UAF School of Natural Resources & Agricultural Sciences

Agricultural & Forestry Experiment Station

Annual Report 2008

Ayla Ongtooguk-Guritz, two, with a peony growing in the experiment plots at the Georgeson Botantical Garden, on the Fairbanks Experiment Farm. AFES and SNRAS have been working with the School of Management and the Alaska Peony Growers Association on peony cultivation and marketing.

—photo by Nancy Tarnai

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

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P.O. Box 757200
Fairbanks, AK 99775-7200

fynrpub@uaf.edu

Subscriptions to our biannual research magazine, *Agroborealis,* are available free of charge. These and other publications are available in PDF. Please include your e-mail address if you would like notification of online availability of our periodicals and other publications. You may download them from our website at:

www.uaf.edu/snras/afes/pubs/

Our blog is kept updated regularly with news, announcements, research highlights, and more. Please see it at:

http://snras.blogspot.com

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UAF UNIVERSITY OF ALASKA FAIRBANKS

Contents:

Letter from the dean:

November 30, 2009

The Honorable Sean Parnell
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 Natural Resources and Agricultural Sciences, University of Alaska Fairbanks, for the period ending December 31, 2008. 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.

The research reports are organized according to our strategic plan, which focuses on high-latitude soils, high-latitude agriculture, natural resources use and allocation, ecosystems management, and geographic information. These areas cross department and unit lines, linking them and unifying the research. We have also included in our financial statement information on the special grants we receive. These special grants allow us to provide research and outreach that is targeted toward economic development in Alaska. Research conducted by our graduate and undergraduate students plays an important role in these grants and the impact they make on Alaska.

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 response 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.

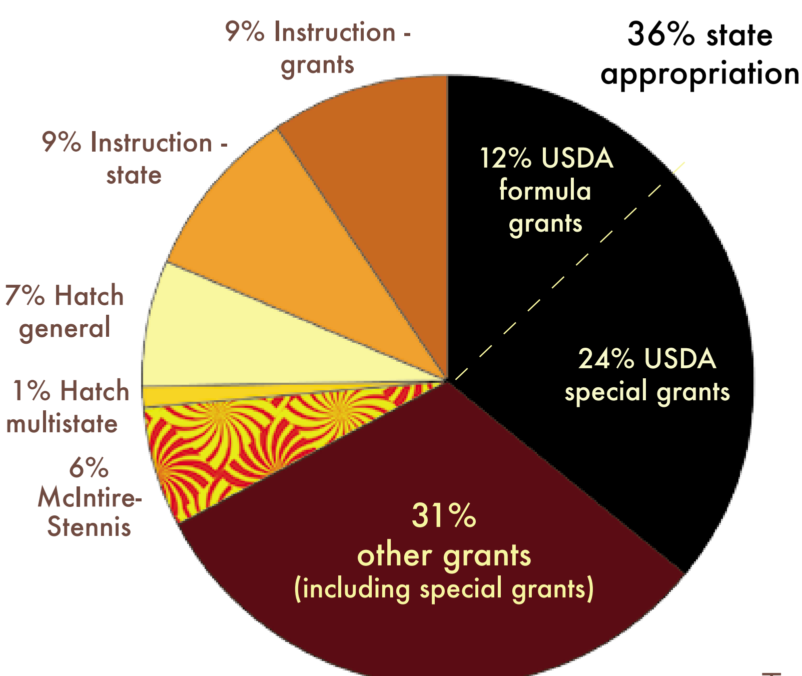
Administratively, AFES is an integral part of the School of Natural Resources and Agricultural Sciences at the University of Alaska Fairbanks. This association provides a direct link between research and teaching. Scientists who conduct research at the experiment station also teach, sharing their expertise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

Darleen Masiak driving a post in the willow study plot at the Fairbanks Experiment Farm. See report p. 24.
—AFES file photo

Financial statement

Expenditures: July 2008 through June 2009

The following statement of expenditures of federal and state funds for the fiscal year beginning July 1, 2008 and ending June 30, 2009 (FY 09) is not an accounting document.



Instruction - Grants
$1,224,226 (9%)

Instruction - State Appropriation
$1,157,077 (9%)

Hatch General Formula Funds
(federal) $895,198 (7%)

Hatch Multistate Formula Funds
(federal) $139,878 (1%)

McIntire-Stennis Formula Funds
(federal) $817,566 (6%)

Other Grants & Contracts
$4,076,751 (31%) (includes public service)

Research - State Appropriation
$4,661,856 (36%)
Matching USDA Formula Grants $1,598,127 (12%)
Research $3,063,729 (24%)

Total Funds: $12,972,552

Grants

GRANTS & CONTRACTS / SPECIAL FUNDS	PI	AGENCY
Small Pub. Water Sys Training & TA	Anderson	Dept. Environmental Protection Agency
Forest Wood Products Program V, VI, VII	Barber	Cooperative State Research Services CSRS
Dynamics of Change in AK's Boreal Forest	Chapin III	USDA Forest Service (ALB)
Forestry Research II, PNW	Chapin III	USDA Forest Service - Fairbanks
IGERT Regional Resilience and Adaption	Chapin III	National Science Foundation
Impacts High-Latitude Climate Change	Chapin III	National Science Foundation
LTER V and 2007, AK's Changing Boreal Forest	Chapin III	National Science Foundation
BP Liberty SEIS	Cronin	BP Exploration AK Inc
Alaska Sea Grant Omnibus 2006-2008	Cullenberg	NOAA
Food Product Dev. 2004	Dinstel	Cooperative Extension Services
NRCS Cooperative Agreement	Finstad	NRCS - Natural Resources Conservation Service
Seasonal Habitat & Diet Composition	Finstad	Bureau of Indian Affairs
Alaska Resident Statistics Program	Fix	USDA Forest Service (JFSL)
Alaska Resident Statistics Program	Fix	USDA Forest Service (Colorado)
CESU AK Resident Statistics Program	Fix	Bureau of Land Management
CESU BLM Visitor Satisfaction	Fix	Bureau of Land Management
Fish & Wildlife CESU Startup	Fix	Fish and Wildlife Service-US Dept of the Interior
Boeing Economic Impact Study	Geier	The Boeing Co.
Data to Improve Reg Econ Models	Geier	OAK Management, Inc.
Improve Regional Economic Models	Geier	OAK Management, Inc.
OAK Management II	Geier	OAK Management, Inc.
Regional Economic Data for SW AK	Geier	National Oceanic & Atmospheric Admin.
Near-Earth Remote Sensing	Harris	USDA Forest Service - Fairbanks
Predicting Ecosystem Trajectories	Hollingsworth	USDA Forest Service (PNWR Oregon)
GBG Children's Garden	Holloway	UA Foundation
GBG Foundation	Holloway	UA Foundation
Drum Beats	Johnson	USDA CSREES
AK Boreal Forest - RWO 166	Juday	US Geological Survey
Berry Research, AK II	Karlsson	Cooperative State Research Services CSRS
Greenhouse Crop Production I, II, III	Karlsson	Cooperative State Research Services CSRS
Oil & Gas Development Impacts	Kofinas	USDI Minerals Management Services
On-Farm Variety Trials	Leiner	Organic Seed Alliance
Alaska Berries I, II	Lewis	Cooperative State Research Services CSRS
Alaska Ethnobotany I, II, III	Lewis	Cooperative State Research Services CSRS
Alaska Seed Growers' Assistance II, III	Lewis	Cooperative State Research Services CSRS
ARS DNA Sequence FY08	Lewis	USDA - Agricultural Research Service
ARS Support Task Order FY07	Lewis	USDA - Agricultural Research Service
ARS Telephone Task Order	Lewis	USDA, ARS
ARS Utilities Task Order	Lewis	USDA - Agricultural Research Service
Dean Discretionary Accounts - SNRAS	Lewis	UA Foundation

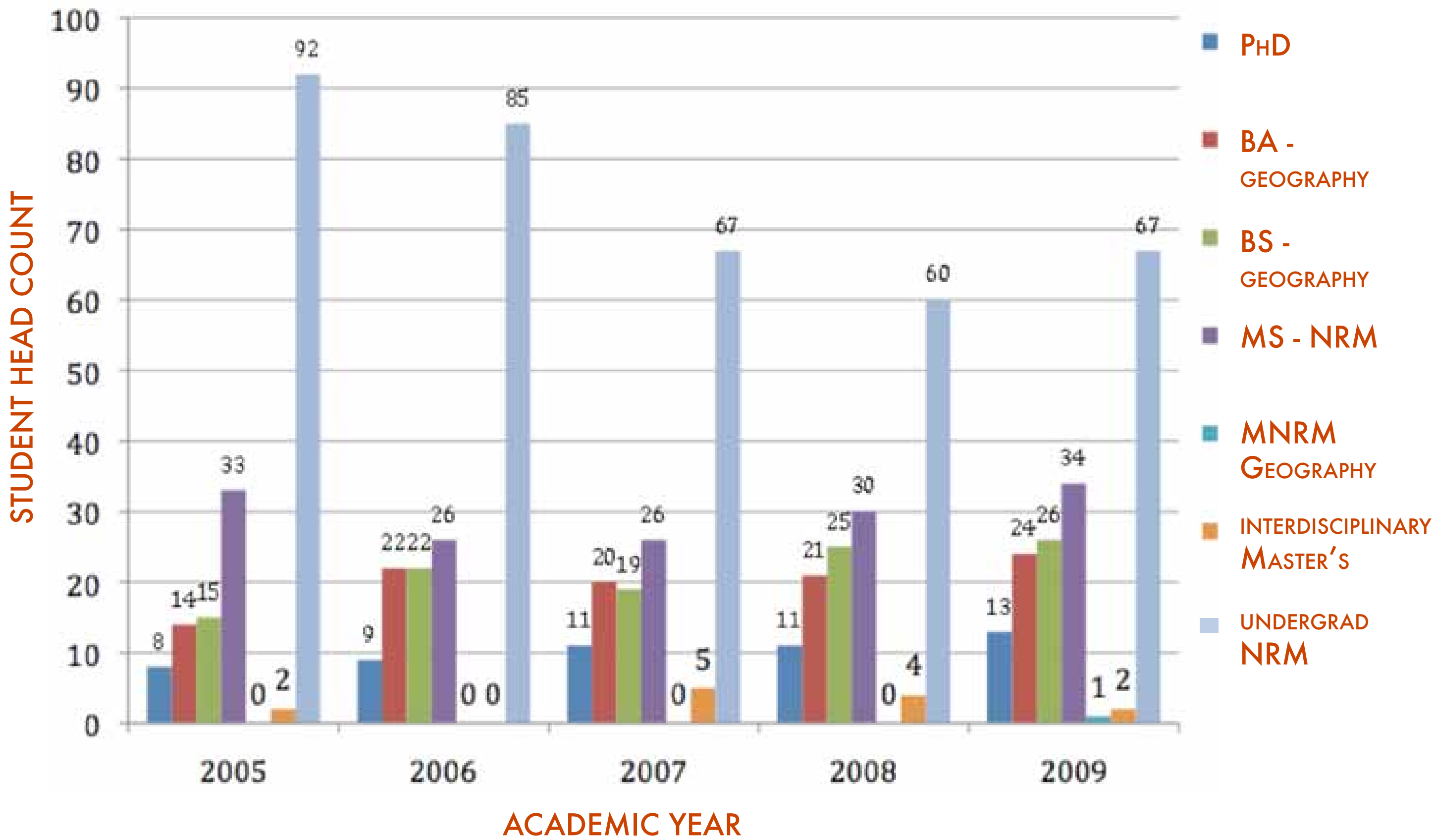
Denali Nat'l Park Soil Sample Analysis	Lewis	National Park Service - Denali Nat'l Park
DNA Task Order FY07	Lewis	USDA - Agricultural Research Service
Virus Free Potato Task Order FY06	Lewis	USDA - Agricultural Research Service
Potential Efficacy of 6th Grade MCC	Lipka	Department of Education
Returning the Gift	Lipka	Department of Education
Laboratory Testing for Import/Expor	McBeath	Alaska Department of Natural Resources
Palmer Task Order FY05	Mitchell, Jr.	USDA, ARS
Educational Technology Project	Perdue	UA Foundation
Flux and transform of carbon	Ping	National Science Foundation
NPS - Recruitment Program / Seminar	Pullar	National Park Service
CESU Connecting Landscapes	Rupp	Fish and Wildlife Service-US Dept of the Interior
CESU Modeling Fire Regimes	Rupp	National Park Service
Effects - Fuels Reduction Treatment	Rupp	Bureau of Land Management
Impacts of climate change on fire	Rupp	National Science Foundation
Joint Fire Science Project	Rupp	USDI Fish & Wildlife Service, Anchorage MS-235
Fish Oil Biodiesel Development	Sathivel	Alaska Energy Authority
EPSCoR Phase III- Resilience	Schweitzer	National Science Foundation
AK Geographic Alliance Ed Network	Sfraga	Nat'l Geographic Society
Barnett 2007 Lecture	Sfraga	UA Foundation
Stewart Lectures	Sfraga	UA Foundation
The UA and AT&T Alaska GeoPortal	Sfraga	Alascom Inc.
SNAP FY08	Sharpton	UA Foundation
Weather Related Vectors - Potatoes	Smeenk	USDA - Agricultural Research Service
Moisture Content Determination	Soria	USDA Forest Service - Juneau
Monitoring Seasons Through Community	Sparrow	National Science Foundation
Geospatial Science Learning	Stephens	National Science Foundation
CESU Remotely Monitor Ice	Verbyla	National Park Service
CIFAR 2nd Cooperative Agreement	Walsh	Nat'l Oceanic & Atmospheric Administration
White Sweetclover in Alaska	Wurtz	Montana State University
ARS Research Support Agreement	Zhang	USDA, ARS
Evaluating AK Whitefish By-Products	Zhang	USDA - Agricultural Research Service
New Crops for Alaska V, VI, VII	Lewis	Cooperative State Research Services CSRS
FORMULA FUNDING, FEDERAL OCT 1 TO SEPT 30 FISCAL YEAR		
Hatch Multistate		
Nitrogen Mineralization NC 1032, ALK 07-08	Zhang	USDA - Cooperative State Research and Extension Services
Rangeland Fragmentation W 1192, ALK 07-07	Joly	USDA - Cooperative State Research and Extension Services
Commercial Greenhouse NE-1017, ALK 07-10	Karlsson	USDA - Cooperative State Research and Extension Services
Regional Administration W-106 ALK #99-05	Lewis	USDA - Cooperative State Research and Extension Services
Livestock Production, W 1112, ALK 06-06	Shipka	USDA - Cooperative State Research and Extension Services

Continued on the next page

Hatch General		
Alternative Agronomic Crops for AK ALK#08-06	Zhang	USDA - Cooperative State Research and Extension Services
Yield & Quality of Barley ALK#04-03	Zhang	USDA - Cooperative State Research and Extension Services
Potato Phytoplasms ALK #07-13	McBeath	USDA - Cooperative State Research and Extension Services
Controlled Environment Horticulture for AK ALK 07-06	Karlsson	USDA - Cooperative State Research and Extension Services
Laws Affecting Environment ALK #05-01	Joly	USDA - Cooperative State Research and Extension Services
Horticultural Crop Production for AK ALK #08-01	Holloway	USDA - Cooperative State Research and Extension Services
Lignocellulosic Energy Crops	Sparrow	USDA - Cooperative State Research and Extension Services
Natural Resources & Economics, ALK 08-02	Greenberg	USDA - Cooperative State Research and Extension Services
Spatially Modeling Dist of Beef Cattle ALK# 03-03	Harris	USDA - Cooperative State Research and Extension Services
Black Spruce Forest Soils, ALK #03-02	Ping	USDA - Cooperative State Research and Extension Services
Reindeer Production & Meat Quality ALK#04-07	Finstad	USDA - Cooperative State Research and Extension Services
Season Extension for High Lat Garden Prod, ALK-08-04	Smeenk	USDA - Cooperative State Research and Extension Services
Administration ALK#99-01	Lewis	USDA - Cooperative State Research and Extension Services
Livestock Production, ALK# 06-06, W-1112	Shipka	USDA - Cooperative State Research and Extension Services
McIntire-Stennis		
Climate Sensitivity #07-12	Juday	USDA - Cooperative State Research and Extension Services
Sensitivity of Carbon ALK #07-11	Valentine	USDA - Cooperative State Research and Extension Services
Forest Stand, ALK #03-12	Liang	USDA - Cooperative State Research and Extension Services
Remote Sensing to Investigate Fire ALK #05-03	Verbyla	USDA - Cooperative State Research and Extension Services
Boreal Forest, ALK #05-04	Fox	USDA - Cooperative State Research and Extension Services
Forest Growth, ALK #06-04	Yarie	USDA - Cooperative State Research and Extension Services
Animal Health		
Mineral Flux in Reindeer ALK #03-07	Finstad	USDA - Cooperative State Research and Extension Services

Students

five-year statistics: number of students enrolled, 2005-2009



Graduates as of May 2009

**December 2008 degree recipient*
***Summer 2009 recipient*

Baccalaureate Degrees

Conor Brennan,* BA, Geography

Nelson Crone, BS, Geography: Environmental Studies

Andrea Devers, BA, Geography; BS Geography: Environmental Studies

David Ellsworth, BS, Natural Resources Management: Plant, Animal, and Soil Sciences

Keith Forte,* BA, Geography

Jessica Guritz,* BS, Natural Resources Management: Forestry, *magna cum laude*

Cassidee Hall Plunkard,** BS, Natural Resources Management: Forestry

David Hamm, BA, Geography

Larsen Hess, BS,* Natural Resources Management: Resources

Jennifer Kapla,* BS, Natural Resources Management: Plant, Animal, and Soil Sciences

Kandace Krejci, BS, Geography: Geographic Information Science and Technology

Cody Maxwell, BS, Natural Resources Management: Plant, Animal, and Soil Sciences, *cum laude*

Ronald Norman, BS, Natural Resources Management: Resources

Alice Orlich, BA, Geography, *cum laude*

Mia Peterburs,* BS, Natural Resources Management: Plant, Animal, and Soil Sciences

Kristen Shake, BS, Geography: Environmental Studies

Albert Sonafrank, BS, Natural Resources Management: Resources

Christopher Van Dyck, BA, Geography

Jesse Wells, BA, Geography

Master's Degrees

Erin Kelly, MS, Peace Corps International

Project Title: An assessment of the potential for developing ecotourism in the San Francisco Menendez sector of El Imposible National Park, El Salvador

BS, Saint Anselm College (New Hampshire), 2002

Lorene Lynn, MS

Thesis: Impacts of coastal erosion on soil properties of the Beaufort Sea coast, Alaska

BS, University of Alaska Fairbanks, 2006

Sarah Runck,* MS

Thesis: Sensitivity of boreal forest carbon dynamics to long-term (1989-2005) throughfall exclusion in Interior Alaska

BA, University of Alaska Fairbanks, 2003

Douglas Smart,* MS

Thesis: Remote sensing aspen leaf miner (*Phyllocnistis populiella chamb*) infestations near Ester Dome in Fairbanks, Alaska

BS, University of Maine, 1999

Quinn Tracy, MS

Thesis: Assessing utilitarian wildlife value orientations of Alaska residents: an urban and rural perspective

BA, University of Northern Colorado, 2002

Noreen Zaman,* MS

Thesis: Characterization of soils associated with black spruce (*Picea mariana* (P. Mill.) B.S.P.) in the boreal forest region of Alaska

BS, University of California Riverside, 2002

Doctoral Degrees

Chanda Meek,** PhD, Natural Resources and Sustainability

Thesis: Comparing marine mammal co-management regimes in Alaska: three aspects of institutional performance

Abstract: This study compares the policy implementation process for managing bowhead whale and polar bear subsistence hunting in Alaska, focusing on how and why agency approaches to conservation differ. The analysis centers on three aspects of institutional performance that drive policy outcomes: historical events, organizational culture, and relationships with stakeholders.

Major Professor: Dr. Gary Kofinas

BS, Marine Biology, Huxley College of the Environment, Western Washington University
MS, Environmental Studies, York University

Martha Raynolds,** PhD, Geobotany/Interdisciplinary

Thesis: Circumpolar Arctic Vegetation and Greenness: a spatial analysis of the distribution patterns and the effects of climate and substrate

Abstract: Analysis of the Circumpolar Arctic Vegetation Map (CAVM) with circumpolar data sets of a satellite vegetation index (NDVI) and environmental characteristics showed the importance of summer temperatures and landscape age in controlling the distribution of arctic vegetation. Results include maps and tables including original GIS layers of environmental characteristics (www.arcticatlas.org).

Major Professors: Dr. Dave Verbyla and Dr. Donald Walker

MS, Botany, Virginia Polytechnic Institute and State University, 1980
BA, Georgraph—Environmental Studies, Dartmouth College, 1978

Research Reports

The school and experiment station pursue their missions with faculty in four departments: High-Latitude Agriculture; Forest Sciences; Resources Management; and Geography. Research is also done in cooperation with the Agricultural Research Service and the Boreal Ecology Cooperative Research Unit. Crossing departments and units are five areas of emphasis: 1) geographic information; 2) high-latitude agriculture; 3) high-latitude soils; 4) management of ecosystems; and 5) natural resources use and allocation. Reports are organized within these major areas of emphasis, by SNRAS faculty author under subject focus. A detailed index with subject links is available at the end of this publication.

Section contents:

Partners & Collaborators

Agricultural Research Service

The Subarctic Agricultural Research Unit of the US Department of Agriculture (USDA) Agricultural Research Service (ARS) is hosted at the School of Natural Resources and Agricultural Sciences. *www.ars.usda.gov*

Alaska Berry Growers Association

The Alaska Berry Growers Association is a nonprofit organization focused on supporting the berry industry. It seeks to create jobs in rural Alaska through the production, harvest, and processing of wild berries. *www.abgrowers.com*

Alaska Center for Energy and Power

The Alaska Center for Energy and Power (ACEP), based at the University of Alaska in the Institute for Northern Engineering, is dedicated to applied energy research and testing. The center is focused on lowering the cost of energy throughout Alaska and developing economic opportunities for the state, its residents, and its industries. *www.uaf.edu/acep/*

Alaska Community Agriculture Association

This group of Alaska farmers and gardeners is a member-driven organization dedicated to supporting small and family-run farms primarily involved in growing food crops (animal and vegetable) for direct sale to the public. Its members are committed to working toward developing a sustainable regional/local food system with an emphasis on a regenerative form of agriculture. Volunteer members are working to create a formal organization that will help define and market community supported farming in Alaska and increase the state's food security. *http://akcommunityag.ning.com*

Alaska Peony Growers Association

This organization is made up of the state's peony growers, who are working to sell high-latitude peonies in national and international markets. *http://alaskapeonies.org*

Alaska Center for Climate Assessment & Policy

The Alaska Center for Climate Assessment and Policy (ACCAP) assesses the socio-economic and biophysical impacts of climate variability in Alaska, and makes this information available to local and regional decision makers, in an effort to improve the ability of Alaskans to adapt to a changing climate. *www.uaf.edu/accap/*

Alaska Climate Change Strategy

Formed in September 2007, the Alaska Climate Change Strategy is a subcabinet that advises the Office of the Governor on preparation and implementation of Alaska climate change strategy. It seeks to be of use to Alaskans by conveying state plans for adaptation to warming as well as presenting realistic approaches to mitigating the root causes of climate change. *www.climatechange.alaska.gov/*

AT&T

AT&T is the world's largest communications holding company, recognized as a leading worldwide provider of IP-based communications services to businesses and the top US provider of wireless, high-speed internet access, Wi-Fi, local and long distance voice, and directory publishing and advertising services. *www.att.com*

Boreal Ecosystem Cooperative Research Unit (BECRU) USDA Forest Service

This unit facilitates conservation and informed management decisions by conducting research to improve knowledge of high-altitude and high-latitude ecosystems. It provides support and coordinates and organizes research at the Bonanza Creek LTER and other research programs. Major research areas are biodiversity, climate/disturbance interactions, hierarchical scaling of processes, and improved forest harvest outcomes. The Alaska Region of the Forest Service works with the public to manage more than 22 million acres in southcentral and southeast Alaska. It is a leader in protecting the land's bounty while providing a place for people to work and play. *www.fs.fed.us/r10/* • *www.becru.uaf.edu/*

Chena Hot Springs Renewable Energy Center

The vision at Chena Hot Springs Resort is to become a self-sufficient community in terms of energy, food, heating, and fuel use. The resort is developing renewable energy and sustainable development projects and is forming partnerships within Alaska and across the US to promote and implement renewable technologies. *www.chenahotsprings.com*

Cold Climate Housing Research Center

CCHRC is an industry-based, nonprofit corporation created to facilitate the development, use, and testing of energy-efficient, durable, healthy, and cost-effective building technologies for Alaska and the world's cold climate regions. The research center was conceived and developed by members of the Alaska State Home Builders Association. w*ww.cchrc.org*

Cooperative Ecosystem Studies Unit (CESU) Network

The North and West Alaska Cooperative Ecosystem Studies Unit is a network of federal agencies, universities, and other organizations that have united in order to better facilitate research in local and regional ecosystems. The University of Alaska hosts the NWA-CESU. Research focuses on arctic and subarctic anthropology, landscapes, ecology, archaeology, and physical and biological sciences. *www.uaf.edu/snras/cesu/*

Cooperative Extension Service (CES)

The UAF Cooperative Extension Service is the state's gateway to its university system, serving 60,000 Alaskans annually, and providing a link between Alaska's diverse people and communities by interpreting and extending relevant university, research-based knowledge in an understandable and usable form to the public. *www.alaska.edu/uaf/ces/*

Google Earth

Millions of people use Google Earth and Google Maps to explore the world. Google Earth Outreach gives nonprofits and public benefit organizations knowledge and resources. Google sent a team of Googlers to Alaska who are passionate about education and whose goal is to make tools like Google Earth more accessible to educators. *www.earth.google.com*

Kawerak Reindeer Herders Association

The Kawerak Reindeer Herders Association provides assistance to its twenty-one members in the development of a viable reindeer industry, by enhancing the economic base for rural Alaska and improving the management of the herds. The program offers administrative, logistical, advocacy, and field support toward the development of a self-sustaining reindeer industry. *www.kawerak.org*

National Geographic Society

The National Geographic Society's Education Foundation funds an alliance in every state. The University of Alaska Geography Program is the home of the Alaska Geographic Alliance, and receives teaching materials which are distributed to schools throughout the state. The AGA participates in Geography Action!, Geography Awareness Week, My Wonderful World, the Giant Traveling Map program, NGS Summer Institutes, and the State Geographic Bee. *www.nationalgeographic.com/education/alliance*

Pike's Waterfront Lodge

The lodge turns over its greenhouses during the growing season to FFA students and university researchers who use the facilities to grow vegetables hydroponically. Nightly educational seminars are offered all summer, and produce is served in the adjacent restaurant. A farmstand sells produce to the public with all proceeds benefiting FFA. *www.pikeslodge.com*

Bonanza Creek Long-Term Ecological Research (LTER) program

This research program is located in the boreal forests of interior Alaska. Ecological research is conducted at two main facilities, Bonanza Creek Experimental Forest and Caribou-Poker Creeks Research Watershed. The LTER program is supported and hosted by the University of Alaska Fairbanks and the USDA Forest Service, Pacific Northwest Research Station in Fairbanks, Alaska. Major funding is provided by the National Science Foundation. The LTER program focuses on improving understanding of the long-term consequences of changing climate and disturbance regimes in the Alaska boreal forest by documenting the major controls over forest dynamics, biogeochemistry, and disturbance and their interactions in the face of a changing climate. *www.lter.uaf.edu/*

Forest Growth & Yield program

With a goal of best-practice forest management, UAF researchers in this program seek to provide the best scientific information. By setting up a system of permanent plots for long-term monitoring, foresters are providing data for growth and yield models. Nearly 200 plots are being actively studied in the Tanana Valley, Copper River Valley, Matanuska-Susitna Valley, and Kenai Peninsula. The growth models of major tree species define the density and diversity of the forests, and measure site index, growth equations, volume equations, and levels of growing stock. Research is focused on simulation and optimization, forest health, wildland fires, and climate change. UAF forestry specialists offer free consultations on forest management to all Alaskans, including Native corporations and the forest industry. *www.faculty.uaf.edu/ffjl2/FGY.html*

Global Learning and Observations to Benefit the Environment (GLOBE) program

GLOBE is a worldwide, hands-on, primary and secondary school-based science and education program. It promotes and supports students, teachers, and scientists to collaborate on inquiry-based investigations of the environment and the dynamics of the Earth system, working in close partnership with NASA and National Science Foundation Earth System Science Projects. The Alaska GLOBE program was established in 1996 through the Center for Global Change and Arctic Systems Research at the University of Alaska Fairbanks. *www.cgc.uaf.edu/Globe/default.html*

MapTEACH

MapTEACH is developing a culturally responsive geoscience education program for middle- and high-school students in Alaska that emphasizes hands-on experience with the geosciences and spatial technology (GPS, GIS, and remote sensing imagery). The project draws upon the combined expertise of teachers, education researchers, remote sensing specialists, geoscience professionals, Native elders, and others with traditions-based knowledge. Participants work directly with local experts and Alaska Division of Geological & Geophysical Survey scientists to authentically emulate scientific activities at a novice level, using real data in a real-world setting. Students and teachers have access to locally and culturally relevant geospatial IT curriculum facilitated by web-served imagery, geographic information systems data, analysis tools, and field resources. *www.mapteach.org*

Math in a Cultural Context (MCC)

Math in a Cultural Context is a supplemental elementary school math series. The math modules that compose MCC are the result of a collaboration of educators, Yup'ik elders and teachers, mathematicians and math educators, and Alaska school districts. This culturally relevant curriculum also includes traditional stories that accompany the math modules. This collaboration produces culturally relevant materials that connect local knowledge to school knowledge, and includes integrated materials (literacy, geography, and science). The reform-oriented curriculum is designed for Alaska students, has been extensively studied, and meets the highest research standards. Studies of its efficacy repeatedly show that MCC students outperform comparable control group students who use their regular math curriculum. It is one of the very few curricula for Alaska Native and Native American students that show such powerful results. *www.uaf.edu/mcc/*

OneTree

OneTree, a community outreach and research project coordinated by the UAF Wood Utilization Research Program, explores art and science through connections to a single tree. OneTree is based on an earlier project by the same name which got its start in 1998, when a single large oak was felled in the National Trust estate of Tatton Park in Cheshire, England. The OneTree project aims to show the unique value of woodlands and wood products by demonstrating the volume and quality of work that can be made from one tree. By focusing on a common goal—full utilization of a single tree—OneTree unleashes the breadth of creativity in its participants. *www.onetree.org.uk*

Reindeer Research Program (RRP)

The Reindeer Research Program is dedicated to the development and promotion of the reindeer industry on the Seward Peninsula and throughout Alaska. Researchers work closely with producers to develop and conduct research projects that can be applied directly to their operations. Outreach is a significant part of the program, which has strong ties to communities and schools across Alaska. Research includes meat science, animal health, range management and nutrition, use of satellite telemetry in herding, and many other production and management issues unique to the far north. *http://reindeer.salrm.uaf.edu/*

Resilience and Adaptation Program (RAP)

This program integrates several disciplines to address the question of sustainability, emphasizing ecology, economics, and culture: three critical factors for understanding interactions between people and their biotic environment in a regional system. It is part of a national effort to produce new models for graduate learning, the Integrative Graduate Education and Research Traineeship (IGERT) program of the National Science Foundation. RAP trains scholars, policymakers, and managers to address regional sustainability issues in an integrated fashion. *www.uaf.edu/rap/*

Scenarios Network for Alaska Planning (SNAP)

SNAP is a collaborative network of University of Alaska personnel and stakeholders from state, federal, and local agencies, industry and business partners, and nongovernmental organizations. The SNAP team, consisting of people with expertise in computer programming, database management, GIS and remote sensing, statistical analysis, and public communications, provides direct support to researchers and collaborators to create scenarios of future conditions in Alaska for more effective planning. *www.snap.uaf.edu/*

UAF Wood Utilization Research Program (WUR)

The long-term objective of the WUR Program is to help Alaska become competitive in the value-added forest products industry by providing specific technical, business, and marketing assistance. Proposals for new markets and new value-added products must take into account such economic factors as high costs of labor and transportation. Program research can potentially increase the volume of wood and nontimber forest products produced and marketed from Alaska's forests. *www.woodutilization.org*

Research Sites & Facilities

Delta Junction Field Research Site

This 300-acre site near Delta Junction provides space for research on tillage practices, soil fertility, cereal grains, oilseed crops, forage crops, insects and weed management, and management of Conservation Reserve Program lands.

Fairbanks Experiment Farm

The farm was established in 1906 and operations began in 1907. It includes 260 acres of cropland and 50 acres of forest land for research and demonstration projects. The farm houses a grain handling facility, feed mill, maintenance shop, combination greenhouse and agronomy lab, the Controlled Environment Agriculture Laboratory, the Georgeson Botanical Garden, the Reindeer Resarch Program, and two residences. Researchers conduct experiments on soil fertility, grains, grasses, energy crops, oilseeds, vegetables, perennials, herbs, and fruit and flower crops. The farm also provides feed crops for the 80-plus animal reindeer herd that is the subject for deer nutrition, reproduction, and meat quality studies.

Controlled Environment Agriculture Laboratory

Simple to highly advanced controlled environment systems—from temporary cold frames and high tunnels to facilities using technology developed for space exploration and missions to Mars—can be adapted to Alaska's regional conditions to improve production of vegetables, berries, and floral crops. Ongoing research at the Controlled Environment Agriculture Laboratory (CEAL) investigates plant requirements, varieties, and treatments to maximize productivity for growers. Unlike a greenhouse, the closed laboratory allows for precise control of lighting, temperature, humidity, and nutrients, so that different varieties and various treatments can be tested.

Georgeson Botanical Garden

This nationally recognized botanical garden is part of the Fairbanks Experiment Farm, and is a member of a national network of educational and research institutions dedicated to plant culture and conservation. In 2006 the GBG was the recipient of the All-America Selections Display Garden Exemplary Education Award. The GBG is one of five botanical gardens in the nation to be a satellite test garden for the International Hardy Fern Foundation. Garden staff test more than 1,000 trees, shrubs, and herbaceous perennials for hardiness each year, including Alaska native plants and those collected from China, Russia, and Iceland. The garden serves as a location for variety trials of annual flowers, vegetables, herbs, and fruits, where researchers conduct experiments on new horticultural crops for Alaska's conditions, such as peonies. *www.uaf.edu/snras/gbg/*

View of Lake ? at the Matanuska Experiment Farm.
—photo by Norman R. Harris

Palmer Research and Extension Center

The Palmer Research and Extension Center (PREC) embraces an expanding urban community while retaining the adventurous and independent spirit of the frontier for self-sufficiency and forging new trails and byways. The definition of agriculture worldwide has changed to include more than traditional agriculture, but also forest products, urban landscaping, sportsturf, agrotourism and recreation, lake and stream management for fish habitat, and nutrition and habitat for wildlife. The 1,000-acre PREC honors and continues the history of agricultural research, education, and outreach with its controlled environments, field horticulture, hay production, organic production fields, animal pastures, turfgrass demonstration plots, sportsturf rersearch, and wildlife nutrition research. It encompasses the Matanuska Experiment Farm, Kerttula Hall, the Biomass Energy Research and Development Laboratory, and the future Alaska Environmental Studies & Learning Park, Matanuska Colony History Center, and UAF Mountain Science Center. Neighbors of the PREC are important to its work, and lend themselves to the linkages between urban and suburban Alaska. The PREC connects Matanuska-Susitna Borough lands, UAA Matanuska-Susitna College lands, and State of Alaska lands in the Kepler-Bradley State Recreation Area. It links the existing, heavily used, trail system in surrounding communities with these lands.

Biomass Energy Research and Development Laboratory

This new facility focuses on the production of renewable hydrocarbons from biomass using thermochemical processing techniques. The efficient and sustainable use of biomass in Alaska is being addressed through gasification and liquefaction research involving agronomic and forest crops. By controlling the reaction conditions, adding or subtracting chemicals, changing pressures and temperatures, biomass is modified into a mixture of gas, solid, and liquid hydrocarbons. Researchers are investigating ways to convert the chemicals into more familiar types of hydrocarbons, analogous to petroleum. Biomass is the only renewable resource that can produce hydrocarbons. These substances, like those in petroleum, have the potential to be refined into fuel, plastics, resins, lubricants, synthetic medicines, and thousands of other hydrocarbon-based products. Obtaining them from biomass will not only provide Alaskans with a sustainable source for these compounds and help decrease dependence on petroleum, it should also provide the state with new industries.

Kerttula Hall

Kerttula Hall is the centerpiece of our education programs in southcentral Alaska. It is the center for many outreach, educational, and research partnerships with educational institutions and state and federal agencies, offering a connection to the largest transportation and communications hub in Alaska, and the headquarters for faculty who are involved in natural resources management, geography, business administration, and related fields. It is our research and laboratory facility, housing scientists whose fields range from soil science to plant science to wood chemistry. It serves as an important center for students who are studying to become leaders in the natural resource management and environmental issues facing Alaska.

Matanuska Experiment Farm

The farm provides a site in southcentral Alaska for research in sustainable agriculture, land reclamation, and other environmental issues. It includes 260 acres of cultivated land and 800 acres of uncultivated land for research or demonstration purposes. There are field and laboratory facilities for research on soils, plants, and livestock, a state-of-the-art biological laboratory, and a greenhouse facility operated by the USDA Arctic Research Service.

GEOGRAPHY PROVIDES a holistic view of the earth, its distinct and varied regions, as well as the types of, and interaction between, human activities and the physical world. Geography is the two-way bridge between the physical and social sciences, as it explores the interrelationships between the earth's physical and biological systems, and how these environmental systems provide a natural resource base for human societies. Geography also provides the framework for the integration of new and emerging technologies such as GIS and Remote Sensing with studies in a broad range of academic disciplines.

Geographers are interested in patterns and process of physical and social change including climate change, geographic information science and technologies, human settlement patterns, natural resources distribution and management, environmental studies, and in the inherent "sense of place" among peoples throughout the world. Geographic methodologies include observation, measurement, description, and analysis of places including likenesses, differences, interdependence, and importance.

GEOGRAPHIC INFORMATION REPORTS:

cultural geography

Determining the potential efficacy of sixth-grade Math in a Cultural Context

Jerry Lipka

purpose

The major purpose of this work is to:

• Determine through testing if five different sixth-grade modules in the Math in a Cultural Context (MCC) series have the potential to be effective;

• Conduct professional development workshops on these modules;

• Conduct and analyze the research findings;

• Improve one module (not yet published—The Kayak, on math statistics) and improve the professional development component of each module.

approach

There are five different sixth-grade modules in the MCC curriculum. One module was implemented in fall 2007 and two in spring 2008. Before teaching the module all teacher volunteers to the project are randomly assigned to teach one of two modules (this process began in spring 2008 and will continue until the project concludes its testing in fall 2009). Because teachers are randomly assigned to teach one module the project is able to compare their results, eliminating teacher factors. However, to ensure reliable data, the project tests classes to determine if different classes are comparable at the starting point (pretests).

progress

By the end of spring 2008 both of MCC's tested sixth-grade modules showed excellent results. Both modules, one on 3-D geometry and the other on probability, when compared to a control group, outperformed the control group at statistically significant levels. Further research will take place toward the end of the granting period when the results will be analyzed in multiple ways. At this time, these modules appear to have the potential to be effective.

impact

The MCC is one of the few programs that has systematically tested culturally-based materials (the math curriculum) and has produced positive results in favor of that curriculum. A study by Demmert and Towner noted that out of approximately 8,000 studies on culturally-based approaches to education, MCC was one of a few such programs to show statistically significant results. Further, the design of this study enables the project to understand the contribution of the MCC curriculum and the MCC pedagogical approach vs. the mainstream pedagogical approach, and vs. the curriculum in place (the regular curriculum). This work has direct implications for schooling in Alaska especially if the results of the forthcoming studies continue to show statistical significance when comparing MCC's curriculum intervention to the curriculum in place. This work also has implications for the field of culturally-based education, and to the larger field of educational reform in the state, nation, and other countries.

Returning the Elders' Gift: Systemic implementation of an effective culturally-based math curriculum and professional development program

Jerry Lipka

purpose

Math in a Cultural Context (MCC) is a long-term federally funded K-12 outreach and research program. It has been continually funded through competitive grants from the National Science Foundation and the US Department of Education. MCC has received two grants from the US Department of Education.

The major goals of Returning the Elders' Gift are to:

- Improve the academic (math) performance of elementary school students, particularly Alaska Native students;
- Implement MCC's curriculum and its professional development component to increase teachers' math pedagogical knowledge as a way to improve students' academic performance;
- Work with at least ten Alaska school districts.

approach

Since 2001 MCC has conducted a series of studies on the effectiveness of its curriculum. These studies have repeatedly shown that students using MCC's curriculum outperform students using their regular curriculum. These findings held in urban and rural areas of Alaska and were consistent across Alaska's diverse geographical and cultural regions. Based on approximately fifteen studies showing statistically significant findings in favor of MCC's curriculum, the major approach is to provide professional development training along with MCC's integrated math curriculum. To accomplish this MCC holds inservice workshops for school districts interested in using MCC; MCC also provides professional development workshops such as its Summer Math Institute (SMI) and Teacher Leadership workshops, and offers "E-live" courses (online courses).

progress

During 2007–2008 MCC/Returning the Gift worked with ten school districts. During this year, 776 students were directly affected by this grant, meaning that teachers implemented modules and students were tested. There were another 100-plus students who received MCC/Returning the Gift grant's instruction but did not test. This is a total student impact of 876 students. The project had a total of 291 participants (mostly teachers) at workshops. As well, MCC's data continues to show that students using its math curriculum continue to outperform students using their regular curriculum.

impact

Results from this project's ongoing testing of students in classes that use MCC's supplemental curriculum show repeatedly that MCC's second-grade curriculum series has a statistically significant advantage over the curriculum in place. This is particularly meaningful since repeated studies have more credence than single studies. This work has direct implications for assisting Alaska's schools, particularly rural school districts. Most of the districts using MCC are rural and noted by the state as not achieving the Adequate Yearly Progress target under the No Child Left Behind Act, so improvements such as the MCC curriculum are important. The implications of this work have been recognized within the state—Annie Blue, an elder who has worked with MCC for years, was one of the 2007–2008 recipients of the Honoring Alaska's Indigenous Literature Award.

Perceptual geography of Alaska

Cary de Wit

purpose

This project explores how popular perceptions of Alaska affect national opinions on Alaska political and environmental issues.

Where do popular perceptions of Alaska come from? Alaska is one of the most recognized states in the country, and yet one of the most inaccurately perceived. Since before Alaska statehood, news stories, popular books, popular films, and advertisements have filled American minds with images of Alaska as a wild, exotic land full of rustic sourdoughs, Eskimos, polar bears, and igloos. A remarkably consistent montage of Alaska imagery appears today on a national scale through advertising, postcards, placemats, greeting cards, product labels, magazines, television shows, and films.

The strength and persistence of these images in the American psyche, however inaccurate, can significantly influence national sentiments toward many salient political and environmental issues. Debates over pipeline development, snowmobile use, and oil exploration on federal lands in Alaska can be highly subject to American public perceptions, though most Americans have never visited, and never will visit, Alaska. The battles over these issues are largely battles to establish the prevailing national perception of Alaska.

approach

I collect imagery from advertising, postcards, films, television programs, and other sources of widely-disseminated images of Alaska, and categorize and analyze images according to source, intended purpose, location of production, and type of Alaska image portrayed.

progress

I continue to collect images for this project, and have begun to formulate an analysis structure and a set of perceptual themes in which to organize the images.

impact

This study will help those who are trying to educate the public on Alaska political and environmental issues to assess whether accurate perceptions of those issues are being conveyed to state and federal lawmakers and to the voting public, whether the citizens of Alaska or of the United States.

Stakeholders and climate change

Sidney Stephens; William Schneider (Curator of Oral History, UAF Rasmuson Library); Craig Gerlach (UAF Center for Cross Cultural Studies); David Atkinson (IARC)

purpose

The goals of this project are to enhance communication about climate change between the International Arctic Research Center and other science researchers, rural community members, and teachers so that the perspectives of each are shared; and to investigate how this approach and how existing or potential climate change resources or activities might further school and community dialog about this complex global and local issue.

approach

The project approach has two strands. Scientists are working with village councils and community members in Tanana, Fort Yukon, and Chalkyitsik to develop an understanding of local perceptions of climate change observations and impacts in the middle Yukon River watershed. Fieldwork and meetings in these communities and in Fairbanks will serve as the venue for these discussions. Some meetings and interviews will be video and audio recorded, produced in a web-based format with synchronized searching capabilities, and housed on the Climate Change Jukebox project website. Participant guidance on creation of public forums and web products will be key to our approach. Teacher review and discussion of this approach and of existing resources for place-based study of climate change will also be key elements of community visits.

Second, the project will survey teachers statewide and meet with a small leadership group to gain a broader understanding and prioritize the approaches, materials, and needs of teachers desiring to further pursue integrated climate change education in their classrooms.

progress

The majority of work to date has involved (1) building partnerships with science and social science researchers, educators, community members, and tribal and city councils; (2) preliminary conversations and interviews in Tanana and Fort Yukon; and (3) review of climate change education curriculum materials and drafting of a teacher survey. In Tanana, this work has taken the form of a diagram that captures local knowledge and uncertainty as well as capturing the perceived impacts of change on seasonal activities. Similar fieldwork during the summer in Tanana, Fort Yukon, and Chalkyitsik is planned.

impact

The exchange of information and perspectives between scientists/community members and teachers is expected to enhance mutual understanding of the complexities of climate change issues. The creation of a permanent and public record of program efforts may serve as a model for similar endeavors. There is also interest in the potential role of local observations for refining climate models to reflect local variability.

physical geography

Scenarios Network for Alaska Planning

T. Scott Rupp, Nancy Fresco, Mark Olson, Tim Glaser, Tom Kurkowski, Anna Springsteen; **Sarah Trainor** (SNRAS/Institute of Northern Engineering); and numerous other UA faculty members

purpose and approach

Most climate models predict that high latitudes will experience a much larger rise in temperature than the rest of the globe over the coming century. Indeed, substantial warming has already occurred at high northern latitudes over the last half-century, and arctic summers are now warmer than at any other time in the last 400 years. In addition to changes in climate, Alaska is undergoing rapid changes in human population and demands on natural resources. Environmental conditions are changing so rapidly in Alaska and surrounding seas that it is increasingly difficult to develop well-informed plans for such things as ocean navigation, pipelines, roads, urban expansion, community relocation, and management of fisheries and wildlife.

The Scenarios Network for Alaska Planning (SNAP; www.snap.uaf.edu—housed within the UA Geography Program) is a collaborative network, with a mission to provide timely access to scenarios of future conditions in Alaska addressing climatic, ecological, and economic change relevant to public decision-makers, communities, and industry. Initiated as part of UA's International Polar Year, and supported by the chancellor and vice chancellor for research at UAF, this UAF-based initiative is producing (1) geographically defined time series (e.g., maps; downscaled projections) of future conditions that are linked to present and past conditions, (2) objective interpretations of scenarios, and (3) detailed metadata and explanations of the models (including assumptions and uncertainties) that describe controls over projected changes.

progress

see following SNAP progress document

impact

SNAP is a pragmatic plan to facilitate integration of the University of Alaska's world-class high-latitude research capabilities and deliver timely information and interpretation of climatic, ecological, and economic change to public decision-makers (managers, policymakers, and planners), communities, and industry. The scenarios produced by SNAP and the data used to produce them will be openly available to all potential users, in accordance with the open-data policy of the International Polar Year. Because SNAP will be driven by Alaska user needs and will deliver the products to these users, it will serve as an end-to-end prototype for similar efforts in other geographical regions. By capitalizing upon the timing of the IPY, SNAP can position Alaska and the Arctic at the vanguard of climate applications relevant to planning and policy.

SNAP Progress Document

Introduction

The mission of SNAP includes not only creating innovative models of climate and land use scenarios in the context of rapid change, but also working closely with those who are most concerned and affected. Interpretation, assessment of uncertainty, and outreach to stakeholders are central to our purpose. Strong collaborations have been forged with diverse partners whose interests range from economics to ecology and from a single community to the whole state of Alaska. The SNAP team is currently working with a wide range of stakeholders, including borough governments, nonprofit organizations, and state and federal agencies. We also work in close collaboration with other University of Alaska groups, including the Alaska Center for Climate Assessment and Policy (ACCAP) and Cooperative Extension Service (CES). We regularly field questions from potential stakeholders and share our existing maps, graphs, and interpretive information. Below is a brief summary of these efforts.

Projects completed or in progress

SNAP and the Wilderness Society have completed projections for climate change in the Yukon Flats area. This project has now moved on to further refining results, including interpretation of the effects of these changes on the ecosystem.

The US Fish & Wildlife Service (FWS) is collaborating with SNAP on several investigations:

- Developing projections of growing season length, degree-days, precipitation-minus-evapotranspiration, potential evaporation, and drought indices statewide and by region. This project includes developing a dynamic data server and public world-wide-web interface linking currently available ecological data with downscaled climate model projections.
- Identifying ecologically important corridors and/or barriers that will affect connectivity in the context of climate change. The goal of this project is sustaining landscape level biodiversity in Alaska by ensuring connectivity into the future, given climate change. This is a consensus-driven product that includes participants from the Alaska Department of Fish & Game, US Geological Survey (USGS), National Park Service, ACCAP, Bureau of Land Management, and several nonprofits. The first workshop has already taken place.

SNAP is working with the Fairbanks North Star Borough as part of the newly formed Climate Change Task Force, which is planning for changes such as permafrost thaw, flooding, growing season length, and moisture balance, and their effects on infrastructure, agriculture, ecosystems, and the local economy.

In partnership with Susan Walker, a marine resources specialist and regional hydropower coordinator with the National Oceanic & Atmospheric Administration Habitat Conservation Division Alaska Region; municipal hydropower utilities managers; and researchers from IARC and the Water and Environmental Research Center; SNAP is helping assess whether recent precipitation and reservoir inflow anomalies in southeast Alaska are within the normal range of variability over the observational record, or whether they are evidence of a potential regime shift associated with climate change. SNAP's role is to provide long-term climate projections downscaled to the watersheds feeding pertinent reservoirs, help assess natural variability on seasonal-to-decadal scales, and help interpret the results of the study.

The US Forest Service Pacific Northwest Research Station is working with SNAP to create scenarios relating ecosystem services and climate change for southeast Alaska.

The Nature Conservancy is working with SNAP to produce monthly-resolution spatially explicit historical climate data and modeled projections for Alaska and the Northwest Territories, Canada, as well as daily temperature and precipitation extremes and threshold exceedence statistics, particularly as related to impacts such as fire, freeze/thaw timing, and evapotranspiration.

Projects being developed

The North Slope Borough plans to work with FWS, SNAP, and other partners to create a modeling tool that would help to predict the long-term cumulative impacts on the North Slope in the context of climate change and expanding natural resources development. FWS is currently actively seeking funding and partners for this project.

The National Park Service is interested in investigating changes in permafrost, interpretation of how these changes may impact infrastructure decisions, and impacts of climate change on visitor experience. These questions will be pursued if and when joint funding is secured.

Community connections

Individual cities, towns, and villages have expressed strong interest in climate projections and interpretation of those projections for their own communities. In some cases SNAP has been able to present to gatherings of community representatives.

At the Alaska Conference of Mayors we presented an overview of SNAP's mission, projects, and capabilities to a diverse audience.

We provided a brochure for the Alaska Municipal League Communities Conference on Climate Change. This document summarized projected statewide climate change impacts region by region, and included graphs specific to Delta, Barrow, Petersburg, Kenai, and Cold Bay. It was created in conjunction with the ACCAP and CES.

In conjunction with ACCAP, we presented information on SNAP to representatives from Kotzebue, Ambler, Kivalina, and Kobuk at a workshop on Planning and Preparing for Climate Change.

Based on specific requests received from each community, we prepared climate graphs, PowerPoint presentations, and maps for Homer, Fairbanks, Petersburg, Sitka, Cordova, Chistochina, Mentasta, and Juneau. In all cases, data were accompanied by metadata and interpretative text.

After being contacted by concerned utility operators in southeast Alaska, we communicated with representatives of Craig, Haines, and Skagway; Juneau; Petersburg; Ketchikan; and Sitka regarding climate projections for Southeast.

University connections

SNAP has been collaborating closely with CES on several projects. For the SNAP/FWS connectivity project, we solicited the assistance of Arlot (Bill) Hall as facilitator. In addition to working for CES, Hall is facilitator and lead developer for an Alaskan Center for Civic Dialogue. We worked with Robert Wheeler, a CES forestry specialist with a strong interest in climate change issues, in developing a brochure for the Alaska Municipal League.

Our work with IPY personnel includes projects with Jessica Cherry (IPY post-doc IARC) and Amy Tidwell (former IPY post-doc, now research faculty with INE Water and Environmental Research Center). Both are working closely with SNAP on the southeast Alaska hydropower project. Amy has also been involved in the discussions with FWS regarding the North Slope Borough project that is under development.

SNAP works closely with ACCAP via Sarah Trainor and Dan White. The two programs collaborate in reaching out to communities and otherwise broadening the scope of outreach efforts, as well as in sharing data and information and creating presentations and brochures.

On behalf of the SNAP/FWS connectivity project, Falk Huettman (Institute of Arctic Biology [IAB]) is developing an Alaska-specific model of vegetation and biome change over the next century, which will be used in corridor modeling, Brad Griffith and Dave McGuire (IAB, Alaska Department of Wildlife and Biology, and USGS) are working with SNAP data—in collaboration with Amalie Couvillion and Evie Whitten of the Nature Conservancy—regarding their modeling of climate change and caribou habitat.

We helped organize a climate change teach-in on the UAF campus in partnership with the student-led Sustainable Campus Task Force.

Other information requests and activities

We provided basic information on SNAP model development and products to Carl Markon of USGS.

SNAP met with Bill Leighty, representing the Millennium Institute, to discuss whether the institute's T21 model, if customized by the institute for a particular Alaska application and supplied with training by the Millennium Institute, would be a useful tool for composing an Alaska Energy Plan in the context on ongoing climate change.

SNAP serves in an advisory capacity for the Alaska Governor's Subcommittee on Climate Change.

Spatially modeling the distribution of beef cattle and reindeer on ranges at high latitudes in Alaska

Norman Harris, Beth Hall, Randy Fulweber, **Greg Finstad**

purpose

The promotion of meat animal production is culturally and economically important in Alaska. A better understanding of animal interactions with their environment will allow producers to optimize feed rations and minimize adverse impacts to the landscape.

approach

Observational and tracking collar data of domestic livestock, beef cattle, and semidomestic livestock, reindeer, are analyzed using spatial/temporal techniques to develop parameters specific to high-latitude areas for use with the KRESS predictive modeling program.

progress

Cattle activity patterns in other regions have been hypothesized to relate to factors such as day length and thermal stress. However, our analysis indicates that cattle in Alaska show similar activity patterns, indicating that activities seem to be unaffected by day length. Thermal stress has a spatial effect as to where animals rest and ruminate, but does not affect the timing of their activities. Data collection for a related project studying the relationship between thermal patterns and reindeer calving sites on the Seward Peninsula has been completed. A master's-level graduate student is analyzing thermal data and correlations with landscape features. A predictive model is being tested against a verification dataset of known animal positions to assess model performance. Results will be published as a master's thesis.

impact

These modeling efforts will give Alaska meat producers more tools for developing cost-effective animal management strategies by incorporating normal animal behavioral patterns and environmental factors. The resulting strategies will benefit local consumers by fostering further development of an Alaska-based meat industry.

Remote sensing techniques for the study of white sweet clover on the Matanuska River flood plain

Norman Harris, Beth Hall; Tricia Wurtz (USFS)

purpose

This study is directed at mapping, over time, infestations of white sweet clover (*Melilotus alba* Desr.) on the Matanuska River floodplain using near-earth remote sensing to detect changes in the population dynamics between sweet clover and native vegetation.

approach

From June through October, spectral data is acquired monthly, or as weather permits, from an altitude of 122m using a small, tethered, helium-filled blimp carrying two digital cameras, one collecting color and the other collecting infrared imagery. Images from both cameras are processed to create four-band spectral imagery which is then subjected to unsupervised and supervised classification techniques to identify targeted species. Photos are also photogrammetrically processed to create orthorectified mosaics of the study area using a dense ground control network.

progress

This was the fifth year of data collection for this study. Earlier analysis of spectral data indicated that white sweet clover was easiest to detect using visible-light spectral bands taken late in the growing season, September or October, when phenological differences between the white sweet clover and other vegetation were at their greatest. At the end of their biennial cycle, white sweet clover dies and turns pink-brown in color. Plants in their first year of growth remain green while the other floodplain vegetation exhibits a color change to shades of red or yellow. These phenological differences are not strongly linked to calendar dates but are dependent on environmental conditions. This year we focused on acquiring late-season imagery to better determine optimal timing for remote sensing imagery. Initial analysis indicates that white sweet clover does not readily invade intact ecosystems but relies on disturbance factors, predominantly flooding on this site, to remove existing vegetation so plants can establish with little competition for resources. We are continuing to study site population dynamics to test this hypothesis. We are currently incorporating high-resolution LIDAR data to refine a probability model for predicting areas susceptible to sweet clover infestation.

impact

Land managers can effectively and cost-efficiently use remote sensing data to detect and monitor major sweet clover infestations if the data is supported with ground based observations to detect proper phenological stages for imaging. Remote sensing is unlikely to detect initial infestations of scattered small plants. A probability model will allow land managers to better use scarce resources to combat the establishment of invasive species in critical habitats.

Cattle at the Matanuska Experiment Farm in Palmer, Alaska. Pioneer Peak is in the background.
—photo by Norman R. Harris

High-Latitude Agriculture

Agricultural research has a long history in Alaska: the first agricultural experiment station was established in 1898 in Sitka by the USDA. The experiment station has since become housed administratively within the University of Alaska, with Fairbanks the main research campus. Agriculture in the circumpolar world has always faced environmental extremes, not the least of which is the short growing season, but also economic challenges based on distance both to world markets and from the great food-growing regions of the world. Alaska has historically needed to import food from elsewhere, yet has rich soils and bountiful harvests that could sustain its population and even provide export crops and products—were an agricultural industry properly tailored and developed for it. Research in high-latitude agriculture helps circumpolar regions toward this goal of a sustainable industry, and provides insight and knowledge benefiting other regions. Alaska contributes unique cold-climate information to agricultural research topics that reflect national and international information needs, particularly in light of the rapidity of climate change effects in the circumpolar regions, acting as a potential bellwether for climate change in lower latitudes.

Research includes exploration and development of new crops and alternative livestock suited to the unique demands and opportunities afforded by high latitudes; controlled environment and greenhouse production systems; production, uses, and adaptive management pertaining to high-latitude crops and landscaping materials; adaptation of livestock production and marketing strategies to the rigors of high-latitude conditions; application of molecular technology and chemistry to northern plant materials and identification of value in new plant products; integrated pest management; marketing, quality control, and acceptance of Alaska agricultural products; revegetation of disturbed lands and treatment of waste products in cold climates; and biomass analysis and treatment for biofuels.

High-Latitude Agriculture reports:

The effect of forage variety on haylage quality and quantity in Alaska
Susan Spencer, Norman Harris, Beth Hall

Field production of bulb onions
Jeffrey Werner, Meriam Karlsson

Growing potatoes in the Tanana Valley
Jeffrey Werner, Meriam Karlsson

Photosynthetic rate in snap bean and corn
Meriam Karlsson, Jeffrey Werner

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Integrated pest management for Alaska agriculture
Alberto Pantoja, et al.

A survey of seed source and virus prevalence in small-scale Alaska potato production
Jeff Smeenk, Jodie Anderson

Distribution, transmission, and molecular characterization of potato phytoplasmas in Alaska
Jenifer H. McBeath

agricultural markets & products

Peonies as field grown cut flowers

Patricia S. Holloway, Nancy Robertson, Janice Hanscom, Shannon Pearce

purpose

The purpose of this project is to learn management strategies for field grown fresh cut peonies to support the peony cut flower industry in Alaska.

approach

Field plots were established from 2001–2003 at the Fairbanks Experiment Farm. Leaf samples were collected during 2007 and 2008 to verify the identity of a virus affecting plants obtained from an Oregon farm. Soil samples were also collected to learn if the transmission vector, Trichodorus nematodes, were present in field plots. One study was conducted to learn if ice packs keep flowers cool in transit for overnight shipping from Alaska. Shipping boxes from FedEx were prepared to hold 20 cut flower stems, four bunches of 20. Boxes were insulated with 1/4-inch foam packing sheets, and two ice packs were wrapped in newspaper and inserted into the boxes adjacent to the flower buds and resting on the stems. Control boxes had no packs. Thermocouples were inserted into the boxes next to the flowers and were compared with sensors outside the box. Boxes were held at room temperature for 48 hours. Boxes of 20 flowers were sent by overnight carrier to eight locations in Lower 48 states. Recipients returned digital photos of the flowers as they were received and commented on shelf life of the flowers after being placed in water.

progress

Virus identification was confirmed on the plants showing strong yellow mottling on the leaves. The tobacco rattle virus is found on peonies growing in the Pacific Northwest. It is transmitted by a nematode, *Trichodorus* sp. Soil samples showed no evidence of living *Trichodorus* nematodes six years after planting, although the pin nematode, *Paratylenchus*, occurred in numbers considered serious in Oregon mint fields. The pin nematode is not known to cause damage to peonies.

Studies with ice packs indicated that internal box temperatures did not differ significantly over the 48-hour test period. In the four trials, some box temperatures did not differ by more than 1-2 degrees (C) over room temperature. One box showed a temperature decrease of more than 5°C for 10 hours, but then temperatures reached room temperature. Boxes sent to Lower 48 recipients showed that flowers need to be secured tightly to the sides of the box or packed well to avoid damage and broken petals from shifting inside the box. We harvested the flowers at a stage that was too loose for transport even in overnight shipping. Despite many flowers blowing open and with very limp foliage, flowers recovered within two hours of being placed in water and lasted an average seven days, maximum ten days.

impact

There are 33 Alaska peony growers statewide, 13 of whom have at least 500 peonies in the ground. The baseline information collected in these studies is critical to the identification of best management practices for Alaska both in identifying potential pest problems and elucidating best methods of shipping a quality product to the Lower 48 and potentially world markets.

animal husbandry

Cattle genetics

M.A. Cronin, Milan Shipka; M.D. MacNeil (USDA); John Patton (Purdue Univ.)

purpose

Feral cattle on Chirikof Island, Alaska, have an uncertain ancestry. It has been hypothesized they are descended from ancient Russian cattle. If so, they may represent a unique germ plasm genetic resource. However, modern European breeds were imported to the island during the 1900s. Regardless of the source of the animals, the selection imposed under feral conditions and genetic drift on the isolated island may have resulted in a unique and useful gene pool. We have quantified the genetic variation in Chirikof Island cattle and compared them with other breeds, including Alaska cattle at the Matanuska Experiment Farm and those from private producers. The project is funded with a natural resources grant from the Alaska Legislature to SNRAS.

approach

We quantified genetic variation at thirty-four microsatellite DNA markers from the cattle gene map in Chirikof Island cattle and from several other breeds. We calculated genetic distances and inferred relationships between the Chirikof Island cattle and other breeds. We are also generating DNA sequence for mitochondrial and nuclear DNA.

progress

We have data from twenty-four Chirikof Island cattle and from ten other breeds. Additional samples were collected in 2006 from the university's cattle herd in Palmer and Larry DeVilbiss' Gallaway cattle. DNA has been extracted from these samples and they will be analyzed during summer 2009 at the ARS lab in Miles City, Montana. This project is part of the WERA 001 Multistate Research Project: Beef cattle breeding in the Western Region.

impact

Chirikof Island cattle may represent a valuable genetic resource, either because of unique ancestry or because of the selection imposed under feral conditions on the isolated island. The data may affect management decisions regarding use of the cattle on the island as a livestock resource, and whether to leave them on or remove them from Chirikof Island. The US Department of Agriculture rare breeds and germ plasm preservation program is very interested in this herd. Addition of other cattle will allow modern genetics to be applied to livestock in Alaska.

Elk genetics

M.A. Cronin; M.D. MacNeil (USDA); J.C. Patton (Purdue Univ.)

purpose

We developed methods for molecular genetic assessment of domestic elk, and to assess genetic variation and genetic components of performance trait variation in elk. The project is funded with a natural resources grant from the Alaska Legislature to SNRAS.

approach

We emulated the USDA research program for assessing quantitative trait loci in cattle to assess molecular genetic variation in elk and to determine associations or genetic variation and performance traits.

progress

Molecular data quantifying genetic variation in domestic and wild elk was previously generated. A manuscript was prepared and submitted for publication to the *Journal of Animal Science.*

impact

We have established a genetic database for Alaska domestic elk and begun work similar to that used to assess the genetics of cattle performance traits. This research and the resulting database may allow use of molecular genetics in domestic elk selection and breeding programs.

Fish bonemeal as a dietary supplement to increase weight gain and antler growth in reindeer

Greg Finstad, George Aguiar

purpose

A high-protein and mineral ration must be fed to farmed reindeer in the summer to support rapid growth of muscle and antler tissue. Various supplements can be used to increase protein levels in rations, but the Alaska fishing industry generates a relatively inexpensive fish bonemeal that has a high concentration of protein and minerals. However, palatabilities of a fish bonemeal-supplemented diet and effects on reindeer weight gain and antler growth are unknown.

approach

Body weight gain and antler growth of reindeer bulls and steers fed a fish bonemeal-supplemented ration (1 percent of the diet) were compared to animals fed a standard ration.

progress

The animals fed a fish bonemeal diet had numerically greater intake rates, greater weight gain, greater antler base circumference, and antler beam length than unsupplemented animals; however, the differences were not statistically significant.

impact

Farmed reindeer will readily consume rations supplemented with fish byproducts. Although there was limited improvement in reindeer performance through supplementation in this study, gains may be greater in animal production settings where the standard ration is of lower quality (protein and mineral concentration).

Meat science workshop in Nome, Alaska

Greg Finstad

purpose

Many people are harvesting animals in Alaska with limited knowledge on techniques to ensure the safety, wholesomeness, and optimum eating qualities of the meat.

approach

An animal harvesting and meat cutting workshop was developed and conducted by the Reindeer Research Program to demonstrate the proper pre-slaughter handling, slaughtering, gutting and skinning, processing and cooking of reindeer and game meat. Aging schedules, cutting guidelines, and cooking recommendations for each species were demonstrated and discussed during the workshops. Across species and within each carcass there are variations between muscles that dictate how the meat should be cut and prepared to give an optimal eating experience. Because of differences in tenderness, juiciness and flavor, meat should be processed and cut according to its final preparation such as steaks, roasts, stew, or ground meat.

progress

There is widespread interest across Alaska in the proper harvesting and processing of local meat resources. A workshop conducted in Nome, Alaska, was well attended. Other communities across the Seward Peninsula and urban areas have requested workshops.

impact

Harvesting and processing of local meat resources are important in Alaska. Providing the public with the proper methods to harvest, process, and cook particular species and cuts of meat will improve the likelihood of safe production and consumption of wholesome and high quality meat products.

A mobile slaughter unit as a meat science laboratory to support High Latitude Range Management curriculum

Greg Finstad, Lee Haugen

purpose

A mobile slaughter unit (MSU) was designed and built for use as a meat science laboratory to support the teaching of meat production courses in the High Latitude Range Management certificate program at the Northwest Campus.

approach

An MSU was designed with increased floor space to accommodate on-site observation and hands-on training of students in the slaughtering and processing of reindeer carcasses. The unit was also designed to function during cold weather and to be easily prepped for winter storage.

progress

The MSU has been completed and will be barged to Nome to support courses in fall 2009.

impact

The meat science laboratory will enhance economic opportunities for development of renewable resources, support careers in meat sciences and natural resource management, and provide instruction in product handling, packaging, marketing, and sales. This laboratory will be a critical link that integrates a local educational platform with animal production research, and provides the regional economy with a highly marketable product. An offshoot benefit of the MSU will be that it will provide the only university-level meat production instruction in Alaska.

Reindeer genetics

M.A. Cronin, Milan Shipka, Greg Finstad, Jan Rowell; M.D. MacNeil (USDA); J.C. Patton (Purdue Univ.)

purpose

We sought to develop methods for molecular genetic assessment of reindeer, and to assess genetic variation and genetic component of performance trait variation in reindeer. The project is funded with a natural resources grant from the Alaska Legislature to SNRAS.

approach

We are emulating the USDA research program for assessing quantitative trait loci in cattle to assess molecular genetic variation in reindeer and to determine associations or genetic variation and performance traits.

progress

We have established a genetic database for Alaska reindeer and begun work similar to that used to assess the genetics of cattle performance traits. Samples from the UAF reindeer herd were collected in 2006. In 2008 DNA was extracted by J.C. Patton at Purdue University and sent to the ARS lab in Miles City, Montana, and is awaiting analysis.

impact

The project will provide information for reindeer husbandry selection and breeding programs in Alaska. Parents of calves can be identified, which will aid in open-range management. In the long term, this will contribute to more efficient reindeer production.

Preliminary investigation into reindeer infertility

M.P. Shipka, J.E. Rowell, G.L. Finstad

purpose

Six female reindeer (between the ages of five and seven years) from the Reindeer Research Program were identified as having poor reproductive histories. All females had been placed in breeding harems every year but either failed to conceive and produce a calf in the spring or had an abortion or stillbirth.

approach

Four of the original six females remain, three that conceived to the synchronized estrous, producing two live calves and one stillbirth (with anatomical defects) and one that failed to conceive. All four females were pasture bred with the main herd. Females that fail to calve in spring 2009 will be slaughtered and the reproductive tracts collected for gross examination and histopathological collection.

progress

Zero out of four reindeer cows produced live calves during spring of 2009 following a breeding season that did not include estrous synchronization. This is considerably fewer successful pregnancies compared to spring 2008 calving histories of these cows following the breeding season that included estrous synchronization.

impact

This project provides observational information indicating that estrous synchronization may increase the likelihood of conception and successful birth of live calves in some reindeer cows with poor reproductive histories. Based on this study, the UAF Reindeer Research Program at the Agricultural & Forestry Experiment Station now considers estrous synchronization a viable tool for management of reindeer cows with life histories marked by reproductive failure. Estrous synchronization provides an opportunity to increase profitability for herd owners by increasing the number of reindeer cows that produce calves each year.

Reindeer milk composition can be changed through diet

Greg Finstad, George Aguiar

purpose

The cost of imported feed is a major factor in the profitability of livestock operations in Alaska. Domestic reindeer require a high energy and protein diet during summer, which is usually provided by a milled ration containing cereal grain and supplemental protein and minerals. However, reindeer can meet part of their summer nutrient requirements by grazing on pasture. Several varieties of grass can be grown in Alaska as pasture, but reindeer preference and the effects of consuming different pasture grasses on animal production are unknown.

approach

In this study we compared the effects of two pasture grasses typically grown in Alaska, *(Bromus inermis)* (smooth bromegrass, SBG) and *(Poa pratensis)* (Nugget bluegrass, NBG), on reindeer feed intake, growth of females and calves, and milk composition.

progress

Females and calves reduced intake of concentrate by 20 percent on SBG pasture and 16 percent on NBG pasture. Cow-calf groups gained significantly more weight (35.0 kg/cow-calf unit) on NBG pasture than pairs on SBG pasture (33.0 kg/cow-calf unit) or the control diet (32.5 kg/cow-calf unit). There was no difference in milk composition among all groups at the start of the trial, but females run on NBG pasture progressively produced milk with higher crude protein (10.7 percent) than either animals on SBG pasture (9.4 percent) or control animals (9.6 percent). Females run on NBG pasture produced milk with significantly lower lipid concentrations (15.0 percent) than those on SBG pasture (19.3 percent) or control animals (18.5 percent).

impact

Reindeer producers can now reduce feeding costs by running their animals on summer pasture, but can also influence milk composition and production by the variety of grass making up the pasture.

Supplemental feeding of reindeer in enclosures on the Seward Peninsula, Alaska

Greg Finstad, George Aguiar

purpose

Reindeer herders wish to increase control of their animals to reduce losses to outmigration with caribou and predation. Free-ranging reindeer were moved into an enclosure and their diet converted from natural forage to a milled ration composed mainly of cereal grains. The reindeer were fed a supplemental ration to promote human-animal bonding, to avoid predators, and to improve the diet when forage on the range was absent or of poor quality. Now, herders must learn and adopt intensive animal husbandry techniques.

approach

During 2008, a reindeer herder in Koyuk, Alaska, successfully kept his herd from running off with migratory caribou. His herd size increased from 9 to 14 animals with the addition of 5 calves. The calves increased the density of enclosed animals and created intra-cohort competition for space and food. The Reindeer Research Program provided information and consultation to the herder as he shifted management to more intensive husbandry techniques.

progress

Reindeer herders traditionally practicing extensive management are now learning and adopting new intensive husbandry techniques.

Reindeer cow and calf at the Fairbanks Experiment Farm.
—photo by Nancy Tarnai

impact

Reindeer herders now have more management options available to them to better respond to environmental and market events.

biofuels & biomass

Customizing biodiesel derived from tropical trees

J. Andres Soria; Richard Ogoshi (Univ. of Hawaii); Ian Gurry (American Samoa Community College); Mari Marutani (Univ. of Guam); Dilip Nandwani (Northern Marianas College); James Currie (College of Micronesia); Darrin Marshall (UAA)

purpose

This multi-state, collaborative project is designed to produce low NOx emission biodiesel from tropical plants that grow in the Pacific Islands and Hawaii, as a means of developing a sustainable and environmentally friendly fuel source that can help offset petroleum-based fuel and emissions. Selected plants include jathropa and coconut.

approach

The collaborating teams from the Pacific Islands and Hawaii will collect the fruits from the selected tree species and extract the raw oil. The oil will be shipped to the UAF AFES Palmer Research & Extension Center for characterization and transformation into biodiesel. The biodiesel will be run in a vehicle and its behavior measured using a dynamometer and emissions analyzer. A correlation between the emissions and biodiesel characteristics along with the original harvesting site will help determine the environmental factors that influence the final product behavior in the vehicle use.

progress

Equipment has been purchased and installed at UAF. Collaborators in Hawaii and the Pacific Islands are collecting the oils.

impact

The development of a renewable fuel source from locally available species is a major benefit of the research, especially for the small isolated communities in the Pacific Rim, which, like Alaska, rely on imported fuels. The development of a cleaner biodiesel that can be used to offset their diesel use, such as in outdoor motors, is a benefit. The research may be a catalyst for promoting a secondary industry, in the planting, growing, managing, harvesting, and processing of the oil species studied.

Potential perennial lignocellulosic energy crops for Alaska

S.D. Sparrow, M. Zhang, d.t. masiak, R. Van Veldhuizen

purpose

The high cost of petroleum-based fuels in Alaska, particularly in remote areas of rural Alaska, has resulted in high interest in local, renewable energy sources, including growing crops for bioenergy. The purpose of this research is to screen various trees/shrubs, perennial grasses, and perennial forbs as potential bio-energy crops for Alaska and to determine best management practices for efficiently producing bio-energy crops.

approach

We used dormant cuttings to establish replicated plots of three native Alaska woody species (feltleaf willow, *Salix alaxensis*; Pacific willow, *Salix lasiandra*; and balsam poplar, *Populus balsamifera)* at Fairbanks in 2008. A similar study was established by a cooperator (Alaska Plant Materials Center) in Palmer. In addition, 10 woody species, including willows, alders, (*Alnus*) and birch (*Betula*) were established in non-replicated plots or in single rows. We also established replicated plots of 14 herbaceous species including indigenous and non-indigenous grasses and forbs at Fairbanks and Delta Junction. None of the plots established in 2008 was harvested that year. Grass plots established for other purposes were used for biomass energy trials in 2008 at Fairbanks. Carlton smooth bromegrass *(Bromus inermis)*, Nortran tufted hairgrass *(Dechampsia caespitosa)*, and Wainwright slender wheatgrass *(Elymus trachycaulus)* were managed under three nitrogen fertilizer rates (0, 50, 100 kg N/ha) and three harvest regimes (two cuts per season: single harvest in fall, single harvest in spring of succeeding year).

progress and results

We do not have any data for materials planted in 2008. Early results from the established grass plots indicate smooth bromegrass, an introduced species, has higher yield potential than either of the native species. For fall harvest at the high nitrogen rate, smooth bromegrass produced 10,590 kg dry matter per ha compared to 6,938 kg/ha for hairgrass and 6,060 kg/ha for slender wheatgrass. However, smooth bromegrass had much higher water content at harvest than did the native grasses, and this would reduce its energy value. Harvesting twice (mid-season and end of season) produced similar yields to a single harvest, indicating no advantage to a two-harvest management regime. Dry matter yields for all species were increased by addition of nitrogen fertilizer, with highest yields usually coming with the highest nitrogen rate. Plant composition analyses have not yet been completed on any of the plant samples from this study.

impact

Since results are from only a single year's data, it is too early to draw conclusions from this study. Expected impacts include provision of management information for farmers and communities wishing to grow biomass crops for energy use in Alaska.

Establishment and evaluation of native willows, alder, and cottonwoods for biomass production

Norman Harris, Steve Sparrow, Andy Soria; Peggy Hunt (Alaska DNR)

purpose

This project is designed to determine the feasibility of growing endemic Alaska woody species as sustainable agricultural crops for bioenergy and bioproduct applications.

approach

Plots of selected woody species have been established at the Plant Material Center (PMC), located in Palmer, Alaska, and at the UAF Fairbanks Experiment Farm. Growth and mortality data will be collected to determine the best species for biomass production. We will use high-resolution remotely sensed images to evaluate plant growth and estimate biomass accumulation. Imagery, using our small, tethered, helium-filled blimp carrying two digital cameras, will be acquired of existing plots containing thirty-year-old trees at the PMC to develop models for accurately estimating biomass. Models will be calibrated and assessed using destructive sampling of selected trees.

progress

Using funds generated from a Matanuska-Susitna Borough special grant, plots were established at the PMC and the UAF Fairbanks Experiment Farm. New cameras and other materials were purchased and a new gondola was fabricated for the remote sensing portion of the study. Funds were not available in time for the imagery to be collected at an optimal time, so that portion of the study was postponed until next year.

impact

The production of biomass will allow Alaskans to develop a renewable source of biomass for energy production and bioproduct applications. This will allow people to wean themselves from expensive, nonrenewable energy sources and allow them to have greater control of some necessities required for life in Alaska.

controlled environment production

Bell pepper and eggplant grown in high tunnels

Meriam Karlsson, Jeffrey Werner

purpose

Bell pepper and eggplant are warm-season crops, and techniques moderating the environment are essential for growth and production during marginal field seasons. Greenhouse and high tunnel covering materials have now been developed to provide options for altering the high tunnel growing climate.

approach

The bell peppers King Arthur, Red Knight, and Tequila were evaluated in the field and in high tunnels using the covering materials K50 Clear, K50 IR/AC, and KoolLite380 from Klerks Plastic Product Manufacturing (Richburg, South Carolina), and Solatrol (Visqueen GCF 925C9, British Polythene Industries PLC, Greenock, United Kingdom). King Arthur is a large sized pepper turning red on maturity, Red Knight is a thick-walled large red pepper, and Tequila is a blocky smaller sized purple bell pepper. The eggplant was the Japanese type Mangan, with glossy dark purple fruits averaging 4 inches long and 2 inches wide.

progress/result

Above-normal precipitation and cool temperatures resulted in poor seasonal growing conditions during 2008. All four high tunnel environments resulted in higher yields of the King Arthur, Red Knight, and Tequila peppers than the field. The K50 IR/AC covering was most favorable, resulting in harvests per plant of 10 King Arthur peppers at 21.6 ounces, four Red Knight peppers weighing 14 ounces, and 10 Tequila peppers at 28 ounces. In comparison, the open field environment produced only one pepper of King Arthur and Red Knight, and two Tequila peppers per plant. The K50 IR/AC plastic is designed to reduce heat radiation from the inside and conserve energy during cold nights. The temperature pattern in the K50 IR/AC covered tunnel compared to the commonly used greenhouse covering K50 Clear showed slightly warmer temperatures during cool nights. The eggplant Mangan also responded with the highest yield in the structure of K50 IR/AC. More than 14 fruits were harvested from each plant with a total weight of 14 ounces in the K50 IR/AC environment. Plants grown in the adjacent field produced only two fruits with a total weight of 2.1 ounces.

impact/implications

These results suggest high tunnels are beneficial for producing bell peppers and eggplant. The warmer night temperatures under the K50 IR/AC material are especially favorable for warm-season crops.

Light emitting diodes (LEDs) for greenhouse crops

Jeffrey Werner, **Meriam Karlsson**

purpose

This study was initiated to evaluate light emitting diodes (LEDs) as a source of supplemental lighting for greenhouse crops. LEDs require less energy than current available technology for supplemental greenhouse lighting. Although switching to LEDs is expected to reduce demand for electricity, the efficiency for supporting plant growth and development is not well understood.

approach

LED lamps with red (660 nm) and blue (450 nm) diodes in the ratio 9 (red) to 1 (blue) were used for the study. The red and blue LEDs provide concentrated light at peak photosynthetic efficiency. The rate of photosynthesis was measured and compared in blackeyed Susan grown under the LED lamps and the commonly used, high pressure sodium (HPS) lamps.

progress/result

The amount of irradiance at plant level measured as the photosynthetic active radiation in the 400 to 700 nm range was higher under the HPS than the LED lamps. Subsequently the absolute photosynthetic rate was also higher using HPS, although in relation to the light intensity photosynthesis was significantly higher for the LED-grown plants. Overall growth and development of the plants were similar under the two lamp types.

impact

The use of LEDs for greenhouse production is promising and may significantly increase the opportunities for producing greenhouse crops at high latitudes. Additional studies are necessary to specifically determine plant development and flowering in various greenhouse crops under LED lighting.

Partnerships with local greenhouses

Jeffrey Werner, **Meriam Karlsson**

purpose

Information from research studies is quickly disseminated and field tested through partnerships with local greenhouse operations.

approach

In a collaborative partnership with the Chena Hot Springs Resort, growing techniques are developed for year-round crop production in a greenhouse heated and powered from geothermal resources. Techniques suitable for northern production are also demonstrated in the greenhouse at Pike's Waterfront Lodge, a local hotel and restaurant. Educational programs on production techniques and UAF research results are given daily throughout the year at Chena Hot Springs Resort and during the summer at Pike's.

progress/result

The educational programs on the operation of the geothermal greenhouse at Chena Hot Springs Resort are conducted several times a day and are well attended. These guided tours have participants from the local population, visitors from various parts of Alaska, and tourists from all over the world. Open to the public, daily formal and self-guided instructional tours at Pike's illustrate commonly used crop production techniques to local and visiting individuals and groups during the summer months. A minimum of 50 daily visitors explored Pike's greenhouse throughout the months of June, July, August, and September in 2008.

The Chena Hot Springs and Pike's greenhouses, in collaboration with UAF and SNRAS, also offer training and summer job opportunities for high school FFA and college students. At Pike's, in addition to taking care of the greenhouse and the grounds, the students provide the daily educational programs and answer questions related to greenhouse production, agriculture in Alaska, and their summer employment experience.

impact

Opportunity to view practical applications stimulates interest and encourages Alaskans to develop greenhouse projects for production and education. Practical hands-on training prepares students for successful careers following high school and college. These partnerships also offer effective dissemination of information on UAF research to commercial producers, the public, and out-of-town and out-of-state visitors.

Flowering primrose

Meriam Karlsson, Jeffrey Werner

purpose

Cool temperatures are sometimes used for prompting flowering of primroses (primula). The response in recently released selections of primrose to cool temperatures is not well known.

approach

The commercially available primrose Orion was used for the study. Seven-week-old seedlings were placed at 40°F for two weeks and then transferred to a greenhouse kept at approximately 68°F. In comparison, one set of primroses remained in the greenhouse without a cool treatment. Time to flowering was recorded as when the first flowers were fully developed and open.

progress/result

The plants kept in the greenhouse flowered seven days earlier from seeding than those exposed to cold for two weeks. If the cold period is considered a holding phase with limited growth and development, time required in the greenhouse was one week less for plants exposed to chilling. Keeping primroses at low temperatures can be a technique to target flowering for specific events or marketing dates.

impact

Understanding patterns of crop development in response to climatic conditions is useful for efficient greenhouse production, particularly as energy costs are high and efficient use of heated greenhouse space is essential.

Direct seeding and transplanting snap beans

Meriam Karlsson, Jeff Werner

purpose

Transplanted seedlings were compared to direct seeded snap beans. Since germination of direct seeded snap beans is sometimes limited or sporadic due to cold soil conditions, transplanting may be a more viable option.

approach

The cultivars Concesa, Provider, Stayton, and Gold Rush were direct seeded or transplanted in high tunnels and the adjacent field on June 5, 2008. The transplants were nine days old at planting. Gold Rush is a yellow wax-type snap bean while Concesa, Provider, and Stayton are green beans. Provider, a proven snap bean cultivar for Alaska, produces larger diameter beans than Concesa and Stayton. The slender beans of Concesa and Stayton are sometimes called French cut beans and receive more consumer appeal because they are tender with less fiber.

progress/result

Below average temperatures and above normal precipitation resulted in poor 2008 growing conditions. Harvest was delayed for direct seeded beans by two weeks compared to transplanted beans. The transplants also outperformed all seeded crops independent of growing environment. Close to 5 lbs was recorded for transplanted

Gold Rush, Provider, and Stayton in the high tunnels for a three-foot long double row of beans. The corresponding direct seeded yields were 1.5 lbs. As expected, Concesa produced the least amount of beans with 2 lbs when planted in the high tunnel and about half a pound as seeded in the field.

impact/implications

For producing snap beans under high latitude field conditions, high tunnels are favorable. Transplanting, although more labor intensive, is recommended for earlier, more reliable, and higher yields. In areas with upscale gourmet markets, producing high quality slender and shiny Concesa beans using high tunnels is worth considering despite the more restricted yields.

Strawberries using specialty high tunnel covering materials

Meriam Karlsson, Jeffrey Werner

purpose

High tunnels offer opportunities to increase yield, improve quality, and extend the field season for specialty crops. Under northern conditions with naturally extreme day lengths and short seasons, high tunnels covered with non-traditional plastic materials may more effectively support crop productivity.

approach

Four commercially available greenhouse films were used to cover high tunnel structures. The evaluated materials were K50 Clear, K50 IR/AC, KoolLite380 (Klerks Plastic Product Manufacturing, Inc., Richburg, South Carolina), and a Visqueen material called Solatrol. Strawberries were grown in the different high tunnel environments and the open field to assess crop response.

progress/result

The temperature patterns in the K50 Clear and K50 IR/AC covered tunnels were similar although slightly higher during cold nights for the K50 IR/AC. During warm days, the KoolLite380 material maintained a cooler environment compared to K50 Clear. The protected environments resulted in higher strawberry yield than the open adjacent field. Three weeks prior to end-of-season frost, the day-neutral strawberry Tristar produced 4.4 ounces of berries/plant under K50 IR/AC and K50 Clear. The harvest was reduced to 2.8 ounces under Solatrol and KoolLite380, while the yield in the field averaged 1.8 ounces. The response was similar for the ever-bearing Fern with the highest yields in the K50 Clear and K50 IR/AC environments (9 ounces) and least in the field at 2.6 ounces of berries/plant.

impact/implications

The results suggest high tunnels are beneficial for growing strawberries. The K50 IR/AC is a good covering material for season extension as night temperatures drop in the fall. Using several high tunnels covered with different materials can be recommended for uninterrupted high quality production throughout the field season.

Short days before transplanting sunflowers

Meriam Karlsson, Jeff Werner

purpose

Six sunflower selections in the ProCut series along with Sunbright and Sunbright Supreme were evaluated for flowering under field and high tunnel conditions.

approach

The sunflowers were seeded in a greenhouse and transplanted into a high tunnel and the adjacent field 17 days later. During the greenhouse phase, one group of each selection was covered with a blackout cloth from 6 pm to 8 am from germination (7 days from seeding) to transplanting, giving the seedlings 10-hour days until they were planted in the fields. A corresponding group developed under natural day lengths.

progress/result

Although the 2008 season averaged below normal temperatures and above normal precipitation, there were only small non-significant differences between the field and high tunnel environments. The cultivars in the ProCut series flowered at a similar time independent of short day treatment. Sunbright and Sunbright Supreme, on the other hand, flowered 4 to 5 weeks earlier with 10 short days before transplanting. Flowering averaged 87 days for untreated and 60 days for the short day treated Sunbright. The earliest flowering was observed 45 days after planting for Sunbright Supreme receiving short days. ProCut Bicolor, Orange, Peach and Yellow Lite flowered 10 weeks after transplanting while ProCut Red/Lemon Bicolor flowered almost a week earlier and ProCut Lemon, 5 days later than other ProCut selections. Stem length at flowering varied from 56 to 70 inches for the ProCut Series and did not differ for plants receiving short or natural day lengths. The flower diameter averaged 9 inches except for ProCut Yellow Lite at 11 inches. Plant height and number of leaves decreased with the faster flowering for Sunbright and Sunbright Supreme. Flower diameter after initial short day treatment only decreased for Sunbright Supreme from 8.7 inches to 5.5 inches.

impact/implications

Providing short days prior to transplanting will shorten time to flower for some cultivars of sunflower.

field crops & field management

Selection, variety testing, and evaluation of cultural practices for alternative agronomic crops for Alaska

Robert M. Van Veldhuizen, **Mingchu Zhang, Stephen D. Sparrow**

purpose

This ongoing research provides a yearly update of information on new and better adapted agronomic crop varieties (small grains and oilseeds) and their response to dryland farming conditions and harvest methods at Fairbanks, Delta Junction, and Palmer. It also provides a database for local producers to determine the economic viability for those crops.

approach

We use variety trials for continued evaluation of spring 6-row feed barley, 6-row hulless barley selections, hard red spring wheat, and oilseeds including Polish canola, Argentine canola, hybrid canola, Oriental and brown mustards, yellow mustard, camelina, and dwarf, open-pollinated Sunwheat selected from northern Canadian and US sources for testing against the standard Alaska varieties (Otal spring feed barley, Thual hulless barley, Ingal hard red spring wheat, and Reward Polish canola) for early maturity and high yields. Replicated trials of all varieties were planted at all three test locations, with the exception of canola, mustard, and Sunwheat varieties, which were tested only at Fairbanks and Delta Junction, and camelina which was tested only at Fairbanks.

progress

Summer growing conditions at all three locations were significantly colder and wetter compared with the long-term averages. This resulted in heading and maturity dates occurring later than the long term average. Small grain and oilseed yields were slightly higher than average due to the extra soil moisture. However, average test weights (an indicator of ripeness) were lower than the long term average due to the colder temperatures. Plant height characteristics were slightly above the long-term average which resulted in an increase in lodging at Fairbanks and Palmer. Average yields for the feed barley at all locations were slightly lower than standard test variety, Otal. The final selection from a hulless, 6-row, barley cross was made in 2008. This selection performed better than the standard hulless barley, Thual. Average maturity occurred about one to two days earlier than Thual, lodging was 20 percent better, and hulless seed characteristics were greater than 95 percent at all three locations. Cooperative research on the milling and baking characteristics with the UAF Cooperative Extension Service assisted in making the final selection for release as 'Sunshine' hulless barley in 2009. Hard red spring wheat varieties were significantly later in maturity so that they did not reach a ripe enough condition for harvest. As a result, plots at all locations were lost due to bird predation before they could be harvested. Argentine canola, hybrid canola, mustard, and camelina yields were significantly lower than standard test variety, Reward. They are later maturing which resulted in green, unripe, and high moisture seed at harvest. The camelina variety was a volunteer crop from last year's harvest at the Fairbanks location. Plant emergence occurred on May 1, well before the soil was warm and dry enough for seeding all other crops. This shortened flowering and maturity dates compared with direct seeded crops. However, average yields were much lower than directed seeded. There were no oilseed trials planted at the Palmer location. The dwarf, open-pollinated Sunwheat yields were slightly higher than average. This selection was unofficially released as 'Midnight Sunflower' to local gardeners in 2008. This selection has resulted in acceptable yields, early maturity of 83 days, and a short plant height of 20 inches.

Three harvest methods for Polish canola were tested again in 2008 in an attempt to increase seed uniformity at harvest with an increase in yields and a decrease in high moisture, green seed. The three methods included direct combining, spraying with a glyphosphate herbicide (Roundup) to kill everything two weeks prior to combining, and pushing with a tool bar six to eight inches off the ground to crimp the main stem and halt translocation of moisture up the plant three weeks before combining. The best method for the best variety, Hysyn 110, at both locations was spraying, with higher than average yields and a corresponding 1 percent green seed. The next best method was direct combining, with below-average yields and 7 percent green seed. The worst method was pushing, with significantly lower than average yields and 6 percent green seed.

Preliminary results from phosphorus rates and application methods for barley fertilization indicate that a medium rate of phosphorus applied as a band with the seed produced the highest yields. Continued research into fertilizer carry-over will be conducted in 2009 at all locations.

impact

For 2008 we found other research possibilities into the use of a urea volatilization inhibitor to reduce nitrogen loss on fall fertilizer applications. For 2009, testing of Argentine and hybrid canola varieties, canola harvesting methods, new oilseed varieties, and fall planting of camelina and winter grains will continue.

The effect of forage variety on haylage quality and quantity in Alaska

Susan Spencer, **Norman Harris**, Beth Hall

purpose

Hay producers often do not have sufficient dry weather to produce good quality hay in southcentral Alaska. The production of haylage, fermented hay, is a viable solution because it requires less time between the cutting and baling of forage. This study examines techniques for production of good quality haylage in Alaska and develops remote sensing techniques for estimation of biomass production.

approach

Different types of forage are harvested at two times during the summer. Haylage is baled using two different colors of plastic wrap with or without preservative. Self-recording thermistors are inserted into the bales. At the end of a six-month storage period, the thermistors are removed and samples collected for fiber analysis and high performance liquid chromatography. Near-earth remote sensing data using our blimp/camera platform is acquired before and after each harvest. The start and end of forage swaths forming each bale are positioned using a global positioning system (GPS) unit. Weights are obtained for all bales.

progress

Data collection has been completed and a master's-level graduate student is analyzing haylage samples to determine treatment effects. A predictive harvest model based on vegetation indices created from remotely sensed imagery is being tested against a verification dataset of known bale weights to assess model performance. Results will be published as a master's thesis.

impact

Haylage can supply a high-quality feed that will foster increased milk and meat production in Alaska. A secure local supply of meat and milk will benefit Alaska consumers. Remote sensing technology will provide farmers with a way to better estimate production, allowing them to make informed decisions concerning their operations.

Field production of bulb onions

Jeffrey Werner, **Meriam Karlsson**

purpose

Day length and temperature control the formation of bulb onions. The twilight-extended extreme day lengths suggest cultivars need to be evaluated for ability to produce bulbs at high latitudes.

approach

The five yellow onions Ailsa Craig, Copra, First Edition, Walla Walla, and Yellow Sweet Spanish were evaluated along with the red onions Red Burgermaster and Red Zeppelin. One white onion, White Spanish Ringmaster, was also included in 2008. The onions were transplanted as starts in the field on June 3 and harvested on September 10.

progress/result

The productivity among the studied cultivars varied significantly but remained high despite a season of above-average precipitation and below-average temperatures. The highest yield of yellow onions was recorded for Ailsa Craig at 35 ounces per square foot. Walla Walla also had a good harvest per square foot of 27 ounces followed by yellow Sweet Spanish (20 ounces) and First Edition (11 ounces). The White Spanish Ringmaster produced 21 ounces per square foot. The two red onions produced 23 ounces per square foot (Burgermaster) and 8 ounces per square foot (Red Zeppelin).

impact/implications

The results suggest good harvests of yellow, red, and white bulb onions may be achieved at high latitudes through careful selection of cultivars.

Growing potatoes in the Tanana Valley

Jeffrey Werner, **Meriam Karlsson**

purpose

The productivity of twelve potato cultivars suitable for the Fairbanks area was documented in field trials.

approach

The seed potatoes were cut and planted on June 4 with harvest on September 20, 2008. The twelve cultivars of potatoes included All Blue, All Red, CalWhite, Caribe, French Fingerling, German Butterball, Magic Molly, NorDonna, Shepody, Swedish Peanut, Yellow Finn, and Yukon Gold. These selections represent a wide range of tuber size, properties, skin and flesh colors. For instance NorDonna, introduced by the North Dakota Agricultural Experiment Station in 1995, is a red-skinned white-fleshed cultivar with microwave, boiling, and baking properties. Caribe, meaning Caribbean in Spanish, has oblong tubers with purple skin and white flesh. CalWhite produces large, smooth white-skinned potatoes for baking and frying. German Butterball, Yellow Finn, and Yukon Gold have yellow flesh with light skin. The colored potatoes All Red with red skin and pale pink flesh, Magic Molly with smooth dark purple skin and flesh, and All Blue with dark blue skin and flesh, add color to any dish. Fingerling potatoes have small irregularly shaped elongated tubers and were represented here with the white-fleshed, red-skinned French Fingerling and the yellow-fleshed, brown-skinned Swedish Peanut.

progress/result

The highest yield for a 4-foot single row of potatoes was recorded for French Fingerling at 29.3 lbs. CalWhite followed closely at 27.9 lbs. Shepody and All Blue produced more than 23 lbs while NorDonna had the lowest yield at 12.6 lbs. The largest sized tubers were produced by CalWhite (6.5 ounces) followed by Shepody (6.1 ounces), Yukon Gold (6.0 ounces) and Caribe (5.5 ounces). All Red produced potatoes of 3.4 ounces and tubers of both Magic Molly and Yellow Finn averaged 3.9 ounces. Swedish Peanut had 1.4-ounce tubers and German Butterball 2.6 ounces. The potato size for NorDonna and All Blue was 3.4 ounces and for French Fingerling, 2.9 ounces.

impact/implications

The below average temperatures and high precipitation of the 2008 field season supported good potato harvests. The variations in tuber types, sizes, and characteristics offer a wide range of options for farmers and gardeners to grow potatoes with high yields in interior Alaska.

Photosynthetic rate in snap bean and corn

Meriam Karlsson, Jeffrey Werner

purpose

The purpose of this study was to determine when photosynthesis is actively functioning in bean and corn crops during the daily conditions of an Alaska field season.

approach

A portable photosynthesis system (LI-6400, LI-COR, Lincoln, NE) was used to measure net photosynthetic rates for 24 hours during July 6 and 7, 2008. Measurements were made intermittently on single leaves of the snap bean Provider and the sweet corn Yellow SuperSweet.

progress/result

The average air temperature for the 24 hours was 65.7°F with a high of 82°F at 3 PM and a low of 50.9°F at 5 AM. Rate of photosynthesis generally increased with increasing amounts of light and was almost three times higher in corn compared to snap beans. Peak photosynthesis was recorded at 1:35 PM for corn and at 1:55 PM in beans. From approximately 11 PM to 6 AM, net photosynthesis dropped close to zero in both beans and corn despite the ongoing summer light.

impact

The results suggest photosynthesis under field conditions vary through the day with lower or no net gain during the conventional night period despite existing light. Additional studies are necessary to map rates of photosynthesis in commonly grown crops through the day and throughout the Alaska field season.

pest & disease control

Arctic and subarctic plant genetic resources conservation, research, and information management

Alberto Pantoja, Bonnie Furman, Nancy Robertson, Joe Kuhl (ARS)

purpose

Agricultural development in circumpolar regions depends upon the availability of a broad genetic base of plant cultivars adapted to long day, short season, and cool climate conditions. The biological properties of most high-latitude native plant and crop species are poorly understood, especially in plant hardiness zones not found in the conterminous US. Characterizations of germplasm and subsequent documentation of data are critical for germplasm management and utilization, and the development of new crops for northern latitudes. There is a need for increased research to improve management of arctic/subarctic germplasm and to understand disease etiologies, host-pathogen interactions, and disease vector relationships. The goals of this project are to conserve, evaluate, and distribute a broad spectrum of genetic resources of plants adapted to short cool seasons and a long photoperiod, to generate and manage associated information, and to provide a scientific base for its use in research and crop improvement.

approach

The USDA/ARS/National Plant Germplasm System (NPGS) is responsible for maintaining a diverse collection of plant genetic material in the US. The Subarctic Agricultural Research Unit is the primary US location for preservation of plant germplasm important as food, feed, medicine, land reclamation, and site remediation in arctic/subarctic zones. This project is the only ARS plant genetic resource conservation unit in the circumpolar region. The germplasm collection in Palmer maintains approximately 400 accessions. Research projects on targeted plant species include, but are not limited to: *Rheum, Carex, Juncus, Calamagrostis, Deschampsia*, and *Angelica* spp. Other species such as potato, lupine, clover, black medic, barley, currant, strawberry, and other fruits are or will be studied on the Palmer site to help other NPGS units.

To achieve our objectives, we:

- Conserve and regenerate priority crops, crop varieties, native species, and other NPGS genetic resources adapted to circumpolar and other high latitude regions efficiently and effectively, and distribute samples and associated information worldwide.
- Strategically expand the genetic diversity in genebank collections and improve associated information for priority genetic resources of crops, crop varieties, and native plant genetic resources adapted to circumpolar and other high latitude regions.
- Strategically characterize (“genotype”) and evaluate (“phenotype”) priority *Rheum, Deschampsia,* and other selected genetic resources for molecular markers, morphological descriptors, and key agronomic or horticultural traits.
- Elucidate the effects of key associated insects and pathogens on selected crops, crop varieties, and native plant genetic resources adapted to circumpolar and other high latitude regions.

progress and impact

Considerable progress has been made in the evaluation of the Palmer germplasm collection. A complete inventory of seed holdings, including updating taxonomic identification, germination status, seed weight and number of seed has been completed. Information has been updated on the Genetic Resources Information Network database (GRIN) as well as on seed containers. Historical information of rhubarb has been corrected and updated on GRIN.

Germination testing

We completed germination testing for the SARU germplasm collection. The seeds of species such as *Carex, Juncus*, and *Calimagrostis* have been in storage for many years subsequent to their transfer to Alaska and seed health was known to be compromised. Germination testing was carried out. Knowledge of the status of the collection is imperative for future conservation, regeneration, and utilization of the collection.

Hairgrass evaluated

55 morphological characters and sequenced nuclear and chloroplast regions from arctic *Deschampsia* were evaluated. Deschampsia species have been widely utilized for their ability to stabilize disturbed areas, including metal contaminated sites. It also represents a genus with circumpolar distribution at both poles. To access the completeness of the NPGS collection it is first necessary to determine the phylogenetic relationship of naturally occurring populations. Molecular data were collected and evaluated to carry out phylogenetic inferences.

Rhubarb

Amplified fragment length polymorphisms previously applied to rhubarb cultivars in the Palmer germplasm collection were added to GRIN. A total of 1400 AFLP markers had been previously generated for 46 accessions of the SARU *Rheum* collection and the results published. These data were added to GRIN for access by other NPGR scientists.

Phenotypic descriptors for *Rheum* were incorporated into GRIN. A total of 26 morphological descriptors were completed for accessions of the SARU rhubarb collection.

Characterization of existing collections is important for their utilization and future expansion. Existing relationships can also be elucidated and gaps identified. These data are now on GRIN for utilization by the public.

Digital images to document each of the *Rheum* accessions were uploaded into the GRIN system. Digital imagery of collection accessions provides a means to document phenotypes as well as horticulturally important traits. Farmers and scientists can now access these images to assist their utilization.

Blueberry study

A blueberry study was initiated in collaboration with growers in the Kenai region of Alaska and the national Clonal Germplasm repository in Corvallis, Oregon. Nine varieties of cultivated blueberry are being grown in two locations.

Legumes

Legumes are being grown in collaboration with the Plant Germplasm Introduction and Testing Research Unit in Pullman, Washington. Two hundred and 85 accessions from the lentil core collection, 17 varieties of peas and 10 accessions of *Scorpiurus* are being grown to test survival and productivity under Alaska growing conditions.

Virus detection

ARS sampled rhubarb from the germplasm collection for potyvirus detection, and more precisely for species identification such as turnip mosaic virus. We initiated potato and carrot sampling for Angelica virus Y (AnVY) detection. We initiated large scale purification for AnVY antiserum production. We continued sampling barley/grasses/oats plant species for Barley/Cereal yellow dwarf virus strains. We confirmed three plant viruses from potato survey by their partial genomic sequences. ARS continued collections and characterizations of pathogens from diseased small fruits (blueberry, raspberry, lingonberry, gooseberry, and currant).

Several native larkspur plants in an ornamental garden were severely stunted with discolored leaves. The pathogen responsible for the disease was determined to be a new plant virus, classified with the potyviruses, and tentatively named Delphinium vein-clearing virus. New viruses detected in native plants may pose as emerging pathogens that may act as potential threats to crops and home gardens.

Insect pests

We initiated sampling *Agropyron* species to identify possible insects affecting seed set.

Rhubarb aphids

The insect fauna associated to *Rheum* species is little known and there is no consensus on the aphid species associated with this plant. This work was initiated to identify the aphids associated with rhubarb in the USDA rhubarb collection in Alaska and to identify potential vectors of virus. Based on their disease transmission, potential, and abundance in rhubarb fields, four aphid species were identified as potential vectors. Information (species composition, phenology, and abundance) needed to develop integrated pest management programs is now available to growers and researchers working on rhubarb.

Integrated pest management for Alaska agriculture

Alberto Pantoja, Dennis Fielding, Jeff Conn, Loretta Winton, Steve Seefeldt (ARS)

purpose

We seek to enhance productivity, profitability, and environmental quality of Alaska's farming industry and natural resource areas by reducing threats posed by invasive insect pests, weeds, and pathogens through research and technology transfer resulting in the introduction of new and innovative Integrated Pest Management (IPM) strategies. We are developing IPM applications suitable to northern latitudes that support viable crop and nursery production systems and the sustainability of natural resource areas. We are also developing IPM systems incorporating biologically based control, host resistance, cultural control, resistance management, and application technology for the control and suppression of major insect, pathogen, and weed pests affecting field, vegetable, and horticultural crops, as well as rangeland ecosystems in the Delta Junction region and other areas of Alaska.

approach, progress, and impact

Potato germplasm

We are conducting replicated laboratory and field trials that are designed to introduce and evaluate potato germplasm for resistance to viral diseases and adaptability to Alaska. Knowledge acquired from these evaluations will set the foundation for a molecular marker-assisted breeding program that will generate new virus-resistant and/or virus-free potato germplasm. We are studying the role of weeds in the development of viral diseases in potato fields. There is a need for increased research to evaluate potatoes grown in northern climates, particularly in developing virus-free potato germplasm. Virus-free potatoes will allow potato producers in Alaska and other northern states to increase export trade with Pacific Rim countries. An environmentally sound and safe method to reduce loss due to viral disease infection is needed. To remain competitive in Alaska varieties must be virus resistant.

Potatoes and leafhoppers

We identified problems for seed potato exports. Leafhopper-transmitted phytoplasma diseases are an emerging problem for potato and vegetable producers in the US. Due to its geographical isolation and climatic constraints, Alaska is considered relatively free of diseases and insect pests; therefore, growers in the state are producing seed potato for export. ARS scientists completed the first extensive study of leafhoppers in Alaska and identified three leafhopper species that are potential vectors of diseases to potatoes in the state. The published manuscript provides the information needed for the development of integrated pest management strategies for leafhoppers affecting potatoes in Alaska.

Carabidae (ground beetles) from Crop Reserve Program plots were collected, identified, and the data entered into a database for analysis. Adult *elateridae* (click beetle) population dynamics studies were completed for the Matanuska-Susitna area and interior Alaska; a manuscript was accepted on the population dynamics of *elateridae* from the Palmer area. We continue studies on aphids in potato fields in Alaska and have initiated studies on insects associated with peonies in Alaska.

Invasive weeds

Exotic weeds come to Alaska in hay and straw. Prevention of new introductions of invasive plants is the most cost-effective way to combat the deleterious effects of these plants on agriculture. The exotic weeds arriving in hay and straw imported to Alaska were studied and found to be a major pathway for introductions of new exotic plant species to the state. Attention drawn to this pathway will result in strategies to prevent new introductions.

Bird vetch does not like moss. The distributions of invasive plants are explained by environmental and management variables that can be used to determine where new invasions could occur. The susceptibility of Alaska plant communities to invasion by bird vetch, another escaped agricultural crop, was established. Bird vetch moved farthest into bluff and aspen communities which had high light levels, but did not move into plant communities with a thick moss layer—information that can be used for planning which bird vetch populations need to be controlled to prevent invasion of adjacent plant communities and preserve Alaska's pristine natural systems.

Response data for orange hawkweed and other vegetation to orange hawkweed control treatments has been collected and entered into a database for analysis. Initial herbicide fate studies and development of extraction methods have been completed for triclopyr and 2, 4-D and follow-up lysemeter studies have been initiated. Studies continue on the impact of weed control in organic farming systems using tillage and cover crops on weed seed banks and soil fertility.

Herbicides and other weed control in Alaska

Herbicides and non-chemical methods (burning, cutting) were studied for controlling invasive white sweet clover. Chlorsulfuron at low rates controlled established plants and eliminated seed production. Cutting was also effective but required more than one application. White sweet clover has escaped cultivation and is spreading on roadsides and on glacial floodplains, threatening native ecosystems.

Herbicide freezes in Alaska. In Alaska, the use of herbicides to control weeds is not only costly, but is complicated by cold soil temperatures which inhibit the breakdown of herbicides, causing injury to subsequent crops and increasing the potential for leaching and contamination. The movement and fate of the herbicide triclopyr in the soil was determined in Alaska soils. Herbicide residuals do not appear to be phototoxic, but accumulation of residuals in cold Alaska soils is a concern for both agricultural production and natural systems contamination.

Grasshoppers

Alaska grasshoppers are not food-limited. The factors leading to grasshopper outbreaks and crashes are not well understood. In many regions, populations appear to be limited by food quantity and quality. Field experiments conducted over two years showed that grasshopper growth, survival, and fecundity were not limited by food even at high grasshopper densities. This information will help scientists to understand the causes of grasshopper outbreaks in different ecoregions.

Soil temperatures under different brush control treatments on CRP ground were measured and analyzed to determine potential effects of brush control on grasshopper hatching date and subsequent fitness.

A survey of seed source and virus prevalence in small-scale Alaska potato production

Jeff Smeenk, Jodie Anderson

purpose

We conducted research to improve the understanding of disease etiologies and disease vectors in uncertified potato growers' fields/gardens.

approach

A two-phase approach was used to understand potato disease etiologies and disease vectors. Phase one: A survey was sent to interested small-scale potato growers that requested information about varieties planted, quantities grown, seed sources, planting and cultivation practices, vector and weed management, and foliage and disease observations. Phase two: Participants sent tubers to UAF for a winter greenhouse grow-out for tissue sampling and ELISA (enzyme-linked immunosorbent assay) analysis for insect-transmitted viruses.

Female migratory grasshopper, Melanoplus sanguinipes.
—photo by Linda DeFoliart

progress

Phase one: 190 surveys were sent and 88 were returned. The 88 respondents reported planting 8,983 tubers. Of the 48 participants who reported the specific varieties planted, 38 participants (79 percent) reported including Yukon Gold potatoes and 44 percent of the participants reported included red-skinned potatoes in their plantings.

Twenty-four participants (27 percent) reported planting Alaska certified seed. Anecdotally, several gardeners mentioned to the research team that they purchase seed at local greenhouse/nursery businesses and assumed they purchased Alaska certified seed.

Sixteen participants (18 percent) reported maintaining their own potato seed stock. The survey identified a significant distribution pathway of community members sharing seed. More than half of the group that saved their own seed reported giving excess seed to others in their communities to plant. Many other growers reported giving extra purchased potatoes to neighbors and community members. (Determining if the potatoes grown from this community distributed seed were saved and used for seed in the following growing season is a question beyond the scope of the survey.) Twenty-eight participants reported planting potatoes that were given to them from a source in Alaska. Of those, 10 were reported as given from Louden Tribal Council, Tanana Chiefs Conference, and Cooperative Extension Service and those were purchased from an Alaska certified seed producer. Since only 18 participants reported seed given to them from an Alaska source, the distribution seems to be more through greenhouse/nursery businesses or direct orders from Alaska certified seed producers

Only six participants reported insects on the potato foliage and of those, only one respondent used an inorganic chemical to remove the pests (mild, soapy water). Respondents didn't use protective measures to prevent insect damage; rather, control methods were initiated only after the insects had been observed.

Phase two: Leaf tissue samples from the winter greenhouse grow out of participant tuber samples were sent to Agdia Laboratories for ELISA analysis for potato latent virus (PotLV), potato virus X (PVX), potato leaf roll virus (PLRV), and screened for potyviruses (PVY, PVS, and PVA).

Only 3 percent of all tested material was positive for insect-transmitted viruses, with four samples positive for PLRV and one sample positive for PVA. No PotLV was observed in the samples and 15 tubers (9 percent) tested positive for the mechanically-transmitted virus PVX.

impact

Each participant who returned a complete survey was offered about 5-8 lbs of free seed in appreciation. As a result, 517 lbs of seed were sent to participants. A total of 33 communities participated in the survey representing all regions of Alaska except the North Slope and the Aleutian Islands. Visual inspections of 16 non-certified potato fields/gardens in 7 communities throughout Alaska were made by a trained member of the research team during 2008. During the field/garden visits, no insect-transmitted viruses were observed in the field/garden plots. Low levels of insect-transmitted viruses were observed in non-commercial potato production sites.

grant

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Distribution, transmission, and molecular characterization of potato phytoplasmas in Alaska

Jenifer H. McBeath

purpose

I am investigating the distribution, host range, mode of transmission, and molecular characterization of potato witches' broom and other phytoplasma diseases found in Alaska. A thorough understanding of these diseases will aid effective management and eradication of these quarantined diseases.

approach

To investigate the presence of phytoplasma in potatoes, including potential latent infection, I will collect samples from potato plants in seed lots on farms in the Delta, Eielson, Nenana, Palmer, and Wasilla areas. Because of the extremely low phytoplasma disease incidence, I will conduct a systematic visual survey of the potato field for phytoplasma diseases. When I find plants displaying symptoms resembling phytoplasma, I will harvest and test the entire plant for the presence of phytoplasma disease. Clover and other potential wild hosts such as leafhoppers in the potato fields and adjacent areas will be also be examined and identified, harvested, and tested. Purified nucleic acids of aster yellow phytoplasma (phytoplasma group 16Sr I) and clover proliferation and vinca rosette phytoplasma (both members of group 16Sr VI) will be obtained as controls. The sequences of 16SrDNA obtained from plants and leafhoppers will be analyzed and the phytogenetic distance tree of phytoplasmas found in Alaska will be constructed by comparing their 16SrDNA sequence with those of other phytoplasmas.

progress

From June through August 2008, potato plants displaying witches' broom and other phytoplasma disease were collected from three farms in Delta and Point MacKenzie, Alaska. In 2008, no aster yellow-diseased potato plants were found. Two potato plants were found displaying symptoms of witches' broom phytoplasma disease and nine of purple top with phytoplasma disease. Tubers were collected from these diseased plants and maintained in growth chambers for symptom and disease development observations. Leaves and stems harvested from diseased and healthy potato plants were stored at -80°C and await further analysis.

impact

A clearer understanding of these diseases in Alaska will aid the development of tools for effective management of them.

High-Latitude Soils

Soils are a fundamental resource, and knowledge about the cold-climate soils of Alaska is crucial for Alaska resource management, production, and construction activities. Proper knowledge and planning of soil-disturbing activities can prevent major impacts on other resources. Under current climate variability, cold soils are experiencing significant changes that are in turn causing changes in natural and managed ecosystems. Research on high-latitude soils at SNRAS is focused on soil properties as they relate to soil quality, ability to resist and recover from disturbance, and soil productivity; origin, formation, and classification of soils; plant nutrition and soil fertility; permafrost soil characteristics, limitations, and potential uses; soil management, land reclamation, and remediation of contaminated soils; soil responses to and influences on climate change; soil biology and processes of boreal ecosystems in a management context; and long-term soil data.

High-Latitude Soils reports:

carbon in soils

Sensitivity of boreal forest carbon dynamics to long-term throughfall exclusion in interior Alaska

Sarah Runck, **David Valentine, John Yarie**

purpose

Our study assesses the effect of long-term simulated summer drought on key components of mid-successional boreal forest carbon balance. We examined aboveground tree growth, root biomass distribution, and carbon storage in surface soils. We hypothesized that simulated drought has reduced aboveground tree growth (stand-level), driven root biomass downward in the soil profile, and slowed decomposition in surface soils.

approach/methods

This study took place in three replicate drought and control sites in upland and floodplain landscape positions. We monitored soil moisture using time domain reflectometry probes installed at four depths in the soil profile. To determine simulated drought's effect on aboveground tree growth, we compared aboveground standing biomass of trees (stand-level response of all species) in 1989 to that when the 2003 stand inventory occurred. To detect changes in root biomass and soil carbon, we analyzed soil cores taken in August 2005 for coarse root biomass and soil organic carbon (SOC) content. Soil cores were analyzed in the O horizon and at three depth intervals in the mineral soil: 0-5, 5-15, and 15-30 cm. To determine if simulated drought has altered the decomposition environment of surface soils, we conducted a common substrate decomposition experiment from July 2005 to July 2007, in which birch tongue depressors (BTDs) were placed at two depths in the soil profile: O horizon and 0 - 15 cm mineral soil below the O horizon. Half of the deployed BTDs were collected in July 2006 and the remainder in July 2007.

progress/results

We previously reported that reduced moisture in the throughfall exclusion shelters dramatically slowed BTD decomposition rates, which approximate foliar litter decomposition rates, at the soil surface. In uplands, experimental drought reduced stand growth and shifted the distribution of root biomass in the soil profile downward without changing the biomass total. Putting together these components of the carbon cycle, we concluded that drought increases ecosystem carbon storage in mid-successional floodplain forest stands but has no net effect on ecosystem carbon storage in similar upland forest stands. Sarah Runck successfully defended her master of science thesis on this research in November 2008.

impact/implications

The results of this study indicate that projected future soil moisture deficits, independent of increased soil temperature, will likely affect carbon storage of mid-successional boreal forests differently across the landscape. In uplands, soil moisture deficits will likely affect both vegetation (reduced aboveground tree growth and increased root biomass with depth) and soils (increased quantity of carbon stored at the soil surface). In floodplains, soil moisture deficits will have fewer direct effects on vegetation (unchanged aboveground tree growth or root biomass) and soils (increased carbon storage at the soil surface). We will address indirect effects of moisture stress on vegetation through changes in nutrient dynamics in future growing seasons.

Carbon cycle science in the Alaska coastal temperate rainforest

David D'Amore, Mark Nay, Rick Edwards (USFS PNW Research Station); **David Valentine**; Eran Hood (UAS)

purpose

Carbon cycle science has become an important issue in research and land management because increasing atmospheric carbon dioxide concentrations are believed to play a key role in driving climate change. Forests are major areas of carbon capture worldwide and carbon accounting is a priority for land management agencies as a means to mitigate gaseous emissions. The Tongass National Forest is located in one of the largest intact areas of the coastal temperate rainforest biome and contains 8 percent of total US forest carbon storage, primarily in its soils. This project was designed to provide a means to measure forest carbon fluxes and scale these fluxes up to the coastal temperate rainforest region for use in carbon flux models.

approach/methods

Measurements of carbon fluxes from terrestrial and aquatic ecosystems have been taken across a suite of replicated, nested study sites within major ecosystem types in forested and peatland watersheds. These measurements are being combined with associated characteristics of forest stands to quantify carbon sequestration rates in coastal temperate rainforests.

progress

Measured and modeled soil respiration rates coupled with dissolved organic carbon flux from replicated catchments have been completed. Soil respiration is primarily influenced by soil temperature and has an inverse relationship with dissolved organic carbon in the summer and fall in forested systems. We are developing a model for carbon flux from three ecosystem types (bog, forested wetlands, and uplands) and are expanding the approach to harvested forest stands.

impact

This research has provided the foundation for models of carbon fluxes across ecosystem types in the coastal temperate rainforest. These measurements are closely associated with variations in temperature and soil moisture. This association is being coupled with predicted changes in regional temperature and precipitation to provide predictions of carbon flux changes due to climate shifts in the coastal temperate rainforest. This will also provide information on the magnitude of the carbon sink or source on the Tongass National Forest that can be applied to regional and national carbon sequestration goals.

Carbon database for permafrost-affected soils in Alaska

Chien-Lu Ping, Gary Michaelson

purpose

We sought to measure soil organic carbon in permafrost-affected soils from boreal to arctic Alaska.

approach

A total of 125 soils were studied and sampled across the arctic bioclimatic subzones from the Canadian High Arctic to arctic Alaska as a part of the National Science Foundation Biocomplexity project. We selected the Alaska data points from this study and then added the data from the USDA Hatch project (soils associated with black spruce), and also incorporated the soil survey characterization data from the National Cooperative Soil Survey Alaska project. A total of over 500 data points were summarized.

results/ progress

In the boreal zone on the upland sites, most of the carbon was stored in the surface organic and the upper mineral horizons. Toward the toe slopes and fluvial lowlands, there is increased carbon stored in depth due to the slope process. On exposed slopes and terraces more carbon has been sequestered in upper permafrost due to cryoturbation. There is a strong relationship between drainage class and carbon store; the poorly drained sites have the highest carbon stores in the boreal zone. In the Arctic Foothills, there is increased surface organic carbon being cryoturbated down to the lower active layer and the upper permafrost due to pattern ground formation, especially the nonsorted circles. The carbon storage on the Arctic Coastal Plain comprises a complex process including ice wedge and ice wedge polygon formation, cryoturbation due to nonsorted circles, thaw lake sequence, and fluvial processes.

The organic chunks taken from the lower active and the upper permafrost are of different C-14 ages, with a maximum of 9000 YBP. This proves that surface organic matter was gradually frost-churned down and incorporated into the lower part of the active layer and then into the upper permafrost on a time scale of hundreds to thousands of years. However, the carbon at depth (>2m) has C-14 dating over 14,000 years, indicating its Pleistocene origin.

impact

The results from this study provided the first complete database of arctic soil characterization and carbon stores. The data has been incorporated into the National Snow and Ice Data Center. The total organic carbon stores measured in soils of the arctic tundra nearly double the earlier reported amount based on a rainfall model. This information means that the contribution of carbon from the Arctic in current global terrestrial carbon budget estimates should be increased. The soil characterization and carbon data associated with the black spruce stands in Alaska also constitute the first of their kind for understanding carbon stores and dynamics in the boreal zone.

Carbon flux and transformation across the arctic coast of Alaska

Chien-Lu Ping, Gary Michaelson; Torre Jorgenson (ABR, Inc.); Fugen Dou (Texas A&M Univ.)

purpose

We sought to study the effects of arctic coastal erosion on carbon transformation across the shoreline.

approach/progress

During the span of the project from the 2005 to 2007 field seasons a total of 58 sites along the 1,960 km of Beaufort Sea coast were studied and sampled. At each site, the physiographic characteristics (including landform, microtopography, GPS position, coastal bluff elevation, and vegetation community) were evaluated and recorded. Site characteristics, permafrost, ice content, and soil morphology were studied and recorded. A total of 289 soil and permafrost samples were taken for soil characterization analysis. Laboratory analysis included carbon content, ice content, bulk density, particle size distribution, and extractable cations. Radiocarbon dating was performed on selected samples. Freeze-dry and ultrafiltration techniques were applied to organic matter fractionation on selected samples to simulate the aftermath of organic matter entering into sea water following coastal bluff collapse. The results were summarized and presented to the Ninth International Permafrost Conference in Fairbanks, Alaska, July, 2008.

impact

The project provided a rare opportunity to train a graduate student in terms of arctic tundra ecology, permafrost landscape, and field techniques. It also provided the opportunity for the ecologists, soil scientists, and geocryologists to work together to look at the common topic of coastal erosion, and to coordinate their efforts and discuss the relationships between permafrost and coastal erosion.

The Alaska arctic coastline is divided into five different coastline types; this study provided baseline data on the carbon stores and nutrient content of each type. Such data coupled with measured rate of coastline erosion (retreat), total amount of material transport, and carbon flux into the

Erosion and slumping along the arctic coastline.
—PHOTO BY GARY MICHAELSON

Arctic Ocean were estimated. The carbon data from each coastal type also represent the carbon stores of a particular tundra type on the coastal plain: this allows the estimation of carbon stores in the Arctic Coastal Plain. In summary, annual erosion across 1,960 km of the Beaufort Sea coastline (based on an average depth of 2m of coast bluff and an average rate of erosion of 2m per year) is causing the release of more than 400,000 metric tons of organic carbon into the Arctic Ocean and more than 500 tons of carbon dioxide and 6 tons of methane gas into the atmosphere. Annual loss of land to the Arctic Ocean is estimated at 2,000 acres.

Over 95 percent of the organic matter contained in the frozen soil or sediments is particulates, and the dissolved organic carbon accounts for <5 percent of the total carbon. Based on C-14 dating, some segments of the Beaufort Sea coast were developed during the Pleistocene period.

fertility & soil properties

Black spruce forest soils in boreal regions of Alaska

Chien-Lu Ping

purpose

We are studying the morphological, chemical, and physical properties of soils associated with black spruce forest stands on different landforms for forest and land management interpretations in the boreal region of Alaska.

approach

A group of fifty-two soils under black spruce (*Picea mariana*)-dominated forest communities was assessed for organic carbon stores and soil characteristics. Study sites are located on a variety of parent materials, landscape positions, soil temperature, and drainage conditions. Soil pits were excavated at each selected site and morphological properties were studied. Soil samples were collected according to the *Soil Survey Manual* and shipped to the USDA-NRCS National Soil Survey Laboratory in Lincoln, Nebraska, for full characterization. For soils with permafrost, core samples with known volume will be taken for bulk density and ice volume or water content determination. In cryoturbated soils where the soil horizons are warped or broken, the pedon carbon storage will be calculated according to percentages of each horizon in the profile. Soils at each study site will be classified according to *Soil Taxonomy*.

results/progress

Soils at most sites are weakly developed, commonly with organic (O) horizons ranging from 3 to 40 cm. Stores of soil organic carbon (SOC) tended to increase as drainage changed from somewhat excessive and well to very poorly drained (12.6 to 50.9 kgSOC m-2, respectively). Lowest SOC stores for individual sites were 7.1 kgOC m-2, found on a well-drained outwash plain, and the highest were 109 kgOC m-2, found on very poorly-drained sites. Surface organic horizons contained 40-60 percent of the total pedon SOC stores. In gelisols, on average 10, 19, and 39 percent of SOC stores for the somewhat poorly, poorly, and very poorly-drained soils, respectively, were stored in upper permafrost. Presence of permafrost in poorly-drained sites increased average SOC stores from 27.8 to 50.1 kgOC m-2. Soil bulk density, cation exchange capacity, and extractable acidity assessed in relation to SOC stores of genetic horizons stress the significance of SOC in soil properties. In many ecological studies SOC was assessed from only the O-horizon plus 15 cm of the underlying mineral soils. Such shallow sampling depth may underestimate the total organic carbon stores by an average of 26 percent and those missed deeper stores of carbon may be especially vulnerable to climate change. Not accounting for permafrost stores will yield even larger errors.

This study was in cooperation with the UAF Forest Growth & Yield program and also incorporated the data from the USDA-Natural Resources Conservation Service statewide soil survey program. A manuscript, drafted to summarize all available data, was submitted to the *Soil Science Society of America Journal*.

impact

Contrary to the commonly held belief that soils formed under black spruce stands are often associated with a wetland environment, the database from this study proves that soils associated with black spruce formed in a wide variety of parent materials on landscapes from lowlands, outwash plains, fluvial terraces, to hilly uplands. The soil temperature regime ranges from frigid to subgelic and soil moisture regimes range from aquic to udic with the drainage class range from somewhat excessively to very poorly drained.

This study is the first of its kind to provide baseline data on soil properties associated with

black spruce stands across the state of Alaska. The soil carbon data summarized from this study has been incorporated into the North American Carbon Database.

Based on this study the USDA-Natural Resources Conservation Service revised their Tech Notes. To convert percent organic matter (Horizon.[OM]) to percent carbon, use the following: Organic matter percent / 2 = carbon percent instead of the commonly used factor of 1.72 that is derived from the midwestern soils. Previous estimates were thus inaccurate, and this revision will lead to correct estimations of the soil organic matter content, better fertility management, and improved ecological modeling.

Estimating post-fire organic soil depth in the Alaska boreal forest using Landsat remotely sensed data

Dave Verbyla

purpose

The goal of this study was to predict post-fire organic soil depth using historic Landsat Thematic Mapper (TM) data. Post-fire organic soil depth is important as an index of potential erosion, revegetation, and future forest flammability after a fire. The main aim of this study was to map fire severity from historic Landsat TM data in an assessment of the long-term effect of fire severity on moose browse such as willow shrubs and aspen saplings.

approach

The Normalized Burn Ratio (NBR) from Landsat TM data was used as an index of fire severity in this study. Regions of five fire severity classes were mapped from Landsat NBR values and 61 plots were located at the center of homogeneous patches within the fire severity classes. GPS was then used to navigate to each location and vegetation density and organic soil depth was sampled at each plot.

progress

The relationship between NBR values and mean organic soil depth was weak among all the plots. However, there was a stronger relationship when only black spruce sites were analyzed, probably due to aspen/birch sites having shallow organic soil depths before the fire. The relationship between NBR and mean organic soil depth was strong among black spruce sites across a gradient of dry to moist sites. There was no relationship in wet black spruce sites, probably due to these sites burning with little consumption of organic horizons.

Sites with the highest density of aspen stems consistently had high remotely sensed fire severity values and shallow organic soil. However, sites with no aspen had varied remotely sensed fire severity values and sites with shallow organic soil varied greatly in aspen density. Sites with the highest density of willow stems consistently had moderate remotely sensed fire severity values.

impact

Sites with high densities of aspen and willow consistently occurred in high and moderate fire severity classes. However, fire severity with low aspen or willow reproduction ranged from low to extreme severity. Information in addition to fire severity, such as seed source and post-fire sprouting and suckering potential, would be needed to accurately map potential post-fire aspen and willow distributions.

Characterizing active soil organic matter pools contributing to soil nitrogen availability in bromegrass (*Bromus inermis* Leyss.) grass fields

M. Zhang, Alan Zhao

purpose

We seek to evaluate potential soil nitrogen mineralization capacity in interior Alaska soils so that fertilizer management regimes for reindeer hay production can be developed. A field experiment with smooth bromegrass (*Bromus inermis* Leyss.) was laid out at the Fairbanks Experiment Farm May 2004. There were three fertilizer treatments: 1) Check (0-30-30); 2) Low nitrogen (50-30-30); and 3) High nitrogen (150-30-30), and two cutting frequencies: one cutting per year and two cuttings per year. In spring 2006, 15N enriched urea (10 percent) was applied in the fertilizer treated plots in 1 m x 1 m microplots. We took plant samples from the microplots in June, July, and August in 2006 and 2007. We dried and ground plant samples, and will determine 15N concentration.

approach

Soil samples from 15N enriched plots were incubated in -5 and 15°C with 20 percent and 90 percent field capacity for one year. Destructive samples were taken during incubation, and mineral nitrogen was extracted by 2 M KCl, and total extractable nitrogen (N) by 1 M hot HCl, and 1 M NaOH was determined.

progress

Soil moisture and temperature during incubation affected mineral N release and mineral N form in soil. With low temperature and high moisture condition, the mineral N release was slow and major mineral N in soil was NH4-N. In contrast, with high temperature and high moisture, mineral N released from soil was fast and major mineral N in soil was NO3-N. The mineral N released at each sampling time was related (r2 = 0.87, p = 0.002) to the total water extractable N, indicating water extractable organic N was the most labile source of N in the soil. Fate of applied 15N is to be determined after each extraction.

impact

The project is providing tools to access potential nitrogen mineralization in soils. This will help to improve nutrient management in Alaska's arable land. Total water extractable organic nitrogen can be used as a tool for estimating mineral nitrogen release in soil.

Phosphorus status in soils: Impact of tillage, rate and time of phosphorus fertilizer application

M. Zhang, S.D. Sparrow, B. Van Veldhuizen, d. masiak

purpose

High phosphorus (P) fertilizer prices and environmental concerns of P runoff from farmland require a good understanding of P status in soil. Such an understanding will help create P best management practices on farmland and minimize the risk of environmental contamination from improper use of P fertilizers. We sought to determine 1) P status in soils under different tillage, rate and method of application; and 2) barley yield response to rate and method of P application.

A tillage and straw management experiment was started in 1983 near Delta Junction (64.8° N, 147.7° W), Alaska, to determine the impact of tillage, straw management, and nitrogen fertilizer application rate on soil properties and barley (*Hordeum vulgare* L.) grain yield. For more than twenty years, phosphorus was applied as mono ammonium phosphate fertilizer at a rate of 21 kg P ha-1. After more than two decades receiving this application, the phosphorus status in soil was unknown. We conducted another field experiment in 2008 in the areas of Delta Junction, Palmer, (61.6° N, 149.1° W) and Fairbanks (64.8° N, 147.7° W) areas to determine the effects of rate and method of P application.

approach

From the long-term tillage research plots, we took soil samples at 0-5, 5-10, and 10-15 cm increments from no tillage, disk once, and disk twice treatments with or without straw retention in spring 2006. For the P application rate and method experiment in 2008, there were four treatments: 1) No P application, 2) 50 kg P2O5/ha, broadcast; 3) 50 kg P2O5/ha, placed in seed-row; 4) 100 kg P2O5/ha, broadcast. Barley (cv. 'Wooding') was used as a test crop. We took soil samples from these treatments in July (growth stage = heading) and August (growth stage = mature). Using air-dried samples, we measured the phosphorus concentration in the samples. For soil samples from tillage study, we determined cation concentrations (Ca2+, Mg2+, Na+, Cu2+, Zn2+, Fe3+, and Al3+) and Hedley P fractions.

progress

Phosphorus concentration was stratified in the long-term no tillage study with most of P residing in the top 0-5 cm soil depth. Tillage affected the labile P (resin P, bicarbonate P, and bicarbonate organic P) fractions in the top 0-5 cm. The rate of nitrogen application and straw retention did not affect any fraction of P at this depth. At 5-10 cm depth, tillage only affected the resin P. For the rate and method of P application study, the seed-row placement of P fertilizer at 50 kg P2O5/ha was as good as the 100 P2O5 kg/ha application for biomass production only at the Palmer site at heading stage of barley. There were no differences in biomass production at the barley mature stage for all three sites. We found no difference for Mehlich 3 P and Bray P in the soils among the rate and application methods of P fertilizers in all three sites.

impact

Cost of P fertilizer has increased dramatically in recent years. Understanding tillage and straw management effects on soil P status over a long period of time will help to guide P applications in soils in Alaska. The results from the P rate and application method experiment will help producers to optimize their P application rate, hence decrease the production cost.

Impacts of experimentally induced drought on soil respiration in interior Alaska

David Valentine, John Yarie

purpose

This study examines how the timing of experimentally induced drought affects decomposition and soil respiration. We hypothesized that snowmelt exclusion would result in an early season drought that would slow tree growth (most ringwidth growth occurs relatively early in the growing season) without significantly slowing soil carbon mineralization, and throughfall exclusion would result in late season drought that would slow soil carbon mineralization without significantly affecting tree growth. We expect the net result of snowmelt exclusion will be to retain less or release more carbon, and the net result of throughfall exclusion will be to retain more or release less carbon.

approach/methods

This study uses existing summer moisture exclusion sites (three replicate 10x15 m plots in both upland and floodplain landscape positions) that have been maintained by the Forest Soils Laboratory since 1989, and adds an additional set of three replicate 15x15 m snowmelt exclusion plots in both landscape positions. All respiration and decomposition measurements began in 2006 in the throughfall exclusion sites, and will begin the summer following the snowmelt exclusion treatment i.e., 2009 in upland sites, 2010 in floodplain sites). Following establishment of soil respiration collars, soil respiration rates have been monitored at biweekly intervals during each growing season using a LiCor 6262 infrared gas analyzer. Surface soil and air temperatures were monitored concurrently with the respiration measurements.

progress/results

Soil respiration rates in 2008 continued to be significantly lower in summer drought treatment sites than in the control sites in both upland and floodplain landscape positions. However, it is not clear yet to what extent differences in autotrophic respiration (Ra, root respiration) and heterotrophic (Rh, mostly microbial respiration) contributed to the overall difference in respiration. This will be addressed in subsequent growing seasons. Snowmelt exclusion shelters were completed in uplands in summer 2008, and will be completed in floodplain sites in summer 2009.

impact/implications

We already know that the timing of moisture stress has important impacts on fire behavior and severity in Alaska's boreal forests: late season drought tends to allow more complete combustion of surface organic fuels, which in turn makes it more likely for broadleaf deciduous trees to dominate the post-fire burned area. This study will enable us also to examine how the timing of moisture stress affects carbon capture and loss in mid-successional, broadleaf deciduous stands. If the results support our hypotheses, then ecosystem modelers will have a basis for projecting carbon balance consequences of a drying climate.

Management of Ecosystems

SITUATED AT high latitudes, Alaska is a bellwether for the effects of climate change. Its climate varies strongly with its broad variety in landscape, from the extreme northern tundra to the Tongass National Forest to the Aleutian Islands. The large land area and coastline of Alaska combined with its significant proportion of public lands make management of natural landscapes an important feature of policy and planning in the state. SNRAS and AFES research and analysis examine the sensitivity of northern resources to climate variability and change; biodiversity and wildland crop opportunities, conservation biology, and revegetation; resource management systems; forest measurement systems, forest growth and yield, boreal forest silviculture and forest health; wildland fire and fire effects and management; wilderness ecosystem management, and the wildland-urban interface.

MANAGEMENT OF ECOSYSTEMS REPORTS:

Alaska climate change: 2008 update

Glenn Juday

purpose

This ongoing project examines the influence of weather, especially weather extremes and climate change, on agriculture and forestry in the far north. I identified the history, risks, and opportunities of climate change and climate variability as they affect natural and managed forest.

approach

Long-term records of daily, seasonal, and yearly temperature and precipitation were updated with the help of the Alaska Climate Research Center. Alaska climate databases were compared to significant events affecting forests, land management, and agriculture in Alaska.

progress/result

In interior Alaska the summer of 2008 provided significant relief from cumulative heat and drought stress that had affected boreal forests in recent decades. The number of warm days (greater than 70°F) in 2008 ranked only 82nd in the 102-year record at Fairbanks. However, the characteristic pattern of warming in recent years continued, in which daily low temperatures during the warm season were ranked much higher (upper third of all years) than daily maximum temperatures (bottom third of all years). Fairbanks experienced a near-average 113-day growing season despite a late (May 30) frost. A strong population of spruce budworm larvae that were favored by warmth in 2007 began to damage trees in May and June 2008, but then largely disappeared in July at about the time that persistent cool and wet weather developed. It is not clear whether biological factors (predators, disease, parasites) or direct effects of cool weather largely eliminated spruce budworm. Significant flooding placed water and sediment on middle and lower Tanana River floodplain forest sites. Mean annual temperature at Barrow was the eighth highest in the 93 years of record. Arctic sea ice extent recovered slightly from the record lows of 2007, but still ranked very low in both the satellite-based measured series (three decades) and in the estimated/reconstructed record (century in length). Southcentral and much of southeast Alaska experienced cool weather as strong La Niña conditions developed and persisted over the North Pacific. Mean annual temperature at Juneau ranked only 46th out of 65 years of record. Relative tree growth on most coastal forest sites is predicted to be moderate to low under such conditions. Glacier mass balance in coastal Alaska was strongly positive for the first time in many years.

impact/implications

From the perspective of the higher temperatures of recent decades, the weather of 2008 seemed cold to many people in Alaska, but for many weather parameters it was closer to a return to long-term normal conditions. Two important short-term natural factors that affect Alaska temperatures, solar activity and coupled ocean-atmosphere circulation, delivered very strong cooling influences over much of Alaska south of the Brooks Range in 2008. Despite these influences, most weather parameters relevant to forestry and agriculture were in the middle to moderately low range from the perspective of the last century. Many trees in Alaska today regularly experienced colder conditions earlier in their lives. If solar sunspot activity resumes and the typical change from La Niña to El Niño conditions occurs in 2009 or shortly after, we can reasonably anticipate a return to elevated temperatures in Alaska typical of the last few decades. This overall pattern of variability has affected Alaska natural systems for many centuries at least, while the steady increase in greenhouse gases in Earth's atmosphere is continuing to dampen heat loss, consistent with detectable patterns such as a greater increase in low temperatures rather than highs.

Collaborative research: Impacts of climatic change on the boreal-forest fire regimes of Alaska: lessons from the past and prospects for the future

Feng Sheng Hu, Philip Higuera (Univ. of Illinois); **T. Scott Rupp**, Mark Olson

purpose and approach

This project confronts the current poor understanding of fire responses to climatic change in Alaska by integrating paleorecords and computer modeling. The centerpiece of the project is its innovative and rigorous approach to understand patterns and mechanisms of climate-fire-vegetation interactions from the recent geological past through the near future. The researchers will monitor charcoal processes (dispersal, transport, and deposition) of contemporary and recent burns to parameterize a newly developed numerical model of charcoal-fire relationships (CharSiM), a tool that greatly enhances the rigor of fire-history reconstruction. The resulting knowledge will be applied to interpret fire histories of the past 6,000 years (focusing on the neoglacial transition and oscillations associated with the Little Ice Age) from sediment charcoal data collected with statistical criteria in two study areas that are characterized by contrasting fire regimes and recent climate anomalies. These fire records will be compared with climatic and vegetational reconstructions using state-of-the-art paleoecological and geochemical techniques. An iterative paleodata-modeling approach will be applied to elucidate mechanistic processes of climate-vegetation-fire interactions (e.g., lead-lag relationship, fuel dynamics) using ALFRESCO, a model developed and well tested for studying Alaska boreal ecosystems. Finally, the improved ALFRESCO will be used to simulate regional fire regimes for the next 100 years based on a suite of forecast climate scenarios.

progress

This is year three of a four-year paleo-modeling project. We have been primarily focused on modeling fire-climate relationships and the influence of vegetation including feedbacks. We have a fully implemented model that is available to state and federal land managers in Alaska (and to the general public; see www.snap.uaf.edu/downloads/boreal-alfresco).

impact

This project promises to bring new insights into the variability of boreal fire responses to climatic change and to improve the robustness of a key model for predicting future changes in boreal ecosystems. The prognostic simulations of the twenty-first-century fire regimes will be directly relevant to fire management planning and policy.

IPY: Impacts of high-latitude climate change on ecosystem services and society

F.S. Chapin, III (UAF Institute of Arctic Biology); **T. Scott Rupp, Gary Kofinas**

purpose and approach

Arctic environmental and ecological changes have had profound social impacts on indigenous and non-indigenous people because of both the large magnitude of changes and the generally strong dependence on renewable resources that characterizes northern societies. Ecosystem services, the benefits that society derives from ecosystems, are the critical link between environmental and ecological changes and their impacts on society. Although we know in a general sense that northern ecosystem services are changing, the overall patterns, causes, interactions, and consequences of these changes are too poorly known (or are considered only in isolation from other changes) to provide policymakers and the public with a firm foundation for policy formulation and change. The goals of this research are to (1) document the current status and trends in ecosystem services in the arctic and boreal forest, (2) project future trends in these services; and (3) assess the societal consequences of altered ecosystem services.

progress

In year two of this project the modeling component (PI Rupp's responsibility) has focused on (1) the development of downscaled historic and projected datasets of climate, (2) preliminary simulations of statewide vegetation and fire dynamics, and (3) development of methodologies to assess past and future response of ecosystem services to climate change. These activities leveraged strongly on the resources and expertise of the University of Alaska's statewide Scenarios Network for Alaska Planning (SNAP) initiative (directed by Rupp).

impact

Ecosystem services are the single most critical link between climate change and societal consequences. By focusing on this critical link, we are, by definition, addressing those ecological changes that are most important to society. By working with communities and other stakeholders to identify the ecosystem services of greatest concern and learning from those communities about the consequences of changes in these services, we are integrating ecological and social dimensions of that linkage, with the explicit goal of helping communities decide which policy options they wish to consider.

Long-term forest change and climate sensitivity of white spruce at Caribou Crossing RNA

Glenn Juday, Claire Alix, David Spencer, Kimberley Maher, Steve Winslow

purpose

This study is the third phase of an examination of the growth history and controls on growth of white spruce trees along the Yukon and Tanana rivers. The first and second phases involved collection and preliminary analysis of trees along the floodplain of the Yukon River in the Yukon Flats of east-central Alaska and on the Tanana River near Fairbanks. The third phase is an examination of the floodplain and upland forest in the Caribou Crossing Research Natural Area (RNA) in the Tanana Valley State Forest about 65 miles (105 km) west of Fairbanks.

approach

Permanent forest plots were established in Caribou Crossing RNA in 1986. In one plot (Y Gulch) all trees were mapped and the diameter of each was measured. A September 2008 expedition revisited the Caribou Crossing site and relocated two of the three original plots and established one new plot in the RNA and one nearby. In 2008 all trees that were mapped and measured at the Y Gulch plots in 1986 were re-measured, and all trees were mapped for the first time at the Trap Flats plot. Penetrating tree cores (2 radii) were collected from forty large, dominant trees in the two upland and two floodplain stands. Ring widths of cores were measured and compared to climate data at Fairbanks.

progress/result

In the Y Gulch upland plot, 52 of the 296 (17.6 percent) white spruce trees that were alive in 1986 at the time of first measurement had died by 2008. The 1986 diameter of the trees that died (15.2 cm) was smaller than the 1986 diameter of the trees that survived until 2008 (18.6 cm) indicating that tree death was concentrated in the smaller size classes of slower growing trees. Overall, mean diameter of all white spruce trees alive in 2008 (21.3 cm) was greater than all live white spruce in 1986 (18.0 cm). Even though tree death was greater in smaller trees size classes, several of the largest dominant trees at Y Gulch died between dates of measurement.

Of the forty ring-width cores from large, dominant trees, all but two have a complete sequence of measurable annual rings from 1890 onward, with the earliest ring in the sample formed in the year 1750. At all four Caribou Crossing plots, years with warm summers consistently were years of poor white spruce growth and years with cool summers were years of best growth except for the period after 1980. A previously developed climate predictive index that was well correlated with ring-width growth of floodplain white spruce from the Yukon Flats and the Tanana River near Fairbanks predicted ring width growth equally well for the forty Caribou Crossing trees. Climate favorability in interior Alaska since the late 1970s is the lowest in the last two centuries because of sustained warm summer temperatures.

impact/implications

The samples from both phase one and phase two of this study of riparian white spruce have some of the highest sustained growth rates in boreal Alaska, and the growth rate of the Caribou Crossing ring-width sample is essentially the same (mean 1.0 mm per year since 1890). However, unfavorable weather since 1977, consisting of warm summers, reduced mean growth to 0.75 mm per year on average. The death of nearly 18 percent of white spruce (and many aspen near the plot) is far above a sustainable rate because practically no new trees are recruited into the population until a disturbance (usually fire) results in complete stand replacement. Essentially this stand is dying, which confirms that a similar result obtained earlier at Bonanza Creek Experimental Forest is not an isolated occurrence, but a widespread phenomenon in central Alaska. The weak increase in growth during favorable weather years since 1977 is consistent with injury to white spruce from elevated levels of wood boring beetles and defoliating budworms which have reduced the vigor of trees that survived attacks from high populations of these insects in recent years. The forest growth potential of a large part of interior Alaska apparently has experienced a significant reduction in the last few decades.

Spruce budworm populations are well-predicted by a temperature index

Glenn Juday, Richard Skeeter Werner, James Kruse

purpose

This study was designed to develop a specific predictive index for occurrence and population levels of the spruce budworm, which has since the late 1970s irregularly both appeared at outbreak levels and disappeared in Alaska. The study is a cooperative effort with the USDA Forest Service Pacific Northwest Research Station and USDA State and Private Forestry, the Alaska Department of Natural Resources, and the Bonanza Creek Long-Term Ecological Research program (LTER).

approach

This study built upon a previous comparison of scientific literature on the effects of temperature on the rate of development of spruce budworm and budworm monitoring data. Budworm population density has been measured since 1975 in the Bonanza Creek Experimental Forest LTER. Alaska statewide spatial extent of visible forest damage from budworm has been mapped since 1974 by the Alaska Forest Health Survey. Budworm abundance data was compared with Fairbanks weather data. A reconstruction of the past century of probable budworm presence/absence was attempted.

progress/result

It was previously established that warm August temperatures allow the rapid completion of development of budworms from eggs to the second larval stage that is not harmed by low winter temperatures. Also, warm temperatures in April, May, and June speed the development of budworms through several additional development stages to reproductive adults. We combined these temperature terms into a single index number of weather favorability at Fairbanks for spruce budworm. At Bonanza Creek LTER, budworm population density was high in years with high index values of budworm weather favorability, and low following years of marginal to moderate weather index values. Years with weather index values that were not sufficient to allow completion of the budworm life cycle were associated with absence of budworms in the LTER monitoring data. Trends in the statewide aerial survey data generally agreed with LTER population data, but abundance peaks tended to occur one to three years later in the statewide data. The peak year of budworm abundance at Bonanza Creek LTER was 1995, but in the Alaska statewide data the peak year of the extent of budworm damage (detected) to white spruce trees was 1990.

impact/implications

Spruce budworm is the largest (by wood volume) single cause of the death of commercial timber in Canada among all diseases and insects. It appears that conditions favorable for budworm outbreak are expanding across Alaska. The specific temperatures that favor spruce budworm reproduction were generally absent until the Alaska/Pacific climate regime shift of 1976/77. Since the climate regime shift, a few specific years of highly favorable budworm weather (warmth) occurred in Alaska and widespread and highly visible budworm damage to trees appeared for the first time, to the knowledge of professional resource managers. Continued warmth at recent levels will make spruce budworm a significant lifetime risk factor for white spruce. Spruce budworm is likely to diminish white spruce in an expanding series of pockets or stands or subregions, while it survives at near current levels elsewhere. Thus, additional warming is likely to make white spruce significantly rarer in interior Alaska. In the early phases of this advance of budworm damage across Alaska, insect populations are well correlated to temperature. If warmer temperatures become more frequent, then predators, parasites, and other complex ecological interactions are likely to control Alaska populations of spruce budworm as they do in Canada today.

fire-related studies

Post-fire studies supporting computer-assisted management of fire and fuels during a regime of changing climate in the Alaska boreal forest

T. Scott Rupp, Daniel Mann, Mark Olson; Karen Murphy (USFWS)

purpose and approach

Land managers face unique challenges in Alaska. Most of the boreal forest is currently managed as wilderness. Though largely free of direct human impacts, the boreal forest grows in a region that is now experiencing significant climate changes. Also, the fire ecology of Alaska is relatively poorly understood, and these data gaps hinder effective fuel and fire management there. To meet these challenges, we have developed the computer model Boreal ALFRESCO for use as a multidisciplinary planning tool and as an operational tool for assessing fuels and fire hazards. Boreal ALFRESCO simulates the responses of boreal forest vegetation on real landscapes to changes in fire management, ignition frequency, and climate.

progress

In collaboration with the UA Scenarios Network for Alaska Planning initiative statewide simulations of future fire regimes based on IPCC climate projections have been completed. Statewide and regional reports have been created for use by federal land management agencies—primarily US Fish and Wildlife Service and National Park Service (see www.snap.uaf.edu/downloads/reports-boreal-alfresco). A manuscript presenting projected fire activity through this century is in preparation and will be submitted in fall 2009.

impact

This project will provide land managers with the ability to simulate the response of future fire regimes to a changing climate. These model simulations also will provide potential natural vegetation groups and estimates of fire return intervals required for federally mandated Fire Regime Condition Classes (FRCC) mapping. These combined capabilities will enable Boreal ALFRESCO to simulate the impacts of climate change on FRCC—a novel ability that has important ramifications for long-term forest management.

Factors influencing large wildland fire suppression expenditures

J. Liang; D.E. Calkin, K.M. Gebert (USDA Rocky Mountain Research Station); T.J. Venn, R.P. Silverstein (Univ. of Montana)

purpose

We sought to address the potential factors that affect the excessive suppression cost of large wildland fires.

approach and results

We studied large wildland fire suppression expenditures by the US Department of Agriculture Forest Service. Among sixteen potential nonmanagerial factors, which represented fire size and shape, private properties, public land attributes, forest and fuel conditions, and geographic settings, we found only fire size and private land had a strong effect on suppression expenditures. When both were accounted for, all the other variables had no significant effect. A parsimonious model to predict suppression expenditures was suggested, in which fire size and private land explained 58 percent of variation in expenditures. Other things being equal, suppression expenditures monotonically increased with fire size. For the average fire size, expenditures first increased with the percentage of private land within burned area, but as the percentage exceeded 20 percent, expenditures slowly declined until they stabilized when private land reached 50 percent of burned area. The corresponding paper was published in the *International Journal of Wildland Fire*.

impact

This study could save millions of dollars of fire suppression cost each year. We suggest that efforts to contain federal suppression expenditures need to focus on the highly complex, politically sensitive topic of wildfires on private land.

Quantifying the effects of fuels reduction treatments on fire behavior and post-fire vegetation dynamics

T. Scott Rupp; Roger Ottmar, Bret Butler (USFS); Robert Schmoll (Alaska Division of Forestry) Randi Jandt, Kato Howard (BLM Alaska Fire Service); Skip Theisen (BLM)

purpose and approach

Concerns about wildland fuel levels and a growing wildland-urban interface have pushed wildland fire risk mitigation strategies to the forefront of fire management activities. Mechanical (e.g., shearblading) and manual (e.g., thinnings) fuel treatments have become the preferred strategy of many fire managers and agencies. However, few observations exist that document the actual effect of different fuel treatments on fire behavior. Alaska's federal and state fire management agencies have identified this data gap as their most important fire science research need and priority. To address this need, our project will quantify the effects of different mechanical and manual fuel treatments on fire behavior and transfer that information to the federal and state fire management community through a series of technical reports and peer-reviewed journal articles.

progress

Our study site at the Nenana Ridge Ruffed Grouse Project Area located thirty miles southwest of Fairbanks, Alaska, represents an ideal location because of its proximity to Fairbanks, existing road network, and large area (600 acres) of homogenous black spruce fuels. In spring and summer 2006 two experimental burn units (approximately 200 acres each) were laid out. Within each burn unit four fuel treatment plots (5 acres) were established. In each unit two shearblade treatments and two 8 x 8 ft thinnings pruned to four feet were established. We inventoried the existing vegetation, including ground vegetation, understory and overstory trees and tree crowns, organic layer, and dead-down woody surface fuels throughout the treatments and surrounding control vegetation matrix. Following treatments we re-inventoried the understory and overstory trees and tree crowns, organic layer, and dead-down woody surface fuels. Due to wet 2007 and 2008 fire seasons we were unable to complete the experimental burns. In the 2009 fire season, provided favorable weather conditions and available fire operations resources, we plan to burn each unit separately—documenting fire behavior from the time of ignition until steady-state behavior ceases using a combination of cameras, video, direct observations, and thermal dataloggers. Consumption plots will be located in both treatment units (thinnings and shearbladings) and the control vegetation. Post-fire vegetation recovery, following initial post-fire vegetation measurements, will be documented in all treatments and the control vegetation matrix for the duration of the project.

impact

We anticipate that this research will lead to the first quantified tests of the effects of fuel reduction treatments on fire behavior in Alaska. Our results will provide the data required by fire behavior models (FARSITE, BEHAVE, and NEXUS), fuels characterization system (FCCS), and fire effects models (CONSUME). We hope to develop guidelines directed at sampling design and methodology issues that can be used to assist in carrying out other experimental burns when the opportunity arises.

forest health & growth

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Evapotranspiration from boreal forest landscapes

John D. Fox, Jr.

purpose

My goal is to assess which of several methods for estimating potential evapotranspiration and actual evapotranspiration are most suitable for management purposes in Alaska's boreal regions. Evapotranspiration is the component of the landscape's water budget that is very sensitive to changes in vegetative cover and land use, including timber harvest, wildfire, and climate change. Since annual precipitation and annual lake evaporation are thought nearly equal in magnitude in Alaska's boreal forest, small changes in evaporation or precipitation can affect the net water gain or loss in a water body. This warrants a better understanding of the evaporative process and a more reliable method of calculating it under specific conditions. This project will help develop that capability.

approach

I am reviewing methods used and values obtained for potential evapotranspiration (PET) and actual evapotranspiration reported for Alaska in the literature. From simple to complex PET methods, I am assessing their sensitivity to the methods for estimating net radiation and the particular wind function used. I will use water balance accounting models to estimate actual evapotranspiration and sensitivity to data sources and assumptions, and will estimate open-water evaporation from a closed lake using short-term lake level measurements.

progress

This year we started a review of historical pan evaporation data for interior Alaska and continued collection of our own pan evaporation data for comparative purposes. Preliminary inspection revealed considerable variability in pan evaporation for the Fairbanks area over a span of almost seventy years. Quality of data in some years and decades was questioned due to: unreasonably high daily values reported prior to 1931; a large number of days of no record; and numerous low values reported in the 1940s. Accounting, as best we could, for data shortcomings, analysis using the Mann-Kendel tests revealed no significant trend over time (1950–2008) in the average daily pan evaporation for the season. We have begun to review methods to calculate pan evaporation since it is a common method of estimating potential evapotranspiration and lake evaporation. The so-called "PenPan" method appears to be useful for deriving pan coefficients. This method takes into account the interactions of pan and solar geometry that are significant in the high latitude boreal forest because of low sun angles. Various standard methods for estimating potential evaporation and lake evaporation result in daily evaporation rates of from 1-5 mm/day. Many methods are very sensitive to the relationship assumed between air temperature and water surface temperature, particularly the Bowen Ratio method. At this point the Penman-VanBavel method and the PenPan method appear promising. The outcome of any particular method may be more sensitive to how net and/or solar radiation is estimated than the method itself. Pan evaporation data from another ice-free season were collected. Solar radiation, air temperature and relative humidity, pan water temperature, and wind speed and direction data were collected this year at the evaporation pan site. One problem of applying empirical methods to the landscape is accounting meaningfully for topography and cloud cover. These two sets of variables interact since the difference in solar radiation received on north versus south facing slopes is greatest under clear sky conditions and negligible under heavy overcast. A method of adjusting the potential evaporation term of the monthly, local water balance procedure has been developed to allow for topographic and cloud cover effects.

impact

Progress in 2008 demonstrated the importance of solar and net radiation estimation techniques in characterizing evaporation and potential evaporation from the boreal landscape. It has helped two PhD students gain insight into their particular projects, and supported the senior thesis project of one undergraduate student. Better information on evaporation will contribute to our understanding of climate change issues, wildfire danger rating, and landscape hydrology.

Photo-monitoring forest development and health

Glenn Juday, Steve Winslow

purpose

This project uses repeat photography to document patterns and events in forest development, forest change, and forest health. The study began in 1989 in Bonanza Creek Experimental Forest (BCEF), and is being expanded.

approach

At BCEF Long Term Ecological Research (LTER) site a comprehensive set of 2008 long-term monitoring photos was collected in three forest types (white spruce, aspen, Alaska birch) in both mature forest condition and in young post-fire (burned in 1983) regenerating forest. In each of the six BCEF LTER stands there are five permanent photo points, with photos taken to the north, south, east, west, and up. Photo documentation using the same protocol was begun at Caribou Crossing Research Natural Area (RNA) in the Tanana Valley

State Forest 100 km (60 mi) west of Fairbanks. A special air photo series of the six BCEF stands was also taken.

progress/result

In 2008 the ground-level photo monitoring shifted to a high-quality digital camera after using digitized film for the past 18 years. A full frame sensor digital camera was selected, using the same wide-angle lens type and aspect ratio of the original film-based series. At Caribou Crossing RNA, 316 pictures at 18 permanent photo stations in three localities were taken, totaling 7.8 GB of data. At Bonanza Creek Experimental Forest the 2008 photo update covered 8 sites and 40 permanent photo points situated over 7.25 hectares, totaling 2,047 pictures. Pictures at BCEF were taken at three times: (1) in early May after snowmelt but before broad leaf expansion, (2) in August with maximum broadleaf development, and (3) in late September and early October with after leaf fall but before the start of snowpack accumulation. This first year of digital camera use was devoted to experimenting to determine the optimum protocol. Pictures at each point were taken in large format (about 9 MB) as well as medium (about 5 MB), and set at infinite focus and on autofocus, representing a composite distance average of the features (branches, leaves, etc.) nearest the lens. At a number of photo points the ground layer vegetation was also documented by depressing the horizontal angle of the camera. The entire digitized archive of all previous BCEF photos was partly color corrected and then organized under a naming protocol that allows rapid retrieval of a particular location, scene, and date. Use of GPS coordinates allowed consistent centering of each aerial picture frame on the center of the plot. The air photos at BCEF used a digital camera with improved resolution over previous air photos taken in 1989 and 1998. Image resolution of the aerial photos was superior and for the first time allows the identification of individual small tree and shrub crowns and logs within the plot. The 2008 aerial photos were taken in October with a light snow cover, and are particularly effective in identifying evergreen conifers.

impact/implications

The long-term BCEF photo series has been particularly useful in documenting the expansion of post-fire tree and shrub regeneration through both height expansion and lateral expansion, and how this expansion process has interacted with ground layer vegetation. In the competition of white spruce with broadleaf trees and shrubs generally it has been assumed that once white spruce is overtopped in the initial seedling establishment phase it will be decades to a century before spruce can re-emerge. However, the BCEF photo series in post-fire plots suggests that the lateral expansion of white spruce crowns may be an important factor in obtaining an advantage over competing broadleaf trees and shrubs. Conifer litter slows the growth of broadleaf trees, providing an opportunity for well-positioned white spruce to re-emerge over broadleaf plants much faster. In mature white spruce forest recent death of canopy-dominant old white spruce trees has allowed enough light penetration to the ground that the formerly dominant moss layer has declined and dense new patches of calamagrostis (bluejoint) grass have developed along with new Alaska birch stems. We are assembling a visual record that allows the viewer to literally see the growth of the forest happen over long periods of time.

Synthesis of Alaska forest health trends, events, and patterns

Glenn Juday, Skeeter Werner, Robert Ott

purpose

This study is a compilation and comparison of forest health data from two sources. Since 1975 the population density of major forest insect species has been monitored at the Bonanza Creek Experimental Forest (BCEF) Long Term Ecological Research (LTER) site 32 km southwest of Fairbanks. Since 1974 the Alaska Aerial Detection Forest Health Survey (ADFHS) has been flown annually to map the extent of insect-caused forest damage statewide. While some LTER data have been used in specific studies and annual ADFHS reports have been issued, this is the first attempt to compile, analyze, and compare both series to see if trends are present and consistent between the two sources.

approach

Insect monitoring at BCEF was started by the USDA Forest Service PNW Research Station, and later was partially supported by the National Science Foundation after the LTER was established. Populations of defoliating insects were monitored in stands of alder, aspen, birch, cottonwood, spruce, tamarack, and willow, and densities of insects recorded. Five sites were selected from floodplain to upland forest stands and a 1-meter-long branch was removed from one tree for each tree species at mid-crown height on the south side of the tree at each site in June and late July. Insect larvae, pupae, and adults were counted on both top and bottom sides of every leaf from the branch samples. Populations of bark beetles and wood-boring beetles were monitored using individual funnel traps baited with pheromones (natural chemical attractant signals used by the insects). In the ADFHS, trained observers prepared sketch-maps depicting the extent (polygons) of various types of visible forest damage including recent bark beetle mortality, and defoliation of hardwoods and conifers. About 25 percent of the forest area of highest management priority in Alaska was covered each summer using fixed-wing aircraft. In the most recent years, trends established from previous year-to-year mapping results informed the search for areas with the most significant pests.

progress/result

Populations of eleven species or species groups were monitored at BCEF, sorted into species or functional groups based on the type of tree damage they caused. Principal defoliators of conifers included spruce budworm, larch bud moth, and larch sawfly. The main defoliators of broadleaf trees included spear-marked black moth, large aspen tortrix, leaf beetles, leaf miners (principally aspen leaf miner), and birch leaf roller. Wood-boring beetles of conifer trees included

Spruce budworm.
—PHOTO BY GLENN P. JUDAY

spruce bark beetle, Ips (engraver) beetle, and larch beetle. The BCEF year-to-year record varied in a way generally similar to the ADFHS data, although there were some differences. BCEF was the statewide center of Ips beetle attack resulting in death of white spruce in the 1980s and 1990s, because a regionally high Ips population was initiated by the 1983 Rosie Creek Fire and then was sustained by local snow breakage in tree crowns and generally high moisture stress levels.

impact/implications

BCEF experienced tree-damaging insect population outbreaks with increasing frequency during the past thirty-three years, and in the most recent portion of the monitoring record, outbreaks of several insect species occurred simultaneously, a pattern not seen earlier. The increased outbreak activity was generally consistent with increased temperatures. Spruce budworm occurred at outbreak levels both statewide and at BCEF in 1989–90, 1993–95, and 2005–07, but probably did not occur or at least persist in interior Alaska until the 1970s because of insufficient heat sums to complete development. A few species, especially spear-marked black moth and large aspen tortrix, ceased outbreak behavior in the 1980s for unknown reasons. In general, due mostly to improved technology and institutional experience, the aerial surveys for the ADFHS have become more consistent and more accurate with time, so that smaller outbreaks are more likely to have been detected in more recent years. Still, trees growing in interior Alaska in the early twenty-first century are more likely to die or experience severe insect attack than similar trees of the mid twentieth century.

Growth reactions of Lutz spruce (*Picea* X *Lutzii)* saplings to fireweed *(Epilobium angustifolium)* removal and the presence of fertilizer

Emily Dickson, **Valerie Barber**

purpose

I seek to determine if 100 percent fireweed (*Epilobium angustifolium* (L.)) removal and the presence of 20-10-5 fertilizer enhances Lutz spruce (*Picea X lutzii* (Little)) saplings' growth through increased foliar nutrient content, internode growth, and total tree height. The results will help determine if annual harvesting affects the future density and nutrient content of fireweed.

approach

P. lutzii needle growth will be determined by collecting foliar needle samples from years 2005, 2006, 2007, and 2008, from both fertilized and unfertilized plots, and plots with and without fireweed removal. Foliar needles from pre- and post treatments will be analyzed individually by plot and year for total nitrogen, potassium, phosphorus, and carbon, along with dry weights. *P. lutzii* internode growth and total tree height will be measured from pre-treatment year (2005) to post treatment years (2006, 2007, and 2008). Again, data will be individually analyzed according to pre- and post-treatment years. Soil moisture and temperature measurements from each plot will be made every three hours over the summers of 2006-2008.

progress

I am in the process of analyzing foliar needles, fireweed leaves, and soil samples in addition to internode and total tree heights from (2008) data collection using a two-way ANOVA. Based on previous years' (2006 and 2007) data, there is no statistically significant difference in needle or tree growth between fertilized and unfertilized plots and plots with or without fireweed removal, although there are some differences showing an effect and we may expect to see a bigger and statistically significant difference between 2006 and 2008 data, which are currently being analyzed.

impact

This research is important to timber managers because total removal of any non-timber forest products, in this case fireweed, could influence the survival and growth of commercially valuable trees. More specifically, fireweed is a competitor species, meaning it competes against saplings for light, water, and nutrients (Thiffault et al., 2003). Management decisions for timber can influence production of non-timber forest products, such as fireweed. For example, post-logging scarification can retard the growth of vegetation (fireweed) through the burial of seed stocks (Palviainen et al., 2007). Non-timber forest product research could benefit from commercial harvesters interested in expanding their product lines. Moreover, this knowledge will assist harvesters in understanding how continual annual harvesting can impact the future growth and survival of non-timber forest products.

This data could also influence local commercial timber owners to apply fertilizer to saplings after recent clear-cuts, contributing to the survival and growth of commercially valuable trees. Practicability, cost, and accessibility should be considered when implementing local management schemes.

Log decomposition in interior Alaska

J. Yarie

purpose

Logs represent a significant carbon and organic matter input into the forest floor in natural forest ecosystems. This input will have implications on the carbon, organic matter, and nutrient dynamics of forest soils. The purpose of this study is to document the decomposition dynamics of logs within interior Alaska.

approach

Fifteen logs are placed on the forest floor in six replicate stands for each major upland and floodplain vegetation type. The logs were 4 meters in length and had a minimum diameter on the small end of 10 cm. Sample locations were also established in upland and floodplain recently burned white and black spruce ecosystems. Individual logs will be sampled to monitor changes in log carbon, nutrient, cellulose, and lignin concentrations over the next century. Due to the timing of initial establishment of all sites, field sampling of decomposed logs will be on a yearly basis. The sequence for sampling will follow a consistent time frame of 0, 2, 5, 10, 15, 20, 25, 30 and 10-year intervals until year 100.

progress

Currently all time zero, two, five, and ten-year samples have been collected for the unburned alder, aspen, birch, balsam poplar, floodplain white spruce, and upland white spruce sites. Chemical analysis is continuing on the collected samples. Additional sites that represent black spruce sites and burned white and black spruce sites in both upland and floodplain locations have been established. The initial results indicate that alder displayed the highest decomposition rates with only 34 percent of its original wood weight remaining after ten years while floodplain white spruce and birch showed the slowest rates of decomposition with 72 and 70 percent, respectively, remaining after ten years. Aspen, balsam poplar, and upland white spruce had 53, 60, and 69 percent of their wood weight remaining after ten years of decomposition. Loss of carbon from the logs ranged from 48 to 50 percent.

impact

It is not yet clear what effect coarse woody debris has on the carbon dynamics of the taiga forest in interior Alaska. However, it appears to take only a single decade for the logs to lose half of their carbon. The results of this study will help to develop a clear picture of log decomposition dynamics on the carbon balance of forests in interior Alaska.

Relationship of tree growth to environmental and soil fertility factors for thirty-five years in interior Alaska

J. Yarie, K. Van Cleve

purpose

Fertilization and thinning studies were developed in birch, aspen, and white spruce forest types representing young, middle, and old age classes in interior Alaska. The studies were started in the late 1960s. Both climatic and tree growth monitoring has continued through 2007. These measurements represent a long-term record of tree growth and climate data for an age sequence of forest stands.

approach

Fertilization and thinning studies started in the late 1960s are being monitored on a yearly basis. The result is the development of a long-term data set related to tree growth and the effects of fertilization and thinning on a number of age classes of the common forest types found in interior Alaska.

progress

The comparative analysis of this large data set indicates that nutrient limitations may only occur during the yearly spring growth period, after which moisture availability is the primary control of tree growth on warm sites. Temperature dynamics, both air and soil, set seasonal bounds on the nutrient/moisture dynamics. Air and soil temperature limitations are the primary control of growth dynamics in the colder topographic locations in interior Alaska. These locations are usually dominated by black spruce vegetation types. A seasonal progression of growth-controlling factors occurs and it is strongly tied to the structure of the climatic and soil nutrient cycling factors of the landscape.

impact

The long-term perspective indicates that changes in the annual and seasonal precipitation dynamics as a result of climate change will have a substantial impact on tree growth and forest ecosystem dynamics in interior Alaska. The magnitude of these changes will be tied to growing season temperature dynamics, vegetation type present on the site, and age structure of the vegetation.

Influence of precipitation timing on tree growth in upland and floodplain forest ecosystems in interior Alaska

J. Yarie

purpose

Due to potential changes in precipitation dynamics as a result of climate change, a set of drought experiments was established in hardwood ecosystems in both upland and floodplain locations in interior Alaska. The overall objective of these studies is to determine the influence of summer rainfall or spring snowmelt on the growth of trees in both upland and floodplain locations. The initial hypotheses were: (1) forest growth in upland birch/aspen (*Betula neoalaskana* Sarg./*Populus tremuloides* Michx.) stands is strongly controlled by summer rainfall, and (2) forest growth in floodplain balsam poplar/white spruce (*Populus balsamifera* L./*Picea glauca* (Moench) Voss) ecosystems will show no relationship to summer rainfall due to the influence of groundwater, linked to river flow dynamics, on soil moisture recharge. Based on results from the summer moisture limitation study an additional hypothesis was added: (3) forest growth in both upland and floodplain locations is strongly tied to soil moisture recharge resulting from spring snowmelt.

approach

PVC greenhouse panels were used to construct a cover under the overstory canopy in each replicate upland and floodplain drought site. The covers were designed to prevent summer rainfall from entering the soil and recharging soil water during the growing season. The covers, designed to drain rainfall off the plot, were placed on wooden framing. On the floodplain sites the high end of the cover was at approximately 2 meters and the low end at 1 meter above the ground. On the upland sites the covers were parallel to the sloping surface of the plot. A hole in the cover was placed at the location of each tree and a dam was placed up-slope from each tree on the cover to force drainage of water around the tree and off of the treatment area. The snowmelt removal covers were constructed using plywood and placed on 2x4 framing that was set directly on the forest floor. To prevent snowmelt drainage into the holes around trees, the snow pack was removed from the plywood surface in the spring prior to the start of the snowmelt period (early April). The rainfall covers were assembled in late May of each year and taken down before the first snowfall in early September. Based on the average precipitation characteristics during the study period, the summer rainfall exclusion reduced the annual inputs by 46 percent with a range from 22.7 to 72.1 percent. The snowmelt covers are assembled and removed within one day of the placement or removal of the throughfall covers.

progress

Summer rainfall exclusion from the upland sites significantly decreased growth for birch in 1992 and 1993 and balsam poplar in 1992. In all other years birch, balsam poplar, and white spruce displayed a nonsignificant decrease in growth. Aspen showed no treatment effect. Tree basal area growth was significantly decreased on the floodplain sites due to summer rainfall exclusion for balsam poplar in 1992 and white spruce from 1990 through 2006. This was the first year of treatment in upland sites for the snowmelt removal. The early soil moisture estimates using TDR equipment (currently installed in one replicate site) indicated a significant difference in soil moisture immediately after soil thaw in the snowmelt removal treatments.

impact

In upland sites soil moisture recharge from melting snow pack is a major moisture supply for tree growth, although it is not clear if a significant moisture limitation occurs during the summer even in the control plots. However, in the floodplain stands tree growth was highly dependent on seasonal rainfall even though the ground water table was within the rooting zone and the soils were supplied with a spring recharge from snowmelt. A number of factors are probably causing this strong relationship. These include rooting distribution, soil texture, and the electrical conductivity of the groundwater, which is sufficiently high on the floodplain to limit moisture uptake.

Natural regeneration of white spruce

Glenn Juday, Steve Winslow

purpose

This is a long-term study of white spruce that regenerated naturally following the 1983 Rosie Creek Fire. The 2008 growing season represents the twentieth year of data collection in the study and the twenty-sixth growing season since the fire. This is the longest and most detailed look in boreal Alaska at the amount, survival, and performance of natural tree regeneration following wildfire on a large plot basis.

approach

Every white spruce tree that occurs in the Reserve West reference hectare (2.47 acres) at Bonanza Creek Experimental Forest LTER has been mapped and measured annually. During the 2008 annual survey, the measurements included white spruce survival, budworm damage levels, 2008 height growth and total height. A close-scale aerial photo was taken in October 2008 to identify individual tree crowns within the hectare.

progress/result

In 2008, 2,235 white spruce trees were measured and entered into the long-term database. Average 2008 height growth of all trees was 12.9 cm (max = 91 cm), which is only 0.8 cm greater than 2007 growth. Average total height was 146 cm (max 798 cm). Slightly more than 76 percent of the white spruce trees were taller than 50 cm and about 40 percent were taller than 137 cm, or breast height (the conventional measurement point for diameter). The great majority (74 percent) of trees were positioned under the shade of another tree or shrub, 19 percent were partially exposed to the open sky, and 7 percent were free of shading. The average stem diameter was 3.1 cm at ground level, and 2.5 cm at breast height. In 2008 spruce budworm damage was markedly reduced from 2007. Budworm effects in 2008 included moderate damage to 0.3 percent of trees, light damage to 1.3 percent, and very light damage to 14 percent of trees. The pattern of the location of dominant crowns of white spruce trees in the new forest that has developed since 1983 clearly shows a dominant spruce canopy in the upper half of the hectare closest to the unburned stand edge.

impact/implications

Twenty-five years after a moderate to severe-intensity wildfire, the process of forming a new forest canopy at this site is nearly, but not entirely, complete. At the larger scale, the portion of the hectare closest to the surviving unburned forest edge (source stand) has a sufficient density of dominant new spruce trees (as revealed by the air photo) that it is now spruce-dominated, as was the stand that burned in 1983. This is direct proof that new white spruce forest development is partly limited by distance from a source stand. Immediately following the fire a *Calamagrostis* grass layer became strongly dominant on about half of the Reserve West site. Remaining parts of the hectare with low white spruce stem density in 2008 generally correspond to areas of densest grass cover. White spruce seeds either never germinated in areas of dense *Calamagrostis* grass or are established at very low numbers of slow-growing trees that remain small in 2008. Where white spruce trees were established by the first (1983) or second (1987) seed crops following the fire, shade and conifer needlefall of these new trees have strongly reduced the vigor of *Calamagrostis*. Fast-growing white spruce trees produce a long, thin-diameter annual height shoot that is easily broken mechanically by snow load, is injured or killed by heavy budworm feeding, or is clipped off as food by squirrels. If the factors that kill or break the terminal shoot are not severe, well-established white spruces become dominant in the new forest. Overall, the decisive factors controlling the new forest are those that produce either a spruce/moss outcome or a broadleaf tree/grass outcome.

range management

Caribou genetics and management

M.A. Cronin; M.D. MacNeil (USDA); J.C. Patton (Purdue Univ.); S. Haskell, W.B. Ballard (Texas Tech Univ.); L.E. Noel, M. Butcher (Entrix Inc.); W. Streever (BP Exploration Alaska Inc.)

purpose

This project assesses caribou *(Rangifer tarandus)* demography, including interactions among herds and effects related to oil field development. Understanding ultimate and proximate causes of animal behavior can help wildlife managers develop and employ effective mitigation measures when potential adverse impacts from human disturbance are of concern.

approach

To assess herd interactions, genetic variation will be determined among the arctic Alaska herds. Comparison of demography and genetics is integral to our approach.

progress

Papers from our study were previously published. New molecular markers from cattle will be applied to Alaska caribou in 2009.

impact

On Alaska's North Slope, understanding caribou demography is an integral part of the multiple-use management of oil and gas and wildlife. Land and wildlife managers can use this study to develop more effective and flexible mitigation measures for industry.

grant

The project is funded with a natural resources grant from the Alaska Legislature to SNRAS.

Grazing management and radiotelemetry

Greg Finstad, Suzanne Worker, Darrell Blodgett

purpose

To ensure the health of rangelands in Alaska, the Natural Resources Conservation Service (NRCS) has offered an EQUIP grazing exclusion program where reindeer producers are compensated for setting aside portions of their permitted rangelands from grazing. The Reindeer Research Program and NRCS worked together to develop a satellite telemetry and mapping system to assist producers in protecting areas from the negative effects of prolonged grazing and to monitor compliance to the grazing exclusion program.

approach

Reindeer were fitted with satellite collars and location data was collected and sent to the Reindeer Research Program, where an automated system has been developed to create location maps and post them to a herder- and agency-accessible website. These maps alert producers if animals move into an excluded area so they can take remedial action.

progress

Thirty-one reindeer from ten herds were equipped with satellite collars. Collars were deployed on the Seward Peninsula and Saint Lawrence and Nunivak islands. Location maps of the islands, including NRCS Land Unit overlays, were created and made available to herders and land managers through a designated website.

impact

Reindeer producers now have a satellite telemetry and internet mapping program to monitor the locations of grazing animals on public lands. Producers can monitor movements of animals on large remote ranges to better manage the effects of grazing on the landscape. Land managers can also monitor practices of grazing permit holders to ensure compliance to the conservation of and sustainable use of public lands.

wildland crops & revegetation

Propagation of northern bog blueberry *(Vaccinium uliginosum)*

Patricia S. Holloway, Katie Kokx, Shannon Pearce

purpose

The purpose of this project was to develop protocols for seed and cutting propagation of bog blueberry, *Vaccinium uliginosum*, for field production and wild stand management.

approach

Fruits of bog blueberry were collected in August and refrigerated for 8 days after which half were cleaned to remove seeds and the remainder were frozen (-5°C). Four replicates of 50 fresh seeds were sown onto filter paper in Petri dishes as a control. Extracted seeds from fresh berries were air dried and sown as before at 2-3-day intervals up to two months to learn the effects of drying on seed germination. This experiment was repeated with seeds from frozen berries to learn the effects of freezing on seed germination. Seeds air dried at 21°C for 60 days were cold stratified on moist filter paper at 4°C for 30, 60, 90, and 120 days and compared to dry seeds held at 4°C and seeds extracted from frozen berries.

Semi-hardwood stem cuttings were collected at two-week intervals from June 20 through August. In a second experiment cuttings were harvested from 30 different wild locations in August and propagated under greenhouse mist propagation, 25°C bottom heat, 0.3 percent IBA powder, perlite/vermiculite 1:1 by volume. Rooting percentages were recorded and root quality evaluated six weeks after being stuck in the medium.

progress

Air-dried seeds showed a linear decline in percent germination with the length of the drying period, but all percentages did not exceed 35 percent during the 60-day period. Seeds from frozen berries maintained high germination percentages regardless of length of freezing time (70 + 12 percent). Cold stratification improved germination over air-dried seeds (9.5 percent+1.9), but there was no difference among stratification times (28.5 – 36.0 percent). Germination of all stratified seeds was significantly lower than seed extracted from frozen berries (71.0+10 percent). Optimum germination occurs with seeds extracted from frozen berries and sown immediately and not permitted to dry out.

Softwood stem cuttings of wild-harvested bog blueberry from new growth rooted more than 50 percent from June 20 through August, and rooting did not differ among collection dates. Cuttings collected from 30 different wild locations showed a significant location effect in rooting percentages. Among individual plants rooting ranged from 0 to 100 percent, averaging 51+ 24 percent. Optimum cutting collection time is nearly all summer, and both plant variation and location influence final rooting success.

impact

Because of the high antioxidant levels in bog blueberries, there is renewed interest in field cultivation of this wild berry as well as managing wild stands for improved fruit production. This information will be useful to commercial growers as well as home berry harvesters to support a cottage industry in jam and jelly making as well as supporting subsistence harvest of wild berries.

Reclamation of disturbed arctic sites with native sedges

M. Sean Willison, **Patricia S. Holloway, Stephen D. Sparrow**

purpose

We sought to learn if seeds of two common arctic tundra species, water sedge, *Carex aquatilis*, and tall cottonsedge, *Eriophorum angustifolium,* can be used to revegetate decommissioned gravel pads at Prudhoe Bay, Alaska; to identify the seed germination requirements and germination potential of these species under laboratory and field conditions; and to develop sedge seed harvest management guidelines.

approach

In 2007–2008, sedges were harvested from Prudhoe Bay for field and laboratory germination experiments of filled seeds that included fresh seeds, seeds stored dry for sixth months (4°C), and fresh and dried seeds cold stratified on moist paper at 4°C for 60 days. Seeds were sown in petri dishes under a variety of temperature and harvest date treatments in germination chambers. Seeds were also sown on a decommissioned oil exploration pad with the gravel partly removed to slightly above tundra grade, and wild populations were sampled to identify variations in seed formation and viability.

progress

Tall cottonsedge seeds are ready to be harvested in late July. The seeds are tiny, difficult to clean, and have not germinated well. The greatest germination percentages for all lab experiments with tall cottonsedge have not exceeded 10 percent. Water sedge seeds mature in late August and are easy to clean, but the number of viable seeds per plant can be very low. Many seeds are unfilled and do not germinate. Preliminary laboratory experiments show that alternating day/night temperatures (25/10°C; 18/6 hr) provide for optimum germination of filled seeds. Once seeds have matured, their germination remains fairly constant regardless of harvest date, and a cold stratification treatment does not improve germination.

impact

This information will aid resource managers in developing strategies for reclaiming old gravel pads in oil fields on the North Slope of Alaska.

grant

This project is funded by BP Alaska and sponsored by Alaska Sea Grant.

Revegetation of a gravel-extraction operation

Norman Harris, Beth Hall, Dot Helm

purpose

While many studies have dealt with revegetation of mining operations, little work has been done on revegetation of gravel-extraction operations in southcentral Alaska. This study addresses that lack of information.

approach

Time-series aerial photography using our blimp platform and ground-based plot frame photography is being used to study revegetation of a gravel-extraction site on the Matanuska Experiment Farm. The photography will be used to document and quantify progress in the re-establishment of vegetation and coverage of bare ground.

progress

This was the sixth year of a long-term study. Imagery was taken on two occasions. Ground-based plot photography was obtained for high-resolution cover estimates to calibrate and test vegetation indices. While chickweed initially infested the site during the first couple of years, it has since decreased in abundance. Other problem species (white sweet clover, hawksbeard, bird vetch, and pepperweed) have increased. Annual ryegrass persists in the area; however, native blue-joint is increasing. Shrubs, wild rose, cranberry, and birch are starting to become visible above the herbaceous layer and are detectable in remote sensing imagery.

impact

This study will help land managers to develop effective revegetation strategies and cost-effective methods to monitor the progress of remediation efforts. The use of digital photography is a rapid and effective method for the monitoring of revegetation efforts.

wildlife studies

Grizzly bear genetics

M.A. Cronin; R. Shideler (Alaska Department of Fish and Game); J.C. Patton (Purdue Univ.); S.C. Amstrup (US Geological Survey)

purpose

This project assesses grizzly bear demography and genetic variation in North America. It is funded with a natural resources grant from the Alaska Legislature to SNRAS.

approach

Molecular genetics technology is used to quantify the family relationships of bears, numbers of bears contributing to breeding, and genetic variation in bears across western North America.

progress

Assessment of grizzly bear demographics and genetics is continuing with analysis of additional genetic markers, including functional genes (k-casein and major histocompatibilty complex). Review of the literature is providing comparative assessment of genetic variation.

impact

The project provides a review of genetic factors influencing the demography of grizzly bears in Alaska and other areas of North America, particularly immigration and emigration.

Polar bear genetics

M.A. Cronin; S.C. Amstrup, S. Talbot (US Geological Survey)

purpose

This project aims to improve understanding of polar bear demographics, with particular emphasis on potential changes due to climate change. The project is funded with a natural resources grant from the Alaska Legislature to SNRAS.

approach

Molecular genetics is used to assess the level of genetic variation of bears in the Beaufort and Chukchi seas in northern Alaska and compare it with that in other worldwide subpopulations.

progress

We are continuing assessment of polar bear genetics with analysis of family level relationships and parentage and genetic variation at nuclear gene loci related to fitness (k-casein and major histocompatibility complex, Mc1r, Mc4r). A paper was submitted for publication to the *Journal of Heredity* in 2008.

impact

This study is helping quantify genetic variation and subpopulation differentiation. Such information is potentially useful in population management and policy formulation at the national and international levels. This is particularly important because of the May 2008 Endangered Species Act listing of polar bears as a threatened species.

Natural Resources Use & Allocation

Resource management in Alaska is constrained by needs to fulfill public expectations, follow processes that are legally required, and meet the substantive requirements of state and federal laws and policies. To be implemented properly, resource management programs must be solidly based on reliable information that can successfully meet legal review and gain public acceptance. The costs of harvesting Alaska resources can be high, and most Alaska products face strong competition in global markets. To remain competitive, Alaska resources must be harvested or extracted efficiently and marketed effectively. Outdoor and wildland recreation and nature-based tourism have become a relatively large part of the Alaska economy and social fabric. This sector is highly dependent on the management of public land resources and the cost of transportation.

Sound natural resource economics requires developing and sharing information to establish more effective market mechanisms, identifying new resource use opportunities, and developing non-market valuation systems. Research in natural resources at SNRAS and AFES focuses on integrated studies of economic, managerial, and ecological aspects of natural resource use and allocation: multi-resource planning and the process of determining public resource policy; non-market resource economics; outdoor recreation resource management; resource economics and policy impact assessment; rural community culture and economic development analysis; nature-based tourism; environmental law and policy; new product opportunities in forests and wildlands; and subsistence resource systems.

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Lake level changes at Harding Lake
John D. Fox, Jr.

Feasibility study for development of a storm water utility in the city of Fairbanks
Jackson Fox

Impacts of water and sanitation projects on communities in Ghana
Josie Osafo-Adu Sam

Status and distribution of wetland habitats in the greater Fairbanks area
Jennifer L. Jenkins

biomass

Chemical characterization of Alaska trees

J. Andres Soria, Magdalena King

purpose

Alaska trees are understood from an ecological perspective, but little fundamental research exists on the chemical composition of the lignocellulosic stock of the state. This ongoing research project is designed to provide fundamental compositional data of the lignocellulosic biomass in the state by conducting chemical characterization of the available biomass.

approach

Characterization of wood involves the determination of carbohydrate, lignin, extractives, and inorganics. Based on this information, further breakdown of these fractions is possible, leading to the determination of specific sugars, propyl-phenolic compounds, and aromatics which can play a significant role in discovering secondary value-added products, particularly pharmaceutical and nutraceutical applications. Chemical characterization involves liquid and gas chromatographic tools and mass spectra to determine the chemical species found. Caloric analysis of the wood sample and measurement of its inorganic compounds (ash) are also performed as a means of collecting fundamental information and producing a baseline database to compliment the existing body of knowledge in physical attributes of dimensional lumber and the ecological role of trees in ecosystems across the state.

progress

We have done analysis on kiln-dried wood furnished by the Ketchikan Wood Technology Center, with basic characterization performed on Sitka spruce, hemlock, yellow cedar, red cedar, birch, red alder, and white spruce. We have done fire-killed black spruce, birch, and alder as well. Detailed chemical analysis will follow in order to identify specific compounds.

impact

The chemical characterization of wood fills the void in knowledge in the fundamental understanding of the local biomass resource. It provides new information that can lead to the development of secondary value-added industries, including pharmaceutical, nutraceutical, fuels, additives, resins, and many other specialized products.

Gasification of Alaska biomass

J. Andres Soria, Magdalena King

purpose

Gasification is a thermochemical technique that, under controlled conditions, can produce a gaseous combustible mixture that can operate small internal combustion engines, and displace natural gas for some applications such as cooking and heating. Alaska biomass has not been studied from a fundamental perspective under gasification regimes. Factors such as chemical composition, moisture, and reactor conditions all play a significant role in the quality of the gas produced. This is the first fundamental study of Alaska lignocellulosic biomass under gasification.

approach

Alaska lignocellulosic biomass will be processed into compressed logs and various particle sizes which will be introduced in a small downdraft gasifier. The reaction conditions will be analyzed using probes, and response surface optimization procedures employed to improve the gasification process. Analysis of the produced gases will occur using chromatography and mass spectrometry. Elemental analysis, caloric value determination, and chemical composition of the raw feedstock as well as of the products after reaction will be conducted. The combination of data from the reaction parameters, results, and baseline information will allow the response surface method used to optimize the system to be tailored to the specific species of biomass and yield the highest

A biodiesel reactor capable of producing 40 gallons a day at the Biomass Energy Research & Development Laboratory at the Palmer Research & Extension Center.
—photo by J. Andres Soria

production of combustible gas. The methods used will enable an understanding of what the output may be if parameters such as moisture are changed, leading to practical range of biomass attributes that could still produce usable gas, outside of ideal conditions.

progress

Equipment setup will be complete by summer 2009 and the first gasification runs will occur in fall and spring, with data collection and analysis to follow.

impact

The production of a gas fuel that can be used directly in generating mechanical power using internal combustion engines can play a significant role in remote locations in the state, where current fragmented energy infrastructure makes it too expensive to pipe natural gas. The utilization of local biomass resources for the production of such a fuel may prove important in diversifying the energy portfolio of the state and enabling the growth of a secondary industry outside of dimensional lumber products that can capitalize on the utilization of Alaska biomass resources.

Pyrolysis of Alaska biomass

J. Andres Soria, Magdalena King; Armando G. McDonald (Univ. of Idaho)

purpose

The production of bio-oil as a stable liquid substrate to hold the chemicals produced by the heating of wood in the absence of oxygen (pyrolysis) is a major goal for finding alternatives to petroleum. This multi-state collaborative research project is geared toward building (University of Idaho) a custom pyrolysis unit designed by the UAF researcher, and performing the initial investigations of Alaska woody species as reacted in this apparatus.

approach

A pyrolysis reactor was designed by Dr. Soria at UAF and fabricated at the University of Idaho. The reactor, to be housed at the Palmer Research & Extension Center, will be able to process Alaska biomass in order to conduct fundamental research in the production of bio-oil and its characterization. The bio-oil is analogous to petroleum oil, where a series of compounds can be extracted and refined into various products. Being a liquid, bio-oil can be stored and transported in similar fashion to petroleum, but processing varies, and fundamental research in this area continues to be an active arena at the national and international level. Alaska biomass will be pyrolyzed in differing conditions and the reactions and products characterized for degree of completion, chemical composition, and analysis of bio-char, bio-oil, and syn-gas by chromatography and spectroscopy techniques.

progress

The pyrolysis reactor has been built and delivered to Palmer. Controllers and peripheral equipment will be designed and installed in fall 2009. Experiments will begin in spring 2010, with subsequent data collection and analysis.

impact

The production of bio-oil from pyrolysis of Alaska species has not been fully investigated. Facilities in Alaska did not exist, and as such this research provides a first in understanding the fundamental principles of pyrolysis for Alaska biomass, as well as establishing the basic research equipment and infrastructure to continue and expand this work.

Renewable hydrocarbon production from Alaska biomass

J. Andres Soria

purpose

The potential uses of biomass for producing renewable hydrocarbons that can replace petroleum hydrocarbons is explored in this research program. By using supercritical fluids, solid woody biomass can be transformed into several hundred hydrocarbon fractions that, analogous to petroleum itself, can be fractioned further and produce similar value-added product lines, including plastics, resins, solvents, and fuels.

approach

Wood species from southeast and southcentral Alaska were collected and processed into sawdust/flour. The biomass was introduced into a high temperature and high pressure reactor containing methanol, sealed, and placed in an electronically controlled heater. Internal reactor conditions were raised above the supercritical points of methanol corresponding to 238°C and 1800psig. Once the desired reaction conditions were reached, the reaction was stopped and material balance determined as well as chemical composition of the collected fractions by several analytical means. The results from the experiments show that all Alaska species liquefied to a mixture of hydrocarbons in a range between 89–96 percent on a solid wood basis. The experiments also show over 200 hydrocarbons can be produced from each Alaska species studied.

progress

Research is ongoing into optimizing the reactions to maximize the amount of wood that is liquefied in this supercritical process. The goal is to reach 95 percent transformation of original solid wood into a liquid hydrocarbon matrix. New capabilities at the Palmer Research & Extension Center will enable further improvements in research progress and in learning the fundamental reactions and characteristics of Alaska species in producing renewable hydrocarbon feedstocks.

impact

The quest for renewable energy resources includes solar, wind, hydro, geothermal, and tidal. Yet, all of these focus on the production of electricity, with the only renewable resource capable of producing hydrocarbons being biomass. The new technology being developed will continue to increase our understanding of thermochemical reactions as a means of producing stable hydrocarbon feedstocks based on Alaska-specific biomass. This knowledge can translate into new discoveries of value-added chemicals, increasing the potential for new product lines being developed in plastics, resins, solvents, fuels, and specialty chemicals.

Salmon waste gasification

J. Andres Soria, Shawn Freitas; Cindy Bower, Peter Bechtel (USDA ARS)

purpose

Alaska produces 100,000 metric tons of salmon waste yearly. These waste streams include heads and viscera which have no commercial value. By combining these wastes with another low-value biomass stream in the way of small-diameter black spruce and alder, the mixture may be used in gasification, leading to the production of a combustible gas that can run small combustion engines. This is the first study to investigate these waste streams for the production and characterization of energy specific uses.

approach

Small-diameter alder and black spruce were harvested at the Palmer Research & Extension Center and the materials processed into sawdust. Salmon wastes from commercial fishing processors in Kodiak Island were mixed with the sawdust in a variety of ratios, not surpassing 25 percent fish due to high moisture content. The mixture of salmon and wood sawdust was compressed into "firelogs" 2.5 inches in diameter and placed inside a downdraft gasifier.

In parallel, fundamental research into the characterization of the individual raw feedstocks, different mixtures, and related products is being conducted to qualify and quantify the best conditions under which gasification technology can be used to produce a combustible gas mixture. The long-term goal is to design reactor and reaction conditions that will optimize the production of combustible gas from these Alaska-specific waste streams, and be able to run a small generator to power a modest load of 2kW.

progress

We have conducted bench top experiments and defined feedstock characteristics, as well as modeled the energy output from each biomass mixture. By summer 2009 we will conduct the pilot scale gasification runs.

impact

This is the first fundamental and applied research study to focus on gasifying Alaska wood and salmon, and one of the first studies anywhere to optimize salmon and wood biomass for combustible gas production. This information, when the research is completed, will provide the basis for design and operation of new reactor systems that can serve as supplemental power systems in remote locations throughout the state, where the resources are available. If a system is further developed and optimized, fish processors may see a direct benefit by offsetting disposal and energy-related costs.

education & outreach

Students and scientists meet and discuss virtually during year two of the International Polar Year

Elena B. Sparrow, David Verbyla; Kim Morris, Martin Jeffries (UAF Geophysical Institute); Martha R. Kopplin (IARC); Sheila Yule (GLOBE Program Office, Boulder, Colorado); Margaret LeMone (National Center for Atmospheric Research)

purpose

Our main objectives were 1) to continue student activities during the fourth International Polar Year (IPY), 2) to provide students in Alaska and Argentina and other countries opportunities to share with other students the changes they observe in their local environment that may be related to climate change, and to connect with and have the opportunity to pose questions to Earth system scientists, 3) to discuss ways that students can be involved in climate change research in their local environments and in collaborative partnerships with scientists and other students worldwide.

approach

We used videoconferencing technology to connect students and their teachers in Alaska and Ushuaia, Argentina, with scientists studying the Arctic and Antarctic. The videoconference was followed by a web chat and an asynchronous web forum to give other students from different parts of the world the opportunity to connect with Earth system scientists.

progress

The fourth IPY began March 1, 2007 and continued through March 2009. The Monitoring Seasons Through Global Learning Communities, or Seasons and Biomes project, conducted another IPY pole-to-pole videoconference on April 8, 2008. Participants (students and teachers) came from Moosewood Farm Home School, and Randy Smith Middle School (Fairbanks, Alaska); Wasilla High School (Wasilla, Alaska) and from Innoko River School (a high school in Shageluk, Alaska); and the high school Base Esperanza School, with teachers from Colegio Nacional de Ushuaia (Ushuaia, Argentina). Participating scientists were from SNRAS, the International Arctic Research Center and other research institutes at the University of Alaska Fairbanks, Global Learning and Observations to Benefit the Environment (GLOBE) program office, the National Snow and Ice Data Center in Boulder; the Arctic Observing Network program in Washington, DC; and in Buenos Aires, and Ushuaia, Argentina. The videoconference was followed by an IPY GLOBE web chat on April 9 and a web forum on April 10, 2008.

impact

More than 400 students in Fairbanks, Shageluk, and Wasilla, Alaska, and Ushuaia, Argentina, and other countries participated in the April 2008 IPY Pole to Pole Videoconference, Web Chat and Web Forum. The students were enthusiastic about the experience. A newspaper article resulted from the videoconference as well as an oral presentation at the IPY Education Outreach Session in the 2008 Annual American Geophysical Union Meeting. Participants responded enthusiastically to the pole-to-pole event. The conference resulted in increased participation of students and scientists in the International Polar Year, connection of students with more scientists, and the initiation of collaborative research studies between schools in different countries.

Monitoring seasons through global learning communities

Elena B. Sparrow, David Verbyla; Kim Morris, Martin Jeffries (UAF Geophysical Institute); Martha R. Kopplin (IARC); Sheila Yule (GLOBE Program Office, Boulder, Colorado); Rebecca Boger (Brooklyn College, Brooklyn, New York); Leslie S. Gordon (Gordon Consulting, Neskowin, Oregon); Elissa Levine (NASA Goddard Space Flight Center)

purpose

Our main objectives are 1) to provide K-12 teachers and their students opportunities to participate in Earth system science research and the fourth International Polar Year by conducting investigations on their biomes, and 2) to use such research and activities to teach and learn about the nature of science, inquiry, and science process skills, and Earth system science.

approach

Rural and urban Alaska K-12 teachers, as well as teachers from other parts of the United States and the world, are being provided professional development (PD) workshops to engage their students in studying seasons and investigating their biomes using the "Earth as a system" approach. By monitoring the seasons, students are learning how interactions within the Earth system affect their local environment and how their local environment in turn affects regional and global environments. During the PD institutes, teachers learn to use standardized scientific measurements and protocols developed by this project (also called Seasons and Biomes), the Global Learning and Observations to Benefit the Environment (GLOBE) program, other Earth system science research programs, and best teaching practices in inquiry- and project-based learning. New protocols are being developed and/or adapted as needed to help teachers and students monitor seasons (internannual variability) in their biomes. Teachers and students will also be connected to scientists from the International Arctic Research Center and SNRAS, at the University of Alaska Fairbanks, as well as from other universities and federal agencies.

progress

Ice seasonality freeze-up and breakup protocols, and frost tube protocols have been developed and pilot tested in Alaska, Illinois, New Jersey, Ohio, and Switzerland. A mosquito protocol was developed in Thailand to help students identify larvae of *Aedes* and *Culex* species. Regional and international professional development workshops for K-12 teachers, GLOBE partner coordinators, and teacher trainings were conducted in Fairbanks, Alaska, in June and October 2008, in Colorado in August, and in Thailand in November. A ninety-minute PD workshop was also provided at the 2008 American Geophysical Union annual meeting.

impact

Several presentations as well as eight publications have resulted thus far from this project. Teachers have been implementing it in their classrooms, teaching their students what they learned at the PD workshops. Their students have contributed data to ongoing Earth system science studies, e.g., plant phenology, atmosphere/weather, and have also conducted their own studies. For example, some students were chosen to present their investigations. Three Alaska Native high school students as well as six students from the Model School for the Deaf in Washington, DC, and Indianapolis were chosen and funded to present their studies at the GLOBE Learning Expedition in South Africa in June 2008. Pre- and post assessments of students have shown a significant increase in their science content knowledge of Earth as a system.

fisheries

Converting Alaska fish by-products into value added ingredients and products

Alberto Pantoja, Peter Bechtel, Cynthia K. Bower (ARS)

Note: This project has several components, all involving the utilization of fish processing byproducts.

purpose

The over-arching goal of this project is to develop new knowledge to increase the value of underutilized seafood processing byproducts for aquaculture and agriculture in a sustainable manner. To this end, we will:

1. Elucidate the chemical, biological, and physical properties of underutilized Alaska fish byproducts and their biochemical constituents to identify properties/compounds that can be used to make new and improved aquaculture and agriculture feed ingredients, and other high value products.

2. Improve processes and methods for analysis, collection, and storage of raw materials, to retain the chemical, biological, and physical qualities of raw materials for developing new and improved ingredients/biochemicals from Alaska fish byproducts.

3. Make and evaluate the value of new and improved aquaculture and agriculture ingredients and feeds from these byproducts and their constituents.

approach

We will first examine the definition of a sustainable byproduct source and the standards for organic aquaculture ingredients. In light of the definitions and standard, byproducts currently produced by fish oil and meal plants in Alaska will be evaluated. The initial effort would focus on utilization of byproducts from the only two sustainable fisheries in the United States, which are the Alaska pollock and salmon fisheries. Altering existing processing methods or incorporating new methods to meet the organic standards will be explored. Organic products will be produced and chemical and nutritional properties characterized. In addition, properties such as lipid oxidation will be evaluated during storage and distribution. Additional studies will evaluate the feasibility to produce unique products such as palatability enhancers and feed attractants for organic aquaculture.

progress and impact

Effects of storage time and temperature on the quality of separate byproducts

There is need for information on how storage time and temperature affect individual byproducts such as heads, viscera, and frames. ARS scientists studied pink salmon and pollock byproduct parts, stored at two temperatures. Rates of change for oxidation, spoilage, and the formation of biogenic amines were different for each species' heads and viscera. The results suggested that if byproduct parts are to be separated, inhibition of microbial growth in viscera and protection against oxidation in heads should be considered during storage of pink salmon.

Chemical characterization of watermarked chum and pink salmon byproducts

When pink and chum salmon are harvested for high quality roe, the remaining carcass has less value. This study by ARS and University of Alaska scientists was designed to characterize late-run chum and pink salmon byproducts derived from fish that showed advanced stages of skin watermarking. Samples were obtained from commercial processors. Analyses included the proximate, fatty acid, amino acid, mineral, vitamins, and biogenic amines concentrations. The nutritional quality of the flesh was good but there were chemical differences. These results will be used by the processing industry to increase the utilization of late pink and chum salmon.

Electrospun fibers containing fish gelatins

Gelatin incorporated into electrospun fibers can improve cell growth in tissue engineering applications. However, no one has evaluated using low-melting point gelatins isolated from cold water fish skin. Gelatin from Alaska pollock was incorporated into electrospun fibers. The pollock gelatin was blended with the biodegradable polymers polylactic acid and polyvinyl alcohol. This is the first time a gelatin sample was electrospun directly from water at room temperature. The fibers had diameters of several hundred nanometers, providing high surface areas, and may have biomedical applications such as wound dressing.

Stabilizing PUFA-rich oils from salmon byproducts

Valuable salmon oils can be extracted from fish processing wastes, but they must be stabilized immediately to prevent damage to long-chain polyunsaturated fatty acids. Smoke processing was evaluated by ARS and University of Alaska scientists as a technology to reduce oxidation of salmon oil. Salmon heads exposed to hot smoking produced oils with decreased oxidation and superior antioxidant potential, including higher levels of tocopherols, than their non-smoked counterparts. Smoking byproducts prior to oil extraction will extend the timeframe for oil removal and allow non-refrigerated transportation of oils without addition of costly antioxidants.

Effects of temperature on the viscosity and oxidation rate of unpurified salmon oil

During oil purification it is important to be able to predict the apparent viscosity value of the oil at each step because each step involves exposing the oil to different temperature conditions. A study was conducted at Louisiana State University and the University of Alaska to provide information on lipid oxidation as well as the thermal and rheological properties of unpurified salmon oil that are useful for designing improved purification processes of the oil. Results indicated that unpurified salmon oil exhibited non-Newtonian fluid behavior; the apparent viscosity decreased and the rate of lipid oxidation increased as temperature increased. The study showed that these changes could be competently described by the Arrhenius equation. These results are being used to design improved fish oil purification processes.

Purifying salmon oil using adsorpton and neutralization processes

The quality of unrefined salmon oil decreases during storage. The development of simplified low-cost procedures to remove pigments, proteins, moisture, free fatty acids, and other impurities from unpurified oil will increase its quality and value. This study was completed by University of Alaska, ARS, and Louisiana State University scientists and students. Crude salmon oil was purified using activated earth adsorption, neutralization, and a combination of both. The results indicated that combining adsorption technology with neutralization can provide an economical and simplified process for refining fish oil for human consumption. Information obtained in this study will assist in designing and building efficient adsorption units for purifying fish oils in a cost-effective way.

Alaska fish bonemeals as mineral supplement in all-plant product diet for trout

There is a potential market for Alaska fish bonemeals as feed ingredients in trout diets. A feeding trial was completed by the University of Idaho, University of Alaska, and ARS scientists with post-juvenile rainbow trout fed all plant-product diets supplemented with Alaska fish bonemeal. Results indicated Alaska bonemeal produced an equivalent weight gain to fish fed the plant diet supplemented with dicalcium phosphate, but this weight gain was lower than that of fish fed a fishmeal control diet. The apparent bioavailability of phosphorus in the Alaska bonemeal was higher than that in fishmeal, but lower than dicalcium phosphate. This suggests that an effective mineral supplement can be produced from Alaska fish bonemeal with further processing.

Alaska fish testes meal supplementation to an all-plant diet for trout

There is potential for making a feed ingredient from salmon testes; however, performance in feeding trials needs to be explored. In a study involving the University of Idaho, the University of Alaska, and ARS scientists, a feeding trial was completed with post-juvenile rainbow trout fed all-plant diets supplemented with graded levels of Alaska testes meal or fishmeal. The dose-response was recorded and showed measurable weight gain with both testes meal and fishmeal supplementation. Fish fed all-plant diets lacking either testes meal or fishmeal had significantly lower final weights than fish fed diets supplemented with these meals. This study supports the concept that all-plant diets for rainbow trout lack the constituents required for the substantial weight gain that are found in Alaska seafood byproducts, but further research is needed to identify these constituents.

Nutritional quality of novel Alaska pollock byproduct meals

The nutritional value for Pacific threadfin *(Polydactylus sexfilis)* of Alaska pollock bone, liver, and milt meals was unknown. The Oceanic Institute, the University of Alaska, and ARS scientists collaborated on a growth trial in which these three meals were included into a pollock fishmeal-based control diet at a 10 percent level. It was found that the threadfin fed diets containing the three meals grew at least as well as those on a pollock fishmeal control diet. This information is useful because it indicates that there are no clear benefits in using fishmeal made from Alaska pollock bone, liver, or testes meals over conventional fishmeal for inclusion in diets for Pacific threadfin.

Palatability of Alaska pollock meals for shrimp

The ability of various meals made from specific waste streams of the Alaska fishing industry (pollock milt and liver meals, bone meal, and crab shell) to act as attractants for Pacific white shrimp was tested. The Oceanic Institute, the University of Alaska, and ARS scientists participated in a study where the control diet containing wheat flour and soybean meal was replaced at the 5 percent level by one of the four test ingredients. Preferences of shrimp for the test diets relative to the control revealed that liver and crabshell meals acted as attractants, while milt and bone meals had no significant impact. A commercial shrimp feed, included as a positive control, also was consumed at a significantly higher rate than the wheat flour/soy control. These results indicate that crabshell and liver meals may be used as feed attractants for this species of shrimp.

Modifying fish gelatin film properties by varying drying temperatures

Gelatin films have been widely used to produce capsules for encasing drugs and have also been envisioned as packaging materials. ARS scientists examined the effects of drying temperature on the barrier and mechanical properties of Alaska pollock and Alaska pink salmon gelatin films. Cold-cast films (dried below gelation temperature) had superior tensile strength, but inferior water vapor permeability compared to hot-cast films. Therefore some of the material properties of fish gelatin films can be controlled by varying the drying temperatures. This provides an easy method to manipulate fish gelatin film properties to become more competitive with mammal-based gelatin films.

Characteristics of byproducts from black rockfish and skates

Black rockfish and skates are commercially harvested species in Alaska. The objective of this study, conducted by University of Alaska and ARS scientists, was to characterize black rockfish and skate byproducts. Byproducts obtained included frames, digestive tracts, and livers from both species. Proximate fatty acid, amino acid, and mineral compositions as well as fat-soluble vitamin content were determined. Skate oils had high levels of long-chain omega-3 fatty acids, and amino acid compositions revealed that byproducts from both species were good sources of essential amino acids. The research affects fish processors by providing guidance on how byproducts from these species can be utilized for production of food and feed ingredients.

Crop yields using Alaska byproduct organic fertilizers

Alaska fish waste has been made into fertilizers for a number of years. However, there is little published information on plant nutrient recovery and soil nutrient status two or three years after the fish fertilizer application. Three fish byproducts (fish meal, fish bonemeal, and fish hydrolysate) were evaluated in two different Alaska locations for their nutrient release and barley growth response in 2007 and 2008 by University of Alaska and ARS scientists. Significant amounts of nutrients (especially nitrogen) were released in the second year after their application, but in the third year, there was little impact from these applications on barley growth. These results suggested a reduced application rate of fish byproduct fertilizer can be used in the second year, and this will help producers managing such fertilizers for crop production.

Can Kenai River chinook salmon survive watershed land use changes? Historical land use effects on salmon in Alaska's Kenai River Watershed

Susan "Shana" Loshbaugh

purpose

I seek to ascertain whether there is a link between land development and salmon productivity in the Kenai River

Watershed (KRW). Land use changes that reduced the quality of freshwater habitat are considered a primary reason for the decline and extinction of salmon stocks in the Pacific Northwest. Could the same thing happen to the Kenai River? This project will look at the land use changes in the watershed over the past century to consider whether the river's famous chinook salmon runs are sustainable if these land use trends continue.

approach

I will use approaches from historical research, interdisciplinary landscape science, and geographic information systems (GIS) to describe the watershed's land use history to see if there is a link between land use changes and the productivity of salmon runs. The study will also compare the KRW with land use histories of other salmon-producing watersheds and suggest ways to maintain or enhance the resilience of the KRW social-ecological system.

progress

I have collected and analyzed historic maps, census data, aerial photographs, and documents. GIS maps of the historic changes to the watershed have been compiled. Interviews with long-term residents will begin in spring 2009; the project should be completed in early 2010.

impact

Although the KRW appears undisturbed compared to many salmon-producing watersheds in other states, over the past sixty years urban sprawl and development close to the river have dramatically altered the riparian vegetation. However, there are still extensive forested areas along the river, so it may not be too late to avoid the fate of so many salmon rivers in the Lower 48.

forests & forest products

Economic and ecological effects of diameter caps: a Markov decision model for Douglas fir/western hemlock forests

M. Zhou (UAF School of Management); J. Buongiorno (Univ. of Wisconsin-Madison); **J. Liang**

purpose

We evaluated economic and ecological effects of not harvesting trees of 41 cm (16 inches) diameter at breast height or larger with uneven-aged management of Douglas fir/western hemlock forests.

approach

The opportunity cost of diameter caps was measured by the difference in maximum expected net present value or equivalent annual timber income, with or without diameter caps. For the two policies, Markov decision models were used to determine the best decision rules and their effects on the net present value, the forest area with late-seral structure, and the forest area with northern spotted owl nesting habitat structure. The opportunity cost of diameter caps was computed for 64 initial stand states defined by basal area of small, medium, or large trees of shade-intolerant species (mostly Douglas fir) or shade-tolerant species (mostly western hemlock).

results

The opportunity cost fell in four distinct quartiles. The sixteen stand states with high basal area in large shade-intolerant and large shade-tolerant trees had the highest opportunity cost ($798 to $816 ha-1y-1, expected over an infinite horizon), while the sixteen stand states with low basal area in large shade-intolerant and large shade-tolerant trees had the lowest ($59 to $89 ha-1y-1). We published our results in *Forest Science.*

impact

The diameter caps policy increased considerably the expected area of forest with late-seral structure, over an infinite time horizon, and the expected area with spotted owl nesting habitat structure, compared to their current level in the study region. This suggests that imposing diameter cap would benefit the stand ecology. However, diameter cap policy could cause potential losses to private landowners ranging from $60 to $800 per ha per year. This loss could be reduced by phasing in the diameter caps, allowing harvest of existing large trees over five or ten years, but the long-term forest structure and volume would not be changed.

Moisture content determination of fire-killed trees in interior Alaska

J. Andres Soria, Norman Harris, Beth Hall, **Valerie Barber,** Magdalena King

purpose

Alaska's interior forests are under a natural fire disturbance regime that results in large areas of forestland being burned yearly. Very little information exists on the quality, from a chemical and physical perspective, of the standing deadwood. This project is designed to fill in this gap by focusing on the areas affected by the fires of 2000 and 2006 in interior Alaska.

approach and progress

The team traveled to the locations along the road system that were affected by fires between 2000 and 2006 in interior Alaska. At each location, plots and trees were selected based on BAF10 prism methodology, noting the landscape characteristics and forest structure. Representative samples of fire-killed trees were harvested and taken to the laboratory for further analysis. Determination of moisture was done by gravimetric and electrical resistance methods, while chemical and physical characterization was done based on ASTM standards for wood. Additional determination of heat content, for potential recovery of biomass for heating fuel was performed based on ASTM standards.

The research project also developed remote sensing algorithms to estimate the biomass available within the affected areas by using optical imagery and geographical information systems. Spatial analysis incorporating field data with laboratory results is being used to create GIS maps that can serve as management tools for the utilization and restoration of this vast biomass resource.

impact

The study will offer insight into the properties and characteristics of fire-killed trees that can potentially be used in a variety of applications including heating fuel, composite materials and other specialized value-added products. The state of Alaska has a very small established forest products industry, which has traditionally been focused on large-diameter trees for producing dimensional lumber products. The current study may provide information that is relevant to salvaging existing deadwood stock for new applications. This may have a positive influence in the industry, as well as provide a financial incentive for restoring burned lands.

Japanese glulam beam research project

Joseph A. Roos, Daisuke Sastani, Ivan Eastin (Univ. of Washington, College of Forest Resources); **Valerie Barber**

purpose

The Japanese glulam beam market has been growing steadily since the early 1990s. From 1993 to 2007, total glulam beam usage increased from 199,300 cubic meters to 1,814,100 cubic meters. Japanese glulam beam supply comes from both domestic production and imports. In 2007, 65 percent of Japan's glulam beam production was from domestic manufacturers. However, even though these glulam beams are manufactured in Japan, much of the lamstock lumber used to produce glulam beams is imported. Two of the major imported lamstock species are European whitewood and Russian red pine. The purpose of this study was to examine this market and explore the potential for Alaska forest products.

approach

The researchers traveled to Japan and interviewed representatives from Japanese glulam manufacturing facilities. The company representatives were asked what species they are currently using for lamstock, technical specifications, market conditions, and what species they intended to use in the future.

progress

The project is finished and a final paper is being written.

impact

The research showed there is potential for increased market share for Alaska forest products in Japan's glulam beam and lamstock market. The researchers offered specific recommendations:

1. Organize workshops to teach Alaska sawmills about the technical requirements of the Japanese lamstock and glued laminated beam market.
2. Pre-qualify sawmills in Alaska that have the technical capability to produce kiln-dried lamstock for the Japanese market.
3. Organize a trade mission to visit glulam manufacturers in Japan.
4. Display Alaska lamstock samples and literature at the Japan Home Show held annually in Tokyo.
5. Invite potential Japanese customers to visit sawmills in Alaska.
6. Create Alaska lamstock brands based on the established WWPA registered trademarks. For example, Alaska Hem Lam, Alaska Yellow Cedar Lam, and Alaska Sitka Spruce Lam.
7. In addition to lamstock, lamstock blanks could also be considered for export to Japan.

Trends in Japan's forest products market project

Joseph A. Roos, Daisuke Sastani, Ivan Eastin (Univ. of Washington, College of Forest Resources); **Valerie Barber**

purpose

With the US housing market at a seventeen-year low, it is becoming increasingly important to find global markets for US forest products. One market that values Alaska forest products and offers tremendous opportunity is Japan. However, due to a previously strong US dollar, increased competition from Europe, and other factors, Alaska forest products have lost significant market share in Japan. We undertook this research project to identify and examine recent trends in Japan's forest products market and analyze their impact on Alaska's forest products industry, particularly those that present potential opportunities for Alaska industry.

approach

We collected data from government and industry organizations and interviewed industry experts, traveling to Japan and interviewing representatives there from industry and government.

progress

The project will be complete with publication.

impact

Five trends were identified and analyzed in the research paper:

1. Changing building regulations: The Japanese government revised its Building Standards Law in 2007. This revision applies more stringent standards to the structural certification of building plans.
2. Changing timber supply: Overall, Japan's lumber and log supply from North America has decreased. In contrast, lumber and log supply from Europe, Russia, and within Japan has increased. However, many recent developments are constricting Japan's timber supply, including a Russian log export tariff and increased demand for timber from other regions.
3. Increased green procurement: Japan has developed a green building certification program called the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE). This system applies to both commercial and residential buildings and consists of various green building criteria. Additionally, the Japanese government has announced a program to require all forest products purchased for use in government projects to originate from legally harvested timber.
4. Changing exchange rates: The US dollar has depreciated approximately 6 percent against the Japanese

yen in the past two years while the euro and Canadian dollar appreciated against the Japanese yen during this same period, making US forest products more price competitive in the Japanese market.

5. Decreased population growth: Two of the most important demographic segments in Japan are the Baby Boomers and their children, or Eco Baby Boomers. The Baby Boomers are retiring and have the disposable income that allows them to improve their houses and their quality of life. Eco Baby Boomers are beginning to have families of their own and many are choosing to purchase value-priced homes rather than buy condominiums or rent apartments.

Alaska has unique, high-quality forest products that are well suited for the Japanese market, and many of the trends presented in this paper offer opportunities for Alaska forest products exporters. First, the weak US dollar makes US products more competitive abroad. This year US forest products priced in yen are approximately 6 percent cheaper than two years ago. This makes Alaska yellow cedar, hemlock, and Sitka spruce much more price competitive in the Japanese market than previously. Second, Russia imposed a softwood log export duty of 20 percent on January 1, 2007 in an attempt to increase value-added processing within Russia, and the Russian government is planning to increase this to 80 percent by January 1, 2009. Many industry experts had pointed out that Japanese mills are looking for new suppliers to replace the Russian supply. Much of the Russian red pine and larch that was exported to Japan could be substituted with North American species. Third, increasing green building and procurement policies may require suppliers to provide documentation certifying that imported wood products are sourced from legally harvested timber. Since there is no question that Alaska forest products are harvested legally, developing a system of documentation to show where the timber originated should be relatively easy.

policy & planning

Adaptive versus fixed policies for economic or ecological objectives in forest management

M. Zhou (UAF School of Management); **J. Liang**;
J. Buongiorno (Univ. of Wisconsin-Madison)

purpose

In the context of forest management, a fixed harvesting policy consists in trying to convert stands of trees to a chosen state, at fixed intervals, regardless of the stand state and of the state of the market. In an adaptive policy, by contrast, the post-harvest state and the timing of the harvest depend on the stand and market states at the time of the decision. Our objective was to determine the practical gain from the theoretically superior adaptive policies.

approach

We compared optimal fixed and adaptive policies obtained with identical models and assumptions, and with data from the Douglas fir/western hemlock forests in the Pacific Northwest of the United States.

results

In maximizing economic returns from harvests over an infinite time horizon, the net present value was 17 percent higher with an adaptive than with a fixed policy. It was 22 percent higher when the objective was to maximize annual harvest. The adaptive policy was even more superior with undiscounted, noneconomic objectives, such as the area of spotted owl habitat (+37 percent gain), or the area of late-seral forest (+51 percent), but less so in maximizing the stock of high quality logs (+6 percent). The adaptive formulation also lent itself readily to multi-objective management. Our results were published in *Forest Ecology and Management*.

impact

The provocative results show that the adaptive policies in forest management are superior over fixed policies in many ways. The findings will help shift the public focus from traditional fixed policies to more flexible adaptive forest management, from which the economic and non-economic outputs will be more balanced and sustainable.

Endangered Species Act science and management

M.A. Cronin

purpose

This project aims to assess science used in policy formation and implementation of the Endangered Species Act (ESA). The project is funded with a natural resources grant from the Alaska Legislature to SNRAS.

approach

Scientific information is synthesized for assessment of ESA issues including designation of subspecies and distinct population segments for ESA listing, assessment of threatened or endangered status, and possible management actions to achieve specific objectives. Information is translated for dissemination to policymakers and managers. Collaboration with state and federal agency biologists is part of this effort.

progress

From August 2004 to May 2009, information has been provided to the Alaska governor's office, state legislators, and the natural resource industries on several Alaska ESA issues, including polar bears, beluga whales, Steller sea lions, sea otters, eiders, loons, goshawks, wolves, and species in the other forty-nine states. Review and assessment of scientific and management documents has been done for several of these species.

impact

This work allows policymakers and managers to better understand the science being used in ESA issues.

When laws affecting the environment conflict: focus on public lands

Julie Lurman Joly

purpose

The objective is to identify situations in which laws or policies with conflicting purposes or methodologies are in place, to analyze that legal conflict in order to understand how it manifested and what its practical consequences are, and perhaps to recommend changes.

approach

1. An examination of the issue of assisted migration, a method of dealing with increasingly endangered flora and fauna in a time of climate change, which is currently being debated by conservation biologists.

2. An examination of how the courts have failed to properly apply the "Best Scientific Data Available" standard and what statistics have to say about what "scientific" really means.

3. An examination of several inconsistencies in the implementation of the Marine Mammal Protection Act regarding the Native Alaskan hunting exemption and the meaning of the term "waste."

progress

1. An analysis of the existing legal support and legal obstacles to such a course of action has been completed. The manuscript describing this work has been accepted for publication and appeared in the May 2009 issue of the *Environmental Law Reporter*.

2. This work analyzes why the courts have not given meaning to the term "scientific" and attempts to define what "scientific" ought to mean within the context of the statutes in which the "Best Scientific Data Available" criteria appears. A manuscript has been submitted and is currently in review.

3. An analysis of the relevant case law, statutes, and policy statements has been conducted and a manuscript describing the inconsistencies and suggesting a clarified approach has been published and can be found at: Martin Robards and Julie Lurman Joly, "Interpretation of 'Wasteful Manner' within the Marine Mammal Protection Act and its Role in Management of the Pacific Walrus," 13 *Ocean and Coastal Law Journal* 171, 2008.

impact

1. As the concept of assisted migration becomes a hot topic in conservation biology circles it will be useful for scientists, conservationists, and advocates to understand the legal regime in which such a program would have to operate.

2. This work will be of interest to all federal land and resource managers who operate under a statute that contains "best scientific data available" language. Failure to consider whether data is "scientific" can have significant management repercussions.

3. The work related to the Marine Mammal Protection Act will be of interest to those agencies that manage marine wildlife under the statute, as well as to the Native communities and organizations that depend on marine mammals for subsistence, economic, and cultural purposes.

Social vulnerability and equity in the context of climate change

Valerie Barber; Ellen Donoghue (USDA Forest Service, PNW Research Station-PFSL, Portland, Oregon); Kathy Lynn (Resource Innovations, Institute for a Sustainable Environment, University of Oregon)

purpose

This is one component of a multi-part project that is charged with synthesizing knowledge about the effects of climate change on indigenous people and resource-based communities in the United States and Canada; this project will relate to social vulnerability and equity. Reports and other publications will inform policymakers and resource managers of the opportunities, challenges, and issues related to social vulnerability and equity in the context of climate change.

approach

Information about issues, policy, and programs pertaining to socioeconomic and cultural effects of climate change on indigenous people in Alaska and Canada will be synthesized into a literature review. Sources of information include academic literature, gray literature, popular media, and governmental and nongovernmental websites, which will go into an Endnote file as a combined searchable resource.

progress

Many references have been collected and entered into Endnote and a few have been annotated.

impact

Using our references will allow us not only to synthesize what available science says about social vulnerability and climate change, but also to document the emergence of issues not currently addressed in academic literature in ways that will educate decision makers, inform the policymaking processes, and serve as a basis for future research.

recreation

Alaska residents statistics program

Peter J. Fix, Quinn Tracy

purpose

This study assessed travel and recreation patterns of Alaska residents, areas residents no longer visit or for which they have changed visitation, and reasons for participating in outdoor recreation. This study was conducted in cooperation with several federal and state agencies (USDI Bureau of Land Management, National Park Service, and Fish & Wildlife Service; USDA Forest Service; Alaska Department of Transportation, State Parks, Fish & Game), and the resulting information will be incorporated into their planning processes.

approach

We gathered information using a mail survey. We stratified the state into five regions and drew samples from each region.

progress

We presented our preliminary results at the 14th International Symposium on Society and Resource Management, June 10–14, 2008, Burlington, Vermont, and the Alaska Park Science Symposium and Beringia Days International Conference, October 14–16, 2008, Fairbanks, Alaska.

impact

The study will assist participating agencies with their natural resource planning, result in a common dataset to be shared among the agencies, and provide baseline information to monitor trends. Results estimate the percent of residents participating in activities, e.g., 57 percent of Interior residents participated in hiking in the previous twelve months, and the percentage of people from various regions participating in specific activities, for example, 43 percent of respondents from the southcentral region participated in freshwater fishing on the Kenai Peninsula compared to 8 percent of Interior residents. In contrast, 19 percent of Interior residents participated in freshwater fishing in the Copper River basin compared to 12 percent of Southcentral residents. Results also showed places residents either no longer visit or for which they have changed their visitation patterns; the Kenai and Russian rivers were often cited. Gaining a better appreciation of nature, spending time with family and friends, obtaining meat/food, exploring new areas, and exercise/physical fitness were chosen often as important reasons for participating in outdoor activities.

Dalton Highway, Denali Highway, and Fortymile Country recreation experience study

Peter J. Fix, Jennifer Stegmann; Tara L. Teel (Colorado State Univ.)

purpose

This project applied the concepts of Benefits Based Management to a study of recreation experiences along the Dalton and Denali highways and the Fortymile country. The study measured the four levels of demand specified by Benefits Based Management: activities, settings, desired experience, and off-site benefits.

approach

Visitors, selected by a random sample, were asked to participate in a short on-site survey and were given a more detailed survey to return by mail.

progress

During summer 2008, the report was completed and presented to the Bureau of Land Management.

impact

This study will assist the Bureau of Land Management in understanding the visitors to these areas and provide guidance in developing appropriate management plans. With respect to the Dalton Highway, the Yukon River to the Arctic Circle, and Toolik Lake Viewpoint to Deadhorse were chosen most often as the primary destination (30 and 31 percent, respectively); for the Fortymile country, Chicken was the most often selected primary destination (27 percent); and for the Denali Highway Maclaren Summit to Tangle Lakes was chosen most often as the primary destination (38 percent). Driving/sightseeing was the most frequently chosen primary activity for all three study sites. For all sites, experiencing new and different things, enjoying the sights and smells of nature, and getting away from the usual demands of life were the top three reasons for visiting, and a greater connection with nature and heightened awareness of the natural world were desirable benefits.

Kamchatka visitor survey

David Ostergren (Goshen College); Tatyana Oborskaya, Martha Madsen (Russian Federation); Bill Overbaugh (BLM); Alan Watson, Daniel W. McCollum, Linda E. Kruger (USDA Forest Service); **Peter J. Fix**

purpose

This project was developed to provide stakeholders with basic information regarding the visitors to the Kamchatka Peninsula in Russia. Information gathered included areas visited, activities participated in, experiences sought, evaluation of services received during their trip, expenditures, and demographics.

approach

A survey was conducted at the Petropavlovsk-Kamchatka Airport from July 2007 through July 2008.

progress

During the study period, 3,434 surveys were completed and preliminary analysis conducted.

impact

The information resulting from this study will be used to improve visitor services and stewardship of the region's protected areas. Of the 3,343 completed surveys, 1,961 were visiting the area for vacation or business and vacation. Sixty one percent were from Russia; US residents made up 5 percent of the visitors. Sixty-four percent of visitors were on their first trip to Kamchatka. The Yuzhno-Kamchatski Nature Park was visitors' most often cited favorite area (33 percent). Trekking/hiking, photography, and freshwater fishing were the top three favorite activities of visitors. Escaping everyday pressure, enjoying wild nature, and learning about nature, geology and/or biodiversity were the top three experiences visitors were seeking. Russians spent on average $2,283 US and non-Russians spent on average $3,365 US.

Squirrel River community and sport hunter study

Peter J. Fix, Andrew M. Harrington

purpose

This project was designed to assist the Bureau of Land Management in developing a management plan for the

Squirrel River area. A study was designed to provide managers information regarding the extent and causes of conflict between residents and non-residents and to gather information to assist in implementing Benefits Based Management.

approach and progress

Non-local hunters were asked to complete a mail survey at the Kotzebue airport. Focus groups were conducted in Kiana and Noorvik. Onsite surveys were completed.

impact

This study will assist the Bureau of Land Management in understanding the nature and extent of conflict on lands they manage and the visitors to these areas as well as providing guidance in developing appropriate management plans. Initial results suggest non-local hunters do not perceive conflict to the extent of local residents, nor do they feel the area is at its social carrying capacity. Interviews revealed sources of conflict for local residents to be a perception that caribou are changing migration paths and that meat is wasted by non-local hunters. Conflict might also result from differing views between local and non-local hunters regarding what is considered appropriate hunting practices, the appropriate relationship between the hunter and the hunted, compensation for guiding, and other issues pertaining to hunting.

White Mountains National Recreation Area winter recreation experience study

Peter J. Fix, Andrew M. Harrington

purpose

This project applied the concepts of Benefits Based Management to study recreation experiences of winter visitors to the White Mountains National Recreation Area (WMNRA). The study measured the four levels of demand specified by Benefits Based Management: activities, settings, desired experience, and off-site benefits.

approach and progress

Sampling was conducted at trailheads and visitors were asked to participate in a short onsite survey. We gathered the data and completed most of the analysis in preparation for presentation to the Bureau of Land Management (BLM).

impact

This study will assist the BLM in understanding the visitors to these areas and provide guidance in developing appropriate management plans. A zone that extended from the Elliot Highway to Lee's Cabin received the most visitation (71 percent). Snowmachining and skiing were the two most often selected primary activities (26 and 21 percent, respectively), followed by dog sledding (19 percent). Experiencing nature, escaping crowds, and escaping personal and social pressures were the top three reasons for visiting the area. Respondents felt a greater connection with nature, enhanced mental health, and an enhanced sense of personal freedom were important outcomes of spending time in the WMNRA.

water & wetlands

Lake level changes at Harding Lake

John D. Fox, Jr.

purpose

Harding Lake is an important recreational lake in interior Alaska that has experienced periods of declining lake levels due to the divergence of a major feeder stream. This study focuses on reconstructing historic lake levels and lake level changes, measuring current levels, and developing a model that might be useful in developing operational rules for a control structure on the divergent stream.

approach

Historic lake levels are being explored through aerial photography/imagery and ground photographs of the lake and lakeshore, and finding original survey meander corners. A recording lake level gauge and rain gauges have been installed to better understand the within-season and between-season dynamics of the lake. An interactive model has been created that captures the general dynamics of the lake water balance.

progress

Historical analysis supports the hypothesis that Harding Lake began to decline in the late 1960s, probably due to local flooding changing the channel of Rogge Creek, the major feeder stream to the lake. The flood was likely associated with the same weather events causing the 1967 flood in the Chena River near Fairbanks. Modeling based on that assumption resulted in simulated lake levels consistent with the historical data. The water balance model of Harding Lake was then run several years into the future starting with the 2007 measured lake level and subjected to initially wet and initially dry time series of weather data. Target lake levels were reached in from one to five years with varying amounts of partial flow from a redirected Rogge Creek. Lake level and precipitation monitoring continued throughout the ice-free period of 2008. Heavy rainfall at the end of July and beginning of August caused the lake to rise nearly 1.5 feet in just a few days. Local flooding also occurred. Modeling and spot measurements of flow in Rogge Creek indicate significant contributions to the lake although much of the rise was likely due to rainfall directly onto the lake. We observed that rainfall recorded at Harding Lake by this project was significantly higher than reported for Eielson Air Force Base and the Fairbanks International Airport. The ice-free period extended into November, with indications that lake evaporation may be significant even with cold air temperatures. This is probably due to energy stored in the lake and the low atmospheric vapor pressures. Measurement of lake levels in the winter continued again this year. The pattern of initial decline under the ice in early winter followed by a period of no decline in late winter was repeated.

impact

The information collected for this project has contributed to the design and operation of the Rogge Creek diversion structure and provided projections of its impact on lake levels. I provided a report describing the model and its projections to agencies managing the lake and provided a slide show of historical photos and model results at the Harding Lake Property Owners Association's annual meeting. From a scientific perspective this project underscores the importance, yet difficulty, of assessing net groundwater flow for the lake. Observations also support the hypothesis that fall lake evaporation may be higher than previously expected.

Feasibility study for development of a storm water utility in the city of Fairbanks

Jackson Fox

purpose

My intent is to determine if the City of Fairbanks would save money on legally-mandated storm water management services by creating a storm water utility.

approach

This project will assess the following:

- The cost of existing city storm water management services;
- The expected future cost of required storm water management services, including capital improvements and large deferred maintenance projects;
- The cost of establishing a storm water utility;
- Alternative utility fee structures.

progress

This project is in the planning stage. Work is expected to begin September 2009.

impact

In June 2005, the US Environmental Protection Agency required the city to institute new storm water management programs, including illicit discharge detection/elimination, construction site storm water management, and other activities. Complying with these requirements has placed a substantial burden on the city's general fund, including the creation of a new environmental manager position to direct the development and implementation of the city's storm water management services. The city is therefore considering developing a storm water utility to represent an equitable way for the community to share the cost of this public service.

Impacts of water and sanitation projects on communities in Ghana

Josie Osafo-Adu Sam

purpose

This project will consider the impacts of water wells on community life in the village of Ofosu, Ghana, with emphasis on its effects on women and children.

approach

A combination of interviews, surveys, local school and health clinic statistics, and participant observation will be used to assess the impacts.

progress

This project is in the planning stage. Initial fieldwork will be carried out in August 2009.

impact

Water, sanitation, and hygiene education projects are vital in Ghana, as inadequate water and sanitation contribute to over 70 percent of diseases in Ghana. As well, women and girls spend an average of four hours each day obtaining the family's water. This time commitment limits women's ability to take part in decision-making and food production and it is common for girls to be pulled out of school to help with this task. Anticipated types of impacts include improved health, improved farming output due to reliable access to water, increased school attendance by girls, more time for women to be involved in decision-making roles and economically productive work, and greater gender equity. The project is funded by the Nyarkoa Foundation.

Status and distribution of wetland habitats in the greater Fairbanks area

Jennifer L. Jenkins

purpose

For this master's degree project, I am delineating wetland habitats in the Fairbanks area.

approach

Using 2007 and 2002 imagery, I am delineating wetlands within the greater Fairbanks area using an on-screen (head-up) method; the wetlands are classified using an image interpretation guide developed by the US Fish and Wildlife Service Fairbanks field office. Once delineation and classification are complete, the data will be field checked.

progress

The project is about 70 percent complete; I expect it to be finished by fall 2009.

impact

It is not possible to protect wetland habitats if you don't know where they are, and that is essentially what the situation has been in the Fairbanks area. The data provided by this effort will be at a higher resolution than anything currently available in Fairbanks and it is being developed using a locally-developed classification system. Fairbanks has seen considerable development in areas that are predominantly wetland habitats. As these habitats are lost and/or degraded, there is a growing need to assess the acreage, locations, and types of wetlands in the Fairbanks area. This project will facilitate such an assessment. It is supported by the US Fish and Wildlife Service.

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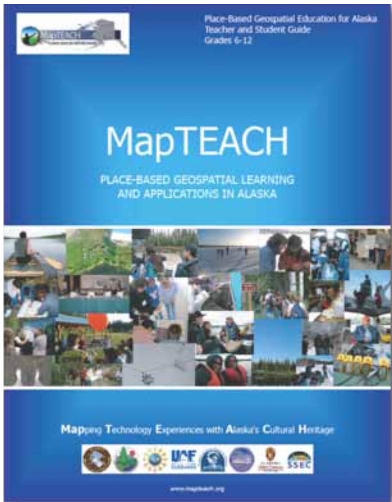

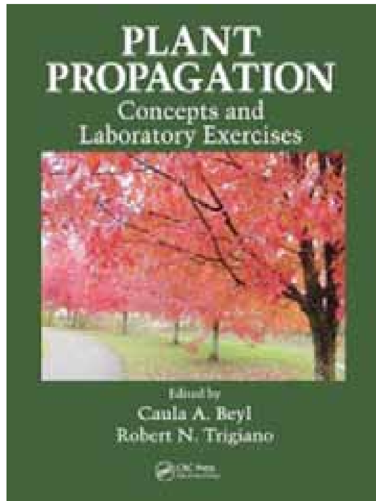

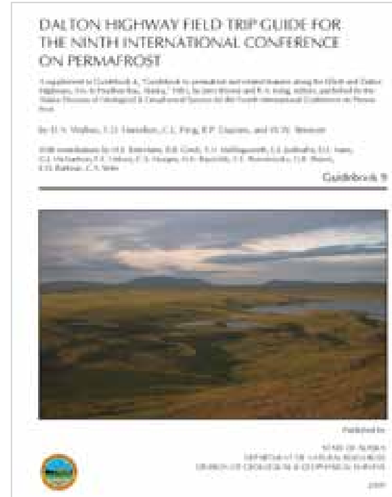

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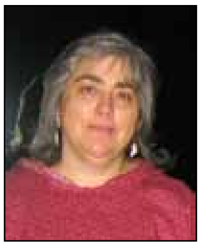

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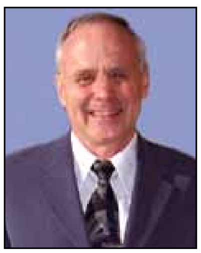

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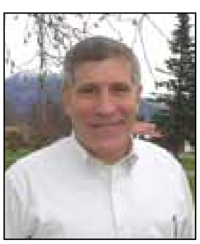

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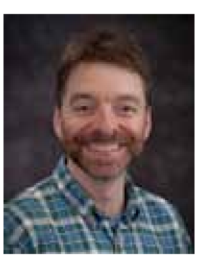

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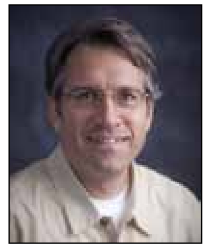

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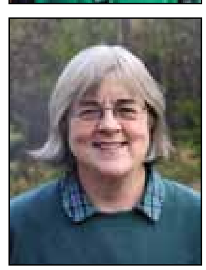

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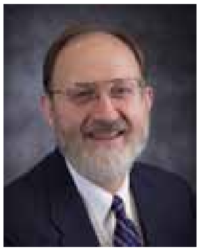

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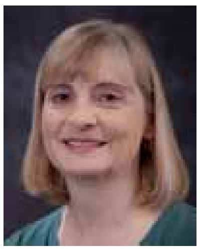

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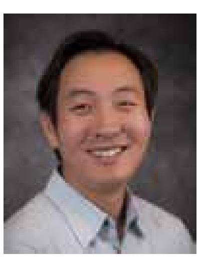

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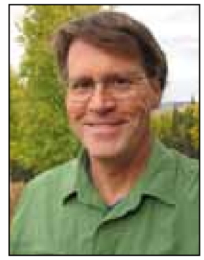

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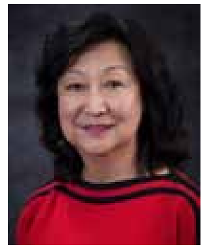

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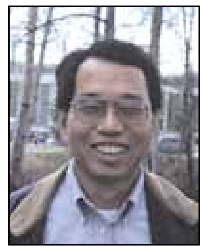

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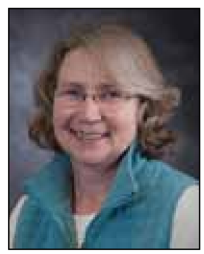

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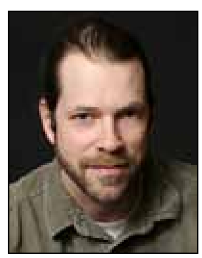

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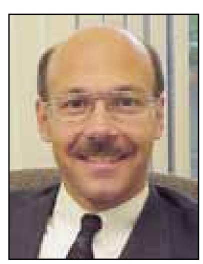

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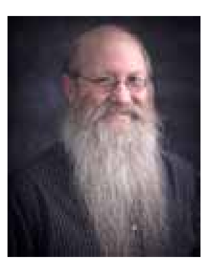

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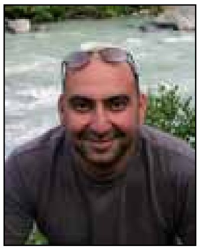

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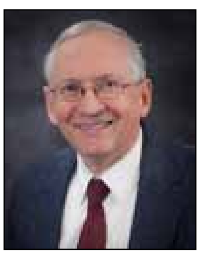

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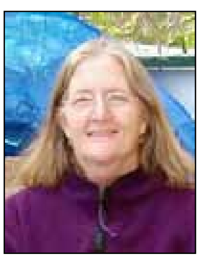

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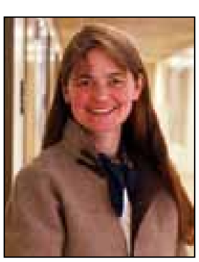

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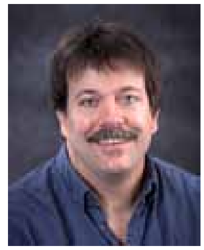

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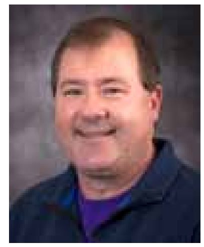

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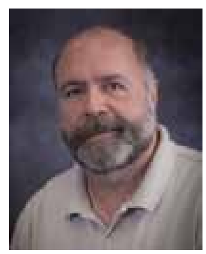

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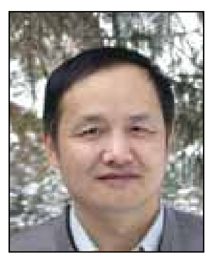

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