AgroBorealis

# School of Agriculture and Land Resources Management

Annual Report

volume 34, number 2

# Dean's Letter

November 5, 2002

The Honorable Tony Knowles
Governor of Alaska
P.O. Box 110001
Juneau, Alaska 99811-0001

Dear Sir:

I submit herewith the annual report from the Agricultural and Forestry Experiment Station, School of Agriculture and Land Resources Management, University of Alaska Fairbanks, for the period ending December 31, 2001. This is done in accordance with an act of Congress, approved March 2, 1887, entitled, "An act to establish agricultural experiment stations, in connection with the agricultural college established in the several states under the provisions of an act approved July 2, 1862, and under the acts supplementary thereto," and also of the act of the Alaska Territorial Legislature, approved March 12, 1935, accepting the provisions of the act of Congress.

Very respectfully,

Carol E. Lewis
Dean and Director

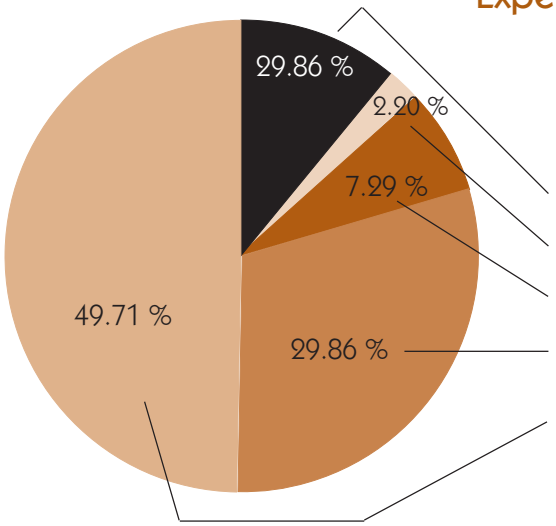
# AFES Statement of Purpose

The Alaska Agricultural and Forestry Experiment Station (AFES) provides new information to manage renewable resources at high latitudes, and to improve technology for enhancing the economic wellbeing and quality of life at these latitudes. While foresters, farmers, and land managers use our research results, all Alaskans benefit from the wise use of land resources. Our research projects are in rsponse to requests from producers, industries, and state and federal agencies for information in plant, animal, and soil sciences; forest sciences; and resources management.

Experiment station scientists publish research in scientific journals, conference proceedings, books, and in experiment station bulletins, circulars, newsletters, research progress reports, and miscellaneous publications. Scientists also disseminate their findings through conferences, public presentations, workshops, and other public information programs.

Administratively, AFES is an integral part of the School of Agriculture and Land Resources Management (SALRM) at the University of Alaska Fairbanks. This association provides a direct link between research and teaching. Scientists who conduct research at the experiment station also teach, sharing their expertise with both undergraduate and graduate students.

## Expenditures—July 2001 through July 2002




The following statement of expenditures of federal and state funds for the fiscal year beginning July 1, 2001 and ending June 30, 2002 (FY 02) is not an accounting document.

Federal

Hatch General Formula Funds: $769,065

Hatch Multistate Forumula Funds: $154,917

McIntire-Stennis Formula Funds: $512,088

Other Grants and Contracts: $2,099,282

State Appropriation/Program Receipts: $3,493,957

**Total: $7,029,309**


# Editorial Staff:



*AgroBorealis* is published by the Agricultural and Forestry Experiment Station, University of Alaska Fairbanks. A written request will include you on the mailing list. Please write to:

**Publications, AFES**
**P.O. Box 757200**
**Fairbanks, AK 99775-7200**

e-mail: fynrpub@uaf.edu

or visit our Web site at:

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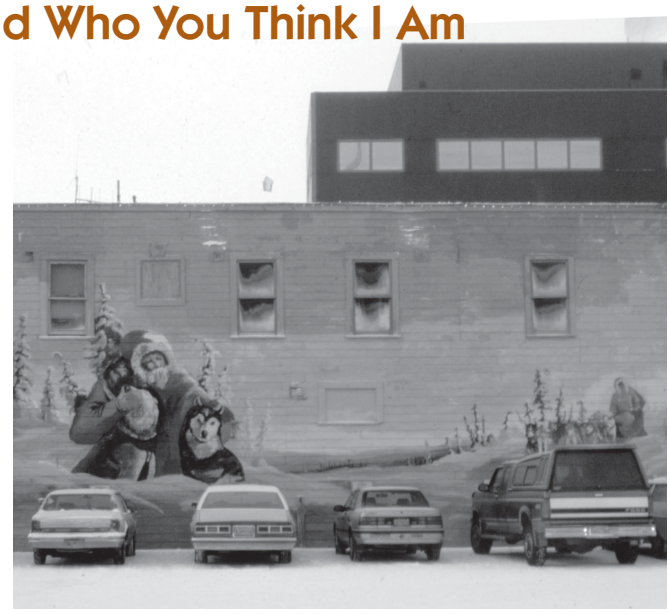
Cover photo by Dr. Scott Rupp shows the aftermath of the Long Creek fire. For more on fire and the boreal forest, see story on page 12.

# Perceptual Geography:

## Where I Am, Who I Am, Where and Who You Think I Am

Doreen Fitzgerald
photos by Cary de Wit





*An Alaska sourdough is portrayed on a mural painted on a building in downtown Fairbanks. Many such murals can be seen in Alaska cities.*

The interplay between self and landscape, and between how we define ourselves, how we portray ourselves to others, and how others see us, are subjects of interest to geographer Cary de Wit, assistant professor of geography at UAF, where he teaches courses on the regional cultures of North America, Europe, and Asia.

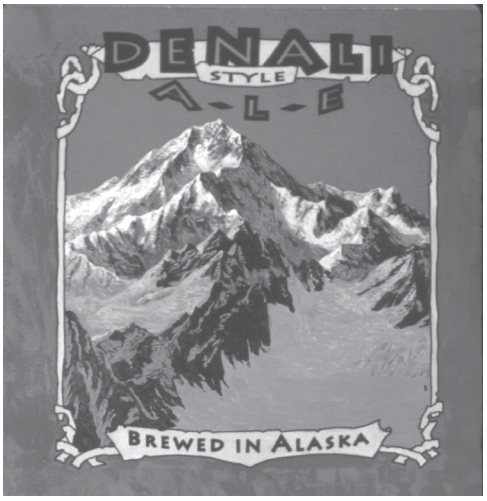
### Alaska—The Last Frontier!

As part of a study on Alaska's cultural landscape and Alaskans' sense of place, de Wit is exploring the ideology of the frontier as it is expressed through the display of frontier imagery and icons. He collects samples of vernacular imagery and iconography—the images and objects Alaskans choose to represent themselves.

Although one's sense of place is an individual perception, it is influenced by the cultural milieu, and the perception affects how one behaves: political outlook, voting behavior, environmental attitudes, and social values. "I suspect that the prevalent frontier ideology in Alaska generally leads to a more cavalier attitude toward environmental damage, financial responsibility, and law and order," de Wit said. "If the degree of 'frontier'-mindedness changes, the images and icons will presumably change, possibly indicating changes in political, environmental, and social attitudes. So, watching for changes in the cultural landscape could help you detect changing political and social attitudes."

To support a study of popular nonresident perceptions of Alaska, de Wit also collects samples of imagery from advertising, postcards, and other items

*Examples of Alaska iconography: below, Denali Ale label. Right, the Chatanika Roadhouse, festooned with icons of frontier Alaska.*




marketed to tourists. "How non-residents imagine Alaska has a significant influence on their sentiments toward many issues relevant to Alaskans and to Americans," he said. "For example, the balance between development and preservation. Such perceptions could effect national decisions such as whether to allow snow machines into the wilderness core of Denali National Park, or whether the Arctic National Wildlife Refuge should be opened to oil exploration and development."

"The images promoted by the tourist industry are intended to attract tourists, so they use images their marketing people think tourists want to believe are real." This becomes a complex interplay of perceptions: the tourist industry tries to second-guess the tourists' perceptions of a place, whereas the popular image has largely been formed through stereotypes presented in popular films, television shows, books, and the tourism advertising itself. "This raises some interesting questions about what draws people to Alaska. Is it the images they see in advertising, what they've seen in movies, or something more based in reality? And what happens when they get here? Are they disillusioned? Do they see the real Alaska, or just what they expect to see? Do they go home and recommend the trip to their friends, or express disappointment?"

## Experiencing the High Plains

In a field study completed before de Wit came to Alaska, he spent several years investigating how people in the High Plains region of western Kansas and eastern Colorado experience the environmental and cultural aspects of this geography. He found that there is a fundamental difference in the way men and women experience the region, both in its environmental and cultural aspects. The study, "Women's Sense of Place on the American High Plains," was published in *Great Plains Quarterly*, Winter, 2001, Vol. 21, No. 1.

De Wit spent several years interviewing a cross-section of women and men in their homes or the workplace. Although various issues influence a person's sense of place, overall he found that women described the experience of the Plains in different terms than men, and they valued different characteristics of Plains life. Their responses to this flat, relatively featureless and rural region turned out to be similar to those reported in pioneer times.

While men typically emphasized the sense of freedom, independence, and opportunity as the most positive aspects of Plains living, women tended to praise the interpersonal qualities of life in the region, especially concerning family. They like the sense of community and the closer intergenerational relationships.

Many women described the rural region as a man's place, where work is a man's domain and where job and recreation opportunities for women are scarce. They often felt themselves more restricted to "traditional" female roles in work, home life, and community than they might in other places. Immigrant women's reactions are especially different from men's. Frequently they had moved to the Plains as a result of a male's decision, and many reported that they would leave if they could. In contrast, immigrant men typically found the place appealing. They embraced a sense of widened horizons and expanded possibilities and appeared relatively undisturbed by social isolation and emptiness of the landscape, often expressing a fondness for both. It was almost exclusively women, immigrant and native, who reported sometimes feeling vulnerable or overwhelmed in the vast, open landscape.

"There were many women who reported that they love living on the Plains, but even they appreciated the life for qualities that were distinctly different from those mentioned by Plains men," de Wit said. For example, men were usually positive about the solitude related to rural life, experiencing it as privacy and freedom from disturbance. For women it often meant social isolation."



*Adventure and opportunity or desolation? Two views of the High Plains illustrate how differently two people may experience the same landscape.*

# Hands-On Science Education



Whether part of an extended cycle or the result of human activity, global change is occurring. Changes in weather patterns, air and water quality, sea ice and sea level, permafrost—all have ramifications today that are likely to become even more pronounced in the future. How humans handle such change in the future largely depends on how today's children are educated to understand and cope with their environments.

Concerns about global change are the foundation for several science education projects involving Elena Bautista Sparrow, Global Change Education Program coordinator at UAF and associate professor in the School of Agriculture and Land Resources Management.

"Our goal is to teach Alaska students science in a meaningful way," said Sparrow, who started global change education work as a volunteer and is now responsible for several grants that are funded by various government agencies.

*Elena Sparrow coordinates the Global Change Education Program at UAF.*

Through a program called GLOBE (http://www.globe.gov), children worldwide and in over seventy Alaska schools are watching planet Earth—mapping it, taking measurements, asking questions, and learning how science works by participating in GLOBE research projects. Sparrow said that all of the grants she is working on are somehow related to GLOBE, either directly or indirectly. The GLOBE program and UAF entered a cooperative agreement in 1996 through the UAF Center for Global Change and Arctic System Research.

The idea behind GLOBE is that K-12 students throughout the world can learn science by participating in environmental research, and can contribute extensive and meaningful data that could not be obtained otherwise.

This hands-on, inquiry-based environmental science and education partnership brings together students, educators, scientists, schools, communities, and countries in environmental studies and cross-cultural enrichment.

*Workshops like this one on soils prepare teachers to help their students collect scientific data. Teachers and students around the world are participating in the GLOBE program.*

In the GLOBE program, scientist and educator teams were challenged to come up with protocols for standardized measurements and support materials for various student age and skill levels covering the topics of atmosphere and climate, hydrology, soil, land cover/biology, and phenology (the study of periodic biological phenomena, such as flowering, breeding, and migration, especially as related to climate). They had to determine how students could collect data with research significance following procedures that could be done by primary and secondary school students, and using equipment that schools could afford.

Alaska teachers are being prepared to participate during one- or two-week session institutes, or split sessions spread over several months. They learn how to guide their students in taking scientific measurements at or near their schools, use the Internet to report and analyze scientific data, and collaborate with scientists and GLOBE students within Alaska or around the world.

In the United States, GLOBE is sponsored by the National Aeronautics and Space Administration, National Science Foundation, Environmental Protection Agency, and the Department of State. Worldwide, 16,000 teachers in 100 countries participate.

The National Science Foundation (NSF) has funded the project Global Change Education Using Western Science and Native Observations, which is based on the idea of cultivating the common ground

*Students collect data on tree budding in their community.*

between Native knowledge and western science in the organizing principles, habits of mind, skills, procedures, and knowledge related to the various earth sciences as students conduct local environmental studies.

"The project responds to identified needs for locally relevant, inquiry-oriented science education appropriate for the diverse multigraded and multicultural teaching situations in Alaska," Sparrow said.

The professional development institute for teachers in this project also called Observing Locally, Connecting Globally (OLCG), whose co-principal investigators are Sidney Stephens (SALRM faculty member) and Leslie Gordon, integrates GLOBE protocols and learning activities, Native knowledge, and the best science education practices. Along with classroom activities, field trips are made on the Tanana River with an Alaskan Native elder and other Athabascan experts, to the Gaale'ya Spirit Camp and to the Fox Farm. In the classroom, the ideas of long-term observations and systems thinking are put into practice as participants start on investigations using GLOBE scientific measurements and learning activities, combined with input from Native elders and other community experts.

The project includes other climate change research relevant to Alaska, such as studies on sea and lake ice, and studies on boreal forest response to climate change. Effective classroom practices (constructivist learning environment, inquiry-based learning in science, learning cycle model, and teaching and assessing to standards and for diversity) are discussed and modeled. Participants also learn how to follow scientific protocols; analyze and interpret data, and to use the computer and Internet for data entry, accessing global data sets, and data visualization.

Back in the schools, K-12 students, guided by their teachers, are involved in global change research and are taking environmental measurements at or near their schools. Teachers and students are supported through e-mail discussions, phone calls, classroom visits from project personnel, community experts and scientists, alignment of project activities with state and national science standards and the Alaska cultural standards, and a Web site (http://uaf.edu/olcg/).

"We have begun the process of coupling Native knowledge and experience with science instruction and research investigations," Sparrow said. "Our aim is to enhance global environmental change awareness, the science skills and knowledge of students, and their cultural wellbeing."

Another grant Sparrow manages, "Climate Change Variability and Its Relevance to Rural Alaska," is funded by NASA and the Alaska Department of Natural Resources. It has provided followup workshops for participating teachers in GLOBE-related projects. This grant brings together Earth system science education activities of the UAF Space Grant Program, Kachemak Bay National Estuarine Research Reserve, Center for Alaskan Coastal Studies, Alaska Challenger Learning Center, Alaska Pacific University Science Center, BLM Campbell Creek Science Center GLOBE Partnership, and the UAF Alaska GLOBE Partnership (that Sparrow also coordinates). Through this grant, the Global Change Education project and in collaboration with William Schneider of the Oral History Program at Rasmuson library, an oral history project called Jukebox has been started where interviews of Alaska Native elders on their climate change observations

*Teachers compare notes during a summer institute that prepares them for GLOBE participation.*

and knowledge have been digitized and published on the Global Change Education Web site.

Under another NSF-funded project titled Seasons: The Global Plant Waves, with Dave Verbyla (also of SALRM) as principal investigator and Elena Sparrow and Leslie Gordon as co-principal investigators, science curriculum was written which integrates plant phenology and climate change research and education. These materials can be found at the GLOBE web site and at http://nrm.salrm.uaf.edu/~dverbyla/globe/.

Phenology is the study of periodic biological phenomena, such as budburst, flowering, leaf fall and migration, as related to seasons and climate. The material has been tested in Alaska and is currently being used in other parts of the world. It will be incorporated in the *2003 GLOBE Teachers Guide*.

The Schoolyard Long Term Ecological Research Project (LTER), is the K-12 education outreach component of LTER program on boreal forest ecology (see *AgroBorealis* 34.1, 2002 for more on this research area). The project uses LTER and GLOBE methodology in engaging students in long term ecological research at or close to their schools.

The NSF-funded Alaska Experimental Program to Stimulate Competitive Research (EPSCoR) also has a K-12 education outreach program, Alaska Rural Research Partnership (ARRP), also coordinated by Sparrow. ARRP has two components. One involves UA scientists working with a few high school students on EPSCoR core research projects. The other involves whole classrooms in grades K-12 working on GLOBE projects with UA and other scientists. An example of the first component in ARRP is "Genetics of the Immune System in Reindeer, Caribou, Whale, and Salmon." George Happ is a UAF mentor scientist for the project, which involves selected high school students at Barrow, Sitka, Kotzebue, and Kodiak. An example of the second component involves Kodiak High School, Polaris K-12 school, and other schools in the circumpolar north countries. It is the "GLOBE Arctic Persistent Organic Pollutants" (POPs) project, which is co-funded by GLOBE U.S., GLOBE Norway, the Norwegian Air Institute and the U.S. Department of State.

Recently completed was the Alaska Environmental Education Outreach Project also involving GLOBE activities, which was funded by Northern Arizona University Institute for Tribal Environmental Professionals and the Environmental Protection Agency.

The overarching goal of these projects is to enrich science education for students in urban and rural areas, and to prepare the next generation of informed citizens, policy makers, and scientists. For more information see the following references.

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Stephens, Sidney. 2000a. *Handbook for Culturally Responsive Science Curriculum.* pp 1-40. Alaska Science Consortium and the Alaska Rural Systemic Initiative, Fairbanks, AK.

Stephens, Sidney. 2000b. Observing Locally, Connecting Globally. *Sharing Our Pathways* (5):6-7. Alaska Rural Systemic Initiative Publication.

*During a summer field trip, a teacher-turned-student pactices scientific observation with a little help from his friends. Students will be taught to make accurate observations and record them, providing data from around the world.*

# Fresh Raspberries in March

Doreen Fitzgerald
photos by Jeff Werner



Unless it's summer and you happen to have some berry bushes in the yard, a bowl of fresh raspberries is rare, and regional out-of-season sources of this fragile crop do not exist. When the berries are found in stores, they're not very fresh, and they're expensive. Retail prices between $3 and $6 for a half-pint are common. The idea of raspberry production in the greenhouse, which apparently originated in New England in the late 1990s, has now been tried at UAF. Professor Meriam Karlsson and research associate Jeff Werner reported their research in *Greenhouse Product News*, Vol. 12, No. 10, October, 2002.

"We have shown that raspberries can be produced in an Alaska greenhouse for marketing at different times of the year," Karlsson said. Because greenhouse production is expected to cost more than conventional production, the targeted local market would be for a high-value, fresh, top-quality fruit in the off-season.


Based on fruiting characteristics, there are two types of raspberries. Following natural winter cooling, the summer or floricane-bearing type produces flowers and berries on the second-year growth (floricanes). The fall or primocane bearing type produces a limited number of flowers and berries on the upper portion of the primocanes at the end of the growing season. During the second year, these, like the floricane type, continue to flower following colder temperatures.

For their study, Karlsson and Werner selected the variety 'Tulameen,' a primocane-bearing type that for yield, berry size, and flavor favorably responds to a greenhouse environment. Various techniques and schedules can be implemented, but the following steps outline the procedure for multicane plants obtained in the spring.

1. In May, plant bare-root, multi- or single-cane plants in three-gallon pots, using a peat-lite medium (mixture of peat and perlite).

2. Allow the plants to grow outside during the summer.

3. Before natural or artificial cooling, prune plants, leaving three to four of the most vigorous primocanes (first year growth). A few strong and well-

*Canes planted in buckets are grown outside, subjected to cooling, and then brought into the greenhouse for raspberry production.*

*Researchers recommend growing single-cane plants under northern conditions.*

supported canes are more efficient producers of high-quality berries than many weaker canes.

4. In fall, leave plants outside for natural cooling or place in a cooler at approximately 40º F.

5. During artificial cooling, provide low light continuously or for a few hours daily and keep plants evenly moist. Under natural conditions, the cooling requirement is met by mid-December; for artificial cooling of Tulameen, cool for at least six weeks or 1,000 hours.

6. Bring plants into a greenhouse at 55º to 65º F. The plants will break dormancy, flower in about six weeks, and produce ripe fruit in ten weeks.

Using this system and schedule, the first ripe raspberries can be picked in early March, with harvest expected to continue for up to 60 days. During the research reported here, canes left in a cooler for six months grew and developed without any reduction in flowering or berry production. "Holding canes at low temperature for greenhouse forcing would make it possible to schedule production for various marketing opportunities," Karlsson said.

Raspberries prefer cool growing temperatures (55º–65º F) and don't require high light levels, although Werner said that providing at least 750 foot-candles during winter will improve growth, flowering, and yield in northern areas. Extending the day length to 16 hours also is beneficial. Spacing depends on management techniques, logistics, and plant size. At first plants were kept pot-to-pot in single or double rows. For larger plants, spacing with 20 to 22 inches between plants allows for adequate development and handling. The rows may be 3 to 5.5 feet apart. Trellising the rows keeps canes upright while fruit develops, making plant management, pest control and harvesting easier. In the UAF studies, a fertilizer regime of a water-soluble fertilizer high in potassium (Hydrosol 5-11-6) and a general purpose fertilizer (Peter's 15-16-17) at alternate irrigations worked well.

Raspberry plants require pollination. Honeybees aren't well adapted to greenhouse use, so this system of raspberry production would not have been possible before the availability of commercial bumblebees, which are now commonly used for pollinated greenhouse crops. One colony of bees is expected to provide efficient pollination for six to eight weeks. While hand pollination is too labor intensive for a commercial crop, it can be accomplished on an experimental scale using an artists' brush.

Karlsson and Werner also grew long- or single-cane raspberry plants. Bare-root long canes (three to four feet) were shipped during late fall or early spring from the Pacific Northwest. Because the plants already have the required cooling, they can be immediately planted and forced into flower and production, or alternatively kept in a cooler for later forcing. These plants were grown using similar management and production techniques as the multicane plants.

*The plants set fruit in the greenhouse after pollination by bumblebees.*

*The experimental plants shown below were grown outdoors during summer on the UAF campus.*

"Under northern conditions, we recommend using single long canes, rather than multicane plants because they are easier to handle and maintain during greenhouse production and more plants can occupy the same space."

During the trials the main pest problem was infestations of two-spotted spider mites, which can be controlled by repeated use of beneficials such as the predatory mite *Phytoseiulus persimilis*, insecticidal soap, and sanitation. Good relative humidity also helps keep spider mites in check. Thrips and aphids were observed on plants, but neither infestation was severe and biological control measures are available (predatory mite *Amblyseius cucumeris* for thrips and lacewing larvae for aphids). Pesticides are not compatible with bee pollination, and the availability of natural controls makes organic production feasible.

An advantage of producing fruit in a controlled environment is that the plants aren't subject to wetting by rain or dew, which reduces the threat posed by many of the disease problems affecting raspberries outdoors, such as blights and fruit rots. Also, many insect pests are simply not present during this winter production period.

"The raspberries produced in our study were of exceptional quality, size, color, and flavor," Karlsson said. "They appear to be a high-value greenhouse crop alternative that may be worth considering for local marketing to consumers who are willing to pay a premium price for high-quality fresh raspberries.

An economic analysis of greenhouse raspberry production for Alaska is planned, Karlsson said. "For persons having existing greenhouse space, there is some information available that suggests a gross return similar to that of growing bedding plants in the spring."

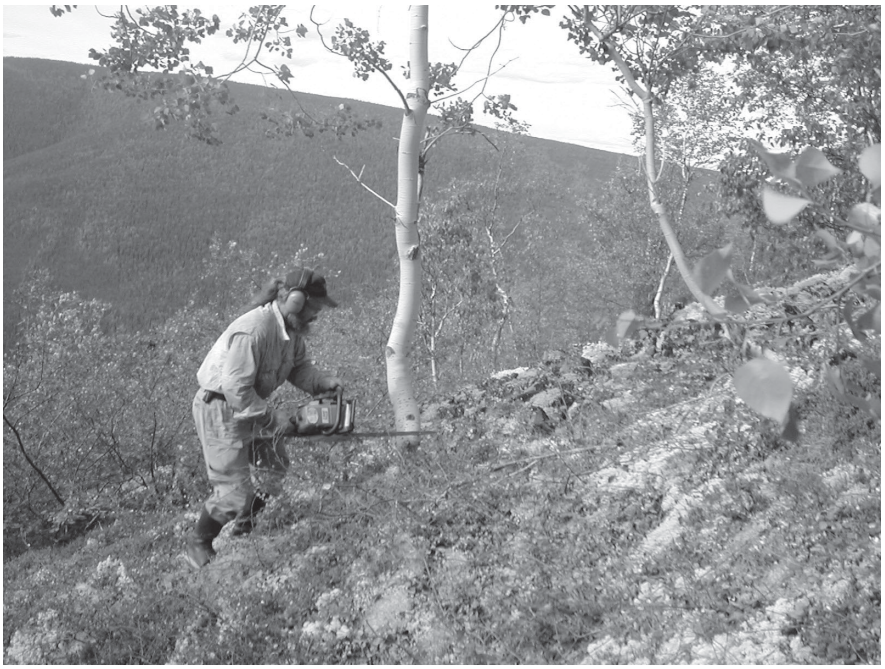
*For more information, contact the researchers at ffmgk@uaf.edu or call (907) 474-7005.*

# Computer Modeling:

## Fire, Climate, and the Boreal Forest



Doreen Fitzgerald
photos courtesy Scott Rupp



*Sampling during the field season provides data for forest research.*

Humans constantly use models to better understand the world. We use many types of models such as words, pictures, three-dimensional objects, and computers to represent reality. To build a house, you may start with a drawing. If you create a three-dimensional model, you can get even more information about how well the design will work as an actual structure, and you could study the design without actually constructing the building. If you want to see how climate warming might affect the tundra a century from now, or how you might mitigate fire risk in a wooded urban setting, computer modeling offers a way to simulate various scenarios and outcomes from the variables involved in these questions. It also allows researchers to investigate how various phenomena are connected. They can manipulate one variable, then look at the effect on the total picture.

Scott Rupp, assistant professor of forest measurement and inventory in the Forest Sciences Department, has spent the last decade developing computer models to better understand some of the complex phenomena related to Alaska's forests. "The commonalities in the various projects I've been working on are vegetation, climate, and fire, and how they interact in the boreal landscape," he said.

Model simulations allow researchers to investigate events before they occur. "I don't like to think of a model as predicting the future," Rupp said, "but a model can provide potential outcomes, allowing managers to consider a range of outcomes before making a decision."

Information derived from some of the modeling projects Rupp is conducting will support decision making by forest managers responsible for assessing and mitigating fire risk. "The results will help them decide whether to use reactive or preventative measures," he said. "At first it may seem like reactive is better, but it is important to consider the long-term consequences. The real issue is the structure of the forest." An example is in the western U.S., where decisions made a hundred years ago about reactive fire management, suppressing all fires after a catastrophic fire season, is today having a huge negative impact.

One of Dr. Rupp's studies aims to develop a computer model to help those who design and implement fire-management plans in interior Alaska. It will integrate fuel buildup, vegetation, climate, and fire-management policy with real geography over time scales of years, decades, and centuries. The model will produce mapped depictions of various future scenarios related to fire management.

A model for fire-related studies employs such information as climate variables, type of forest, density of growth, and forest floor (decaying organic material and vegetation). If data is not already available, it must be collected through fieldwork before a simulation can be made.

Wildland fires threaten human values, but they are also crucial to forest ecosystems. "People want to build houses in places where fire is the forest's main reproductive agent, and this complicates forest- and fire-management decision making," said Rupp.

In the Anchorage bowl area, the steep hillsides surrounding the city are dotted with homes, and the spruce bark beetle epidemic, having killed thousands

*The scar on this tree marks the passage of fire, which is essential for reproduction of the forest.*

*An inventory of fuel loadings (availability and type) in the Anchorage bowl area will provide data for computer simulations of fire behavior ad identify fuel inputs.*

of trees, has increased the fuel load, causing much concern by the municipality about the risk of wildfires that endanger both property and human life. The goal of a collaborative study with the Anchorage Fire Department is to model the expected fire behavior and identify fuel inputs that can be proactively managed. Proactive management might include the removal of dead trees and the thinning of live forest stands. Graduate student Dan Cheyette is inventorying the area's fuel load by identifying fuel types and amounts.

During three years of postgraduate study at the University of Minnesota, Rupp developed ALFRESCO, a spatially explicit model that simulates the response of subarctic vegetation to climatic warming. It can explicitly simulate spatial processes, meaning that results can be expressed on a real map. It also simulates transient responses; that is, the progressive responses over time rather than at discrete intervals.

## Climate Change

Modeling the effects of climate warming is complex, because "everything" affects everything else. For example, since the 1950s, Alaska has experienced both increased average temperatures and more precipitation. Although models show these trends continuing throughout this century, the state is not expected to become both warmer and wetter because the projected rise in air temperature would offset the increased precipitation and lead to slightly reduced soil moisture throughout most of the state. Changes in terrestrial ecosystems also have feedbacks to climate. For example, the dark color of spruce forests absorb more energy from the sun. In winter the difference between the energy absorption of a spruce forest and snow covered tundra can be considerable. These differences can affect regional climate systems and lead to a positive feedback loop. In other words, a warming climate might lead to an expansion of spruce forest into former treeless areas, which will cause further climate warming. Understanding how vegetation responds to climate warming is of interest because changes in vegetation strongly influence both climate and the ecosystem characteristics that are important to people. Spatial processes, such as fire spread and plant

migration can strongly influence rates and patterns of vegetation change. To test the importance of these spatial processes, Rupp and colleagues decided to look at an area having a large geographic barrier, the Brooks Range.

In this study, "Modeling the Influence of Topographic Barriers on Treeline Advance at the Forest-Tundra Ecotone in Northwestern Alaska," the simulations showed that a significantly warmer (6°C average) (42.8° F) growing season climate would cause expansion of forest through the Brooks Range onto the currently treeless North Slope only after a period of 3000 to 4000 years. Substantial forest establishment on the North Slope did not occur until temperatures warmed 9° C, and then only following a 2000-year time lag. The long time lags between change in climate and change in vegetation indicate current global change predictions greatly overestimate the response of vegetation to a warming climate in Alaska.

At high latitudes, it appears that interactions between topography, climate, and disturbance could alter recruitment patterns to reduce or offset current positive feedbacks to warming at high latitudes. "These simulated changes indicate that the Brooks Range would significantly constrain regional forest expansion under a warming climate, with similar implications for other regions possessing major east-west oriented mountain ranges," Rupp said.

In another study, "Response of Subarctic Vegetation to Climatic Change on the Seward Peninsula in Northwest Alaska," ALFRESCO was used to model responses to warming in an 80,000 square kilometer area. Model calibration efforts showed that fire ignition (number of fires) was less sensitive to regional climate (temperature and precipitation) than fire spread (size of fires).

In these model simulations, a warming climate led to slightly more fires, with much larger fires and the expansion of forest into previously treeless tundra. Vegetation and the fire regime continued to change for centuries after the climate warming ended.

Flammability increased rapidly in direct response to climate warming and more gradually in response to climate-induced vegetation change. For the total area burned per decade, warming caused as much as a 228 percent increase, leading to a landscape increasingly dominated by a forest that was early successional and more homogenously deciduous. A single transient 50-year drought led to the development of a novel grassland-steppe ecosystem that persisted indefinitely and caused permanent increases in fires in both the grassland and adjacent vegetation. These simulated changes in vegetation and disturbance dynamics under a warming climate have important implications for regional carbon budgets and biotic feedbacks to regional climate.

Because about one-third of the world's forested area is in the north, and these boreal forests are fire driven, questions involving fire, forest, and climate will continue to have global significance. As development and population pressure increase worldwide, problems related to the wildland-urban interface also will increase. Model simulations are an important tool for developing new insight into these issues. While revealing potential outcomes, they also provide information that contributes new perspectives for developing future research.

*Darkened forest floor after fire at Long Creek.*

# Research
# Agricultural Research Service



## Monitoring grasshopper populations in cultivated crops

Dennis Fielding

purpose

I wished to evaluate the usefulness of windowpane/pan traps for sampling grasshopper populations in a variety of habitats.

approach

Windowpane-style traps were constructed consisting of a vertical pane of glass (about 39 inches wide) with trays of water (sections of plastic rain guttering) at the base of the glass pane. Grasshoppers were captured as they hopped about, hit the glass, and fell into soapy water.

progress

Preliminary results from 2001 field tests suggest that grasshoppers were attracted to the traps.

impact

Standard methods of estimating grasshopper abundance are not very reliable in most crops. A reliable method of monitoring grasshopper populations is needed to study their invasion of crops.

## Phenology of Alaska grasshoppers

Dennis Fielding

purpose

I sought to explain how grasshoppers successfully grow and reproduce in the short subarctic summers.

approach

I looked for genetic adaptation by comparing growth rates of grasshopper populations from Alaska and Montana under a variety of controlled temperature regimes in the laboratory, and measured internal body temperatures of grasshoppers outdoors to quantify the effect of basking in the sun. The growth rates of natural populations are regularly determined.

progress

I measured internal body temperatures of grasshoppers under a range of sunlight levels, wind speeds, and air temperatures. During the winter, I measured growth rates under a range of constant temperatures.

impact

Current phenological models developed in more temperate climates severely underestimate growth rates of Alaska grasshoppers. Accurate models of grasshopper growth and development will allow better estimates of the time available to treat infestations of grasshoppers and improve predictions of population trends.

## Response of small grains, oilseed, and forage crops to pest damage

Sultan Begna, Dennis Fielding

purpose

The objective of this project is to measure several parameters of plant growth in relation to biotic (insects and weeds) and abiotic (moisture) stresses.

approach

Varying numbers of grasshoppers are caged with plants and the amount of leaf tissue consumed is measured. Water stress is induced by extending the time between waterings. Competition from weeds is studied by manipulating the number of weeds in the cage. In outdoor field studies, the amount of light intercepted and absorbed by the plant canopy will be measured in relation to defoliation by insects.

progress

Results of greenhouse experiments indicated that wheat and canola are more susceptible to grasshopper damage than barley or oats.

impact

This information will enable us to better estimate yield reductions due to grasshopper feeding and thus determine whether treatment is economically justified. Also, this information can be used to incorporate pest damage models into existing crop growth models, increasing their utility.

# Forest Sciences

## Assessing the vulnerability of human populations to wildfire in the Lake States

T. Scott Rupp, Robert Haight

purpose

The overall goal is to provide forest managers with a scientifically based decision support tool for prioritizing fire risk reduction activities in a regional, landscape, and local context.

approach

The risk of wildfire within the Lake States (Minnesota, Wisconsin, and Michigan) is high. Moreover, fire supression and forest management has led to uncharacteristically expansive tracts of fire-susceptible ecosystems with altered age-class distributions of short-lived species (e.g., jack pine and balsam fir), which produced serious forest health concerns resulting in increased fuel loadings, and hence fire risk. Using a Geographic Information System (GIS) we are developing new approaches to regional fire risk assessment that couple ecological and social factors into a fire risk and consequence model.

progress

We developed and analyzed maps of historical fire regime, current land cover, and U.S. census data on housing and population density, and identified vulnerable human settlement areas for a test region in northern Lower Michigan. This preliminary work was recently presented at the National Wildland Urban Interface Working Team Meeting in Minneapolis.

impact

Spatial data sets of community vulnerability to wildfire, based on analysis of biophysical-based fire risk, human settlement patterns, and suppression resources, will provide critical current and long-term fire risk information to fire management personnel and planners.

## Birch bark use in Alaska

Mark T. Fortunato, Edmond C. Packee, Sr.

purpose

People of the circumboreal north used birch bark to make baskets, plates, and pails. Today, emphasis has shifted from the utilitarian to items for sale to tourists and as *objets d'art*. Our objectives were to determine the extent of birch bark harvest, characteristics of trees harvested, amount of bark used per item, and retail price of items.

approach

Peeling activity along travel routes in the Tanana Valley was inventoried and distances of peeled trees from the road were measured with a laser. At three locations, the number of trees, peeled and unpeeled, and the diameter and length of bark peel were determined. An Alaska Native demonstrated basket construction from tree selection to finished product. Retail outlets were visited to determine square inches of bark per item and prices. This study is a natural resources management senior thesis project.

progress

Bark harvest occurs along all travel corridors and is more extensive than anticipated. Commercial harvesting occurs. No permits are obtained. Square inches of a peeled sheet of bark range from less than 100 to over 1200. Quality of finished items varies by artist. Retail price of individual items ranges from $20 to over $200.

impact

The information we are obtaining can be used to better manage bark harvest activity on public lands.

## Black spruce growth and yield

Edmond C. Packee, Sr., Carolyn Sheehy

purpose

No information exists concerning black spruce growth and yield in Alaska. Small black spruce has potential for production of phytochemicals, including high-value pharmaceuticals and ethanol. We began development of individual tree and stand volume tables and growth equations and a description of community chatracteristics.

approach

We developed productivity equations and volume tables using data on age characteristics, years-to-breast-height, stand volumes, and community characteristics. Regression will be used to construct volume and growth equations. See Permanent Sample Plots (PSPs); Northern Forest productivity, below. This study is a natural resources management M.S. thesis effort.

progress

Volume measurements were completed on 885 Tanana Valley trees; stump and breast-height age were determined for 450 trees. Two distinct types of stands, upland and lowland, were recognized. Potential stands for establishing PSPs were located.

impact

Volume tables are essential for calculating allowable harvests and biomass determination. Years-to-breast-height is essential for determining rotation ages.

## Black spruce tree growth and climate

Glenn Patrick Juday, Valerie Barber, Rob Solomon

purpose

We wished to compare previous findings on the relationship of temperature to the growth of black spruce in the Caribou-Poker Creeks Research Watershed (CPCRW) to newly sampled sites across central Alaska.

approach

We cut disk sections of black spruce trees at the base of the tree (ground surface level) and at breast height (4.5 feet), and measured ring width along two or three radii from the bark to the center of the tree. We correlated the mean growth per year of each sample site to the Fairbanks temperature and precipitation record.

progress

We sampled stands at Bonanza Creek Experimental Forest (Zasada Road), Toghotthele Corporation land, and Fort Wainwright-Badger Road. We found that early spring (April or May) temperature was the most significant predictor variable for black spruce growth at most of the newly sampled sites, as it was for trees at CPCRW. However, warm summer temperatures in the prior year had a strong negative effect on growth at several sites as well.

impact

The expanded sampling allows more accurate predictions of the climate-controlled amount of growth for the different sites that black spruce occupies. The equations developed allow the prediction of black spruce growth under different future climate scenarios.

## Carbon cropping—the contribution of tree uptake

Glenn Patrick Juday, Valerie Barber

purpose

With concern about the buildup of greenhouse gasses in the Earth's atmosphere, market exchanges have developed involving payments to forest land-owners for carbon uptake and storage by trees. This project is designed to determine the relative increase or decrease of carbon uptake by boreal forest species in Alaska under different climate scenarios, and the potential market value of this climate-related tree growth.

approach

We are applying equations that predict the relative increase or decrease of radial growth in white spruce, black spruce, and paper birch trees on different site types as affected by climate.

progress

Indexed tree growth vs. climate relationships have been developed for white spruce and black spruce for five climate scenario models. Several black spruce populations are showing negative effects of summer warming on growth, and on some sites warming in the 2.5 to 3 degree Celsius (4.5 to 5.4 degrees F) range results in a reduction in growth to zero, or the elimination of black spruce.

impact

Carbon cropping may be added to the mix of other important forest land uses in Alaska, such as fire management, wildlife habitat, wilderness, forest products, and non-traditional forest products. However, in order for carbon cropping to function (obtain carbon credits), reliable measurements agreed to by buyers and sellers are needed.

## Collaborative Research: an integrated approach to understanding the role of climate-vegetation-fire interactions in boreal forests responses to climatic change

T. Scott Rupp, Linda Brubaker, Patricia Anderson, Feng Sheng Hu

purpose

A problem facing scientists trying to predict responses of northern landscapes to climatic change is the extent to which the distribution of the boreal forest is driven solely by climatic factors or by feedbacks among climate, vegetation, and fire. Palynological records from central Alaska reveal a perfect, natural experiment to explore this issue. During the early Holocene, white spruce expanded rapidly into Alaska from northwest Canada, reaching its western limit in central Alaska approximately 9000 years ago. Within 500-1000 years, spruce populations declined or disappeared across a 1 million $km^2$ area and did not recolonize the region until 2000 years later.

approach

We will apply an integrated data-model approach to understand the mechanisms that caused a complex shift in spruce treeline in central Alaska during the early-to-mid Holocene.

progress

Field data collection and model development are underway with initial data analysis begun.

impact

The improved understanding of boreal forest-tundra dynamics in Alaska is an important step in understanding processes and mechanisms controlling circumarctic ecosystem responses to climate change. This approach, of explicitly linking paleo-data and modern ecological modeling, can act as a template to be used in other northern areas or adapted for more temperate regions.



## Collaborative research: modeling the role of high latitude terrestrial ecosystems in the arctic system: a retrospective analysis of Alaska as a regional system

A. David McGuire, T. Scott Rupp, David Verbyla, Donald Walker; Gordon Bonan, Amanda Lynch, James Maslanik, Wanli Wu; Jerry Mellilo; Steve Running, John Kimball; Charles Vorosmarty, Richard Lammers, Steve Frolking

purpose

Analyses by the Intergovernmental Panel on Climate Change (IPCC) project that buildup of greenhouse gases in the atmosphere is likely to lead to increases in mean annual temperature of between 1.0 and 3.0 degrees C by 2100, with increases greater at high latitudes. The responses of high latitude terrestrial ecosystems to global change have important consequences for the Arctic System that are associated with (a) water and energy exchange with the atmosphere, (b) the exchange of radiatively active gases with the atmosphere, and (c) the delivery of fresh water to the Arctic Ocean. We will evaluate the performance of a regional climate model, an ecosystem modeling framework, and a large-scale hydrological model.

approach

Our focus is on Alaska, which will allow us to assess how well the models close the water and energy budgets for the region, simulate exchange of $CO_2$ with the atmosphere, and evaluate the linkages between the atmosphere, the land, and the ocean.

progress

The first year of this study focused on recruitment of project personnel, sponsoring a workshop to interact with the project investigators, initial data set development, and preliminary component model evaluation.

impact

This study will provide a synthesis mechanism for field-based and modeling research in the Arctic and will

communicate results that can be used to direct future research on the Arctic System. State-of-the-art data set development will provide coherent data sets for other researchers. Model evaluation will establish credibility for applications of models to the pan-Arctic in future climate change scenarios.

## Development of a computer model for management of fuels, human-fire interactions, and wildland fires in the boreal forest of Alaska

T. Scott Rupp, Daniel Mann; Randi Jandt; Larry Vanderlinden; Layne Adams; Bruce Dale

purpose

Wildland fires threaten human values, but they also are crucial for the maintenance of forest ecosystems. How do we manage wildland fire in Alaska for the mutual benefit of humans and natural ecosystems?

approach

We are developing a computer model to assist land managers who design and implement fire-management plans in the boreal forest of interior Alaska. This model will integrate fuel buildup, vegetation, climate, and fire management policy with real geography over time scales of years, decades, and centuries.

progress

We have recruited a PhD student, Paul Duffy, and are currently recruiting an M.S. student. Our first field campaign was successfully completed. Model development is underway and focusing on interannual fire and vegetation dynamics.

impact

Our model will produce mapped depictions of changes in wildland fuels, fire risk, and vegetation under multiple future scenarios of fire management, climate change, and human development. The model will serve as an integrative and adaptive planning tool for land managers designing fire management plans that can safeguard both human and natural values.

## Early height growth of white spruce

Edmond C. Packee, Sr., Jamie Hollingsworth

purpose

How many years does it take white spruce to reach breast height (4.5 feet) in Alaska? Is early height growth (through 20 years of age) affected by distance between trees or overstory competition? Our objective is to determine 1) age for planted, open-grown and understory trees to reach breast height and 2) tree height at 20 years.

approach

For white spruce, Levels-of-Growing Stock (LOGS) plantations with five espacements (distance between trees) were established at Bonanza Creek (west of Fairbanks) and Red Fox (Tok). Overstory competition is removed regularly. Height growth is measured annually through age 20, thereafter at five-year intervals. LOGS research heights were compared to operational plantation heights.

progress

The penultimate M.S. thesis draft was submitted for final review. For open-grown white spruce, minimum average age to reach breast height is eight years on average or better quality sites.

impact

Data will better predict age at which planted white spruce reach breast height, free-to-grow status (overstory competition no longer a problem), and early growth trajectories for yield forecasts and ecological changes.

## Espacement effect on early diameter of white spruce stems

Craig W. Bosveld, Edmond C. Packee, Sr.

purpose

Growing space and age affect diameter growth of trees. The effect of espacement, distance between planted seedlings, on early diameter growth of white spruce is unknown for Alaska. Our objective is to determine the effect of espacement on diameter growth.

approach

Two Levels-of-Growing Stock plantations, established May 1986 west of Fairbanks with five espacements were measured to obtain 15-year breast high diameter. All trees at least 4.5 feet tall were measured to the nearest millimeter in spring 2001. Regression analysis will determine if statistically significant differences exist between the two plantations and between espacements. This study is a natural resources management senior thesis project.

progress

A literature review was completed. All trees were measured before the 2001 growing season. Preliminary analysis found a significant difference between the two plantations.

impact

Knowing diameter-espacement relationships addresses economics (planting costs), early wood quality (e.g., juvenile wood, knot size), and early growth (essential for forest stand prediction models)—information essential for forest management decisions.

## Evaluating influences of varied wildland fire regimes on caribou forage lichen abundance through state and transition models

T. Scott Rupp; Layne Adams, Kyle Joly; Bruce Dale, Bill Collins

purpose

Caribou wintering in boreal forest ecosystems of Alaska forage primarily on “climax” stage fruticose lichens. Wild-

land fires, however, chronically burn boreal forests, reducing the availability of forage lichens for decades. Factors affecting fire regime on caribou winter range may therefore influence caribou nutritional status by influencing availability of lichen.

approach

We chose to develop a spatially-explicit succession model to evaluate specific objectives relative to influences of various fire and climatic regimes on abundance and distribution of caribou forage lichens in the eastern Tanana Hills and Tetlin Flats.

progress

We developed a spatially-explicit model; we analyzed preliminary results and used them to further calibrate the model and implement climate change scenarios. These initial results will help guide the development of specific management scenarios.

impact

Changes in the frequency and distribution of wildland fires have obvious implications for caribou nutritional and population status. Exploring the influences of various fire regimes on caribou winter range will aid in addressing current management issues, as well as those in the foreseeable future.

## Evaluation of MODIS snow cover product in Alaska

Dave Verbyla

purpose

The main use of the snow cover product, or estimates, will be in a Dall sheep habitat model for Wrangell-St. Elias National Park. MODIS stands for Moderate Resolution Imaging Spectrometer and is a new sensor on board the TERRA satellite launched in spring 2000.

approach

We downloaded, reprojected, and merged the MODIS eight-day maximum snow cover grids for Alaska tiles. We visually examined the maximum snow cover for each eight-day composite period from May to September 2001 for obvious flaws.

progress

The snow cover estimate looked reasonable during the spring snow-melt period of May–June 2001. Unfortunately, the MODIS instrument experienced a power supply shutdown and did not take data beween June 15 and July 2, 2001. When it was restarted using a different power supply and electronics side A, the science lookup tables were from calibrations using electronics side B. This may have created erroneous estimates of snow cover, since maximum snow cover images from July and August 2001 had significant false detections of snow at low elevations, and wetland areas consistently misclassified as cloud for every composite period.

impact

Spring MODIS snow cover data prior to the power supply failure looked reasonably accurate throughout the state of Alaska, but after the power failure looked unreliable.

## Forest Vegetation Simulator (FVS) Model

Edmond C. Packee, Sr.

purpose



Today, forest managers utilize stand or individual tree models to forecast probable results of alternative silvicultural prescriptions. No such models are currently utilized on public and private lands in Alaska's Northern Forest. Our objectives are to select model(s) suitable for Alaska forests, determine data requirements, and initiate implementation.

approach

Through literature review and demonstrations we will select the most suitable model(s). Selection criteria include: quantitative and visual outputs, ability to handle wide range of silvicultural treatments, minimal data inputs, and user-friendliness.

progress

We selected the Forest Vegetation Simulator (FVS) model, which includes the Suppose and Stand Visualization Simulator (SVS). No variant exists for Alaska Northern Forest; it must be developed or adapted from an existing variant. We identified essential data and requested it from various forestland managers. The FVS was presented at a graduate/faculty seminar; planning was begun for a summer 2002 course.

impact

FVS provides current and post-prescription quantitative and visual results of treatment prescriptions that can provide the public with a clearer picture of silvicultural treatment outcomes and improve and support State of Alaska Forest Land Use Plan harvest options.

## Fuel load analysis and fire risk assessment for the Municipality of Anchorage

T. Scott Rupp, David Valentine; Sue Rodman

purpose

The Municipality of Anchorage encompasses 1956 square miles and has a population of 247,681, but only 204 square miles of the municipality is populated and the majority of the population squeezed into the Anchorage Bowl, an area that covers only 126 square miles. These areas have population densities of 756 and 1054 persons per square mile, respectively. The spruce bark beetle epidemic has killed thousands of spruce trees within Anchorage's wildland-urban interface, which makes the municipality extremely susceptible to wildfires that could cause considerable damage in terms of both property and human

life. To help prevent this, our goal is to model the expected fire behavior in the Anchorage wildland-urban interface and to identify fuel inputs that can be proactively managed so as to minimize Anchorage's risk and exposure to any such fire.

approach

We seek to inventory the fuels present in Anchorage's wildland-urban interface, create custom fuel models that accurately describe the fuels inventoried, model the expected fire behavior were a wildfire to occur in the wildland-urban interface under current forest conditions, and identify fuel conditions that should, according to our model, lessen the extent and/or intensity of the predicted fire.

progress

An M.S. student, Dan Cheyette, has been recruited and is currently inventorying fuel types across the Anchorage Bowl.

impact

Research has demonstrated that fuel management practices will reduce the predicted fire behavior. This research should be of immediate benefit to Anchorage fire managers who can use the results for that purpose.

## Gall aphids on Alaska white spruce

Jeffrey D. McArthur, Edmond C. Packee, Sr.

purpose

Gall-forming aphids, not true aphids, on planted white spruce may be a serious forest health and landscape problem because they can stunt growth, curl twigs, delay budburst, and cause small, brown abnormalities on branches. We sought to identify causal agent(s); determine infestation levels as related to espacement (distance between trees) and overstory shading in interior Alaska.

approach

Two Levels-of-Growing Stock plantations with five espacements were used. Each sample tree was divided into lower and upper crown sections and assigned an infestation level. Infestation levels for 8 x 8-foot espacement were compared with trees planted at the same time outside the plantations. Analysis of Variance and "t" test will be used to analyze data. This study is a natural resources management senior thesis project.

progress

A literature review is underway. Field sampling was completed and empty galls were sent to a specialist for insect identification. The seedlings were grown in Alaska, so insects are not imported. We will need to determine if planted seedlings have higher levels of infestation than natural seedlings.

impact

Results may influence nursery practices, seedling treatment, planted seedling espacement, or desirability of shade.

## Individual tree volume equations

Edmond C. Packee, Sr., Thomas Malone

purpose

Accurate tree volume equations are known to be essential for marketing fiber for products; oftentimes, the importance of accurate equations is overlooked for ecological uses including: biomass determinations, carbon-sequestration, biodiversity functions and processes. For Northern Forest species, existing equations are inadequate and no equations exist for black spruce, tamarack, or balsam poplar, Our goal is to develop new cubic-foot volume equations.

approach

We measure felled-tree diameters at four-foot intervals, calculate volumes for individual trees, and use regression to develop average tree volume tables.

progress

Where analyses suggested an inadequate sample, we measured 365 additional white spruce in the Delta area and sampled 20 aspen. (*See also* Black spruce growth and yield, *above*.)

impact

Improved equations will contribute to better or improved management practices, including growth and yield forecasts, forest fiber product sales, ecological modeling, and wildlife habitat manipulation.

## Lake level changes in southcentral Alaska

Brian Riordan, Dave Verbyla

purpose

The research is part of a NASA Land Cover Change project examining the impact of climate-related land cover change in Alaska.

approach

We used USGS maps, historic aerial photography, and satellite data to examine the change in the lake levels on the Kenai Peninsula and the Copper River Basin.

progress

We found significant, widespread lake level decline and loss of small ponds in both the Kenai Peninsula and the Copper River Basin from 1950 to 2000.

impact

The decrease in closed-basin ponds and lowering of lake levels may be due to an increase in regional evapotranspiration associated with climate warming, especially since the early 1980s. Both areas had dramatic increases in bark beetle infestations during the same period.

## Land cover change on the Seward Peninsula

C. S. Silapaswan, D. L. Verbyla, A. D. McGuire

purpose

The research is part of a NASA Land Cover Change project examining the impact of climate-related land cover change in Alaska.

approach

We used historic aerial photography and satellite data to estimate decadal-scale changes in vegetation cover on the Seward Peninsula.

progress

Satellite scenes were radiometrically and geometrically corrected for change vector analysis. Change vector analysis, unsupervised classification, and visual interpretation of historic aerial photography showed an increase in shrub cover. Advance of spruce tree line could not be detected by remote sensing methods.

impact

The increase in shrub cover estimated by remote sensing supports other studies that have shown an increase in tundra shrub cover associated with climate warming in the Arctic.

## Limits to white spruce growth at treeline: Nitrogen availability and forest floor characteristics both limit diameter growth

David Valentine, Steve Winslow

purpose

Near treeline in northwest Alaska, "forests" cling to precarious existences in galleries along rivers and in scattered patches in other sheltered areas; yet there are signs that the tree line may be advancing northward. Moreover, trees in the gallery forest along the Kugururok River have been growing more rapidly since around 1980. In July 1997, we had begun two complimentary experiments to address why.

approach

First, since nitrogen is the most frequently growth-limiting nutrient in ecosystems, we added 10 g m-2 nitrogen (as urea) to ten 100 $m^2$ plots. Second, since the forest floor may chemically (via plant chemistry) and physically (via thermal insulation) alter soil biogeochemistry and tree growth, we performed a series of manipulations of the forest floor in two-meter radius bands surrounding several individual trees. We reduced or increased the thickness of the forest floor, or added charcoal beneath it to adsorb potentially detrimental organic compounds, around each of five replicate trees.

progress

In 2001, we extracted increment cores to evaluate how trees responded to these manipulations (compared to untreated controls) based on changes in tree ring widths.

impact

Tree growth increased strongly following nitrogen additions and weakly following forest floor removal; tree growth was negatively affected by increasing forest floor thickness; and charcoal additions had no consistent effect on tree growth.

## Northern Forest productivity

Edmond C. Packee, Sr.

purpose

Using height-over-age curves called site index curves we assess the productivity of forestlands. Curves are not available for all Northern Forest species; existing 35-year-old curves are suspect. We published curves for balsam poplar and are working on new polymorphic site index curves for birch and aspen.

approach

Four healthy, vigorously growing trees are selected from pure, single-age stands at least 50 years old and of various productivities. Trees are felled and cut into four-foot sections; the age of each section is determined. Height-over-age curves are plotted and regression analysis is used to develop the site index curves.

progress

A paper relating poplar growth to landform and soils was published. Aspen site index curves are being finalized for publication in late 2002. Paper birch curves are being reworked. An additional 80 black spruce trees were sampled.

impact

Site index equations and curves permit objective assessment of site productivity for each species so that sites can be ranked for management and investment purposes.

## Permanent Sample Plots (PSPs)

Edmond C. Packee, Sr.

purpose

Long-term continuous inventory of forest stands is essential for forest management, wildlife habitat, ecological modeling and assessment, and carbon sequestration. Permanent Sample Plots (PSPs) provide essential data and are remeasured on a regular basis. The objective is to establish a network of PSPs throughout the Northern Forest of Alaska.

approach

Three 0.1-acre PSPs are established in a stand. Each PSP location is described: location, geology, topography, general soil characteristics. Individual trees are numbered and diameter, height, crown position, vigor, percent live crown are measured/remeasured. Non-tree species present and percent cover are described. Tree regeneration, by species, is counted on five subplots. The resulting database is used for statistical analyses. This study is a component of two natural resources management M.S. thesis efforts.

progress

We established 75 PSPs, bringing the total to 406 PSPs that represent 134 sites. We also completed five-year remeasurement for 12 PSPs (four stands). We aged 375 increment cores. We located 106 potential new PSP sites and initiated permit applications. Based on review data,

beginning in 2002, we will reduce minimum diameter of measured trees to 0.5 inches from 1.5 inches at breast height.

impact

PSPs and Selected Yield Plots—treatment plots—support development of improved yield equations, Forest Vegetation Simulator stand modeling, improved prescriptions for yield and wildlife habitat management, and testing of long-term ecological models addressing stand competition, processes, and biodiversity. PSP data and sites are available to other researchers.



## Phytochemicals from the Northern Forest

Edmond C. Packee, Sr.

purpose

Alaska's Northern Forest consists of high value fiber, but much is small-sized trees having little traditional value. Phytochemicals, chemicals derived from the forest, have high potential value as pharmaceuticals, human food components, industrial chemicals, and biofuels. The objective of this study is to determine potential (type, quality, and quantity) of chemicals contained in Northern Forest species, extractive processes, and markets.

approach

The effort primarily involves a review of the literature and contact with various scientists and entrepreneurs.

progress

Tree components (bark, wood, foliage, reproductive tissue) have different chemical properties. Bark of birch in Minnesota contains betulin or betulinic acid but the wood does not. Tests suggest that betulinic acid or betulin may cure herpes. The quantity of these and other chemicals in Alaska birch (different species) is unknown. We have initiated arrangements to compare Alaska birch with Minnesota birch. We completed a literature review on birch bark growth and renewal; final report anticipated in late 2002. Financing for a wood refinery is still being pursued.

impact

The extent of forest biomass available for phytochemicals suggests that the opportunity for family-size through large (350 ton/day) facilities and attendant employment is possible for Alaska. Ethanol for energy may be reduced to by-product status.

## A potential wildfire-feedback mechanism in the Alaskan boreal forest: do fire scars increase lightning activity?

Dorte Dissing, Scott Chambers, Dave Verbyla, John Yarie

purpose

We examine whether large changes in vegetation and surface properties caused by wildfires can enhance local atmospheric circulation patterns strongly enough to promote thunderstorm development.

approach

Using the Yukon Flats as a study area, we use radiant temperatures derived form satellite imagery in wildfire burn scars and adjacent unburned areas to represent the net radiation difference. Lightning strikes are used as an indicator of whether the mesoscale circulations reach a strength conducive to electric storm development.

progress

The biggest changes in lightning strike activity in and around the wildfire burn scars seem to happen 5–6 years after the fire. At this time, lightning activity decreases within most of the burn scars, and increases in 40% of the surrounding areas. The most influential factor in these changes is the extreme temperature differences between the still-warmer burned area and the unburned surroundings.

impact

This research has potential impact on global change scenarios, where predictions of an increase in temperature at high latitudes has lead to speculations on future increases in fire frequencies. This study addresses the idea that the presence of wildfires in an area of boreal forest can increase the potential for more wildfires.

## Practical GIS analysis

Dave Verbyla

purpose

As part of my sabbatical, I wrote a book, *Practical GIS Analysis,* and found a publisher (Taylor & Francis). Learning GIS can be overwhelming because there are thousands of GIS commands. My reason for writing this book was to teach conceptually how GIS tools work and how they can be used to solve practical spatial problems.

approach

The book uses exercise problems and solutions to teach GIS analytical tools at a conceptual level. It covers GIS data models, tabular analysis, point analysis, line analysis, network analysis, dynamic segmentation, polygon analysis, grid analysis, time-saving tips, and exercises in vector and grid applications. Since this is a practical guide independent of GIS hardware and software, the reader can learn how to solve GIS problems away from the computer.

progress

I successfully published the book, which is now available (distribution began in spring 2002).

impact

The book is the only practical guide with exercises and solutions to solving GIS problems using conceptual vector and grid GIS tools.

## Recreational use impacts on arctic wilderness lakeshore vegetation, Brooks Range, Alaska

Adam J. Liljeblad, Edmond C. Packee, Sr.

purpose

Camping may negatively affect shoreline plant communities of Walker Lake, a designated Wilderness Lake in the southern foothills of the Brooks Range and within Gates of the Arctic National Park and Preserve. The objective was to determine camping impacts on plant communities by comparing affected with unaffected sites for three distinct environmental settings: North (mature, open white spruce without aspen), South (young, open white spruce with aspen, and Peninsula (mature, open black spruce).

approach

Vegetation, species, and cover class for each environmental setting was sampled using a paired plot technique. Similarity indices and "t"-test for will be used for final analyses. This study is a natural resources management senior thesis project.

progress

The basic literature review is complete. Species composition and cover class were characterized and tree age cores collected.

impact

If camping negatively affects shoreline vegetation, managers can use information to address recreational-use impacts to indefinitely maintain biological diversity and the integrity of an area.

## Seedling tree growth in 2001 at Reserve West Plot

Glenn Patrick Juday, Rob Solomon

purpose

This study is a long-term monitoring project in the Bonanza Creek Experimental Forest Long-Term Ecological Research site that measures survival and height growth of seedlings and saplings in an area burned in the 1983 Rosie Creek Fire. Monitoring of the actual individual performance of a large population of seedlings is giving new insight to the process of and controls over forest development following disturbances such as fire and logging.

approach

All white spruce seedlings in a 100m by 100m hectare (2.47 acres) have been mapped and annual survival and height growth measured since 1988. All seedlings belong to the 1983, 1987, or 1990 seed crops.

progress

Mean 2001 growth of 1983 seed crop seedlings was nearly identical to growth in the 2000 season, which was the greatest of all years measured. The continued cool and relatively moist summer climate appears to be responsible for the excellent growth. We completed a re-evaluation of the assignments to age classes.

impact

Regenerating white spruce is generally the biggest reforestation problem in the boreal forest region. This project is providing a detailed look at what kind of forest develops following fire, the most important cause of disturbance in Alaska boreal forest, and what processes control new forest development in burned areas. With a sufficient number of years' data, predictive equations of white spruce height growth can be developed related to climate, seed crop year following fire, and other factors.



## Soil respiration following wildfire in interior Alaska forests (Frostfire)

David Valentine

purpose

The thick, mossy forest floor in boreal forests contains much more carbon than the vegetation or the forest floor of any other forest type. Periodic fires abruptly convert much of the forest floor into $CO_2$; subsequently, they also increase solar soil warming. Since warmer temperatures tend to accelerate soil respiration, we hypothesized that burned boreal forest soils would release more $CO_2$ than unburned ones.

approach

We used the Frostfire project's "experimental wildfire" to study how fire affects soil dynamics. Knowing where and roughly when the fire would occur gave us a unique opportunity to measure soil respiration before, during, and after the fire.

progress

Soil respiration initially decreased by ~50% in mixed hardwood stands and by ~15% in black spruce stands following the fire, in part because roots belonging to fire-killed trees no longer contributed. This difference has continued and grown since, suggesting that fire does not enhance heterotrophic respiration, and may decrease it. At the same time, a "standard" decomposition substrate lost mass more rapidly in burned sites than in unburned sites. These results suggest that respiration in burned sites may be limited by low substrate availability. M.S. candidate Sarah Masco is examining that possibility for her thesis research. We also are trying to separate the two major components of respiration (autotrophic and heterotrophic) so that we can more sensitively assess the impacts of fire on both.

impact

Our results contrast sharply with previous studies of fire in other ecosystems, which have generally found heterotrophic respiration was enhanced by fire. Future efforts to model carbon dynamics in boreal forest ecosystems will need to take this into account as they consider the role of fire in tipping the balance of boreal forests between $CO_2$ sink and source.

## Stand Density Indices (SDI) for Alaska's Northern Forest

John D. Shaw, Edmond C. Packee, Sr.

purpose

SDI is a measure of stand stocking, indexing stand density to the number of trees per acre when mean diameter equals 10 inches. It is independent of age and site quality. Our goal is to determine SDI maximum and self-thinning values for pure and mixed stands.

approach

We obtain basic data from existing plots (e.g., inventory, timber sale cruise, PSPs, LOGS) and collect supplemental data (stand basal area, tree diameters) from densely stocked stands. Finally, we calculate SDI values for pure and mixed species stands using the summation method.

progress

We obtained ±12,000 cruise, inventory, and research plots for our database. SDI values were calculated for 500 pure and mixed U.S. Forest Service inventory plots and our mixed-stand PSPs. Preliminary analyses suggest that the majority of Alaska stands are inadequately stocked and cannot sustain long-term, economical thinning regimes for fiber production.

impact

SDI are used to determine/predict stand competition, wildlife habitat, and fire management conditions and stand treatments (e.g., thinning). It is an essential component for the FVS model (*see* Forest Vegetation Simulator, *above*).

## Stream temperature response to timber harvest activities in interior Alaska

John D. Fox, Jr.

purpose

This project addresses three questions: Can ice bridges increase ice thickness such that fish or fish habitat might be negatively affected? How does summer water temperature vary with downstream distance regardless of local buffering by riparian vegetation? Can stream temperature be affected by broad-scale changes in watershed vegetative cover, independent of riparian buffers?

approach

Because stream water temperature and ice conditions are sensitive to complex interactions of many variables, we are focusing on models to explore the sensitivity of these systems to specific changes and the Alaska climate.

progress

We completed an annotated bibliography on ice thickness data and ice-bridge construction. Models of water temperature-dynamics are being modified or programmed. A multilayered model of ice growth with snow cover is being used to investigate ice growth under different ice-bridge management regimes and weather conditions.

impact

Areas of upwelling along salmon spawning streams are not good sites for ice bridge construction from an engineering and safety perspective. Project results also indicate that channel blockage due to ice growth under ice bridges would not be a problem where water depths are greater than two meters deep.

## Understanding the interactions between climate, vegetation and fire in Alaska, to identify current and future trends in fire frequency and extent

T. Scott Rupp; Randi Jandt

purpose

Understanding the interactions between climate, vegetation, and fire are crucial to development of sound wildfire prevention and use strategies, prescribed fire planning for hazard reduction at urban interface areas, and resource considerations of wildlife habitat and recreation area management.

approach

We will use a spatially explicit state and transition model of succession to simulate current and future fire regime in interior Alaska.

progress

A spatially-explicit model has been developed and preliminary results have been analyzed. These results were used to secure additional funding for a more detailed study (*see* Development of a computer model…, *above*).

impact

The model will allow land managers to identify current and future trends in fire frequency and extent across Alaska, and to identify the influence of fire management on vegetation pattern and the associated future fire regime.

# Geography

## An Alaska sense of place

Cary de Wit

purpose

This study explores frontier ideology as it is expressed in the Alaska cultural landscape through the display of frontier imagery and icons.

approach

By collecting samples of imagery from advertising, postcards, and other items marketed to tourists, and "vernacular" imagery and iconography that shows how Alaskans choose to represent themselves, I study non-residents' popular perceptions of Alaska and Alaskans' sense of place.

progress

I've collected hundreds of images and gave a presentation at the Association of American Geographers meeting in Los Angeles about frontier iconography in Alaska.

impact

How nonresidents imagine Alaska has a significant influence on their sentiments toward many issues relevant to Alaskans and to Americans, for instance: the balance between development and preservation. Specifically, such perceptions could have a major impact on decisions such as whether to allow snowmachines into the wilderness core of Denali National Park, or whether the Arctic National Wildlife Refuge should be opened to oil exploration and development. How residents conceive of themselves in the context of Alaska can have major impacts on their political outlook, voting behavior, environmental attitudes, and social values.

# Natural Resources Management

## The Alaska Public Land Planning Directory

Susan Todd

purpose

"Alaska—the Planned Frontier!" Perhaps no other state in the union has as much land planning as Alaska. This occurs because almost 90% of Alaska is managed by federal or state agencies. By law, agencies are required to prepare plans to inform and involve the public and to guide their activities.

approach

The Alaska Planning Directory provides a comprehensive review of the agencies, their planning goals and processes, and the opportunities for public involvement they provide. It also lists the plans they produced in the past, those currently in progress, and those scheduled for production in the near future.

progress and status

The directory is intended for anyone with questions on public land management in Alaska: the general public and tourists as well as professional planners, community leaders, business and development managers, and nonprofit groups. Prior editions of this publication (1985, 1987 and 1991) were distributed widely by the Cooperative Extension Service. The directory was completed in June 2001 and is now available as an AFES publication.

## Amchitka long-term stewardship: who are the stakeholders and how should they participate?

Robert Perkins, Susan Todd

purpose

In 1971, the the world's largest underground nuclear warhead was detonated about six miles below the surface of Amchitka Island in the Aleutian Chain. At the time, the Atomic Energy Commission thought this was an ideal place to test atomic bombs since it was far from urban centers. Attempts to stop the test were made in the U.S. Congress, and by the Aleut people and Greenpeace, but all three failed. The Atomic Energy Commission believed the radioactivity would be contained within the rock melted by the blast. However, in 1996, Greenpeace provided evidence that the island could be leaking radionuclides into the Bering Sea. Scientists have shown that it is probably not an ideal test site: the island lies within one of the most seismically active areas of the world, it is criss-crossed by many faults and it is also moving westward, rotating and probably breaking up in the process. However, at the current time, no monitoring is taking place to determine if the island is leaking.



The U.S. Department of Energy (DOE), which absorbed the Atomic Energy Commission, is required to prepare Long-Term Stewardship Plans for the nuclear waste sites under its jurisdiction. Amchitka Island is one of these sites. One of the requirements for such a plan (and the purpose of this project) is to determine who the stakeholders are and how they should participate.

approach

While determination is a typical first step in any planning effort, Amchitka is far from typical. First, the project has a much longer life span than most. Who are the stakeholders in this case, where radioactive pollution will be present for 10,000 years? Who can represent future generations?

progress

In 2001, we searched the literature for related experiences, such as the Marshall Islands atomic bomb test site, and prepared for a preliminary workshop of agencies, scientists and interest groups to take place in February 2002.

impact

The project will help determine both who should be involved and how they should be involved in developing the research plan and conducting long term monitoring.

## Are maps being used to their full potential in planning and environmental mediation?

Laura Walker, Susan Todd, Cary de Wit, Roger Pearson

purpose

The purpose of this research was to examine both the extent and the ways in which maps are used in planning and mediation.

approach

A web survey was developed in 2001 and sent by e-mail to planning agencies as well as nonprofit planning and mediation organizations. Respondents were asked to indicate how often they used maps for everything from orienting participants to developing an agreement in the form of a single negotiated map. They were also asked to

rank the relative importance of maps compared to text in developing an agreement and to suggest ways in which the use of maps could be improved.

progress

The survey closed in February of 2002 and results will be analyzed at that time.

impact



It is hoped that this study will create an awareness of the many ways maps can be used in both planning and mediation. This, in turn, should improve both the efficiency of planning and mediation and the likelihood of reaching agreement.

## Managing growth and resources at Toolik Field Station: a survey of users and personnel

Bill Toxvard, Susan Todd, Brian Barnes, and Terrence Cole

purpose

Toolik Field Station on the North Slope of Alaska grew considerably in the past decade. The maximum population at the research camp doubled and the number of research projects also increased. The purpose of this project was to assist in managing the growth of the station by asking for the opinions of those most familiar with it: the users and personnel of the station.

approach

The survey asked for their preferences in the following areas: facility priorities, a possible cap on station growth, attitudes toward "green utilities" that minimize the environmental impact of the station, water and wastewater management, and ways to control the impacts of the research itself.

progress

The survey and the analysis were completed in early December 2001.

impact

The results will assist the Toolik Field Station Steering and Science User Committees determine what, when, and how future improvements should be made.

## Poker Flats Rocket Range impact study

Joshua Greenberg, Hans Geier, Chuck Hamel, Mark Herrmann

purpose

We are producing an economic model of sectors affected by activities of the Poker Flats Rocket Range. Several scenarios will be modeled to gauge the impacts on the surrounding communities, as well as the state of Alaska.

approach

The specific research method used is regional economics, with special attention given to the Fairbanks North Star Borough IMPLAN input/output model.

progress

The Fairbanks North Star Borough input/output model was corrected using Alaska Department of Labor employment statistics, and specific information gathered from particularly affected industries. Additional data pertinent to the different activities carried out at Poker Flats was collected.

impact

The completed study will serve the Geophysical Institute and Poker Flats to calculate their economic effects on the Fairbanks North Star Borough and the State of Alaska.

## Reindeer herding in transition—economic impacts of the Alaska reindeer industry

Joshua Greenberg, Stefanie Moreland

purpose

This is part of an NSF-funded interdisciplinary project examining the unprecedented, massive influx of caribou from the Western Arctic Herd onto reindeer ranges on the Seward Peninsula, Alaska, during the last few years.

approach

The reindeer industry impact study is based on input-output analysis, constructing a Seward Peninsula regional economic model. This approach allows for a more complete representation of economic impacts by capturing the multiplier effect of changes in the reindeer industry to the regional economy.

progress

An IMPLAN input-output software regional impact model was developed for the region, incorporating a reindeer industry sector. This permitted the model to explicitly represent the interlinkages between the reindeer industry and other components of the regional economy.

impact

The Alaska reindeer industry is in trouble. This industry, which has been an important part of the Alaska Seward Peninsula economy for over a century, is being overwhelmed by an influx of caribou onto the Seward Peninsula. This study provides a measure of the impact that this industry decline has had, not only to the industry, but also to the broader regional economy. The developed input-output model can serve as an excellent planning tool in developing future strategies to revitalize the industry.

## Wild salmon risk insurance for Bristol Bay

Joshua Greenberg, Hans Geier, Mark Herrmann, Chuck Hamel

purpose

We explored the feasibility of crop insurance for Alaska wild salmon. UAF SALRM and SOM researchers provided the feasibility study for the pilot program to be implemented in Bristol Bay.

approach

The project was very complex, with a complete economic analysis of numerous scenarios and insurance programs. We investigated application of a risk management program by USDA to the Bristol Bay salmon fishery.

progress

SALRM and SOM researchers recommended, in a draft publication submitted to the Risk Management Agency, USDA, that at this time crop insurance may be inappropriate because it would provide the wrong incentives to a troubled fishery. We strongly recommended that the concept be revisited once economic health returns to the salmon fishing industry in Bristol Bay.

impact

While there will not be a pilot program for Bristol Bay this year, in the future, following fishery rationalization, such programs may become as important to fishermen as to farmers.

# Plant, Animal, and Soil Sciences

## Abandoned mined land revegetation monitoring

Dot Helm

purpose

Monitoring of state-directed revegetation on abandoned mined lands north of Palmer provides information to the Alaska Division of Mining, Land, and Water on what treatments may best be continued during ongoing revegetation projects.

approach

Selected sites have been permanently marked and are remeasured each year for cover or density of plants.

progress

Although woody species appeared to colonize in sufficient numbers for regeneration after five years regardless of whether the site was seeded or left unseeded to reduce competition with colonizers, more seedlings were found on the unseeded area. In a comparison among mineral and organic (slow-release) fertilizers, the organic fertilizers have not shown any benefit over mineral fertilizers.

impact

Results of this study are being used by the state for revegetation and may also help mining companies in their revegetation efforts.

## Arctic climate impact assessment

Glenn Patrick Juday

purpose

The Arctic Council, made up of representatives of the eight arctic nations, is sponsoring the Arctic Climatic Impact Assessment (ACIA), an international scientific synthesis of existing studies on the effects of climate change and increased ultraviolet light from ozone depletion in the arctic region. The Arctic experiences one of the most naturally variable climates in the world, and possible future climate warming is predicted to be greatest in the far north.

approach

The ACIA project summarizes current understanding of past climate changes and their effects, recent trends in climate in the Arctic, risks and vulnerabilities to society from climate change, and an analysis of the effects of five climate change scenarios. The ACIA project will publish a scientific synthesis book and a summary of policy-relevant findings. AFES is providing the lead author for the chapter on Forests, Land Management, and Agriculture

progress

An outline was adopted for the chapter, and contributing and consulting authors were selected. Coordination meetings with the executive and other chapter authors were held in Reykjavik, Iceland, and Ottawa, Canada.

impact

ACIA will serve as an important summary and information reference for the public, natural resource managers, and policy makers in anticipating, planning for, and dealing with consequences of climate change in the Arctic.

## Automated data harvesting, processing, and archiving

Darrell Blodgett, Greg Finstad

purpose

We sought to automate harvesting, processing, and archiving of data generated at remote sites.

approach

We used several programs for automation: Cron, a scheduling program, to schedule our automated events; WGET, a program for retrieving information from the Internet to harvest data from online sources; Unix shell scripting to combine data collection, processing, and archiving steps into one script; and a MYSQL database to store processed weather and satellite collar data.

progress

We now harvest our weather station data hourly and archive it daily from the Natural Resources Conservation Service Web site. We harvest caribou location maps from an Alaska Department of Fish and Game Web site and archive them as they are updated. Reindeer program satellite collar locations are sent directly to our server and automatically processed into a MYSQL database. We use this database to produce reindeer location maps, which are accessible to reindeer herders via the Internet.

impact

Information important to the Reindeer Research Program and our constituents is collected, processed, and archived without any human intervention.

## Baby greens grown at two spacings

Roseann Leiner

purpose

Alaskans can grow gourmet greens for salad mixes by cultivating young leaves of plants in the cabbage family (*Brassica* spp.).

approach



We planted seeds of fifteen cultivars of baby greens and compared two spacings, four or eight rows, on a bed two feet wide. We harvested individual leaves three to five weeks after planting.

progress

We saw an appealing variety of color, texture, and taste among leaves, but yield among cultivars was similar. We found that the quality of baby greens is dependent on gentle handling during harvest, washing, and transport.

impact

Since baby greens can easily be grown in Alaska, opportunities exist for specialty markets and home gardens to provide fresh, healthy salads in short cool seasons.

## Biological control of pink rot by *Trichoderma atroviride*

J. H. McBeath, P. A. Gay

purpose

Pink rot, caused by *Phytophthora erythroseptica*, is a serious disease on potato, especially during storage conditions. Recently, *P. erythroseptica* has developed fungicide resistance. There is no effective control of this disease. Use of a biological control agent may be a viable alternative in the management of this pathogen.

approach

Because the hyper-parasite *Trichoderma atroviride* can parasitize plant pathogenic fungi, including *P. erythroseptica*, we chose to study the biochemical interactions between *T. atroviride* and *P. erythroseptica*.

progress

Our research has shown *T. atroviride* is effective in controlling *P. erythroseptica*. *T. atroviride* has shown increases in glucanase activity and decreases in peroxidase activity. The enzymes produced inhibited growth in the fungus. Further studies are in progress to relate the coordinated enzymatic response of *T. atroviride* to biological control of *P. erythroseptica*.

impact

We can improve the use of *T. atroviride* as a biocontrol agent of plant diseases with greater understanding of the biochemical and physiological mechanisms underlying the control.

## Control of potato pink rot with fungal biocontrol agents

T. Yokogi, P. A. Gay, J. H. McBeath

purpose

Pink rot, caused by *Phytophthora erythoroseptica*, has become a problem in potato. The economic loss from the disease could be 30% and management has depended on fungicides. The discovery of fungicide-resistant P. erythroseptica has led to the need for alternative control methods.

approach

Many Trichoderma species restrict the growth of plant pathogens. Bioassays against *P. erythoseptica* with total extracellular filtrates from *Trichoderma atroviride* and *T. viren* (GL3) liquid culture were conducted.

progress and impact

The extracellular filtrates dramatically inhibited the growth of *P. erythroseptica*, which shows that Trichoderma metabolites are effective in the control of pink rot.

## Ectomycorrhizae on disturbed lands in southcentral and interior Alaska: a comparison of regional similarities and differences

Dot Helm

purpose

The primary objective of this project is to compare communities of fungi-root positive relations (ectomycorrhizae) in early successional sites across a latitudinal gradient in Alaska to determine whether there are similarities in species of ectomycorrhizal fungi and plant species to assess feasibility of a common inoculum or strategy for revegetation. Ectomycorrhizae are needed by most woody plant species in Alaska to grow in the wild, and they may be slow to form on nursery or greenhouse transplants used in revegetation.

approach

Roots and surrounding soil are collected in the field, washed in the laboratory, and morphotypes of root-fungi combinations are described and compared among early successional sites ranging from Kenai Peninsula to Brooks Range.

progress

More roots and surrounding soils were collected in 2001, and laboratory analyses continues on them. At least some mycorrhizal fungi appear the same across sites.

impact

Successful revegetation using woody species in Alaska usually requires formation of ectomycorrhizae. Inoculation with fungal propagules may facilitate this process, but it is unknown whether the inoculum source needs to be from the same latitude as the planting.

## Effects of *Trichoderma atroviride* on snow mold disease of turfgrasses in interior Alaska

J. H. McBeath, T. Yokogi

purpose

The Fairbanks Golf and Country Club has problems with snow mold disease. This project objective was to test *T. atroviride* in controlling snow mold disease on turfgrasses.

approach

A commerical product from Ag Tech† (Plant Helper), containing *T. atroviride,* was applied on nine golf greens. Tee boxes, fairways, and bunkers were left untreated. Disease surveys were conducted in spring.

progress

Untreated grasses had disease ranging from 52-100%, average of 88.8%. In contrast, *T. atroviride*-treated greens had little damage (0-16%, average of 2.4%) and so is a viable biocontrol agent for the control of snow mold disease on turfgrass.

impact

The use of an effective biocontrol agent means a reduction in the use of chemical fungicides.

## Efficacy tests of *Trichoderma atroviride* in controlling diseases on ginseng

J. H. McBeath; T. Parent; K. Baumann; R. Kreuger

purpose

This study was to determine the effects of *T. atroviride* in disease control on ginseng and to compare it to other biocontrol products.

approach

We sprayed a suspension of Plant Helper directly on one-year old seedlings of ginseng on the seedbed. We measured stand density and growth of seedlings.

progress

Plants growing in ginseng beds treated with Plant Helper were found significantly bigger and healthier. Ginseng roots harvested from beds treated with Soil Guard (a commercial product from Thermo Trilogy that uses *T. viren* GL21) were significantly larger than the untreated control, but roots harvested from plants grown with Plant Helper were larger than those with other treatments. Ginseng roots harvested from beds treated with Plant Helper were found free of soil particles, whereas visibly larger numbers of soil particles clung to roots growing in beds treated with Soil Guard.

impact

The product using *T. atroviride* was a more effective control agent than that using *T. viren*.

† Jenifer McBeath is the vice president for research and development for AgTech, maker of the product Plant Helper.

## Enzymes of *Trichoderma atroviride* associated with biocontrol of plant pathogenic fungi

M. Cheng, P. A. Gay, J. H. McBeath

purpose

Our objective was to determine the enzymatic responses of *T. atroviride* during the control of diverse plant pathogenic fungi to help determine the mechanisms of biocontrol.



approach

Four autoclaved plant pathogens (*Rhizoctonia solani, Phytophthora capsici, Botrytis cinerea,* and *Sclerotinia sclerotiorum*) were used as carbon sources to determine the induction of enzymes associated with biocontrol activity of *Trichoderma atroviride*.

progress

Results showed that the enzymes produced by *T. atroviride* depended on timing and were specific to the pathogen. Further studies are necessary to determine specific activities of individual isozymes for each enzymatic grouping produced by *T. atroviride* as a result of induction by different pathogens.

impact

This work is important for determining the biochemical mechanisms of fungal biocontrol agents.

## Greenhouse strawberries

Meriam Karlsson, Jeffrey Werner

purpose

Strawberries are classified based on day length requirements for flowering as short-day (June-bearer), long-day (ever-bearer) or day-neutral cultivars or selections. For greenhouse production systems, day-neutral types are commonly recommended. We evaluated strawberries for flowering and berry production under greenhouse conditions in Fairbanks from June to September.

approach

'Totem' (short-day), 'Quinault' (long-day) and 'Tristar' (day-neutral) were grown at eight hours, sixteen hours, and naturally long days.

progress

The eight-hour days resulted in no flowering or yield for any of the cultivars, including Totem, classified as a short day type. Totem only produced scarce flowering at naturally long days. Yield was significantly higher at naturally long days (1,130 grams) for Tristar than at 16-hour days (340 grams), despite the day neutral classification. The long-day type Quinault produced similar yields at 16-hour and naturally long days (1,445 grams).

impact

A controlled environment growing system provides opportunities to extend the growing season of locally produced fresh strawberries.

## Hydric soil properties of permafrost-affected soils in the boreal zone of interior Alaska

Chien-Lu Ping

purpose

The objectives of this research are to establish soil morphological indicators for hydric soils and to support the National Cooperative Soil Survey programs in interior Alaska.

approach

Soil morphological properties of selected sites in the Fairbanks and Nenana area were studied in detail and the soils were sampled for analysis. Then the soil morphological properties were used to calibrate with soil hydrology and temperature data.

progress

With the cooperation of the USDA's Natural Resources Conservation Service, the Tetlin Native Corporation, and Dr. Packee of the UAF Department of Forest Sciences, the study has been extended to the Yukon-Kuskokwim Delta, Northway, and the Tok areas.

impact

The results from this research can be used by the Natural Resources Conservation Service soil survey program to define soils of concern and by public agencies and the private sector to better delineate wetlands in interior Alaska.

## Improved file organization, management, and accessibility

Darrell Blodgett, Greg Finstad

purpose

Searching for and locating specific data or documents was inefficient for Reindeer Research Program users in Fairbanks, and impossible from Nome. A system for storing, finding, and accessing files among users and from remote locations was needed.

approach

We created an Internet-accessible file management system.

progress

We used a MYSQL database to store file information used to document and retrieve files. We created a file directory structure representing the many types of files we have on the reindeer research program's Linux server. We then manually inventoried our computer systems and uploaded files into the new online file management system.

impact

Reindeer Research Program personnel can now store and retrieve files using an Internet connection. Now data can more easily be shared with user groups and the public.

## Induction of proteins in biocontrol agents during control of several plant pathogens

P. A. Gay, J. H. McBeath

purpose

*Trichoderma atroviride* is a versatile, aggressive hyperparasite found in Alaska that acts against plant pathogenic fungi. Protein expression differences may give insight into how *T. atroviride* controls plant pathogenic fungi.

approach

Antagonistic assays have shown *T. atroviride* to be an effective biocontrol agent against *Botrytis cinerea* (gray mold), *Phytophthora erythroseptica* (pink rot) and *Rhizoctonia solani* (black scurf). Protein expression of *T. atroviride* was determined over time.

progress

At least fourteen unique proteins were identified in T. atroviride that were expressed in association with control of all three pathogens. Antifungal enzymes were increased in the presence of all three pathogens.

impact

This work is important for determining how fungal biocontrol agents may control plant diseases.

## Isolation of an endochitinase gene from fungal biocontrol agents implicated in the control of plant pathogens

P. A. Gay, M. Cheng, J. H. McBeath

purpose

Endochitinases have been implicated in the biocontrol of plant pathogens.

approach

Because some fungal endochitinases may inhibit plant pathogens, primers of an endochitinase gene were used to amplify corresponding genes of biocontrol fungi. We have isolated genes from *T. atroviride* using nucleic acid primers specifically designed to amplify a 42-kilodalton endochitinase using polymerase chain reaction.

progress

Genetic differences were found when the amplified products were compared. A 1.4 kilobase major amplification product was observed in most of the *T. atroviride* strains. Sequence analysis revealed 95% similarity to the 42 kD endochitinase gene from *T. atroviride* and differences in the genes between fungi were observed.

impact

These differences may be important in how endochitinases function in biocontrol fungi. This research will help determine how some fungi may control organisms that cause diseases in plants.

## Insect visitors and potential pollinators of lingonberries

Amy N. Davis, Patricia Holloway, James J. Kruse

purpose

This research project identified potential pollinators of lingonberries in the Tanana River floodplain.

approach

Hives of bumblelees and honeybees were established in open forested habitats to determine if addition of domestic pollinators would enhance fruit set.

progress

The most frequent insect visitors were domestic honeybees and bumblebees as well as native bumblebees, syrphid flies, andrenid bees, and wasps. Neither hive type improved fruit set or fruit quality in wild stands, even though honeybees and bumblebees visited the flowers.

impact

This research will assist the wild berry industry in managing wild stands of lingonberries for fruit production.

## Lettuce and cabbage cultivar trials

Roseann Leiner

purpose

Lettuce and cabbage grow well for fresh market in Alaska. We compared cultivars under the same growing conditions to see genetic differences among cultivars that are relevant to local production.

approach

In cooperation with growers in the Matanuska Valley, we transplanted fourteen cultivars of crisphead lettuce and twelve cultivars of green cabbage into plots in commercial fields to compare yield and quality in replicated trials.

progress

Several cultivars of lettuce show similar commercial potential to 'Alpha' and 'Premiere,' the cultivars commonly planted in Alaska. Three cultivars suited for winter production in California grew too large in the long days and will not be included in future trials. In cabbage trials, plants were susceptible to wirestem early in the season and gray mold on wrapper leaves in storage. More cabbage cultivars will be planted in the 2002 season.

impact

Some cultivars are better adapted to Alaska's long cool days than cultivars grown commercially in other states. These trials provide information on cultivars with potential for commercial cultivation in Alaska.

## Light quality and flowering of black-eyed Susan

Meriam Karlsson, Jeffrey Werner

purpose

Artificial lighting is required for high-latitude greenhouse and controlled-environment production. The wavelength distribution or the quality of supplemental lighting is essential for proper plant development. High-pressure sodium lamps are often used, although compared to daylight, the blue and far-red wavelengths are reduced. We sought to determine the quality of light necessary for optimal flowering.

approach

The ratio between red and far-red (R/FR) characterizes light quality at the longer wavelengths. There are slightly more red than far-red wavelengths in sunlight resulting in a R/FR value around 1.1, compared to 2.2 for high pressure sodium lamps. The importance of the R/FR ratio for flowering and development was determined for the dwarf selection 'Toto' of black-eyed Susan *(Rudbeckia hirta)*. Incandescent bulbs (R/FR = 0.75) were combined with high-pressure sodium lamps to modify the R/FR ratio.

progress

Black-eyed Susan grown under incandescent bulbs flowered 90 days from seeding. Daylight or the mixture of high-pressure sodium and incandescent light with R/FR of 0.9 resulted in five days slower flowering. Under the high-pressure sodium lamps, flowering was delayed 18 days compared to the incandescent environment.

impact

For efficient crop production in greenhouses and controlled environments, optimal light qualities are essential. Minor modifications of the commonly used high-pressure sodium environment bring about faster plant development and improved productivity similar to growing conditions with natural light.

## Locally produced feed ingredients for use in captive-reindeer diets

Carrie Bucki, Greg Finstad

purpose

We seek to develop a nutritious and cost-effective reindeer feed using Alaska-grown ingredients.

approach

Barley and fish byproducts produced in Alaska could be used as livestock feed. We evaluated winter reindeer production using diets containing two different barley varieties as the primary energy source, Thule and Finaska. We also determined the palatability of two protein sources, whitefish (currently used) and salmon meal (less expensive than whitefish) used in reindeer diets.

progress

Thual has higher digestibility and lower fiber content but higher production cost than Finaska. Reindeer fed Thual did not maintain a higher winter weight than reindeer fed Finaska. The deer demonstrated no preference for either protein type during the two-week trial.

impact

Thual barley, while appearing to be a higher quality feed ingredient, did not produce greater reindeer production

in winter. Thual is more expensive to produce than Finaska in Alaska, which suggests Finaska is a more economical ingredient to be utilized in winter reindeer diets.

Salmon meal, after further evaluation, may be used as a less expensive protein source in reindeer diets than current protein sources.



## Mulches for tree plantings in Alaska landscapes

Patricia Holloway, Grant Matheke

purpose and approach

Our goal was to establish long-term plots to evaluate organic (bark, wood chips) and inorganic (coal ash, basalt rock) mulches with and without landscape fabric on long-term growth of 'Shubert' chokecherry.

progress

After three years, all mulches yielded the same tree height and diameter, and none differed from a bare soil and turf grass control. The best mulch for weed control was wood chips, and all mulches increased soil moisture.

impact

This project will continue for seven years and will provide guidelines for tree planting that will benefit homeowners and landscapers in Interior Alaska.

## Long-term tillage practices and soil properties in central Alaska

Stephen D. Sparrow, Charles W. Knight, Carol E. Lewis

purpose

Our objective was to determine the effects of long-term tillage and small grain crop residue management practices on various soil chemical, physical, and biological properties in a subarctic environment.

approach

We cropped the study site to barley each year except for occasional years when chemical fallow was used to control perennial weeds. Tillage treatments consist of: 1) disk-twice (disked each autumn and spring) 2) disk-once (disked each spring) 3) chisel-plow (tilled with a chisel plow each fall) and 4) no-till (no tillage done). Crop residue management treatments consist of leaving all residues on the plots following harvest, removing loose residues but leaving standing stubble, or removing all aboveground residues. For purposes of this study, we sampled only the disk-twice, the disk-once, and the no-till treatments and the treatments with all crop residues removed or all crop residues left on the plots. Soil samples were collected in 1998 and 1999 in spring prior to all tillage operations and in fall following harvest. We analyzed soils for total carbon (C) and nitrogen (N), microbial biomass C and N, mineralizable C and N, pH, and wet aggregate stability.

progress

Results were highly variable, but in general, total C and N and mineralizable C were lowest in the disk-twice treatment and were similar in the disk-once and no-till treatments. Microbial biomass C was highest in the no-till and lowest in the disk-twice treatment; microbial biomass N was little affected by tillage. Soil pH was not affected by tillage treatments. Soil aggregate stability was highest in no-till and lowest in the disk-twice treatment. Crop residue management had little effect on any of the soil properties measured.

impact

This research will help us to understand how crop and soil management practices affect important soil properties in a subarctic environment.

## No-till forage crop establishment in Alaska

S.D. Sparrow, R.G. Gavlak; M.T. Panciera

purpose

The objectives of this project were to evaluate the efficacy of no-till planting for establishing timothy, smooth bromegrass, or red clover, and effects of nitrogen fertilizer rate, seeding rate, or nurse crop on perennial forage crop establishment.

approach

We established no-till seeding rate, fertilizer rate, and nurse crop trials at six locations, representing various soil and climatic conditions.

progress

Direct seeding into established grass stands generally did not improve forage yields. Seeding rate and nitrogen rate (applied with the seed at planting) had little effect on establishment of newly seeded forages, but the nitrogen rate had significant, and sometimes dramatic, impact on forage yield in established stands. Grass yields were usually depressed significantly when nurse crop yields were high, but usually recovered in subsequent years to equal those planted without a nurse crop. Red clover did not establish under no-till at two of the sites, but did at a third site.

impact

Pasture and hay stands in Alaska periodically need to be renovated due to occasional winterkill and depletion over time. Dry spring conditions prevail in most of Alaska, making establishment of grasses difficult. Also, unprotected soils are subject to wind erosion due to strong spring winds common in many areas of Alaska. Thus, farmers need better methods for establishing grass stands in Alaska.

## Ovarian activity and bull management in farmed muskoxen

Jan Rowell, Marsha Sousa, Milan Shipka

purpose

Farming muskoxen for their underwool is an emergent industry in Alaska, and fundamental husbandry tools need to be developed. We investigated the importance of the bull presence in the hastening of fall breeding and tested a radiotelemetric system for heat detection.

approach

We used 21 muskox cows, divided into three groups of seven. The first group received radio transmitters and were put into harem on Aug. 1. The second group received radio transmitters and were put into harem on Aug. 22. The third group was separated from a bull throughout the normal breeding season. We collected blood samples twice weekly from all the muskox cows from July 24 until Oct. 2. We analysed the samples for progesterone, which indicates when the breeding season began for each individual, how synchronous this activity was within groups, and when each cow became pregnant. We also used progesterone to evaluate the accuracy of the radiotelemetric heat detection.

progress

The onset of the first fertile estrus cycle differed significantly between all three groups. Cows put in harem early came into estrus and bred earlier than cows put into harem late. However, the time from bull introduction to the beginning of breeding season was shorter when the harem was formed late. Estrus was synchronized in both harem groups but spread over 24 days in the group with no bull present. The onset of the breeding season was delayed in the absence of a bull. The radiotelemetric heat detection correctly identified estrus in 18 of 19 instances. The system failed to detect mounting and mating in one cow. Mounting behavior was more frequent at night and occurred least frequently during the workday on the farm. Introducing the bull to a harem in mid-August shortened the breeding period to two weeks, four to six weeks shorter than the traditional harem period.

impact

This study is the first step in developing a successful bull management strategy for muskox farmers. Our data demonstrate the importance of the bull in stimulating ovarian activity and effecting the breeding season. We also showed that radiotelemetric system can be considered an excellent tool for estrus detection in breeding harems, both for the producer and future research.

## Peonies as field-grown cut flowers

Patricia Holloway. Janice Hanscom, Grant Matheke

purpose

We seek to determine the feasibility of growing peonies as cut flowers for export to European, Asian and American markets.

approach

Thirty cultivars of peonies were planted during the summer of 2001 in replicated trials. Data will be collected on survival, bloom time, bloom quality, and productivity during the next ten years.

progress and impact

Peonies bloom up to six weeks later in Fairbanks than in major production areas in the Lower 48. No peonies are sold in worldwide markets at the time they bloom in Fairbanks. This timing may provide a niche market for Alaska cut flower growers and allow for expansion into export markets.



## Producing forget-me-not

Meriam Karlsson, Jeffrey Werner

purpose

Forget-me-not flowers are often requested at events commemorating companionship, romance, and appreciation. As the state flower of Alaska, forget-me-not also generates local demand from visiting tourists, hotels, restaurants, and other public establishments. Production guidelines for optimal growing conditions need to be refined.

approach

Forget-me-not requires a cold treatment at approximately 40°F to flower. Some light is necessary for the plants to actively perceive the cold temperatures. Recent studies on other herbaceous perennials suggest the cold period is more efficient when combined with considerably higher irradiance than earlier recommended.

progress

Increasing the irradiance from 100 to 900 foot-candles during six weeks of 42°F resulted in eight to ten days slower flowering at 60°F. The plants at high irradiance during the cold period produced flowers on sturdier stems, making them more suitable for corsages, chaplets, and other floral arrangements.

impact

Production guidelines including irradiance and cold treatment parameters outlining the optimal growing conditions are necessary to consistently and efficiently produce high quality forget-me-not flowers to meet local demands at special occasions, holidays, and celebrations.

## Producing pansy

Meriam Karlsson, Jeffrey Werner

purpose

We sought to identify spectral light requirements for producing pansies under artificial light. Greenhouse conditions with artificial light often result in slower plant growth than natural daylight. Even after adjusting to similar daily quantities of light, daylight tends to more efficiently support crop development.

approach

Growth of pansies in daylight is compared with the commonly used growing environment of high pressure sodium lamps. In contrast to daylight, the composition of high pressure sodium light is limited in long far-red wavelengths. Light from incandescent bulbs is far-red enriched and therefore was included as a comparison.

progress

Pansies under the natural and incandescent light qualities flowered 65 days from seeding. In the high-pressure sodium environment, flowering was delayed more than three weeks. The growth habit under high-pressure sodium light also reflected the slower flower development.

impact

Supplementing far-red wavelengths to modify the light quality of high-pressure sodium lamps is expected to significantly improve overall plant growth and development in control environments.

## Reindeer bull introduction affects the onset of the breeding season

Milan Shipka, Janice Rowell, Marsha Sousa

purpose

We analyzed calving data from reindeer cows to document the timing and synchrony of calving in relation to the time cows were placed in harem the preceding fall.

approach

We put reindeer cows in harem on either Aug. 23 or Sept. 25 during the fall and documented calving dates during the following spring.

progress

We found that the early harem group had a more synchronized calving period of seven-days compared to the late harem group that had calves over a 31-day period. Gestation lengths ranged from 211 to 226 days.

impact

Gestation lengths varying by as much as 24 days was an unexpected finding in this study. Further research is necessary to evaluate the impact, if any, of variable gestation lengths on calf birth weights and calf survival. This in turn will have an effect on breeding management decisions.

## Reindeer radio telemetry

Greg Finstad

purpose

Locating and evaluating foraging patterns of free-ranging animals is critical to managing Alaska's reindeer industry. The Reindeer Research Program developed an animal location, GIS mapping, and Internet management system to locate and track reindeer.

approach

Locations of satellite and conventional VHF collars were obtained by the NOAA satellite system and fixed wing aircraft. The locations were mapped and placed on a special Web site where herders could access the information.

progress

Reindeer movements were monitored to determine home ranges, identify and evaluate preferred foraging areas, and establish seasonal movement patterns. Locations of collared reindeer were accessed by herders real-time through the Internet, and they based management decisions on this information.

impact

A more efficient management system is possible by integrating radio telemetry with traditional herding methods. Reindeer herders can monitor their herds for seasonal habitat usage or unexpected movements, and quickly make adjustments in herd location to use range resources more efficiently or to avoid migratory caribou. Researchers, land managers, and herders can obtain a consistent seasonal map of reindeer range utilization. Monitoring the behavior and survival of reindeer commingling with caribou may help us ameliorate the current reindeer/caribou conflict.

## Reindeer Research Program Educational Outreach Program

Carrie Bucki, Greg Finstad

purpose

The program is designed to increase awareness of the reindeer industry in Alaska: its history, economics, and the use of reindeer as a renewable resource.

approach

We visit local schools with Elsa, a halter-trained reindeer, and provide tours of the reindeer facilities on campus.

progress

We visited some new schools and schools that participated in previous years. We have continued advanced presentations at the high school level, emphasizing science and research questions in the area of reindeer biology. The tours of the captive reindeer facilities were added this year as a further hands-on component.

impact

Conducting tours to schools that have already participated in our slide show presentations reduces the need to explain the basics in reindeer biology and allows the tour guide to build upon what has already been covered in the classroom, augmenting a curriculum requirement on Alaska animals. We will offer a curriculum development course for local teachers in which they will develop a reindeer biology curriculum and be able to teach their students the same information that we present. This curriculum will be approved by the state of Alaska to fulfill the Alaska state standards.

## Salt tolerance of Alaska wildflowers, grasses, and weeds

Patricia Holloway, Amy N. Davis, Diane Hunt

purpose

We seek to determine the salt tolerance of plants that may be sown along roadsides and in revegetation projects at airports and mine sites throughout Alaska.

approach

Fifteen native plants and introduced weeds were planted in field plots during 2001. They will be treated with a variety of salts commonly used for de-icing along roadways and airport runways and mine sites. Seed germination will also be evaluated under saline conditions.

impact

This project will help resource managers evaluate species suitable for revegetation in areas treated with salts.

## Sclerotinia white mold on lettuce

Roseann Leiner

purpose

Lettuce and other vegetables are sometimes affected by white mold, a disease caused by the fungus *Sclerotinia sclerotiorum*. When lettuce is irrigated for good plant growth, the moist soil also promotes growth of small cup mushrooms (called apothecia) that release spores. The spores may land and grow into white mold on lettuce or many other broadleaved plants, such as cabbage, carrots, beans, sunflowers, and even petunias.

approach

In this study, some lettuce and cabbage heads were inoculated with white mold to measure the amount of black survival structures, called sclerotia, produced on plant tissue. The black sclerotia can overwinter in soil and cause white mold disease in future years.

progress

We found that one infected lettuce or cabbage plant may produce over a hundred black sclerotia if the plant is completely decomposed by *Sclerotinia sclerotiorum*.

impact

Since black sclerotia can overwinter in soil and cause white mold disease in future years, minimizing the number of black sclerotia in soil is an important part of disease control.

## Wet soils monitoring

Chien-Lu Ping, Ron Paetzold, Vladimir Romanovsky

purpose

Our purpose was to establish baseline data for soil temperature and soil moisture for long-term climate change and its effect on soils in Alaska.

approach

We set up monitoring stations to collect long-term soil climate data in arctic Alaska and in southeast, southcentral, and southwest Alaska, where there are active soil survey projects. The monitoring parameters include air and soil temperatures, soil moisture, wind speed and direction, and solar radiation.

progress

We found that soil temperature in arctic Alaska remains constantly below "biological zero" of 40°F during the growing season (July and August). During the field season of 2001, we added two monitoring stations in western Alaska near Aniak and one in the Nenana Valley agricultural area.

impact

The research provides soils data to the USDA-NRCS National Soil Survey Center soils database that is used to construct the Circumpolar Soils Map and the North America Carbon Map. The data are also used to define the soil climate regimes of Alaska and to formulate land use interpretations.

## Winter C-flux in arctic ecosystems under changing climates: effects of soil carbon and active layer dynamics

Chien-Lu Ping, Gary Michaelson, Vladimir Romanovsky

purpose

We explored the relationship between soil organic matter quality/quantity and winter soil respiration.

approach

We sampled a wide range of arctic soils, performed characterization analyses of soils and soil organic matter, and incubated soil at low temperatures to correlate $CO_2$ respiration with soil property and character of soil organic matter.

progress

Carbon dioxides evolved from soils incubated at temperatures as low as 20°F, indicating positive microbial activities during the winter. Large amounts of soil organic carbon (SOC) are found in both the active-layer and upper permafrost due to cryoturbation. This portion of SOC is not highly decomposed, and thus is susceptible to increased decomposition with warming winter and shoulder-season conditions such as those that are now being observed in arctic Alaska.

impact

This research provides a basis for future work to link terrestrial C-flux to soil C stocks and quality for the circumpolar Arctic, laying the soils groundwork for this link while providing important data to other global change research projects.

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# Faculty

## Current Faculty

### Donald E. Carling
Professor of Horticulture
Ph.D., Univ. of Missouri-Columbia, '75
pfdec@uaa.alaska.edu

### Kenneth A. Barrick
Assoc. Professor of Geography
Ph.D., Southern Illinois Univ., '83
ffkab@uaf.edu

### Cary W. de Wit
Asst. Professor of Geography
Ph.D., Univ. of Kansas, '97
ffcwd@uaf.edu

### Greg Finstad
Instructor and Program Manager
Reindeer Research Program
B.S., Univ. of Alaska Fairbanks, '81
ffglf@uaf.edu

### Peter J. Fix
Asst. Prof. of Outdoor Recreation Management
Ph.D., Colorado State Univ., '02
ffpjf@uaf.edu

### John D. Fox, Jr.
Assoc. Professor of Forestry
Ph.D., Univ. of Washington, '76
ffjdf@uaf.edu

### Joshua A. Greenberg
Assoc. Professor of Resource Economics
Ph.D., Washington State Univ., '90
ffjag@uaf.edu

### Norman R. Harris
Asst. Professor of Range Management
Ph.D., Oregon State University, '01
pfnrh@uaa.alaska.edu

### Dorothy J. Helm
Research Professor of Vegetation Ecology
Ph.D., Colorado State Univ., '81
pndjh@uaf.edu

### Patricia S. Holloway
Assoc. Professor of Horticulture
Ph.D., Univ. of Minnesota, '82
ffpsh@uaf.edu

### Glenn P. Juday
Professor of Forest Ecology
Ph.D., Oregon State Univ., '76
gjuday@lter.uaf.edu

### Meriam G. Karlsson
Professor of Horticulture
Ph.D., Michigan State University, '87
ffmgk@uaf.edu

### Carol E. Lewis
Dean, SALRM & Director, AFES
Professor of Resources Management
Ph.D., Georgetown Univ., '70
M.B.A., Univ. of Alaska Fairbanks, '76
ffcel@uaf.edu

### Roseann Leiner
Assist. Professor of Horticulture
Horticulture Extension Specialist
Ph.D., Cornell, '99
pfrml@uaa.Alaska.edu

### Jennifer H. McBeath
Professor of Plant Pathology
Ph.D., Rutgers Univ. '74
ffjhm@uaf.edu

### G. Allen Mitchell
Assoc. Dean, SALRM & Assoc. Director, AFES
Professor of Agronomy
Ph.D., Univ. of California, Riverside, '71
pfgam@uaa.alaska.edu

### Edmond C. Packee
Professor of Forest Management
Ph.D., Univ. of Minnesota, '76
ffecp@uaf.edu

### Chien-Lu Ping
Prof. of Agronomy, Soil Scientist
Ph.D., Washington State Univ., '73
pfclp@uaa.alaska.edu

### T. Scott Rupp
Asst. Professor of Forestry
Ph.D., Univ. of Alaska Fairbanks, '98
scott.rupp@uaf.edu

### Milan P. Shipka
Asst. Professor of Animal Science
Ph.D., Iowa State Univ., '96
ffmps@uaf.edu

### Elena B. Sparrow
Research Assoc. Prof. of Resource Management
Ph.D., Colorado State Univ., '73
ffebs@uaf.edu

### Stephen D. Sparrow, Jr.
Professor of Agronomy
Ph.D., Univ. of Minnesota, '81
stephen.sparrow@uaf.edu

### Sidney Stephens
Research Instructor
Global Change Program
M.Ed., Univ. of Alaska Fairbanks, '86
ffss1@uaf.edu

### Susan Todd
Assoc. Professor of Regional and Land Use Planning
Ph.D., Univ. of Michigan, '95
susan.todd@uaf.edu

### David Valentine
Asst. Professor of Forest Soils
Ph.D., Duke Univ., '90
ffdwv@uaf.edu

### David L. Verbyla
Professor of Geographic Information Systems
Ph.D., Utah State Univ., '88
dverbyla@lter.uaf.edu

### John A. Yarie
Professor of Silviculture
Ph.D., Univ. of British Columbia, '78
jyarie@lter.uaf.edu

## Emeriti

**Arthur L. Brundage**
Professor of Animal Science

**Robert A. Dieterich**
Professor of Veterinary Science

**Don H. Dinkel**
Professor of Plant Physiology

**James V. Drew**
Dean of SALRM, Director of AFES, & Professor of Agronomy

**Anthony F. Gasbarro**
Assoc. Professor of Forestry Extension

**Alan C. Epps**
Professor of Natural Resources

**Fredric Husby**
Dean of SARLM, Prof. of Animal Science

**Alan Jubenville**
Professor of Resource Management

**Leslie J. Klebesadel**
Professor of Agronomy

**Charles W. Knight**
Assoc. Professor of Agronomy

**Charles E. Logsdon**
Professor of Plant Pathology

**Jay D. McKendrick**
Professor of Agronomy

**William W. Mitchell**
Professor of Agronomy

**Bonita J. Neiland**
Professor of Land Resources and Botany

**Sigmund H. Restad**
Asst. Director, Alaska AFES

**Wayne C. Thomas**
Professor of Economics

**Keith Van Cleve**
Professor of Forestry (Soils)

**Robert B. Weeden**
Professor of Resources Management

**School of Agriculture and Land Resources Management**
University of Alaska Fairbanks
PO Box 757200
Fairbanks, AK 99775-7200



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