

# Birch: white gold in the boreal forest

**B**irch trees provide far more than beauty and shade. The root or twig is used to make birch beer, the sap can be condensed and used like maple syrup. The bark is used to make containers and art objects. Chemicals found in the bark are showing promise as industrial lubricants, fungicides, and in fighting diseases.

Birches are the most numerous deciduous trees in the boreal forest, and are proving to have a wide range of uses in addition to the traditional use of its wood. Birch is classed as a hardwood, known for its fine-grained white or reddish wood (depending on whether sapwood or heartwood is used). The wood is used for everything from flooring to cutting boards, bowls to chairs, decorative plywood to jewelry. Spalted birch has color or black introduced into specific grain lines, either artificially or naturally via disease or insect infestation. It and birch burls are prized for their decorative qualities, and are used in wood turning, jewelry, furniture, and cabinetry.

While the wood may be the best known of this tree's products, others also lend themselves to commercial application: sap (made into syrup, sugar, candy, wine, beer, soft drinks, vinegar, and other foods); leaves (made into tea and herbal supplements or used for extracts); and bark (made into such items as canoes, baskets, boxes, jewelry, sculptures, and used for dye and extracts such as birch tar and medicinals).

There are six forms of birch in Alaska: Paper or white birch (*Betula papyrifera*) and two birches sometimes described as variants of *B. papyrifera*: *B. neoalaskana* or Alaska birch, and *B. kenaica* or Kenai birch); water birch, also known as red birch or black birch (*B. occidentalis*, also sometimes described as a white birch variant); dwarf birch (*B. nana*); and bog or ground birch (*B. glandulosa*). The latter two species are shrubs. Taxonomic battles are being waged in the scientific community over whether Alaska tree birches should be considered variations of the same species (*B. papyrifera*) or species in their own right.

Researchers at the School of Natural Resources and Agricultural Sciences are investigating birch in many ways: tree growth and climate change, bark harvest and use, sap production, twig water and sap rise, phytochemicals in birch, tree volume equations for determining such things as carbon sequestration, and recreational use impacts on lakeshore vegetation such as dwarf birch. Working with the Alaska Boreal Forest Council and the local school districts, present and former SNRAS students and faculty are helping local schoolchildren obtain scientific data on birch trees, such as the timing of their sap rise.

New industries are being developed in Alaska based on birch products, chief among them syrup manufacture and value-added birch bark and wood products. Other potential nontimber industries include pharmaceutical and cosmetics production. Birch bark is high in betulin and betulonic acid, phytochemicals which have a potential for pharmaceuticals that could be used to treat herpes, brain tumors, and melanomas. These may be found in higher percentages in Alaska trees than those of trees in the Lake States. (The University of Minnesota Duluth and the University of Alaska Fairbanks are comparing samples.) Birch oil is used for aromatherapy, leather oil, and in cosmetics such as shampoo and soap (particularly in Scandinavia). The leaves are used in herbal supplements and for medicinal tisanes (herbal tea). The commercial potential for birch is a tantalizing prospect: from its lumber to its chemical storehouse, sweet success may be on the horizon with Alaska's birch forests.

*Text & photos  
by  
Deirdre  
Helfferich*

# birch beverages

Birch sap straight from the tree is a traditional and refreshing spring tonic, tasting somewhat like mineral water. In Finland, Korea, Japan, and the Ukraine, birch sap is a valued drink. It is sold commercially in Scandinavia, Russia, and China, and is used as a traditional medicine. The sap can be drunk as is, or used instead of water to make other beverages, such as tea. Uncondensed sap has from about .5 to 2 percent sugar content, averaging around one percent and depending on the birch variety, location, and weather. Even though this may not seem like much, it is higher than many other tree species. Maples produce sap with about 2 to 2.5 percent sugar content. Unlike maple sap sugar, which has a very high proportion of sucrose, birch sap's sugar is about 42–54 percent fructose and 45 percent glucose, with a small amount of sucrose and trace amount of galactose.

## Root Beer

A simple birch soda can be made by boiling down birch sap to about ten percent of its original volume and then using a soda siphon or an air pump to provide bubbles. Birch sap needs to be refrigerated to prevent spoilage.

Among the many products derived from birch sap is birch beer. This is in fact a carbonated beverage, like root beer, although alcoholic birch beer can also be made, usually a beer with birch syrup or extract (termed birch oil) added for flavoring.

Birch beer requires about fourteen percent sugar content. Traditional root beer recipes often included birch twigs or birch root, from sweet birch (*B. letula*, a species that does not grow in Alaska) for its wintergreen flavor. Birch flavoring in lieu of the twigs, or entire birch beer brewing kits, can be purchased at shops selling brewing supplies.

Many commercial birch root beers are available, and some of them use Alaska birch syrup. A producer in Vermont, for example, the Journey Food and Beverage Company, makes Borealis Birch Beer, using birch syrup from the Tanana Valley.

The Great Bear Brewing Company, a brewpub in Wasilla, Alaska, makes a root beer and a cream soda using birch syrup from local producers. The company uses birch syrup, granulated sugar (sucrose), flavorings, and then carbonates the drink without using yeast. They have been producing these soft drinks for about four or five years. According to one of the brewers at Great Bear Brewing, birch root beer makes great root beer floats.

Traditional root beer making required yeast. During the first stages of growth, the yeast produces carbon dioxide. When fermentation begins, alcohol is produced, and beer results.

## Birch root beer recipe

Ingredients:

sweet birch twigs or birch oil (optional)

1 gallon honey

4 gallons birch sap

1 cake soft yeast

1 slice of bread, toasted (rye bread is recommended)

The traditional recipe calls for measuring four quarts of finely chopped twigs of sweet birch into the bottom of a five-gallon crock or carboy. (Where sweet birch is not available, sweet birch oil can be used, or no added birch flavoring.) In a large kettle, stir the honey into the birch sap and boil for ten to twelve minutes, then pour over the chopped twigs (or add flavoring). When cool, strain to remove the twigs and return to the crock.

Spread the cake of soft yeast on a slice of toasted bread and float on top of the beer. Cover with a cloth and let ferment until the cloudiness just starts to settle, a few days to about a week, depending on the temperature.

Bottle and cap tightly. Store in a dark place. (Capping at this stage prevents continued fermentation to alcohol, although even early on there may be some alcohol present.) It should stand in the bottles for about three months before using. If opened too soon, it will foam too much; the storage time allows it to become carbonated, as the carbon dioxide produced by the yeast slowly dissolves into the liquid.

## Beer

Haines Brewing Company makes an alcoholic birch beer every spring, Birch Boy Summer Ale. Paul Wheeler, brewmaster and owner, describes it as a lighter style of ale with a slight woody, birchy taste (like a popsicle stick). The flavor, he said, is subtle. Using premium syrup purchased from Birch Boy Products, Wheeler uses about a gallon of syrup to 140 gallons of brewery liquor (water), replacing some of the malted barley that he normally uses. He finds that the sugars in birch syrup are very fermentable, converting readily into alcohol and thus producing a dry ale, not a sweet one.

Resource management student Kimberley Maher (see also p. 10) and a friend tried making a home brew beer with

birch sap and syrup. Instead of water, they used sap, and they replaced some of the malt with syrup, producing a birch ale. Below is their beer recipe.

### **Berley's Birch Brew**

(recipe crafted by Steve Sheehy)

Ingredients:

- 5 gallons birch sap
- 1 lb crystal malt or other light malt,  
lightly crushed, in mesh bag
- 6 lbs extra light malt extract
- 1 pint birch syrup

Bring to a boil; remove grain bag.

Add 2 oz hops (we used Cascade) and 1 oz finishing hops (for flavor) and boil five minutes.

Cool to approximately 70° F.

Funnel into carboy and pitch yeast.

Allow to ferment for approximately two weeks; bottle.

### **Wine**

Great Land Wines in Haines, Alaska, produces a birch sap wine, using sap from a local syrup producer, Birch Boy Products. The company, which started up in 1997, has produced two batches of birch wine. Co-owner Dave Menaker says he is still experimenting with the recipe, trying to get the right balance of sugars. In his first batch he used uncondensed tree sap, which made an acceptable wine, but didn't move as well as he'd hoped. The next batch of sap was condensed to ten percent sugar by Birch Boy, and the resultant wine had a distinctive woody to nutty taste. Menaker thinks that it might be worth trying sap with a higher concentration of sugar, perhaps forty percent.

### **Birch wine recipe**

Recipes for winemaking vary, some calling for citric acid rather than lemon juice, corn syrup rather than grape concentrate, Campden tablets, raisins, and other ingredients. Times for fermentation and racking differ as well. A search on the web under "birch wine recipe" will reveal numerous variations on the theme below.

Ingredients:

- 1 gallon birch sap
- 2 lemons
- 2 oranges
- 1/2 cup strong tea
- 1/2 pint white grape concentrate
- 2 1/4 lb sugar
- wine yeast
- yeast nutrient

Peel oranges and lemons, discarding all white pith, and heat the peel in the sap at 120° F for 20 minutes.

Add enough water and the tea to bring to one gallon. Pour into container with sugar and concentrate, and stir until sugar is dissolved.

When mixture is cooled, add the fruit juice, yeast, and nutrient.

Ferment to dryness and rack twice, then mature for six months before bottling. Some recipes suggest adding sugar to taste prior to bottling.



*Alaska paper birch, such as these trees growing on the University of Alaska Fairbanks campus near the forest soils laboratory of SNRAS, may show tremendous variety in color. This small stand, for example, has trees with bark colored charcoal gray next to those that are golden orange next to still others that are brilliant white.*

# BIRCH SYRUP PRODUCTION IN ALASKA

Although birch syrup production is a more challenging process than maple syrup production, the potential for birch syrup has attracted commercial manufacturers to the industry: there are currently eight Alaska companies harvesting birch sap and producing birch syrup products. Alaska is on the cutting edge of birch syrup production, and most of the world's birch syrup is produced here. Alaska producers make about 1000 gallons of birch syrup a year. It is also produced in smaller quantities in Russia, Canada, and Scandinavia. Birch sap, condensed into syrup, is used for pancake syrup, candies, as an ingredient in sauces, dressings, and glazes, and as a flavoring in beer, wine, or soda pop.

The Alaska Birch Syrupmakers' Association (ABSA) is a group of seven manufacturers that was founded in the early 1990s by Marlene Cameron and three other birch syrup producers. Most of Alaska's birch syrup producers are members. The Alaska Science and Technology Foundation provided a grant to the association to promote birch syrup and its production, which helped get the group going. The current membership includes: the Alaska Boreal Forest Council (Fairbanks), Birchboy Birch Products (Haines), Birch Grove Birch Syrup (Eagle River), Chickaloon Birch Syrup (Chickaloon), Chugiak Mountain Birch Syrup, Kahiltna Birchworks (Wasilla), and Knik Birch Syrup Company (Wasilla).

Dulce Ben-East, of Kahiltna Birchworks, is the president of the association, which has produced guidelines for best practices for producing birch syrup (see facing page). The Food and Drug Administration has not yet created a legal definition for birch syrup, nor established grades of syrup, but the association has provided certification standards for birch syrup production, and is working toward independent certification by the state or another entity.

To receive ABSA certification, a birch syrup producer must be a member of the Alaska Birch Syrupmakers' Association and the syrup must be made from sap of Alaska birch trees (genus *Betula*); the producer also must adhere to the ABSA Best Practices and Department of Environmental Conservation and Food and Drug Administration regulations for equipment, facilities, and labeling; and the syrup must have a minimum 67 brix (percentage weight of sugar content), have no metallic or burnt flavors, and must be filtered and free of suspended solids. Syrup is evaluated according to color; flavor; specific gravity, or concentration of sugars and other nutrients; and viscosity.

## Making syrup

There are several challenges in birch syrup production. While the process is similar to reduction of maple sap, the differences are important. The tapping window for birch is shorter than for maple, primarily due to climate: The quicker transition to warmer temperatures during Alaska springtimes means that wild yeasts and other organisms—and hence a bitter flavor—increase in the harvested sap sooner than for maples, which grow far to the south, where seasonal changes are slower. Another problem created by the short tapping season (approximately three weeks in southcentral Alaska, and as short as ten days in the Interior) is that by the time the sap begins flowing, air temperatures can be well above freezing. If the temperature is in the fifties or sixties before the sap run is over, the sap can easily spoil in the collection buckets. In maple country, the temperature change is more gradual, and so there is less risk of spoilage.

Birch sap is acidic, which means that the metal taps, buckets, or tanks used in maple sugaring will give the sap a metallic taste; thus, plastic or nylon equipment is preferred. Alaska birch trees have shorter lives than maples, living around 100 years, although 200-year-old stands have been found. They are susceptible to heart rot, and so care must be taken to sterilize equipment not only for the safety of the customer, but for the safety of the tree. According to Marlene Cameron, of Cameron's Birch Syrup and Confections, trunk and root pressure is not strong, so the pipeline or tubing method of sap collection that is used in large maple operations is not efficient for birch sap collection.

Because birch sap is normally only about one percent sugar, it takes about 80 to 100 gallons or more to make one gallon of syrup. In contrast, a gallon of maple syrup requires only about 40 or 50 gallons of sap. Whereas maple sap can simply be boiled down, this is time-consuming and expensive with birch sap. The first step in sap concentration is reverse osmosis. Approximately 70 percent of the water in the sap is removed using a reverse osmosis machine, which concentrates the sugars to about five percent. Then the sap is further concentrated using an evaporator, to approximately 60–70 percent sugar concentration. About 99 percent of the water in the sap is removed to make syrup. Low-heat, low-pressure extraction is used to avoid burning the syrup. Because of the high fructose content, birch syrup must be distilled at lower temperatures than maple syrup, or a scorched or off-flavor will result. (Fructose burns at a lower temperature than sucrose, the chief sugar in maple sap.) The ease with which the syrup can be scorched means that the sap can only be heated in a narrow temperature range, and greater care must be taken.

Because of these factors, birch syrup is almost five times as expensive to make as maple syrup, but its flavor is distinctive and marketable, particularly in the specialty gourmet food market, as Alaska's producers have demonstrated.

# Alaska Birch Syrupmakers' Association

## \*BEST PRACTICES For Producing High Quality Birch Syrup

### Guidelines and Recommendations

#### A. Tree Tapping

1. Time to tap varies by location; usually first part of April
2. Tap holes: 1½–1¾" deep, slight upward angle, using a  $\frac{5}{16}$ – $\frac{7}{16}$ " bit, depending on spout used
3. Location of hole: 2–4 feet high, to the side of previous holes
4. Tap healthy trees; 8" diameter at breast height or larger
5. Do not tap trees that have ever had pesticides sprayed on or around them.
6. Use one tap per tree.
7. Use plastic, nylon, or steel spouts, or tubing supplies commercially available through local syrup equipment suppliers.
8. Do not drive taps too deep—wood can split, causing leakage.
9. Sterilize taps before use.
10. Tap trees when the sap flow is continuous.
11. Tap trees only where access is good and equipment will not compromise ground cover. Minimize damage to trails during break-up.
12. Remove spouts at end of season; may spray hole with pure water. Cork tap holes upon removal with appropriate sized cork (available through local suppliers).

#### B. Sap Collection

1. Use equipment appropriate for trail conditions. On public lands follow regulations.
2. Use stainless or food grade plastic collection containers and storage tanks. Do not use containers previously containing toxic materials.
3. Use only food grade hose and lines or standard maple tubing (no garden hoses!).
4. Collect sap daily.
5. Clean collection tanks and pumps daily.
6. Discontinue collection when yeast appears on taps and sap turns cloudy. Once sap has begun to turn it should no longer be used for bottled pure birch syrup.

#### C. Sap Storage

1. Use FDA-approved food grade poly, stainless, or glass-lined tanks.
2. Process all sap daily in the order in which it was gathered. Keep stored sap below 42° F and out of direct sun.
3. Clean sap storage tanks daily.
4. Monitor sap brix (sugar content) with refractometer or hydrometer.
5. Filter all sap through 5-micron water filter.

#### D. Syrup Production—Reverse Osmosis (RO) —optional equipment

1. Follow manufacturer's instructions for operating and cleaning.
2. Keep RO-concentrated sap cool and out of direct sunlight. Process as soon as possible to prevent spoilage and yeast growth. Do not store concentrated sap.
3. Use FDA-approved storage tank for concentrated sap.
4. Use food grade lines, fittings, and valves on RO.
5. Never use chlorine bleach for cleaning tanks or lines—it will compromise RO membranes.

#### E. Syrup Production—Evaporator

1. Use standard or modified maple syrup evaporators (wood, oil, or gas-fired) with tig welded or lead-free soldered pans.
2. Run sap through hot and shallow, using consistent heat to establish proper gradient.
3. Clean evaporator daily, using standard pan cleaners available through local suppliers.
4. Rinse, Rinse, Rinse.
5. Filter sap back into cleaned pan.

#### F. Syrup Finishing

1. Evaporate syrup to minimum of 67 percent sugar (brix scale) by weight using a calibrated refractometer. Using a thermometer, syrup is reached at approximately 11° F above the boiling point of water (variable by barometric pressure).
2. Hand filter through approved rayon and felt filters OR, preferably, filter press (available from local suppliers).
3. For filter press use food grade filter aid (diatomaceous earth) matched to the filter papers used.
4. Heat syrup to a minimum of 180° F, and no higher than 190° F; immediately hot pack into approved non-metallic food grade container and seal, or bottle (see below).
5. Record date and/or batch number on container. Note quality: brix, flavor, color.
6. Cool all bottled or packed syrup as quickly as possible and store in a cool, dark place.
7. Bottle syrup between 180–190° F. Use only glass or food grade plastic containers and heat seal lids. Lay container on side for at least 10 seconds after bottling to sterilize lid.

\*Best Practices is reproduced courtesy the Alaska Birch Syrupmakers' Association. For more information, contact Dulce Ben-East, Kahiltna Birchworks, 907.733.1309; Danny Humphries, Birch Boy Products, 907.767.5660; Trudy Carlson, Birch Grove Birch Syrup, 907.696.0893; Marlene Cameron, Cameron's Birch Syrup and Confections, 907.373.6275; Jim Garhart, Chickaloon Birch Syrup, 907.746.2828; or Charlene Montague, Knik Birch Syrup, 907.373.2935.

# Birch Growth and Sap

## Sap content and flow

Kimberley Maher, a masters degree student at SNRAS, is conducting a study to assess sap production by birch in interior Alaska. The study, a United States Department of Agriculture New Crops II and III project, is quantifying sap flow (volume and timing), sap chemistry (cation presence and sugar concentrations and components), and the relationship of sap productivity to environmental factors such as temperature. Maher is checking for the presence of seventeen different cations (mineral ions with a positive charge), such as calcium, magnesium, and potassium. Among the cations for which she has tested is arsenic, which appears only in low amounts, meaning that birch apparently does not concentrate this poisonous element—good news for syrup producers. She is also looking at factors such as soil moisture around the trees and their position on a slope.

Maher's work is done on three south-facing transects within fifteen miles of Fairbanks, in Ester, Ballaine, and on Murphy Dome. The trees are tapped from prior to the start of sap flow, usually during the second half of April, in accordance with the Alaska Birch Syrupmakers Association's guidelines for best practices. Data is available for two transects in 2002 and 2003. In the Ballaine transect, the first area established for the study, three years' sap production data was gathered, beginning in 2001. The trees were tapped at three sites in each transect, according to the position on the slope (top, middle, or bottom). Sap is collected daily and measured for volume and sugar concentration. Sap samples are taken every three days, frozen, and then analyzed later for their cations and sugar concentrations (fructose, sucrose, glucose, and galactose).

The results to date show that sap production varies widely from site to site and between years, but that most stands produce best during cool, prolonged spring weather. The sugar content of the syrup does not appear to be highly affected by the weather, but the volume and flow are.

## Tree growth and weather

Syrupmakers are concerned with maintaining and protecting their trees, and some of the research done by SNRAS is exploring how trees are affected by tapping. Glenn Juday, professor of forest ecology at SNRAS, and Valerie Barber, director of the Tree-Ring Laboratory, are examining the correlation between tree growth, sap production, and age, climate, or other factors in productive birch stands (see p. 33). Because sap represents stored reserves of energy that were manufactured the previous year, Juday and Barber suspect that there is probably a direct relationship between sap and ring growth. They have collected tree cores from ten trees (five tapped and five not tapped) at each of the nine stands in Kimberley Maher's study of birch sap production. One of the nine is the Pearl Creek site of the Alaska Boreal Forest Council's Tapping Into Spring project.

Juday and Barber's results so far show that birch stands in prime condition for sap production are generally in the range of sixty to one hundred years old, the same age range in which radial growth reaches a maximum. They also find that in certain years most birch across interior Alaska experienced major decreases in growth (1958, 1969–70, 1993) or increases in growth (1933–36, 1952–53). Decreases in radial growth in particular years are associated with strong drought (1957–58), widespread outbreaks of defoliating insects (1969–70), and stem breakage from heavy snow (fall 1992). Increases in particular years are generally associated with cool, moist weather.

Juday says that it is hard to find mature Interior birch that are sound enough for a solid core sample—a high proportion of trees are decayed in the center. Matanuska-Susitna valley birch, Juday and Barber have found, are generally bigger trees and show less decay than trees in the Fairbanks area.

Tree growth will need to be examined in many birch stands to confirm the relationship between type of site and level of production of sap or wood, according to Juday. But based on the limited sample so far, the more exposed (low elevation, south-facing slope) the site is, the stronger the tendency for birch growth to be limited by warm summers. These trees are negative responders to warmth. Birch on moister sites, such as shaded northeast-facing slopes or low-lying areas, generally are positive responders to warmth. These two opposite growth responses to climate may be of use to birch syrup producers. By tapping a mixed population of trees made up of both positive responders and negative responders, birch syrup producers might be able to avoid poor production even in extremely warm or cold years.

## Tapping Into Spring

The Alaska Boreal Forest Council began educational programs in the mid-1990s in the schools to educate people about the boreal forest and to encourage them to think more broadly about its uses. In 1998, Sally Anderson, UAF biology student, and Dan Stein, of the council, helped set up Tapping Into Spring, a place-based sap-tapping educational program that has grown to become a complete curriculum in sustainability. Every year, pupils tap trees and take scientific measurements that make up part of a long-term ecological study. The boreal forest council and community volunteers make syrup using a small sugar shack (called the North Star Syrup Works) that was purchased in 2000 with grant money from the Alaska Science and Technology Foundation. They develop products (such as Boreal Bliss ice cream, made with wild lingonberries and birch syrup), and market them.

With their teachers and sometimes their parents, the schoolchildren measure sap volume and sugar content, take daily weather observations, and create ecological profiles of trees (girth at an average breast height of four feet, height of tree, tree spacing). The data collected has proved to be helpful in predicting when the sap will start running. Preliminary results show that three days in a row where the temperature is 50° F or higher prior to April 15 results in sap flow about a week later; after April 15, the sap flows three days later.

The program has continued to expand through the help of the AmeriCorps Vista program, and volunteers Sunna Fessler, Kimberley Maher, and others. Tapping Into Spring has expanded from one to eight area schools and is offered to

homeschoolers and members of the community as well.

The boreal forest council created teacher training toolkits through an Environmental Education Grant, and began a training course in 2003 for teachers and others who wish to participate in Tapping Into Spring, working with the Fairbanks North Star Borough School District and in cooperation with the University of Alaska's education department. The trainees can receive professional development credit through the university. The course will be offered again in March 2004, pending paperwork approval. This 500-level course, according to the description, "uses the activity of tapping birch trees as a window into the ecology, economy, and historical uses of the boreal forest of interior Alaska," and is designed for K-12 teachers.

The council also offers backyard syrupmaking classes through the community schools program, and conducts an biannual forest use survey in the Tanana Valley watershed, a collaborative effort between state, university, and borough agencies to understand use patterns for diverse forest resources. Birch bark harvesting and sap tapping are among these uses; one discovery as a result of the survey is that birch bark use is more widespread than previously realized. The survey analysis is done by masters students at the UAF School of Management in cooperation with forest council staff.

Elena Sparrow of SNRAS and GLOBE provides equipment for weather data monitoring and helped to train members of the forest council to train teachers, pupils, and parents in use of the equipment and in taking measurements. Deb Wilkinson, who was a local teacher at Pearl Creek Elementary and now is a faculty member at the UAF School of Education, has been involved from the program's early years and was instrumental in developing the educational programs with the council. Shawn McGee, also at Pearl Creek, helped establish the sugar shack, which was originally located at the school but is now at the council's office in Fairbanks.

### For more information:

#### Alaska Birch Syrupmakers Association

Dulce Ben-East, president  
800.380.7457 (toll free in Alaska)

#### Alaska Boreal Forest Council

www.akborealforest.org  
P.O. Box 84530  
Fairbanks, AK 99708-4530  
907.457.8453; fax: 907.457.5185  
abfc@mosquitonet.com

#### Birch Boy Products

www.birchboy.com  
Daniel and Susan Humphries  
P.O. Box 637  
Haines, AK 99827  
907.767.5660  
birchboy@wytbear.com

#### Birch Grove Birch Syrup

www.birch-grove.com  
Trudy and Bob Carlson P.O. Box 771375  
Eagle River, AK 99577  
907-696-0893  
sales@birch-grove.com

#### Chickaloon Birch Syrup

www.chickaloon.org/Forestry/BirchSyrup.html  
Jim Garhart  
907.746.2828  
cvforest@chickaloon.org

#### Great Land Wines, Ltd.

www.greatlandwines.com  
Dave and Jeanie Menaker  
P.O. Box 1083  
Haines AK 99827  
907.766.2698; fax: 907.766.2094  
dave&jeanie@greatlandwines.com

#### Haines Brewing Company

Paul Wheeler  
P.O. Box 911  
Haines, AK 99827  
907.766.3823  
hainesbrew@yahoo.com

#### Kahiltna Birchworks

www.alaskabirchsyrup.com  
Dulce and Michael East  
907.373.1309, 907.733.1309  
quietlake@matnet.com

#### Knik Birch Syrup Company

www.knikbirchsyrup.com  
Charlene Montague  
P.O. Box 877372  
Wasilla, AK 99687  
907.373.2935; fax: 907.373.2936  
kbsc@mtaonline.net

### Further reading:

#### Alaska Boreal Forest Council:

*Backyard Birch Syruping. The How-to-Tap Manual.* Rev. March 2003.

Developed by Integrative Graduate Education and Research Traineeship program student Nancy Fresco during a summer internship for the ABFC:

*Alaska Birch Tapping for Everyone. Advice for experimenters, educators, hobbyists, and entrepreneurs on what can be gained from tapping birch trees, what delicious treats you can make from your sap, and how to avoid frustration—whether you're tapping one tree or one thousand.*

*Cooking with Birch Syrup and Birch Sap. Hints, marketing advice, and tested-and-approved recipes.*

*Sap and Syrup Science: Experiments in biology, chemistry, and math based on the sweet science of birch tapping and sugaring.*

#### Alaska Cooperative Extension Service, UAF:

*Under the Canopy*, July 1999. "Factors that influence sap flow in paper birch," and "Tapping Into Spring," by Bob Wheeler. The newsletter is available on line at: <http://www.uaf.edu/coop-ext/forestry/canopy/canopyjul99.html>

#### Alaska Science Forum

"Sap's Arising," by John Zasada, Institute of Northern Forestry, U.S. Forest Service, available on line at <http://www.gi.alaska.edu/ScienceForum/ASF4/467.html>.

#### American Cancer Society

For information on studies of betulinic acid's potential as a treatment for cancer, go to: [www.cancer.org/docroot/eto/content/eto\\_5\\_3x\\_betulinic\\_acid.asp?sitearea=eto](http://www.cancer.org/docroot/eto/content/eto_5_3x_betulinic_acid.asp?sitearea=eto)



Birch Boy Products:  
[www.birchboy.com/articles.html](http://www.birchboy.com/articles.html)

*The Alaskan Birch Syrup Producer's Manual*, by Danny Humphries

Cameron Syrup and Confections:

"Establishing an Alaskan Birch Syrup Industry: Birch Syrup—It's the *Un*-maple!" by Marlene Cameron. Available on line in pdf format at <http://ncrs.fs.fed.us/pubs/gtr/other/gtr-nc217/>

Grant Station:

"Tapping Into Spring Offers Sweet Lesson in Forest Sustainability," by Linda Schockley. Available on line at [www.grantstation.com/Public/News\\_Views\\_px/sp\\_archives/sp1100.asp](http://www.grantstation.com/Public/News_Views_px/sp_archives/sp1100.asp) newsletter is available on line at: <http://www.uaf.edu/coop-ext/forestry/canopy/canopyjul99.html>

Alaska Science Forum

"Sap's Arising," by John Zasada, Institute of Northern Forestry, U.S. Forest Service, available on line at <http://www.gi.alaska.edu/ScienceForum/ASF4/467.html>.



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American Cancer Society

For information on studies of betulinic acid's potential as a treatment for cancer, go to: [www.cancer.org/docroot/eto/content/eto\\_5\\_3x\\_betulinic\\_acid.asp?sitearea=eto](http://www.cancer.org/docroot/eto/content/eto_5_3x_betulinic_acid.asp?sitearea=eto)

Birch Boy Products:

[www.birchboy.com/articles.html](http://www.birchboy.com/articles.html)

*The Alaskan Birch Syrup Producer's Manual*, by Danny Humphries

Cameron Syrup and Confections:

"Establishing an Alaskan Birch Syrup Industry: Birch Syrup—It's the *Un*-maple!" by Marlene Cameron. Available on line in pdf format at <http://ncrs.fs.fed.us/pubs/gtr/other/gtr-nc217/>

Grant Station:

"Tapping Into Spring Offers Sweet Lesson in Forest Sustainability," by Linda Schockley. Available on line at [www.grantstation.com/Public/News\\_Views\\_px/sp\\_archives/sp1100.asp](http://www.grantstation.com/Public/News_Views_px/sp_archives/sp1100.asp)

## School of Natural Resources & Agricultural Sciences Agricultural & Forestry Experiment Station

P.O. Box 757200

University of Alaska Fairbanks  
Fairbanks, Alaska 99775-7200

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