School of Natural Resources & Extension
Agricultural & Forestry Experiment Station

volume 44
2014

agroborealis

SNRE AND BROADER IMPACTS

• STEAMpower • biomass research • species analysis by DNA •

UAF UNIVERSITY OF ALASKA FAIRBANKS

Contents:

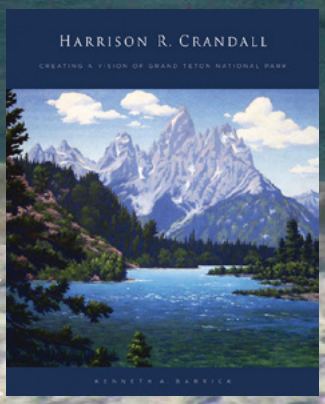
FOREST SCIENCES

4 • STEAMpower
Inspiring Students, Teachers, and the Public
The Boreal Alaska — Learning, Adaptation, Production K–20 programs include a wide array of special projects and programs, including a Forest Entrepreneur Camp, an interactive educational mural in a library, place-based narrative and altered books, Tapping Into Spring and birch syrup, and citizen science.…*By Deirdre Helfferich, Jan Dawe, Zachary Meyers, Nancy Tarnai, and Joan Parker-Webster*

19 • The Forest for the Trees
A History of the Forest Growth & Yield Program
The studies undertaken by this program aim to quantify forest productivity by providing publications, data, and equations and/or models of forest growth and yield. This information is essential for basic state-of-the-art timber management decisions, stand prescriptions, and monitoring long-term forest health and change.…*By Tom Malone*

GEOGRAPHY

22 • Painting Sacred Space
Harrison Crandall and Grand Teton National Park
Painters and photographers in the 1800s played a large role in the creation of the national parks system, conveying the beauty and awe-inspiring power of natural, sacred spaces across the United States. Crandall was one such artist, and his work caught the eye of UAF geographer Kenneth Barrick.…
By Deirdre Helfferich



HIGH-LATITUDE AGRICULTURE

25 • Circumpolar Agriculture Conference
Connecting to the Land
The 8th Circumpolar Agriculture Conference & UArctic Inaugural Food Summit in Girdwood, Alaska, drew 128 people from seven arctic countries and Japan, with presentations on food security, food safety and health, development of a sustainable agricultural sector, greenhouses, berry production, sustainable livestock production and health, and more.…*By Nancy Tarnai*

29 • The Alaska Natural Fiber Business Association
Connecting Alaska's Fiber Community
Alpaca, bison, sheep, goats, llamas, yaks, muskoxen, even dogs yield natural fibers that can be used for everything from clothing to housing insulation to oil spill cleanup batts. In Alaska, wool production has remained largely a cottage industry, but now a statewide business association hopes to change that.…*By Jan Rowell and Lee Coray-Ludden*

NATURAL RESOURCES

35 • Growing Our Energy At Home
Biomass Crops in Alaska
Biomass as an alternative fuel may be feasible in Alaska due to high energy costs in the northernmost state, particularly in rural areas off the road system. Bio-oils, woody biomass, and

About the cover:
Handmade journals and altered books became part of a science, technology, engineering, art, and math curriculum in eighth- and seventh-grade classes in Fairbanks. See story on STEAM education, p. 4.
—photo by Zachary Meyers

About this background panel:
Bear genetics may provide clues to how species such as the polar bear evolved and survived previous warming periods. This bear was photographed at Wapusk National Park, Manitoba, Canada. See story p. 44.
—photo by Ansgar Walk, CC BY 2.5

About the contents page photos:
Top to bottom: child's drawing of a fall leaf in a OneTree Alaska STEAM school program; marker at a tree on a Permanent Sample Plot (photo by Tom Malone), cover of book by former SNRE associate professor Ken Barrick, Alaska ewe and lamb pre-shearing (courtesy Becky Hammond).

Agroborealis is published by the Alaska Agricultural and Forestry Experiment Station, University of Alaska Fairbanks. For more information about our research and education programs, please contact us at:

School of Natural Resources & Extension
P.O. Box 757140
Fairbanks, AK 99775-7140

Office of the Dean
(907) 474-7083 •
uaf-snras@alaska.edu

Student Information
(907) 474-5276 or visit our website:
www.uaf.edu/snre/

Changes of address and requests for a free subscription or extra copies should be addressed to:

AFES Publications
P.O. Box 756180
Fairbanks, AK 99775-6180

Agroborealis and other SNRAS/AFES publications are available in PDF. Please provide your e-mail address if you would like e-mail notification of online availability of our periodicals and other publications. You may download them from our website at:

www.uaf.edu/snre/publications/

Agroborealis is produced by the AFES Information Office.

ISSN: 0002-1822

AFES Managing Editor
Deirdre Helfferich
dahelfferich@alaska.edu

Information Officer/Science Writer
Nancy J. Tarnai
njtarnai@alaska.edu

IT person & Web specialist
Steve Peterson & Mallory Morton
slpeterson@alaska.edu
memorton2@alaska.edu

To simplify terminology, we may use product or equipment trade names. We are not endorsing products or firms mentioned. Publication material may be reprinted provided no endorsement of a commercial product is stated or implied. Please credit the authors, the researchers involved, the University of Alaska Fairbanks, and the Agricultural and Forestry Experiment Station.

UAF is accredited by the Commission on Colleges of the Northwest Association of Schools and Colleges. UAF is an AA/EO employer and educational institution.

UAF UNIVERSITY OF ALASKA FAIRBANKS

agronomic crops are some of the possibilities that researchers at the Agricultural & Forestry Experiment Station are exploring for their energy potential.…*By Stephen D. Sparrow, Amanda Byrd, darleen masiak, Minchu Zhang, Robert Van Veldhuizen, William Schnabel, Valerie Barber, J. Andres Soria, Theodore Dickerson, and Magdalena King*

44 • Finding the DNA Difference
Sleuthing the ultra-conserved elements of animal DNA and analyzing the genetic relationships among and within species such as brown, black, and polar bears has made Dr. Matthew Cronin, professor of natural resources at SNRE, both a respected geneticist and a perforator of Endangered Species Status applications.…*By Nancy Tarnai*

EVENTS, PEOPLE, & PLACES

46 • What Are the Implications of Your Research?
Starting the Broader Impacts Conversation in Alaska
How do the broader impacts of research affect your community, develop a diverse and healthy economy, form partnerships, increase scientific literacy, foster sustainable ecosystems, and bridge gaps in cultural understanding? What does the term "broader impacts" mean to different people? And why is their benefit to society important?.…
By Meriam Karlsson and Jan Dawe

48 • SNRE News & Events
- School & Extension merge
- Advisory Council
- Geography moves to CNSM
- Degree program streamlined; pre-veterinary medicine track added
- Retirements
- Outstanding volunteer honored
- CES relocates to Matanuska Experiment Farm
- Elena Sparrow wins Usibelli Award
- Employees of the Quarter

THANK YOU!

Interim Dean & Interim AFES Director Steve Sparrow, Vice Provost for Extension & Outreach and Cooperative Extension Service Director Fred Schlutt, and the entire SNRE faculty and staff express their deepest appreciation to our financial donors & volunteers; from those who donate to the Reindeer Research Program, Georgeson Botanical Garden, scholarships; and graduate fellowships; to the sponsors & volunteers who help make our conferences & events possible. You are helping us fulfill our mission in Alaska. Thank you.

Barley heads and straw: a possible fuel source? See story p. 35.
—AFES FILE PHOTO

STEAMpower: Inspiring Students, Teachers, and the Public

edited by Deirdre Helfferich, Jan Dawe, Zachary Meyers, & Nancy Tarnai

Final journal for the Alaska EPSCoR StoryTelling project conducted by BAKLAP's K–20 STEAM Education program. This journal was created by an eighth-grade student at Effie Kokrine Early College Charter School, from the paper to the finished piece.
—PHOTO BY ZACHARY MEYERS

STEAM: Science, Technology, Engineering, & Mathematics powered with Art

Kindergarten through graduate education (K–20) in the sciences, technology, engineering, the arts, and math is of utmost importance to innovation and creativity in design. STEM fields are all traditionally left-brained, logic-oriented endeavors. They develop critical thinking skills, and are lauded for their importance in building a strong economy. The arts, however, are right-brained, and contribute to creativity and invention and develop not only critical thinking skills but also critical making skills—all important to success in technical fields as well as the fine arts.

STEAM education is a means of exciting students, teachers, and the public, and motivating them to become learners for life, involved and inspired with an inquiry-based approach to learning. Learning happens everywhere: in formal settings, such as classrooms, workshops, apprenticeships, and during on-site job experience; in informal settings, including after- and out-of-school programs, field trips, museums, zoos, botanical gardens, galleries, on vacation, and through hobbies and digital and online resources; and in more unstructured, playful environments, too. Wherever it occurs, learning is a cumulative, never-ending, lifelong process. STEAM education is suited to all these formal and informal settings.

STEAM education empowers individuals to pursue their own interests at their own pace. It's also not exactly new: the perfect example of STEAM thinking is embodied in Leonardo da Vinci's approach to integrative learning and invention. While not everyone can be a da Vinci, anyone can be a critical thinker and maker through practicing these principles.

While integrated education can be part of a normal curriculum, in STEAM education, the hands-on, creative aspect is stressed and becomes a means of creating a broader, deeper understanding of all the other parts. Each activity explicitly relates to a specific subject area or topic that is the focus of exploration. For example, if the topic is botany, the students may explore a plant's biology through sketching its anatomy, discover physics or math through learning about the amount of water needed to maintain turgor pressure, and learn technological skills when they document changes in the plant through a time-lapse video. All these experiences offer different perspectives on what is happening with the plant and how it is growing.

In the UAF School of Natural Resources & Extension, the Boreal Alaska—Learning, Adaptation, Production (BAKLAP) K–20 STEAM education program, directed by Dr. Janice Dawe, uses four methodologies—integrated curriculum, K–12 teacher professional development, peer teaching, and community collaborations—to fulfill its educational mission:

> *To improve STEM teaching and learning outcomes by developing model integrated K–12 curricula based on hands-on experiences with the Alaska boreal forest through inquiry science and art.*

OneTree Alaska is the model for STEAM education, connecting the university with K–12 schools, teachers, and students. As part of BAKLAP, OneTree Alaska is developing curricula through classroom activities (e.g., Tapping Into Spring) and special projects such as the Forest Entrepreneur Camp, and as a result of teacher professional development courses and citizen scientist field training.

Classroom activities & special projects

The BAKLAP K–20 STEAM Education program classroom activities range from studies of germination and tree growth experiments, to investigating competition among maternally related lineages in Alaska white birch (*Betula neoalaskana* Sarg.). The core curriculum includes scientific inquiry and observation studies and the Tapping Into Spring program. Special projects include collaborative instructional design projects such as an interactive mural and altered books. None of these are isolated from each other: the very nature of STEAM education, from K–12 classrooms up to adult community courses, is to create connections and collaborative work. Teachers from a dozen different elementary and middle schools in the Fairbanks North Star Borough School District have worked with BAKLAP since 2012, with new schools and teachers joining each year. The origins of this classroom work date back to efforts by the Alaska Boreal Forest Council from 1998–2005, and by OneTree Alaska from 2009–2012.

Classroom visits, university service learners, and UAF coursework

To make the program work, the STEAM personnel are committed to customizing lesson plans and activities to suit grade-level curricula and teachers' special topic focus areas, and gathering ongoing feedback and evaluations to improve the program from one year to the next. Classroom visits are an important part of the K–12 work, with scientists and graduate student service learners going to classrooms to work directly with teachers and students. K–12 teachers have commented repeatedly how much they appreciate having scientists and university graduate student service learners come into their classrooms, saying how inspiring these interactions are for students.

Service learning is a teaching and learning strategy that integrates meaningful community service with instruction and reflection, and is designed to enrich the learning experience, teach civic responsibility, and strengthen communities. A graduate level resource management course at SNRE, Independent Study in Natural Resource Service Learning, offers a platform for a "community of learners" such as Peace Corps Master's International degree-seeking

students, a UAF alumna seeking her K–12 art teacher's certification, and more. The graduate student course is paired with a companion professional development course taken by borough schoolteachers. An example is "OneTree: From Seed to Tree," which focuses on supporting teachers working with OneTree Alaska to grow trees in their classrooms as a means to integrate student explorations of science, technology, math, art, and stewardship concepts. Together, these courses create a cohort of mutually supportive teachers and students who support each other's efforts both to teach and to learn and to support their community, adding a collaborative breadth and depth to both K–12 and university coursework.

Peer teaching has been a hallmark of OneTree Alaska since 2009, and has been further developed as a teaching methodology by the STEAM Education program. Student peer teaching gained new heights during the 2013–2014 school year. Teachers at Tanana Middle School and Salcha Elementary worked together to create a middle-school level service learning program, independent of BAKLAP's K–12 STEAM Education program. Carri Forbes, a Tanana Middle School science teacher, wrote a successful proposal to State Farm Foundation to initiate a service learning program at her school. Her seventh-grade students worked with Ronda Schlumbohm's third-graders on the "Family Matters" experiment and "Tapping into Spring." Students from both grades spoke enthusiastically about their work together, and the peer teaching paid off: the third-graders took the top prize at the Interior Alaska Science Fair with their presentation of their "Family Matters" experiment.

Peer-to-peer mentoring worked well for Forbes' seventh-graders and Schlumbohm's third-graders.
—Photo by Zachary Meyers

"Tapping Into Spring"

Deirdre Helfferich, Nancy Tarnai, Jan Dawe

"Tapping Into Spring" is a curriculum project developed by Jan Dawe and the staff of the Alaska Boreal Forest Council from 1999–2005, with a curriculum kit of ten lessons created in 2003. The BAKLAP K–20 STEAM Education staff integrated its lesson plans into other OneTree Alaska curricular offerings, thus providing teachers with the resources to guide their students in understanding the spring phenology of birch trees, ways in which people use birch sap, and a means to practice citizen science. Through these activities, students employ the scientific method, develop math and writing skills, and practice making scientific observations.

The activity of tapping birch trees for sap each spring brings seasonality and tree physiology alive for K–12 students and adults. Even the toughest middle school students seem

Zachary Meyers, OneTree Alaska instructional designer, tapping a birch in preparation for the 2014 Earth Day demonstration event hosted by Carri Forbes' Tanana Middle School class. The theme of the event was "Sap to Syrup: The Birch Way."
—Photo by Nancy Tarnai

to connect to their trees with real gratitude when the sap runs for making birch syrup. Sound stewardship makes sense, perhaps for the first time, for many students. They're involved in a reciprocal relationship with the tree and, by extension, with the forest. It comes as no surprise that every school that participated in Tapping Into Spring during the previous school year wanted to do so again the next year, and teachers from additional schools are inquiring to see if there's room for them as well.

Tappers (called "sapsuckers" in the trade) agree that the primary hindrances to producing high-quality birch syrup and developing a stronger birch sap industry in Alaska are the high cost of fuel oil to process sap and the near-certainty of scorching sap and creating bitter syrup when the sap is boiled over direct heat. Reverse osmosis machines are used to reduce processing time, but cost thousands of dollars and are often far too large for backyard or small-scale syrup makers.

As part of her independent study work for her master of science degree, service learner and Peace Corps Volunteer Tricia Kent decided to renovate the old Northstar Syrup Works sugar shack, originally purchased in 2000 as part of the original Tapping Into Spring program. The renovation would have used waste steam from the UAF power plant to heat the sap for evaporation into syrup, whereas before it required no. 2 fuel oil. Kent wrote about the project, "Renovating the Sugar Shack is valuable due to its potential for educating students and the community about syrup making, alternative energy, and the value of our forests. …This project combines many of my interests including community-based natural resource management, education, and engineering design," she said. "Steam-powered syrup making is not a new technology, but will provide exciting challenges due to the integration of existing steam sources and evaporator equipment into one cohesive apparatus. Additionally, this project has the potential to contribute to community development in the future, which makes it an appealing project for me."

Kent consulted with syrup makers and evaporator builders in the Lower 48 as well as with UAF Facilities Services, concluding that purchasing a flat steam pan for Northstar Syrup Works' evaporator would be a better approach than attempting to fabricate one. "However," she said, "between the huge demand for custom-made evaporators and the renovations to the power plant coming in the next couple of years, the evaporator project got pushed to the back burner." So instead, she designed and constructed a reverse osmosis unit that costs around $500 with parts that are easily obtainable. This unit was then improved upon by UAF mechanical engineering students Jordan Merkes and Zach Alkire for their senior capstone project. "We increased the efficiency modification for birch sap reverse osmosis," Merkes explained. The machine creates two product streams: purified water and concentrated sap that can be turned into syrup in less time, at less expense, and with greater quality control over the end product, since there is less opportunity to scorch.

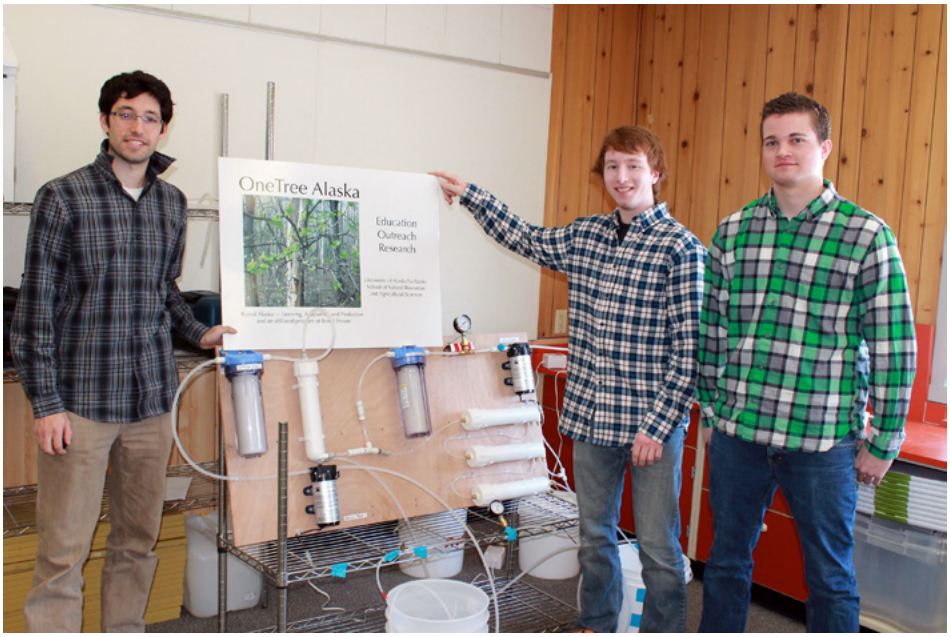
This spring, Dawe and Birch Pavelsky put the reverse osmosis unit through its paces, processing about 20% of the 220 gallons of sap that had been collected by schools and backyard birch sap tappers. The unit handily removed 70% of the water from sap coming straight from the tree, increasing the sugar concentration from 1 brix (1% sugar concentration at 20°C) to 4.5

Tricia Kent, above, demonstrating her initial low-cost reverse osmosis unit. The vertical unit at center is a filter to remove debris; the three horizontal units contain the reverse osmosis membranes. A video showing how it works is available for viewing at http://snras.blogspot.com/2014/01/graduate-student-invents-diy-reverse.html.

—Still image from the video by Jan Dawe

Zachary Meyers, left, and the reverse osmosis machine improved by Jordan Merkes and Zach Alkire, right.

—Photo by Nancy Tarnai



brix. After it was concentrated, Dawe boiled the sap over direct heat for an hour, and finished the syrup slowly over steam.

The reverse osmosis unit needs further testing and refinements. If you would like to be involved with Tapping Into Spring over the summer, please contact Jan Dawe at jcdawe@alaska.edu or call (907) 388-1772.

"Family Matters"

Deirdre Helfferich, Nancy Tarnai, Jan Dawe, Jen McDougall

A growing field of plant investigation, kin recognition, resonates with K–12 students, whose life experience outside of school centers largely on family. "Family Matters" is an experiment that explores this concept. It was initiated by K–20 STEAM Education staff, and embraced by Carri Forbes, seventh-grade science teacher at Tanana Middle School, who used Family Matters as an integrative activity for her five life science classes. The experiment uses progeny from two maternal birch trees from Nenana Ridge, labeled NR5 and NR14, and looks at the interactions between seedlings potted in different configurations. A parallel study was conducted at UAF. The objective of the experiment at both venues is to learn whether growth response differs when sibling seedlings are grown together as opposed to unrelated seedlings grown together. Experiments at other universities, with other species, have shown that some plants recognize and even "help" close relatives.

The experiment was introduced to the seventh-grade science students as an open inquiry investigation, with no expectation of what the results might show. Forbes and STEAM staff emphasized science process skills: the importance of controlling variables (soil, watering, pot shape/volume, size of seedlings) and having an adequate number of replicates in a scientific sample. Attention was also paid during the experimental setup to discussing the limits of the experiment and considering what important information would be missed. For example, only aboveground growth is observed in Family Matters, but other kin recognition studies look principally at root interactions as evidence of cooperation and/or competition between seedlings.

Studying birch trees is one small window onto the world, Dawe said. "But anything that's part of [the children's] natural world could serve the same purpose, salmon or blueberries in rural Alaska, Sitka spruce in southeast Alaska, bird migrations anywhere," she said. "The point is to pay close attention to something accessible in their home environment. If they like working with birch trees, they could become natural resource managers or any kind of field scientist. If they like working in greenhouses they could specialize in plant production. But no matter what career path they take, we're hoping this work helps them become lifelong learners, critical thinkers and good stewards of the environment."

Two pre-service K–12 teachers, Diane Hunt and Jen McDougall (both seeking master's in education degrees),

Jan Dawe explained the methods the students should use to take scientific measurements for the Family Matters parallel experiement on their visits to the UAF greenhouses.
—Photo by Nancy Tarnai

are assisting with the experiment. McDougall describes her experience:

> Diane Hunt first introduced me to the One Tree Alaska program last fall after learning that we both had a passion for place-based science education and for the importance of melding of science and art within classroom projects. She invited me to come along as a volunteer to Carri Forbes' seventh-grade class to help introduce the students to birch tree biology. With each class we walked to a schoolyard birch tree stand, Diane read a Robert Frost poem as the students listened and gazed up at the trees, and we helped students root around beneath the trunks to find decomposer organisms that might be found amongst the birch tree leaf litter.
>
> After watching that day unfold and speaking with Diane and Janice Dawe, I was struck by how much impact OneTree Alaska projects could have on science curricula and the educational experience of participating students. The program's thematic and interdisciplinary nature invites teachers to weave boreal forest references within lesson units to make abstract science concepts more tangible and relevant. In an age where young people are often not found playing outside, OneTree projects encourage students

to explore local habitats and gain further appreciation for ecological intricacies and their importance.

…. I have noticed students eagerly wait for "OneTree days." The kinesthetic and artistic elements of the project have helped to draw out engagement from students that are typically harder to reach or struggle in science class. With the Family Matters project, botany becomes exciting for the students as they forge personal connections with the birch trees, and begin to experience the thrills and satisfaction fostered by citizen science participation.

"Exploring Our Environment"

Zachary Meyers

Establishing connections between students and the natural world through art, science, and technology.

Many towns and cities have murals on their buildings, and some buildings even have murals inside. Few have schools with murals created as teaching tools that use interactive features integrated into their curricula—but now Fairbanks is among the first.

The 8' by 40' mural had its nascence in 2011 when the Watershed Charter School librarian at the time asked teacher Ron Harper if his students would be interested in painting a mural in the library. Harper asked second-grade teacher Moira O'Malley, who is an artist, for help. In spring 2013 Laura Cartier, intern teacher, Klara Maisch, local artist, Zachary Meyers, OneTree Alaska instructional designer, and O'Malley met to discuss the possibility of using art to promote multidisciplinary, place-based learning. The group developed ideas for an interactive teaching mural that would be painted with the help of students at the school, as originally envisioned. "Exploring Our Environment" is the result of this community collaboration.

Watershed principal John Carlson was instrumental in gathering curriculum and reference material for the mural. Support from the Fairbanks Arts Association allowed Watershed to hire Maisch through the artists-in-schools program for the initial portion of the project. The BAKLAP program and OneTree funded Meyers to develop the integrated technology for the mural. The Watershed Parent-Teacher Association, the Boreal House Art and Science Center, and Delta Kappa Gamma Theta are also contributors and collaborators to the project. With Cartier, Maisch and Meyers formed the main team working on the mural.

To create the mural, many sketches were developed during the planning stage. The team worked with teachers so that pertinent educational topics and useful examples were represented in the mural, including transportation for second grade, boreal plants for third grade, the salmon life cycle for fourth grade, and fire ecology and Alaska biomass for fifth and sixth grades. The team and Watershed staff (Carlson, O'Malley, Marlene McDermott, and others) worked hard to develop and integrate the content, putting in more than 800 hours, with Meyers concentrating on how the mural would incorporate interactive technology.

After the planning stages were complete, the drawing was prepared and the students' summer art club took on the task of assisting with the actual painting. The younger students blocked in the first layers, and older students added more detail and supplemental paintings. A total of 60 students participated. The painting has taken what felt like a "really sterile" and unfriendly library environment, according to Cartier, and made it "a more welcoming place."

While the mural shines as a beautiful piece of collaborative artwork, its true splendor lies in its hidden ability to serve as a dynamic platform for place-based learning. Through the use of augmented reality, additional layers of content enhance the multidisciplinary, interactive nature of the mural. The images in the mural have reference to both materials in the library and to online information: Using the Aurasma app, Meyers loaded a dozen interactive points throughout the wall with more imagery and details. To use the mural's virtual reality, viewers can download the Aurasma app from Google Play or the App Store on a smartphone or iPad, then open the app and search for Steam Works: Interactive Mural. By following the Steam Works: Interactive Mural channel and previewing the trigger images that are shown on the mural at each interactive point, additional content will pop onto the screen, such as more images, videos, and suggested library books that contain more details. The images on the smartphone device can be double tapped to enlarge them for even more detail. The students' supplemental paintings of boreal animals will be integrated later via augmented reality into the mural's content as more virtual layers are added.

The team carried out several classroom visits to test pilot lesson plans that directly tie keystone concepts with the library's mural content. In McDermott's kindergarten class they used the mural as a platform to talk about leaf shapes and initiated an I Spy game to determine the students' baseline knowledge of local flora. This information is being used to design a supplemental activity this spring. In O'Malley's class the team used the mural to talk briefly about light, shade, and optics. This was followed by a supplemental STEAM optics activity where students demonstrated refraction and reflection phenomena. The activity was so well received by both students and teacher that it is being turned into a lesson plan.

While the mural was under construction, Cartier, Maisch, and Meyers attended the 24th Annual Electronic Visualization and the Arts (EVA) Conference in London July 29–31, 2013. The EVA is an international conference that includes graduate students, museum directors, IT consultants, cognitive scientists, designers, artists, and others. The dynamic and enthusiastic presentation the team gave about "Exploring Our Environment" prompted a lot of excitement in the

audience. Many were particularly struck by the student integration throughout the process of developing the mural. The project was unlike any of the other projects discussed at EVA 2013 because teachers, students, and community members led it. The majority of the talks at EVA focused on academic interests and had substantial capital to support their research. The idea of the project itself was novel through the integration of community, place, and media.

The mural has been successful with the public as well: a First Friday open house in December 2013 saw more than 200 attendees ranging in age from infants to seniors, all of whom interacted with the wall through several iPads that were provided by the School of Natural Resources & Extension. The Watershed PTA provided homemade food and beverages and O'Malley contracted a parent to design a permanent plaque in honor of all who participated. During the event, a looping movie displayed time-lapse shots of the overall process and development of the mural. Student artwork that was created during the summer art club was featured at the open house as well. The two-hour event provided a platform for the students to share their work with friends and family as well as display the power of the true collaborative process. The augmented reality technology mesmerized children and adults alike but it was the wall canvas that stole the show, with its radiating colors and overall cheerful aesthetic.

StoryTelling: A Student's Perspective

Zachary Meyers, Jan Dawe, Nancy Tarnai

This project, supported through the Alaska Experimental Program to Stimulate Competitive Research (EPSCoR) Native Engagement Award, was proposed as a means to provide tools to blend traditional and scientific knowledge of place names, cultural knowledge, and ecological processes through an integrative multidisciplinary STEAM curriculum, using a range of multimedia tools. The hope is that by learning of past, present, and predicted changes, the project will help prepare the current generation to respond to socioeconomic and environmental changes. The goal of this project is to work with a K–12 school, to integrate traditional and scientific knowledge in a way that can be used as a model in schools throughout Alaska rural communities.

Climate change is disrupting many communities in rural Alaska with increased fire frequency, thawing permafrost, reduction in sea ice, large-scale vegetation changes, and shifts in seasonality. Traditional lifestyles cannot keep pace with the rate of change. Each generation faces greater challenges adapting to environmental change while attempting to preserve its cultural identity.

In the past, oral history was the main vehicle for transmitting cultural knowledge. Today, there is a growing body of literature and documentary films—short stories and memoirs

"Exploring Our Environment" and attendees at the December 2013 open house at Watershed Charter School. See detail image on the back cover.
—Photomontage and photos by Zachary Meyers

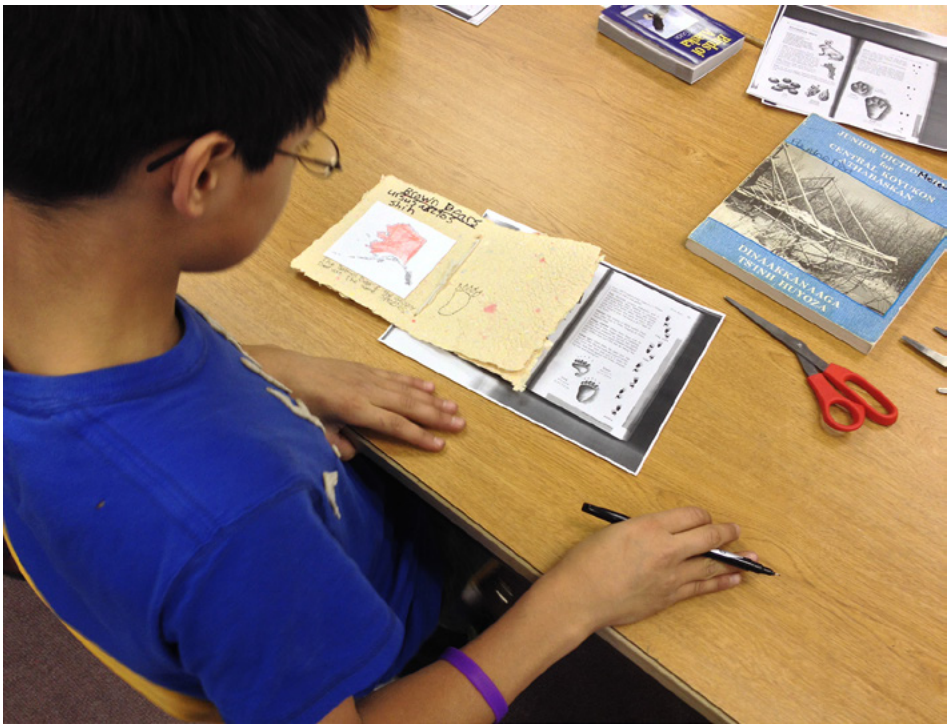
told by Alaska Native elders and storytellers—that act as time capsules for future generations. Many of the traditional stories delve into people's sense of place in relation to the land. These act as great conduits to explore historical environmental change to present and future climatic changes through ecological processes as well as reinforcing the cultural context of the local people.

The melding of technology, art, and science with traditional place-based narratives provides a novel way for students to see their surrounding landscape. By studying a specific site though a story, and documenting the story's cultural, historic, and ecological relevance, participating students gain a deeper appreciation of, and sense of connection to, their local landscape. They also gain skills and knowledge to respond to future changes in ways that reflect local interests and values.

The pilot school used to model the project was Effie Kokrine Early College Charter School in Fairbanks. The teachers were enthusiastic about incorporating elements from a traditional story and having the students explore place-based topics in depth. Throughout the 2013 fall semester eighth-graders from the classrooms of Sheryl Meierotto and Sarah State used art and science to explore local topics in depth (i.e., salmon life cycle, fire ecology, edible plants, and seasonality). With a blend of traditional and scientific knowledge, the lessons helped students apply historical and ecological processes using multimedia tools.

Meyers and Maisch led in the development and implementation of supplemental classroom activities and worked in collaboration with the teachers to reinforce content, creating lesson plans and other materials for teachers that will be hosted on the OneTree Alaska website.

"We introduced exploring story-telling about place as a prelude to a bigger project," Meyers said. The Peirce Park Living Lab Project will create a place near the Effie Kokrine school that will serve as an outdoor living lab for citizen science, offering opportunities to learn and apply science, technology, engineering, math and the arts in a natural setting. (For more about the Peirce Park project, see www.createpeircepark.com.)



Eighth-graders at Effie Kokrine Early College Charter School learned aobut papermaking and created their own journals, exploring local topics and using content to incorporate science and art in a way that honored both literary and oral place-based traditions.
—Photo by Nancy Tarnai

"We wanted to give them a foundation," Meyers said. "This project allowed students to have creative license to explore place and the interconnected relationships among place," Meyers said.

Altered Books and Journals: Honoring literary and oral traditions

The students created altered books in Sheryl Meierotto's class. Altered books are a well-established form of mixed media artwork that changes a book from its original form into a different form by altering its appearance and/or meaning. Students took part in a serious discussion detailing the differences between altering and honoring an original book versus destroying and being disrespectful to it. The project emphasized respect and care for others' work and unique forms of expression. The class was given a choice of topics from their favorite Alaska sport, animal, or season.

The project was intended to focus students on introspective reflections about place through art and science, and to help them communicate their ideas through a creative outlet. Supplemental lessons about story and place were taught in the classroom. For example, students were introduced to Alaska plant taxonomy or dendrochronology (tree rings) and taught how trees illustrate a unique story based on patterns observed in their leaves or the rings of wood. A botanical sketching activity reinforced these principles.

Four activities were directly integrated into each student's altered book. A detailed, reflective narrative describing experiences and knowledge of the student's topic was artistically transcribed into a word path, accompanied by representative objects and imagery. Meierotto's students learned how to write haiku and compose the pieces within their altered books. Three students were chosen to provide audio content by reading their personal

narrative, and all journals were digitized with the three oral narratives overlaid on their own altered book.

The second StoryTelling series that Meyers and Maisch worked on focused on similar themes (sense of place, community, working with raw materials), with Sarah States' eighth-grade class. Meyers and Maisch wanted the students to take ownership of the project from the beginning, so the first STEAM activity with the class was papermaking. The eighth-graders were led through the process of papermaking, learning about pulp, various binding agents, and history. Students were given a choice of warm or cool tones and shown how to manipulate the overall hue of their paper. The students then created handmade journals, using science lessons on dendochronolgy, taxonomy, interpreting animal tracks in the snow, and exploring ecosystem relationships.

The dendrochronology lesson encouraged students to become familiar with tree anatomy, the overall growth process of a typical tree, and how a tree can serve as a proxy for climate records. Samples of tree cross-sections were brought in for a hands-on demonstration. A supplementary lesson was provided to talk about the students' own history in relation to the tree samples (i.e., what year were you born?). An analogue tree cross section was created by the students in their journals to relate anatomy function to relatable items in their own lives. The class was taught basic taxonomic principles (i.e., binomial nomenclature) and history.

Resources were provided to the students so that the scientific name, the English common name, and their Native language name for their chosen animal were integrated into the species profiles. The students created distribution maps with unique facts about each species. Maisch demonstrated making an artistic rendering of an animal track. Students made their own and incorporated them into their journals along with a unique handprint that served as their own "track."

Last, for the literary portion, students were prompted to reflect on what community means to them. The students were given freedom to interpret "community" in both the narrow and the broad sense. The quality of the journals along with the content was high. All journals, like the altered books, were digitized and will be hosted on the OneTree Alaska website, which will serve as a portal to archive these works.

Each lesson utilized science and art curricula to help students explore and express ideas. "This emphasized that there is more than one way to represent and share a story," Meyers said. "We wanted to accommodate a broader sense of place by incorporating observational skills, botanical terminology and introspective thinking."

By working together all semester, the students began to open up to the guest instructors. "It took time to get where we needed to be," Meyers said. "It was a good learning process for both the students and us. We both had to figure out how to share information.

"It was nice to challenge the 'cool factor' that middle school students sometimes have."

Forest Entrepreneur Camp

Nancy Tarnai

The Forest Entrepreneur Camp, or FORENCA, is one of the K–12 programs developed by the BAKLAP K–20 STEAM Education program. Although the original idea was to hold a weekend workshop each month during the school year, this proved too difficult to implement. Instead, the first FORENCA activity was a weeklong intensive camp offered in May 2013.

Chris Pastro at Randy Smith Middle School invited expert craftsman Birch Pavelsky to work with her seventh- and eighth-grade students to manufacture birch knitting needles, chopsticks, and hair chops as a capstone project for the school year. Pavelsky is a longtime professional finish carpenter and woodworker who has worked with OneTree Alaska since its beginning on many projects. A favorite of his has become knitting needle manufacture because it ties together practical knowledge, physics, and entrepreneurship. Pavelsky led students through the needle-manufacturing process, from round logs to finished products. Pastro's classroom was abuzz while students turned birch square stock into needles with the help of a Stanley 77 tenon and dowel maker. Students meticulously smoothed their needles with several grades of sandpaper. Some carved elaborate top decorations. The students chatted excitedly while working.

Before production day, Pastro and the students made predictions about how much material would be lost during manufacture. They took weights and measurements at every step in the process and compared their results to what they had predicted. They tied their needle-manufacturing work to birch germination and growth experiments by sketching birch leaves on watercolor paper. These were fashioned into presentation envelopes to go along with their knitting needles as Mother's Day gifts.

The value of such "maker"activities, as they've come to be called, is that students learn critical making skills. The students in Pastro's classroom learned how to recognize the best types and grain characteristics of wood used in manufacturing different products. They even created business plans for marketing their birch products to two target audiences: tourists at Chena Hot Springs Resort and locals visiting the Tanana Valley Farmers Market.

These forest entrepreneur activities were done against a backdrop of other OneTree Alaska activities completed throughout the winter and spring in Pastro's class, which created opportunities to involve students with different interests and learning styles. Some students excelled at science studies, such as observing the effects of different soils on tree growth, and documenting different life stages, from germination and growth through seedlings' entrance into dormancy. Each student kept a OneTree journal, following a specific protocol known as the Grinnell System of Nature Journaling.

"It's been a wonderful long-term project for these students," Pastro said. "They know more about birch than

Above: Chris Pastro, left, and Birch Pavelsky at her classroom, introducing the students to knitting needle manufacturing. Right: a student trimming the square end of his rounded dowel in preparation for sanding.
—Photos by Nancy Tarnai

a lot of people." She loves that the project incorporates science, math, art, writing, and interpreting data. The fact that OneTree projects are hands-on, and not learned by just reading a book, is another aspect that excites her.

"I want my students to be citizen scientists and observe the natural world," Pastro said. "They are learning to understand the life cycle of birch. It's good for them to slow down and understand something in their back yard and appreciate it."

Having a scientist and graduate students work alongside the children has been inspiring, Pastro said. "It's been invaluable to the students to see someone working in the field and to see that they love their jobs." When the students have the opportunity to work alongside scientists, she said, "They see the possibilities and begin to think they could do that type of work too."

The Importance of Professional Development

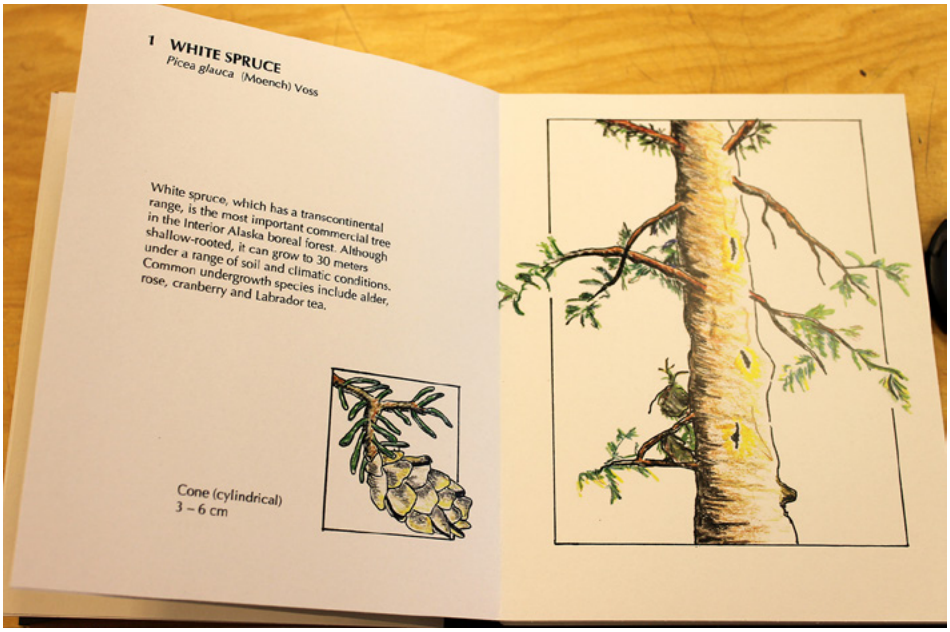
Jan Dawe

Research shows that teacher quality is the most important in-school factor contributing to student academic success, and professional development—the continuous updating of teachers' knowledge, skills, and attitudes—is widely accepted as critical to improving student performance. Professional development begins during the intensive pre-service certification process, and continues throughout a teacher's career. School districts and states determine the minimum number of continuing education credits a teacher needs for recertification.

Even with ongoing commitment to teacher improvement, professional development cannot, by itself, keep the education system on track. In 1983, the Commission on Excellence in Education's report "A Nation at Risk: The Imperative for Educational Reform" chronicled a steady decline in student performance and pointed to the patchiness of the education system's expectations for students as a root cause of the decline. The report called for more coherent national policies: the federal Improving America's Schools Act (1994) and the No Child Left Behind Act (NCLB: 2001) are key pieces of legislation enacted to bring about standards' reform. Thirteen years later, NCLB is credited with both successfully documenting large disparities in learning outcomes between states, and failing to produce the desired result of raising proficiency levels for all.

These failures appear even more glaring when compared against international benchmarks. In 1997 the Organisation for Economic Co-operation and Development began administering international tests every three years to allow countries to compare their students' performance. Results show that the best students in the United States score among the highest-performing international students, whereas the US as a whole ranks below the average for developed countries in reading, science and, especially, mathematics. Our country's concern with falling behind in global competitiveness and the global economy has led both the business and education communities to focus their efforts more keenly on improving teaching and learning outcomes in STEM disciplines. The Common Core State Standards and Next Generation Science Standards can be seen as direct outcomes of this concern.

Developing a teacher-learning community—in which a group of teachers and education leaders continually question



"White Spruce," botanical study number 1 in Trailwalk: July in the Boreal Forest, *resulted from BAKLAP's first professional development course, organized as a STEAM Institute.*
—AFES FILE PHOTO

their practice and together uncover and create new ways to improve—has come to be recognized as one of the most important drivers for raising STEM learning and teaching outcomes at both the national and state level. Collaboration is central to OneTree Alaska and to K–20 STEAM education, but nowhere more than in professional development. One of OneTree's first collaborators, Karen Stomberg, artist and former coordinator of the FNSB school district's Art Center, spearheaded the creation of three statewide Fairbanks Art Institutes designed to be two-week intensive professional development opportunities for K–12 teachers. From these institutes arose eight art curricula kits that are used in the district's elementary schools. "The lessons the art center folks created [in fall 2011] are lovely; good art and good science and very connected to OneTree in philosophy," said Stomberg.

BAKLAP's K–20 STEAM Education program focuses on building teacher-learning communities via two types of K–12 professional development: 1) short-duration, immersive STEAM institutes each summer to acquaint teachers, school staff, and community members with the STEAM approach and 2) stand-alone professional development workshops and courses during the school year to familiarize OneTree Alaska teachers with curriculum content and inquiry protocols to be used in their classrooms.

K–20 STEAM offers its professional development course in partnership with UAF's Summer Sessions and the Boreal House Art and Science Center. The Fairbanks STEAM Institute 2014: "A Botanical Immersion Through Multiple Lenses," for example, was held July 2014 in Fairbanks at West Valley High School. The course is designed for K–12 teachers, artists, scientists, university faculty and students, and community members. Twenty-four participants, including teachers from Fairbanks, Salcha, Central, Eek, and Chugiak, chose field sites in the boreal forest on the UAF campus for inspiration and scientific inquiry. They described, identified, and worked with the plants and insects of their individual plots, and observed interrelationships between organisms and their environment. They made their observations through multiple lenses—i.e. through drawing, data collection, creative writing responses to their plots, and technology. Each contributed a plate of illustrations and writing to an encased portfolio, which was printed and presented to everyone in the institute. Teachers were able to earn four continuing education credits

Participants in the second STEAM Institute, "A Botanical Immersion Through Multiple Lenses," held July 2014. From left to right: Jan Dawe, Chris Pastro, Zach Meyers, Hannah Hill. The 42-inch diameter hula hoop outlines the area of study for each student (in this case Hill) over the two-week period of the institute.
—PHOTO BY NANCY TARNAI

STEAM Institute participants came to know the woods and identify the plants, mosses, mushrooms, lichens, and flowers growing within their hoops. Each student learned biology, writing, and drawing, and created a portfolio with an original piece of their own artwork and copies of their classmates' work. An additional feature was technological: like the mural at Watershed Charter School, each artwork is enhanced digitally with data support on line. The book The Forest Unseen*, by David George Haskell, was reading material for the course.*

—Photo by Nancy Tarnai

for their participation in the course. Six UAF students and one incoming UAA faculty member received full tuition scholarships to attend the Institute, as a form of "forward payment" for service learning projects they'll complete with the K–20 STEAM Education program during the upcoming academic year.

The first STEAM Institute, "Trailwalk: July in the Boreal Forest," was held in 2012. Nineteen teachers participated, and following the production of the limited-edition book a First Friday art exhibit was held in September at the borough's school district central administration office, and featured the contributors' botanical illustrations. The book was so popular, and OneTree and Boreal House Art and Science Center have received so many requests for copies, that it has undergone six reprints.

Laurel Herbeck, North Pole High School art teacher and one of the participants in the 2012 STEAM Institute and the 2013 field drawing class, incorporated what she learned into her classroom practice. She had this to say about the STEAM Institute:

> I would recommend this class to teachers as a way of integrating science, math, engineering, technology and art, as well as a way to challenge students to work the way professional scientists, botanical artists and book designers work. These projects were a form of authentic learning that teaches creativity, problem solving and skill mastery, exactly what we want our students to be able to do as twenty-first-century learners!

Citizen Science and the Generation OneTree Long-Term Ecological Monitoring Plot

Jan Dawe

Citizen science, also called community participation in scientific research, refers to the collection and analysis of long-term data sets by members of the general public in collaboration with professional scientists. One well-known example is the Audubon Society Christmas Bird Count. Each year since 1900, thousands of volunteers take part in making field observations and counting bird visits to backyard feeders during a carefully regulated period. The Christmas count has allowed researchers to gather far more comprehensive data than would have been possible by individual or coordinated professional research teams.

Other citizen science activities, including those coordinated by the National Phenology Network and Project Budburst, record seasonality data such as the arrival and departure of migratory waterfowl, the emergence dates of overwintering insects, and leaf-out and flowering times of target species of trees and forbs. SNRE's professors Elena Sparrow and David Verbyla are primary creators of the Global Learning and Observations to Benefit the Environment (GLOBE) program's Green Up and Green Down protocols, which are used to monitor vegetation phenology and boreal forest disturbances throughout the circumpolar north. Over time, these observations can be expected to greatly aid our understanding of current and potential impacts of climate change on plants and animals.

OneTree Alaska's foray into citizen science came about directly because of community interest in one of our K–12 science experiments. In the 2010–2011 academic year, three classrooms at Watershed Charter School began exploring a climate change-related question with OneTree Alaska. The schoolchildren, their teachers, and university researchers asked: "What are some of the effects of Fairbanks' lengthening growing season on the growth characteristics of Alaska white birch?" To find out how white birch is affected, the students germinated birch seeds, and the resulting seedlings were maintained under thermostatically stable conditions at Watershed School for three-, four-, and five-month growing periods. The same experiment was repeated in a university growth chamber with conditions more closely simulating average Fairbanks growing conditions—including weekly changes in minimum/maximum temperatures. K–12 and university investigators took the same weekly observations, recording seedling height, number of leaves, and seedling branching architecture.

On April 1, 2011, the seedlings were taken out of winter dormancy conditions to become part of the month-long OneTree K–12 exhibit at the Morris Thompson Cultural and Visitors Center in downtown Fairbanks. Dawe and SNRE forestry student Dan Coleman took daily budburst observations on the 144 seedlings in the exhibit. Invariably, visitors to the exhibit stopped by to chat. Although initially

disappointed that they couldn't purchase the research seedlings, they lingered to talk about the growth of birch in their home communities, and landscape changes they'd seen over the years. The seedlings garnered so much interest that the decision was made to keep the collection together.

On June 2, 2011, a 0.3 acre long-term monitoring plot was established in the 'T-field" to continue the collaboration between University of Alaska Fairbanks researchers and public K–12 schools in the Fairbanks North Star Borough School District. Thirty-two Boy Scouts and their leaders from Troop 92 helped plant the seedlings, having learned of the project at an Arbor Day Committee meeting. Dawe and company will gather data at the T-field in the coming years to track how the trees grow. "Then 60 to 100 years from now we will do a second OneTree art and science exhibit from several of the trees we've planted here," said Jesse Hensel, a sculptor and teacher and at the time OneTree's art education lead.

The Generation OneTree Plot is a progeny evaluation trial of eight genotypes from a west-facing Alaska white birch stand (*Betula neoalaskana* Sarg.) located on Nenana Ridge in interior Alaska. Introductory ecology classes at UAF and local K–12 teachers taking summer professional development courses have helped collect data on seedling architecture (summer field sketching courses, for example); UAF graduate students have helped OneTree personnel take monthly productivity observations. "We hope to begin K–12 field trips to the plot this autumn," said Dawe. "If you are interested in helping out in the Generation OneTree Plot, please get in touch!"

Semiotics, Translation, Ecosystems, Assessment, and Metaphor

Jan Dawe, Joan Parker-Webster

America's education system is in a time of rapid change. Federal legislation (The No Child Left Behind Act) and more recent state-driven curricular frameworks based on newly developed Common Core State Standards and Next Generation Science Standards all seek to improve the US education system with a common underlying goal: to provide our nation's youth—no matter where they live—with a high-quality K–12 education that prepares them as lifelong learners who are professionally and personally competent to meet twenty-first century workplace needs and bear the responsibilities of a well-informed citizenry.

Although these three frameworks are drivers of the educational debate in the country today, the decision of whether to adopt or opt out of each one is left to individual states and school districts. Alaska has chosen to opt out of all three in the belief that we can do a better job in-state.

But, as is true with other states, Alaska's educational debate focuses on how exactly to navigate the tension between establishing accountability to authentically assess teaching and learning outcomes and balance the necessity of providing individual teachers, schools and districts the autonomy to meet standards according to their own best practices.

Service learner and master of education student Hunt (far left) discusses the cold hardiness and dormany experiment with Interior legislators, legislative aides, and university personnel during the legislative field tour September 2013.
—Photo by Nancy Tarnai

How and why does BAKLAP relate to these concerns? On September 20, 2013, BAKLAP provided a field tour and report for Interior legislators to review the progress that had been made during the first year of work. Legislators donned rain boots and vests to visit forest research installations and hear about the project's activities and results, including biomass research and other, non-K–12 related activities. Then they came back to town to meet with OneTree Alaska's personnel, participating K–12 teachers, FNSB School District Central Administration staff, and community experts collaborating with the program. The delegation said they were impressed by what they saw and heard: the integrative approach of STEAM, which has youth make products with boreal forest resources, participate in semester- and year-long inquiry science explorations, and leverage their successes via peer and community service learning opportunities, made intuitive, gut-level sense to the legislators. They liked the STEAM approach, and asked if STEAM's success as an educational philosophy could be documented. More pointedly, they asked if the K–20 STEAM Education program could help legislators and the state define new student and teacher performance assessments.

Assessing the STEAM approach via the OneTree Alaska model was already a deliverable, or product of the BAKLAP grant. The legislators' interest heightened the focus on this part of the project and so OneTree personnel set to work, bringing in both Joan Parker-Webster, formerly with UAF's School of Education, and Diane Noble, who supervises School of Education pre-service teachers. Together they helped design a spring semester course, "Effective Instruction Through OneTree," for OneTree Alaska's core group of teachers to begin functioning as a teacher research group that would help define and implement a pilot project to address three goals:

(a) developing a STEAM-based pedagogy;

(b) further developing and revising OneTree lessons aligned with FNSBSD standards and objectives; and

(c) addressing assessment of student learning gained from OneTree lessons.

The workshop activities were based in the two related frameworks: the STEAM approach and the concept of multiliteracies.

In today's education climate, educational leaders and policy makers are renewing their commitment to the STEM subjects, recognizing these as a driver of innovation with the potential to provide creative solutions to address the global challenges of the next and future generations. However, some educators would argue that STEM alone cannot do the job. What is needed is a STEAM approach, which is the insertion of the arts and design into STEM.

So, what does it mean to turn STEM to STEAM? According to John Maeda (2012), former president of the Rhode Island School of Design (RISD):

> The problem-solving, the fearlessness, and the critical thinking and making skills that I see every day in the RISD studios are the same skills that will keep our country innovating, and their development needs to start in the K–12 schools. Design creates the innovative products and solutions that will propel our economy forward, and artists ask the deep questions about humanity that reveal which way forward actually is. Sustaining arts education in its own right remains critically important. But equally important is taking a page from schools that have been successful at integrating the arts into STEM curriculum (retrieved from www.edutopia.org, June 17, 2014).

Oregon State University post-doctoral scholar Dr. Lissy Goralnik (front row left) met with the 2013 Field Sketching Observation class in the T-field August 1 as a special guest. Her work focuses on the impact of the arts and humanities on the Long-Term Ecological Network sites.
—Photo by Nancy Tarnai

A similar philosophy underlies the concept of multiliteracies, which is predicated on the notion that literacy and literacy practices are always socially situated and ideologically formed. Being citizens in today's social, cultural, and economic worlds, which are technologically dependent and driven, now requires us to negotiate a variety of multimodal texts that utilize a multiplicity of discourses. Such a shift requires a semiotic approach, which means examining how meaning is constructed through all kinds of signs (e.g. drawings, gestures, music, mathematics, dance, movies, etc.), not just the linguistic sign system (reading and writing), which is heavily privileged in school-based education.

Because multiliteracies incorporates multiple sign systems, transmediation—the process of how meaning is constructed and reconstructed as it moves from one sign system to another—provides us a way to frame a pedagogy that has multiliteracies at its core. Multiliteracies, when conceptualized through semiotic representation and transmediation, allows for meaning making across multiple sign systems. Therefore, rather than ask what a child knows, we can ask how many ways are available for this child to know.

This kind of multiliteracies/multimodal and interdisciplinary approach to teaching and learning requires an innovative and appropriate means of assessing how and what students are learning. Consequently the idea that a paper and pencil test alone cannot provide such information is at the crux of the ongoing discussion of the teacher research group involved in the OneTree Alaska Project.

At present this group is involved in collaborative efforts taking place in monthly meetings to align the OneTree lessons with district standards and objectives and begin mapping curricula that include OneTree over the course of the upcoming academic school year. The group is also beginning to develop guidelines for performance assessment based on STEAM and multimodal interpretations of student learning, with science content as a primary objective. It is the goal of the pilot project, which will continue throughout the 2014–2015 academic school year, to develop and field test a set of OneTree lessons and accompanying assessment rubrics.

This is your brain on STEAM

The STEAM integrative philosophy promotes synergy across varying modes of learning. As the many examples above illuminate, a single concept or topic can be explored at depth from different angles, and these enriched experiences allow the learner to retain content longer, think critically about concepts in a metaphorical context, apply knowledge that extends from their learning experiences and make connections to the world outside the academic environment. Physiologically, this has an effect on the neuropathic connections in the brain, which strengthen from repetition and/or looking at a problem from different vantage points. Coupled with the different ways of learning the student is able to establish a robust network of pathways (a "neural network") all relating to a single subject

or topic. It has also been shown that emotional experiences have a pronounced effect on retention, and so all classroom activities incorporate some element of student-driven inquiry learning. This allows the student to take ownership and become vested in the learning experience. The physiology of the brain and what happens while people learn is a large and dynamic field of psychology and education, and full of discovery (in many senses).

BAKLAP and OneTree Alaska have been developing curricula and working with children and teachers since 2009. Just as STEAM engages the child's whole mind and body in active and integrative learning, so too the assessment of learning outcomes should be multi-sensory, comprehensive, and integrative. As new collaborations and projects develop from the foundation that OneTree Alaska and its partners have achieved together, Alaska's students will have a better chance to recognize and bring their strengths, talents, skills, and passions to the world.

Further Reading

Augmented Reality

"32 Augmented Reality Apps for the Classroom From edshelf," Sept. 10, 2013. Mike Lee. Te@chThought. Available on line at: www.teachthought.com/technology/32-augmented-reality-apps-for-the-classroom-from-edshelf/

"Augmented Reality Brings New Dimensions to Learning," Nov. 4, 2013. Drew Minock and Todd Nesloney. Edutopia. Available on line at: www.edutopia.org/blog/augmented-reality-new-dimensions-learning-drew-minock

Family Matters

"Growing with siblings: a common ground for cooperation or for fiercer competition among plants?" April 29, 2009. Rubén Milla, Diana M. Forero, Adrián Escudero, and Jose M. Iriondo. Proceedings of the Royal Society B (Biological Sciences). Available on line at: http://rspb.royalsocietypublishing.org/content/early/2009/04/27/rspb.2009.0369.abstract

"The Intelligent Plant: Scientists debate a new way of understanding flora." Dec. 23, 2013. *The New Yorker*. Michael Pollan. Available on line at: www.newyorker.com/reporting/2013/12/23/131223fa_fact_pollan?currentPage=all

"Plants Know Their Siblings," April 18, 2010. Rakefet Tavor. *The Epoch Times*. Available on line at: www.theepochtimes.com/n2/science/plants-know-their-siblings-33635.html

"Plants with Family Values," April 11, 2013. Anna Rothschild. NOVA Online. Available on line at: www.pbs.org/wgbh/nova/nature/plant-family-values.html

STEAM philosophy

"Broad Vision: the Art & Science of Looking," 2013. Heather Barnett and John R.A. Smith. *Integrated Perspectives: The STEAM Journal*. Vol. 1 No. 1. DOI: 10.5642/steam.201301.21. Available on line at: http://scholarship.claremont.edu/steam/vol1/iss1/21/

Mind, Brain, and Education Science: A comprehensive guide to the new brain-based teaching. 2010. Tracey Tokuhama-Espinosa. W.W. Norton.

"Neuroeducation: Learning, Arts, and the Brain," 2009. Mariale Hardiman, Susan Magsamen, Guy McKahnn, and Janet Eilber. DANA Foundation. Available on line at: http://steam-notstem.com/wp-content/uploads/2010/11/Neuroeducation.pdf

"Nurturing STEM Skills in Young Learners, PreK–3," Dec. 3, 2013. Successful STEM Education STEM Smart Brief. Available on line at: http://successfulstemeducation.org/resources/nurturing-stem-skills-young-learners-prek%E2%80%933

"STEAM: Experts Make the Case for Adding Arts to STEM," Dec. 1, 2011. Erik W. Robelen. *Education Week*. Available on line at: www.edweek.org/ew/articles/2011/12/01/13steam_ep.h31.html

Tapping Into Spring

"Assessment of paper birch trees tapped for sap harvesting near Fairbanks, Alaska," January 2008. Lori Trummer and Tom Malone. USDA Forest Service. Available on line at: https://scholarworks.alaska.edu/handle/11122/3204

Birch Boy Gourmet Alaskan Syrup: Educational Articles. Available on line at: www.birchboy.com/articles.html

"Birch: White gold in the boreal forest," 2004. Deirdre Helfferich. Agricultural & Forestry Experiment Station Miscellaneous Publication MP 2004-02. Available on line at: www.uaf.edu/files/snre/MP_04_02.pdf

"Factors Influencing Birch Sap Production in Alaskan Birch (Betula neoalaskana Sarg.)," 2006. Kimberly Anne C. Maher. Workshop presentation. Available on line at: www.uaf.edu/files/ces/aknfc/resources/workshops/06FactorInfluenceBirchSap.pdf

Assessment and Professional Development

"The History of Common Core State Standards. What some see as a surprise attack on states' rights, others know as a carefully thought out education reform." *US News & World Report*, Feb. 27, 2014. Available on line at: www.usnews.com/news/special-reports/articles/2014/02/27/the-history-of-common-core-state-standards

Multiliteracies: Literacy learning and the design of social futures. 2000. B. Cope and M. Kalantzis (Eds.). Oxford, UK: Routledge.

Next Generation Science Standards: For States, By States. National Research Council. Washington, DC: The National Academies Press, 2013. Available on line at: www.nap.edu/NGSS/

PISA (Programme for International Student Assessment) 2009 Assessment Framework: Key competencies in reading, mathematics and science. Organization for Economic Co-operation and Development, 2009.

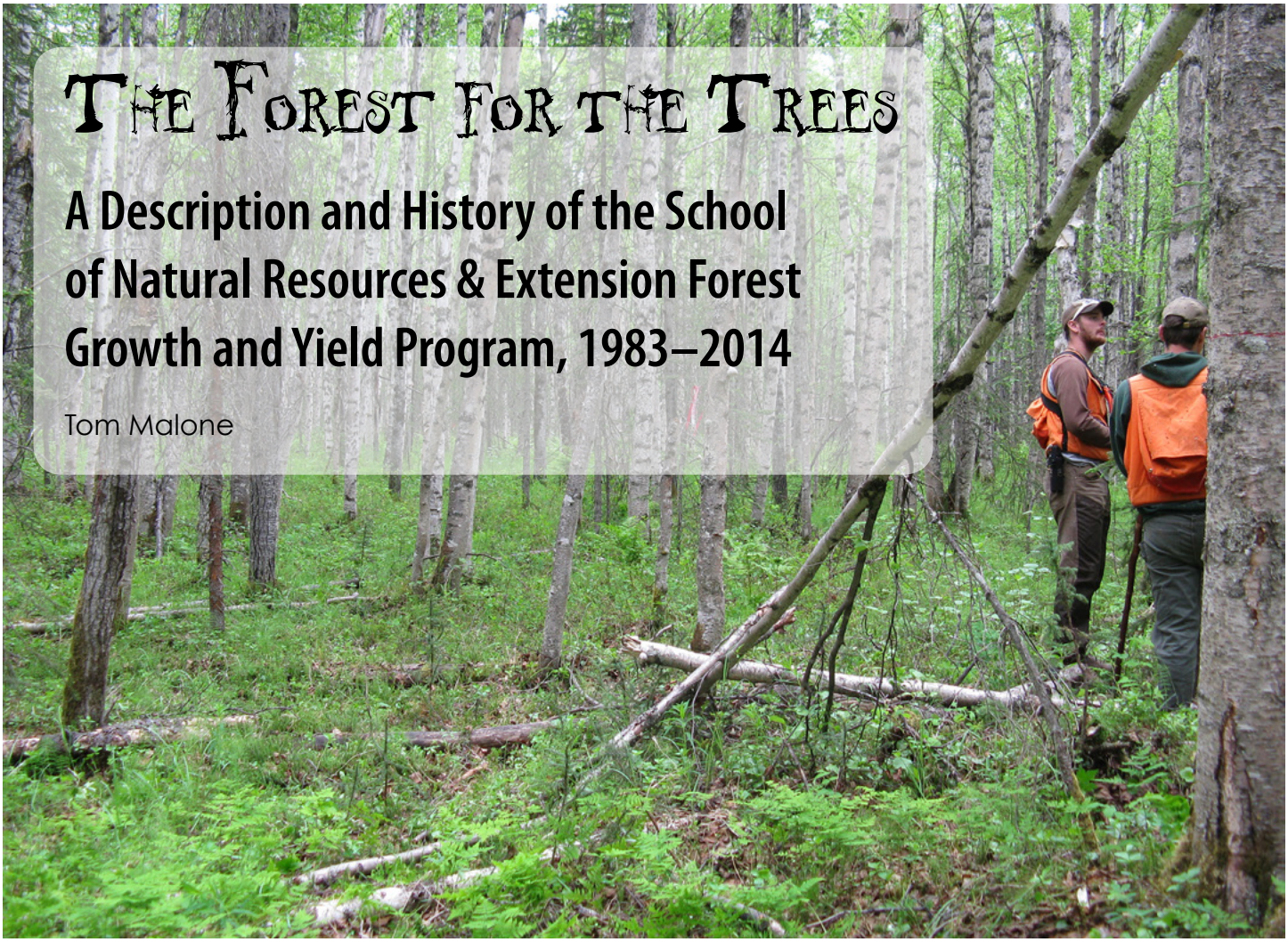
Teachers Matter: Understanding Teachers' Impact on Student Achievement. Rand Corporation on-line, 2012. Available at: www.rand.org/pubs/corporate_pubs/CP693z1-2012-09.html

"What are new literacies?" New London Group, New Literacies & Classroom Practice. On line at: www.newliteracies.com.au/what-are-new-literacies?/138

The Forest For the Trees

A Description and History of the School of Natural Resources & Extension Forest Growth and Yield Program, 1983–2014

Tom Malone



Research crew at a Permanent Sample Plot in the Matanuska-Susitna Valley, near Parks Highway mile 92.
—Photo by Tom Malone

In 1983, the then-School of Agriculture & Land Resource Management at UAF hired Dr. Edmond C. Packee as an assistant professor of Forest Management to start a Forest Growth and Yield Program (FG&Y). The purpose of the FG&Y Program was to provide landowners and land managers with tools to help them better manage the forests of Alaska. The studies undertaken by the FG&Y would quantify forest productivity by providing publications, data, and equations and/or models. This information is essential for basic state-of-the-art timber management decisions, stand prescriptions, and monitoring long-term forest health and change.

The first order of business was to survey Alaska landowners and managers to determine what forest management tools were most important to them. Site index (the potential for forest trees to grow at a particular location, based on the age and height of trees in the area), individual tree volume, and forest yield (the total amount of wood available for sustainable harvest, based on annual growth increments) were top on the list so the program immediately started collecting data to develop site index curves.

The US Forest Service conducted much of the same research in the coastal forests of Alaska, so the UAF program concentrated its efforts on the northern forests of Alaska. These northern forests consist of the boreal forests of the Interior and the transitional forests of southcentral Alaska. The transitional forests are characterized by the same tree species as occur in the boreal forest but many of the understory species are considered coastal species.

Ed Packee in 2003 on the Kenai Peninsula.
—AFES photo by Jeff Werner

Forest Growth & Yield Projects

In 1985, the FG&Y program started one of its two largest projects by establishing a Levels of Growing Stock (LOGS) study in Bonanza Creek. Thousands of white spruce and eastern larch seedlings were planted to study regeneration and determine

Naomi O'Neal, forestry research assistant, taking Diameter at Breast Height measurements in the UAF arboretum, specifically, Permanent Sample Plot 448.
—Photo by Tom Malone

John Yarie, current principal investigator for the Forest Growth & Yield Program.
—UAF photo by Todd Paris

the best spacing for forest yield. There are numerous LOGS studies in North America and the Alaska LOGS installation was set up in a similar manner. In 1992 another LOGS study was established near Tok. This was a larger plantation that included white spruce, black spruce, eastern larch, and lodgepole pine.

The Cooperative Alaska Forest Inventory (CAFI) was the second large project started by the program. CAFI is a comprehensive database of forest conditions and dynamics. It consists of field-gathered data from many permanent sample plots distributed across interior and southcentral Alaska, ranging from as far south as Ninilchik on the Kenai Peninsula and extending north to the Brooks Range. Currently there are 609 permanent sample plots at 203 sites representing a wide variety of forest growing conditions. New plots are added annually and existing plots are remeasured periodically. Repeated periodic inventories of CAFI permanent plots provide valuable long-term information for determining forest growth and yield, for modeling forest dynamics, biomass estimations, monitoring forest health, and for monitoring large-scale environmental and climate change.

In 1987, the FG&Y Program absorbed the school's Intensive Forest Management Program. Scientists working on this project had been studying tree regeneration and the effects of thinning forests in the Fairbanks area, resulting in ten thinning studies and five regeneration studies added to the FG&Y program project list.

There were also minor studies conducted through the Forest Growth & Yield Program. These have included: moose browse damage to hardwoods in the Matanuska-Susitna valleys, specific gravity/density of Alaska wood, a bark thickness equation for white spruce, effects of tapping birch trees, development of a growth model for the Haines State Forest, and continued remeasurements of 110 one-tenth acre plots in ten thinning studies.

Personnel and Publications

The Forest Growth and Yield Program has had three principal investigators since its inception in 1983. Dr. Edmond C. Packee, Dr. Jingjing Liang, and the current principal investigator, Dr. John Yarie. Tom Malone began working for the FG&Y program as part of the absorption of the Intensive Forest Management Program in 1987. He was responsible for the field operation until 2014. Matt Stevens took over as the program's research forester in June 2014. Twelve UAF graduate students have earned their master's degrees at the School of Natural Resources & Extension through work and research in this program. To date, the field work has been accomplished by 90 college students or technicians and 43 international forestry interns.

The organizations the FG&Y program lists as cooperators are extensive and include state, federal, and local agencies, regional Native corporations, and village corporations.

The Forest Growth & Yield Program has been funded by the School of Natural Resources & Extension, through a McIntire-Stennis federal grant, numerous grants from the State of Alaska Division of Forestry, and with support from its cooperators.

Recently, the University of Alaska initiated a ScholarWorks project as an institutional repository to share research and works of UA faculty, students, and staff. The Forest Growth & Yield

Jingjing Liang in 2008 at UAF.
—AFES FILE PHOTO

Program has established a link to the UAF Communities and Collections section under the School of Natural Resources & Extension, Agricultural and Forestry Experiment Station. Work is in progress to make the 14 publications from this program and the associated databases available in an electronic format.

Program publications include:

2012. Malone, Thomas; Jingjing Liang; and Edmond C. Packee, Sr. Total and Merchantable Volume of White Spruce in Alaska. *West. J. of Appl. For.*, 28(2): 71–77.

2012. Malone, Thomas; Packee, Edmond C. Sr.; Liang, Jingjing. List of Plant Species Present on Forest Permanent Sample Plots in Interior and Southcentral Alaska. Agricultural and Forestry Experiment Station Misc. Pub. MP 2012-01 (Update).

2011. Liang, Jingjing; Mo Zhou; David L. Verbyla; Lianjun Zhang; Anna L. Springsteen; and Thomas Malone. Mapping forest dynamics under climate change: A matrix model. *For. Eco. and Mgt.*, 262(2011): 2250–2262.

2010. Liang, Jingjing. Dynamics and Management of Alaska boreal forest: An all-aged multi-species matrix growth model. *For. Eco. and Mgt.*, 260(2010): 491–501.

2009. Malone, Thomas; Jingjing Liang; and Edmond C. Packee, Sr. Cooperative Alaska Forest Inventory (revised 2014). USFS, PNW-GTR-785.

2009. Malone, Thomas; and Jingjing Liang. A Bark Thickness Model for White Spruce in Alaska Northern Forests. *Intl. J. of For. Res.* Vol. 2009, Article ID 876965. Hindawi Publishing Co. p 5.

2008. Trummer, Lori; and Thomas Malone. Assessment of paper birch trees tapped for sap harvesting near Fairbanks, Alaska. USFS, R10-S&PF-FHP-2008-1.

2008. Trummer, Lori; and Thomas Malone. Some impacts to paper birch trees tapped for sap harvesting in Alaska. USFS, R10-S&PF-FHP-2009-3.

2001. Shaw, John D.; Edmond C. Packee, Sr.; and Chien-Lu Ping. Growth of balsam poplar and black cottonwood in Alaska in relation to landform and soil. *Can. J. For. Res.*, Vol. 31. pp 1793–1803.

1998. Shaw, John D. and Edmond C. Packee, Sr. Site Index of Balsam Poplar/ Western Black Cottonwood in Interior and Southcentral Alaska. *Nor. J. Appl. For.*, 15(4): 174–181.

1992. Packee, Edmond C.; Pham X. Quang; and Roselynn Ressa-Smith. Bolewood specific gravity of Alaskan Northern Forest trees. *For. Prod. J.*, 42(1): 29–34.

1990. Packee, Edmond C. White Spruce Regeneration on a Blade-Scarified Alaskan Loess Soil. *Nor. J. Appl. For.*, 7(3): 121–123.

1986. Putman, William E.; and John C. Zasada. Direct Seeding Techniques to Regenerate White Spruce in Interior Alaska. *Can. J. of For. Res.*, Vol. 16(1986): 660–664.

1985. Putman, William E. Raven Damage to Plastic Seeding Shelters in Interior Alaska. *Nor. J. of Appl. For.*, Vol. 2(1985): 41–43.

Tom Malone, FG&Y research forester until 2014. See stories on his retirement and his receipt of the Employee of the Quarter Award, p. 49 & 51.
—PHOTO BY NANCY TARNAI

Matt Stevens, the new research forester for the FG&Y as of June 2014. Stevens previously worked on a crew for Malone in the program for two summers while he was earning his university degree.
—PHOTO BY NANCY TARNAI

Painting Sacred Space

HARRISON CRANDALL AND GRAND TETON NATIONAL PARK

Deirdre Helfferich

Harrison R. Crandall: Creating A Vision of Grand Teton National Park, by recently retired SNRE geography professor Kenneth A. Barrick, begins by stating:

> "You might be curious to know how a professor from Alaska became interested in Harrison R. Crandall, who preferred to be called 'Hank', and his role in creating a vision of Grand Teton National Park."

"Wild Rose," by HR Crandall.
—Courtesy K.A. Barrick Collection

It turns out that Barrick has been collecting national park art, and in particular photochromes (color lithographs), for a very long time. William Henry Jackson's—and now Harrison "Hank" Crandall's—works are Barrick's particular passion. Jackson was a photographer in the 1870s in the Hayden expedition, a scientific expedition which explored the Yellowstone area. He and Thomas Moran the painter brought the visual wonders of the area to the eyes of the public and Congress, helping show people who didn't know what a geyser was, for example, and in the process providing support for the creation of the 1872 Park Bill.

In a similar way, Crandall helped to visually interpret and explain the Grand Tetons to people through his work, enabling them to connect to the West through his hand-painted photographs and landscape paintings. Crandall was the park's first and only official photographer and Jackson Hole's first resident artist, homesteading in the Teton Range from before the park was officially created, and he continued to live in the Tetons until his death in 1970.

Barrick first discovered this painter/photographer at an art show in Bozeman, Montana, while he was looking for photochromes by Jackson. His eye was caught by two portraits, one of a wild rose and another of fringed gentian, both of which he promptly purchased.

"Many people today don't realize that color photos first became available as hand-painted black and white photographic images," Barrick explained. So, people could hang a "color photo" on their wall more than a hundred years before color photography was invented. "[Hank Crandall's] have very bold, deeply saturated colors, so they're very beautiful to look at."

Barrick tried to find out more about the artist, but there was very little information available. His research eventually led him to Grand Teton National Park, and Alice Hart, now former curator at Teton, with whom he was to work for six years, and Crandall's family. Images in the book came largely from the park archives, Crandall's family, the National Archives in Washington, DC, and two galleries (Cayuse Western Americana and Fighting Bear Antiques). Some images were unique to the Crandall family archives, particular the early items, so the public is seeing them here for the first time; some commercial items were displayed in Hank's studio over the years at the park. These range in size from small souvenirs to full-sized paintings, including the large and dramatic landscape that hangs in the Moose Visitors' Center and adorns the book cover.

Crandall excelled in more than one genre: black and white photography, opaque overpainting on photos, and painting. The opaque paints were unusual: most hand-painted photos of the day used transparent paints. Crandall depicted people within a recreational wilderness in his photos and movies, often inserting gags and staging the images. His paintings of landscapes very rarely included people, and almost always were

"Solitude Country in the Tetons," painting by HR Crandall.
—Courtesy private collection

Crandall painting outdoors in the Tetons.
—Photo courtesy of the Quita and Herb Pownall Collection

of a slightly romanticized wilderness. He also made a dozen films during the 1920s, including documentaries of life in Jackson Hole and a dramatic film titled *The Hold Up*.

Crandall had been fascinated from an early age by the area: he had decided as a child to go to the Tetons because of a photograph he saw of the area by William Henry Jackson. He moved from Kansas to California, and eventually homesteaded in Jackson Hole, where he remained.

Barrick explains the concept of *geopiety*, or the belief that certain geographical sites are sacred. Many such sites evoke awe, including the Tetons, which dramatically jut up from a comparatively flat area. Barrick makes the case in his book that the Teton Range was Crandall's sacred mountains. It is certainly apparent in Crandall's many decades of painting the mountains of the Teton Range that he brought respect to his subject and appreciation for their drama and beauty.

Hank Crandall and his family in front of the Grand Tetons. From left to right: daughter Nancy, wife Hilda, Hank, and daughter Quita.
—Photo by HR Crandall, courtesy of Grand Teton National Park Archive

"Begging for Sugar."
—Photo by HR Crandall, courtesy Grand Teton National Park Archive

The parks and Hank Crandall

- **1872 Park Bill:** The first national park was Yellowstone, approved by Congress in part because of the images that Moran and Jackson sent. The mandate of the bill was that the park be for the enjoyment of the American people. At first, a civilian staff managed the park.
- **1872–1916:** In 1886, the military took over management of Yellowstone National Park. Other parks began to be added, some managed by the states, some by the federal government.
- **1916:** The Organic Act created the National Park Service and system and established the goals for park service. The young Park Service was competing with the Forest Service for funds and recognition, trying to prevent poaching on park grounds, and figure out how to get the public to come visit. Artists and their on-site studios became important because they were the only park interpreters. Artwork depicting the parks also became significant in Washington, DC, for more than its beauty. Stephen Mather and Horace Albright, the first and second directors of the Park Service, respectively, and several prominent members of Congress, for example, displayed Crandall's paintings in their offices.
- **1920s:** While Crandall was homesteading at Jackson Hole, Albright entertained John D. Rockefeller, Jr. and son, taking them to see the Grand Tetons. Rockefeller was so taken by the area that he eventually donated $1.5 million to buy up a portion of the valley floor for the park expansion (an act that is still controversial to some!). Albright depended on artists like Crandall, who supported the park expansion, to interpret and portray the landscape. Hank spent his life in the park, painting and photographing the people and wilderness around him. His studio is now the Jenny Lake Visitor Center.
- **1954:** Hank's studio at the old homesite at Paintbrush Point burned down, but 1,200 negatives were saved, including photos of Native Americans, portraits of the family, movie actors, early national park managers, Civilian Conservation Corps crews, and other images, and a dozen 1920s-era vintage silent films.

"There's still lots of Crandall's art out there that we don't know about," said Barrick. "Maybe there will be enough for a second edition of the book, or even a second volume!"

More information:

Dr. Barrick may be contacted at kabarrick@gmail.com.

Harrison R. Crandall: Creating A Vision of Grand Teton National Park. 2013. Kenneth Barrick. Gibbs M. Smith, Inc. ISBN-13: 978-1423634003. 240 pp.

Interview of Dr. Ken Barrick by Mary Schmitt of Cayuse Western Americana, Part 1 and Part 2. On line at: http://cayusewa.com, and www.youtube.com/watch?v=vB6m-y2mP4g (part 1) and https://www.youtube.com/watch?v=cGcsZmxgzx8 (part 2) (YouTube).

Grand Teton National Park Interpretive Center (www.nps.gov/grte/planyourvisit/visitorcenters.htm)

In his retirement, Barrick continues working on other book projects, including:

National Park Souvenirs: Taking Home the Sacred, which will document the history and unique meaning of souvenir art and ephemera of the national parks.

The Impact of Geoengineering on American Wilderness and Naturalness. A major part of the definition of wilderness is that it is a self-willed environment or ecosystem without human control or development. Geoengineering, by definition, is an attempt by humans to control climate by technological fixes, so naturalness will disappear from the region (depending on the size, up to global). In the United States, any impact on wilderness by geoengineering appears to violate the intent of the Wilderness Act, said Barrick, which incorporates naturalness as a key component of wilderness.

(An earlier version of this story was previously posted on line at SNRE Science & News, http://snras.blogspot.com.)

Circumpolar Agriculture Conference: Connecting to the Land

Nancy Tarnai

In the fall of 2013, 128 people from seven arctic countries and Japan gathered in Girdwood, Alaska, with a common goal: increasing food production in and for the Arctic.

The 8th annual Circumpolar Agricultural Conference & UArctic Inaugural Food Summit was hosted in part by the University of Alaska Fairbanks School of Natural Resources and Agricultural Sciences (now School of Natural Resources and Extension) and UAF Cooperative Extension Service. Working together, attendees attempted to focus on where people of the North get their food and how to supply more of their own food.

Professor Milan Shipka, a conference co-chair, said the forum helped create a conversation to put the pieces surrounding food issues together. "It's a multi-level, multi-country, multi-disciplinary, multi-governmental and agency approach," he said.

"It brought people who share similar environments and face similar challenges together to share common concerns and interests, even though we are separated by international boundaries and usually have little opportunity to interact," Shipka said.

The gathering also stimulated efforts to find funding to address common interests and common needs to feed people. "We want to help farmers apply their chosen vocation based on principles of sustainability and to share what they are doing and what is happening in agriculture in their countries," Shipka said.

"By making this a Northern Food Summit and Circumpolar Agriculture Association sharing sponsorship of the meeting with the University of the Arctic,

Timeline of the CAC

1992 Whitehorse, Yukon Territory, Canada

1995 Tromso, Norway

1998 Anchorage, Alaska, USA (see article in *Agroborealis* 30.1, "The 3rd Circumpolar Agricultural Conference, Anchorage, Alaska)

2001 Akureyri, Iceland (see article in *Agroborealis* 34.1, "A Trip to Iceland")

2004 Umea, Sweden

2007 Goose Bay, Newfoundland, Canada

2010 Alta, Finnmark, Norway

2013 Girdwood, Alaska, USA

Above: Co-chairs Carol E. Lewis (Conference Planning Committee), left, and Karen Tanino (Scientific Program Committee).

Left: Co-chair Milan Shipka, left, handing off the presidency of the Circumpolar Agriculture Association to Torfi Johannesson of Iceland, right. In the background is the conference poster.

—Photos by Nancy Tarnai

Conference attendees photographing a black bear at the Alaska Wildlife Conservation Center, near the conference hotel.
—Photo by Nancy Tarnai

we introduced the Circumpolar Agriculture Association members and members of the University of the Arctic each to a new group of people who share common interests centered around food and sustainable agriculture practices."

In opening remarks on Sept. 30, UAF Chancellor Brian Rogers said, "UAF was founded as an agricultural and mining college. Alaska has welcomed expertise from northern countries. To have this conference here is special for us.

"UArctic aims for a strong, sustainable circumpolar region through shared knowledge. The thematic network on food security works for self-sufficiency for northern communities. We want to increase training and research so we have the ability to produce more of our own food.

"At UAF we are researching reindeer, vegetable cultivars, Alaska's growing season and growing guides. We are at the end of the supply lines and it is tenuous. Work on circumpolar agriculture is critical to the future of Alaska."

At the end of the conference, the guiding principles called for a multi-disciplinary approach encompassing animal health, human health and the environment, coming up with new ways of thinking about food systems, focus on resource and information sharing, support grassroots initiatives, promote responsible economic development that respects the environment, increase collaboration across barriers. The group wants to increase educational outreach, spread the word that humans are healthier when connected to the land, conduct economic analyses of local food systems, enable community and inter-community trade of locally produced and harvested foods, provide a forum for community identification of policy and food safety issues. Another point was that circumpolar science should focus on creating dialogue about survival issues and assist communities to become more self-sufficient, provide transportation subsidies so the price of food is evened out around the country, focus on efficient food use and reduction of waste, long-term monitoring of food systems.

Comments from attendees were positive:

"I have a new understanding of food security issues, impacts and initiatives and potential for progress."

"Very good networking and putting faces to names."

"Poster sessions were an excellent way to learn in-depth about projects taking place and meet the people who we can collaborate with."

"The participation of indigenous people must be a priority in discussions on food security."

Alaska Cooperative Extension Agent Steven Seefeldt, second from left, in discussion with visiting conference participants. At far left is Torfi Johannesson, senior advisor, Rural Affairs, Ministry of Industries and Innovation, Iceland Department of Economic Development, who became the new president of the Circumpolar Agriculture Association at the event.
—Photo by Nancy Tarnai

"The workshop was excellent. I enjoyed learning about the different approaches in improving/building regional food systems."

"The opportunity to interact with researchers from across the Arctic was eye opening. The challenges of the future of feeding Arctic peoples go beyond one country."

"The diversity of backgrounds was fantastic. Even more important was the commonality of the needs from diverse backgrounds."

"I've been researching food security possibilities with an open mind and came here to get an idea of what I might have overlooked. Now I have a marvelous selection of contacts and resources to work with."

Anthropology student Azara Mohammadi wrote:

As one of the only (if not the only) undergraduate students attending the Circumpolar Agricultural Conference, I was slightly awestruck at first. Although I read and reread the agenda many times before leaving, I was not prepared for the impact the conference as a whole would have on my understanding of the world. It would be an understatement to say that it was inspiring to meet and speak with individuals from around the world, leaders in their field, who share a common desire to address food security. The privilege of witnessing a part of the process by which decisions about the world are made is a memory that will stay with me.

As an anthropology student I was very excited to learn about a more holistic approach to food security, which explicitly includes anthropological knowledge and conceptual tools. The emphasis on understanding food as not just food, but a confluence of many of the aspects of human life within a unique ecological zone, was so wonderfully articulated by many presenters.

As an aspiring champion for local agriculture in my own community, I particularly enjoyed when presenters shared their success stories. In most cases, their challenges were far greater than those I am facing in Fairbanks. This left me with a new perspective that at once made me feel that my challenges were not so difficult, relative to those who truly suffer from food insecurity, while at the same time reminding me why it is important to address food security. I left with a renewed sense of purpose and determination, which

I attribute to a clearer vision of what achieving my goals promoting local agriculture might actually resemble and look like in action.

▲

Conference presentations and proceedings

Most of the presentations listed below are available for download at www.uaf.edu/cac/. The proceedings, due to be published this fall, will include all submitted abstracts and full peer-reviewed, edited papers from thirteen presenters.

"Redefined Northern Security - a challenge to Arctic geopolitics?" Lassi Heininen, Univ. Arctic Thematic Network Lead, Geopolitics, Finland (on line)

"Cross-Border Dimensions of Vuntut Gwitchin Food Security," David Natcher, Director, Indigenous Land Management Institute, University of Saskatchewan, Canada (on line)

"Indigenous Community Food Security in the Yukon Territory," Norma Kassi, Director Indigenous Collaboration Arctic Institute of Community Based Research, Yukon, Canada (on line)

"Food safety in the arctic and human health:" Contaminant exposure by dietary intake," Arja Rautio, Univ. Arctic Thematic Network Lead, Arctic Health, Finland (on line)

"The Bioeconomy of the Arctic," Torfi Jóhannesson, V.P. Circumpolar Agriculture Association, Iceland representative (on line)

"The Land Grant University System in the US: Its role in agricultural development in the Arctic and Subarctic," Carol E. Lewis, University of Alaska Fairbanks (on line)

"Developing Sustainable Small Businesses in the North: The Case of Northern Food Producers and Distributors," Svein Johansen, Univ. Arctic Thematic Network Lead, Managing Small and Medium Sized Enterprises in the North, Norway (proceedings)

"Yukon Agricultural Association – Initiatives and Projects," Sylvia Gibson and Kirsten Scott, Yukon Agricultural Association

Azara Mohammadi.
—Photo by Nancy Tarnai

Yellowknife Commons Co-operative Ltd. (on line, proceedings)

"Stimulating Yellowknife's local food economy and success stories of local agri-food skills activities in the Northwest Territories, Canada," Amy Lizotte and Lone Sorensen, Yellowknife Commons Cooperative, Yellowknife Garden Collective, Ecology North and Territorial Farmers Association (on line)

"Experimental horticultural projects in the Canadian Mid- and High Arctic in the early 1980s: Lessons Learned," Josef Svoboda, Professor Emeritus, University of Toronto (on line, proceedings)

"Costs and Benefits of a Northern Greenhouse," Tom Allen, Professor Dept. Bioresources Policy, Business and Economics, University of Saskatchewan (on line, proceedings)

"Alternative soil nutrient sources: meeting the needs of rural Alaskan growers," Lydia Clayton, Janice Chumley, Pam Compton, Meg Mueller, University of Alaska Fairbanks Cooperative Extension Service; USDA - Natural Resource Conservation Service (on line)

"Agricultural Production of Biomass as Energy Crops in Alaska: Is It Feasible?" Stephen D. Sparrow, Amanda Byrd, darleen masiak, Mingchu Zhang, Robert Van Veldhuizen, William E. Schnabel, Agricultural and Forestry Experiment Station and Alaska Center for Energy and Power, University of Alaska Fairbanks (on line, proceedings)

"Ten Years of Creating Partnerships towards Community Food Security and Northern Rural Development in Manitoba," Kreesta Doucette, Founding Director, Food Matters Manitoba (on line, proceedings)

"The Kuujjuaq Greenhouse Project: Sustainable Community Development through Food Production," Ellen Avard (PhD Candidate) Université Laval, Département de Géographie, Quebec (on line, proceedings)

"Bilberry – wild superberry from Europe," Laura Jaakola, Eivind Uleberg, Inger Martinussen, Climate laboratory, Department of Arctic and Marine Biology, University of Tromsø, Norway (on line, proceedings)

"Antioxidant Levels in Alaska Berry Products," Julie Cascio, Roxie Dinstel, University of Alaska Fairbanks, Cooperative Extension Service (on line)

"Sustainable Livestock Production Systems in Alaska: production practices and marketing," Milan Shipka and Jan Rowell, University of Alaska Fairbanks (on line, proceedings)

"Animal Health Issues for Alaska Agriculture," John Blake, University of Alaska Fairbanks (on line)

"One Health" Perspectives on Environmental Contaminants in Subsistence Foods of Alaska," Todd O'Hara, University of Alaska Fairbanks (on line)

"Losses of sheep on summer range in Norway," Inger Hansen and Rolf Rødven. Bioforsk Nord, Norway (on line, proceedings)

"Small Scale Poultry Production Education in Alaska," Stephen C. Brown. University of Alaska Fairbanks Cooperative Extension Service (on line, proceedings)

"Building Educational Programs to Promote Food Security for Indigenous Populations in the Americas," Diane Holland Rickerl, South Dakota State University (on line, proceedings)

The Alaska Natural Fiber Business Association:

Connecting Alaska's Fiber Community

Jan Rowell and Lee Coray-Ludden

A one-and-a-half day workshop in the fall of 2012 rekindled a passion for community among Alaska's fiber producers and artists. "Fiber Production in Alaska: From Agriculture to Art" provided a rare venue for fiber producers and consumers to get together and share a strong common interest in fiber production in Alaska. The workshop was sponsored by the Alaska State Division of Agriculture and organized by Lee Coray-Ludden, owner of Shepherd's Moon Keep and a cashmere producer.

There is nothing new about fiber production in Alaska. The early Russians capitalized on agricultural opportunities wherever they could and domestic sheep and goats were a mainstay in these early farming efforts. But even before the Russians, fiber was historically used for warmth by Alaska's indigenous people. They gathered their fiber from wild sources, and some tribes handspun it and wove it into clothing, creating beautiful works of art.

Some of the finest natural fibers in the world come from animals that evolved in cold, dry climates, and many of these animals are grazers capable of thriving on Alaska's natural vegetation. Within the state there is tremendous diversity in the animals being raised for fiber: bison, yak, llama and alpaca, cashmere goats, and many types of sheep

Angora rabbits produce a soft and silky fiber finer than cashmere. Pictured below is Michael, a German angora, shortly before shearing. Angora rabbits may be sheared, plucked gently, or combed to obtain their downy hair.
—Photo by Becky Hammond

The Alaska Natural Fiber Business Association: Mission & Goals

Mission:

The ANFBA serves and supports the Alaskan fiber producer and fiber artist by strengthening Alaska's natural fiber industry, economy and marketplace.

Goals:

- Develop and maintain a business network based on Alaska natural fibers
- Promote and support sustainable natural fiber production and agriculture in Alaska
- Support family farms in Alaska
- Promote sustainable in-state processing for Alaska natural fibers
- Identify and develop Alaska natural fiber marketing structures
- Increase professional opportunities and market access for producers and artists
- Coordinate products and services to maximize efficient production, distribution and use of Alaska natural fibers
- Develop quality standards for both fiber production and processing
- Disseminate information to members, affiliate organizations and the public regarding Alaska natural fibers

Surveys:

The ANFBA conducts ongoing surveys of the fiber production and fiber use industry in Alaska. If you are a fiber **producer or a fiber artist, you can jo**in this developing network or contribute to knowledge of the state of the Alaska fiber industry by filling out the appropriate survey, found on line at their website, or on pages 32–34, and mail to the address below.

Contact information:

Website:
http://alaskanaturalfiberbusinessassociation.webs.com

Address:
ANFBA, PO Box 254, Clam Gulch, AK 99568

President & contact: Lee Coray-Ludden, (907) 394-6146, aknfba@gmail.com

(Shetland, Black Welsh, Mountain, and Icelandic sheep, to list just a few). Then there are muskoxen, an animal indigenous to the North that produces a fiber recognized as one of the finest natural fibers currently on the market. Alaska leads the world in the production of qiviut from farmed muskoxen. Our arctic/subarctic climate poses no barrier to growing high-quality fiber and production is not only possible here, it's an ideal fit for the state's grazing ecosystems.

Despite Alaska's suitability, fiber production is not an industry here—not yet. The reasons for raising fiber-producing animals are as diverse as the species themselves, while the barriers to growing this industry are common to all. Farms are small and scattered across a huge state. There is no organization or system for the collection and marketing of locally produced natural fibers. Because of this, as well as raising the animals, the farmer has to take on the additional work involved to prepare, market, and sell the fiber. Added to this is the lack of in-state fiber processing. Taking wool to the next level—whether it is felted, carded, spun, and/or dyed—requires shipping to a woolen mill in the Lower 48 or, once again, having it all hand done by the producer or artist wishing to use local fiber. With few exceptions, this bottleneck relegates Alaska's fiber potential to novelty status.

The Alaska Natural Fiber Business Association (ANFBA)

A survey circulated after the 2012 meeting found an overwhelming 95% of responding artists and craftspeople would prefer to use Alaska Grown fibers in their work and that 83% of all respondents were interested in an association/cooperative that included value-added marketing support. Building on the energy generated at the meeting and through the dedicated volunteer efforts of the Steering Committee, the Alaska Natural Fiber Business Association (ANFBA) was created.

In the spring of 2013 the group established its official name, mission statement, and goals, and as of 2014 the association achieved nonprofit status. The questions became "What next and how?"

The information collected through surveys has provided a good base of preliminary data, but the picture is far from complete. Because fiber producers and artists are scattered throughout the state, communication is central to our continued success.

A website has been established and is being developed. With a web presence ANFBA members can post information related to available fiber and fiber needs. Members can search for assistance, information and ideas, and find common solutions to shared problems.

The very nature of fiber encourages creative value-added cooperatives and marketing structures. The fiber producer can benefit from cooperatives for purchasing supplies, services such as artificial insemination, breeding stock, and culled livestock. The fiber artist or craftperson can benefit from cooperatives that include fiber sources and pool marketing efforts.

Wild Fibers, *a magazine dedicated to understanding the role natural fibers have played in developing cultures and supporting communities throughout the world, hosted a tour in Alaska and came to the University of Alaska Fairbanks this March, where participants met with SNRE assistant research professor Jan Rowell to discuss qiviut. Above, a tour participant explores the amazing softness of a raw qiviut fleece.*
—Photo by Nancy Tarnai

In May 2013, UAF released a video featuring Rowell that showed how to comb the blanket of qiviut shed by muskoxen. Muskoxen release their qiviut in a synchronous shed, or all over their bodies at once. This is unlike dogs, for example, which shed sporadically, or sheep, which must be sheared. To view the video, go to www.youtube.com/watch?v=uSFeO4aN_0g&feature=youtu.be.
—Photo by Nancy Tarnai

Marketing of fiber products was identified as a priority and need in two different surveys conducted in Alaska, once in 1995 and again in 2013.* An association collectively has the ability to help the individual market their products. This can be accomplished by: identifying and disseminating information on local venues; tapping into established media networks; establishing standards and guidelines; creating a recognizable Alaska brand; and ultimately connecting producers, artists, and craftspeople with Alaska's diverse and well-established tourism industry.

Through an ANFBA network, grassroots support can be harnessed to look into options for growing Alaska's fiber industry. Participants at the meeting in 2012 voiced overwhelming support for the establishment of in-state fiber processing. Without the ability to mill fiber in Alaska, the critical value-added component is lost to most small farms. Starting a mill is a big financial proposition, and requires careful planning and research. The ANFBA is the perfect umbrella organization to carry out a feasibility study and investigate creative options and alternatives for a mill.

Natural fiber has commercial potential far beyond the production of yarn. Its fire retardant properties and resistance to mildew make it a natural insulator. Businesses in the Lower 48 like Good Shepherd Wool (Alberta, Canada, and Florida) and Black Mountain Sheep (distributing nationally throughout the US) make wool insulation as batts, rope, rolls, insulation panels, and fill. In Oregon Jetson Green has been chopping up industrial-grade yarn and using it as blow-in insulation for homes. Lower quality fleeces can be felted and used as oil spill batts (biodegradable), bioremediation batts for streams and roadsides (no seeds and biodegradable), or liners for hanging baskets and mulching for gardens, especially under perennials.

The development of a fiber business/marketing network diversifies income opportunities in rural Alaska beginning with the fiber producer and reaching out to include a web of interrelated businesses. But best of all, a fiber network provides an all-Alaska outlet for a shared, common passion: fiber, from agriculture to art, shared on many levels by many people. It's like a favored yarn store, you don't go there just to buy yarn—you go there to be wowed by all the colors, feel the sundry textures, marvel at the creativity, and share it all with friends and new friends. The ANFBA may be a virtual room, but it's still a fiber sanctuary where the conversation can continue.

❖

* Editor's note: the surveys are ongoing; reprints of these surveys are on pp. 32–34, and can be found at the association website.

Alaska Fiber Survey – Producers

This survey is designed to help the ANFBA determine the feasibility of a natural fiber processing facility in Alaska. The contact information you provide will also contribute to a statewide network of producers who are interested in possible associations and cooperatives for processing, breeding, and marketing of natural fibers in Alaska. Feel free to share this survey with other Alaska fiber producers who you think would be interested in offering feedback. The economic development potential is substantial if we work together.

Background image: Sabrina, a Shetland sheep living at Calypso Farm & Ecology Center.
—Photo by Gerrit Vyn

Name:

Farm/Ranch/Business Name:

Mailing Address:

Phone: E-mail:

Number of years in production:

Natural Fiber Producer Questions

1. Type and number of fiber animals you own:

Breed:

How many:

Males/Females:

2. Amount of fiber produced per year?

Type of fiber:

Amount produced (lbs ozs):

3. How is the fiber harvested? (select all that apply)

Combed Shorn manually Shorn w/electric clippers Self-heaved

4. Do you shear yourself? (select one) Yes No

Comments:

5. Do you provide stud services? (select one) Yes No

Breed:

Type:

Contact phone or e-mail

6. Have you used AI? (select one) Yes No

If yes, what was the outcome?

Breed AI used with:

Outcome:

What happens to your fiber?

7. How do you store your fleeces post-shearing/combing?

Tie your fleece? Yes No

Bag your fleece? Yes No

Type of bag (select one): Plastic Cloth Other

Comments:

8. Do you personally process your fiber? (select one) Yes No

If yes, I personally process my fiber by (select all that apply)

Washing Picking Carding Spinning into yarn Other

Comments:

9. I send my fiber to a commercial mill for processing (select all that apply)

Batts Roving Cloud Yarn Other

10. Which mills have you liked/used?

11. Do you sell your fleeces? (select one) Yes No

If yes, how do you sell it? (select all that apply)

Raw in the grease Hand processed at home Processed at a mill

Value-added processed (spun, finished product, etc.) Other

Comments:

12. Do you store the fleece and do nothing with it? (select one) Yes No

13. Who do you sell to? (select all that apply)

Individuals Commercial Guilds Other

Comments:

14. How do you market your fleece? (select all that apply)

Formal advertising Word of mouth Other

Comments:

15. If you have used formal advertising, what method did you use (select all that apply)

Trade mag/newsletter Trade/craft shows Farmers Market Other

Comments:

16. What barriers have you found in marketing?

17. What workshops would you like to attend or teach?

18. Are you interested in an association/cooperative to increase your success?

If you know of other AK producers who would like to be part of this conversation that we should contact please provide their information below.

Name:

Contact Info (phone/e-mail):

Thank you for taking the time to complete the survey! Please return it by e-mail or mail to:

*Lee Coray-Ludden, leeaq7175@gmail.com, PO Box 254, Clam Gulch, AK 99568. Phone: (907) 394-6*146

Alaska Fiber Survey – Fiber Artists

This survey is designed to help the ANFBA determine the feasibility of a natural fiber processing facility in Alaska. The contact information you provide will also contribute to a statewide network of fiber artists who are interested in possible associations and cooperatives for processing, breeding, and marketing of natural fibers in Alaska. Feel free to share this survey with other fiber artists who you think would be interested in offering feedback. The potential is substantial if we work together.

Name:

Farm/Ranch/Business Name:

Mailing Address:

Phone: E-mail:

Number of years in production:

Background image: three skeins of natural yarn. Left: 100% qiviut. Middle: 70% qiviut, 30% merino. Right: 60% qiviut, 40% cashmere.
—Photo by Jan Rowell

Natural Fiber Artist Questions

1. What do you use natural fibers for? (select all that apply)

Quilt batting Knitting Crocheting Spinning Weaving Felting Other

Comments:

2. How do you purchase your fiber? (select all that apply)

Catalogs Internet Guilds Co-op Raise your own Neighbors/friends Local Producers/Farmers Other

Comments:

3. What condition do you like to purchase in? (select all that apply)

Raw & skirted Roving Batting Spun Other

Comments:

4. What volume do you usually purchase? (select all that apply)

Whole fleece Pound

What quantity do you purchase annually?

Comments:

5. What type of fiber do you require? (select all that apply)

Fine wool Medium/Downy Wool Long Wool

Alpaca Llama Cashmere Bison Angora Mohair Yak Qiviut Other

Comments:

6. What do you use the fiber for? (select all that apply)

Personal Gifts For Sale Other

Comments:

7. Are you interested in local wool/fiber for your art? (select one) Yes No

Comments:

8. What barriers have you found in marketing your finished product?

9. Would you like assistance in marketing finished product?

10. What workshops would you like to attend or teach?

11. Would you be interested in an association/cooperative to assist in marketing?

12. Do you know of other Alaska fiber artists who would like to be part of this conversation that we should contact? If yes, please provide their information below.

Name:

Contact Info (phone/e-mail):

Thank you for taking the time to complete the survey! Please return it by e-mail or mail to:

Lee Coray-Ludden, leeaq7175@gmail.com, PO Box 254, Clam Gulch, AK 99568. Phone: (907) 394-6146

Growing Our Energy at Home:

Biomass Crops in Alaska

introduction by Stephen D. Sparrow

Alaska is home to vast energy resources and is a net exporter of energy in the form of crude oil. Yet Alaskans, especially those residing in remote communities, pay some of the highest energy prices in the country. Energy experts are working to identify opportunities for developing cheaper, renewable energy sources for Alaskans. Alaska has vast quantities of biomass, mostly in the form of trees, which provide an excellent and often cheap fuel source for many communities in the forested regions of the state. However, there are concerns over the long-term sustainability of repeated harvests of forests, especially if the harvest repeat rate is short. Also, many communities in Alaska do not have ready access to forest biomass. Growing biomass crops for energy may be a feasible way to sustainably produce renewable energy in some parts of Alaska.

Scientists at the University of Alaska Fairbanks Agricultural and Forestry Experiment Station are researching the cropping potential of several types of plants for biomass, as well as different methods for converting the energy contained in biomass into usable energy. We report here on research on growing barley, a commonly grown feed grain in Alaska, as a product that can be directly burned and converted to heat energy; on the feasibility of growing canola, an oilseed crop, and using the oil directly as a fuel or converting it to biodiesel; on growing indigenous and introduced grasses and woody shrubs as biomass crops; and on converting waste forest or agricultural products, such as sawdust or cull potatoes, into bio-oil which can be used as a liquid fuel.

Darleen masiak, now retired, worked on biomass cropping potential for woody shrubs such as these willows (Feltleaf willow, Salix alaxansis*) growing on the Fairbanks Experiment Farm at UAF. This stand was only two years old and already almost twice as tall as masiak, illustrating why woody species such as these excite such interest.*
—Photo by Stephen D. Sparrow

Potential Perennial Lignocellulosic Energy Crops for Alaska

Stephen D. Sparrow, Amanda Byrd, darleen masiak, Mingchu Zhang, Robert van Veldhuizen, William Schnabel

With interest spurred in alternative, locally available renewable energy sources, chief among the resources AFES is investigating is lignocellulosic biomass, which include the primary fiber types making up wood and the stems of grasses. It is used as an energy source through direct burning or by first converting it to liquid or gaseous fuels through various chemical and physical procedures. The former is, of course, "low-tech," and is currently the most common use of fibrous biomass for fuel. The latter, which require sophisticated and often expensive technology, not yet widely used.

In Alaska, the most common source of fibrous biomass is trees harvested from native forests. The rotation period is long (decades) and energy yields per unit of land per year are often low. There has been a great deal of research across the globe on the potential use of both grasses and woody species as short-rotation energy crops. Plants receiving the most interest are fast growing, heat-loving grasses (such as switchgrass and *Miscanthus*) and fast-growing shrubs or trees, most notably willows and poplars. Warm-season grasses, such as switchgrass, do not grow well in Alaska. However, research in Northern Europe has indicated that some species of cool-season grasses may have potential as energy crops. Both willows and poplars are indigenous to and

widespread in Alaska, so there is a great deal of interest in their use as energy crops.

Over the past decade, we have studied the potential of growing lignocellulosic biomass crops at several locations in Alaska, including Anchorage, Yakutat, Palmer, Delta Junction, and Fairbanks. These locations represent a wide range of climate and soil conditions.

We converted a six-year-old planted balsam poplar plot to a biomass study at Anchorage (61.25°N, 149.80°W); the location has a mean annual temperature (MAT) of 35°F and mean annual precipitation (MAP) of 16 inches. The entire plot area was harvested and divided into four quadrants, two of which received nitrogen fertilizer (N) at 100 lbs per acre, and two of which received none. Tree regrowth was harvested after two growing seasons and analyzed for energy, ash, and nutrient contents.

At Yakutat (59.55°N, 139.73°W), located in a north temperate maritime climate (MAT of 39°F and MAP of 151 in), we planted dormant cuttings of 10 willow species and two poplar species and transplants of one alder species. Plots at Yakutat have not yet reached harvest stage.

We planted dormant cuttings of two willow species and one poplar species at Palmer (61.53°N, 149.08°W) and two locations at Fairbanks (64.82°N, 147.87°W). Plots at Palmer (MAT, 37°F; MAP, 12 in), were overtaken by weeds and were destroyed in their second year. Plots at Fairbanks (MAT 27°F; MAP, 11 in) were fertilized with 90 lb N/ac in the second year after establishment. Willow/poplar plots at Fairbanks were harvested at the end of the fourth year after establishment.

Grass plots, both native and introduced, were established in Delta Junction (64.04°N, 145.72°W) (MAT, 29°F; MAP, 11 in) and Fairbanks by seeding and were harvested annually beginning in their second year of growth. Three harvest regimes, consisting of a double harvest (midsummer and autumn), a single fall harvest, and an early spring harvest while still dormant were imposed, as were three nitrogen fertilizer treatments (10, 45, and 90 lb N/ac).

At Anchorage, poplar regrowth produced 2.45 tons biomass per acre per year over the two-year period, with no effect from the nitrogen fertilizer addition, likely because weeds absorbed most of the added nitrogen. The energy in an acre of harvested biomass was equivalent to the energy in approximately 610 gallons of diesel fuel. At Fairbanks, on a moderately drained site, the highest yielding species, feltleaf willow, produced <½ ton per acre per year and at a wet site, it produced 1 ton per acre per year.

Annual grass yields at both Fairbanks and Delta Junction varied greatly among species. Overall, smooth bromegrass produced the highest yields, with annual yields exceeding three tons per acre in some years at Fairbanks, and with yields for other grasses typically less than two tons per acre per year. Yields at Delta Junction were considerably lower than those at Fairbanks, probably because the site tends to be droughty, so water deficiency limits growth. Grasses generally responded to application of nitrogen fertilizer with the highest

Amanda Byrd standing amidst poplars in an experiment plot for the biomass study.
—AFES FILE PHOTO

yields at the highest N rate. Moisture content of grasses was lowest for spring harvests, but highest dry matter yields were at fall harvest. The loss of biomass for spring harvest was due to loss of leaves and lodging, caused by snow load, to the point that the harvester could not recover the downed stems.

The grass yields were lower than usually reported in warmer climates for fast growing grasses, but were comparable to those reported for cool-season grasses in other high-latitude regions. Our woody biomass yields at Anchorage were within the range usually reported for willows and poplars in other regions; our yields at Fairbanks were quite low compared to most other studies. We do not know if the low yields were because the shrubs/trees had not become well enough established to produce rapid growth or if climatic or soil factors limited growth potential. We have not yet done assessments to determine the economic feasibility of growing bioenergy crops in Alaska.

Poplar cuttings soaking in a bucket to sprout. Cuttings are brought out of cold storage and soaked for a week to induce sprouting before planting.

—Photo by Jeff Graham, Alaska Department of Forestry

Stooling Beds: Poplars as a sustainable biomass energy resource

Valerie Barber

Woody biomass systems financed through the Alaska Energy Authority are being installed in more and more communities for heat and in some places for combined heat and power (CHP). Some of the biomass facilities are supported by mill waste, imported (or local) pellets, or driftwood, but many locations rely on local forest harvesting. Forest regeneration is an important element of sustainable forest management and with a changing climate, there is much uncertainty about natural forest regeneration and planting trees in remote locations could be cost prohibitive. Poplar, aspen, and willows stump sprout abundantly after harvest and can be fast growing, while spruce and birch do not stump sprout and grow more slowly. Most of the woody biomass needed for energy will likely be harvested in winter, and if lacking reforestation efforts, spruce and birch forest types can become dominated by smothering grass and herbaceous vegetation for decades. The Alaska Forest Resources and Practices Act requires reforestation within seven years of timber harvest. Hence, inexpensive reforestation is critical to support woody biomass energy sustainably in Alaska.

Stooling beds are perennial hedgerows commonly used for stem cuttings (whips) to grow trees in the nursery industry. Stooling beds can be harvested each year and will grow back from stump sprouts. The harvested whips can be planted directly into the ground, providing a low-cost and technically simple way to reforest. Stooling beds might be a solution for reforestation after harvesting in Alaska but more research is needed to see if the technique of directly planting cut whips will work in Alaska. Demonstration stooling beds should be near research facilities that are easily accessible for demonstration access.

The Alaska Energy Authority Emerging Energy Technology Fund program provided funding for the stooling beds project being conducted by the State of Alaska's Division of Forestry (in the Department of Natural Resources) and the UAF Forest Products Program, with a goal to adapt, demonstrate, and disseminate inexpensive reforestation methods applicable following woody biomass harvest.

The project's staff harvested more than 4,000 stem cuttings from balsam poplar (*Populus balsamifera*) growing in Palmer and Delta Junction in March of 2013 and stored in a freezer. We soaked the unrooted stem cuttings for a week in late May/early June and planted them in mid-June 2013. We planted logged sites in Matanuska-Susitna Valley (five) and Delta Junction (five) with cuttings. We planted stooling beds that will serve as parent material for future cuttings at two locations, one each in Delta Junction and Palmer, where UAF has research sites with available land. At the Delta Junction and Palmer sites, we planted stooling beds of hyprid poplar, using cultivars of Green Giant, Okanese, and Hill obtained from Canada. We evaluated all planted stems for growth and survival at the end of the growing season.

Anomalous weather conditions during the spring and summer of 2013 didn't bode well for the propagation and survival of the whips. A late spring snowstorm and cold conditions delayed planting in the spring, and record-breaking heat and low precipitation induced drought stress over the growing season. Later, an early frost in Delta Junction adversely affected the planted hybrids.

Most of the planted whips started sprouting early in the summer but many were shriveled and brown by the end of the summer. Survival overall on the logged sites was about 10%. Sites that had more moisture had a higher success rate and one site had 45% survival.

The stooling beds at the research sites were watered periodically and many survived the heat. Most of the hybrid whips sprouted and were growing much faster than the local

Delta Junction Research Site, first week of June 2014. Cutting origin was marked by colored flags. In addition to balsam poplar cuttings from Delta Junction, Fairbanks, Glennallen, and Palmer, and Alberta, Canada, hybrid poplars from Alberta were also planted, for a total of five different balsam poplar provenances and one hybrid.
—Photo by Valerie Barber

Planting whips at a logged site. Left, Jeff Graham. On the right, Jim Smith of the Alaska Department of Natural Resources.
—Photo by Valerie Barber

balsam poplar throughout the growing season, but Delta Junction had an early frost and most of the hybrids were killed.

The study will continue this year (2014). Cuttings were taken in March from Delta Junction, Fairbanks, Palmer, and Glennallen. The thought is to expand the collection area to try to get more plasticity in the gene pool. Whips collected from each area will be planted at the Delta Junction and Palmer logged sites and at the research sites. A collection of all provenances will also be sent to Galena where a graduate student will plant the cuttings, develop a research project, and monitor survivability. A new biomass CHP system will be installed in Galena in 2015 that will be fueled by local logging efforts so low-cost and simple reforestation techniques are needed there.

We will also collect some survivors from each of the sites and take them back to Palmer. These might have greater gene plasticity that allowed them to survive drought, heat, and unpredictable frost, and if we can grow them, we might have trees that are better adapted for a warming Alaska. It might also be possible to create a hybrid poplar that can withstand the greater heat and drought that we are experiencing in Alaska.

While the hybrids used in Alaska grew better than the local balsam poplar, there is still a problem with phenology (budset and senescence) and with photoperiod. The light regime in Alaska is very different than lower latitudes. The hybrids that were damaged by the early frost did not harden off as early as the Alaska balsam poplar and thus still retained their leaves when the temperature dropped, while the Alaska trees had already lost theirs.

To alleviate this problem, we plan to develop an Alaska balsam poplar hybrid that will better adapt to the changing climate. The results will be documented, published, presented, and available for demonstration site visits. Results will be applicable to communities in boreal forest regions worldwide.

References

Agriculture and Agri-Food Canada. 2006. Hybrid Poplar Clones for Saskatchewan. Information for this factsheet was compiled from "Hybrid Poplar Plantations for Farm Diversification in Saskatchewan," Agriculture Development Fund Project 20010048 - Final Report - January 2006.

Thomas D. Landis and Tara Luna. Summer 2007. Establishing, Culturing, and Harvesting Stooling Beds. *Forest Nursery Notes*. Available on line at: www.rngr.net/publications/fnn/2007-summer/articles/establishing-culturing-and-harvesting-stooling-beds. RNGR. USDA Forest Service.

Thomas D. Landis and Tara Luna. Winter 2007. New Stock Types and Species from Stooling Beds. *Forest Nursery Notes.* Available on line at: www.rngr.net/publications/fnn/2007-winter/articles/new-stock-types-and-species-from-stooling-beds. RNGR. USDA Forest Service.

Matthew S. Olson, Nicholas Levsen, Raju Y. Soolanayakanahally, Robert D. Guy, William R. Schroeder, Stephen R. Keller and Peter Tiffin. 2013. The adaptive potential of *Populus balsamifera* L. to phenology requirements in a warmer global climate. *Molecular Ecology.* 22(5): 1214–1230, March 2013. DOI: 10.1111/mec.12067.

Raju Y. Soolanayakanahally, Robert D. Guy, Salim N. Silim, and Minghua Song. 2013. Timing of photoperiodic competency causes phonological mismatch in balsam poplar (*Populus balsamifera* L.). *Plant, Cell and Environment* 36, 116–127.

Diomides S. Zamora, Gary J. Wyatt, Kent G. Apostol, Ulrike Tschirner. 2013. Biomass yield, energy values, and chemical composition of hybrid poplars in short rotation woody crop production and native perennial grasses in Minnesota, USA. *Biomass & Bioenergy.* Vol. 49, Feb. 2013, pp. 222–230. Available on line at: http://dx.doi.org/10.1016/j.biombioe.2012.12.031.

Agronomic Crops for Biofuel Production in Alaska

Bob Van Veldhuizen and Mingchu Zhang

Barley for Biofuel Production

Barley is the most important cereal grain crop grown in Alaska and is well adapted to the state's long day length and short growing season. Although it is used primarily as an animal feed, both the harvested grain and straw can also be used as a biofuel source. An advantage of barley grain for biofuel is that it would require very little modification to typical pellet stoves for conversion to use grain as the biofuel source. There are several concerns with barley as a fuel source, however, such as moisture in the harvested grain, high ash content, high nitrogen content, and rough awns posing a hazard to animals.

Most barley varieties grown in Alaska have been the six-row types, which usually mature earlier and are more uniform at harvest than the two-row types. Early-maturing six-row barley varieties usually produce three to four tillers per plant that often reach maturity, increasing yields at harvest. Two-row varieties, which mature later, often produce many tillers, even late in the growing season. These late tillers may be immature at harvest when the main head is ripe. When the main head is harvested, the late tillers' wet plant material is mixed in with the ripe seed, increasing drying costs and reducing the quality of the grain for use as a biofuel.

The optimum moisture level in grain at harvest is around 14%, but this can range from as low as 12% to as high as 20%. Within this moisture range, barley grain will have a net heating value of between 6,000–8,200 BTU/lb (Clark et al. 2011). This moisture will volatilize during combustion, decreasing the energy produced. It will also have a negative impact on the metering of the grain from storage bins into the combustion chamber by bridging and plugging up transfer equipment. Higher moisture also means that the grain must be dried prior to storage.

After combustion, the material left over is the ash. Barley grain contains between 3.0–6.0% ash, much higher than wood products, which can range from 0.5–3.0% (Finnan and Caslin 2007). Contained in the ash are concentrated levels of potassium, sodium, chlorine, and silicon, as these elements do not volatilize during the combustion process. These elements tend to increase the ash content of grains and lower the melting temperature of the ash (Finnan and Caslin 2010). Barley grain has an ash melting temperature of between 1,300–1,800°F, compared with that of wood, which is around 2,300°F (Finnan and Caslin 2007). This lower temperature causes an increase in the formation of lumps of congealed ash or "clinkers" in the combustion chamber as well as condensing on the heat transfer surfaces in the boiler chamber, reducing the effectiveness of the boiler and requiring more boiler maintenance for proper efficiency.

'Wooding' barley growing at the Fairbanks Experiment Farm. Each grain is covered with a long rough awn.
—Photo by Robert Van Veldhuizen

Of additional concern is the nitrogen content of the grain. Nitrogen is the element needed in the highest concentrations for maximum yield and quality of the grain at harvest. During the combustion process these nitrogen compounds (proteins) are converted into nitrous oxides (NOx) and released into the atmosphere with the rest of the flue gasses. Immature, unripe grain will contain higher amounts of biomass nitrogen as well as a higher moisture content. This potentially reduces the efficiency of the combustion and increases the amount of ash and nitrous oxides.

Most barley varieties have a long rough awn attached to the hull surrounding the kernel. These rough awns are barbed in one direction, a holdover genetic trait from wild barley that may have helped to ensure seed dispersal by animals. If left on grain or found in straw, the awns do not have any impact on its use as a biofuel even though they are not desireable in a crop used as animal feed or bedding.

Barley straw is around the same moisture content of the grain at harvest, but because it is less dense than the grain, it will have slightly lower net heating values of between 6,000–7,500 BTU/lb and similar ash content of between 4.8–5.9%

(Caslin and Finnan 2010, Clark et.al. 2011). One advantage of straw over grain is the lower levels of potassium, sodium, chlorine, silicon, and nitrogen contained in the ash. There are still much higher levels of ash over that of wood products but the overall production of clinkers and scale deposits on the heat transfer surfaces will be lower than that produced by grain. The straw is usually left in the field for a time before it is baled and removed for future use. The weathering process tends to leach many of these elements out of the biomass, resulting in a lower incidence of clinker and scale formation. Unfortunately, the harvesting process for straw collection often accumulates significant amounts of soil in with the biomass. The mineral fraction of soil does not combust, leading to an increase in the formation of clinkers and residue accumulation, and thus increasing maintenance costs. Also, the straw would need to be processed into pellets to be fed into the combustion chamber, or the biomass furnace metering system would need to be modified to be able to feed straw bales. Either option would increase costs of operation.

Canola and Rapeseed for Biofuel Production

Rapeseed (from the Latin *rapum*, meaning turnip) is an annual or biennial industrial oilseed crop specifically developed for the lubrication and biofuel markets. There are two types of rapeseed, Polish or turnip rape (*Brassica rapa* or *Brassica campestris* L.) and Argentine rape (*Brassica napus* L.). Polish rapeseed is a mid tall, multibranched, annual, spring, cool-season, broadleaved oilseed plant. It is earlier maturing than the Argentine type by two to three weeks and requires about the same growing season length as barley. This makes the Polish types the best-suited oilseed for Alaska growing conditions. Rapeseed contains between 35–40% oil by weight. The oil contains high levels of erucic acid (30–60%) that can cause heart lesions and high levels of glucosinolates (30–40 micromoles per gram) that can cause goiters when fed to animals (Canola Council of Canada 2000). Because of the high levels of erucic acid and glucosinolates, rapeseed oil is valuable as a biofuel, but is unsuitable for the food and feed markets.

Canola is an edible oilseed crop specifically selected and bred from rapeseed to be low in erucic acid (2% or less) and glucosinolates (less than 30 micromoles per gram). In order to differentiate this new edible oil from the industrial oilseed rapeseed, the Canadian Oilseed Association used the first few letters of their association name, Can+Ol+A, or canola. Canola seed, like rapeseed, contains between 35–40% oil by weight. Canola oil is lower in saturated fats at 6% than any other vegetable oil with a favorable mix of mono- and polyunsaturated fats making it a high value cooking oil (Canola Council of Canada 2000).

Canola and rapeseed oil are obtained by a combination of pressing and solvent extraction of the mature seed. The best of the commercial oilseed presses is only capable of extracting about half of the oil contained in the canola seed, or about 20% by weight. The remaining half of the oil that remains in the meal is extracted with a hexane solvent process. The solvent is then removed from the oil, which is blended in with the pressed oil and everything is run through a filtration and cleaning process which yields about three quarters of the oil or about 30% by weight. Canola oil for the edible market can't contain more than 2% green seed. Green seed is immature seed containing chlorophyll which imparts a green color to the oil and shortens the shelf life by turning rancid quickly. Canola and rapeseed oil can be used after extraction as a biofuel either directly or after a chemical refining process that uses methanol and potassium hydroxide to remove water and glycerol from the oil. The biodiesel yield from this process is only about 80% of the oil yield.

Canola oil has a net heat value of between 16,000–17,500 BTU/lb depending on the maturity and quality of the harvested seed prior to pressing (Adams, et.al. 2006). The resulting canola meal after processing is a high-protein supplement for animal diets that contains around 5% oil by weight. The meal has a net heat value of between 8,700–12,200 BTU/lb (Porter and Crompton 2008, Clark et.al. 2011). Canola meal is higher in ash content than barley grain at about 6.0–6.5% ((Porter and Crompton 2008). In addition, there are comparable levels of potassium, sodium, chlorine, and silicon which tend to increase the ash content of the meal, lower the melting temperature of the ash (Finnan and

Canola blossoms and honeybee at the Fairbanks Experiment Farm.
—Photo by Robert Van Veldhuizen

Caslin 2010, Clark et.al. 2011), and increase the formation of clinkers in the combustion chamber as well as condensing on the heat transfer surfaces in the boiler chamber reducing the effectiveness of the boiler. Similar to barley grain, this will require more boiler maintenance for proper efficiency.

Depending on the percentage of green seed at harvest, the nitrogen content of canola meal is close to two times higher than for barley grain. This increases the amount of nitrous oxides (NOx) that can be formed and released into the atmosphere with the rest of the flue gases during the combustion process. More problematic than barley grain, immature, unripe canola will contain higher amounts of biomass nitrogen as well as a higher moisture content. This potentially reduces the efficiency of the combustion as well as increases the amount of ash and nitrous oxides.

Canola straw contains high levels of glucosinolates, around 5–20 micromoles per gram (Canola Council of Canada 2000). As mentioned previously, these glucosinolates can cause palatability and nutritional problems if fed to livestock or poultry. However, glucosinolates have a positive allelochemical effect that inhibits growth of some species of weeds, nematodes, insects, and soil-borne plant diseases in the field the following year. For this reason, the biomass would have greater value for crop rotation when returned to the soil rather than used as a biofuel source. Canola straw does have a net heat value of between 6,100–7,000 BTU/lb with an ash content of between 4.5–6.2% (Caslin and Finnan 2010, Clark et.al. 2011). Canola straw contains lower levels of potassium, sodium, chlorine, silicon, and nitrogen in the ash than grain straw. There will still be higher levels of ash over that of wood products but the overall production of clinkers and scale deposits on the heat transfer surfaces will be lower than that produced by grain straw. However, the same issues that affect the collection of barley straw for use as a biofuel also affect canola straw. There are additional problems with the collection of canola straw that further limit its use as a biofuel. Canola straw is very light in density compared to barley straw and can be blown across fields and lost before collection. The stems are much more brittle at maturity and tend to break into smaller pieces during combining. These small pieces are much more difficult to collect without also accumulating significant amounts of soil in the process.

Table 1. Average yield and quality of barley grown in interior Alaska

Barley Variety Name	Source	Seed Yield (lbs/ acre)	Seed Yield (bu/ acre)	Seed Test wt. (lbs/ bu)	Net Heat Value[1] (BTU/lb)	Straw Yield (lbs/ acre)	Net Heat Value[1] (BTU/ lb)	Lodging (%)	Average Maturity Date	Average Maturity (GDD)[2]
Albright	Alberta	4,524	94	49	8,200	1,706	6,990	53	26 July	1,947
Finaska	Alaska	3,360	82	47	7,173	1,316	6,590	18	25 July	1,919
Otal	Alaska	3,841	80	48	8,100	1,113	6,590	35	27 July	1,975
Weal*	Alaska	3,282	68	43	7,007	7,874	7,500	35	26 July	1,647
Wooding	Alaska	3,783	79	48	8,076	1,774	7,000	40	25 July	1,919

1. Net Heat Values for barley seed and straw were not measured in this study. Values were calculated by multiplying yield data and average BTU/lb published in Finnan and Caslin (2007), and Caslin and Finnan (2010).

2. GDD, growing degree days are the cumulative average temperatures above 32°F to reach 50% maturity.

* 'Weal' is a hooded forage variety.

Table 2. Average yield and quality of Polish canola grown in interior Alaska

Canola Variety Name	Source	Seed Yield (lbs/ acre)	Seed Yield (bu/ acre)	Seed Test wt. (lbs/bu)	Net Heat Value[1] (BTU/lb)	Oil Yield (gal/ acre)	Net Heat Value[1] (BTU/lb)	Lodging (%)	Average Maturity Date	Average Maturity (GDD)[2]
Deltana*	Alaska	1,583	32	49	11,150	41	13,422	40	16 Aug	2,511
Reward	Manitoba	1,522	30	48	11,111	39	13,353	77	14 Aug	2,460
Sunbeam	Alberta	1,432	29	50	11,189	37	13,665	93	5 Aug	2,225

1. Net Heat Values for canola were determined in Agricultural and Forestry Experiment Station research at the University of Alaska Fairbanks using a bomb calorimeter on the pressed oil and resulting meal which contained 10% oil by weight.

2. GDD, growing degree days are the cumulative average temperatures above 32°F to reach 50% maturity.

* 'Deltana' is an open pollinated experimental variety.

References

Adams, J., C. Cassarino, J. Lindstrom, L. Eslin, S. Lux, and F. Holcomb. 2006. *Canola Oil Fuel Cell Demonstration, Volume III– Technical, Commercialization, and Application Issues Associated with Harvested Biomass*. US Army Corps of Engineers, Engineer Research and Development Center, Washington, DC.

Canola Council of Canada. 2000. Canola Growers Manual, Chapter 2 – Canola Varieties. Winnipeg, Manitoba. Available on line at: www.canolacouncil.org/crop-production/canola-grower%27s-manual-contents/chapter-2-canola-varieties/ (accessed on Feb 18, 2014).

Caslin, B. and J. Finnan. 2010. Straw for Energy. Teagasc, The Irish Agriculture and Food Development Authority, Oak Park, Carlow, Ireland. Available on line at: www.teagasc.ie/publications/2010/868/868_strawforenergy.pdf (accessed on Feb 18, 2014).

Clark, S., P. Eng, and F. Preto. 2011. Biomass Burn Characteristics. Ontario Ministry of Agriculture, Food and Rural Affairs. Guelph, Ontario. Available on line at: www.omafra.gov.on.ca/english/engineer/facts/11-033.pdf (accessed on Feb 18, 2014).

Finnan, J. and B. Caslin, B. 2007. Cereal Grains as a Boiler Fuel. Teagasc, The Irish Agriculture and Food Development Authority, Oak Park, Carlow, Ireland. Available on line at: www.teagasc.ie/publications/2010/861/861_Cereal%20GrainsAsABoilerFuel.pdf (accessed on Feb. 18, 2014).

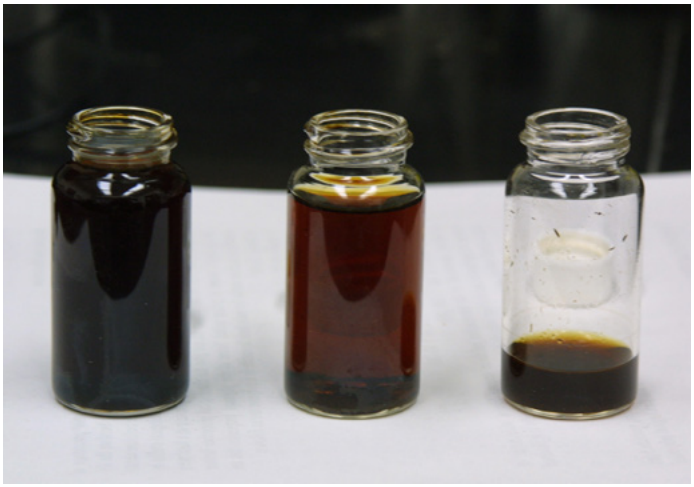
Porter, P. and D. Crompton. 2008. Cold Pressed Canola: A Biodiesel Option. North Central RC&D Conference, Rochester, Minnesota. Available on line at: www.mgwa.org/meetings/2008_spring/2008_spring_crompton.pdf (accessed on Feb. 18, 2014).

Salcha/Delta Soil and Water Conservation District. 2011. Delta Barley for Fuel Makes Sense for Interior Alaska. A Proposal for a Biomass Project at Fort Greely. Salcha/Delta Soil and Water Conservation District. Delta Junction, Alaska. Available on line at: www.salchadeltaswcd.org/images/Barley_for_Fuel_v14.pdf.

Van Veldhuizen, R.M. and C.W. Knight. 2004. Performance of Agronomic Crop Varieties in Alaska 1978–2002. Bulletin 111. Agricultural and Forestry Experiment Station, University of Alaska Fairbanks, Fairbanks, Alaska. Available on line at: www.uaf.edu/snre/research/publications/.

Zhang, M. and B. Van Veldhuizen. 2010a. Growing *Brassica rapa* in Interior Alaska. Poster presentation, National Canola Research Conference, US Canola Association, Long Beach, California. 2 November 2010.

Zhang, M. and B. Van Veldhuizen. 2010b. Canola Harvest Methods in Relation to Oil Quality – Delta Junction. Presentation of Results at the Delta Harvest Wrap-Up. Agricultural and Forestry Experiment Station, University of Alaska Fairbanks, Fairbanks, Alaska. December 2010.



Bio-oils made from different Alaska trees, using supercritical fluid liquefaction. Left to right: birch, alder, and Sitka spruce.
—Photo by Juan Andres Soria

Drop-in Biofuels

From the Department of Energy's Alternative Fuels Data Center website:

> "Drop-in biofuels are hydrocarbon fuels substantially similar to gasoline, diesel, or jet fuels. These fuels can be made from a variety of biomass feedstocks including crop residues, woody biomass, dedicated energy crops, and algae.The goal for drop-in fuels is to meet existing diesel, gasoline, and jet fuel quality specifications and be ready to "drop in" to existing infrastructure by being chemically indistinguishable from petroleum derived fuels. This minimizes infrastructure compatibility issues, which are a barrier to fast commercialization of biofuels like ethanol and biodiesel. Drop-in fuels are in a research and development phase with pilot- and demonstration-scale plants under construction. The current focus is aimed at replacing gasoline, diesel, and jet fuel, which may fuel vehicles that aren't good candidates for electrification."

(See www.afdc.energy.gov for more information.)

Researchers are developing drop-in fuels using various methods, among them pyrolysis or liquefaction of biomass to bio-oil with hydroprocessing, catalytic conversion of sugars to hydrocarbons, fermenting sugars to hydrocarbons, hydrotreating algal oils, upgrading syngas from gasification, and upgrading alcohols to hydrocarbons. At the Matanuska Experiment Farm, former Associate Professor of Wood Chemistry and Applied Environmental Science and Technology J. Andres Soria* and graduate students employed catalytic pyrolosis and liquefaction procedures to create complex hydrocarbons for drop-in fuels.

* Editor's note: Dr. Soria is now with Pacific University in Oregon. He may be reached at (503) 352-2446 or jasoria@pacificu.edu.

Catalytically Upgrading Bio-oil

J. Andres Soria, PhD and Theodore Dickerson, MSc

We carried out the conversion of different biomass streams into fuel products at the Palmer Center and included the transformation of lignocellulosic biomass into drop-in fuels, or direct alternatives to gasoline and diesel via catalytic pyrolysis pathways using a novel small-scale microreactor. The novel reactor system included a modified SGE Australia pyrojector unit that was fitted with a series of valves that allowed for different gases to be employed and investigated. (An SGE pyrojector is a brand of microfurnace pyrolysis injector used for capillary gas chromatography.) The reaction chamber was fitted with a glass wool plug that kept the catalysts in place. The catalysts used were metallic forms of nickel, cobalt, palladium, and ruthenium (obtained from Acros Organics).

For our biomass, we used sawdust from locally sourced alder *(Alnus rubra)*, birch *(Betula neoalaskana)*, and black spruce *(Picea mariana)*, and introduced it into the reactor system by means of a sealed plunger unit. The reaction chamber, already containing the catalyst, was kept at 500°C by an electronically control system. The reaction chamber was purged and pressurized with hydrogen gas and maintained under these conditions for several minutes. Once the reaction time was completed, a valve allowed the gases to enter a gas chromatography/mass spectrometry unit that separated the chemicals produced based on their boiling point. We identified the compounds using computer software and compared the spectra that were produced to gasoline and diesel boiling point chemicals.

The results of this experimental setup are encouraging, as all Alaska species investigated were able to produce chemical profiles that matched the boiling point range of chemicals found in gasoline and diesel fuels. The small-scale reactor approach allowed the investigation to be done at a much reduced cost and with a faster response time than doing the work at scale. However, to validate the results we did scale up the alder wood upgrading using a pilot-scale pyrolysis unit to produce bio-oil. The bio-oil was then transferred into a Parr Instrument Company 7340 series vessel which was purged with hydrogen gas and sealed in the container containing the catalyst. The vessel was pressurized to 3,500 psig by raising its internal temperature to 400°C and kept there for several minutes. Once the reactor was quenched, the liquid content was removed and transferred to a gas chromatography/mass spectrometry vial.

The results show that the alder upgrading products match the boiling point range of diesel and gasoline, further vindicating the work of the microreactor. This is the first reported Alaska biomass-based drop-in fuel study and opens the door for further work to be done using the microreactor unit as well as the pilot-scale pyrolysis unit.

Liquefaction of Potatoes Using Supercritical Water

J. Andres Soria, PhD and Magdalena King, MSc

There are several possibilities for converting biomass into chemicals and fuels as well as using different sources of biomass for the conversion. In Alaska, we are capable of using various woody and lignocellulosic biomass streams for conversion, but also, we can use food matter that has gone bad. Using cull potatoes offers a unique opportunity to use an agronomic resource that can be grown locally, and that can be used to produce a drop-in fuel in the form of a chemical compound called 5 hydroxymethyl furfural (5HMF).

To produce this chemical we used supercritical water, which is pressurized and heated water that is raised to and above 374°C and 3,200 psig. (When a fluid reaches a supercritical state, the temperature and pressure are so high that distinct liquid and gas phases do not exist.) We used a Parr Instrument Company reactor and an electronically controlled heating unit to do this. We collected different potato varieties from the Matanuska Experiment Farm's fields and reacted the biomass with pure water under supercritical conditions. Under these conditions, the starch of potatoes dissociated into sugars, which further converted into the chemical 5HMF, as well as other secondary compounds. We found that the 5HMF was unstable once the supercritical reaction was stopped. The concentration of 5HMF reached the highest concentration seconds after the reaction stopped and then it reduced rapidly to zero within a few hours. The 5HMF polymerized, that is to say, it reacted with itself and the other secondary chemicals produced under the supercritical state to produce very large molecules that resembled tannin and humin compounds. So, as the 5HMF concentration dropped, the tannin and humin type compounds increased to the point that they precipitated out of solution.

From a fundamental perspective, this work shows a potential pathway for producing value-added chemicals from cull potatoes, but the approach requires further refinements to stop the precipitation reactions from occurring, and more work to enable starchy food wastes to become sources of drop-in fuels and chemicals.

Andy Soria was a co-author on the 2011 National Academy of Sciences report, "Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuel Policy." He is shown here in 2011 with a small-scale gasifier, part of an experiment using fish waste and alder sawdust to create bio-oil.

—UAF photo by Todd Paris

FINDING THE DNA DIFFERENCE

Nancy Tarnai

Matthew Cronin, Research Associate Professor of Animal Genetics at SNRE, at Bird Creek September 2012.
—Photo courtesy Matt Cronin

Professor Matthew Cronin's life work is researching genetic relationships among large mammals, including bears, wolves, bison, Steller sea lions, and beluga whales.

The Yale-educated animal scientist was naturally drawn to the field of evolution and finds it equally satisfying to see results applied to the real world, whether in agriculture or resources management. "My work is very rewarding," Cronin said.

His most recent study on polar bears was published in the *Journal of Heredity* in January, "Molecular Phylogeny and SNP Variation of Polar Bears (*Ursus maritimus*), Brown Bears (*U. arctos*), and Black Bears (*U. americanus*) Derived from Genome Sequences."

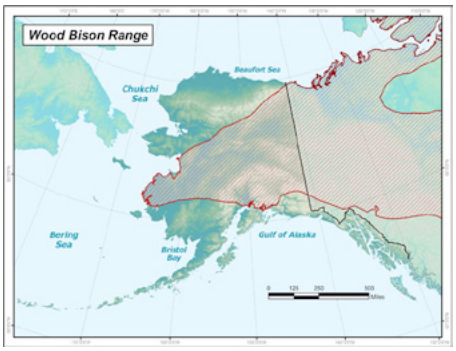
By studying DNA, Cronin estimated that 2.3 million years ago black bears diverged from polar and brown bear populations and 1.2 million years ago, polar and brown bears diverged. "This means polar bears have been a distinct species through previous periods of global warming," he said. This has important implications for the predictions of polar bears' extinction due to future global warming.

"I do DNA analyses," he said. "It's a simple observation [that polar bears have been around for previous periods of warming.] What does this mean for your predictions? I'm trying to be dispassionate. It's a simple question to which I'd like an answer."

In the study, Cronin and colleagues at the University of California Davis, Montclair State University in New Jersey, and Delta G Company analyzed genetic variation in more than 300 polar bears from Alaska, as well as genetic elements not used in earlier studies.

These are known as ultra-conserved elements, and show the polar and brown bears to be more closely related than either is to black bears.

The data was used in a "molecular clock" that uses the numbers of differences (mutations) in DNA sequences to estimate when the sequences, and hence the species, diverged. Utilizing labs at UC Davis, Cronin and technology experts pored over huge datasets and analyzed tissue samples from Montana and from Alaska's Admiralty, Baranof, and Chichagof islands, obtained from state and federal wildlife agencies. In



Wood bison are the largest native land mammal in North America, attaining weights as great as 1,200 pounds. While the wood bison is still known as Bison bison athabascae, *and is legally considered distinct from the plains bison,* B. bison bison, *this may change soon in light of the genetic research done by Cronin and his colleagues.*
—Photo and map courtesy Alaska Department of Fish & Game

recent years DNA science has improved so much that Cronin is able to study billions of nucleotides of DNA rather than the thousands he used to be limited to. "It's very advanced because of the applications in medicine and agriculture," Cronin said.

"The ramifications are that if the polar bear was an independent species for about 1 million years it survived previous cold and warm periods," Cronin said. "This means the polar bear has been an independent lineage a long time through glacial and interglacial and warm periods."

The last glacial period was at maximum extent about 22,000 years ago, and was preceded by a warm interglacial period about 130,000 years ago. Other warm and cold periods preceded that. Cronin thinks that if polar bears survived previous warm periods in which there was little or no arctic summer sea ice, this should be used in models predicting the species' response to current climate change.

"It seems logical that if polar bears survived previous warm, ice-free periods, they could survive another. This is of course speculation, but so is predicting they will not survive, as the proponents of the Endangered Species Act listing of polar bears have done."

In 2013, Cronin determined that wood bison and plains bison are not different subspecies. Wood bison from northwest Canada and plains bison from southern Canada and the Lower 48 have been designated as different subspecies, although scientists don't all agree that they should be. Wood bison are listed as an endangered subspecies, while plains bison are not. "This is important because the Endangered Species Act allows subspecies to be listed as species," Cronin said. "The ESA is mandated to use the best available science, so thorough assessment of the subspecies status is necessary." Cronin found that the animals in some plains bison herds are genetically more different from each other than some plains bison are from wood bison, yet those herds are not identifiable as two distinct groups. They also found that wood and plains bison are much more genetically similar than cattle subspecies and breeds, such as Angus and Texas Longhorn cattle.

The bison herds Cronin studied are located in Alaska, Montana, Utah, Wyoming, New York, Alberta, and the Northwest Territories and include plains bison in Alaska at Delta Junction, Chitina, Copper River, and Farewell, and wood bison at the Alaska Wildlife Conservation Center. Cronin emphasized that the term "subspecies" denotes a formal taxonomic category and that evolutionary history is a primary criterion for subspecies designation. For example, European cattle and tropical cattle have separate origins, are genetically distinct and thus have a scientifically supported subspecies designation. Wood and plains bison originally had contiguous ranges, were mixed in the 1900s and are not genetically distinct groups. These factors do not support subspecies designation, he said.

"My work replicates previous work," said Cronin. "I worked with different herds and got the same results, that they are not distinct subspecies."

It's common for wildlife to be named as subspecies without adequate evidence, Cronin said, often resulting in lack of consensus in the scientific community.

"This creates a paradox for biologists because subspecies can be designated by one author, rejected by another and still others reject the entire subspecies ranking," he said. "These factors make formal designation of bison subspecies a seemingly intractable taxonomic exercise."

Cronin said plains bison and wood bison should be considered geographic populations and not subspecies. "The bison subspecies are currently recognized by management agencies so their taxonomy needs to be assessed," Cronin said. "I hope that bison management across North America can be done in a practical manner and not by preconceived notions about subspecies."

Cronin's next project is comparing wolves in southeast Alaska to species across the country.

A recent letter to UAF officials from Governor Sean Parnell's chief of staff, Mike Nizich, praised Cronin's work. "I support Professor Cronin's initiative to coordinate states, counties, land grant universities, government agencies, and the agriculture and natural resource industries to ensure that good science and consistent policies are used in resource management and endangered species issues. His work on the…cattle breeding project, the Alaska Board of Forestry, and as an affiliate professor at Montana State University are integral parts of this effort."

Dr. Carol E. Lewis, retired dean of the school and director of the experiment station, said, "His science has been his exemplary weapon and his work has been accepted and lauded nationally and internationally. He is a spokesman against the extreme applications of the Endangered Species Act and his science has indeed spoken for him. He is one of the exemplars of scientists that the school and station have been able to attract with its multidisciplinary approach to sustainable management of Alaska's and the national and international resources that support the world's economy."

"It seems logical that if polar bears survived previous warm, ice-free periods, they could survive another."

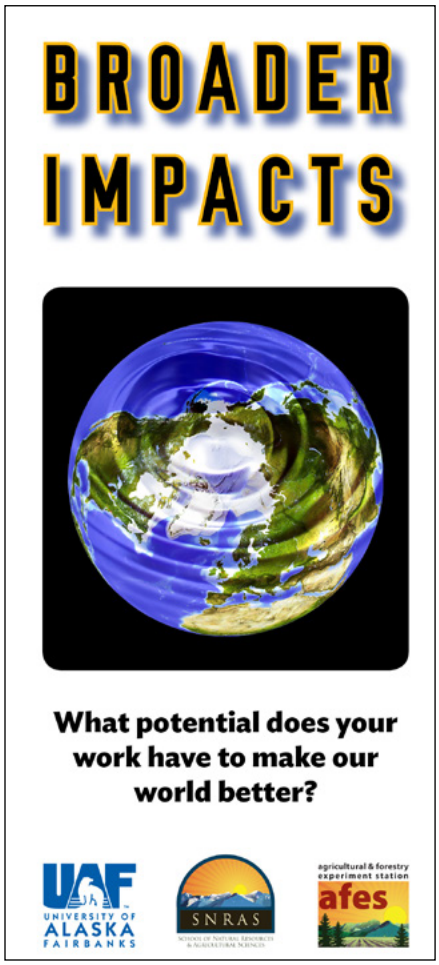
What are the implications of your research?

Starting the Broader Impacts conversation in Alaska

Meriam Karlsson and Jan Dawe

Natural Resources Graduate Seminar students who focused on the idea of Broader Impacts and developed a guideline for researchers and students, below. From left to right: Willie Wilkins, Tricia Kent, Bryant Wright, Christin Anderson, and Lauren Lynch with their poster at the EPSCoR annual meeting, held in Fairbanks in 2013.

—Photo by Nancy Tarnai



In 1997, the National Science Foundation began considering two components in its review and evaluation of research proposals: 1) Intellectual Merit and 2) Broader Impacts. Since that time, the difference between a project receiving funding and one denied has depended, in part, on the development and quality of an innovative Broader Impacts plan. The 1997 Broader Impacts criterion included the proposal's potential to:

- Integrate research and education,
- Broaden participation of underrepresented groups,
- Enhance infrastructure for research and education,
- Broadly disseminate scientific ideas and methods (enhance scientific literacy), and
- Be of direct benefit to society.

In October 2012, NSF issued a new version of its Grant Proposal Guide, and added three goals to the five Broader Impact elements stated above:

- Increase partnerships between academia and industry,
- Improve national security,
- Increase economic competitiveness of the US.

Today, the scientific community agrees that Broader Impacts are important, but opinions diverge widely about how best to forge closer connections, communication,

and understanding between researchers and society. In the fall of 2013, the School of Natural Resources & Extension graduate seminar (NRM 692) adopted Broader Impacts as its focus. The graduate students studied, discussed, and sought opinions about what Broader Impacts mean to various groups of researchers and fellow students. As well as gathering opinions about Broader Impacts, they were also interested in examples of broader impacts from various research fields.

For the 2013 Alaska EPSCoR annual meeting (Oct. 23–24: Fairbanks), the NRM 692 students developed two questions about Broader Impacts:

- What does "Broader Impacts" mean to you?
- Have you used Broader Impacts in your research and, if so, how?

The 2013 EPSCoR meeting was a particularly well-suited venue to gauge views on Broader Impacts in scientific communities. Alaska EPSCoR was in the process of ending the first year of the five-year project, "Alaska Adapting to Changing Environments," and is centrally engaged with Broader Impacts work. The students were available at the meeting to introduce the questions and encourage conversations on Broader Impacts in various types of research and science-related studies with local to worldwide scope. The meeting participants were asked to reflect on the two questions and record their impressions and responses on sticky notes. These were grouped by theme on the poster, creating an interactive display titled "Starting the Broader Impacts Conversation in Alaska."

Based on the weekly seminar discussions and the outcomes from the EPSCoR meeting, the students developed a Broader Impacts brochure at the end of the semester (AFES Miscellaneous Publication MP 2013-07). In this brochure, the students conclude that "Broader Impacts" refer to the potential of one's work to benefit society. A person can help achieve important, relevant outcomes such as improved well-being of the local community, sustaining healthy ecosystems, increased scientific literacy in one's community, increased public engagement, developing a diverse and competitive workforce, partnerships among academia, industry and community, and bridging gaps in cultural understandings. Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project.

The students concluded that people should consider the broader impacts of their research work because all work needs support. Granting agencies want to know why an idea is important, and how it will affect the community and beyond. Being able to identify and articulate the potential impacts of one's work can help one get the support one needs to get the ball rolling and make a real difference in the world.

Summit Two

The importance the students placed on broader impacts during the 2013 seminar is mirrored by recent developments at the national level. In April 2014, the second Broader Impacts Infrastructure Summit was held in Arlington, Virginia. More than 120 members of the national Broader Impacts community attended the summit to work on three goals:

- Increase collaboration among broader impacts professionals,
- Enhance broader impacts scholarship, and
- Influence policy regarding broader impacts.

As a result of the 2014 summit, a national framework of the Broader Impacts and Outreach Network for Institutional Collaboration (BIONIC) has been established with funding from NSF's Directorate for Biosciences. Four institutions will coordinate BIONIC's activities.

More information about Broader Impacts:

Because A Little Bug Went Kachoo (this animated children's story illustrates the idea of broader impacts to young students): www.youtube.com/watch?v=pfxf_iwS4Nc

The Florida Museum of Natural History and the University of Florida are now offering a graduate course dedicated to the topic: "Broader Impacts of Science on Society," covering the history, theory, relevance, and best practices of broader impacts and related activities through a participatory blended learning environment. Intended participants include graduate students from any STEM (science, technology, engineering, and mathematics) discipline, including (but not limited to) anthropology, astronomy, botany, entomology, geology, science education, wildlife, and zoology. Advanced undergraduates are also welcome. It is set up to allow external participants, so students from anywhere can join the course on line. (For more information, contact Bruce McFadden at bmacfadd@flmnh.ufl.edu.)

NRM 692 Broader Impacts guide (MP 2013-07): www.uaf.edu/research/publications/

NSF broader impacts guidelines: www.nsf.gov/pubs/2007/nsf07046/nsf07046.jsp

Ideas for NSF broader impacts statements: www.txstate.edu/research/Resources/develop-proposal/nsf.html

Reports from the Broader Impacts Infrastructure summits: www.broaderimpacts.net

Woods Hole Broader Impact Group: www.whoi.edu/page.do?pid=122856

Fred Schlutt is Vice Provost for Outreach & Director of Extension, now working with Interim Dean of SNRE and Interim AFES Director Stephen Sparrow to lead the newly merged School of Natural Resources & Extension.
—CES FILE PHOTO

School and Extension merge

As of July 1, the School of Natural Resources & Agricultural Sciences and the UAF Cooperative Extension Service merged into one unit. The goal of the merger is to strengthen the research, teaching and outreach missions of both units. Stephen D. Sparrow, interim dean of the school and interim director of the Alaska Agricultural & Forestry Experiment Station, and Fred Schlutt, vice provost for outreach and director of Extension, will lead the newly named School of Natural Resources & Extension.

The collaborative structure is common at many land-grant institutions around the nation. UAF is Alaska's land-grant university, designated by the state to receive the benefits of the Morrill Act of 1862 and the Hatch Act of 1887.

"Each unit carries out different aspects of the land grant mission," Sparrow said. "By merging we'll more effectively carry out that mission for the entire state of Alaska."

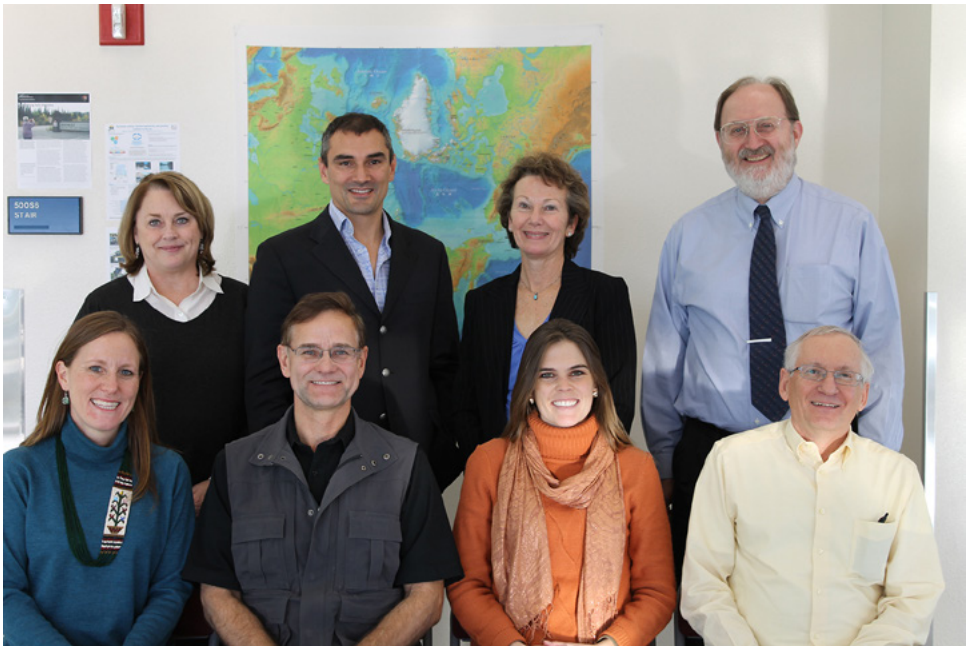
AFES has four major research sites: Fairbanks, Delta Junction, Palmer and the Seward Peninsula. Extension has offices in Fairbanks, Anchorage, Bethel, Delta Junction, Palmer, Juneau, Kenai Peninsula, Nome and Sitka. Extension also serves Alaska Natives through its Federally Recognized Tribes Extension Program administered through Tanana Chiefs Conference and the Bristol Bay Native Corp.

Schlutt noted that constituents of both entities should not notice a change in service, however there may be opportunities for additional services as the units become fully integrated.

"We are hoping for better cooperation and communications between research and Extension faculty," Schlutt said.

Advisory Council

The school now has an Advisory Council, formed in fall 2013 by the direction of Interim Dean and Director Stephen D. Sparrow. Council members are Anna Atchison, community and government relations manager, Fort Knox Mine; Christi Bell, director UA Center for Economic Development; Craig Fleener, recently resigned deputy commissioner Alaska Department of Fish and Game and now a candidate for political office; Roberta Graham, assistant commissioner Alaska Department of Commerce, Community and Economic Development; Glenn Juday, professor



Advisory Council members, left to right. Top row: Robbie Graham, Craig Fleener, Nancy Tarnai, Glenn Juday. Bottom row: Christi Bell, Bryce Wrigley, Maggie Rogers, Stephen Sparrow. Not pictured: Anna Atchison.
—AFES FILE PHOTO

Vet-med program faculty include Karsten Hueffer, Associate Professor of Microbiology and Comparative Biomedical Sciences; Lisa Lunn (left), Associate Professor of Large Animal Cooperative Extension and Food Animal Medicine; Todd O'Hara, Professor of Toxicology and Pharmacology, Wildlife Disease; Ors Petnehazy, Associate Professor of Anatomy and Diagnostic Imaging, and Arleigh Reynolds (above, at the 2014 Fur Rondy), Associate Professor of Veterinary Nutrition. For more information on the vet-med program and the pre-vet med track, please see www.uaf.edu/vmed/.

—Lund image Vet-Med file photo
—Reynolds photo courtesy Diane Hirshberg

of forest sciences, SNRAS/AFES (faculty representative); Maggie Hess, environmental impact analyst for the Alaska Department of Transportation and Public Facilities; Stephen Sparrow, SNRAS/AFES interim dean and director; Nancy Tarnai, SNRAS/AFES public information officer (staff representative); and Bryce Wrigley, owner Alaska Flour Co., president Alaska Farm Bureau, district manager Salcha-Delta Soil and Water Conservation District.

Atchison, Bell, Fleener, and Hess are SNRAS alumni and Graham is currently an interdisciplinary PhD student.

The council has met three times. Sparrow said he looks to the group to provide input and to advocate for the school and station.

Geography moves to CNSM

The geography department, which has been housed within the UAF School of Natural Resources and Agricultural Sciences for 15 years, will move to the College of Natural Science and Mathematics July 1. Geography will become part of the Geology and Geophysics Department.

UAF offers a bachelor of arts and a bachelor of science in geography. The program has 30 undergraduate students.

"This is best for the geography program in the long run," said Department Chair Cary de Wit. "It's difficult to break formal ties with people I respect and have enjoyed working with. I hope we will continue to work together in various ways."

Eventually, the geography professors will relocate from O'Neill Building to the Reichardt Building, but the move could take a while. "We are working toward a smooth transition for the students," de Wit said.

SNRE Interim Dean Stephen Sparrow said, "We hate to see our geography colleagues leave but we wish them the best."

Degree program streamlined; pre-veterinary medicine track added

SNRE has eliminated the three options (forest sciences, high latitude agriculture, humans and the environment) under the bachelor of science degree and honed in on natural resources management. Students who began their studies under the options will be allowed to complete their degrees in the area they began in.

A new pre-veterinary medicine track emphasizing agriculture and natural resources for undergraduate students has been added. A new three-credit course, introduction to sustainable agriculture, will be added for fall semester. Professors Milan Shipka, Meriam Karlsson, and Mingchu Zhang will teach the course. Other courses, such as animal science and sustainable livestock production, will be offered.

Retirements

Congratulations to two longtime employees for their retirements. Tom Malone stepped down in April after 31 years as a research forester and Grant Matheke also in April after 35 years as a research technician.

Malone monitored 603 sites in a research area the size of Michigan and Ohio combined, alongside summer workers, student interns and volunteers. Each field season he had from three to nine people on his crew, working eight days on, six days off. Not only did he hire and train these young people, he and his wife Karen housed 43 international forestry students in cabins on their property.

He plans to fish more often, stay active and travel.

Matheke's legacy is seen everywhere at the Georgeson Botanical Garden, as he helped design and build it, handling the landscape construction and experimental design for vegetables and peonies. He planned and installed an automated sprinkler system and built all but two of the garden structures. Data analysis was another big area of his job.

His plans are to spend more time camping and canoeing.

"Tony is one of the most dedicated, passionate individuals I know."

Gasbarro showing off the certificate at the Spring Picnic. The photo on the award for his volunteerism shows him surrounded by the Peace Corps students he has worked so much with at UAF.
—Photo by Nancy Tarnai

Outstanding volunteer honored

At the SNRE spring picnic May 2, Tony Gasbarro was honored for outstanding volunteerism. Ten years ago, Gasbarro helped start the Master's International Program at UAF and more recently the Paul G. Coverdell Fellows program. He has worked tirelessly to grow the programs for SNRE, working with Associate Professor Susan Todd. The two programs have grown so much that there is always a waiting list of students wanting to get involved.

"Tony is one of the most dedicated, passionate individuals I know," said Erin Kelly, UAF's first MIP graduate. "He genuinely cares about the well-being of others and does all that he can to help improve the quality of life of all those he encounters. Tony has touched countless lives through his volunteer work in El Salvador and as a professor at UAF. He is an inspiration for so many people. Seeing his numerous acts of compassion has empowered me to always challenge myself, to strive to be a better person and to serve those in need."

CES relocates to Matanuska Experiment Farm

The Mat-Su Copper River District Office of the UAF Cooperative Extension Service has relocated to the Matanuska Experiment Farm in Palmer. The new space has a larger classroom and access to the videoconference network for teaching opportunities. It is also the first major move toward physically merging the School of Natural Resources and CES.

CES personnel now based at the farm are:

Winona Benson - Nutrition Educator/ Family Nutrition Program

Steve Brown - Agricultural and Horticulture Agent

Julie Cascio - Health, Home and Family Development Agent

Lee Hecimovich - 4-H and Youth Development Agent

Pam Compton - IPM Technician (seasonal)

Becky Hall - 4-H Administrative Aide

"This is a great thing for CES, AFES and the new School of Natural Resources and Extension," said Norm Harris, administrator of the Matanuska Experiment Farm. "It is a move that I think should have happened long ago. It will help us to better tie our missions together and make sure that the people of Alaska are getting the latest scientific research-based information to help them lead a sustainable lifestyle. This move should greatly benefit the people of the Matanuska-Susitna Valley and the state of Alaska as well."

Three faculty members now at the Matanuska Experiment Farm. Clockwise from above: Julie Cascio, Steve Brown, Lee Hecimovich.
—CES file photos by Jeff Fay

Elena Sparrow wins Usibelli Award for service

SNRE Professor Elena Sparrow has been awarded the 2014 Emil Usibelli Distinguished Service Award.

Sparrow has worked at the University of Alaska Fairbanks since 1985, focusing on work to share science with elementary and secondary school students and K–12 teachers.

Her work with the Global Learning and Observations to Benefit the Environment program works to engage students and teachers as citizen scientists. GLOBE is an international science and environmental education program in which students and teachers gather and analyze environmental data.

From classroom visits to community volunteerism to workshops for colleagues, both at UAF and throughout the international scientific community, Sparrow's nominators consistently noted the depth and breadth of her contributions to both science and education.

At the post-award celebration at the Museum of the North, from left to right: Elena Sparrow, Stephen Sparrow, Laura Bender, School of Ocean Fisheries & Marine Sciences Dean Mike Castellini and his wife, Maggie, and Graduate Dean John Eichelberger.
—Photo by L. Eichelberger

Employees of the Quarter

For the past year, SNRAS (now SNRE) has recognized an outstanding staff person on a quarterly basis.

Dawniel Dupee, travel technician, was the first person recognized, in July 2013. Executive Officer Michelle Pope said, "Dawniel is a wonderful asset to the department. She has been the positive driving force in implementing the new electronic travel module not only for our school, but for the entire UAF community.

"She is willing to spend the extra time to make sure that travel is done accurately and that we are getting the best deal for our travel dollars." (Dupee has since relocated to the UAF travel office where she is an auditor.)

In October 2013, **Nancy Tarnai**, the school and station's public information officer, was the EOQ. One nomination said, "Nancy approaches her work with optimism and energy. She is our best representative to the community concerning the good work we do." Another nomination stated, "The articles Nancy writes and the information she gets out to the public help keep the school and station connected with the community. Nancy's work isn't just professional, it is personal; she loves what she does and truly cares about the students, staff and faculty of SNRAS/AFES."

Laurie Wilson, laboratory manager at the Matanuska Experiment Farm in Palmer, was the EOQ for January 2014. She has been the lab manager since 1977. Her supervisor, Norman Harris, said Wilson keeps the aging lab equipment in tip-top shape. "Professional maintenance technicians on service agreements have often commented that this is the cleanest and best-maintained equipment they have seen," he said.

"Many school departments and state and federal agencies send samples to the lab because of their confidence in her excellent work and her attention to detail."

When the former lab manager retired, Wilson picked up that portion of the job as well as her original responsibilities. "She has been instrumental in maintaining the stellar reputation of the lab when major cuts led to the termination of three lab technicians, leaving her as the only employee for five years," Harris said.

Tom Malone, research forester, was named the EOQ for spring quarter 2014. He was recognized for his outstanding efforts over the past three decades of service. Professor Glenn Juday said, "Tom has been particularly responsive to our efforts to archive his many plots and studies into the Boreal Alaska—Learning, Adaptation and Production archive of Data Atlas of Forest Research Installations. He has organized the data beautifully and has all the data sets in good shape. It's a model of handing on a long-term study."

Malone's longtime colleague, Alan Tonne, manager of the Fairbanks Experiment Farm, said, "If you were to look up Forest Growth & Yield Program it would or should say Tom Malone. He's been so much a part of that program that it won't be the same without him, but it will carry on." (Malone retired in April 2014. For more on the Forest Growth & Yield Program, see p. 19.)

Tom Malone, right, at his retirement party, receiving a certificate for Employee of the Quarter. Malone laughingly appreciated the irony.
—Photo by Nancy Tarnai

School of Natural Resources and Extension
University of Alaska Fairbanks
P.O. Box 756180
Fairbanks, AK 99775-6180

Nonprofit Organization U.S. POSTAGE PAID Permit No. 2 Fairbanks, Alaska

Detail from the "Exploring Our Environment" mural. *See story p. 4.*