

# HARVESTER'S GUIDE

STARTING A RAW MATERIALS  
HARVESTING BUSINESS  
LOWER NORTH SHORE, QC



PRODUCED BY  
**CEDEC**  **COASTERS**  
ASSOCIATION  
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## 1. INTRODUCTION

### 1.1 PRISTINE NATURAL RESOURCES

The Lower North Shore covers a territory of around 65,000 km<sup>2</sup>, containing a variety of different geographical landscapes and interesting natural resources that are unique to subarctic climates. These resources are clean and pristine and have been used by our ancestors and Indigenous peoples for medicinal and health purposes. The people that continue to live in this region take pride in their heritage and their environment, protecting its natural beauty as much as they can.

The natural resources found in these types of climates have adapted to surviving in harsh conditions and cold temperatures. They typically contain chemical compounds that allow them to survive and withstand these conditions. These enriched compounds are the key ingredients for nourishment and treating conditions for human health and have great value in the holistic health global market.

### 1.2 BIO-DEVELOPMENT OPPORTUNITIES

These natural resources have the potential to be used for economic development in the region while maintaining a healthy and sustainable environment. The materials must be collected using sustainable harvesting practices and should be monitored regularly, so that every harvester and local inhabitant protects the resource for future generations to come.

There are multiple possibilities of products that can be developed using these resources; however, it is worth researching the nutraceutical, cosmeceutical, and pharmaceutical industry opportunities. These products are very high in value and typically require smaller amounts of biomass to produce a unit. It is therefore essential to follow protocols and maintain best quality control to ensure high-end quality products.

### 1.3 USING THE GUIDE

This Harvester's Guide should be considered a continuous working document. It will be edited as more research is conducted and information becomes available. Harvesters are suggested to read this document to understand the resource, its characteristics and possible uses, and the technical processes required to harvest and preserve the product. Owners and managers of a harvesting business should understand the resource in addition to operations of a business.

### 1.4 HARVESTING 101

When harvesting any materials from the environment, there are important considerations to keep in mind for your well-being and that of the ecosystem you live in.

Unless otherwise stated as requiring a harvesting permit, these natural resources are common resources found on publicly owned land. It is then the responsibility of the land users to collectively respect the environment and practice sustainable harvesting methods. These practices will safeguard the pristine environment found in our region and the natural resources themselves. It is important to minimize damages when accessing resources on your harvesting site and minimize disturbances to its surrounding environment. Do not leave any materials or

garbage behind when you leave the site. It is also important to document your collections for the season and report any observations that may be useful for future studies. Some of this documented information may be very helpful if needing to develop resource management recommendations or regulations in the future.

All steps taken for harvesting, storing, processing, or transporting procedures must consider the impact an action can have on the valuable qualities of the raw material and prevent the growth of mold and bacteria. This guide will outline the specific methods on how to harvest and process the material to optimize its value and preserve its key chemical compounds. However, it is just as important to monitor your handling actions. Sanitation is essential and should be thought about at each point of harvesting and processing. It is important to wear gloves or clean your hands (with sanitizer or hand wipes) during all steps of the season. Well-kept personal hygiene, such as tying back long hair, wearing gloves if you have cuts or burns, and not collecting materials when ill, are all important considerations to keep in mind. Any equipment or collection containers used must also be well cared for and sanitized regularly. Also, while collecting, any insects or debris observed should be removed from the material immediately. These steps are necessary, since the material can easily develop microbial growth, and this cannot be rectified.

The final consideration to keep in mind while harvesting raw materials is taking all safety precautions, since you will be working alone or in small groups in the field. It is highly suggested for all harvesters to take a basic or wilderness first aid course and pack a first aid kit with the rest of your supplies. It is also important to carry at least one charged source of communication (satellite phone, VHF, etc.) and let someone who is not going with you know of where you are going and when you expect to return.

## **2. BUSINESS START-UP**

### **2.1 IDENTIFYING BUSINESS PURPOSE**

Understanding why you want to start a raw materials harvesting business is important for you, employees and co-workers, your financial partners and of course your clients. Two simple questions can go a long way to helping you.

- Why are you starting this business? Is it because you want to use resources around you, to help people eat better or maybe help the local economy grow and create jobs?
- What do you want out of the business? More time to do other things, more money, to grow the business so you can expand elsewhere?

Taking the time to answer these questions will help make sure the business works for you and not the other way around. It is also a guide when you need to make business decisions in the future.

### **2.2 BUDGETING AND BUSINESS PLANNING**

How you define your business will shape your offer. What are you going to sell, what price and to whom? You need to start with understanding your needs. What is the minimum amount of money you need to earn, how many hours a week can you work and how much time do you need for other activities in your life? You need to be honest. Building a business on what people

will pay for your product instead of what the offer needs to be to meet your needs will lead to stress and dissatisfaction down the road.

Now you can begin to build a simple budget around how much of your product you need to sell at what price to meet your business needs and have money left over to grow and cover bumps in the road. Next is a plan with clear action steps of what you need to do and who is going to do it. There are business advisors, business support organizations and online tools that can help you build that plan.

Before building a detailed plan and legal structure, start by getting some proof that people will buy your product based on the way you have decided to build your offer. The easiest way to get this “proof of concept” is to actually sell or have a signed agreement to sell from a buyer. This critical step will allow you to adjust your plans before investing time and resources into a formal business plan.

## 2.3 MARKETING

Any of the local resources can be marketed as coming from a pristine natural resource and being harvested using sustainable practices. The consumer should also be informed about your social story, explaining how initiatives were taken to develop a northern region by turning natural resources into sustainable economic development.

## 2.4 FINANCING

Financing primarily comes from a combination of the following sources:

- Money that you and partners invest as owners,
- Cash that is generated by the company as it makes sales,
- Loans from banks and other lending partners,
- Government grants and programs.

The budget and business plan will outline how much money you will need and when you will need it to start and grow your business. Having the proof of concept goes a long way to help you secure investments from partners as well as loans and grants, not to mention giving you some proof that investing your time and money is a good decision. There are many government loans, grants and programs to help. Reach out to business advisors, business support organizations and online tools that can help you build that plan.

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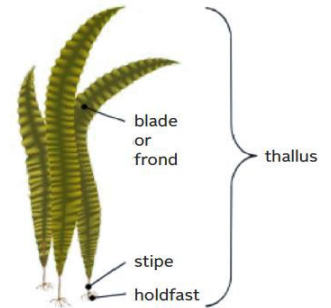


## 3. ALGAE

### 3.1 CHARACTERISTICS

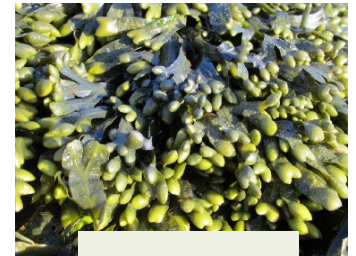
#### 3.1.1 SPECIES & DESCRIPTION

There are three types of macroalgae, also known as seaweeds, in the world: the brown, red, and green seaweeds. However, the brown seaweeds are the most common species in colder climates. All of the seaweeds are attached to the bottom of the ocean floor with a holdfast, where then a stipe joins the blade or frond to the holdfast (Côté-Laurin et al., 2016). Below are descriptions of three brown seaweeds which are among many seaweeds found on the Lower North Shore that are known to have an industry development opportunity.



#### Bladderwrack (*Fucus vesiculosus*)

This species is known mostly for its large air bladders, giving its name bladderwrack. They are dark green in colour and are almost black when dried a bit from exposure to the sun. The bladderwrack ranges on average of 40-90 centimetres in length and has multiple fronds branching out to make it a very dense resource. It has flattened fronds that split off into a Y shape at the tips. The inflated bladders are filled with mucus that helps it float at high tide to reach sunlight (Côté-Laurin et al., 2016).



#### Rockweed (*Ascophyllum nodosum*)

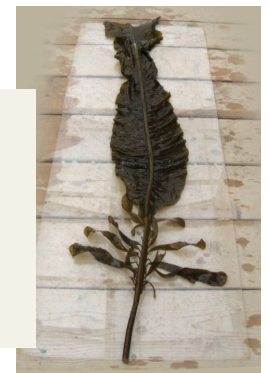
This seaweed species is similar looking to bladderwrack seaweeds, having scattered but usually smaller air bladders. However, the rockweed is more of a yellowish-green seaweed that has longer and more narrow blades. It averages in length of about 30-60 centimetres, but it could reach up to 3 metres long. The seaweed grows in height from the tips of the fronds and the base is the oldest part of the plant. The holdfast part can reach up to 40 years old, and the plant has difficulty colonizing in new areas. This makes it extremely important to cut all seaweed species but not the holdfast from the rock so it can regenerate (Côté-Laurin et al., 2016).



#### Winged Kelp (*Alaria esculenta*)

The Alaria has a single long blade, resembling a long lasagna noodle, and several small flat blades at the base attached to the stipe. The long mid-blade is thin and fragile, and can become severely damaged over time due to exposure to currents and waves.

The seaweed is dark brown and is only found in deeper waters, without any exposure at low tides. It averages about 0.5 to 1.5 metres long; however, it can reach lengths up to 5 metres (Côté-Laurin et al., 2016).



Photos from the Guide to Commercial Harvesting of Quebec Seaweed

### 3.1.2 BIOLOGICAL CHARACTERISTICS

Macroalgae beds are vital to marine ecosystems, since they provide other organisms with a food source, a habitat and a source of protection from predators. It is important that the algae are harvested sustainably in order to ensure we are conserving our resource and not harming other resources like fish.

### 3.1.3 CHEMICAL CHARACTERISTICS

Brown algae species are well known for two major compounds that have ingredient potential: alginates and phlorotannins. Alginates are found within the cell walls of macroalgae, and it helps the seaweed have more flexibility, especially for those populations found in more turbulent waters. Alginates are commonly used as a thickening agent in foods since it can emulsify easily. The species mentioned also contain high levels of phlorotannins, which is a chemical compound found exclusively in brown seaweeds. Phlorotannins are phenolic compounds that aid the algae by protecting it from UV radiation, deterring grazers and repairing any wounds. Many studies have found that the phlorotannin extracts express rich antioxidant levels, and some have proven to contain anti-inflammatory, anti-senescence and antimicrobial properties (Dutot et al., 2012). Macroalgae are also well known to be very nutritious, since most species are rich in fibre, iodine, vitamins, and many trace elements and minerals.

Table 1. The nutritional and molecular interests of seaweed species *Ascophyllum*, *Fucus*, and *Alaria*, from the Guide to Commercial Harvesting of Quebec Seaweed (Côté-Laurin et al., 2016).

<b>Ascophyllum</b>	<b>Fucus</b>	<b>Alaria</b>
<ul style="list-style-type: none"> <li>• Rich in minerals (sodium, potassium, magnesium, calcium) and trace elements (copper, iron, manganese, zinc)</li> <li>• Good source of fibre and iodine</li> <li>• Good source of vitamins (A, B1, B2, B3, C, E)</li> <li>• Source of alginates and fucans</li> <li>• Contains polyphenols and D-mannitol</li> </ul>	<ul style="list-style-type: none"> <li>• Rich in minerals and trace elements (copper, iron, zinc, manganese, magnesium, calcium, sodium)</li> <li>• Contains polysaccharides, namely alginates and fucans</li> <li>• Rich in vitamins A, C, B1, B2, B9, K</li> <li>• Rich in iodine</li> <li>• Contains polyphenols and glutamic acid (taste enhancer)</li> </ul>	<ul style="list-style-type: none"> <li>• Alginate-rich (up to 42% dry weight)</li> <li>• Rich in minerals and trace elements (copper, iron, potassium, manganese, magnesium, calcium, phosphorus)</li> <li>• Good source of fiber</li> <li>• Contains high levels of vitamins A, E, B2, B5, B9 and K)</li> <li>• High levels of iodine</li> <li>• Contains alginates and polyphenols</li> <li>• Source of glutamic acid (taste enhancer)</li> </ul>

### 3.1.4 HABITAT

The three species of seaweed described are all found distributed along some coasts of Atlantic Canada in colder water temperatures. These seaweeds are especially found in abundance along Quebec's Lower North Shore, which spans more than 335 kilometres of rocky shoreline.

The *Ascophyllum* and *Fucus* seaweeds are found within the mid-intertidal zones, which means they are under water at high tides and exposed to sun and air at low tides. They are both usually attached to bedrock, rock beaches or boulders, and they prefer to form in calmer waters like bays. This helps to protect from strong winds and currents, as well as drift ice in the spring. These two species are even often found mixed together within the same area since they optimize in the same conditions (Côté-Laurin et al., 2016).

The *Alaria* species prefers cold waters and is found in less dense fields further south than this region. The long kelp is restricted to staying in deeper waters, below the limit of low tides. It is usually attached to the seabed floor in rocky areas, and this species prefers moving environments, where there are strong waves and currents (Côté-Laurin et al., 2016). The deeper water *Alaria* seaweed is harder to find in high-density patches; therefore some Quebec producers have opted to grow the seaweed in aquaculture.

## 3.2 PRODUCTION POSSIBILITIES

### 3.2.1 INDUSTRY OPPORTUNITIES

According to the Food and Agriculture Organization, the global seaweed industry in 2012 was valued at 6.4 million dollars and harvested 23.8 million tons of wet weight (Côté-Laurin et al., 2016). The seaweed market is predominately located in Asia, however, countries in that area are having difficulty supplying the demand due to rising water temperatures and pollution. The province of Quebec actually has an abundance of macroalgae biomass and the resource is very clean and of high quality, making it a favourable production opportunity (Côté-Laurin et al., 2016). The Lower North Shore in particular has a large stock of intertidal species like *Fucus* and *Ascophyllum*. According to one inventory study, this region has an abundance due to its geographical landscape, vast shoreline, and majority of protected bays, making the calm waters an optimal location to harvest macroalgae. The biomass abundance is suggested to be equivalent or even greater than the stock in Nova Scotia, which already has a large seaweed production industry.

The production possibilities are multiple and still expanding, which include products for: "food, agriculture and horticulture, cosmetics, animal feed, nutraceuticals, pharmaceuticals, biogas, biotextiles, bioplastics, etc." (Côté-Laurin et al., 2016).

Table 2. The potential markets of three seaweed species *Ascophyllum*, *Fucus*, and *Alaria*, from the Guide to Commercial Harvesting of Quebec Seaweed (Côté-Laurin et al., 2016).

<b>Ascophyllum</b>	<b>Fucus</b>	<b>Alaria</b>
<ul style="list-style-type: none"> <li>• Food extracts (alginates: thickening agents, gelling agents, stabilizers)</li> <li>• Animal feed</li> <li>• Agriculture and horticulture (fertilizers, biostimulants)</li> <li>• Cosmetics (skin care, hair care)</li> <li>• Nutraceuticals (nutritional supplements, weight-loss products)</li> <li>• Industrial (stabilizers for textiles and paints)</li> </ul>	<ul style="list-style-type: none"> <li>• Food (sea vegetable)</li> <li>• Food extracts (alginates)</li> <li>• Nutraceuticals (nutritional supplements)</li> <li>• Agriculture and horticulture (fertilizers, composts)</li> <li>• Cosmetics (creams, bath products, softeners, emollients)</li> <li>• Restaurants and fish markets (food decoration, shellfish presented on a bed of seaweed)</li> <li>• Transport (can be used to help preserve shellfish during transportation)</li> </ul>	<ul style="list-style-type: none"> <li>• Food (sea vegetable)</li> <li>• Nutritional extracts (alginates)</li> <li>• Animal feed</li> <li>• Agriculture and aquaculture (food for mussels, abalone)</li> <li>• Cosmetics (anti-aging creams, masks, exfoliators, sunscreens, bath products, lip balms, self-tanners, etc.)</li> <li>• Nutraceuticals (nutritional supplements)</li> </ul>

### 3.2.2 QUANTITIES REQUIRED

Depending on the final product you wish to produce and the procedure of transformation, you may have to adjust the amount of raw biomass to harvest in order to meet the need. A seaweed processing facility may want to purchase the material frozen or dried. If freezing your final biomass, the weight will remain the same as your harvested weight. However, if drying the material, you will need to account for some weight loss. For instance, macroalgae contains approximately 72% water of its weight. If the client wants to receive a dry product, either by exterior drying or dehydrating, the remaining weight will be only about 28% of its original biomass. Therefore it is suggested to multiply the demanded dry weight by 3.6 to get the approximate weight of raw material you will need to harvest.

### 3.2.3 OPTIMIZING REVENUES

In order to be a profitable business on the Lower North Shore, it is suggested to use the resource for a final product that has higher value and requires less biomass to be transported within the region and shipped out to the exterior. Below is a diagram explaining the value opportunity of each product that can be manufactured using the seaweed resource. As you go towards the top of the pyramid, you will obtain more profit since the product is higher in value and requires less biomass to produce it. However, it is important to keep in mind the added research and quality control required to produce these high-value products.

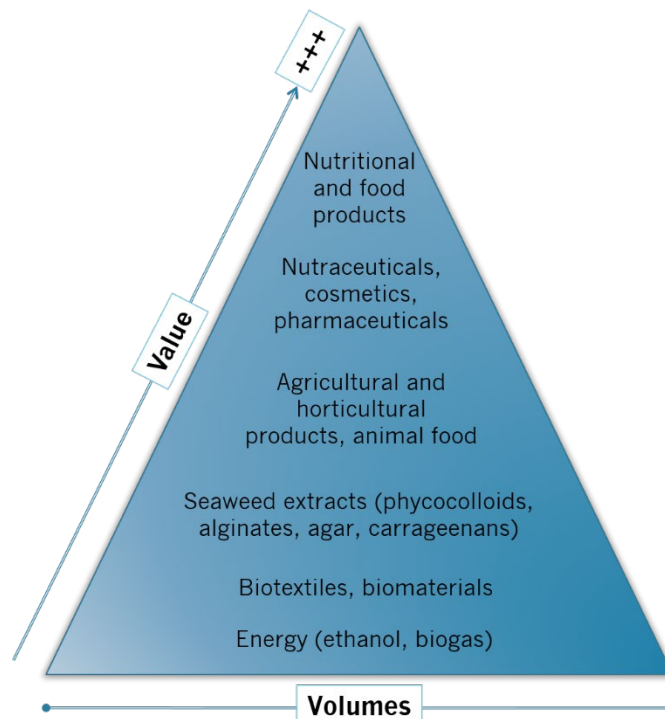


Figure 1. The market value and required volumes of the potential markets for seaweed, from the Guide to Commercial Harvesting of Quebec Seaweed, (Côté-Laurin et al., 2016).

### 3.3 BEST HARVESTING PRACTICES

#### 3.3.1 SITE SELECTION AND PLANNING

Before harvesting begins, the following factors should be considered. A dense harvestable area of seaweed is preferred. A suitable area should be easily accessible by boat at low tides and easy to transfer heavy containers of harvested algae into boats. It is suggested that harvesting locations be near the processing facility. Also, it is recommended to preserve the material within 12 hours of cutting, and this must take into consideration the time required to rinse the material.

When determining the number of sites and the area required to harvest an anticipated quantity within the year, it is suggested you would need an area of at least 2000 m<sup>2</sup> to obtain one ton of *Fucus* seaweed on Quebec's North Shore (Côté-Laurin et al., 2016). For instance, if your designated sites are on average 15m x 15m you would need to harvest approximately 9 sites to aim for a total of 1 wet ton.

Once a harvesting area is selected, it is important to stake off the perimeter of the site so that you can find the area the following year. It is recommended to use steel T-bars hammered into the substrate or eco-friendly waterproof paint on rocks to have permanent edge markers. If you are thinking of harvesting algae annually, it is highly suggested to plan out yearly harvest sites within your permitted area since cut algae sites must be left fallow for three years. See section 3.4.1 on suggestions of how to plan and map out yearly harvest locations.

### 3.3.2 HARVESTING PERMIT APPLICATION

You must request a harvesting licence with the Department of Fisheries and Oceans (DFO) prior to cutting any seaweed attached to the bottom of the ocean. The number of harvesting licences in an area is limited, and a new application needs to be submitted yearly for renewal. It is suggested to begin the application process at least two months in advance of your anticipated harvesting start date (Côté-Laurin et al., 2016). You can contact your regional DFO office for further application questions.

### 3.3.3 HARVESTING TECHNIQUES

Currently, manual cutting of macroalgae is the only method of harvesting permitted by DFO in Quebec. Cutting seaweed plants by hand requires more time and labour; however, it ensures resource sustainability without damaging the habitat.

Harvesting *Ascophyllum* and *Fucus* species is done at low tide when the seaweed is exposed and not covered in water. Manual harvesting is simple and requires little equipment. Knives or shears are used to cut at least 15 cm above the plant's attachment to the rock or substrate, called the holdfast. The harvester must be careful not to pull or tear the base of the plant. Leaving the base ensures that the algae plant has the chance to regenerate from its existing holdfast (Côté-Laurin et al., 2016). Macroalgae harvesters also have the option to rake up beached algae at low tide that are not attached to any substrate.

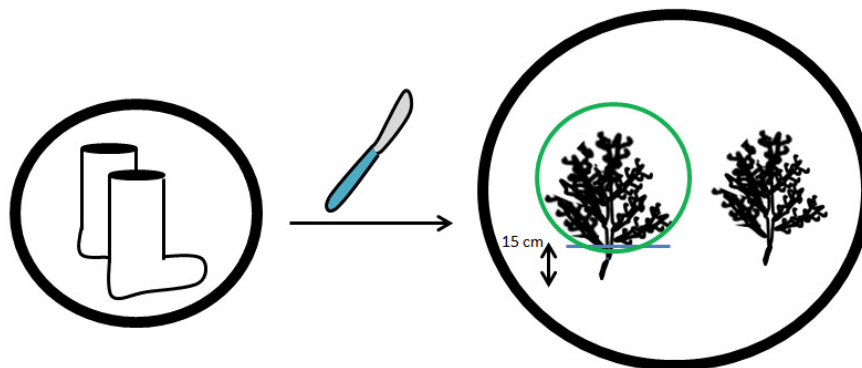


Figure 2. Harvesting method suggested for cutting intertidal seaweed species, on foot and with a knife. Sourced from the Guide to Commercial Harvesting Quebec Seaweed (Côté-Laurin et al., 2016).

A scuba diver may harvest other macroalgae species, such as *Laminaria* and *Alaria*, found in deeper waters where the seaweed does not get exposed at low tide. The diver must cut at least 1 metre above its holdfast and he/she cannot harvest an area that exceeds 15m in diameter (Côté-Laurin et al., 2016). These measurements are given to ensure habitat protection and leave fully grown algae within proximity to the harvested area.

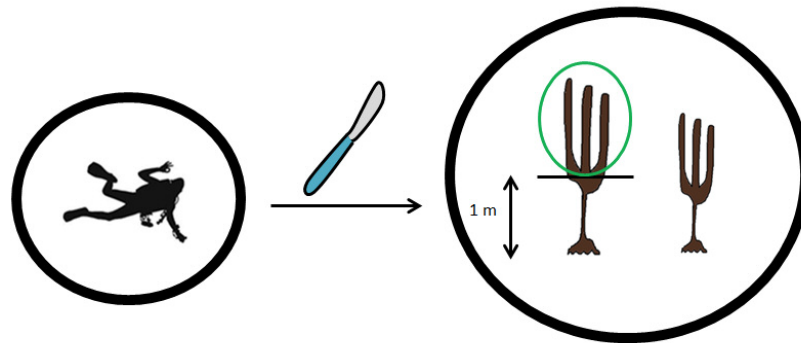


Figure 3. Harvesting method suggested for cutting deeper water seaweed species, by diving and with a knife. Sourced from the Guide to Commercial Harvesting Quebec Seaweed (Côté-Laurin et al., 2016).

There are other techniques to harvest seaweed in other countries and provinces that are not licenced yet in Quebec but may be a research opportunity in the future. For instance, in the maritime provinces, some seaweed harvesters collect attached intertidal macroalgae at high tide instead. They use a handheld device, similar to a rake, which has a cutting blade above 15 centimetres from the bottom. The cut seaweed then floats to the top of the water and is collected using a dip net.

It is also possible to grow deeper water species by aquaculture; however, this is still in the feasibility and research stages. Seedlings are attached to a long piece of rope and placed in the sea, for the algae to grow throughout the winter months. The algae are then harvested in the spring and planting procedures are done again. Many aquaculture owners try this seaweed cultivating method in conjunction with their shellfish aquaculture operations.

### 3.3.4 MAINTAINING QUALITY CONTROL

Depending on the purpose of the resource and the final product you intend to supply for, your level of caution on maintaining quality of the material will vary. Algae are very susceptible to degradation depending on the environment it is exposed to. The concentrations of valuable chemical compounds start to decrease once cut from the plant, therefore it is very important to preserve the material as soon as possible. Once cut, the algae biomass must be brought to a facility where it can be washed/rinsed in vats of fresh and clean local saltwater. This step of the harvesting process is for the purpose of rinsing the material of any debris, sand, or other marine organisms. The process can be quickened by continuously stirring the algae and saltwater mixture for quite some time and then leaving the mixture for approximately one hour to let the debris and substrate sink to the bottom of the container. Another method is to leave the materials to soak for around eight hours in a closed vat container in a cool area. It is important not to let the water temperature warm up. The seaweed can then be dipped out of the rinsing container using a dip net and placed in cleaned fish tubs to drain excess water, until the

preservation process occurs. Make sure to keep in mind that algae collected from different sites or days should not be mixed in the same vat, and that labels must continue to be attached with any containers and packaging used. Containers must be labeled with the site name and date collected in order for the materials to be traceable (see Annex A).

It is also important to use clean equipment while harvesting. The collection containers and cutting knives must be cleaned with hot soapy water prior to use and rinsed thoroughly. Also, keep in mind to have your hands clean while cutting, rinsing, and packaging the material. Make sure your hands are free of dirt and harmful substances such as sunscreen by washing them with hot soapy water and rinsing well before handling any seaweed.

### 3.3.5 PROPER STORAGE

After rinsing, the collected algae should be stored in sealed containers and kept cool until processing occurs (Côté-Laurin et al., 2016). Again, make sure that this step is minimal and try to process the materials as soon as possible. For long-term storage, until the processing or extracting transformation steps begin, the biomass should be frozen to guarantee that the compounds of interest are being preserved. Whether the materials are kept as is or dried, the product should still be kept frozen. All packages of wildberries supplied to the Bioproducts Cooperative must be labelled properly (see Annex A).

Based on research from Ascophyllum, there are two ways to preserve the materials that maintain similar chemical composition levels. The rinsed and drained seaweed can be placed in airtight bags and frozen directly. The biomass can also be placed in a dehydrator and dried at 40°C for eight hours, then ground into small particle pieces, and finally placed in airtight bags and frozen. It is suggested not to dry the material on racks outside or in a greenhouse, since results from research has shown this process to cause a degradation in valuable chemical compound levels, likely due to solar exposure. Drying the material may be an added step in the harvesting procedure; however, it helps cut down major volume and mass therefore making it much easier to store and transport.

### 3.3.6 LOCAL TRANSPORTATION

Collection of seaweed can be done using a small outboard boat so that a harvester can have easy access to sites at low tide. If harvesting a far distance from a processing facility, a larger longliner boat should be used as well to collect the containers of harvested biomass. The rinsing process step can also be done while on a large boat with room to store vats. Once packaged, the material must remain frozen until it reaches the processing facility. Therefore, any transportation methods to ship long distances require that shipping boxes are in a container below 0°C.



### 3.3.7 REQUIRED EQUIPMENT

- Transportation: small outboard boat rental, lifejackets
- Site materials: permanent stakes, eco-friendly paint, measuring tape, lead rope, GPS
- Cutting equipment: knives or shears
- Collection containers: cleaned fish tubs and vats with covers or light-coloured tarp, dip nets
- Documenting materials: Write-in-Rain paper and labels, pencil
- Field safety: First aid kit, oars, bailing bucket, satellite phone, VHF
- Preserving (if drying): Commercial food dehydrator, high power grinder
- Storing: Ziploc bags or vacuum bag sealer, boxes and packing tape

## 3.4 SUSTAINABLE RESOURCE MANAGEMENT

### 3.4.1 PLANNING HARVEST ZONES

Based on the biomass weight you wish to obtain annually, you should be able to predict how many 15 m x 15 m sites you will request to harvest for your licence from DFO. It is suggested to inspect the anticipated site locations each spring and take the GPS coordinates for your permit application form. Each site should be mapped out and labelled with a number or code to document your annual biomass harvest. It is ideal to plan your anticipated site locations for the following two years, to ensure that you have enough zones to harvest for the future to meet your aimed annual biomass harvest. Since you must leave a harvested zone untouched for three years following cutting, it is ideal to plan to ensure continuous resource collection annually.

### 3.4.2 DOCUMENTING & REPORTING ANNUAL HARVESTS

Each site location harvested must be documented for total weight collected in that year (see Annex B). These records should be kept and filed so that any harvesting in the same site can be compared for total weight in the future or can be used to better estimate biomass density. This will help predict how many sites are required the following year.

DFO may also request to report back to them on the annual regrowth following harvesting a site. This requires minimal effort, where you must take 30 random plants from the cut site, one year later, and measure the height and weight above 15 centimetres.

### 3.4.3 CERTIFICATION

To optimize marketing and advertising your resource, you can apply to register your product to become certified as a natural and organic material. Conscious consumers like to be able to trace the product back to its origin and know that it was harvested in a sustainable manner and is free from any harmful product (Côté-Laurin et al., 2016). For more information on the different possible certifications and how to apply, please see the Guide to Commercial Harvesting of Quebec Seaweed.

## **3.5 BUSINESS MANAGEMENT**

### **3.5.1 SKILLS & TRAINING RECOMMENDATIONS**

A seaweed harvester is recommended to take basic training in resource sustainability, mindful preservation of the environment, and maintain product cleanliness. As well, any harvester working in the field should complete a basic first aid or wilderness first aid to prioritize safety.

An employer wishing to manage a seaweed harvesting business is recommended to consider the above skills, as well as take an entrepreneur course and training in documenting and reporting annual production. It is also important that the employer should have strong skills in overseeing good manufacturing practices.

### **3.5.2 LEGAL & ETHICAL CONSIDERATIONS**

In order to ensure resource sustainability and maintain the health of the intertidal environment, it is important to follow the harvesting guidelines suggested. Do not pull out the plant. Only use sharp cutting equipment to minimize the impact on the attachment of the plant.

A first aid kit must always be at the harvest site. As well, proper communication equipment should be designated to harvesters. Harvesters must be in groups of two, in which a satellite phone should be shared.

In the event of an incident/accident, an Incident Report should be completed by the harvester (see Annex C).

## **3.6 ADDITIONAL INFORMATION & BUSINESS SUPPORT**

There are alternative business opportunities and seaweed species present for harvesting. You can find more information by reading the Guide to Commercial Harvesting of Quebec Seaweed written by Merinov (le Centre d'innovation de l'aquaculture et des pêches du Québec). If you have further inquiries concerning research opportunities or development strategies, you can also contact Merinov with questions.

## 4. BERRIES

### 4.1 CHARACTERISTICS

#### 4.1.1 SPECIES & DESCRIPTION

##### Cloudberry (*Rubus chamaemorus*)

The cloudberry is an orange mid-sized berry, which has a bumpy surface that resembles a cloud; giving them their name. The cloudberry is locally known as a bakeapple, but it is also called chicoutai, Nordic berry, knotberry, aqpiq, and low bush salmonberry in other places in the world. This small fruit is similar in shape to raspberries; however, they grow low to the ground where a single berry can be found on a stem 10-15 centimetres high. The plant grows a single white flower in spring, which forms into a firm red berry in early summer and softens into an amber orange colour later in summer. This is when the berry is ripe and ready to pick.

##### Crowberry (*Empetrum nigrum*)

Also known locally as a blackberry, the crowberry is a small spherical black berry growing on a low ground-covering bush. The small leaves are usually only 3-6 millimetres long and are arranged alternately on the stem. Multiple small flowers develop into small fruits in the summer months, where the berries only grow to be 4-6 millimetres wide. The crowberry is typically ripe and ready to be picked at the end of summer or beginning of fall.

##### Lingonberry (*Vaccinium vitis-idaea*)

Also known locally as the redberry or the partridgeberry, the lingonberry is also a small fruit growing on a low ground bush. The plant can form dense colonies since its stems spread out underground. It also has small, shiny leaves only 5-10 millimetres long and alternate along the stem. Very small white and pink flowers start to bloom in early summer and develop into small red fruits, usually only 6-10 millimetres wide. The berries are usually ready for picking in autumn.



Photos from Wikipedia.org

#### 4.1.2 BIOLOGICAL CHARACTERISTICS

These berries are a common food source for small mammals and birds. The leaves of the cloudberry plant are also a food source for moth larvae and caterpillars in the spring.

#### 4.1.3 CHEMICAL CHARACTERISTICS

The cloudberry, crowberry, and lingonberry fruits are very nutritious for their size since they are loaded with vitamins, polyphenols, and flavonoid compounds. These chemically enriched berries are what makes the fruit full of high antioxidant levels. The cloudberry, for instance, is rich in vitamin C and contains organic acids and vitamins A and E. The oils within the seeds are

also full of omega 3 and 6 fatty acids. The crowberry, on the other hand, contains very high levels of anthocyanins, which gives it the very dark purple colour and this compound is what causes the berry to have such a high antioxidant content. The crowberry has an oxygen radical absorption capacity (ORAC) well above the average score for fruit. The lingonberry is also very nutritious containing organic acids, vitamin A, B, and C, and trace elements potassium, calcium, magnesium, and phosphorus. The seed oil also contains omega 3 fatty acids.

#### 4.1.4 HABITAT

All three of these wildberries are found distributed in northern countries, in arctic and sub-arctic climates. They are commonly found growing in marshes, bogs, wet meadows and tundra landscapes and are typically only growing in acidic soils, with a pH level ranging between 3.5 and 5.



Figure 4. Example of the estimated global distribution of cloudberry (*Rubus chamaemorus*) from Wikipedia.org

## 4.2 PRODUCTION POSSIBILITIES

### 4.2.1 HISTORICAL USES

These berries have been a traditional food staple for a long time and continue to be frequently eaten by locals. Historically, it has been known to be eaten by northern Indigenous people as a healthy fruit food source to help prevent and treat illnesses.

The cloudberry was used to treat urinary infections, cure vitamin deficiencies, ease difficult labours, treat coughs and colds, ease menstrual cycle complaints and prevent or treat scurvy. The crowberry had been used to treat epilepsy, paralysis, nervous disorders, and anthrax. It was also thought to have astringent and diuretic effects. As well, the crowberry was also used commonly as a natural dye for textiles. The lingonberry has been used for centuries in food and medicine, as a remedy for pain, inflammation, and rheumatoid arthritis, to treat urinary infections and oral health, and as a source of pigmentation.

## 4.2.2 INDUSTRY OPPORTUNITIES

These subarctic berries are used commonly for local food markets, to produce jams, jellies, desserts, and syrups. However, it can also easily be used in the beverage market globally to be a flavour infused in waters, wines, and beers.

The nutrient-rich fruit can also be used as an ingredient in cosmetic and nutraceutical products, since its extracts are proven to have very high concentrations of antioxidants and vitamins, as well as other powerful chemical compounds. These ingredients are already entering the cosmetic market and becoming more well known to consumers. The cosmetic industry is suggested to be the most favorable since its small concentrated volume can be extremely high in value.

Table 3. Examples of benefits for using cloudberry, crowberry, or lingonberry as an ingredient in cosmetic products

Cloudberry	Crowberry	Lingonberry
<ul style="list-style-type: none"> <li>• Vitamin C content revives and brightens skin</li> <li>• Omega 3 and 6 in seed oil help improve the overall health of the skin.</li> </ul>	<ul style="list-style-type: none"> <li>• Boosts collagen production, which enhances skin elasticity</li> <li>• Helps skin recover from oxidative damages caused by free radicals, UV radiation, and environmental pollutants</li> <li>• Safe for normal to dry and sensitive skin types</li> </ul>	<ul style="list-style-type: none"> <li>• Helps rejuvenate skin</li> <li>• Seed oils help improve the overall health of skin by reducing skins water loss and speeding up the healing of wounds</li> <li>• Sterols help reduce redness and sensitivity in the skin, and promote tissue regeneration as well as being anti-inflammatory</li> </ul>

## 4.3 WILDBERRY HARVESTING PRACTICES

### 4.3.1 SITE SELECTION

When choosing a site to begin picking wildberries, first, it is important to remember safety and easy accessibility. Think about the amount of biomass you may be picking and how easily you will be able to bring it back to your method of transportation. It is recommended not to harvest wildberries near a road or construction area, which may cause dust or exhaust contamination to the resource. While it may be ideal to select a site that has a dense field of the species you are picking, it may not be realistic. In addition, the density and growth patches may vary year-to-year depending on the climate, so your site location may need to alter annually.

### 4.3.2 HARVESTING TECHNIQUES

Harvesting the cloudberry, crowberry, and lingonberry fruits is quite simple, by gently pulling the berry from the plant. However, you must ensure that the fruit is ripe before picking so that it will easily come off the plant without pulling at the roots. Picked berries can then be placed in small collection containers or buckets with lids. It is suggested not to use large buckets since the heavy weight will squash the berries on the bottom if filled.

### 4.3.3 MAINTAINING QUALITY CONTROL

When using the berries for either a food, beverage, or cosmetic product, it is essential to keep the resource as clean as possible to maintain quality control. The wild berries must be picked at the exact time the fruit is ripe before the fruit begins to get too soft. For instance, the cloudberry begins to develop brown or black spots when it softens too much, and these would not be suitable for sale for any processing facility or consumer.

It is important to take precautionary measures to prevent bacterial growth or contamination; wash your hands with hot soapy water or sterilize with an antibacterial rub, wash the buckets after each use, rub with alcohol before using for collection, make sure the covers are on any container, etc.

At the end of a harvesting day, the wild berries collected must be rinsed with sterile water in a strainer, and drained or patted dry before storing.

### 4.3.4 PROPER STORAGE

Once the wildberries are cleaned of debris and rinsed well, the fruits must be frozen as soon as possible to maintain nutrients and prevent bacterial growth. If freezing is not possible right away, the collection buckets should be placed in a cooler. If the crowberry and lingonberry are well strained and do not have much water content, the berries can be stored in an airtight bag in a freezer. However, since the cloudberry is a softer fruit and contains more moisture, it must be spread out evenly on a tray before being placed in the freezer. Once the fruit is frozen, it can be packed in an airtight bag and placed back in the freezer. This technique prevents the fruit from freezing in one solid chunk. All packages of wild berries supplied to the Bioproducts Cooperative must be labelled appropriately (see Annex A).

### 4.3.5 LOCAL TRANSPORTATION

When transporting the materials from the collection site to the place of packaging or processing, it is necessary to keep the containers well sealed and upright. This can be done by any means of transportation, whether it is by boat, truck, or an all-terrain vehicle.

When shipping the packaged materials to the consumer or processing facility, it is important to inquire about transporting the boxes in a freezer container, since the product must not thaw during transport.

### 4.3.6 REQUIRED EQUIPMENT

- Collection containers: cleaned fish tubs and vats with covers or light-coloured tarp, dip nets
- Documenting materials: Write-in-Rain paper and labels, pencil
- Field safety: First aid kit, oars, bailing bucket, satellite phone, VHF
- Storing: Scale, Ziploc bags or vacuum bag sealer, boxes and packing tape

## **4.4 BERRY CULTIVATING RESEARCH**

If these subarctic wild berry species continue to be marketed for their health benefits, the demand may increase and wild stocks of the fruits may not be a sufficient supply. Cultivating the resource would be a solution to preventing depletion of wild stocks, and would also save a harvester time by picking a large amount of fruit in a smaller area. Cultivation of these species of berries is currently in the initial stages of research, but further studies need to be continued to determine the feasibility of agriculturally growing these northern fruits. Research should also focus on selecting an optimal site, finding the best farming techniques, and determining the costs and equipment necessary for an agricultural set-up.

## **4.5 SUSTAINABLE RESOURCE MANAGEMENT**

### **4.5.1 DOCUMENTING & REPORTING ANNUAL HARVESTS**

All packaged materials must be labelled with the species of berry, harvester name, and the date and location of the harvest (see Annex A). It is highly suggested to take notes on the biomass weight collected at each site and any observations you may notice that could be useful for research.

## **4.6 BUSINESS MANAGEMENT**

### **4.6.1 LEGAL & ETHICAL CONSIDERATIONS**

In order to ensure resource sustainability and maintain the health of the natural environment, it is important to follow the harvesting guidelines suggested. Do not pull on the plant, pull gently on the fruit to minimize the impact on the attachment of the plant.

Take proper precautions and ensure that you always have the mandatory first aid kit at the harvest site. As well, proper communication equipment should be designated to harvesters who must work in groups of two and have a shared satellite phone.

In the event of an incident/accident, an Incident Report should be completed by the harvester (see Annex C).

## **4.7 ADDITIONAL INFORMATION & BUSINESS SUPPORT**

### **4.7.1 SKILLS AND TRAINING RECOMMENDATIONS**

A wild berry harvester is recommended to take basic training in resource sustainability, mindful preservation of the environment, and maintain product cleanliness. As well, any harvester working in the field should complete a basic first aid or wilderness first aid to prioritize safety.

## 5. BIRCH SAP

### 5.1 CHARACTERISTICS

#### 5.1.1 DESCRIPTION

Paper birch (*Betula papyrifera*), also known as white birch and canoe birch, is commonly found in the boreal forests of North America and is the most abundant birch species on the Lower North Shore. This tree can be identified mainly by its thin bark that tends to peel in layers looking similar to pieces of paper. The bark of paper birch is typically white; however, the inner young bark is reddish-brown. This species is also identified by its dark green pointed egg-shaped leaves, which have double serrated and sharp toothed edges (Parish & Thomson, 1994).



*Photo by Nicolas Shattler, LNS Bioproducts  
Solidarity Cooperative*

Paper birch trees can reach 20 metres (66 feet) tall and can have a diameter of 76 centimetres (30 inches) in length. Interestingly, trees growing in colder climates tend to live longer than those living further south, where they can survive upwards to 100 years. Since the bark found on paper birch has a high oil content, the tree has the ability to be more weather-resistant to harsh conditions such as rain, snow, and wind.

#### 5.1.2 HABITAT

Paper birch trees are found growing in many conditions within the boreal forest; however, large patches of this species are most commonly found on sloped terrain and along floodplain lands. The species does not establish well in shaded areas but can grow in many different soil types (Parish & Thomson, 1994). Paper birches are known for being pioneer species, where the trees tend to establish first following a disturbance. The disturbance could be caused by a wildfire, avalanche, flood, clear-cutting, and so on. This explains why large areas of mostly paper birch trees are found clumped together.

#### 5.1.3 BIOLOGICAL CHARACTERISTICS

Paper birch trees play a key role in the ecosystem of boreal forests. The trees provide animals with habitat, nesting sites and food sources, especially in winter months. Therefore, it is not recommended to use this resource for timber production, since clear cutting a birch grove would have negative effects on the ecosystem. It is suggested instead to use the sap within the trunk of the birch trees for production as a sustainable resource since the sap also has profitable product opportunities.

Trees collect and store nutrients in their roots every autumn to help with new tree growth in the following spring. The nutrients that are collected by the tree are contained within its sap. This sap is a mixture of approximately 99% water and 1% of a mixture of sugars, minerals, and other compounds. During the spring while the tree begins to thaw, the sap flows from the roots and spreads throughout the remainder of the tree before the new leaves develop. Once this sap flow



cycle begins, the sap can be collected. Typically, this collection process begins in mid-April when the temperature starts to get warmer (Cascio & Barber, 2014).

### 5.1.4 CHEMICAL CHARACTERISTICS

Most of the chemistry research available has been studied on the similar European birch tree, the silver birch (*Betula pendula*). Therefore, chemical composition analysis will need to be studied in the future to compare the sap characterization and its nutritional value. A study on silver birch trees showed that the sap contains bioactive compounds such as antioxidants, electrolytes, amino acids, minerals (calcium, iron, magnesium, manganese, phosphorus, and potassium), as well as small amounts of fructose, glucose and sucrose sugars (Küka et al., 2013). This chemical composition of birch sap is what makes the product valuable for nutritional and cosmetic products.

## 5.2 PRODUCTION POSSIBILITIES

### 5.2.1 HISTORICAL USES

In the past, Indigenous people used birch sap as a beverage in the spring, since it was the first source of carbohydrates available after the winter months. They also drank the sap as a medicinal substance to treat the flu and colds (Parish & Thomson, 1994).

As well, Northern European countries had commonly used birch sap in the past for a variety of nutritional and medicinal uses. Historical records were reviewed, and several European countries used birch sap for specific medical treatments differently. However, almost all countries researched used sap to both drink and apply to the skin (Svanberg et al., 2012). See below for examples of historical medicinal and cosmetic uses from the *Betula* species in Europe.

Table 4. Review of the historical applications of birch sap from several Northern European countries. Table sourced from *Uses of tree saps in northern and eastern parts of Europe*, (Svanberg et al., 2012).

Country	Medicinal use	Cosmetic use
Belarus	Lung diseases, gout	
Bulgaria		Hair growth
Czech Republic	Poor health, infertility	For beauty, against freckles
Estonia	Prevention of eye diseases, skin diseases, source of vitamins	Washing hair, treat skin against freckles, skin bleaching
Hungary	Stomach and lung diseases	Against freckles
Poland	Revitalization, kidney stones	Washing hair for strengthening
Romania	Kidney stones, jaundice, treat scabs, diuretic, pneumonia, constipation, wounds, headache, weakness in children	Hair-colouring and conditioning, remove sun spots and moles
Sweden	Scurvy, cholera	
United Kingdom	Tonic, rheumatism, first nourishment for newborn children	Prevention of baldness

## 5.2.2 INDUSTRY OPPORTUNITIES

Birch sap contains captivating bioactive compounds and minerals that have been consumed for centuries and is known to be beneficial for human health. Whether drinking birch water or applying it to the skin, birch sap is said to treat a number of different illnesses and improve skin conditions. Birch sap has the possibility to be used as is, also called birch water, and can either be produced for beverage consumption or within a cosmetic formulation to apply to the skin. Birch water is slowly entering the beverage market in North America and is compared to having similar benefits to drinking coconut water without consuming as much sugar. The water could be sold plain or with added flavours. Birch water could also be used to replace the water content found in cosmetic products, such as lotions, body wash, shampoos, etc.

As mentioned above, research on birch sap characterization and composition has found interesting compounds and minerals, which assumes to be beneficial for human health. Most of the benefits of using birch sap have been based on personal experiences of holistic health rather than proven research.

Otherwise, birch sap can be processed into birch syrup, much like maple syrup, where the water is reduced to make syrup. However, due to the lower sugar content of the sap compared to that of the maple, it would require about 100-150 litres of birch sap to produce one litre of syrup (Cascio & Barber, 2014). Commercial production of this process uses a reverse osmosis and evaporation equipment to remove water.

## 5.2.3 QUANTITIES REQUIRED

Production of birch sap into a supply for birch water production takes little transformation, with minimal volume lost during this procedure. Therefore, the volume requested from the purchaser is the amount to collect from your birch tapping site.

## 5.2.4 OPTIMIZING REVENUE

Birch sap harvesting season typically lasts 2-3 weeks and supplies an average of 1 gallon (3-4 litres) of sap per tree per day. Revenue will, of course, depend on the number of trees tapped as well as the seasonal conditions. However, it is important to keep in mind that the revenue earned will also highly depend on the quality of the sap. Since the final product is intended for consumption and cosmetic use, it is important to take every preventative measure possible to stop bacterial growth and to have clean water. The purchaser may not buy sap of poor quality; therefore, it is necessary to follow careful quality control procedures.

## 5.3 BEST HARVESTING PRACTICES

### 5.3.1 SITE SELECTION

Selecting an ideal site and dense paper birch forest should begin in the winter months prior to sap collection, while accessibility by snowmobile can be done safely. The harvest site selection will depend on safe accessibility during the spring months, the areal density of paper birch trees, and the number of suitable trees for sap harvesting.

Trees chosen for harvesting practices must be a diameter of 20 centimetres or greater at breast height (Ministère des Forêts, de la Faune et des Parcs Québec, 2017). Trees that are tapped should not be exposed to any toxic substances such as petroleum or pesticides. Trees along

maintained roads should not be harvested. Trees for harvesting should have healthy treetops and bark. If the birch contains multiple mushrooms or conks, it is considered unsuitable for use as the trees are dying or dead (Cascio & Barber, 2014).

Once a site is selected, a spring trail should be constructed in preparation for safe accessibility and the suitable trees should be labelled in preparation for when sap harvesting conditions become optimal.

### 5.3.2 PERMIT APPLICATION

Collection of birch sap can only happen in areas designated by permits issued by the Ministère des Forêts, de la Faune et des Parcs Québec (MFFP). To apply for a tapping permit, contact your local MFFP office (for Côte-Nord region, email [cote-nord.foret@mffp.gouv.qc.ca](mailto:cote-nord.foret@mffp.gouv.qc.ca)).

### 5.3.3 OPTIMAL HARVESTING CONDITIONS

Once temperatures are above freezing during a harvest day, sap should be gathered quickly to ensure high-quality products and prevent exposure to potential debris from surrounding environments that may contaminate the harvested sap (Hopkins, 2002). Harvesters must be mindful of varying start and end dates that are dependent on the season. Ideally, the harvesting season has temperatures above zero degrees Celsius during daytime hours and temperatures below zero degrees Celsius during the night. Usually, the harvest season for paper birch is two to three weeks long.

Tapping in Québec can be carried out from the first of January and must end no later than July of the same year. Spouts must be removed from trees by the first day of July (Ministère des Forêts, de la Faune et des Parcs Québec, 2017).

### 5.3.4 TAP & BUCKET HARVESTING TECHNIQUE

#### Drilling

Only one tap hole is allowed per tree, per year, regardless of the diameter of the tree. The tap hole should be at a height of 1.30 metres above the highest ground level. The hole is created using a drill bit with a diameter of 11 millimetres or smaller and must not exceed six centimetres in depth (including the bark) (Ministère des Forêts, de la Faune et des Parcs Québec, 2017). A piece of tape can be placed on the drill bit to indicate the depth inserted into the tree and the drill bit should be properly sanitized before drilling into the tree. When drilling the hole, the drill should be almost 90° perpendicular to the tree with a slight tilt upwards to aid with the downhill flow of sap. When drilling into the tree, the wood shavings should be white. If there is brown wood present in the shavings the tree is not suitable for use, as it is dying or already dead (University of Alaska Fairbanks, 2014). Once a tap hole is made, make sure all wood fibres or shavings are cleaned out, and this can be done by making a drilling a second time and spraying with clean distilled water (do not blow into the tap hole).



Photo from <http://herbalways.net/birch-tree-tapping/>

### Tapping

The spout (or spile) can then be inserted into the drilled hole by tapping gently with a hammer. Only products registered under the Pest Control Products may be inserted into the tree's tap hole (Ministère des Forêts, de la Faune et des Parcs Québec, 2017). It is recommended to use the type of spout that is plastic and can connect to clear plastic tubing so it can flow into the sap collection bucket placed on the ground. This way, a hole can be drilled into the cover of the collection bucket the same size as the tubing so that no other debris falls into the sap.



*Photo by Nicolas Shattler, LNS Bioproducts  
Solidarity Cooperative*

### Collecting

It is advised that the sap collection buckets be emptied every 24 hours to maintain freshness and prevent microbial activity, since naturally occurring yeast within the sap will begin to ferment. The daily collected sap can then be refrigerated for 1-2 days before beginning to spoil; otherwise it should be placed in a freezer for longer storage.

### End of Season

Towards the end of the sap harvesting season, the sugar content of the sap begins to lower, leaving it with a woodier taste. The end of the harvesting period is indicated when the sap is no longer clear and as sweet tasting. At the end of each season, the spouts must be pulled and the hole can be sprayed with sterilized water. Some commercial sap harvesters suggest plugging the hole with pieces of cork once the spout is pulled out for the season. However, researchers suggest it is better for the tree to heal the wound naturally.

In efforts to help protect the health and life of the tree, the tree must only be tapped every two years. As well, tap holes created on the same tree should be drilled at least four inches away from any previous tap holes (Cascio & Barber, 2014).

## **5.3.5 TUBING SYSTEM HARVESTING METHOD**

The tubing system method guidelines are based on current knowledge and existing set-ups in the maple sap harvesting industry. It is suggested to begin with these guidelines as a research and feasibility study before implementing fully at your harvest site. Many years of research in North America has proven that collecting sap with plastic tubing yields higher amounts of cleaner sap compared to the traditional bucket method. The tubing method also improves efficiency by reducing the amount of labour time required (Pennsylvania State University, 2011).

Before tapping begins, the site of installing a tubing system must be evaluated to consider tree size, abundance, slope aspect and percentage, and the distance to the collection container. A sufficient number of paper birch trees large enough to be tapped should be in close proximity to minimize the amount of tubing the sap must run through. The slope percentage must be measured by the vertical rise over the horizontal distance to estimate the length of tubing, its size, and how the system should be laid out. The direction of the slope is also important to consider, and ideally the slope would be facing east or south since the tubing would receive sunlight in the morning and thaw out more quickly (Pennsylvania State University, 2011). It is

suggested to map out your site with the feasible trees to plan the tubing layout before beginning installation.

Initial set-up of drilling tap holes and collection/transport/storage methods should follow the same methods as explained in the previous section. Once tapped, a tree will be set up with a lateral line attached to the spout using fittings and the lateral lines run sap to the mainline. The mainline is a larger plastic tube that collects from several lateral lines and runs the sap to the collection container. It is important to remember to have clear or white tubing to prevent the sap from heating (Pennsylvania State University, 2011). It is suggested as a rule of thumb to have at least 15 feet of lateral line tubing per tree.

When designing the layout of the tubing system, the mainline tubing must have a downward slope after each lateral line attached and should be supported by a post or tree every 50 feet (Pennsylvania State University, 2011). Make sure there isn't any obstruction of the mainline and try to keep the mainline as straight as possible. A gravitational tubing system can be used as a natural vacuum if there are 20-30 tapped trees, a minimum of 3-5% percent slope gradient, and a tight leak-free line system (Pennsylvania State University, 2011). Otherwise, a vacuum pump system must be used and can only be operating when the air temperature is above 0°C. Vacuum pumping is still a sustainable practice since it does not pull sap out of the tree.

It is suggested that tubing installation be tried as a research study in a portion of your tapping site before solely using this method. Steps may be followed from the maple syrup industry, but they will likely have to be adapted for the birch tree and different climate. Some factors to consider when testing sap collection tubing systems to prove feasible in northern regions are:

1. Whether the cooler temperatures will cause the lines to freeze, shortening the sap flow time length per day.
2. If the system would require a vacuum to keep the sap moving through the lines, or if the gravitational flow is sufficient.
3. Whether the lines will accumulate more bacterial growth since the tubing is more difficult to sanitize.

### 5.3.6 MAINTAINING QUALITY CONTROL

Cleanliness is a significant factor while conducting birch sap operations to eliminate the formation of microorganisms, bacteria, or yeast; which may affect the sap and the flavour and colour of the products. Improperly cleaned equipment can serve as a host for these types of microbes. The use of sanitary steps and equipment when collecting, packing, transporting and storing birch sap is required to produce quality products (Hopkins, 2002).

Proper sanitization is necessary for sap collection instruments and storing units. However, it is important to note that not all disinfectants are suitable for these types of equipment. For instance, household cleaning detergents and soaps are not used for sanitization purposes due to their fragrance and unsuitable ingredients. Properly scrubbing and rinsing equipment with clean, hot water is ideal for cleaning equipment (Hopkins, 2002).

Spouts must be sanitized two to three days prior to use. Sanitized spouts will keep the tap hole open longer and will prevent the growth of microorganisms in the tubing (Hopkins, 2002). Any cracked spouts are to be discarded (Cascio & Barber, 2014). Gathering buckets and storing tanks should be rinsed and scrubbed throughout the season with hot water between runs, when reasonable (Hopkins, 2002). It is suggested that tubing be clear or white-coloured (avoid black

tubing to prevent drawing heat from the sun). Tubing should be sanitized/cleaned after the last sap run (Hopkins, 2002).

It is recommended that gloves and a mask be worn to prevent contamination from occurring during the harvesting process. Adequate footwear must be worn (closed toe). It is also important to ensure that particles from vehicle exhaust will not float into gathering buckets (Hopkins, 2002).

All sap collected in buckets and storage containers must be properly monitored and given designated labels (see Annex A).

Daily equipment sanitization requirements include:

- cleaning drill bits by polishing them with rubbing alcohol
- rinsing gathering buckets with hot water
- rinsing the reusable sap filters with hot water after each use

End of season equipment sanitization requirements include:

- soaking drill bits in rubbing alcohol then polishing each of them
- cleaning spouts with bleach solution and flushing with clean water, followed by boiling in hot water and left to dry completely before storing
- rinsing tap holes with distilled water

### 5.3.7 SAP FILTRATION

Two stages of filtering must be completed. The first filter must be used to filter any debris, bark, and small wood shavings. A second filter is used for finer particles. Filters should be changed/cleaned often to ensure the quality of the sap (Hopkins, 2002).

Sieves and large coffee filters can be used as filters. It is recommended to use a sieve to filter larger debris and the coffee filter for the second process to eliminate the smaller materials. If desired, other suitable sanitized products may also be used for filtration.

### 5.3.8 PROPER STORAGE

Buckets must be kept covered and cool at all times (Hopkins, 2002). Sap should be kept below five degrees Celsius for periods under six days. Since the sap is highly perishable, it is suggested to freeze or pasteurize it for long-term storage. During the harvesting, transportation and storage process, it is necessary that these precautions be taken to ensure that the sap does not become contaminated. In sap collection procedures, it is important to keep sap as cool as possible during the collection and transportation phase or placed in temperatures below freezing in a properly sealed container until the preservation process for long-term storage takes place. All buckets/containers of birch sap supplied to the Bioproducts Cooperative must be labelled properly (see Annex A).

### 5.3.9 LOCAL TRANSPORTATION

Any means of transportation for the job must be proven suitable for use and considered safe. Seasonal variability will be the leading factor determining which means of transportation is suitable. When travelling in a boat, a lifejacket is required and helmets must be worn when travelling on a snowmobile or an all-terrain vehicle.

When transporting sap, buckets must be kept tightly sealed and covered. Whether using a snowmobile or airboat for transportation from the harvest site into town, a tarp must cover the buckets to avoid any debris or any contaminants from making contact with the buckets. Light coloured tarps must be used to avoid drawing heat from the sun.

### 5.3.10 REQUIRED EQUIPMENT

All equipment and materials used for birch sap harvesting and processing must be approved for food application. The following is a list of equipment required for harvesting birch sap through the tap and bucket method, and a pipeline system would require additional materials.

- **Spouts/spiles:** Must use plastic commercial spouts, not metal. These are usually available to purchase at most hardware stores.
- **Collection buckets and covers:** Use 2-gallon or 3-gallon (7.5-11 litres) plastic buckets with a cover if hanging from the spout. However, it is necessary to have a container that is large enough to prevent overflow. Otherwise, use 5-gallon (19 litres) plastic buckets with a cover on the ground at the base of the tree with tubing certified for food grade running from a specially designed spout that attaches the tubing.
- **Gathering and transporting containers:** 5-gallon (19 litres) plastic buckets can be used to collect sap from collection buckets. This can then be placed in larger plastic barrels or containers when transporting back to the processing site.
- **Filtration materials:** coffee filters and funnels
- **Tools:** Drill, drill bit (max 11 mm), rubber mallet/hammer, measuring tape
- **Labelling:** Flagging tape, Write-in-Rain paper and labels
- **Field and safety equipment:** GPS, first aid kit, satellite phone

## 5.4 SUSTAINABLE RESOURCE MANAGEMENT

### 5.4.1 DOCUMENTING & REPORTING ANNUAL HARVESTS

Field reports are to be completed both weekly and seasonally. Weekly reports must be written by the harvester and include weather, temperature, volume of sap harvested, and any other comments regarding the harvest during the week (see Annex D to view the template for the weekly logs that will be used). Then, the employer completes seasonal logs at the end of each harvesting period (see Annex E). This will also include the monitoring of birch trees followed in accordance with the MFFP protocols (see Annex F).

## 5.5 BUSINESS MANAGEMENT

### 5.5.1 LEGAL & ETHICAL CONSIDERATIONS

In order to ensure resource sustainability and maintain health of the tree, sap harvesters globally assure that only a portion of the nourishing sap is extracted out of the tree during the harvesting time. The remaining portion of sap will deliver nutrients and minerals to the tree's spring buds in order to flourish into leaves.

A first aid kit must always be at the harvest site. As well, proper communication equipment should be designated to harvesters. Harvesters must be in groups of two, in which a satellite phone should be shared.

In the event of an incident/accident, an Incident Report should be completed by the harvester (see Annex C).

## **5.6 ADDITIONAL INFORMATION & BUSINESS SUPPORT**

### **5.6.1 SKILLS & TRAINING RECOMMENDATIONS**

A birch sap harvester is recommended to take basic training in resource sustainability, mindful preservation of the environment, and maintain product cleanliness. As well, any harvester working the field should complete a basic first aid or wilderness first aid to prioritize safety.

An employer wishing to manage a birch sap harvesting business is recommended to consider the above skills, as well as take an entrepreneur course and training in documenting and reporting annual production. It is also important that the employer has strong skills in overseeing good manufacturing practices.



## 6. ALTERNATIVE RAW MATERIAL BUSINESS POTENTIAL

### 6.1 LABRADOR TEA (*RHODODENDRON GROENLANDICUM*)

#### Description:

Labrador tea is a tough, slow-growing shrub that is native to the boreal forests of North America. Surviving some of the harshest of weather conditions, such as brutal colds, it still grows dense in wet acidic soils. From the evergreen, slow-growing shrub, blooms a beautiful umbrella-like cluster of flowers. The leaves are thin and long and grow in an alternate form. The top of the leaf is leathery, whereas the underside has wooly hairs which are white and turn to a rusty-brown colour when mature.



#### Characteristics:

- Its rhizomes are found deeper in the soil and typically do not get damaged from a fire and it is one of the first plants to recolonize
- The leaves contain oils and have a distinctive fragrance
- Sometimes a food source for moose and caribou



#### Potential Uses:

- Used as a tea to treat stomach and kidney complaints
- Has calming properties to reduce redness, clear acne/eczema/psoriasis
- Rich in skin repairing, anti-inflammatory keeps the natural elasticity of the skin, promotes collagen production
- One of nature's best anti-aging ingredients
- Prevents water loss from skin

#### Harvesting & Processing:

Leaves of Labrador tea can be harvested from the plant beginning in early spring and usually ending in September. It is recommended to only take a few leaves from each plant, by cutting with scissors or pulling gently, in order to avoid damaging the plant. Further research should be conducted to study the variability in properties and essential oils between young leaves (with white underside) and those leaves that have wilted (turned brown). Once collected, the leaves must be completely dried by air drying (out of direct sunlight), freeze-drying, or dehydrating, before being stored in an air-tight bag or container.

## 6.2 ROSEROOT (RHODIOLA ROSEA)

### Description:

The roseroot plant can be identified by its single scaly rootstock with several thick leaves stemming from it, usually growing among rock cracks. The plant can grow 5 to 40 cm high, and during the summer it blooms a single bright yellow flower sometimes tipped with red. The root is what makes the plant attractive, having a stalky root looking similar to the roots of plants in the ginger family. The roseroot can be found distributed globally in Northern regions or at high altitudes, making it unique to surviving in cold and harsh conditions.



### Characteristics:

- The roots contain essential oils, rosavin compound, organic acids and phenolic acids and their derivatives; flavonoids, anthraquinones, alkaloids, tyrosols, and salidroside
- Its rich polyphenol content makes the plant strong in antioxidant activity



### Potential uses:

- Leaves and stems can be eaten raw or cooked like spinach, having a bitter taste; and some use the extracts as a flavour for vodkas
- Even though there is no scientific research proving health benefits, the roots are thought to help the body counteract adverse physical, chemical, and biological stress factors
- It is said to reduce the effects of stress on memory and cognitive function, by eliminating fatigue and decreasing depression
- The roots were traditionally used to increase physical endurance, work productivity, longevity, and resistance to high altitude sickness
- Extracts can be used in cosmetics since it is shown to contain anti-aging, anti-inflammatory, and skin protecting properties

### Harvesting & processing:

Harvesting wild stocks of plants are not recommended since the small biomass would not be economically viable for larger productions and since removing the entire plant including the root system would not make it a sustainable practice. Further research on cultivating roseroot in large fields, as a future product, is anticipated to increase biomass and decrease harvesting costs. In order to transform the roots into an herbal tea product, for example, they must be washed, thoroughly dried and ground into small pieces.

## 6.3 JUNIPER BERRY (*JUNIPERUS COMMUNIS*)

### Description:

The juniper berry growing on juniper trees/shrubs may resemble a berry but is actually a female seed cone covered with a fleshy coating. The juniper is a conifer tree species and is distributed widely in Canada. The shrub is often low growing and spreads easily in exposed areas. The small berries typically range from 4 to 12 mm in diameter and are green when young and ripen to a purple colour sometimes eight months later.



### Characteristics:

- The juniper berry is known mostly to contain a unique flavour that can be used in spices, foods, and drinks
- Contains essential oils and these have been shown to express anti-microbial and anti-fungal properties
- They are quite powerful ingredients, therefore only small amounts are required

### Potential uses:

- Berries have been traditionally used for diuretic, antiseptic, aromatic, rubefacient, stomachic, antirheumatic treatment purposes
- It was also used to treat illnesses such as colds, congestion, coughs, urinary tract infections, arthritis, and gout
- The ripe purple berries are typically used for flavouring food (sauerkraut, stuffings, vegetable pâtés) and while beverages such as gin are usually flavoured using fully grown but unripe green berries
- Essential oils extracted from the juniper berry can also be used in cosmetics for aromatherapy and perfume products
- It is not advised to be consumed by a pregnant woman or someone with kidney disease

### Harvesting & processing:

Ripe berries can be picked from the shrub when the berry turns dark in colour, and they usually fall off the tree quite easily. It is suggested to wear gloves while harvesting since the conifer leaves are sharp. The juniper berries are then usually dried to use in teas or as a spice, and this can be done by air drying for a few weeks or by dehydrating.

## 6.4 NORDIC CHAGA (*INONOTUS OBLIQUUS*)

### Description:

The chaga mushroom is a parasitic fungus most commonly found growing on birch trees. The mushroom resembles a large chunk of burnt charcoal. Chaga can continue to grow and cause decay to the tree for decades; however, the tree will continue to be alive as the fungus requires a live tree in order to survive.



### Characteristics:

- Contains the highest ORAC (Oxygen Radical Absorbent Capacity) score for antioxidants ever recorded in any natural food
- Packed with essential nutritive minerals (zinc, copper, magnesium, selenium, potassium) and vitamins B, C and E
- Rich in polyphenols and flavonoids
- The black colour is due to the large amount of melanin, an oxidation of the amino acid tyrosine

### Potential uses:

- Used for centuries in folk medicine
- Predicted to be very beneficial as an ingredient in cosmetic products
  - Zinc soothes skin (for sensitive/dry skin)
  - Copper promotes collagen production for skin regeneration
  - Magnesium helps maintain moisture levels, elasticity, reinforcing skin barrier
  - Selenium protects cells from damaging
  - Potassium maintains electrolyte balance keeping skin internally moisturized



### Harvesting & processing:

It is recommended to harvest chaga mushroom from the birch tree in late fall or winter months, while the tree is inactive and the chaga has an increase in nutrient levels. In order to maintain sustainable harvesting practice, it is recommended to leave 10-15% of the fungus attached to the tree for regrowth. The chaga mushroom can be removed using a knife or axe, and it should then be broken into smaller chunks, dried completely by air drying or dehydrating, and stored in a dry place.

## 6.5 CHANTERELLE (CANTHARELLUS CIBARIUS)

### Description:

The chanterelle is a small forest-growing wild mushroom, golden yellow in color. The species found locally to the area grows in colder parts of North America and is ripe very late in the mushroom season, giving it the alternative name, winter mushroom. It is a common edible wild mushroom.

### Characteristics:

- Contains high amounts of vitamin D<sub>2</sub> which helps the body absorb calcium
- Has significant amounts of protein, vitamin A, potassium, iron, chromium, 8 essential amino acids, selenium, copper and fiber

### Potential uses:

- Can be used in a variety of food recipes; it's one of the most commonly eaten wild mushroom
- It is thought to break down sugars in your body, to support the heart, nervous, and immune systems
- Consuming it is thought to reduce stress, depression, fatigue, and improve brain health
- Mushroom is also thought to help maintain hair, skin, and nail health

### Harvesting & processing:

It is best to cut the stem of the chanterelle mushroom with a sharp knife so that the root system of the fungus is left in the ground. The mushroom should then be cleaned thoroughly to remove dirt and can be stored in a paper bag in a refrigerator for up to 10 days. If you would like to preserve for longer, it is suggested to sauté pieces of the mushroom and freeze it, to use in recipes later on.



## 6.6 OTHER IDENTIFIED RESOURCES

Table 5. A list of other identified berries, plants, trees, and mushrooms found in the region that have production possibilities.

Berries	Plants	Trees	Mushrooms
Sea buckthorn ( <i>Hippophae</i> )	Fireweed ( <i>Chamerion angustifolium</i> )		Waxcap ( <i>Hygrocybe</i> )
Squashberry ( <i>Viburnum edule</i> )	Yarrow ( <i>Achillea millefolium</i> )	Tamarack ( <i>Larix laricina</i> )	Hedgehog/Sweet tooth ( <i>Hydnum repandum</i> )
Marshberry/Meshberry ( <i>Vaccinium oxycoccos</i> )	Marsh valerian ( <i>Valeriana dioica</i> )	Willow ( <i>Salix spp.</i> )	Hollowfoot ( <i>Suillus cavipes</i> )
Wild blueberry ( <i>Vaccinium angustifolium</i> )	Pitcher plant ( <i>Sarracenia purpurea</i> )	Dogwood ( <i>Cornus spp.</i> )	
Black Current ( <i>Ribes nigrum</i> )	Bloodroot ( <i>Sanguinaria</i> )	Mountain ash ( <i>Sorbus spp.</i> )	
Blueberry ( <i>Vaccinium myrtilloides</i> )	Seneca root ( <i>Polygala senega</i> )	Pine ( <i>Pinus spp.</i> )	
Raspberry ( <i>Rubus idaeus</i> )	Indian pipe ( <i>Monotropa uniflora</i> )	Birch ( <i>Betula spp.</i> )	
Dewberry ( <i>Rubus pubescens</i> )	Wild ginger ( <i>Asarum spp.</i> )	Yellow birch ( <i>Betula alleghaniensis</i> )	
Teaberry ( <i>Chiogenes hispidula</i> )	Pipsissewa ( <i>Chimaphila umbellata</i> )	Juniper ( <i>Juniperus</i> )	
Sandberry/bearberry ( <i>Arctostaphylos uvaursi</i> )	Goldthread ( <i>Coptis</i> )	Green alder shrub ( <i>Alnus viridis</i> )	
Crackers/bunchberry ( <i>Cornus canadensis</i> )	Showy lady slipper ( <i>Cypripedium reginae</i> )	Balsam fir ( <i>Abies balsamea</i> )	
Dogwood berry ( <i>Sorbus spp.</i> )	Round leaved sundew ( <i>Drosera rotundifolia</i> )	Cedar ( <i>Cedrus spp.</i> )	
	Alumroot ( <i>Heuchera</i> )	Spruce ( <i>Picea spp.</i> )	
	Sweet grass ( <i>Hierochloe odorata</i> )		
	Common hop ( <i>Humulus lupulus</i> )		
	Coltsfoot ( <i>Tussilago farfara</i> )		
	Nordic cotton grass ( <i>Eriophorium</i> )		
	Garden angelica ( <i>Angelica archangelica</i> )		
	Cow parsnip ( <i>Heracleum spp.</i> )		

	Sweet gale ( <i>Myrica gale</i> )		
	Common dandelion ( <i>Taraxacum officinal</i> )		
	Wild red clover ( <i>Trifolium pretense</i> )		
	White clover ( <i>Trifolium repens</i> )		
	Wild rose ( <i>Rosa</i> )		

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## 8. APPENDIX

### ANNEX A: LABEL

# LOWER NORTH SHORE BIOPRODUCTS SOLIDARITY COOPERATIVE



Name of Harvester: \_\_\_\_\_

Name of Species: \_\_\_\_\_

Date: \_\_\_\_\_

Location: \_\_\_\_\_

## ANNEX B: ALGAE HARVESTING ANNUAL DOCUMENTATION

<b>Algae Harvesting Record Log</b>			
<b>Name:</b>		<b>Year:</b>	
<b>Permit #:</b>			
Date	Site Code/ Coordinates	Biomass Harvested (kg)	Comments Regarding Harvest
<b>Date:</b>		<b>Signature:</b>	

## ANNEX C: INCIDENT REPORT

### EMPLOYEE INFORMATION

Name:	
Name of Industry Partner:	
Phone Number:	
Email:	
Signature:	
Date:	

### FEEDBACK

Did you feel your working conditions were safe?	<input type="checkbox"/> Good	<input type="checkbox"/> Average	<input type="checkbox"/> Poor	<input type="checkbox"/> Very Poor	<input type="checkbox"/> N/A
How would you consider your relationship with the Co-op?	<input type="checkbox"/> Good	<input type="checkbox"/> Average	<input type="checkbox"/> Poor	<input type="checkbox"/> Very Poor	<input type="checkbox"/> N/A
Did you feel that you had adequate training?	<input type="checkbox"/> Good	<input type="checkbox"/> Average	<input type="checkbox"/> Poor	<input type="checkbox"/> Very Poor	<input type="checkbox"/> N/A

1. Would you recommend more training be given by the Co-op and why? If yes, please state the type of training.
  
2. Do you feel that the harvesting season ran smoothly? Please explain.
  
3. Is there anything that can be done differently to improve the harvesting process/procedures?

Additional Comments:

## ANNEX D: WEEKLY BIRCH SAP DOCUMENTATION

Weekly Record Log			
Name of Industry Partner:			
Date	Weather	Temperature (Daily high/low)	Comments Regarding Harvest
Name:		Signature:	

**ANNEX E: SEASONAL BIRCH SAP HARVESTING DOCUMENTATION**

<b>Seasonal Record Log</b>
Name of Employee/Harvester:
Signature:
Date:
Site:
Season Start Date:
Season End Date:
Number of Litres Harvested:
Number of Trees Tapped:
Number of Incidents/Accidents:

## ANNEX F: MONITORING PAPER BIRCH TREES

**Monitoring of the Actual Tapping of White Birch Standards** (According to the Ministère des Forêts, de la Faune et des Parcs Québec (MFFP))

**Objective:** Document the healing of the tap holes and detect the dieback that could be caused by the tapping of birches. The information gathered will be used to validate the framework set up and, if necessary, to modify it.

**Take the following measurements during the period when the trees have leaves:**

**1. Condition of the tap holes:**

- Note the number of visible tap holes for each sampled birch
- Note the healing site for each of the visible tap holes as follows:

A: No scarring, no healing bead

P: Partially closed notch, presence of a healing bead

C: Complete healing, completely closed notch

X: Presence of a fungus (sporophore, mycelium, etc.)

**2. Crown condition (detection of dieback):**

- Note the percentage of tree crown in 8 classes:
  - 0 (1 to 5%)
  - 10 (6 to 15%)
  - (16 to 25%)
  - (36 to 65%)
  - 75 (66 to 90%)
  - 95
  - M (dead)
- Note: take note of the year when tapping was done

**Method**

- Start the measurements three years after the first tapping and continue the measurements every two or three years afterwards
- Sampling a minimum of 30 tapped birches on a continuous sampling line or with well distributed sampling plots

If the presence of Class 10 decay or more is observed in several birch trees following the inventory of the notched birch, it would be advised to carry out an inventory of untapped birches (control trees) to be able to link the observed dieback to the fact that the birches have been tapped.

**Data Transmission**

Data must be sent to Mrs. Marie-Claire Dumont from the DSOF (Direction du soutien aux opérations Faune et Forêts).