

Working for Alaskans 2009

— a wealth of opportunity

School of Natural Resources and Agricultural Sciences
Agricultural and Forestry Experiment Station

Fireweed and spruce in Wrangell-St. Elias National Park, representing opportunities in new crops (forage, biomass for biofuels production), Alaska timber production and standards, and recreation and tourism.
—photo by Matt Helt



note from SNRAS Dean Carol E. Lewis

Alaska is celebrating its 50th anniversary as a state in 2009. There have been changes in the way we live, some external, and many internal, brought about by our own actions. One thing has not changed. Alaskans live on an edge geographically, politically, and climatically. The 680,000 people in our state are scattered over 656,425 square miles. Despite the distances separating our villages and urban centers, we are small enough that we can and must understand our needs, though diverse, and work together to help each other. New ideas and innovative thinking have long been characteristic of the people of Alaska, no more in evidence than when we banded together to create the constitution of Alaska, one of the strongest and most forward looking of the fifty states.

Today, Alaskans face a world that is increasingly vulnerable to supply shortages and the cost of food and energy, and do so as a population that is the harbinger of the effects of changes in climate. We are concerned about educating our children, who will grow up in this changed environment. It is time that we bring strongly to the foreground the frontier spirit of new ideas and innovative thinking. We at the **School of Natural Resources and Agricultural Sciences** and the **Agricultural and Forestry Experiment Station of the University of Alaska Fairbanks** are here to help generate new ideas and new directions by working for Alaskans and bringing them stimulating opportunities. The changes we face—and the opportunities we create—will impact all of our lives, as well as those of our neighbors, both in the circumpolar north and in more southerly latitudes, including the Pacific Rim.

This year we have some exciting projects and programs that we hope will energize Alaskans to bring their state to the forefront in leadership on innovations in adaptation and knowledge about climate change. SNAP, the **Scenarios Network for Alaska**

Planning, is a collaborative effort among UAF, state agencies, communities, businesses, and anyone interested in what changes the years to come will bring. SNAP tailors large-scale climate models to local needs, with accuracy specific to a given community or communities. An example is bringing a better knowledge of how permafrost might thaw and affect ground stability. From SNRAS soils specialist Chien-Lu Ping's research, we know now that frozen arctic soil contains nearly twice as much organic material than we previously thought and this will contribute significantly to planet-warming as the permafrost thaws; how this will affect the state or a particular town in Alaska is part of what SNAP's models predict.

Alaskans are at risk for their supply of food; we import over 95 percent of the food we consume. We can increase the local foods we consume, such as crab and reindeer, and we here at the School and Experiment Station are working to make that possible. The positive impact of fresh, locally-grown produce on remote Alaska regions is powerful, and now, thanks to the efforts of our **Controlled Environment Agriculture Laboratory**, it will eventually be possible to have a just-picked meal of vegetables in winter in places as far north as Barrow on the north slope of Alaska. If we are to move forward in improving the percentage of food that we produce in Alaska for Alaskans, we will need a reliable, efficient, cost-effective, and local supply of energy. Researchers at the School and the Experiment Station are seeking new answers in the ever-challenging field of energy production. Our work ranges from testing numerous plant species, both native and introduced, to working on the use of low-value biomass for fuels including production from field crops, harvest from our forests, waste oils, and landfill products. We are building our own refineries that are appropriate for small-scale applications in our new **Biomass Energy Research and Demonstration Laboratory**.



Alaska is rich in its natural resources, from its forests to its soils. What could be more appropriate for Alaska than promoting the use of local logs in cabin building? The **Wood Utilization Research program** is testing and evaluating the strength of several Alaska wood species that has resulted in new design values for Alaska lumber. A new business venture is growing rapidly as the **Alaska Peony Growers Association** adopts research from the Agricultural and Forestry Experiment Station to export their cut flowers worldwide. More than a dozen growers have joined the ranks, ranging from those managing 50 plants to those with more than 7,000 plants.

Future generations of Alaskans will benefit as we share our knowledge about Alaska agriculture, forestry, geography, and natural resources with elementary and secondary students and their teachers. K-12 outreach is a vital component of the School's and the Experiment Station's missions. Our K-12 programs include the **Alaska Geography Alliance Education Network, FFA, GLOBE, Google, MapTEACH, Math in a Cultural Context, the Reindeer Research Program, and Stories of Culture and Place**. We work with teachers and students throughout Alaska from remote villages to metropolitan centers.

It is hard work for our faculty and staff to maintain the high quality programs they deliver. I thank them for the invaluable service they bring to you, the people of Alaska, and our neighbors to the south and north. We are looking forward to serving you in the coming years.

SNAP: predicting the effects of climate change

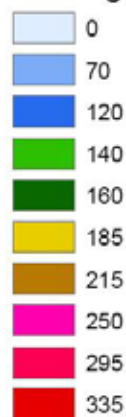
Creating potential scenarios about the future of Alaska's landscape is the mission of Scenarios Network for Alaska Planning (SNAP)—a collaborative effort between UAF, state agencies, communities, businesses, and anyone interested in what changes the years to come will bring to the state. SNAP presents the results of its models using maps, graphs, data-sets, and interpretive text. Projects are based on stakeholder needs and jointly selected goals, and results are shared openly, available at the SNAP website (www.snap.uaf.edu).

SNAP models are based on down-scaled versions of climate models used by the Intergovernmental Panel on Climate Change, selected and tailored for local precision and accuracy. Scientists predict the changes in each area for any given time in the future. An example would be an interior Alaska village that plans to construct buildings on permafrost. With SNAP's assistance, the villagers will have a better idea of how permafrost thaw may affect ground stability two decades in the future. Other useful predictions include temperature, fire regime, vegetation, flooding, drought, growing season, thawing dates, and erosion.

SNAP collaborates with Google Earth to provide innovative and user-friendly online maps. Since SNAP Director Scott Rupp, UAF associate professor of forestry, and his team first connected SNAP research to Google Earth, he noticed a remarkable increase in the use of their "product." Each month the



Growing Season Length (days)



Sample map showing estimated growing season length in days in 2039, from a report to the governor's Subcabinet on Climate Change.

number of people using the technology is increasing.

Gov. Sarah Palin's Subcabinet on Climate Change relies heavily on SNAP research when making decisions. Other users include the US Fish and Wildlife Service, the Fairbanks North Star Borough Climate Change Task Force, the US Forest Service, the Nature Conservancy, the North Slope Borough, and the National Park Service.

The data is of particular interest in the area of subsistence, for determining wildlife and fish populations and the depth of sea ice for hunting safety. Other factors of importance to Alaskans include the rate of permafrost thaw, erosion and flooding, marine fisheries, hydrology and water resources, fire, agriculture, and alternative energy resources. Rather than a prescription, SNAP provides a range of options to users that is not available elsewhere.

Climate change clues found in arctic soil

UAF research shows that frozen arctic soil contains nearly twice as much organic material that gives rise to planet-warming greenhouse gases as was previously estimated.

Soil Sciences Professor Chien-Lu Ping published these findings at the *Nature Geoscience* and *Scientific American* websites, after conducting extensive examinations of a wide range of landscapes across Alaska. Ping and his team of scientists took soil samples at 117 sites. Rather than testing to a depth of only 40 centimeters, as previous researchers had done, the team consistently dug down to more than one meter at each site. Similarly conducted Canadian research was added to Ping's study.

Wielding jackhammers, the scientists discovered that underneath the surface, there is a second layer of organic matter (carbon) accumulation right on top and in the upper part of permafrost, ranging from 60 to 120 centimeters deep. This "buried" organic matter is produced on the surface of the tundra soils, where it accumulates and is then dragged down because of frost heave and patterned ground formation. Due to the turbulent nature of the arctic landscape, arctic tundra soils are characterized by warped, broken, and distorted soil horizons. Movement is routinely caused by cracking of the Earth's surface during freezing and thawing cycles, transporting organic matter to the lower active layers and upper permafrost.

The resulting patterned ground plays a key role in determining tun-



Chien-Lu Ping using a jackhammer to take a soil sample.
—SNRAS file photo

dra vegetation and the dynamics of carbon storage and release, Ping found. When temperatures warm and the arctic soil "churns," less carbon from the surface gets to the deeper part of the soil, and the carbon stored in the deeper part of the soil is released into the atmosphere as carbon dioxide, methane, and other gases. Ping predicted that with even a two to three degree rise in air temperatures the arctic tundra would switch from a carbon sink (area that absorbs more carbon dioxide than it emits) to a carbon source (area that emits more carbon dioxide than it absorbs). The greater the carbon store the greater the impact of any future releases, Ping stated.

"The distribution of the Arctic carbon pool with regard to the surface, active layer and permafrost has not been evaluated before, but is very relevant in assessing changes that will occur across the Arctic system," Ping wrote in his study. "Where soil organic carbon is located in the soil

profile is especially relevant and useful to climate warming assessments that need to evaluate effects on separate soil processes that vary with temperature and depth throughout the whole annual cycle of seasons."



Example of patterned arctic ground, showing polygons seen from the air. The photo was taken on the Beaufort Sea coast.

—photo by Gary Michaelson

An international market model for Alaska crab



When the Alaska crab industry became threatened by population and harvest declines, as well as by changing market conditions, the UAF School of Natural Resources and Agricultural Sciences experts took up the challenge. Researchers like Joshua Greenberg, associate professor of resource economics, studied how various market determinants affect Alaska snow crab and king crab prices and revenues both at wholesale and dockside levels. They estimated the relationship between crab landings and harvester revenues, seeking to understand how the rise to prominence of Canada and Russia affected the Alaska crab industry. Also, they sought to establish a foundation for future economic analyses of the crab industry.

An integrated market model explained long-term movements in snow crab and king crab prices, proving that the Alaska crab industry had been confronted with major competition from Canadian, Greenlandic, and Russian snow crab, and Russian king crab. Simulation results showed that Alaska crab rev-

Inset: Alaska king crab.
—Wikipedia photo



Top: a bald eagle stands vigil over crab pots. Bottom: more crab pots.
—photos by Mark Herrmann

enues were severely affected by dramatic increases in snow crab from Canada. The recent emergence of Greenland and Russia as major crab producers acted as a further drag on Alaska snow and king crab prices and revenues. Russian competition may intensify as more products flow from its Barents Sea fishery to world crab markets.

Results of the two-year study were published and presented to industry leaders. The continuous gathering of economic data and analysis of human interactions with marine ecosystems help industry leaders evaluate the changes that new management regimes bring to Alaska fisheries.

Meat for Alaskans

The Reindeer Research Program is developing and promoting Alaska's reindeer industry through research and collaboration with producers and local communities (Nome, Fairbanks, Seward Peninsula). Goals are improving range management, determining best practices for animal nutrition and health, animal handling and husbandry, and meat quality.

The research herd is used primarily for nutritional studies, specifically the development of a balanced and cost-effective ration made from Alaska grown products. Over the past several years, feeding trials have been used to investigate the ways that various barleys, hays, and protein sources affect both feed palatability and animal performance.

Scientists are interested in the ways rations affect meat quality and flavor. Reindeer in Alaska are typically range fed, though there is increasing interest in developing the market by providing supplemental feed or raising animals in a farm type setting. Comparing the meat of range fed deer to that from farm raised deer, as well as investigating the effects of various protein sources on meat quality, is part of the study.

Research includes:

- radio telemetry for range management
- online reindeer herd record keeping system
- similarities and differences in composition and selected sensory attributes of reindeer, caribou, and beef
- locally produced feed ingredients for use in captive reindeer diets
- educational outreach program



Reindeer eyeballing the photographer.
—photo by Greg Finstad

A mobile meat processing lab that will arrive at the UAF Northwest Campus in Nome in the summer of 2009 will add an important element to the high latitude range management certificate program. The USDA-funded equipment will support the meat production courses offered at the Northwest Campus. Dr. Greg Finstad, SNRAS assistant professor and manager of the Reindeer Research Program, said the lab will bring together researchers from the University of Alaska and universities across the circum-polar north to engage with students and local residents in the design and conduct of animal production research. This project exemplifies how local community colleges can engage in partnerships that encourage economic sustainability through university educational research that directly applies to local concerns. With the portable lab, students and researchers will be able to conduct meat science experiments, and the information will be incorporated

into training protocols, coursework, published scientific journals, and public information forums. Local applications in animal husbandry and slaughtering techniques are expected to become more responsive to regional needs.

The self-contained lab, which will be able to move from one remote community to another, will make possible on-site USDA inspections of reindeer meat for the first time. The lab is a critical link integrating a local educational platform with animal research.

(<http://reindeers.salm.uaf.edu/>)



Rural food supply

The positive impact of fresh, locally-grown produce on remote Alaska regions is powerful, and thanks to UAF research led by Professor of Horticulture Meriam Karlsson, director of the Controlled Environment Agriculture Laboratory, a just-picked meal of vegetables in Barrow is not an impossible dream. Through controlled environments, fresh produce could become a reality across the state. In cold frames, high tunnels, or high-tech facilities, researchers are focusing on plant requirements, varieties, and treatments to maximize productivity for growers. Objectives are to develop cultural management techniques and reliable protocols to efficiently produce suitable vegetable, culinary herbs, small fruit, floral, transplant, and hanging basket crops in various environments. Once developed, guidelines will be distributed to potential growers.

Dr. Karlsson's work determines the best materials for high tunnels so that crop productivity is expanded. She studies specific crops, including green beans, strawberries, and lettuce, so that optimum conditions for best output can be shared with agricultural producers across the state. Partnerships with commercial enterprises such as Pike's Waterfront Lodge and Chena Hot Springs Resort not only provide scientific expertise to the businesses but showcase innovative agricultural methods such as hydroponic techniques to the public in a positive light. A summer-long project in cooperation with FFA volunteer students at Pike's provides fresh produce for the restaurant next door and reaches hundreds of visitors through daily tours and seminars. At Chena Hot Springs, researchers and graduate



Trellised, hydroponically grown tomatoes in a greenhouse at the Chena Hot Springs Resort.
—photo by Meriam Karlsson

students conduct ongoing trials in the state-of-the-art greenhouses. At Palmer, Assistant Professor of Horticulture Jeffrey Smeenck works to find ways to extend the south-central Alaska growing season using high tunnels, and is proving that with the high cost of vegetables these structures likely have a relatively short payback period. This technology will assist remote communities in becoming more food secure.



Plants for energy production

S**NRAS** researchers are seeking new answers in the ever-challenging field of energy production. By testing numerous plant species, both native and introduced, including several types of plants (grasses, forbs, woody plants), scientists are determining the potential for biomass crops as feedstocks for energy uses. In cooperation with USDA Agricultural Research Service, UAF scientists are investigating bluejoint reedgrass, slender wheatgrass, tufted hairgrass, smooth brome grass, reed canarygrass, tall fireweed, rhubarb, balsam poplar, aspen, alder, and several willow species (both native and introduced). Also, oilseed crops are being studied for their potential to produce oils for biodiesel. In Fairbanks, Professor of Agronomy Stephen Sparrow is looking at an Alaska icon, tall fireweed, as a potential bioenergy crop. Because it flourishes in subarctic conditions



Above: bio-oils created from different tree species through supercritical methanol liquefaction. Below: wood samples after pyrolysis.

—photo by J. Andres Soria



and is not an invasive weed, fireweed has proven to be a feasible forage crop. Investigation continues as to its energy appeal.

In Palmer, Assistant Professor of Wood Chemistry Andres Soria is working on the utilization of low value biomass for fuels and chemicals, mostly through thermochemical means (gasification, pyrolysis, supercritical fluids). He studies the chemical composition of alder, birch, hemlock, yellow cedar, Sitka spruce, red cedar, white spruce, and aspen and produces biofuel from these species via supercritical liquefaction. This work is the initial step toward analyzing Alaska biomass for biorefinery applications. Producing a liquid substance that can mesh

with the existing petroleum infrastructure will greatly enhance the transition toward a renewable energy future.

Left: fireweed in bloom.

Below: Aspen grove.





Above: A log cabin building workshop sponsored by UAF's Wood Utilization Research Program and the US Forest Service produced a handicapped-accessible recreation cabin at the Starrigwan Recreation Area Campground, shown here being reassembled. Below: Inside the garage where the cabin was built. The entire cabin was prepared in Sitka and then moved and assembled at the final cabin site.

—photos courtesy Sitka Ranger District

Forest products

Promoting the forest products industry throughout Alaska provides economic advantages and maximizes the use of locally available, natural, renewable resources. UAF's Forest Products Program, working under the multistate Wood Utilization Research Project promotes wood products industries in a positive way and educates the public that there is enough timber, that forests are sustainable, and that harvesting can be done in ways that can work for everyone. Under the direction of Assistant Professor of Forest Sciences Valerie Barber, the project, which utilizes research, education, and outreach, is testing and evaluating the strength of several Alaska

species, including cedar, hemlock, and spruce. This has already resulted in new design values for Alaska lumber and improved confidence in Alaska wood as a replacement for imported lumber.

The properties of Alaska birch and other non-timber forest products, such as tea and syrup, are being examined for their antioxidant capacity and positive health impacts. Phytochemicals found in Alaska trees show promise in medicine, as industrial lubricants, and for other applications. Many such chemicals may be in higher concentrations in the plants of the boreal forest than in those from lower latitudes.

A new initiative seeks to discover potential biofuel products employ-

ing liquefaction of wood using supercritical fluids. This pioneering research has revealed liquefaction in excess of 90 percent for eight Alaska woody biomass products. A biofuel laboratory where low-grade wood, woody biomass, and fire and insect-killed trees will be tested is being prepared at the Palmer Research and Extension Center.





Turfgrass test plots at Moose Run Golf Course, Fort Richardson.

Turfgrass research

Sports turf is big business in Alaska, and athletics are an important part of the Alaska lifestyle. Adequate facilities to pursue that lifestyle are in short supply and high demand and, therefore, playing time is highly contested. Each summer, in the Municipality of Anchorage alone, more than 11,000 soccer players compete for playing time on 125 existing fields. The story is similar for baseball and football. The development of new facilities and the maintenance of old fields in Anchorage were budgeted at over \$12 million in 2008. Similar demands and requirements for these athletic resources exist throughout the rest of the state. Grasses suitable for this demanding job are limited and their performance in the harsh growing conditions normal for these high latitudes are relatively unknown. Successful grasses must exhibit winter hardiness, early spring greenup, and good color and texture combined with the durability to deal with both early and late-season use. Nugget bluegrass, bred in Alaska, is one variety used in the test program to develop a sports turf for Alaska. Improved field design and construction techniques, best maintenance

practices, and agricultural techniques that maximize resource utilization while minimizing adverse impact on the environment are all necessary to tailoring sports turf for subarctic conditions. The Turfgrass Research Program at the Palmer Research and Extension Center exists to help turfgrass managers and the sport industry develop and economically maintain safe, high-quality playing surfaces for the people of Alaska.

Peonies: growing a new product

Exporting cut flowers from Alaska is opening new realms of opportunity for commercial growers. AFES is in the midst of a ten-year research project on this low-maintenance and cold-tolerant plant that produces high-value crops. Rather than an obstacle, the late blooming season of peonies in the far north provides a commercial advantage—the flowers are available when the growing season in warmer climates has passed.

Researchers are identifying which peony cultivars are suitable and what pests and diseases can pose problems. Guidelines are being established for field cultivation. More

than a dozen producers who have joined the ranks of the state's peony growers have planted peony fields, ranging from plots of fifty plants to more than 7,000 plants. Growers are learning the techniques used in growing cut flowers for sale, the nature of cut flower markets, and the process of selling cut flowers. Professor of Horticulture Pat Holloway has been instrumental in providing stellar research and sound advice to peony growers. The Alaska Peony Growers Association promotes and supports all aspects of the peony industry in Alaska. The aim is to unite members through cooperative exchange of technology and information, support efficient commercial production and business practices, and identify premiere markets. With the help of UAF experts, the organization is promoting Alaska-based research and successful marketing strategies which support growers in their production of high quality peonies for markets around the world.

(www.alaskapeonies.org/)



Peony cultivars in test plots at the Georgeson Botanical Garden.

K-12 outreach

Sharing knowledge about Alaska agriculture, forestry, geography, and natural resources with elementary and secondary students and their teachers is a vital component of the SNRAS-AFES mission. This is demonstrated by:

Alaska Geography Alliance Education Network: This provides connections between K-12 educators and higher education faculty from three university campuses: UAF, UAA, UAS. (www.ngsednet.org/community/index.cfm?community_id=253)

FFA: The agricultural science education program is built on the three core areas of classroom/laboratory instruction, supervised agricultural experience programs, and FFA student organization activities/opportunities. FFA prepares students for premier leadership, personal growth, and career success. FFA programs in Alaska high schools and universities represent a large diversity of careers in the food, fiber, and natural resources industry. (www.alaskaffa.org)

GLOBE: This is an international hands-on environmental science and education program that connects K-12 students, teachers and scientists around the world for research collaboration and cross-cultural enrichment. (www.cgc.uaf.edu/Globe/default.html)

Google: the UA Geography Program collaborates with Google experts to educate high school students and teachers about employing the latest technology to make learning geography exciting and fun.

MapTEACH: This program, Mapping Technology Experiences and Community Heritage, is a hands-on education program for middle and high school students and their teachers in Alaska that focuses on understanding the local landscape from multiple perspectives and on learning to



The UA Geography Program brought National Geographic's Giant Traveling Map of Africa to school-children around the state.

make and use computer-based maps of scientific, cultural, and personal significance. (www.mapteach.org)

Math in a Cultural Context: A long-term collaborative project between UAF and Yup'ik communities, elders, teachers, mathematicians, and math educators have published nine supplemental, culturally-based math curricula used in rural and urban schools. MCC consists of nine supplemental math modules from second grade to seventh grade, eight stories that accompany the modules, CDs and DVDs that show exemplary cases of teachers using

MCC. (www.uaf.edu/mcc/)

Reindeer Research Program: Researchers developed a curriculum for teachers to demonstrate the importance of reindeer in Alaska and as a means of teaching about agriculture, biology, anatomy, Alaska history, northern ecology, and geography. (<http://reindeer.salrm.uaf.edu>)

Stories of Culture and Place: Teachers and students learn to blend oral, written, and digital storytelling in a unique approach to art, literacy, and content exploration.



Greg Finstad with Rip the reindeer at school.

Research Partnerships

US Dept. of Agriculture

Agricultural Research Service (ARS): www.ars.usda.gov
Boreal Ecosystem Cooperative Research Unit (BECRU): www.becru.uaf.edu
Forest Service (USFS): www.fs.fed.us
Subarctic Agricultural Research Unit

Cooperative Ecosystem Studies Units Network

(CESU): www.cesu.org

Cooperative Extension Service

(CES): www.uaf.edu/ces/

Integrative Graduate Education and Research Traineeship Program

(IGERT): www.igert.org

Long-Term Ecological Research Network

(LTER): www.lternet.edu

Degrees

Bachelor of Arts in Geography

Bachelor of Science in Geography

- Environmental Studies Option
- Geographic Information Science & Technology Option
- Landscape Analysis & Climate Change Studies Option

Bachelor of Science in Natural Resources Management

- Forestry Option
- High Latitude Agriculture Option
- Resources Management Option

Professional Master's in Natural Resources Management & Geography

Master of Science in Natural Resources Management

Peace Corps Master's International in Natural Resources Management

PhD in Natural Resources & Sustainability

Facilities & Research Sites

Fairbanks Experiment Farm (AFES)

Controlled Environment Agriculture Laboratory
Georgeson Botanical Garden
Reindeer Research Program

Palmer Research and Extension Center (AFES)

Matanuska Experiment Farm
Kerttula Hall

Research sites

Bonanza Creek Experimental Forest
Caribou/Poker Creeks Research Watershed
Delta Junction Field Research Site
Point MacKenzie Field Research Site
Nome Field Research Site

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

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Students at SNRAS may develop individualized programs that complement their interests and draw upon the faculty's expertise. Programs emphasize preparation for careers in high-latitude environments. Courses and curricula were developed in cooperation with groups and agencies that work professionally with resource management in Alaska. Students have opportunities to gain hands-on experience: state and federal agencies such as the Alaska Department of Natural Resources and the US Fish and Wildlife Service contribute significantly to the instructional program by providing guest lecturers, internships, and field work opportunities for students. Internships and field work for credit can also be arranged through nongovernmental organizations.