in for Food, Medicine, Shelter and Tools.* Gwich'in Social and Cultural Institute and Aurora Research Institute Publishers.

Arctic Monitoring and Assessment Programme. 1997. *Arctic pollution issues: A state of the arctic environment report*. Oslo.

Berkes, F., A. Hughes, P.J. George, R.J. Preston, B.D. Cummins and J.Turner. 1995. The persistence of aboriginal land use: Fish and wildlife harvest areas in the Hudson and James Bay Lowland, Ontario. *Arctic* 48: 81-93.

Berkes, F., P.J. George, R.J. Preston, A. Huggins, J. Turner, and B.D. Cummins. 1984. Wildlife harvesting and sustainable regional native economy in the Hudson and James Bay lowland, Ontario. *Arctic* 47: 350-360

Boxall, P.C., G. Murray, and J. Unterschultz. 2002. Non-timber forest products from the Canadian boreal forest: An exploration of aboriginal opportunities. Unpublished paper under review.

Brubacher, D. 1999. Non timber forest products: Exploring opportunities for Aboriginal communities. National Aboriginal Forestry Association, Ottawa Ontario. 135p.

Brumbach, H.J. and R. Jarvenpa. 1997. Ethnoarchaelogy of subsistence space and gender: a subarctic Dene case. *American Antiquity* 62:414-436.

Chapeskie, D. 1997. The maple syrup industry in Ontario. Ontario Ministry of Agriculture, Food and Rural Affairs-Agroforestry. **http://www.gov.on.ca/OMAFRA/english/crops/facts/maple.htm**

Duchesne, L.C., J.C. Zasada, and I. Davidson-Hunt. 2000. Nontimber forest product industry in Canada: Scope and research needs. *Forestry Chronicle* 76:743-746.

Gwich'in Social and Cultural Institute. 1995. *Traditional Uses of Plants in Gwich'in Territorial Park.* Gwich'in Social and Cultural Institute Publishers.

Haener, M.K., D. Dosman, W.L. Adamowicz, and P.C. Boxall. 2001. Can stated preference methods be used to value attributes of subsistence hunting by Aboriginal Peoples? A case study in Northern Saskatchewan. *American Journal of Agricultural Economics*. 83(5):1334-1340.

Hendrikson, P. 1997. The wild lingonberry industry in North America. In Proceedings of the 46th International Symposium on *Vaccinium* culture, Orono Maine, 12-17 August 1996. *Acta Horticulturae* 446:47-48.

http://www.theweathernetwork.com/weatherstatistics/static/C02194.htm Date accessed June 14 2002.

http://weatheroffice.ec.gc.ca/saisons/index_e.html/ Date accessed June 11 2002.

Jarvenpa, R. 1976. Spatial and ecological factors in the annual economic cycle of the English River Band of Chipewyan. *Arctic Anthropology* 13:43-69.

Johnson, D., L. Kershaw, A. MacKinnon, and J. Pojar. 1995. *Plants of the Western Boreal Forest and Aspen Parkland.* Lone Star Publishing.

Kuhnlein, H.V., and N. J. Turner. 1991. *Traditional plant foods of Canadian indigenous peoples: nutrition, botany, and use.* Gordon and Breach Science Publishers.

Mackey, M.G.A., and R.D. Orr. 1987. An Evaluation of household country food use in Makkovik, Labrador, July 1980-June 1981. *Arctic* 40:60-65.

Marles, R., C. Clavelle, L. Monteleone, N. Tays, and D. Burns. 2000. *Aboriginal Plant Use in Canada's Northwest Boreal Forest*. Natural Resource Canada. UBC Press.

Marquardt, O. and R.A. Caulfield. 1996. Development of West Greenlandic Markets for Country foods since the 18th century. *Arctic* 49:107-119.

Mater Engineering Limited. 1993. Special forest products market analysis (for Saskatchewan Timberlands Division, Weyerhaeuser Canada Ltd.). Canada-Saskatchewan Partnership Agreement in Forestry Project No. 3017. Canadian Forest Service, Edmonton Alberta.

Mohammed, G.H. 1999. Non-timber forest products in Ontario: An overview. Forest Research Information Paper No. 145, Ontario Forest Research Institute, Ontario Ministry of Natural Resources, Sault Ste. Marie, Ontario.

Murray, G.A. 2002. An exploration of non-timber forest product potential in a sub-arctic aboriginal setting. Unpublished MSc. thesis, Department of Rural Economy, University of Alberta.

Porslid, A.E. 1937. *Edible Roots and Berries of Northern Canada.* Department of Mines and Resources. National Museum of Canada. J.O. Patenaude, I.S.O. Printed to the King's Most Excellent Majesty.

Porslid, A.E. 1953. Edible plants of the Arctic. *Arctic* 6:15-34.

Raatikainen, M.R.J.T. 1983. The berry yield, picking and marketing of *Vaccinium myrtillus* in the commune of Pihtipudus, Northern Central Finland. *Silva Fennica* 17:113-123.

Raatikainen M., E. Rossi, J. Huovinen, M. Koskela, and M.N.T. Raatikainen. 1984. The yield of the edible wild berries in Central Finland. *Silva Fennica* 18:199-219.

Rossi, E., M. Raatikainen, J. Huovinen, and M.K.J.M. Niemalä. 1984. The picking and use of edible wild berries in Central Finland. *Silva Fennica* 18:221-236.

Salo, K. 1985a. Non-timber forest products and their utilization. Pp. 117-156, In Hytönen, M. ed. *Multiple-use Forestry in the Nordic Countries.* Gummerus Printing, Jyväskylä, Finland.

Salo, K. 1985b. Wild-berry and edible-mushrooms picking in Suomussalmi and in some North Karelian communes, Eastern Finland. *Folia Forestalia* 621:22-25.

Thornton, T.F. 1999. Tleikw aaní, the "berried" landscape: the structure of Tlingit edible fruit resources at Glacier Bay, Alaska. *Journal of Ethnobiology* 19:27-48.

Tobias, T. 1995. Algonquins of Barriere Lake harvest study, Volume 1, Appendix 7: Notes on the production and sale of crafts. Unpublished Report for the Trilateral Secretariat, Algonquins of Barriere Lake.

Tobias, T.N. and J.J. Kay. 1993. The bush harvest in Pinehouse, Saskatchewan, Canada. *Arctic* 47:207-221.

Usher, P.J. 1976. Evaluating country foods in the Northern native economy. *Arctic* 29:105-120.

Wein, E.E., and M.M.R. Freeman. 1995. Frequency of traditional food use by three Yukon First Nations living in four communities. *Arctic* 48:161-171.

Wein, E.E., M.M.R. Freeman, and J.C. Makus. 1996. Use of and preference for traditional foods among the Belcher Island Inuit. *Arctic* 49:256-264.

Appendix

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