School of Natural Resources & Agricultural Sciences

Agricultural & Forestry
Experiment Station

Annual Report 2007

Sweet peas at the Georgeson Botanical Garden.
—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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UAF UNIVERSITY OF ALASKA FAIRBANKS

Contents:

Letter from the dean:

December 5, 2008

The Honorable Sarah Palin
Governor of Alaska
P.O. Box 110001
Juneau, Alaska 99811-0001

Dear Madam:

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, 2007. 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.

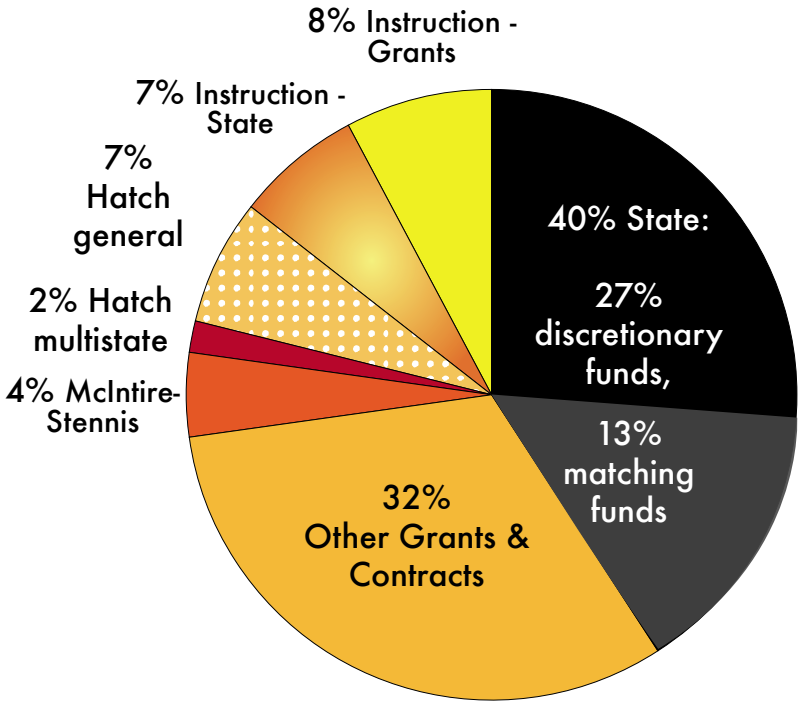
Administratively, AFES is an integral part of the School of Natural Resources and Agricultural Sciences at the University of Alaska Fairbanks. This association provides a direct link between research and teaching. Scientists who conduct research at the experiment station also teach, sharing their expertise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

Kerttula Hall (red-roofed building) at the Palmer Research and Extension Center.
—SNRAS FILE PHOTO

Financial statement

Expenditures: July 2007 through June 2008

The following statement of expenditures of federal and state funds for the fiscal year beginning July 1, 2007 and ending June 30, 2008 (FY 08) is not an accounting document. (Figures and percentages are rounded off to the nearest dollar and percent.)



Total Funds: $11,962,528

- Instruction - Grants $920,997 (8%)
- Instruction - State Appropriation $778,698 (7%)
- Hatch General Formula Funds (federal) $823,181 (7%)
- Hatch Multistate Formula Funds (federal) $198,759 (2%)
- McIntire-Stennis Formula Funds (federal) $529,444 (4%)
- Other Grants & Contracts $3,803,802 (32%) (includes public service)
- Research - State Appropriation $4,907,647 (40%)
- Matching USDA Formula Grants $1,551,384 (13%)

Research $3,356,263 (27%)

Grants and Contracts

GRANTS & CONTRACTS/SPECIAL FUNDS	PI	AGENCY
Small Pub. Water Sys Training & T.A	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	Chapin III	USDA Forest Service (ALB)
Forestry Research II, PNW	Chapin III	USDA Forest Service - Fairbanks
IGERT Regional Resilience and Adaptation	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 Service
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

Continued on the next page

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/Export	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 - Potatos	Smeenk	USDA - Agricultural Research Service
Moisture Content Determination	Soria	USDA Forest Service - Juneau
Monitoring Seasons Through Global Learning Communities	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- Agricultural Research Service
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 & Extension Services (CSR&ES)
Rangeland Fragmentation W 1192, ALK #07-07	Joly	USDA - CSR&ES
Commercial Greenhouse NE-1017, ALK #07-10	Karlsson	USDA - CSR&ES
Regional Administration W-106 ALK #99-05	Lewis	USDA - CSR&ES
Livestock Production, W 1112, ALK #06-06	Shipka	USDA - CSR&ES

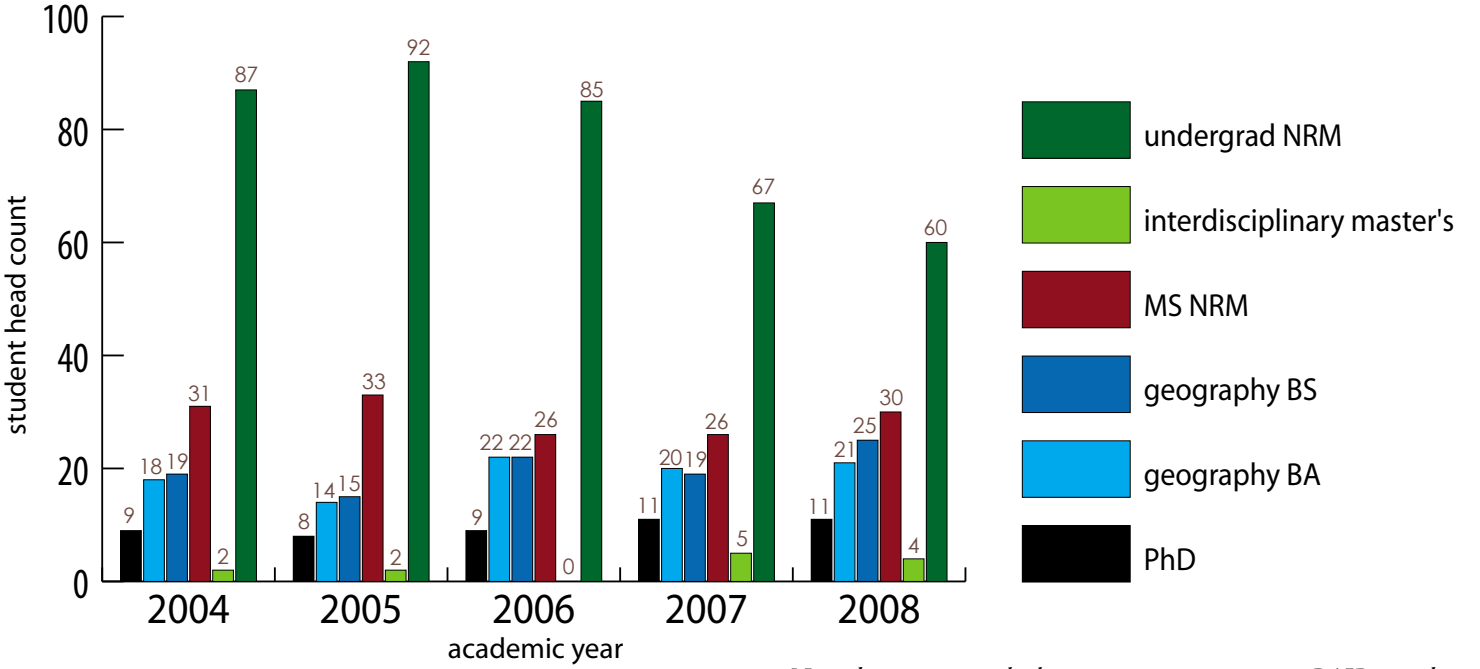
CONTINUED ON THE NEXT PAGE

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

Below: Bison at Ruby & Scott Hollembaek's ranch near Delta Junction. This ranch participated in the annual NRM 290 class, which features a tour of businesses and facilities around the state that offer examples of natural resources management and high-latitude agriculture.
—Photo by Matthew Helt

Students

five-year statistics: number of students enrolled, 2004-2008



Note: beginning with this year, we are reporting PAIR numbers, going back to 2004. These numbers may differ from those shown in previous annual reports.

Graduates as of May 2008

Baccalaureate Degrees

Shawn Biessel,** BA, Geography, *magna cum laude*

Kevin Breitenbach,** BA, Geography

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

Nickol Dameron, BS, Geography: Environmental Studies

Melissa Deiman, BS, Natural Resources Management: Resources, *cum laude*

Emily Dickson,* BS, Natural Resources Management: Forestry

Christopher Held,** BS: Geography: Environmental Studies

Joshua Kunz, BS, Natural Resources Management: Plant, Animal, and Soil Sciences

Yosuke Okada,* BS, Natural Resources Management: Plant, Animal, and Soil Sciences

Jessup Olson,* BS, Geography: Environmental Studies, *cum laude*

James Riedman, BS, Natural Resources Management: Forestry

Ryan Sloger, BA, Geography

Emily Sousa,* BS, Geography: Environmental Studies

Nicholas Thompson, BS, Natural Resources Management: Resources

Master's Degrees

Natalie Howard,* MS

Thesis: Nitrogen fertilization of cool-season grasses for forage quality

BA, Hollins University (Virginia), 1996

Brian Jackson,* MS

Thesis: Foxtail barley *(Hordeum jabatum)* control with propoxycarbazone-sodium and fluazifop-p-butyl in three Alaska native grass species

BS, University of Wisconsin-Platteville, 1999

Richard Ranft, MS

Thesis: Triclopyr in a silt loam soil of interior Alaska: A comparison of chemical extraction and bioassay methods

BS, University of Alaska Fairbanks, 2005

Blaine Spellman, MS

Thesis: The impacts of invasive sweetclover in early-successional floodplain habitats of Alaska

BS, Shepherd University (West Virginia), 2004

Stephen Winslow, MS

Thesis: Tree growth history, climate sensitivity, and growth potential of black and white spruce along the middle Kuskokwim River, Alaska

BS, University of Alaska Fairbanks, 2002

* December 2007 degree recipient

** Summer 2008 degree recipient

Doctoral Degree

Gregory L Finstad, PhD

BS, University of Alaska Fairbanks, 1981

Thesis: Applied range ecology of reindeer *(Rangifer tarandus tarandus)* on the Seward Peninsula, Alaska

Abstract: Environmental variation across reindeer ranges of the Seward Peninsula in Alaska was linked to differences in animal production. Reindeer producers can now identify high quality grazing areas and place animals to maximize body weight and rate of gain, thereby increasing meat production and economic development in rural Alaska.

Major Professors: Dr. Norman R. Harris and Dr. Knut Kielland

Summary

15 undergraduate degrees conferred

BA, Geography: 3
BS, Geography: 4
BS, Natural Resources Management: 8
Forestry: 2
Plant, Animal, and Soil Sciences: 4
Resources: 2

6 graduate degrees conferred

MS in Natural Resources Management: 5
PhD, Interdisciplinary Program: 1

Above: Samples from the Gulkana fish hatchery north of Glennallen, an Alaska Department of Fish & Game hatchery operated by the Prince William Aquaculture Corporation. From left to right: salmon roe, salmon embryos, just-hatched salmon fry, salmon smolts, older smolts, and juvenile fish.

Below: NRM 290 students receiving an overview of fish hatchery operation as part of the class tour. Denny Patnode explains the system of incubators at the Gulkana Hatchery while students look on. The class exposes students to real-life application of natural resources management theory and skills: what it means to be in a particular industry such as aquaculture, and the controversies and approaches to the day-to-day operation of a natural resources-based business.

—PHOTOS BY MATTHEW HELT

Research Reports

The school and experiment station pursue their missions with faculty in four departments: High-Latitude Agriculture (formerly Plant, Animal, and Soil Sciences); 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 links is to be found at the end of this publication.

Partners and Collaborators

Agricultural Research Service

The Subarctic Agricultural Research Unit of the US Department of Agriculture (USDA) Agricultural Research Service (ARS) was re-established in the winter of 2002–2003, and 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 Peony Growers Association

This new organization is made up of the state's peony growers, who are working to sell high-latitude peonies in the international market. *www.alaskapeonies.org*

Alaska Center for Climate Assessment & Policy

The Alaska Center for Climate Assessment and Policy 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 the 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 Forest Service works with the public to manage more than 22 million acres in southcentral and southeast Alaska The Alaska Region of the Forest Service 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

Chena Hot Springs' vision is to become a self-sufficient community in terms of energy, food, heating, and fuel use. Chena is developing numerous renewable energy and sustainable development projects and is forming partnerships within the community 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. *www.cchrc.org*

Cooperative Ecosystems Studies Unit 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, with the University of New Hampshire and the Alaska SeaLife Center as partners. Research focuses on arctic and subarctic anthropology, landscapes, ecology, archeology, and physical and biological sciences. *www.uaf.edu/snras/cesu/*

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Cooperative Extension Service

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/*

EPSCoR: Alaska Experimental Program to Stimulate Competitive Research

Alaska EPSCoR is a university-state partnership which builds Alaska-based research and addresses national scientific priorities, training students for the twenty-first century technologically based workforce. EPSCoR aims to strengthen science and technology infrastructure for enhanced research competitiveness in universities, for broader participation of students in science, mathematics, and engineering, and for increased linkages among higher education, government agencies, and the private sector. *www.alaska.edu/epscor/*

Google Earth

Millions of people use Google Earth and Google Maps to explore the world around them. 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 UAGP 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. *www.pikeslodge.com*

Programs

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/fffjl2/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 franchise 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/*

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

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 for Alaska Native and American Indian students that show such powerful results. *www.uaf.edu/mcc/*

Reindeer Research Program

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 program of the National Science Foundation. RAP trains scholars, policymakers, and managers to address regional sustainability issues in an integrated fashion. *www.rap.uaf.edu/*

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/*

Wood Utilization Research Program

The long-term objective of the Alaska 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.

Research Sites

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 forestry.

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 red barn, a 65-foot high grain handling facility, a small stationary sawmill used to cut rough lumber for farm structures, feed mill, maintenance shop, combination greenhouse and agronomy lab, a controlled environment agriculture lab, a botanical garden, a visitors' center with a small gift shop, two residences, and several storage facilities. Researchers conduct experiments on soil fertility, nutrient cycling, grains, grasses, and other agronomic crops, and new crops such as canola, camelina, and sunflowers. The Reindeer Research Program's main research herd is housed at the Fairbanks Experiment Farm. *www.uaf.edu/snras/afes/fairbanks_experiment_farm.html*

The **Controlled Environment Agriculture Laboratory** (CEAL), a state-of-the-art horticulture facility, is used to evaluate and develop growing techniques suitable for local year-round crop production. Areas of specific interest include production systems, crop lighting, irrigation technologies, climate management, crop and variety selections, and the sustainable use of alternative energies. Since 2004, the faculty

and staff of CEAL are working in partnership with Chena Hot Springs Resort investigating various topics including facility management, product development, and personnel training. These areas are critical components in the operation of an efficient greenhouse using renewable energy for electrical and heating needs. The projects at Chena Hot Springs are demonstrating and inspiring opportunities for similar applications all over Alaska. Staff from CEAL are also working with greenhouse operators, high school teaching programs, farmers' market producers, and properties such as Pike's Waterfront Lodge, in exploring and advancing the relevance of horticulture science and controlled environment agriculture throughout Alaska.

The nationally recognized **Georgeson Botanical Garden** is a member of a national network of educational and research institutions dedicated to plant culture and conservation. The GBG is one of five botanical gardens in the nation to be a satellite test garden for the International Hardy Fern Foundation. Its 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, and researchers conduct experiments on new horticultural crops for Alaska's conditions, such as peonies. *www.uaf.edu/snras/gbg/*

Palmer Research and Extension Center

The **Matanuska Experiment 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 forest land for research or demonstration purposes, including barns, feed storage facilities, and pasture land. The experiment farm has a complete complement of farm equipment to produce and harvest grain, forage (both hay and silage), and other crops. There are also field and laboratory facilities for research on soils, plants, and livestock, and an adjacent greenhouse facility, operated by the Alaska Department of Natural Resources. This facility includes a modern headhouse and physical plant capable of supporting six greenhouse units. Kerttula Hall is located on the Matanuska Experiment Farm. *www.uaf.edu/snras/afes/palmer_research_station.html*

Report Subjects

Geographic Information

GEOGRAPHY PROVIDES a holistic view of the earth; as a whole, in its distinct and varied regions, and in the concomitant interaction between human activities and the physical world and biological. Geography is the bridge between the physical, biological, and social sciences. It promotes exploration of the interrelationships between the earth's environmental systems and human societies and provides the framework for the application of new and emerging cyber-technologies in a broad range of academic disciplines.

Geographers are interested in patterns and process of physical biological, and social change that include climate variability, human settlement patterns, resource distribution, environmental influences on population mobility and "sense of place", and soiciopolitical and economic policy. Geographic methodologies include observation, measurement, description, and analysis aided by new and emerging computation tools that help explore likenesses, differences, and interdependence of biological and physical components of ecological systems, humans, and societies.

cultural geography

Harrison R. Crandall—artist, pioneer, and patron of the Grand Teton National Park, Wyoming

Kenneth A. Barrick

purpose

Harrison R. Crandall was the first artist with a studio in Jackson Hole, and a pioneer and homesteader in the area that is now known as the Grand Teton National Park. The project documents for the benefit of a national audience Crandall's contributions to national park art, souvenir concessions, and the early history of the park.

approach

The project relies on library scholarship, interviews, and Crandall family archives.

progress/results

I conducted field research at the University of Wyoming's UW-NPS Research Center in the Grand Teton National Park. I also did library research and prepared a manuscript for publication in an academic journal.

impact

Crandall's contribution to the interpretation of the Grand Teton National Park is little known beyond the Jackson Hole community. Iconic examples of Crandall's enduring legacy of art (oil paintings and photographs) are provided, including Teton mountain landscapes, cowboys and cowgirls, wildflowers, and ranch life. This project will provide useful information for environmental managers and historians.

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.

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.

The study of sharing to assess the vulnerability of coastal communities to oil and gas development in arctic Alaska

Gary Kofinas, Peter Fix, Shauna BurnSilver, Marcy Okada; Craig Gerlach (UAF Anthropology); Jim Magdanz (ADFG)

purpose

The Sharing Project uses multiple methods to assess the resilience and vulnerability of two North Slope coastal communities and one Interior rural community of Alaska to the effects of oil and gas development with climate change. The project is funded by Mineral Management Services of the Department of Interior through the Cooperative Ecological Studies Unit. The study seeks to inform communities and resource management agencies on potential changes in northern Alaska and contribute to theory on social-ecological sustainability.

approach

In partnership with local communities, we use social network analysis, focus groups, ethnographic analysis, and simulation modeling to study sharing systems of indigenous communities as strategies for coping with change. We focus on the sharing of subsistence foods, information, and money, collecting qualitative data with focus groups and quantitative data through a survey administered to all households. Researchers and leaders of participating communities compare community resilience and vulnerabilities with other communities through the activities of the Community Adaptation and Vulnerability in Arctic Regions (CAVIAR), an initiative of the International Polar Year.

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progress

The initial phase of our project has 1) established formal research partnership agreements with the communities of Kaktovik, Wainwright, and Venetie, Alaska; 2) completed a review of subsistence and sharing literature for Alaska communities; 3) developed a conceptual framework for assessing harvesting, sharing, and cooperation in subsistence based on this literature and input from community collaborators; 4) designed a questionnaire to quantify the patterns and magnitude of social ties related to subsistence and evaluate community resilience; and 5) pre-tested the questionnaire in the three study communities in preparation for administering it to all households in the future.

impact

Local communities have traditionally used informal institutions of sharing subsistence resources as a method of coping with uncertainty. In contemporary Alaska Native communities, subsistence sharing is part of a dynamic and evolving cultural system that contributes to identity, livelihoods, and community wellbeing. Historically, resource management agencies have studied subsistence primarily through the documentation of total harvest and without a careful examination of community social-ecological dynamics. This study explores the application of recent theories on the networks to northern community sustainability and represents a novel approach in assessing the implications of Arctic oil and gas development on indigenous culture. Our project team is collaborating closely with the NSF-funded "IPY: Impact of High-Latitude Climate Change on Ecosystem Services and Society" (Chapin, Hepa, Kofinas, and Rupp) to explore how oil and gas development with climate change will affect rural livelihoods.

Place-based geospatial science learning and applications in rural Alaska (MapTEACH)

Sidney Stephens

purpose

This project provides geospatial information technology (GsIT) science and technology education for teachers and students in rural Alaska that is directly applicable to understanding the local geographic context and that relates modern science and information technology to traditional knowledge.

approach

MapTEACH began as an NSF-funded, four-year informal science education project to develop a place-based educational program for middle and high school students in Alaska. It emphasizes hands-on experience with geology and spatial technology in conjunction with traditional activities. It draws upon the combined expertise of teachers, education researchers, remote sensing specialists, geoscience professionals, and Native elders and others with traditions-based knowledge. This project involved three collaborating institutions with differentiated roles: UAF (curriculum development and evaluation), the Alaska Division of Geological & Geophysical Surveys (imagery, GIS and geoscience expertise), and the University of Wisconsin-Madison's Environmental Remote Sensing Center (GsIT infrastructure, web-serving, and interface).

progress (UAF portion only)

The MapTEACH curriculum was introduced to teachers from around the state through a four-credit summer course held at UAF; teachers subsequently implemented the curriculum in their classrooms. At a winter meeting, these teachers enthusiastically shared their students' successes, advised us on program development, and offered to take on leadership roles in program training and outreach. Using this feedback, the curriculum has been revised, edited, and formatted for distribution via DVD and web download. With the end of NSF funding, MapTEACH is transitioning to a new home with the UA Geography program.

impact

DVD and web-based curriculum and data resources hosted by UA Geography were accessible by June 1, 2008. A blueprint for region-specific educational modules was produced and can be adapted for use elsewhere in Alaska. A cadre of students and teachers now has rudimentary proficiencies in geospatial technology and can connect these understandings to local issues and local knowledge.

physical geography

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

Norman Harris; Tricia Wurtz (USFS)

purpose

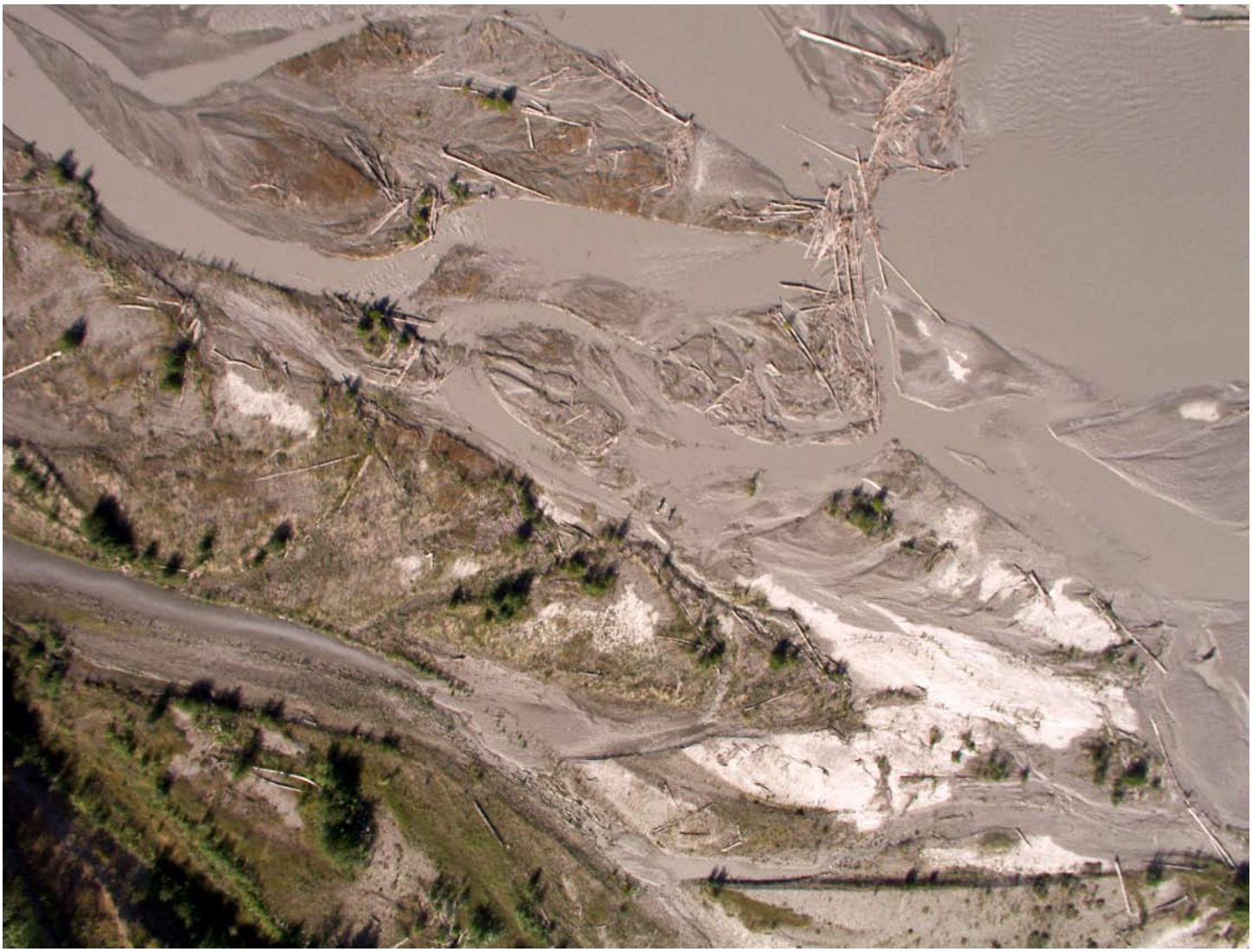
This study is directed at mapping, over time, infestations of white sweetclover (*Melilotus alba* Desr.) on the Matanuska River floodplain using near-earth remote sensing to detect changes in the population dynamics between sweetclover and native vegetation.

approach

From June through October, spectral data is acquired monthly, or as weather permits, from an altitude of 122 meters using a small, tethered, helium-filled blimp carrying two 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

Continuing analysis of spectral data indicates that white sweetclover is easiest to detect using visible-light spectral bands taken late in the growing season when phenological differences between the target plant and other vegetation are at their greatest. It is easiest to detect sweet clover at the end of



Photograph of Matanuska River floodplain and tributaries, showing the sandbars and banks with the distinctive pinkish color of white sweetclover at the end of its biennial cycle.

—PHOTO COURTESY NORMAN HARRIS, USING THE BICAMERAL OBSERVATION BLIMP

the biennial cycle when the plants die and turn pink-brown in color, and when plants are in their first year of growth, as they tend to remain green while the other floodplain vegetation exhibits a color change to shades of red or yellow. However, these phenological differences are not strongly linked to calendar dates. Our current analysis indicates that white sweetclover does not readily invade intact ecosystems but relies on disturbance factors (i.e., flooding) to remove existing vegetation so plants can establish with little competition for resources. A probability model predicting susceptible areas for infestation is still under development and refinement.

impact

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

Grazing management and radiotelemetry

Greg Finstad, Suzanne Worker, Darrell Blodgett; Karin Sonnen (NRCS)

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 with 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

Forty-two reindeer from ten herds were equipped with satellite collars. Collars were deployed on the Seward Peninsula and St. Lawrence and Nunivak islands. Location maps of the islands, including NRCS Land Unit overlays, were created and made available to herders and land managers. In addition to several map formats previously provided, a KML (Keyhole Markup Language) file type was added to allow quick three-dimensional viewing of location data using Google Earth software.

impact

Reindeer producers now have a satellite telemetry and Internet mapping program to track the locations of animals to better manage the effects of grazing on public lands. Land managers, in turn, are using this system to monitor practices of grazing permit holders to ensure compliance to the conservation of and sustainable use of public lands.

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 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 activity patterns similar to cattle elsewhere, indicating that activities seem to be unaffected by either of these factors. 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 that also will benefit consumers by fostering further development of an Alaska-based meat industry.

A GIS habitat suitability model for selecting reindeer calving areas on the Seward Peninsula, Alaska

Randy Fulweber, **Norm Harris, Greg Finstad**, Brad Griffith

purpose

Reindeer herders on Alaska's Seward Peninsula periodically need to move reindeer to new calving areas to improve access to quality forage, reduce predation, ease grazing pressure, and/or improve herding logistics. We built a GIS habitat suitability model (HSM) to help herders identify new areas suitable for reindeer calving.

approach

We used the following habitat factors to build an HSM for reindeer calving areas: elevation, slope, aspect, vegetation, and temperature. Using known reindeer calving sites from a reindeer herd near White Mountain, we measured the ability of the HSM to accurately identify these suitable calving areas using a relative operating characteristic curve (ROC) analysis. An ROC value greater than 0.5 indicates an HSM that performs better than randomly guessing where suitable calving areas might be located.

progress

Results of temperature data analysis revealed a strong contrast between day and night temperature patterns across the landscape during the spring calving season, as expected. Warm areas during the day became the coldest areas during the night. Temperature data also revealed the ability of a spring snow storm to temporarily invert the established temperature pattern on the landscape: areas that were typically warm became cool, and vice versa.

The best HSM (ROC value: 0.73) needed to use only the elevation and aspect habitat factors to identify the known reindeer calving areas from the White Mountain herd. Including the other habitat factors did not improve model performance.

impact

Reindeer herders on the Seward Peninsula can use our HSM to locate the most suitable reindeer calving areas within their range. Moving pregnant reindeer to these areas could potentially improve calf growth, survival, and herd productivity. Increases in herd productivity could lead to increased economic income for Seward Peninsula reindeer herders.

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, on the Fairbanks 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, but also provides insight and knowledge benefitting 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 techniques to the rigors of high-latitude conditions; application of molecular technology to northern plant materials and identification of value in new plant products and chemistry; integrated pest management; marketing, quality control, and acceptance of Alaska agricultural products; revegetation of disturbed lands; treatment of waste products in cold climates; and biomass analysis and treatment for biofuels.

agricultural markets & products

Peonies as field-grown cut flowers—market research and analysis

James D. Auer, **Joshua Greenberg, Patricia S. Holloway**

purpose

We seek to identify potential markets for Alaska-grown fresh cut peonies, explore methods of post harvest handling of cut stems, and examine national trends in peony cut flower sales.

approach

Personal interviews were conducted with individuals at all levels of the cut flower industry including growers, farmers' market sellers, wholesale and retail flower distributors, florists, and brokers. Published literature, both academic and trade, were examined, and a hedonic price model was applied to the wholesale cut flower peony industry in the United States.

progress

Key points for Alaskans to focus on in flower production are: 1) proper harvesting stage specific to individual peony cultivars, 2) postharvest handling and packaging, 3) marketing and cold chain management, and 4) examining closely the costs and benefits of selling flowers in available markets. Best practices at this time include cutting stems at least twice a day, moving stems into a 1°C (34°F) cooler (>90 percent relative humidity) as soon as possible, and storing the stems dry until sufficient quantities are available for shipping. Stems are bunched into bundles of five using rubber bands, labeled according to cultivar, and cut to even lengths when they reach the cooler. Bunches are packed in boxes using foam inserts and newspaper to protect plants from damage, and secured with wooden stakes to prevent bunches from moving in transit. Cool cell packs wrapped in newspaper are inserted into the boxes to help maintain cold conditions in transit.

Data from national markets indicates that cultivars with double blooms are in greater demand than single blooms. There is a price advantage to red flower color, although a mix of colors is probably preferred for greater product diversity. There are small local markets mostly at the farmers' markets for fresh cut flowers, but volume sales will be wholesale export and should emphasize East Coast buyers.

impact

This information will be used by the newly formed Alaska Peony Growers Association to establish export markets. Currently there are twelve growers with 14,000 peonies in the ground. This number will double at the end of summer 2008.

Peonies as field grown cut flowers—field production

Patricia S. Holloway, Janice T. Hanscom; James D. Auer (UAF School of Management); Nancy Robertson, Lori Winton, Alberto Pantoja (ARS)

purpose

We sought to learn methods of field-grown cut flower production and marketing to establish a peony cut flower industry in Alaska.

approach

Field plots were established from 2001–2003 at the Fairbanks Experiment Farm in three experiments: trials for thirty cultivars; plant spacings of 30, 45, or 60 centimeters within rows; soils amended with compost or peat; and fencing of 0, 15, or 60 percent shade to delay snow melt and budbreak. Samples of leaf and bud tissue were examined to identify potential virus and disease pathogens. Buds were examined to identify insect pests.

progress

Thirty cultivars were evaluated for their potential as field-grown cut flowers in Alaska. After six years, two main cultivars can be recommended as the ones to start with for

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Cut peony trial plots at the Georgeson Botanical Garden, summer 2007.
—photo by James D. Auer, Georgeson Botanical Garden Collection

beginning cut flower growers: Sarah Bernhardt and Duchess de Nemours. Also, Red Charm, despite its short stems, should be grown for its deep red color. Amending soils with garden waste compost or Lemeta peat moss did not increase the number of flowering or vegetative stems in the first four years. A within-row plant spacing of 30, 45, or 60 centimeters showed no consistent difference in number of flowering and vegetative stems or stem quality in the first three years. Variation among individual plants in both experiments was so great it masked any treatment effects. No differences were recorded in flowering times and number of vegetative and flowering stems during the first growing season between Sarah Bernhardt and Duchess de Nemours, with three levels of shade (0, 10, and 60 percent) used to delay spring snow melt and potentially delay flowering times. Roots imported from Oregon showed symptoms of tobacco rattle virus. Research is continuing to determine if the nematode vector survives in Alaska soils. Botrytis rot is present, but not common. Two insects have been identified as pests of peony buds, an aphid and a Lygus bug (*Lygus borealis, L. punctulatus*). Their damage can be minimized with the use of exclusionary screens.

impact

Peonies as field-grown cut flowers have potential as a horticultural export from Alaska because harvest times occur in late June to August when peonies from other world markets are not available. More than fifty Alaskans met in December 2006 and twelve indicated they had already planted peonies, most on a trial basis to identify hardiness and regional cultivation issues. Growers are located in Fairbanks, Delta Junction, North Pole, Nenana, Trapper Creek, Palmer/Wasilla, Anchorage, Kenai, Soldotna, and Homer.

Summer stem cutting propagation of thirteen Alaska native woody plants

Patricia S. Holloway, Mia R. Peterburs

purpose

We sought to identify appropriate timing of stem cutting collection for the propagation of common Alaska shrubs and shrubby trees for use as ornamentals and in revegetation projects.

approach

Thirteen Alaska native shrubs and shrubby trees were propagated from leafy stem cuttings collected from late June through August. Cuttings of new growth were treated with 0.3 percent indole-3-butyric acid powder and propagated in perlite/vermiculite (1:1 by volume) under intermittent mist with bottom heat (26°C) in a greenhouse with a minimum night temperature of 15°C and natural light. After six weeks, cuttings were harvested and rated for root quantity (1 [fewest] to 3 [most]).

progress

Three species rooted poorly (<20 percent) regardless of collection date: *Alnus viridis* ssp. *crispa*, *Elaeagnus commutata*, and *Betula glandulosa*. Best rooting (>70 percent) and the highest rating of root quantity (>2.5) occurred at the earliest collection date, 20 June, for: *Spiraea stevenii, Myrica gale, Alnus incana* ssp. *tenuifolia*, and *Rosa acicularis*. Peak rooting for *Betula nana* was estimated as 6 July, and 11–18 July for *Salix alaxensis, S. arbusculoides, Populus balsamifera* ssp. *balsamifera* and *Ledum groenlandicum. Vaccinium uliginosum* showed no peak rooting pattern but rooted more than 60 percent with a similar root quantity rating all summer. With the exception of *Populus balsamifera*, all species that rooted best in July showed greater root quantity ratings on the 20 June collection date even though best rooting percentages were recorded up to three weeks later. *P. balsamifera* showed greatest rooting percentages and root quantity in mid July. Late June summer propagation is recommended for all species that produced roots to ensure adequate root development before autumn. This timing fits well for greenhouse/nursery businesses between the close of bedding plant production season and autumn closure of greenhouses.

impact

This information will aid horticulturists and resource managers to manage collections of stem cuttings to provide for the greatest rooting percentages and highest level of rooting success during the season. Although few people now use stem cuttings for propagation of Alaska native plants, this project provides baseline information that may promote the use of Alaska native plants in landscaping.

animal husbandry

FEEDING & CARE

Intake, rate of gain, and milk composition of reindeer cow:calf pairs on two different pasture grasses

Greg Finstad, George Aguiar

purpose

We evaluated varieties of grasses that could be used as pasture for reindeer to reduce pelleted feed costs in farmed reindeer operations. Our particular emphasis was to investigate the type of pasture that produced highest rate of gain of cow/calf pairs and highest quality milk composition (protein and fat concentration).

approach

The project was conducted at the Agricultural and Forestry Experiment Station with reindeer from the Reindeer Research Program. In June 2007, eighteen cow/calf pairs were randomly allocated for seven weeks to a bromegrass pasture, a nugget bluegrass pasture, or a control pen in which they were fed a 16 percent crude protein milled feed free choice. Milk samples were collected at the start and finish of the trial and adult females and calves were weighed twice a week.

progress

Consumption of milled ration was approximately 17 percent less for cow:calf pairs on pasture. Cow/calf pairs on both pasture grasses gained approximately 25 percent more weight than animals eating only the milled ration.

impact

Our investigation of feeding options for reindeer producers in Alaska revealed that use of pastures in farmed reindeer operations will reduce operating costs by decreasing the consumption of expensive milled rations. The use of pasture will also increase production of the herd by increasing weight gain in reproductive females and calves.

GENETICS

Cattle genetics (Chirikof Island, University of Alaska herd, private Alaska cattle)

M.A. Cronin; M.D. MacNeil (USDA); John Patton (Purdue University); **Milan Shipka**

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 this 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.

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 sequences for mitochondrial and nuclear DNA.

progress

We have data from twenty-four Chirikof Island cattle and from ten other breeds. A paper describing microsatellite DNA variation in the Chirikof cattle and other breeds was published in *Animal Genetics*.

Additional samples were collected in 2006 from the university's cattle herd in Palmer and Larry DeVilbiss's Galloway cattle. DNA has been extracted from these samples, which will be analyzed during summer 2008. This project is part of the Western Education/Extension and Research Activity 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 selection pressures. 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 the Chirikof cattle to the program will allow modern genetics to be applied to livestock in Alaska.

Elk genetics

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

purpose

We sought to develop methods for molecular genetic assessment of domestic elk, and to assess genetic variation and genetic components of performance trait variation in elk.

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. An unpublished 2005 manuscript describing molecular genetic variation (microsatellite and mitochondrial DNA) has been revised and submitted 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.

Assessment of genetic markers in reindeer: Association of DNA polymorphisms with milk yield, milk composition, and calf growth rate

M.P. Shipka, M.A. Cronin, J.E. Rowell

purpose

The identification of genetic markers and their association with performance traits allows the selection of breeding livestock early in life. This removes the need to wait for animals to mature before assessing performance and selecting breeding stock. A genetic marker-assisted selection system has the potential to enhance the reindeer industry in Alaska.

approach

Estrus in twenty-four female reindeer was synchronized during the fall breeding season using established techniques and the cows were bred over a short period. Following parturition, cow/calf pairs were used in the genetic analysis.

progress

Milk samples were collected from reindeer cows and analyzed for percent milk protein, milk fat, and lactose. The total dry matter and total energy content were calculated using the above values in published formulae. All calves were weighed at birth and weekly thereafter until weaning, and average daily gain was calculated. DNA has been extracted from blood samples collected from the reindeer bull used in this project, reindeer cows bred by the bull for this project, and the resulting calves. DNA from individual animals is currently being subjected to genetic marker analysis for milk traits.

impact

This is the first analysis of genetic variation and performance traits of individual reindeer. This approach is especially appealing for reindeer because of the unique and potentially valuable characteristics of reindeer milk, and because this technology will fit seamlessly into current reindeer herding practices on the Seward Peninsula and for reindeer farmed behind fence along the Alaska road system.

Reindeer genetics

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

purpose

We sought to develop methods for molecular genetic assessment of reindeer, and to assess genetic variation and the genetic component of performance trait variation in reindeer.

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 and DNA has been extracted; lab analyses are being planned.

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.

REPRODUCTION

Establishment of a dedicated reindeer herd for the study of reproductive biology and reproductive management in farmed reindeer

M.P. Shipka, J.E. Rowell

purpose

We are training reindeer in a handling facility to allow safe handling for reindeer and researchers, specifically for procedures associated with ultrasound and other research procedures. Once the handling has become routine, procedures such as blood collection and ultrasound will be slowly introduced.

approach

The calves were weaned and moved to a pen with close proximity to the new handling facility at the Fairbanks

Experiment Farm. Three times a week, calves were moved through the handling facility as part of the feeding routine. Once a week they are stopped and weighed in the scale located behind the squeeze chute and stopped again briefly in the squeeze chute.

progress

The Reindeer Research Program has provided eleven female calves born in spring 2007 for this project. These yearlings are undergoing training and are adapting to the indoor handling facility. This has established a nonthreatening routine, and enabled us to troubleshoot and refine the facility design.

impact

These deer will be acclimated to the handling facility and dedicated to studies in reproductive biology and reproductive management of female reindeer. Having a dedicated group of tractable reindeer is the first step in furthering a program in reproductive management of farmed reindeer. The facility and training protocols will provide practical designs and handling routines immediately applicable to small-scale game farms in Alaska. Reindeer acclimated to the handling facility will help future applications in reproductive management research such as artificial insemination, ultrasonagraphy use in examination of pregnancy and the estrous cycle, and in the application of other reproductive technologies.

Variability of gestation length in reindeer

M.P. Shipka, J.E. Rowell

purpose

Gestation length in Alaska reindeer has been reported to range from 198–240 days. This exceeds mean estrous cycle length (24 days; range 16–28 days) and limits our ability to predict calving. Variable gestation length was reported in Russian reindeer as long ago as 1939 and recently a Norwegian team reported that reindeer cows bred early in the breeding season had a longer gestation period than did reindeer cows bred late in the breeding season. We investigated the implication of this correlation.

approach

A switchback trial that separated breeding dates in two groups of reindeer by approximately one month was complemented with historical data. The historical data included individual reindeer with known breeding dates (confirmed by pregnancy hormone analysis) along with recorded dates of parturition, spanning years 1989–2008. This includes seventy pregnancies from two separate reindeer facilities at UAF. In the switchback trial, seventeen reindeer cows were divided into two groups balanced for age and weight as of mid-August 2005. An early-breeding group was bred to a fertile bull August 24 while the late-breeding were

Alaska reindeer.
—PHOTO BY GREG FINSTAD

bred to the same bull, but one month later on September 21. In 2006 the groups were reversed: the late-breeding group from 2005 was bred with the same bull from the previous year on August 23, 2006. Reindeer from the early-bred group in 2005 were placed with the bull on September 20, 2006. Calves produced from these breeding dates were born during the spring of 2007, allowing the calculation of gestation length.

progress

Historical data: Reindeer bred early in the breeding season exhibit a gestation length approximately nine days longer than did reindeer bred late in the breeding season.

Switchback study: Gestation length of reindeer cows placed with breeding bulls on August 24 averaged 225 days while gestation length of reindeer cows placed with breeding bulls on September 21 averaged 216 days, and the difference between the two groups was highly significant.

The sex ratio of calves (M:F) did not vary significantly between early (12:19) and late conceptions (19:15). The sex ratio over the two years was 31:34.

Calf birth weight did not differ between males (6.8 kg) and females (6.7 kg) or between early (6.83 kg) or late conception (6.68 kg).

Older reindeer cows tended to have longer gestation length.

impact

Understanding the relationship between breeding date and gestation length will allow herders and reindeer farmers to better predict the time of calving. This will allow greater vigilance at calving time and improve calf survivability.

Introduction of reindeer bull during mid-estrous cycle

M.P. Shipka, J.E. Rowell, N.C. Ripley

purpose

Estrous cycle length in reindeer is 22 ± 1 day, although short estrous cycles (10–12 days) have often been reported. Reindeer bull introduction is a very effective means of inducing and synchronizing estrus near the beginning of the breeding season, but there is no information on the male effect over the course of an estrous cycle. We sought to determine whether bull introduction at different stages of the estrous cycle would result in a shortened cycle and return to estrus followed by breeding and conception.

approach

Reindeer cows were randomly allocated to five treatment groups balanced for age and body weight. All groups were estrous synchronized to begin this experiment. Group 1 was placed in harem with two bulls immediately following synchronization protocol and remained there for one week. Groups 2–4 were each put into harem for one week as soon as the previous group was removed. Group 5 (control) had no contact with the bulls. All groups were blood sampled via jugular venipuncture two to three times weekly starting two weeks before estrous synchronization and continuing until six weeks post-harem for radioimmunoassay of progesterone. The group 5 sampling schedule followed the group 1 schedule.

progress

Time of the estrous cycle when bull introduction occurred did not affect estrous cycle length. Pregnancy rates for groups were as follows:

Group 1 = 5 of 5 cows conceived a pregnancy,
Group 2 = 0 of 5 cows conceived a pregnancy,
Group 3 = 0 of 5 cows conceived a pregnancy, and
Group 4 = 2 of 5 cows conceived a pregnancy.

Bull introduction did not shorten the mean length of reindeer estrous cycles when bull introduction occurred during the mid-cycle luteal phase and conception rate was different.

impact

While reindeer are affected by male presence and can be estrous synchronized, the male effect does not extend to interrupting the cow's normal estrous cycle to return to estrus, breed, and conceive a pregnancy. Introduction of the reindeer bull during mid-estrous cycle does not explain the occurrence of short estrous cycles reported by other researchers.

Demonstration project—Use of estrous synchronization for enhanced pregnancy rate on reindeer with previous reproductive failure

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

purpose

Reproductive failure is thought to be high among reindeer on the Seward Peninsula in western Alaska. This conclusion is based on barren females observed during winter reindeer harvest as well as low percent of females with calves or in lactation during summer reindeer handlings. Our objective was to estrous synchronize six reindeer cows with previous reproductive failure, expose these cows to a proven reindeer bull for one week and observe pregnancy rates.

approach

A blood sample was collected in early August to establish baseline endocrine values. In late September to early October the six females were estrous synchronized using modified Controlled Intravaginal Drug Releasing devices (CIDR), following the procedure previously established, and bred to the herd bull at the sychronized estrous. Blood samples (10 ml) were collected before synchronization, following CIDR removal, and twice weekly for six weeks post-synchronization (to establish pregnancy) and then every two weeks until calving. Blood will be analyzed for progesterone and compared to previously published profiles of progesterone during pregnancy. The animals will be trained for the use of rectal ultrasound to verify pregnancy and to monitor fetal health and development over the course of pregnancy. Any reindeer cow(s) that fail to conceive will be taken to Delta Meat and Sausage, slaughtered (production of USDA-inspected meat), allowing collection of reproductive tissues for inspection of abnormalities that may have negated pregnancy.

progress

Pregnancy has been established in five of the six reindeer cows. The other cow currently remains on the farm until the optimum time for shipping to Delta Meat and Sausage. All pregnant cows will be observed for delivery of live calves during the spring of 2008.

impact

This project demonstrates the effectiveness of estrous synchronization in reindeer cows with poor reproductive performance histories.

DISEASE

Prediction of susceptibility of muskoxen to transmissible spongiform encephalopathy based on genetic similarity to caprine TSE

M.P. Shipka; G.M. Happ, T.M. O'Hara, E.R. Wood

purpose

Spongiform encephalopathies are neurodegenerative diseases brought on by the conformational change of the cellular prion protein (PrPc) into a pathogenic form (PrPsc). Transmissible spongiform encephalopathies (TSE) have been identified in many species. Variants of prion diseases include bovine spongiform encephalopathy (bovine, human), scrapie (caprine, ovine species), chronic wasting disease (cervine species), and Creutzfeldt-Jakob disease (human). The prevalence of bovine spongiform encephalopathy in particular and its transmission from cattle to people has spurred research into prion diseases within the past twenty-five years. The effects of scrapie on sheep and goats, however, have been known since the eighteenth century. Key alleles in the goat prion gene are suspected contributors to disease characteristics. We sought to compare the muskoxen prion protein gene to that of goats (subfamily relatives) to examine potential muskoxen susceptibility to prion diseases.

approach

Six muskoxen (*Ovibos moschatus*) from the Robert G. White Large Animal Research Station were used in this study. Blood samples were obtained by jugular venipuncture during a single handling. Whole blood samples were frozen for later DNA extraction. Goat (*Capra hircus)* whole blood was purchased (Innovative Research, Inc. Southfield, Michigan) for use as comparison species. The DNA was extracted and confirmed, and the resulting data were analyzed allowing a comparison of the known goat PRP gene to the same locus of the muskoxen genome to identify homology between the two genotypes. A composite of all known goat polymorphisms provided reference to those sites associated with disease characteristics.

progress

No base substitutions were observed in the muskoxen sequences at those sites linked to prion pathogenesis in caprine species. All six muskoxen carried gene sequences that were identical to that of the goat PRP gene, indicating genetic susceptibility to TSE in all cases. This may be due to small sample size and, maybe more important, a genetically isolated population. All muskoxen sequenced possessed the wildtype alleles most closely associated to vulnerability to prion disease in goats (HH143 RR154).

impact

This is the first study to compare genetic similarity of muskoxen to goat for genes associated with prion disease (TSE) susceptibility. Our results indicate that muskoxen may have a relatively high degree of susceptibility to TSE based on the genetic similarity to the goat, a close relative. These results are particularly important for consideration of proximity of domestic or wild goats to muskoxen.

controlled environment production

Covering materials for high tunnels

Meriam Karlsson, Jeffrey Werner

purpose

High tunnels are used for season extension, higher yields, improved quality, and more consistent and predictably timed harvests. Under northern conditions with naturally extreme day lengths, high tunnels with nontraditional plastics may more efficiently support crop productivity.

approach

Four commercially available plastic covering materials were evaluated. K50 Clear plastic is commonly used in high tunnels and plastic greenhouses. K50 IR/AC plastic is expected to conserve energy resulting in warmer temperatures during cold nights. KoolLite380 blocks short ultraviolet radiation and selectively filters infrared radiation to maintain a cooler environment during hot days. Solatrol selectively absorbs far-red wavelengths and alters the ratio between red and far-red light. The relative amount of red and far-red light in the growing environment is significant for morphology and development of plants.

To evaluate the various environments, raspberries were grown in a container system. Long canes of Tulameen, a raspberry cultivar well adapted for containers, were planted in June using three-gallon containers for first-season berry production.

progress/result

The temperature patterns in the K50 Clear and K50 IR/AC-covered tunnels were similar although during cooler nights, K50 IR/AC maintained a warmer environment. There was a trend for lower temperatures during the warmest part of the day under KoolLite380. Excellent pollination and growth resulted in high yields of top-quality fresh market raspberries in all environments including the field. In all environments, more than 100 high-quality fresh market raspberries were harvested from each single cane plant. The highest yield (17.2 ounces) was recorded in the high tunnel covered with K50 IR/AC, while the lowest was harvested on plants grown in the adjacent field (13.8 ounces).

impact/implications

The results suggest K50 IR/AC is a good covering material for season extension as night temperatures drop in

the fall. The cooling under KoolLite380 is an advantage for crop productivity during hot summer periods. Combinations of high tunnels with different cover materials can be recommended for uninterrupted high-quality production throughout the field season.

Successional snap bean production in field and high tunnels

Meriam Karlsson, Jeff Werner

purpose

Snap beans respond with slow and limited growth in cold and windy conditions. Therefore, high tunnels were used in efforts to increase productivity with earlier maturity and production extended beyond fall frost.

approach

The cultivars Concesa, Provider, Stayton, Gold Rush, Royal Burgundy, and Roma II were direct seeded on June 3, 18, and 30 in high tunnels and the adjacent field. Concesa, although developed for warmer climates, produces shiny slender pods with excellent consumer appeal. Provider is well adapted and recommended for northern conditions. Stayton is a snap bean with extra-fine pods. Gold Rush is a yellow wax-type bean, Royal Burgundy is purple with green interior, and Roma II is a flat Italian-style snap bean.

progress/result

The first mature pods were picked on August 1 from the June 3 seeding. The last beans were harvested on September 20 as frost ended the season. Usually more mature beans were picked in the high tunnel than the field. The yield for each cultivar decreased with the seeding date. Provider had the highest overall yield with 22.9 ounces per high tunnel-grown plant and 20.8 ounces in the field for the first and second seeding. For the earliest seeding in the high tunnel, Gold Rush averaged 21.2 ounces per plant followed by Stayton (18.7 ounces), Roma II (17.8 ounces), Concesa (17.2 ounces), and Royal Burgundy (14.9 ounces). Although similar in the field and high tunnel, the yield of Provider decreased to 9.4 ounces per plant for the June 30 planting. For the other five cultivars, the yield of the last seeding doubled in the protection of the high tunnel.

impact/implications

Sequential seeding of beans is useful to maximize seasonal productivity. In years with early end-of-season frost, a high tunnel environment is critical for crop maturation. Seeding beans beyond the last day of June does not appear advisable, as time is insufficient for complete crop development.

Strawberries grown on black plastic in high tunnels

Meriam Karlsson, Jeff Werner

purpose

This study was initiated to determine strawberry cultivars suitable for seasonal production using high tunnels and raised beds covered with black plastic.

approach

A mechanical bed shaper was used to make the two-foot wide black plastic-covered beds. Four cultivars of strawberries (Fern, Tribute, Tristar, Quinault) were planted through the plastic of the raised beds in high tunnel and field environments.

progress/result

Harvest was initiated in early July and continued until end-of-season frost on September 21. All cultivars performed better in the high tunnel than the field environment. The largest yield was recorded for Tribute, with 15.13 ounces per plant in the high tunnel and 10.37 ounces in the field. Fern followed, with 10.62 ounces of berries in the high tunnel and 7.9 ounces in the field. The least productive cultivar was Quinault. Contrary to the previous two seasons, berry size was similar or larger in the high tunnel. Since berry size is related to water availability, irrigation management is critical to ensure strawberries of acceptable size in high tunnels. The average berry size for Tribute was 0.42 ounces.

impact/implications

The protective environment of a high tunnel offers opportunities to produce high quality strawberries. The yield often also increases although dependent on seasonal conditions. Additional advantages of high tunnels include a more comfortable and efficient working environment during inclement weather and shelter on frosty days.

Lettuce grown in a hydroponic nutrient film technique system

Yosuke Okada, Jeff Werner, **Meriam Karlsson**

purpose

We aimed to determine growth and quality of lettuce grown in a hydroponic greenhouse system using different solution temperatures.

approach

The nutrient film technique (NFT) is a commonly used hydroponic system with plants resting in a growing channel. A nutrient solution continuously bathes the roots. The solution is recirculated after being replenished with water and nutrients in a stock tank. The lettuce Nevada was grown using an NFT system with nutrient solutions of 60°F and 68°F. Nevada is a green butterhead or bibb-type lettuce with leaves arranged in a loose head. The study was conducted in the summer with, for lettuce, above-optimum air temperatures averaging 68 to 72°F. The lettuce was harvested after 28 days of growth.

progress/result

No growing disorders were observed such as extension of a flower stalk (bolting) or browning of the leaf edges (tipburn). The lettuce grown in the colder solution had significantly higher weight than in the 68°F solution. The weight of the lettuce heads averaged 4.8 ounces at 60°F and 4.5 ounces at 68°F. Comparing the weight of roots and shoots, lettuce grown with a colder solution had a higher percentage partitioned to leaf growth than lettuce in warmer solution.

impact/implications

High quality lettuce can effectively be produced in northern greenhouses using an NFT system. Adjusting the solution temperature to offset unfavorable and often more difficult to control air temperatures offers opportunities to produce high-quality year-round hydroponic lettuce.

Using high tunnels to extend the southcentral Alaska growing season

Jeffrey Smeenk, Jodie Anderson; Joe Kuhl (ARS)

purpose

We sought to determine the effectiveness in extending the southcentral Alaska growing season and to increase the heat units for the crop using high tunnels.

approach

Large (30' by 96') and small (12' x 16') high tunnels were established in May to capture solar gain and extend the growing season. Unprotected raised beds were established adjacent to the structures to compare the temperature and productivity differences.

progress

Sweet corn planted in the high tunnel yielded 180 ears from 200 plants while sweet corn planted in the plots adjacent to the high tunnel did not produce any marketable ears. Several varieties of tomatoes were planted in the high tunnels and in unprotected beds adjacent to the south side of the large high tunnel. The 19 plants in the large high tunnel yielded 34 lbs of ripe tomatoes (and 43 lbs of green tomatoes at frost time). The seven plants in the small high tunnel yielded 24.6 lbs of ripe tomatoes (and 13.8 lbs of green tomatoes). Of the 19 plants in the unprotected bed only 8 plants yielded any tomatoes and these yields were 6.8 lbs of ripe tomatoes and 13.8 lbs of green tomatoes. Similar productivity responses were seen with cucumbers. Of the 11 plants established in the unprotected beds only one plant produced cucumbers (0.71 lb), while the 11 plants in the large high tunnel produced 67.4 lbs of cucumbers.

impact

First year results indicated that with the rising costs of vegetables these structures may have a relatively short payback period. Although the level of frost protection given to the warm season crops in the fall was only several days, several weeks of continued productivity were seen with cool season salad greens. This technology may assist remote communities to become more food secure during the Alaska summer and fall.

field crops & field management

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 high-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 bales. At the end of a six-month storage period, samples are collected for fiber analysis and high-performance liquid chromatography. Thermistors are removed at this time. 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 unit. Weights are obtained for all bales.

progress

This was the second and final year of data collection for this study. Samples from last summer's harvest were obtained as bales were opened at the end of the six-month storage period. Fiber analysis was conducted on these samples. Also, two fields at the Matanuska Experiment Farm containing different types of grass were harvested twice during the summer. Samples of this forage will be collected at the end of the six-month storage period. Imagery is now being processed to produce vegetative indices for predicting forage biomass and estimation models are being developed.

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-grown cut sunflowers

Jeff Werner, **Meriam Karlsson**

purpose

Sunflowers are of local interest as cut flowers. Recently introduced day-neutral selections are recommended for flowering throughout the Alaska field season.

approach

The sunflower ProCut series has improved post-harvest keeping quality because the flowers do not produce pollen. Six ProCut cultivars were direct seeded in the field on June 9: ProCut Bicolor, ProCut Red/Lemon Bicolor, ProCut Orange, ProCut Lemon, ProCut Peach, and ProCut Yellow Lite.

progress/result

Although all the included cultivars are indicated to produce flowers in 50 to 60 days, flowering time varied by up to three weeks. Two cultivars (ProCut Bicolor and ProCut Red/Lemon Bicolor) flowered within the anticipated 60 days. ProCut Lemon had the slowest development with flowering at 75 days. All were of impressive size with 7.5 to 10-inch diameter flowers and stem lengths from 55 to 82 inches.

Jan Hanscom bagging potatoes at one of the Georgeson Botanical Garden's experimental plots.
—PHOTO BY NANCY TARNAI

impact/implications

Recent introductions offer opportunities to produce sunflowers under extreme northern day lengths. During most years, the Alaska summer season is sufficiently long and warm enough for sunflowers in various color patterns to develop and produce blooms for cut flowers.

Novelty potatoes

Jeffrey Smeenk

purpose

The primary goal of the novelty potato project is to identify existing varieties, along with evaluating new genetic material, for public market and/or specialty restaurant sales.

approach

This project has two main thrusts. First is the determination of which existing potato varieties are worth further examination. New and heirloom potato varieties are acquired from various tissue culture repositories. They are examined at the Alaska Division of Agriculture's Plant Material Center (PMC) to ensure they are not contaminated with diseases. Once released from the PMC, the varieties are planted in unreplicated demonstration plots at the Matanuska Experiment Farm. After harvest the varieties are graded for yields and quality aspects. The varieties and results are presented at grower meetings and numerous garden club meetings around the state. If interest is shown in a particular variety, the material will be included in replicated trials for further evaluation.

The other thrust of the novelty potato project is to collaborate with ARS potato geneticists working with colored potato germplasm. The ARS collaborators make the potato crosses using parents known to have colored skin and/or fleshed progeny. Minitubers resulting from these crosses are sent to the Matanuska Experiment Farm to evaluate the material under Alaska production conditions. Unlike production potatoes, each of these tubers is genetically different from the other tubers. The tubers are planted individually and their unique identity is maintained at all times. At harvest time all of the plants are individually evaluated and only the top 5 percent of material showing promising agronomic characteristics will be collected. Ten tubers of each of the top 5 percent of the accessions will be planted in the following growing season for another round of selections based on larger samples.

Jeffrey Smeenk at the Matanuska Experiment Farm discussing novelty potatoes with members of the NRM 290 class summer 2008.
—PHOTO BY MATTHEW HELT

The accessions that make it through the second growing season evaluations are then sampled for cooking flavor. The remaining accessions that have good flavor get planted as a replicated trial in the following growing season. The results of the replicated trial is presented to the growers that focus on the farmers' markets.

progress

Approximately 180 named or numbered potato varieties were demonstrated in an unreplicated trial for their production potential under southcentral Alaska irrigated production conditions. The varieties Red Lasoda and Sangre II were the highest-yielding red-skinned varieties. Nipigon and Aaron Victory were the highest-yielding white varieties and Yellow Finn and German Butterball were the highest-yielding yellow-fleshed varieties. Twenty-five varieties were boiled at a taste test held with approximately seventy five participants. The varieties Bintje, Peanut, and Stampede Russet consistently received strong, positive flavor ratings.

Approximately 3,000 new potato accessions with potential for the Alaska novelty market (tubers with strong flesh colors and/or uniquely colored skin) were grown under non-irrigated conditions during the 2007 growing season. Tubers from the most promising 3 percent of material were collected for further evaluation in 2008. Likewise, the top twenty-five accessions of the 2006 season were replanted to increase the amount of material available for horticultural and taste evaluations. The top eight varieties of the 2006 material, based on the winter taste trials, were chosen for replicated trials in the 2008 growing season.

impact

Numerous potato growers and wholesale produce buyers came to a "Potato Day" event in which we showcased 180 varieties and their yield and grading results. The individuals who control most of the potatoes available to Alaska consumers had the opportunity to examine the many potato varieties available and discuss production aspects with growers.

The Garden Club that evaluated the flavor of the top twenty-five varieties now has a better understanding of their different flavors. The club is trying to influence seed growers to make these varieties available to the club, and is also hoping to get grocers to carry some of the unique varieties.

Lupinaster clover as a forage crop for interior Alaska

Stephen D. Sparrow, darleen t. masiak

purpose

We seek to determine the potential of lupinaster clover *(Trifolium lupinaster)* as a forage crop in Alaska's Tanana Valley.

approach

We began this study by seeding small lots with seed from various sources in individual rows in 2002 at Fairbanks and Delta Junction. Since then, we have collected mature seeds at Fairbanks and have established small plots. We hand harvested samples from 1 m^2 areas for yield data in 2006 and 2007. We seeded larger plots in 2007, and hope to have enough area for machine harvest in 2008.

progress and results

At Delta Junction, lupinaster died out during the winter after seeding in each year it was tested. Therefore, we abandoned trials there. Lupinaster clover herbage samples collected in 2006 averaged 15.9 percent protein and yielded < 1.0 ton/acre. Yields in 2007 averaged 3.3 ton/acre. We did not measure tissue protein for the 2007 samples. Yield data from 2007 indicate lupinaster clover may have potential as a forage crop in some areas in interior Alaska.

impact

Lupinaster clover does not appear to be well adapted to the Delta Junction area, but it may have potential as a forage crop in other parts of interior Alaska; if so, it will provide an alternative perennial forage crop for farmers in parts of the Interior.

Tall fireweed as a potential crop for interior Alaska

Stephen D. Sparrow, darleen t. masiak

purpose

Tall fireweed (*Chamerion angustifolium*, *Epilobium angustifolium*), an indigenous herbaceous perennial plant in Alaska, often grows in thick stands and is known to be an important food source for some species of grazing animals. As such, it may be a useful forage crop for livestock producers in Alaska. It may also be useful as a bioenergy crop. We seek to determine the potential of tall fireweed as a managed crop in Alaska.

approach

We seeded tall fireweed at the Fairbanks Experiment Farm in autumn 2004, 2005, and 2006. We harvested small plots at approximately one-week intervals from early June until late August in 2006 and 2007.

progress and results

Yields ranged from 0.5 tons per acre for the earliest harvest to 3.0 tons per acre for the mid-August harvest in 2006 and 0.7 to 4.9 ton/acre in 2007. In 2008, we will again evaluate fireweed plots for survival following intensive harvesting the previous year and begin studies on harvest management practices on yield and persistence. While this preliminary research indicates tall fireweed may have potential as a crop in Alaska, much more research is needed to determine long-term productivity and best management practices.

impact

Farmers in interior Alaska are currently limited to a few, introduced forage crop species. These crops do not always do well under subarctic conditions and some of them are considered potential invasive weeds. If fireweed proves to be a feasible forage crop, it will provide Alaska farmers with an option to produce a new crop which is well adapted to subarctic growing conditions, and will not become an exotic invasive weed.

Barley yield response to fishmeal application in two interior Alaska soils

M. Zhang, S.D. Sparrow; P.J. Bechtel, A. Pantoja (ARS)

purpose

Annually, there are over one million metric tons of fish byproducts produced from Alaska fishing industries. These fish byproducts are rich in nitrogen and can be processed and used as a nutrient source for crop production. We sought to determine barley biomass yield response to type and rate of fish byproduct application in two interior Alaska soils.

approaches

Field experiments were conducted at the Fairbanks Experiment Farm (Lat. 64°38'N, designated as Site 1) and the Delta Junction Field Research Site (Lat. 63°56'N, designated as Site 2) in 2006 and 2007. Three fish byproducts were used in the experiment: fish meal (10.9 percent nitrogen), fish bone meal (6.2 percent nitrogen), and fish hydrolysate (4.4 percent nitrogen, wet base). Each fish byproduct was applied at 50, 100, and 150 kg nitrogen/ha. Along with the fish byproducts, a urea treatment (100 kg nitrogen/ha) and a control with neither fish byproducts nor urea were implemented. The experiment was in a completely randomized block design with four replicates. Plant tissue and soil samples were taken in July and August in 2006 and 2007. Plant biomass, nitrogen, and phosphorus concentration in plant tissue and soil samples were determined.

progress

BIOMASS PRODUCTION AT CURRENT YEAR OF FISH BYPRODUCT APPLICATION

2006 results

For the Fairbanks site, there were slight differences between nutrient treatments and the control at the July sampling. Apparently, nitrogen application in the form of fish byproducts increased barley biomass production, indicating benefit from the fish byproducts. For the August sampling, there was no statistical difference among the treatments. However, barley biomass apparently increased in response to increase of nitrogen application. The biomass from fish byproducts was apparently better than that from urea application.

In Delta Junction, the barley biomass taken in July was lower with the fish byproducts than with urea. For the August samples, fish meal and fish bone meal at 150 kg nitrogen/ha were similar to urea at 100 kg nitrogen/ha for biomass production. But for the same rate of nitrogen application, the biomass from fish meal and fish bone meal was lower than that of urea. For fish hydrolysate, biomass from the three nitrogen application rates was lower than the urea treatment.

2007 results

At the Fairbanks site, due to shortage of fish hydrolysate, coarse bones without grinding were substituted for the fish hydrolysate treatment. These coarse bone treatments generated a biomass significantly higher than the control at 100 and 150 kg nitrogen/ha rate about two months after application (July sampling). As for fish meal and fish bone meal, the results were consistent with 2006; at the same application rate, fish meal and fish bone meal results were as good as from the urea treatment for both July and August samplings.

For the July sampling at the Delta Junction experimental site, the fish meal treatment at 150 kg nitrogen/ha had a similar biomass production as the urea treatment. Fish bone meal was similar to the urea treatment in biomass production at 100 and 150 kg nitrogen/ha. In general, fish hydrolysate generated a lower biomass than the urea treatment. For the samples taken in August, biomass yield from fish meal and fish bone meal applied at 100 kg nitrogen/ha was similar to urea applied at the same rate. Biomass from fish hydrolysate treatment was lower at all application rates than the urea treatments, but higher than the control, indicating the beneficial impact of nitrogen from the hydrolysate. It would be interesting to know why fish hydrolysate had less impact on crop growth in comparison with fish meal and fish bone meal.

BIOMASS PRODUCTION FROM PREVIOUS FISH BYPRODUCT APPLICATION (RESIDUAL EFFECT)

Barley growth benefited from previous year fish byproduct application for both sites and sampling dates when compared with the control, but the residual effect on barley biomass production from fish byproducts was not different than the urea treatment applied at the same rate (100 kg N/ha). The biomass from fish meal applied at 150 kg N/ha apparently had a higher yield than the urea treatment in August sampling at both sites. Due to variation in growing conditions from year to year, it would be interesting to examine the residual benefit from the fish byproducts for another year.

conclusions for current year and residual effect

Through the two-year experiments, fish meal and fish bone meal were as good as urea fertilizer. In some site/year combinations, the fish meal and fish bone meal were better than urea in barley biomass production. There was beneficial impact on crop biomass yield from fish hydrolysate, but the fish hydrolysate generated less biomass as compared to fish meal and fish bone meal. There were residual effects from the three fish byproducts, but this residual impact on barley growth was not statistically significant when compared to the urea treatment. Due to variation in growing conditions from year to year (e.g. temperature, precipitation), we will study the residual effect of fish byproducts for another year using the field plots of 2007 so that a more concrete conclusion can be made.

impact

Partial results were presented at the Sustainable Agricultural Conference in Fairbanks and received a good response from producers. Fish meals are common nutrient sources used by organic growers in Alaska, yet the nutrient release characteristics and crop response are not fully understood. The results from this project fill the information gap of nutrient release from fish byproducts, and will serve as a user guideline for organic growers for fish meal applications.

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, 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, which was tested only at Fairbanks and Delta Junction, and camelina and Sunwheat varieties, which were tested only at Fairbanks.

progress

Summer growing conditions at all three locations were warmer and slightly wetter (especially at Palmer) compared with the long-term (thirty-year) averages. However, this did not produce any significant improvement for the agronomic characteristics of the crops: heading and maturity dates were very close to the long-term average. Plant height characteristics for all species 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 those for the standard test variety. The six hulless barley cross selections performed better than the standard hulless barley. Average maturity occurred about one to two days earlier than Thual, lodging was 20 percent better, and percent hulless seed characteristics (the percent of crop after harvest that show kernels without hulls) were greater than 90 percent for all selections at all three locations, thus maintaining hulless variety status. Cooperative research on the milling and baking characteristics with the Alaska Cooperative Extension Service will assist in making a final selection for release as a named variety in 2008. Yields for hard red spring wheat varieties were greater than the standard

test variety at all locations. The Palmer yields for both barley and wheat were lower still due to bird predation. Yields for Polish canola were lower than the standard variety at the Fairbanks location and higher at the Delta Junction location. Mustard and camelina yields were comparable to canola yields. However, they are later maturing, which resulted in green, unripe, and high-moisture seed at harvest. The dwarf, open-pollinated Sunwheat yields were slightly higher than average. Compared with the commercial Sunwheat varieties they are earlier in maturity by seven to ten days, and have a shorter plant height of 20 inches vs. 48 inches.

Three harvest methods were tested in an attempt to increase canola 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 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 at Fairbanks and average yields at Delta Junction and 5 percent green seed. The worst method was pushing, with significantly lower than average yields at both locations and 6 percent green seed.

impact

For 2007 we found other research possibilities including phosphorus rates and application methods for barley fertilization. Testing of hybrid canola varieties and research into canola harvesting methods and new oilseed varieties continues.

plant pest & disease control

Quantification of the effectiveness of blackberry leaf rust (Phragmidium violaceum) as a biological control using remote sensing

Norman Harris; Amy Peters (Oregon State Cooperative Extension); Ken French (Oregon Dept. of Agriculture)

purpose

Leaf rust is a viable biological control of blackberries in Australia, New Zealand, and Chile, but nothing is known of its effectiveness as an agent in Oregon. We are studying the effect of blackberry leaf rust on the defoliation of Himalayan blackberry at the Oregon coast where the rust was accidentally introduced.

approach

Blimp photography is obtained during June for detection of blackberry leaf rust using remote sensing and to quantify blackberry coverage on our study site. Additional photos are obtained in October to quantify defoliation caused by the disease using time change analysis to evaluate the effectiveness of this biological control agent.

progress

We obtained imagery in late June and mid-October for our site on the Elk River. However, promised funding did not materialize and we have been unable to analyze the imagery. Cursory analysis indicated that the plants were heavily infected with rust when images were obtained in June. October imagery showed most blackberry plants to be severely defoliated. Gorse plants (*Ulex europaeus* L.) in the study area were found to be infected with Gorse spider mites, a biological control agent which was released in 1994. The mites had been subjected to predation by other mites and were thought to have failed to establish. We are currently searching for alternative sources of funding to continue the work.

impact

This study will help land managers determine if blackberry leaf rust can be an effective biological control agent for Himalayan blackberries in Oregon. This may lead to a cost-effective and efficient method for control of this noxious weed.

Arctic plant germplasm research and introduction

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

purpose

The primary mission of the Arctic Plant Germplasm Introduction and Research Project (APGIR) is the acquisition, propagation, storage, and distribution of plant germplasm for agricultural and nonagricultural plant species from arctic, subarctic, and alpine regions of the world. APGIR serves as a grow-out site for seed and clonal samples for certain cool-season accessions from other plant germplasm repositories within the National Plant Germplasm System.

The mission includes research on certain diseases and physiological features of germplasm of arctic, subarctic, and alpine crop and noncrop species. Plant diseases in Alaska, both indigenous and introduced, are not well documented. Comprehensive plant disease surveys in agricultural and nonagricultural plant species are few, especially for plant viruses, although viral and other contagious diseases can have a significant negative impact on agricultural and nonagricultural crops adapted to arctic, subarctic, and alpine environments. Physiological aspects of plant adaptation and these environments also require more research.

approach, progress, and impact

Virus isolated from Mertensia paniculata

The native plant *Mertensia paniculata*, abundantly growing near crops, in home landscapes, and in natural woodlands in Alaska, was determined to be infected by a new plant virus. Based on biological properties and genomic sequence, the isolated virus was determined to be a new species in the family *Tymoviridae,* and tentatively named Mertensia latent virus. Experimental plant host range assays indicated virus transmission to several ornamental plant species. This is the first incidence of a virus detected from

the plant genus *Mertensia* and the first tymovirus reported in Alaska. Naturally infected *Mertensia paniculata* may act as a virus reservoir, and accordingly is a potential threat to crop and ornamental plants.

Molecular analysis of rhubarb completed

Rhubarb molecular analysis was completed and published. Genetic relationships are established among cultivars in the Palmer collection, enabling closely related lines to be identified. This information will be used to identify duplicates in the collection and will assist curators in the identification of cultivars needed to expand under-represented species and areas.

International collaboration on hairgrass

More than 200 arctic *Deschampsia* herbarium specimens were acquired from museums around the world. Fifty-five morphological characters were evaluated, DNA extracted, and nuclear and chloroplast regions sequenced, all contributing to refinement of species relationships in the arctic. The data was standardized and a similarity matrice generated. Clustering was performed using the unweighted pairgroup method (UPGMA) and principal coordinates analysis (PCO). DNA was extracted from herbarium specimens and two regions amplified, chloroplast trnK-rps16 and nuclear ITS. These regions were cloned and sequenced and will be analyzed with the morphological data.

Integrated pest management strategies for Alaska agriculture

Alberto Pantoja, Dennis Fielding, Jeffrey Conn, Loretta Winton, Steve Seefeldt (USDA)

purpose

In recent years, the potential of agricultural expansion in the circumpolar region has received renewed attention. However, knowledge of best pest management practices for agricultural and natural areas in arctic/subarctic regions is not well developed. There is a need for increased research to improve management and to understand the biology of invasive plants, diseases, and insect pests in arctic regions.

approach, progress, and results

Factors influencing plant diversity in Conservation Reserve Program lands in interior Alaska

In Alaska, highly erosive fields that were enrolled in the Conservation Reserve Program (CRP) over seventeen years ago in interior Alaska are becoming increasingly difficult to manage to be compliant with regulations concerning woody vegetation management. In a field study that measured plant diversity in twenty separate fields, we determined that plant diversity and most diversity indices increased with the number of years the field had been in CRP. The increase in plant diversity was not associated with any management practices before and including the establishment of the CRP field. Woody species, five native grasses, and five native forb species increased in abundance as time in CRP increased, whereas two introduced grasses and one native forb decreased in abundance. As the woody species increases, conversion to farmland becomes more difficult and the fields become less compliant with CRP regulations. Results of this research are being used in studies of new management techniques that farmers can implement to make fields more compliant with CRP guidelines. Farmers, federal managers, and scientists will use the results of this research.

The distribution of invasive sweetclovers in Alaska

Sweetclovers (*Melilotus alba* and *M. officinalis)* occurred at 721 and 205 sites, respectively. The northward limit for *M. alba* and *M. officinalis* was 67°15'N and 64°87'N. Both species were strictly associated with soil disturbance. *Melilotus alba* extended no farther than 15 m from road edges except where *M. alba* on roadsides met river floodplains and dispersed downriver (Matanuska and Nenana rivers). *Melilotus* has now reached the Tanana River, a tributary of the Yukon River. Populations on floodplains were most extensive on braided sections. On the Nenana River, soil characteristics did not differ between where *M. alba* was growing versus similar areas where it had not yet reached. The pH of river soils (7.9–8.3) was higher than highway soils (7.3). Upland taiga plant communities grow on acid soils which may protect them from invasion by *Melilotus*, which prefer alkaline soils; however, early succession communities on river floodplains are susceptible because soils are alkaline.

New sweetclover DNA markers

Melilotus alba (white sweetclover) is invading the subarctic regions of western Greenland, the Yukon, the Northwest Territories in Canada, and Alaska's glacial river floodplains. At lower latitudes, both *M. alba* and *Melilotus officinalis* (yellow sweetclover) have invaded the floodplains in northern Montana and southern Ontario as well as the prairies of the Midwest, and are spreading at Rocky Mountain National Park in Colorado. DNA markers were developed to help determine the origins of the sweetclover invasion and to compare patterns of genetic diversity between populations. This will allow determination of how these species are spread and differentiated.

Pan trapping of grasshoppers in small grains

Study of grasshopper dispersal from source habitats into small grains is hindered by inadequate sampling methods in the dense canopy of field crops. ARS scientists in the Subarctic Agricultural Research Unit, Fairbanks, Alaska, tested a method of sampling grasshoppers in barley fields using pans of water to capture grasshoppers. Data were analyzed to provide an estimate of the optimum number of traps necessary to provide an adequate sample of grasshopper abundance within a field. This will allow development of experimental designs to assess efficacy of different control measures to prevent crop losses from grasshoppers.

Unripe seedhead of foxtail barley.
—photo by André Karwath, Wikimedia; Attribution/Share Alike 2.5 Creative Commons copyright

Horticultural factors that influence aphid transmission of potato viruses

Jeffrey Smeenk, Jodie Anderson; Joe Kuhl, Aaron Haggerty, Alberto Pantoja (ARS)

purpose

Potato viruses can have significant impacts on the yield of potatoes grown for the tablestock market and the presence of viruses can cause seed lots to lose their seed certification. Several important potato viruses are spread by aphids. We sought to determine the impact of selected horticultural techniques on the yields of potatoes and on aphid population levels.

approach

Horticultural aspects of potato management strategies that may influence aphid populations were evaluated. These treatments included using varieties with differing canopy size, different forms of irrigation, and intercropping with cover crops species that have been reported to affect aphid populations in other crops.

progress

Crop canopy volume (canopy height and canopy width) of the variety Green Mountain was consistently larger than the crop canopy volume of Russet Norkotah, as were yields. Marketable yields (US#1 grade) of Russet Norkotah grown using drip tape were 118 percent of the yields of Russet Norkotah grown using conventional sprinkler irrigation. The yields of potatoes grown with strips of canola (a suspected aphid inhibitor) between the rows and potatoes grown with strips of oats (a suspected aphid attractant species) were 60 percent and 58 percent respectively of those seen by Russet Norkotah grown without an interseeded crop. In addition to the reduction of marketable yields the harvesting operation was slowed by the roots of the oats.

impact

These results may be useful for organic potato growers (who do not have certain pesticide options) to manage aphid-transmitted viruses.

Foxtail barley (*Hordeum jubatum*) control with propoxycarbazone-sodium and fluazifop-p-butyl in three Alaska native grass species

Brian E. Jackson, **Stephen D. Sparrow**

purpose

Foxtail barley is one of the most detrimental weeds in the Alaska native grass seed industry. Its control is essential for improving seed production and stand longevity so producers can meet statewide seed demands for revegetation projects. We sought to determine suitable chemical controls of foxtail barley for three different native grass species: Nortran tufted hairgrass (*Dechampsia caespitosa),* Gruening alpine bluegrass *(Poa alpina),* and Wainwright slender wheatgrass (*Elymus trachycalus,* formerly *Agropyron pauciflorum*).

approach

Following preliminary field trials, greenhouse experiments were conducted during winter 2005–2006 at the Matanuska Experiment Farm in Palmer, Alaska, to determine the efficacy of propoxycarbazone and fluazifop. Final field experiments were conducted at the Fairbanks Experiment Farm and the Delta Junction Field Research Site during summer 2006. Plots were planted in fall 2005 using a randomized complete block design. Herbicide applications of propoxycarbazone and fluazifop were made in spring 2006 before shoot elongation. The plants were subjected to five different herbicide concentrations: 1X, 1/2X, 1/4X, 1/8X and 0X, the highest being the recommended field use rate from the label, to a control, which received no herbicide.

progress

In field trials Nortran tufted hairgrass was tolerant of propoxycarbazone. Gruening alpine bluegrass and Wainwright slender wheatgrass were not tolerant of either compound at the recommended field use rate, but showed greater tolerance of propoxycarbazone at the 1/2X rate. This experiment revealed that propoxycarbazone is a potential tool for foxtail barley control in Nortran seed production. A student completed his master of science thesis in 2007 based on research from this study.

impact

Native grass seed is an important commodity for the continued ecological health of Alaska. Without suitable supplies of native grass seed available, revegetation specialists will be forced to use non-native plants in reclamation projects. The use of non-native plants can be a source of invasive species. A stronger native seed production industry will ensure that native germplasm is being reintroduced in reclamation projects.

High-Latitude Soils

Soils are a fundamental resource, and knowledge about the cold-climate soils of Alaska is crucial for most 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.

carbon in soils

Carbon flux and transformation across the arctic coast of Alaska

Chien-Lu Ping, Fugen Dou, Gary Michaelson

purpose

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

approach and results

During the 2005 field season a total of 25 sites, including one intensive site, were studied and 285 soil/permafrost horizon samples were taken. During spring 2006, 68 sediment samples were taken from four sites near Barrow. During the 2006 summer field season, 272 soil/permafrost samples were taken from 29 study sites, including two intensive sites, one at Prudhoe Bay and the second at Barter Island. These sites include coastal marshes/tidal flats, bluffs with elevation up to 10 meters, and sites ranged across the coast from the Eielson Lagoon north of Barrow to the coastal bluff east of Barter Island.

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. In addition to sediments, samples were taken on the beach and in shallow waters. Wave-monitoring cameras were installed at one of the additional intensive sampling sites. A total of 289 soils and permafrost samples were taken for soil characterization analysis. Laboratory analysis underway includes carbon content, bulk density, and particle size distribution. There were 100 samples taken for the incubation experiment that was started at the Barrow Arctic Science Consortium facility

Abandoned radar station on Barter Island, near the village of Kaktovik. The arctic coasts of Alaska are experiencing significant erosion due to climate change, annually releasing more than 400,000 metric tons of organic carbon into the Arctic Ocean and more than 500 tons of carbon dioxide and six tons of methane gas into the atmosphere.
—PHOTO BY GARY MICHAELSON

in Barrow and continued in the laboratory at the university. Sixteen additional samples were taken from seven sites for radiocarbon dating.

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 geocryologist 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. According to our preliminary estimates, annual erosion across 1,900 miles of the Beaufort Sea coastline (based on an average depth of five feet of coast bluff and an average of six feet of coastline) 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 six tons of methane gas into the atmosphere. Annual loss of land to the Arctic Ocean is estimated to be 1,000 acres.

Black spruce forest soils in boreal regions of Alaska

Chien-Lu Ping, Edmond Packee

purpose

We are studying the morphological, chemical, and physical properties of soils associated with black spruce forest stands on different landforms.

approach

To select representative sites for black spruce growing in different environments, we chose the study sites jointly with a forest management specialist. There will be two categories of soil sampling sites; one is to pair-sample the soils in burned and unburned black spruce forest stands, and the second to sample the soils associated with Permanent Sample Plots in interior Alaska. Soil pits will be excavated at each selected site and morphological properties studied. Soil samples will be collected according to the *Soil Survey Manual* and shipped to the USDA-NRCS National Soil Survey Laboratory in Lincoln, Nebraska, for full characterization. At each site, soil

samples will be subsampled and sent to the Palmer Research and Extension Center laboratory for organic carbon, charred organics, and soil fertility analysis. 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*. The quantity of charred organic carbon or black carbon will be determined. Selected samples will be radiocarbon dated.

progress

The investigation of the physical environment and soils' properties continued during the 2007 field season. One additional aspen and two black spruce sites were described and sampled; these sites were associated with Permanent Sample Plots and the Site Index Plots of the ongoing Alaska Forest Growth and Yield Program in the Northern Forest region of Alaska. Soil descriptions from these additional and other plots will permit results of both studies to be tied together.

In the northern part of the region, many aspen and birch stands occur as islands that occupy high knobs and terraces in the black spruce forest. Most of these mixed to pure stands grow in well to somewhat excessively drained soils formed in either coarse to medium textured glacial deposits, such as eskers, kame terraces, outwash, or residuum from fractured bedrock.

An MS graduate student has completed all the soil analyses and turned in results. In the past two years all soil sampling associated with the Permanent Sampling Plots was in cooperation with the USDA National Soil Survey Center and all their soil analyses are complete. Based on field data and these analyses, we have begun describing the soil carbon status across the boreal forest of Alaska. The study documents a basic difference in carbon accumulation mechanisms for the boreal forest compared to the arctic tundra. In addition to surface accumulation, arctic tundra soils accumulate carbon through cryoturbation and, thus, store carbon deep within the profile. In the upland boreal forest, the main mechanism of carbon storage is through surface deposition of forest vegetation litter and mosses and lichens, with storage mainly in the forest floor. There is less carbon storage in the lower soil horizons than in arctic soils.

impact

The Alaska Regional Office of USGS is interested in the soils data, especially in terms of east-west and north-south transects. This office collaborated in a joint sampling effort during the 2007 field season and used the data for a preliminary estimate of the soil carbon status in Alaska. The USGS is also interested in using our past sampling sites for their reference sites for microelement assessment. Based on current climate models, the permafrost under the black spruce forest will gradually thaw and the soil will be warmer and drier; ultimately, it is hypothesized, aspen and birch will expand at the expense of black spruce.

Carbon cycle science in the Alaska coastal temperate rainforest

David D'Amore, **David Valentine**, Mark Nay, Rick Edwards, Eran Hood

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. 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. Some of this carbon is cycled rapidly and lost through gaseous and dissolved pathways while a small but persistent quantity is sequestered in long-term soil storage. Neither this quantity nor its response to a warming climate is known because the mechanisms governing carbon balance are poorly understood. This project seeks to gain insight into these areas of large uncertainty in the Alaska coastal temperate rainforest.

approach

We have established a suite of replicated, nested study sites within major ecosystem types across major portions of the Tongass, and have initiated measurements of the major fluxes of carbon in terrestrial and aquatic ecosystems. These measurements are being integrated to reduce the uncertainty in quantifying carbon sequestration estimates in coastal temperate rainforest ecosystems.

progress

We have measured and modeled soil respiration rates coupled with dissolved organic carbon flux from replicated catchments. 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) for application in estimates from unharvested landscapes.

impact

This research coupled with adaptive management applications will provide information on the magnitude of the carbon sink or source on the Tongass National Forest and the mechanisms governing it. This information can then be applied to regional and national carbon sequestration goals.

Impacts of experimentally induced drought on soil respiration in interior Alaska

David Valentine

purpose

This study examines the impact of experimentally induced summer drought on the major process responsible for releasing carbon from ecosystems: soil respiration. This study capitalized on the 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.

approach/methods

Soil respiration collars were established in July 2006 in three replicate summer drought and control sites in both upland and floodplain landscape positions. Soil respiration rates were monitored at biweekly intervals during subsequent growing seasons using a LiCor 6262 infrared gas analyzer. Surface soil and air temperatures were monitored concurrently with the respiration measurements.

progress

Soil respiration rates in 2007 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 (Ra, root respiration) and heterotrophic (Rh, mostly microbial respiration) respiration contributed to the overall difference in respiration. This will be addressed in subsequent growing seasons.

impact

Based on these results, we cannot yet conclude that drought has slowed soil carbon losses via respiration, as it is possible that much or all of the measured difference in soil respiration may be from changes in root respiration (Ra). However, a related study by Runck et al. showed that drought has slowed the decomposition of standard substrates, strongly implying that at least some of the difference in soil respiration rates is due to changes in heterotrophic respiration, such that reduced soil carbon losses may in part ameliorate slowed aboveground productivity.

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 stand-level tree growth, 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 in 2003, when the most recent 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 by the following depth intervals: O horizon, 0–5, 5–15, and 15–30 cm mineral soil. 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

Last year, we reported that the throughfall exclusion shelters successfully reduced soil moisture in the late growing season (July–September), when most rainfall occurs. We also reported that simulated drought had a more pronounced effect on forest growth and root biomass in upland sites and slowed decomposition at the soil surface of both landscape positions. Second-year mass loss of BTDs was generally greater than the first year, likely a result of a lag in microbial colonization common to decomposing woody detritus. Nevertheless, the two-year BTD decomposition rate in the control plots was very similar to the two-year decomposition rate of foliar litter (1989–1991, data from BNZ-LTER website), suggesting that BTD decomposition patterns are reasonable approximations of actual decomposition patterns. We also found simulated drought to have no impact on litterfall (the amount of foliage, branches, etc. falling to the ground every year from vegetation); combining these two results, we conclude that drought is increasing carbon storage in surface soil. We developed a simple model showing that this is quantitatively consistent with the changes measured in forest floor mass over the study period.

impact

The results of this study indicate that predicted future soil moisture deficits, independent of increased soil temperature, will 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 near the soil surface). In floodplains, soil moisture deficits will have far less effect on vegetation (unchanged aboveground tree growth or root biomass) but will affect soils (increased amount of carbon stored near the soil surface). Thus, this forest is sensitive to soil moisture deficits and future changes in climate will affect forest carbon pools and fluxes across the landscape, primarily in uplands.

Soils associated with pattern ground in arctic Alaska and Canada

Chien-Lu Ping, Gary Michaelson

purpose

We sought to characterize soils associated with pattern ground, especially nonsorted circles in arctic Alaska and Canada.

approach

A total of 65 soils were studied and sampled across arctic bioclimatic subzones from the Canadian High Arctic to

arctic Alaska as a part of the National Science Foundation Biocomplexity in the Environment project.

progress

We found the influence of nonsorted circles on soil formation appears to increase from north (Subzone A) to south (Subzone E) based on soil morphology. On close examination of soils in subzones D and E, nonsorted circles are more common but their appearance is masked at the surface by vegetation. They are closely packed under the surface organic mat, especially in Subzone E, where the vegetation includes significant amounts of low shrubs. Such a close packing of the nonsorted circle was noted by early researchers and it seems to be the end stage of nonsorted circle development. In addition to soil characterization, we studied the organic carbon stores in soils associated with the nonsorted circle landscape. Carbon distribution in a typical soil profile under an active nonsorted circle is not evenly distributed in the mineral matrix. Instead, it appears as discrete chunks or bodies of organic material of different degrees of decomposition mixed in a reduced mineral matrix. The organic chunks taken from the lower active and the upper permafrost are of different C^{14} ages with maximum of 9,000 YBP. This suggests 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, most of the carbon deposited during the Holocene and cryoturbated onto the upper permafrost is within a depth of one meter, and these carbon stores can be related to biomass production.

impact

Soil characterization data provide the baseline soil data to the vegetation study group and also to the modelers. The total organic carbon stores measured in the tundra zone of the North American Arctic by using landscape units nearly double the previous reported amount, which was based on a rainfall model and limited sampling points. This information means that the contribution of carbon from the Arctic in current global terrestrial carbon budget estimates should be increased. Results from the soil morphological study and chemical analysis suggest that cryoturbation mainly due to frost heave plays a controlling role in carbon sequestration in arctic tundra soils. Methods of description of cryogenic soils should be modified based on the finding of major cryogenic structures.

fertility & soil properties

Evaluation of southcentral Alaska manufactured topsoils

Jeffrey Smeenk, Jodie Anderson; Joe Kuhl (ARS)

purpose

'Topsoil' sold in southcentral Alaska is rarely true native topsoil. Most often the product sold as topsoil is a mixture of sand, peat, and native topsoil. The manufactured topsoil is usually screened and blended before delivery to the buyer. We sought to characterize manufactured topsoils so buyers can make informed decisions about fertilizing it.

approach

Product samples were collected from vendors in the Anchorage and Matanuska-Susitna region. These samples were subjected to several physical tests along with the standard soil nutrient analysis.

progress

Due to the blending/screening process and the high peat content of the blends, the manufactured topsoils were very fluffy. Compression tests indicated that the products from different vendors had similar rates of compression. All of these manufactured soils need to be applied at depths significantly thicker than would be needed with 100 percent native topsoil to compensate for the additional settling. All the manufactured soils had high water-holding capacities indicating that they would retain adequate moisture for plant needs. An evaluation of the soil aggregates indicated that while the manufactured soils did not have many aggregates, those that were present were quite stable. The water-stable aggregates will assist in forming good soil structure. The high level of peat in the blends is contributing to the soils' high water-holding capacity and the high stability of the aggregates.

The nutrient analysis of the various soils was much less consistent. The pH of all products was in the low to acceptable range. In general, the macro and secondary nutrients levels were low but in some soil blends a single nutrient may be in the medium to high range. The nutrient composition of the soil blends depends on the source of peat and native topsoil used in the blends and these sources vary throughout the production season. Often, the nutrient analysis of a vendor's product in the early summer would be completely unrelated to the nutrient analysis of the product sold in mid-summer.

impact

It is crucial that the buyer gets a fertilizer recommendation based on the material that is actually delivered to the job site. A buyer's guide is in process, and will give characteristics of various soils based on this data.

Land use changes and soil properties

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

purpose

In the Delta Junction area of Alaska (64°49'N, 147°52'W), forest land (FL) was converted to agricultural land (AL) in the late 1970s. Under the USDA Conservation Reserve Program (CRP), some of the agricultural land was then removed from production in the late 1980s. The soils in the area were developed from loess overlaid on stream outwash materials. The soil has less than 10 percent clay, and was low in soil organic matter content before clearing. Because of land use changes, quality and quantity of plant residues returned to soil are different among the three types of land uses. This will affect the quantity and quality of the soil organic carbon, and soil physical, chemical, and biological properties. We sought to compare the soil properties in different land uses.

approach

Three replicated soil samples from forest, CRP, and agricultural land were taken in fall 2005 in the Delta Junction area. The forest sites were primarily black spruce (*Picea mariana*), birch (*Betula papyrifera*), and poplar (*Populus tremuloides*). The CRP land consisted of grasses and shrubs. The agricultural land was in continuous barley (*Hordeum vulgare* L.). Mineral soil (Volkmar, Aquic Eutrocrepts) samples were taken from 0 to 15 cm depth. Wet and dry aggregate (> 2 mm) stability and soil bulk density were determined. Surface undecomposed organic matter, semidecomposed organic matter (density < 1.0 g/cm^3) in mineral soil, and mineral soil organic matter content were determined. Soil mineralizable carbon and nitrogen and soil microbial biomass carbon and nitrogen were measured. Soil total nitrogen, phosphorus, and Melhich 3 extractable ions were analyzed.

progress

Soil pH and electrical conductivity were not different among the three land uses, but soil bulk density was higher in FL as compared to CRP and AL. Wet aggregate stability was higher with soils from CRP than the ones from AL. Again the dry aggregate stability was high in CRP, but low in FL. Soil total nitrogen, total phosphorus, and extractable mineral nutrients (phosphorus, sodium, calcium, magnesium, zinc P, K, Ca, Mg, Zn) were higher in AL than FL. In contrast, extractable iron and manganese were higher in FL than AL. Organic residues on the soil surface and semidecomposed organic matter in mineral soils were higher in FL than CRP and AL. In comparison, total soil carbon was higher in AL than FL. Soil microbial carbon and nitrogen were higher in CRP than FL. Soil mineralizable carbon and nitrogen in 10-week incubation were higher with AL than FL.

impact

Land use alters soil properties. Accumulation of soil organic matter in forest soil was largely due to undecomposed and semidecomposed organic residues. After many years not in production, CRP land still has significantly higher mineralizable nitrogen and carbon, an indication of higher reserved soil fertility as compared to forest soil. This makes it easy for CRP land to convert back to agricultural production, from the aspect of soil productivity potential.

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. I undertook this study to document the decomposition dynamics of logs within interior Alaska.

approach

Fifteen 4-meter logs are placed on the forest floor in six replicate stands for each major upland and floodplain vegetation type. Sample locations were also established in upland and floodplain white and black spruce ecosystems recently burned. Individual logs will be sampled to monitor changes in log carbon, nutrient, cellulose, and lignin concentrations over the next century. Field sampling of decomposed logs will be done 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 aspen, birch, balsam poplar, and white spruce sites. Chemical analysis is continuing on the collected samples. Additional sites that represent floodplain 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 displays the highest decomposition rates, with only 38 percent of its original weight remaining after 10 years, while floodplain white spruce and birch showed the slowest rates of decomposition with 70 percent remaining after 10 years.

impact

It is not yet clear what effect coarse woody debris has on the carbon dynamics of the taiga forest in interior Alaska. The results of this study will help to develop a clear picture of log decomposition dynamics on the carbon balance of these forests.

Phosphorus distribution in the soil profile under a 23-year no-tillage and straw management study in subarctic Alaska

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

purpose

A tillage and straw management study was started near Delta Junction, Alaska, in 1983 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 elemental phosphorus ha-1. After more than two decades receiving this application, the phosphorus status in soil was unknown. Phosphorus stratification in no-tilled soil is reported in other states in the US. Accumulation of phosphorus in soil could be a problem with runoff leading to fresh water neutrification. We sought to determine various extractable phosphorus deposits in the soil, and its phosphorus adsorption capacity.

approach

From the long-term tillage research plots, soil samples were taken 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. Soil samples were air dried, and the phosphorus concentration in the samples was extracted. One point soil phosphorus adsorption for all depths and cation concentrations (Ca^{2+}, Mg^{2+}, Na^{+}, Cu^{2+}, Zn^{2+}, Fe^{3+}, and Al^{3+}) were determined.

progress

High phosphorus concentration was found in the top ten centimeters of soil for no- and minimum-tillage treatments. In comparison, conventional tillage had a relatively uniform phosphorus concentration throughout the sampling depth. Similar results were reported in the literature. Apparently, there was no difference in phosphorus adsorption capacity among the treatments and depths. Cation concentrations of Ca^{2+}, Mg^{2+}, Na^{+}, Cu^{2+}, Zn^{2+}, Fe^{3+}, and Al^{3+} were not different among treatments.

impact

The research results provide information on soil phosphorus distribution status after long time P application under different tillage conditions. This information can be used to guide P applications in arable land in the Delta Junction area. Phosphorus accumulation in no-tilled surface soil can lead to a reduction of phosphorus fertilizer application, which eventually can reduce phosphorus runoff potentials from arable land.

Characterizing active soil organic matter pools contributing to soil nitrogen availability in bromegrass (*Bromus inermis* Leyss.) 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 conducted at the Fairbanks Experiment Farm in 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. Plant samples from the microplots were taken in June, July, and August in 2006 and 2007. Plant samples were dried and ground, and 15N concentration will be determined.

approach

Soil samples from 15N enriched plots were incubated in 15°C for 200 days. Destructive samples were taken during incubation, and mineralizable nitrogen was extracted by distilled water, 2 M KCl, hot HCl, and 0.1 M NaOH. Mineral nitrogen, total nitrogen, and 15N concentration in solution are to be determined. Hay samples were taken both from 15N-treated plots and large nitrogen fertilizer treated plots in 2006 and 2007. Samples were oven-dried (65°C) and weighed.

progress

Statistical approaches reported in the literature for simulating nitrogen release in incubation studies were carefully evaluated. Alternative simulation approaches such as Robust, Maximum Likelihood, and Bayesian statistics were chosen for model simulation in comparison with the most often used least-square methods. Heteroscedasticity is also tested with the data set, and appropriate weighing methods used.

Bromegrass, Bromus inermis.
—James K. Lindsey, Wikimedia, Creative Commons Attribution ShareAlike 2.5 License

Results from plant biomass data of 2007 showed that early cutting can result in high total biomass production by the end of the growing season. The nitrogen fertilizer applied in 2006 still benefited grass biomass production. Experiments to assess various soil nitrogen pools are being conducted by use of different extraction methods.

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. The results from evaluation of statistical methods will provide alternative approaches that can be used for unbiased estimation of mineralizable carbon and nitrogen in soil.

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.

climate research & global change

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

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

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 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 two 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.

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.

Alaska climate change

Glenn Juday

purpose

This project continues to examine 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 forests.

approach/method

I compiled long-term records of daily, seasonal, and yearly temperature and precipitation, 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. A temperature-based prediction of white spruce tree growth that was developed in 1997 was tested with data from white spruce tree rings collected at Bonanza Creek Experimental Forest from 1997 to 2007.

progress/result

The temperature-based model quite accurately predicted white spruce growth from 1997 to 2007. Mean monthly temperatures over the period May through August in 2004 were the highest in the 104-year Fairbanks record and, as predicted, white spruce growth in the following year was the lowest in the 200-year life span of the trees. In recent years in interior Alaska if the mean of monthly temperatures has not been at a record high level, other ecologically significant measures of warmth (not restricted to mean summer temperature) have been among the highest. During summer 2007 an index combining five different measures of summer warmth was the highest in the 104-year Fairbanks, Alaska, record. Extreme warm temperature anomalies occurred across the North Slope of Alaska in 2007, associated with the record retreat of Arctic Sea ice. The greatest area burned on the North Slope tundra in the 56-year record occurred in September.

impact/implications

The verified model of temperature control of tree growth indicates that an increase of 1–2°C above the record temperatures of 2004 would be associated with widespread

death of white spruce on similar, commercially productive sites. Different temperature factors best predict the growth of different Alaska tree species on various site types, and a few of those relationships predict increased growth at warmer temperatures. Wildfire on North Slope tundra was not known to be a significant risk until it occurred. Temperatures in the Interior have fluctuated in eleven-year cyclical patterns over the last 200 years, with high temperature peaks occurring at or just after solar sunspot maxima and/or strong El Niño years. The next solar cycle peak is projected to occur in 2012–2014, although the cycle is late to begin. New warm temperature records in the Interior are most likely to occur at the solar cycle peak, and in coastal Alaska during the next strong El Niño.

A synthesis of climate change effects on circumpolar boreal forests

Glenn Juday

purpose

The boreal forest region is a circumpolar belt of the far northern hemisphere immediately south of the treeless tundra, occupying about 17 percent of the Earth's land surface area. This study was a synthesis of important climate changes affecting boreal forests, and was presented as a chapter in the *Oxford Companion to Global Change*, among other venues.

approach

The results of recent scientific studies and management surveys were examined and compared for trends and interrelationships. Aspects of climatology, tree physiology, hydrology, and studies of forest insects and forest fire were consulted. Reports on natural resource management, wildlife management, and human subsistence and traditional resource use were cited.

progress/result

Growing seasons have become longer, wildland fire and tree-killing insect outbreaks accelerated, permafrost temperatures warmed, tree growth rates altered, lake and pond surface area decreased in some regions, river ice-off dates moved earlier in the year, and river temperatures increased. Overall habitat suitability for migratory wildlife such as waterfowl, shorebirds, and songbirds has been reduced. Human cultures adapted to the predictable availability of subsistence resources to harvest have been disrupted, and human structures and developments face additional costs and risks as a result of climate change.

impact/implications

The compounding and interacting aspects of climate changes in the boreal region are an important part of understanding current conditions created by climate warming and especially future management challenges and options. This synthesis chapter is intended as a reference for students, teachers, researchers, and other professionals seeking to understand this aspect of global change in a reference volume addressing global change topics comprehensively.

Resilience and Adaptation Program / IGERT

Gary Kofinas; Terry Chapin, David McGuire (IAB); Bernice Joseph (CRCD); **Glenn Juday, Joshua Greenberg, Scott Rupp**; Craig Gerlach (Anthropology), Branka Valcic, Mark Herrmann (School of Management); and other UAF faculty

purpose

The Resilience and Adaptation Program (RAP) is a UAF graduate program that trains scholars, policy makers, community leaders, and managers to address issues of sustainability in an integrated fashion. RAP prepares students to address a major challenge facing humanity: to sustain the desirable features of Earth's ecosystems and society at a time of rapid change. The RAP is sponsored by the National Science Foundation (NSF) through its Integrative Graduate Education and Research Traineeship (IGERT) program.

As directed by NSF, IGERT programs are intended to change the culture of graduate education by encouraging interdisciplinary research by PhD students. This goal is motivated by the belief that questions at the intersection of two or more disciplines are the most critical to the future of our society. The IGERT at UAF meets this objective by focusing on issues of sustainability through the study of social-ecological systems and their resilience and adaptation.

approach

RAP is open to master's- and PhD-level students of participating departments, including SNRAS. PhD students are supported with an IGERT Fellowship for two years. All students integrate social and natural science as a part of their dissertation research and take the RAP core classes—Regional Sustainability, Adaptive Management & Integrated Assessment, and the Resilience Seminar. These courses are taught by a faculty team with expertise in the social, economic, and ecological dimensions of sustainability. Students participate in summer internships after their first year to gain experience and insight outside their home disciplines. Along with hosting guest scholars and visiting lecturers, RAP sponsors special programs that build a community for interdisciplinary inquiry.

progress

In 2007–2008 more than fifty graduate students were enrolled in RAP, with thirty seven at the PhD level. SNRAS has assumed a lead role in RAP through faculty participation and the involvement of interdisciplinary PhD and natural resource management graduate students. Examples of current research topics of graduate students working with SNRAS faculty include: climate change and its effects on subsistence systems, alternative energy options for villages of Alaska, the effect of agency culture on marine mammal co-management, and the use and implementation of community sustainability indicators in public decision making.

impact

RAP has developed into an internationally recognized graduate program. Faculty and students are contributing to understanding of resilience, adaptability, and transformation

of social-ecological systems of the North, and developing new models for partnering with local communities in research. The program has also strengthened inter-departmental cooperation across campus and created an interdisciplinary community of young scholars. In 2007 RAP hosted a meeting of seventy-five PhD students from twenty-seven other IGERTs with a sustainability theme from across the country. The event demonstrated RAP's leadership among these programs and the common interest, benefits, and special challenges facing students seeking to do integrated research.

Monitoring seasons through global learning communities

Elena B. Sparrow, Leslie S. Gordon, Kim Morris, **David Verbyla**, Sheila Yule, Martha R. Kopplin, Elissa Levine, Martin Jeffries, Stephanie Stockman, Jessica H. Robin

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 (IPY) 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 to integrate use of technology to support classroom learning.

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 will learn 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 will learn to use standardized scientific measurements and protocols developed by 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 (interannual variability) in their biomes. Teachers and students will also be connected to scientists from the International Arctic Research Center at UAF, the NASA Landsat Data Continuity and Terra Satellite missions, and we hope to include other such programs in other countries.

progress

Ice phenology, freeze-up and break-up, and frost tube protocols have been developed. Three international professional development workshops for K-12 teachers, GLOBE Partner Coordinators, and teacher trainers were held in Fairbanks, Alaska (representing thirteen countries), in George, South Africa (twenty African countries), and in Federovskoe, Russia. One- to three-hour PD workshops were also provided at the annual meetings of the National Science Teachers Association, the Mathematics and Science Teachers of Alaska, and the GLOBE program; at the Alaska Department of Education Teacher to Teacher Conference, and the Current Trends Class for Teachers in the Fairbanks North Star Borough School District.

impact

Several presentations as well as eight publications have resulted thus far from this project. As a result of the professional development workshops, teachers are teaching their students about IPY and scientific measurements in Earth system science/environmental studies. Hence plant phenology investigations are being conducted by students in Fairbanks, Kodiak, Nome, Shageluk, Wasilla, and White Mountain in Alaska; in Illinois, Minnesota, and Washington, DC; and in Argentina, Croatia, Czech Republic, Estonia, Germany, Norway, South Africa, and Switzerland. Frost tube protocol pilot tests are being conducted by students in Fairbanks, Healy, McGrath, Takotna, White Mountain, and Wasilla in Alaska, in Connecticut, Ohio, and in Switzerland. Ice phenology investigations are being conducted by students in Fairbanks, Nome, Shageluk, and Wasilla in Alaska; and in Illinois, Ohio, and in Switzerland.

fire-related studies

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

T. Scott Rupp; Bret Butler, Roger Ottmar, (USFS); Robert Schmoll (Alaska Division of Forestry); Kato Howard, Randi Jandt (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 4 ft 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 a wet 2007 fire season we were unable to complete the experimental burns. In the 2008 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 proposed 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 also 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.

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 Intergovernmental Panel on Climate Change climate projections are being completed. Several manuscripts are anticipated to be submitted in 2008 and 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.

Saturation of fire severity indices in Alaska black spruce systems

Dave Verbyla

purpose

I assessed the utility of several remotely sensed indices for estimating fire severity among 2004 wildfire burns in interior Alaska.

approach

The mapping of high fire severity is important for short-term applications such as mapping of erosion and subsequent sedimentation problem areas, and long-term applications such as predicting future moose browse and low-flammability hardwood stands. Several remotely sensed indices have been developed for general fire severity mapping applications. However, in interior Alaska most tree species are thin-barked and easily killed by wildfire; therefore remote sensing indices that have successfully mapped variable tree mortality following wildfire in the Lower 48 may not be as important in Alaska. The depth of the post-fire organic soil horizon is a key factor controlling potential erosion of mineral soil, as well as post-fire revegetation vegetation types. In this study, I assessed the utility of three remotely sensed indices for estimating fire severity within the range of moderate to severe burns.

progress

The relationship between conventional remotely sensed indices and fire severity was tested using a field-based composite burn index (CBI). There was a strong correlation between the field-based and the remotely sensed fire severity estimates within a range of low to moderate fire severity (CBI 0.0 to 2.0), but there was no correlation at higher fire severities.

Even areas with completely exposed mineral soil such as mining areas had only moderate remotely sensed severity values. Because there appears to be a saturation of the spectral response to fire severity, remotely sensed fire severity estimates from the 2004 fire season may be unreliable because many black spruce stands likely burned with high severity.

impact

This research demonstrated that the spectral response is linearly related to fire severity, but then the response saturates. The remotely sensed fire severity maps can be used for applications such as mapping unburned stands within a

fire perimeter, or mapping low to moderate severity stands susceptible to beetle infestations. However, the remotely sensed indices are not reliable for mapping high and extremely high severity sites that may have exposed mineral soil.

forest health & growth

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. For 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

A greatly improved statistical relationship that determines the mean monthly Kt value (the ratio between ground level, global solar irradiance, and top-of-the-atmosphere solar irradiance) as a function of mean monthly sky cover and an index of mean monthly optical air mass continues to be enhanced and expanded geographically. This relationship has been tested with data from around the United States and data have been obtained to expand the testing globally. This should lead to improved estimates of global and net radiation values for use in characterizing the spatial and temporal variability of potential and actual evapotranspiration.

An evaporation pan was installed and equipped with a recording device that allows unattended readings of pan evaporation every fifteen minutes. Readings from one full season have now been obtained which show evaporative loss rates less than, but consistent with, the measured rate of lake level decline during non-rain periods. This supports the hypothesis that net groundwater outflow is occurring from the lake.

We attempted to measure net groundwater flow directly by taking winter lake level readings when surface water gains and losses are minimized. A third year of under-ice measurements of lake level showed an initial drop in lake level followed by little or no decline during the latter part of winter. This was a pattern similar to the previous year and may indicate that an equilibrium level was reached with respect to subsurface inflow and outflow rates.

impact

Progress in 2007 helped one undergraduate student with a senior thesis project. Further analysis of pan data and calculation methods will enable better estimates of energy inputs to ecosystems and landscapes, and in turn, better estimates of evaporative losses.

Monitoring forest development and health

Glenn Juday, Steve Winslow

purpose

We are documenting patterns and events in forest development, forest change, and forest health; the study began in 1988 in Bonanza Creek Experimental Forest (BCEF).

approach

Trees in all stands have been mapped and measured for diameter, height, and condition at various intervals. A comprehensive set of long-term monitoring photos was collected in six forest types (white spruce, aspen, Alaska birch) including both young post-fire (burned in 1983) regenerating forest and mature forest. Five permanent photo points were established and photos taken to the north, south, east, west, and up.

progress/result

The 2007 photo update covered 8 hectares, 7 dates, 522 pictures, and 8 sites. The photos were digitized from film, color corrected, and labeled and organized. High-precision GPS coordinates were collected at the plots. The photos demonstrate the general aging and senescence of older aspen trees and the heavy impact of the attacks of the defoliating aspen leaf miner insect. Burned and intact birch stands both show little change in the low density of tree stems. Older white spruce stands have sustained high rates of tree death, treefall, invigoration of alder shrubs, and some establishment of new birch trees; only 52 percent of the white spruce trees alive at the start of monitoring in 1987 were alive in 2007.

impact/implications

A wave of tree mortality and forest health problems, above the levels of tree death typical of the mid twentieth century, was detected in the long-term forest reference and photo monitoring plots. Forest health in the BCEF hectare plots appears to be representative of much of central Alaska. Most of the major factors responsible for tree mortality in BCEF are triggered or intensified by warm temperatures. The boreal forest of Alaska is experiencing a period of major change, with new or intensified insect outbreaks, higher temperatures, high variation in snow conditions, and accelerated fire regimes.

Moose browse exclosure at Cooper Landing on the Kenai Peninsula. A US Forest Service employee is showing members of the NRM 290 class the difference in vegetation between an area left open to moose and one closed to these shrub-browsing ungulates.

—PHOTO BY MATTHEW HELT

This study is providing on-the-ground documentation and measurements to detect and quantify some of these changes.

Effects of diversity of tree species and size on forest basal area growth, recruitment, and mortality

J. Liang, J. Buongiorno, E.L. Kruger (Univ. of Wisconsin-Madison), R.A. Monserud (USFS PNW Research Station); M. Zhou (UAF School of Management)

purpose

Our goal was to determine the relationship, or lack thereof, between growth and diversity of tree species and size in conifer stands of western North America.

approach

Growth was measured by net basal area growth and its components: survivor growth, recruitment, and mortality. The analysis used inventory data from permanent plots in the Douglas fir/western hemlock forest type in Oregon and Washington, and in the mixed-conifer forest type in California. The methods consisted of generalized least square regression with spatial autocorrelation, controlling for the effect of other stand characteristics.

results

Other things being equal, in the two forest types under study there was a strong positive relationship between net basal area growth and tree-species diversity. This effect was associated with higher recruitment in stands of higher tree-species diversity. Neither mortality nor growth of survivors was related to tree-species diversity. The relationship between growth and tree-size diversity was less clear. For Douglas fir/western hemlock, net basal area growth was negatively correlated with tree-size diversity, essentially because recruitment was lower on plots of high tree-size diversity. For mixed conifers, net basal area growth tended also to be lower in plots of high tree-size diversity, but this was mostly because mortality was higher in plots of higher tree-size diversity. A paper on our study was published in *Forest Ecology and Management*.

impact

This study helps to improve our understanding of the relationship between biodiversity and forest productivity. Other factors being equal, multi-species forests tend to have better net basal area growth than single-species forests. The study suggests that the effort to improve forest productivity should focus on diversifying tree species, instead of tree size.

Climate sensitivity of the growth of Kuskokwim River white spruce

Steve Winslow, Claire Alix, **Glenn Juday**

purpose

Along the Kuskokwim River (second-longest in Alaska, ninth-longest in the US), riparian forests have been valued for centuries and frequently exploited as driftwood, but never industrially harvested. The only major study of the Kuskokwim riparian forest was a 1967 forest inventory. Recently rural Kuskokwim communities have begun to look to forests as a potential alternative fuel source. Past timber feasibility studies indicated a potential for sustained yield harvest of white spruce on the Kuskokwim, but recent temperature-induced drought stress has reduced growth of this species elsewhere in Alaska. This study was designed to determine recent growth history and growth potential of the riparian forest that is the source of driftwood on this river system.

approach

Tree-ring samples from along the Kuskokwim River were collected and correlation analyses performed between tree-ring growth and climate variables at McGrath and Bethel. Patterns of wood use in communities were surveyed.

progress/result

Tree-ring samples from 118 white spruce (eight stands) and 77 black spruce (five stands) growing along a 370 km stretch of the Kuskokwim River were collected in 2002 or 2007. Tree ages ranged from 56 to 321 years. The average rate

of ring growth for all white spruce for all years was 1.37 mm per year, the highest sustained rate of growth yet reported for the species north of the Alaska Range. Results also demonstrate an east-west gradient of changing response to temperature and precipitation in both species. Inland Kuskokwim tree populations generally decreased in growth during warm summers (especially August and June) and grew best in cool summers. The coastward populations grew best in years with warm April and November temperatures and grew the least when those months were cool. Survey results indicated that dependence of households on wood as a primary heating fuel increased with distance upriver.

impact/implications

The greatest extent of productive riparian spruces along the Kuskokwim River is in the upriver or inland locations where recent growth trends (and prospects in a further warming climate) are the most negative. However, the potential of other tree species was not examined in this study. Total wood availability could remain at levels high enough to support both community biomass-energy generators and individual home heating even if white spruce may not be the main contributor of fuel wood. Given this uncertainty, it would be advantageous for communities that plan to adopt biomass energy generation to install generators which can accommodate wood from a variety of tree species. Coastward locations may be able to plan on higher rates of tree growth than the historical average, because temperatures in recent decades have been closer to the optimum for growth than during much of the past two centuries in those locations.

Climate sensitivity of the growth of Yukon River white spruce

Glenn Juday, Claire Alix, Steve Winslow

purpose

This study is the second phase of an examination of the growth history and controls on growth of white spruce on the floodplain of the Yukon and lower Tanana rivers. The first phase involved collection and preliminary analysis of trees in the Yukon Flats and middle Tanana River near Fairbanks. All sampled stands are contributors to the supply of driftwood that reaches the treeless Yukon-Kuskokwim Delta, the Bering Sea shore, and the coast of the Arctic Ocean.

approach

A summer 2007 collecting expedition traveled by river from Fairbanks to the Yukon Delta. Both tree cores and disks were collected from large, dominant trees likely to fall into the river from continued bank erosion. Ring widths of samples collected from the phase one study on the Yukon Flats were measured and compared to climate data at Fairbanks.

progress/result

The sample collected in 2007 includes 197 trees from eight stands on the Yukon River and two stands on the Tanana River. Mean diameter of all trees was 36.5 cm (maximum 57 cm) and mean height was 21.8 m (maximum 34 m). Tree-ring growth of the sample from phase one on the Yukon Flats was found to be well-predicted by a set of monthly mean temperatures across three years. Warm years were consistently years of poor growth and cold years were the years of best growth. Climate favorability since the late 1970s is the lowest in the last two centuries, and probably the lowest for several centuries before that.

impact/implications

The samples from both phase one and phase two have shown some of the highest sustained growth rates of white spruce trees in boreal Alaska. White spruce on floodplains of the major glacial-fed rivers in Alaska were the subject of some of the first tree-ring studies in North America in the 1930s. However, the early samples were limited in number, and measurement techniques were much more time consuming, difficult, and imprecise. This study is the first to obtain an adequate preliminary tree-ring sample of trees in this extensive and productive forest type of boreal Alaska. Before this study, floodplain populations of white spruce were hypothesized to have the potential to respond to temperature increases with increased growth because of the presence of subsoil water from the river, but reduced growth with higher temperatures is clearly the strongly dominant response in white spruce on the Yukon Flats and in the middle Tanana River valley.

Comparison of two vegetation indices in interior Alaska

Dave Verbyla

purpose

I compared the Enhanced Vegetation Index (EVI) with the Normalized Vegetation Index (NDVI), available as a MODIS (Moderate Resolution Imaging Spectroradiometer) land product. The MODIS EVI and NDVI are available globally every sixteen days from 2000 to present, and can be used as a surrogate for vegetation productivity. The EVI is similar to the NDVI, but corrects for subcanopy soil background and does not become saturated as easily as NDVI in high phytomass areas such as the Amazon basin. However, the EVI has never been compared with the NDVI for high latitude boreal applications.

approach

The MODIS EVI and NDVI sixteen-day values were extracted for four elevation zones in interior Alaska from late April through early August 2006. Only pixels with good quality (no cloud or smoke contamination) were used in the analysis. The temporal pattern of mean vegetation indices was compared among the four elevation zones ranging from low elevation, boreal forest areas to high elevation, alpine tundra areas.

progress

The NDVI was a better vegetation index because mean NDVI values were substantially greater from the low-elevation boreal zones compared with the high-elevation tundra zones. There was no substantial difference in mean EVI among the elevation zones, and at the peak of the growing season the mean EVI from the highest elevation zone was slightly higher

than for lower elevation zones. The temporal pattern of NDVI was reasonable with the increase in NDVI during the spring greenup period occurring earlier at lower elevation. Also all elevation zones had maximum NDVI during the early July composite period.

impact

The Enhanced Vegetation Index may perform better than NDVI in other areas of the globe such as deserts, where subcanopy soil background is a problem, or the Amazon, where the spectral response of NDVI to phytomass becomes saturated. However, based on this research the NDVI appears to be a better vegetation index for boreal Alaska applications.

Effects of moisture limitation on tree growth in upland and floodplain forest ecosystems in interior Alaska

J. Yarie

purpose

Due to potential changes in summer 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 this study was to determine the influence of summer rainfall on the growth of trees in both upland and floodplain locations in interior Alaska. 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 ground water, linked to river flow dynamics, on soil moisture recharge.

approach

PVC greenhouse panels were used to construct a cover under the overstory canopy in each replicated 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 plots, were placed on wooden framing. On the floodplain sites the high end of the cover was at approximately two meters and the low end at one 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 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.

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 2007.

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 groundwater 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 to limit moisture uptake.

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

The stands are 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 dataset 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. Both 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 is strongly tied to the state factor structure 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.

policy & planning

Endangered Species Act science and management

M.A. Cronin; S.A. Amstrup (US Geological Survey); K. Scribner (Michigan State Univ.)

purpose

This project aims to assess science used in policy formation and implementation of the Endangered Species Act (ESA).

approach

Scientific information is synthesized for assessment of ESA issues including designation of subspecies and distinct population segments (DPS) 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.

progress

From August 2004 to October 2007, information and its assessment have been provided to the Alaska governor's office, state legislators, and natural resource industries on several Alaska ESA issues, including polar bears, beluga whales, Steller sea lions, sea otters, eiders, loons, goshawks, wolves, and other species in the Lower 48 states. Review and assessment of scientific and management documents have been done for several of these species. Two papers on subspecies and DPS criteria were published in 2007, one in *Nature* and the other in *Animal Conservation*.

impact

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

pests & invasive species

Spruce budworm is now at outbreak levels in Alaska because of climate warming

Glenn Juday, Richard Skeeter Werner, James Kruse

purpose

This study is designed to examine why the spruce budworm has appeared at outbreak levels in interior Alaska irregularly since the late 1980s. The study is a cooperative effort with the USDA Forest Service (Pacific Northwest Research Station and State and Private Forestry) and Bonanza Creek Long-Term Ecological Research site.

approach

The study reviewed (a) scientific literature on the development and temperature controls of the spruce budworm, (b) daily temperature data at Fairbanks from 1907 to 2007, and (c) monitoring data on the population density of spruce budworm since 1975 in Bonanza Creek Experimental Forest LTER, and the outbreak history of spruce budworm in interior Alaska as mapped by the annual Forest Health Survey.

progress/result

The spruce budworm completes its life cycle within a twelve-month period, but spread across two different years. Warm August temperatures allow the rapid completion of development of budworms from eggs to the second larval stage that is not harmed by frosts. The scientific literature suggests that cold winter temperatures do not limit survival of budworms that have developed to the second larval stage. Warm temperatures in May and June speed the development of budworms through several additional development stages to reproductive adults. Outbreaks appeared in central Alaska when warm Augusts were followed by warm spring/early summer weather in which the heat requirement for the adult budworm stage occurred by July 7 or earlier.

impact/implications

Spruce budworm is responsible for 40 percent of all timber volume lost to insects and diseases in Canada each year. Spruce budworm outbreak behavior was not reported in central Alaska until 1989, following years in which the heat requirements were particularly favorable (occurred early in the season and the minimums were greatly exceeded). Subsequent years that have similarly met budworm heat requirements in central Alaska have also experienced outbreaks, including a locally severe outbreak at Fairbanks in 2006/2007.

range management

Estimating lichen biomass, current population, and recommended stocking density of reindeer (*Rangifer t. tarandus*) on St. George Island, Alaska

Michelle St. Martin, **Greg Finstad, Norm Harris**, Christine Hunter, Kris Hundertmark

purpose

Declining lichen biomass on St. George Island has led to concerns of overgrazing by reindeer and the effect on sustainable range management. Lichen is considered the primary winter forage for reindeer, but is easily overgrazed and slow to recover if reindeer stocking densities are too high for available range resources. Stakeholders on St. George Island want to know current reindeer population numbers, lichen biomass available for grazing, and a recommendation on reindeer stocking density to ensure sustainable use of range resources.

approach

We determined sex and age composition of the reindeer population in spring 2007 via visual observation aided by a spotting scope and binoculars. Transects were laid within the Natural Resources Conservation Service's ecological classification sites to sample lichen. Sample frames were randomly placed along these transects and a point frame method was used to estimate lichen biomass.

progress

We estimated the reindeer population on St. George Island in 2007 to be 290 animals (120 adult cows, 75 (± 5) adult bulls, 17 yearling cows, 12 yearling bulls, and 66 calves). An initial estimate of total lichen biomass was begun in 2007, but field work will not be complete until 2008. A reindeer stocking density based on sustainable lichen utilization will be developed after lichen biomass estimation is complete.

impact

This study will provide the St. George reindeer stakeholders with an estimate of total winter forage available on the island. The total lichen biomass will be used to determine a reindeer stocking density that will be used as a management tool for the herd. This number can help manage the herd to a sustainable herd size while minimizing the impact on the winter range.

revegetation

Black spruce growth and fire history

Glenn Juday, Valerie Barber, Julie Morse, Steve Winslow

purpose

Black spruce-dominated forest is about half of the forest area of the boreal region of Alaska and the species apparently regenerates primarily following fire. This study was designed to see if a series of years in the 1800s were also major fire years in interior Alaska. This series was reconstructed using tree-ring techniques in a previous study as warm years.

approach/method

Our reconstruction of nineteenth-century summer temperatures in central Alaska indicate warm intervals from 1834 to 1851 and 1862 to 1879, with particularly warm summers in 1836, 1849, and 1867. We compared the dates of fire-originated black spruce with our temperature reconstruction and the suspected fire years across the one-million-hectare White Mountains National Recreation Area and Steese Conservation Area 120 km north of Fairbanks.

progress/result

Age counts of 367 black spruce collected from the White Mountains and Steese Conservation areas include a higher than expected proportion of trees projected to have originated (a) in the 1840s and 1850s, and (b) in the late 1860s and early 1870s, consistent with seedling establishment following fires at the period of warmest reconstructed summers. The sample contained a noticeably lower than expected proportion of trees with dates of origin from the 1880s and 1890s, consistent with low fire incidence during the years with reconstructed cool summers.

impact/implications

This study adds to the growing evidence of the critical role of temperature in shaping the boreal forest and the probable impact of warmer temperatures in the future. In addition to fire-caused tree regeneration, year-to-year variability in radial growth of black spruce is negatively related to warm season temperatures on many sites in central Alaska. As a result, an increase in the number of hot summers would not only increase the probability of burning (as long as fuel is available), it would also decrease regrowth of this evergreen conifer on such sites, possibly reducing the ability of black spruce to compete for dominance in future stands.

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. Data from the 2007 growing season are from the nineteenth year of data collection in the study and the twenty-fifth 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 2007 annual survey, the measurements made included white spruce survival, budworm damage levels, 2007 height growth and total height.

progress/result

In 2007, 1,533 white spruce trees covering 0.75 ha were measured and entered into the long-term database; the remainder will be measured early in 2008. Average 2007 height growth of all trees was 12.9 cm (max = 78 cm); average total height was 137 cm (max 746 cm). Slightly more than 75 percent of the white spruce were taller than 50 cm and about 38 percent were taller than 137 cm, or breast height (the conventional measurement point for diameter). The great majority (72 percent) of trees were positioned under the shade of another tree or shrub, and the remainder were partially exposed or fully exposed to the open sky. The average stem diameter was 2.9 cm at ground level, and 2.3 cm at breast height. In 2007 spruce budworm caused moderate or heavy damage to 0.6 percent of trees, light damage to 17 percent, and very light damage to 44 percent of trees.

impact/implications

The main cause of tree death or near-zero height growth (which results in near-term tree death) is the dense shade of logs that were the live trees killed in the 1983 fire. Many of the logs are lodged on support points, and seedling white spruce most at risk are either completely under logs or on the deeply shaded north side of logs. Some seedling trees are able to grow up around the side of logs that have displaced them, providing an explanation for the occurrence of curved or bow-shaped distortions at the base of many large trees harvested from natural stands. The identity of trees that will be the new forest canopy is becoming clear now. The major spruce budworm outbreak of 2006 (stimulated by optimum warm weather conditions in 2004 and 2005) continued in 2007. Although the percentage of budworm-affected trees at the lightest damage class was the same in 2007 as in 2006, the

NRM 290 class being introduced to B.O.B., the bicameral observation blimp used in creating time series aerial photography, tracking invasive species, movements of herds of range animals such as cattle, and revegetation progress.
—PHOTO BY MATTHEW HELT

proportion affected at the highest damage classes (those likely to die or have reduced competitive ability) was considerably reduced, probably because of cool summer weather in 2006.

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 fifth year of a long-term study. Imagery was taken on four occasions. Ground-based plot photography was obtained for high-resolution cover estimates to calibrate and test vegetation indices. All three revegetated pits initially responded similarly regardless of whether they were broadcast seeded or hydro-seeded. At the end of the first growing season, chickweed covered 35 to 45 percent of reseeded areas. Seeded grasses began to dominate the sites during the third and fourth years. Invasive plants, primarily birdvetch and white sweetclover, have established at all sites and still persist after five years.

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.

Three different bio-oil extracts, from birch, alder, and Sitka spruce, created using supercritical fluid liquefaction of woody biomass.
—PHOTO BY J. ANDRES SORIA

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 sustainably and efficiently harvested, extracted, and processed, 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 and development 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: multiresource planning and the process of determining public resource policy; nonmarket 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.

biofuels

Bio-oil composition of Alaska woody species

J. Andres Soria

purpose

The project is designed to investigate the yield and composition of Alaska woody biomass under supercritical fluid liquefaction for production of biofuels and chemical feedstocks.

approach

Kiln-dried material was provided by the Ketchikan Wood Technology Center, including alder, birch, hemlock, yellow cedar, Sitka spruce, red cedar, white spruce, and aspen. Bio-oil from these species was produced under supercritical liquefaction with production of solids, liquids, and gases that can be separated into individual fractions by distillation and used as biofuels and chemical feedstocks.

progress and results

The study has yielded promising results for all species studied, with an average liquid fraction production of 90 percent (weight basis). The number of chemical species collected in the bio-oil averaged 170 compounds with boiling points less than 250°C, showing potential applications as fuels and additives. Chemical characterization of the bio-oil is continuing to produce new compounds, with more work expected using green material.

impact

The utility of wood waste, small-diameter timber, yard and municipal waste, and other underutilized resources for production of fuels and chemicals is of great importance for Alaska. The production of a liquid substrate that can enter traditional manufacturing and processing activities using the petroleum infrastructure will greatly enhance the transition toward a renewable energy future. This work is the initial step toward analyzing Alaska biomass for biorefinery applications.

Bio-energy crops for Alaska

Stephen D. Sparrow, Mingchu Zhang, darleen t. masiak, Robert Van Veldhuizen

purpose

The high cost of petroleum-based fuels in Alaska and the need for communities to become more self-sufficient in energy has resulted in an increasing interest in renewable energy sources, including producing crops for bio-energy. This research is intended to screen various shrubs/trees, perennial grasses, and perennial forbs as potential bio-energy crops in Alaska.

approach

We established single row plots of eight species of willow (*Salix*) and two species of poplar (balsam poplar, *Populus balsamifera*, and quaking aspen, *P. tremuloides*) from either stem cuttings or transplants in 2006. We established single row plots of thin-leaf alder (*Alnus tenuifolia*) in 2007 and seeded small plots of seven native, perennial grass species. Yield data were collected in 2007 for four willow species (felt-leaf willow, *Salix alaxensis*; little-tree willow, *S. arbusculoides*; sandbar willow, *S. interior*; pacific willow, *S. lasiandra*) and balsam poplar by collecting a few plants from each plot after leaf fall in autumn.

progress and results

Dry matter yields ranged from 0.6 ton/acre for Pacific willow to 4.5 ton/acre for felt-leaf willow. These plots were all established as preliminary screening trials only and yield data from these plots may not be indicative of yield potential for large-scale plantings. However, they will aid us in determining which species to use for future research. In 2008, we will collect samples from plants that have not yet been cut to obtain three-year growth estimates for the willow and poplar species and will evaluate stand survival and obtain yield estimates for the grass plots. We intend to establish larger plots of select native woody species and native and non-native grasses and forbs for more detailed evaluation in 2008. These plots will be used to determine persistence and yield potential under various management regimes, including various fertilization and harvest practices.

impact

This research will ultimately allow land managers to determine which plant species can be used as bio-energy crops in Alaska, and to provide recommendations on best management practices for these crops.

Tarry extract from a potential Alaska bio-energy crop.
—PHOTO BY J. ANDRES SORIA

education & outreach

High-latitude range management certificate program

Greg Finstad, Carrie Bucki, Lee Haugen

purpose

We seek to recruit and train students for entry-level employment in the field of natural resources management. In 2007 ten Alaska Native students began a two-year program in Nome to acquire a UAF certificate in high-latitude range management.

approach

Students receiving the HLRM certificate will be trained in conventional field-based techniques used by agencies to inventory and monitor high-latitude plant and animal populations. Students will also be trained in the ecological concepts of sustained yield and the manipulations and management of animal populations in northern ecosystems.

progress

Students completed the courses HLRM 120 - History of Domesticated Alaskan Ungulates, and HLRM 150 - Alaskan Ungulate Husbandry, in June 2007.

impact

Completion of the requirements for this certificate will provide the training necessary for local, entry-level natural resource jobs but also serve as a bridge to a variety of natural science associate and baccalaureate programs. The certificate curriculum delivers continuing education to rural Alaska that is relevant to the needs of local employers and land managers and is compatible with the experience and lifestyle of the local people.

Communicating climate change to the public and policy makers

Glenn Juday

purpose

The public and policy makers are dealing with climate change events, predictions, and possibilities, and want and need to have the latest information to make informed decisions. The presentation of results of scientific and technical investigations to these audiences requires additional effort beyond the scientific and technical literature. The purpose of this project is to integrate, synthesize, and formulate complete and accurate information useful to the public and policy makers.

approach/progress

I testified twice to the US House of Representatives, to the Committee on Science and Technology, and the Select Committee on Energy Independence and Global Warming. My testimony was based on results about climate change effects on boreal forests, and a review of other results on sea ice, permafrost, and forests. Seminars were presented to several different audiences made up of resource managers (three), state and county legislators (two), national policy makers (one), Alaska professional foresters (one), religious leaders (one), and elementary school classes (two), across the US. The project contributed to organizing a special session of the American Geophysical Union annual meeting. A field trip to project field sites was conducted for an international scientific meeting and for news media. A radio interview was broadcast, a Korean TV science program filmed, and two international newspaper interviews were published.

impact

Audience feedback provides valuable guidance for modifications. Impacts have included teacher training and incorporation of lesson plans into school curricula, improved depth of media reports, improved public understanding of the climate change challenges, more effective public participation in task forces and working groups preparing adaptive measures particularly at the local government level, and guidance and evaluation of national legislation. Repeat invitations are taken as an indication of success in achieving objectives.

International Polar Year Pole-to-pole Videoconference, Web Chat, and Web Forum

Elena B. Sparrow, Teresa Kennedy, Martha R. Kopplin, Rebecca Boger, **David Verbyla**, Martin Jeffries, Jessica H. Robin, Kim Morris

purpose

Our main objectives were 1) to launch the fourth International Polar Year (IPY) for students in Alaska and Argentina and other countries, 2) to provide students 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.

approach

We used videoconferencing technology to connect students and their teachers in Alaska, Ushuaia, Terra del Fuego, 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. The Monitoring Seasons Through Global Learning Communities or Seasons and Biomes project launched the IPY with a pole-to-pole videoconference on March 5. Participants (students and teachers) came from a sixth-grade class from Pearl Creek Elementary, fifth through twelfth-grade students from Moosewood Farm Home School, and junior high students from Effie Kokrine School (Fairbanks); two fifth-grade classes from Tri-Valley School (Healy, Alaska); and elementary and high school students from Base Esperanza School and teachers from Colegio Nacional de Ushuaia (Ushuaia, Argentina). Participating scientists were from SNRAS, the International Arctic Research Center and other research institutes at UAF, the Global Learning and Observations to Benefit the Environment (GLOBE) program office, the National Snow and Ice Data Center in Boulder, Colorado, 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 March 7 and a web forum on March 8–9, 2007.

impact

More than 400 students in Fairbanks and Healy, Alaska, and Ushuaia, Argentina, and other countries participated in the March 2007 IPY Pole to Pole Videoconference, Web Chat and Web Forum. The students were enthusiastic about the experience. A newspaper article and a television interview resulted from the videoconference. Response was good from participants. The conference resulted in increased participation of students in the International Polar Year and connection of students with more scientists, and the initiation of studies at their local schools.

Converting Alaska fish byproducts into value-added ingredients and products

Peter Bechtel, Cynthia Bower, Ted Wu (USDA)

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

purpose

We are characterizing various fish processing byproducts and existing secondary products and developing new and higher-valued ingredients for use in animal (agriculture and aquatic) feeds. Greater utilization of this material will also reduce waste disposal problems.

approach, progress, and impact

Purification of commercial salmon oils

The quality and value of salmon oil can be increased by removing protein, moisture, and other impurities commonly found in unpurified oil; however low-cost simplified procedures are needed. A University of Alaska scientist and graduate student evaluated different materials for absorbing impurities from crude salmon oil. Crude salmon oil was obtained from a commercial fishmeal company, purified using two absorbent materials (shrimp chitosan or activated earth) and three different processes. Results indicated that activated earth had a good ability to adsorb peroxides, minerals, moistures, and insoluble impurities of unpurified salmon oil. Neither chitosan nor activated earth was effective in removing free fatty acids from unpurified salmon oil. This study showed that the adsorption process used for edible oil purification not only removes non-triglycerides but is a rather cost-effective and low-temperature process.

Comparing characteristics of crude and purified salmon and pollock oils

UA and ARS scientists in Kodiak, Alaska, compared selected chemical and physical characteristics of crude and purified pollock (PO) and salmon oils (SO). Three batches of commercial crude PO and SO were treated three consecutive times with chitosan and physical and chemical properties analyzed and statistically compared. Results indicated that one to two chitosan treatments were sufficient to positively affect oil quality under these conditions, showing that there is a simple and economical method of adding value to oils produced from fish processing byproducts.

Byproduct storage time and temperature on fish meal and oil quality

Occasionally raw fish byproduct must be stored before it can be processed into meals and oils; this study was designed to evaluate how storage time and temperature affected the quality of the resultant meals and oils. A storage study on fish byproducts from pink salmon and Alaska pollock was conducted in Kodiak, Alaska, by ARS scientists at two temperatures. After storage, the byproducts were processed into fishmeal and oil extracts and the quality of the meal and oil were examined. Results indicated oil quality deteriorated with storage time; however, the amino acid composition of the protein in the meal was good after all storage times and temperatures. These results provide the industry with a better understanding of meal and oil quality when produced from aged byproducts.

Stabilizing fish processing byproducts

High-quality byproducts from fish processing are sometimes discarded unless fishmeal plants are located nearby. We evaluated acidification as a preservation method for individual salmon byproducts (heads, viscera, and a mixture). Byproduct components were stabilized through fermentation by lactic acid bacteria and through ensilage by direct acidification using formic acid. Stable silage pHs were maintained by all treatment groups for 120 days, although lipid and protein quality decreased. Of note, viscera and heads preserved separately consistently maintained a lower, more effective pH than when mixed together, regardless of treatment, which has major implications for how fish processing waste should be collected and stored if maximum nutritional quality is to be preserved.

Characterization of dried heads from five Pacific salmon species

Traditionally, fresh and dried fish heads have been a part of human diets in many countries. In Alaska approximately 65,000 mt of salmon heads are produced annually from the salmon processing industry. We sought to evaluate two low drying temperatures on the quality and chemical composition of five different types of wild Pacific salmon heads. UA and ARS scientists obtained red, pink, chum, king, and silver salmon heads from commercial processors and then dried them at 40° and 77°C and analyzed their chemical and physical properties. There were large differences between salmon species, less drying time at the higher drying temperature, and similar quality attributes at both drying temperatures. Salmon heads were of high nutritional value, and show potential for commercialization as a human-grade food ingredient.

Use of Alaska fishery byproducts in diets for sturgeon

There is a potential market for Alaska byproduct feed ingredients in sturgeon diets. An Oceanic Institute and University of Hawaii-Hilo scientist completed a second grow-out diet for sturgeon incorporating fish meal derived from byproducts of the Alaska seafood industry. The study utilized sturgeon at UH-Hilo and evaluated growth and survival performance of groups fed control diets and diets containing Alaska pollock fish meal. There were no significant differences between groups fed commercial feeds and those fed the diet containing pollock meal. This indicates a potential further market for Alaska pollock byproduct meal and also could benefit feed producers and farmers raising sturgeon looking for an alternative source of fish meal.

Use of pollock skin as binders in shrimp diets

Potential products that can be made from fish skin include binders from aquaculture and other feed ingredients. Scientists from the Oceanic Institute and ARS completed a second trial to evaluate a processed pollock skin material as a feed binding ingredient. Protein binders from pollock skins and stickwater were made and evaluated at the 5 percent inclusion level as feed binding ingredients in an aquaculture diet. Results indicated that pollock skin, but not stickwater, added at 5 percent inclusion significantly improved pellet water stability at two hours submersion. These promising results are being followed up with a third pollock skin binding trial using a further processed pollock skin product.

Using Alaska fish oil to alter the omega-3 composition of fillets

There is a need to understand how the composition of dietary fat alters the fat composition in market-size fillets. We sought to investigate the differences in the kinetics of fatty acids (FA) deposition in the fillets of a market-sized class of Idaho cultured rainbow trout fed commercial Alaskan fish oils versus menhaden oil. After eight weeks of feeding it was possible to boost EPA and DHA levels and increase the ratio of omega-3 to omega-6 FA in fillets of rainbow trout by replacing menhaden oil with the Alaska fish oils. The FA composition of oils derived from Alaska seafood byproducts was nutritionally well suited for inclusion into feeds for rainbow trout, and in respect to long-chained omega-3 FA levels, superior to menhaden oil.

Crop yields using Alaska byproduct organic fertilizers

Fish meals manufactured from Alaska fish waste can be used for vegetable production. To best understand the nutritional value of the fish meals, three fish byproducts (fish meal, fish bone meal, and fish hydrolysate) were evaluated in two Alaska locations for their nutrient release and barley growth response in 2007 and 2008 by UA and ARS scientists. The three fish meal products were applied at 50, 100, and 150 kg N/ha rate along with a control treatment receiving no nutrient application, and a urea treatment with 100 kg N/ha application. The results showed that at current year of application, the fish meal and fish bone meal were as good as urea fertilizer, and crops also responded from fish meals applied in the previous year. The information was presented in an agriculture producers' meeting and provides guidelines for producers who use fish meal as nutrient sources for crop production.

Impact of Alaska organic meal on fillet quality of Pacific threadfin

There is lack of information on the use of Alaska "organic" fish byproduct meals on fillet quality and sensory characteristics. Oceanic Institute scientists conducted a twelve-week feeding trial to ascertain the impact of utilizing Alaska "organic" (no synthetic antioxidant) meal on fillet quality of market-size Pacific threadfin. Sensory assessment from a trained taste panel did not show consistent differences in fillet aroma, appearance, texture, and flavor between the experimental diet containing Alaska organic meal and control diets which were nonorganic. This indicates that Alaska organic meal can be a suitable ingredient in diets for grow-out of market-size Pacific threadfin.

Barrier properties of films made from Alaska fish skin gelatins

There is increasing interest in making biodegradable and/or edible films from gelatins; however, gelatin films from cold-water fish skin will have different physical properties than films made with the more common bovine and porcine gelatins. In this study ARS scientists in California and Alaska determined the effects of drying temperature on barrier and mechanical properties of pollock and salmon gelatin films. The films dried below gelation temperature had higher helical content levels, resulting in higher strength, but worse water vapor barrier properties. These results are of importance in providing methods of altering the physical properties of gelatin films.

Physical properties of commercial salmon oil

Many of the important physical properties of salmon oils have not been determined. This study by UA scientists was designed to characterize salmon oils obtained from a commercial fishmeal company in Alaska. Fresh commercial fish oils were obtained; the oils exhibited non-Newtonian fluid behavior and the apparent viscosity of unpurified salmon oil was significantly increased with decreased temperature. The study showed that changes in the magnitude of apparent viscosity and the lipid oxidation rate of the unpurified salmon oil with temperature could be well described by the Arrhenius equation. This information on thermal and rheological properties and lipid oxidation of unpurified salmon oil is useful for designing purification processes for the oil.

Characterization of sea cucumber byproducts

Giant red sea cucumbers are commercially harvested in Alaska primarily for their longitudinal muscles; the body wall is a byproduct that is often discarded. This study was conducted by UA and ARS scientists to characterize the body wall and see if greater value may be obtained from this byproduct. Commercial size sea cucumbers were obtained, muscle and body wall components separated, freeze dried, and chemically analyzed. The dried body wall averaged 47 percent protein, 26 percent ash, 15 percent carbohydrate, and 8 percent fat, and had an amino acid composition consistent with a large content of connective tissue in the body walls. SDS electrophoresis band patterns indicated one major high molecular weight protein band. Sea cucumber body wall had properties that can be used to make value-added food and feed ingredients.

Characteristics of byproducts from yelloweye rockfish

Yelloweye rockfish (YER) is a highly prized species in both commercial and recreational fisheries in Alaska. UA and ARS scientists sought to characterize YER byproducts. YER heads and livers were obtained and yields, proximate

composition, fatty acid, composition, amino acid profiles, lipid classes, cholesterol content, and mineral composition were determined. Oils were similar in many aspects to oils from other demersal cold water marine finfish and were rich in omega-3 FA. Also, amino acid analysis revealed that the liver and head proteins were of high quality and would serve as good sources of essential amino acids. Overall, results indicated that YER byproducts can be utilized for the production of good quality specialty ingredients that can be used as food and feed components.

Sustainable Alaska dogfish fishery

Joshua Greenberg, Jason Gasper, Gordon Kruse

purpose

To develop strategic fishery management plans necessary for implementing a sustainable commercial spiny dogfish fishery in Alaska, we will provide state and federal fishery management agencies with a comprehensive evaluation of alternative management strategies. This interdisciplinary study will directly address development of new market opportunities for a commercially underutilized fishery resource.

approach

The study relies on an interdisciplinary modeling approach. An econometrically estimated equilibrium supply and demand model will be integrated with population models that incorporate demographic and life history parameters. Empirically based ratio estimators will be developed to address the relationship between target species catch and dogfish discards.

progress

The research efforts this year focused on data analysis. The data analysis is essential to developing the bio-economic model of the dogfish fishery. Dogfish bycatch in the Gulf of Alaska longline fishery was modeled and results were presented in a poster session of the February 2008 Western Groundfish Conference.

impact

Alaska's commercial fishing sector is central to the socio-economic wellbeing of the state. However, changes in market conditions and resource availability have challenged the continued prosperity of many Alaska commercial fisheries. Spiny dogfish are an exciting opportunity for the state to expand its commercial fishing sector through development of a new directed commercial fishery.

forests & forest products

HARVESTING

Level of harvest

Cascade Appraisal Services, Inc., Juneau Economic Development Center, UAF-Forest Products Program (**Valerie Barber**)

purpose

The Juneau Economic Development Center is looking at the level of harvest needed to sustain an integrated forest industry in southeast Alaska. In an ideal situation, an integrated forest industry is a sustainable one in which the trees are managed in a way to provide a continuous supply of wood and nothing is wasted in the process. Waste wood is used for heat for buildings and kilns and is also used for secondary products such as fiberboard, bioproducts, etc. Sawlogs are pulled and used for high end wood products.

approach

The estimated required investment is based on the amount of equipment required to harvest an annual amount of timber over a seventy- to ninety-year rotation. An area in the Tongass National Forest (TNF) was selected that had volume sufficient to maintain a level of harvest capability required to support an integrated forest products industry. Cascade Appraisal Services, Inc., forest consultants, was hired to do the research and write the report. The company analyzed published and unpublished reports from the US Forest Service (USFS), the State of Alaska, and a variety of private data. Secondary data was supplied by industry and USFS representatives. GIS mapping was used to select an area of suitable timber resources in the TNF that would supply an annual harvest of approximately 360 MMBF over the rotation period. Equipment and manpower required to harvest this volume were determined by taking into consideration both assets in place in southeast Alaska and necessary additional assets, and the investment needed in additional equipment for both existing and new operations was estimated.

progress

The study was completed and a report written in April 2007. An investment of up to $21 million would be required for equipment alone.

impacts

Results support the upper level of the allowable cut in the Tongass Land Management Plan (360,000 MMBF/yr) which is currently under review. An integrated forest industry would provide economic support and lend stability to the region and could provide up to 2,000 direct and indirect jobs, pumping billions into the economy.

While the study reveals that an economically viable level of harvest can be sustained, that opportunity cannot be made use of without a substantial investment from industry in new equipment and infrastructure. This is not a viable alternative at this time. The quantity of high-quality used equipment that is presently available and the current lack of a guaranteed annual volume would preclude new logging companies or the expansion of existing companies from investing in equipment.

Sitka Tribe Harvesting Study Part 2

Valerie Barber; Helen Dangel-Lorrigan (Sitka Tribe)

purpose

Sitka Tribe has seventeen different tribal groups under its jurisdiction in southeast Alaska. We are surveying these groups' annual harvesting practices (past and present) of non-timber forest products. Sitka Tribe is also conducting

interviews with elders to record and preserve harvesting practices information. The UAF Forest Products Program is using the survey to assess interest and resources in potential non-timber forest product businesses. This is Part 2 of a three-part project. Part 1 surveyed the communities of Sitka, Kake, Hoonah, Yakutat, and Craig. Part 2 surveys the communities of Ketchikan, Hydaburg, Kasaan, Klawock, and Saxman. Part 3 will include Haines, Klukwan, Skagway, Juneau/Douglas, and Angoon.

approach

Surveyors were hired in each community to gather information from the local inhabitants with a readymade survey. Many of these communities are primarily Native Alaskan but the survey is not limited to only Native Alaskans.

progress

Surveys from Part 2 communities have been collected and about half have been entered in the database. Marketing workshops conducted in Sitka, Craig, and Thorne Bay in 2007 generated some interest from tribal members. Communities have been contacted for Part 3 and surveying is expected to begin in summer 2008.

impact

Hiring surveyors from each community has provided some much-needed cash; several communities are excited about potential non-timber forest product businesses.

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 of 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.

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 in) 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 hectare 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.

MARKETING FOREST PRODUCTS

Marketing Alaska wood products

Andy Anger (UAF Tanana Valley Campus, Applied Business and Accounting Program); **Valerie Barber**

purpose

We conduct workshops to provide participants with an understanding of small business marketing with application to (but not limited to) forest products, including timber and non-timber forest products. The workshops will explore the challenges of identifying specific markets, determining customer desires, and scrutinizing how to communicate effectively with potential customers by exploring useful marketing strategies.

approach

Multiple workshops were held in small communities in southeast Alaska. Although forest and non-forest timber businesses are targeted, the sessions are open to anyone with a small business or wanting to start a small business. The workshop format, titled "Reaching Customers for Forest Products—the Marketing Process," covers identifying target markets (process, identifying customer base, determining customer desires, developing products based on customer needs and wants); marketing strategies (with attention to quality, convenience, innovation, customer satisfaction, and speed) and wholesaling; and advertising and publicity.

progress

Sessions were held in April 2007 in Sitka (two evening sessions with four attendees), on Prince of Wales Island in Craig (half-day session with ten attendees), and Thorne Bay (full-day session with twelve attendees). Attendees ranged from those wanting to start businesses to those wanting to know how to improve marketing for established businesses and looking for ways to market their products more economically and effectively. The Thorne Bay workshop consisted entirely of people in the forest product businesses while the other two were primarily people in other industries. Followup communication will be attempted in 2008 with those attending the forest products session in Thorne Bay to document progress and/or problems and to provide additional help if needed. A followup session may be conducted.

Similar marketing workshops will be conducted in 2008–2009 in additional communities in southeast Alaska.

impact

In total there were about twenty-six attendees representing twenty small businesses. Feedback from attendees indicated satisfaction from topics taught and Thorne Bay wood product businesses indicated interest in future workshops.

International markets study Japan

Valerie Barber; Joe Roos (Univ. of Washington CINTRAFOR)

purpose

With the creation of new design standards for Alaska tree species, there is renewed interest in using Alaska timber for construction where strength properties are crucial. New markets are being explored in Japan and China, where wood is becoming more popular in construction projects as the sustainability of forests and a lower carbon footprint (using wood rather than steel or concrete) is recognized.

approach

We conducted marketing research to help determine new markets for Alaska timber and value-added Alaska wood products domestically and abroad. Surveys were conducted at the Japan Home Builders Show in Tokyo in November 2007. The surveys targeted knowledge and uses of Alaska forest products and secondary softwood products in Japan. Industry experts were interviewed to research lumber and residential housing market trends in Japan.

progress

The Softwood Export Council provided travel to Japan and space at their booth at the home show for UAF. Volunteers helped collect close to 100 surveys at the Japan Home Builders Show.

At the GoHo Wood Conference, regarding Japan's future policy to require government purchased wood products to come from legally harvested timber, interviews were conducted with Nihon Jutaku Shinbunsha of the *Japan Housing Newspaper*, Jutaku Sangyo Shibunsha of *Japan Residential Construction Industry Newspaper*, the Enokido Lumber Company, the Japan Laminated Lumber Association, Japan's Wood Information Center, the *Japan Housing Industry News*, the *Japan Lumber Journal*, and the Softwood Export Council. Roos attended the American Forest & Paper Association forest products industry reception at the American Club, and renewed and established important contacts.

impact

New market opportunities for Alaska wood could pump more money into a slumping economy. As the dollar declines against world currencies, there is renewed interest in Alaska wood. The Port of Prince Rupert container shipping port is now operating and aims to be a leading trade corridor 'gateway' between North American and Asian markets. This could provide a more economical way to get Alaska forest products to Asian markets.

WOOD PROPERTIES

Strength ratios in Alaska softwoods

John Bannister (Ketchikan Wood Technology Center); Kevin Curtis (KWTC, Institute of Northern Engineering); Leroy Hulsey (INE); **Valerie Barber**

purpose

The effect of knots on the failure strength of full-size lumber pieces is integral to the calculation of design strengths in in-grade lumber testing programs. Each type and size of knot is assigned a "strength ratio" intended to indicate degrade in failure strength from clear wood failure values. Currently, these knot strength ratios are calculated using formulas developed during the North American in-grade testing program and based on data that did not include test

results from any lumber harvested in Alaska. Alaska softwood in-grade testing indicated that some timber species grown in Alaska exhibit failure behaviors that differ from similar species grown in the contiguous United States. One possibility for this difference may be the effect of knots on lumber strength, so we are investigating this in two Alaska-grown species, yellow cedar and Sitka spruce.

approach

To investigate the effects of various types and sizes of knots, lumber specimens were tested using both in-grade and small clear test methods. A comparison of small clear and in-grade failure stresses will provide an empirical strength ratio for the knot which causes the in-grade failure of the piece. These empirical strength ratios can then be compared to strength ratios currently in use for in-grade design strength analysis. Full-size lumber pieces were tested according to the in-grade testing procedures outlined in ASTM 1990 (American Society for Testing and Materials). A corresponding small clear specimen harvested from a non-stressed portion of each in-grade specimen was tested according to ASTM 143 procedures. This produced a data set of in-grade test results (including failure defect type and size) and matched small clear results.

progress

All in-grade and small clear testing has been completed. A statistical analysis has been performed on the results data. A rough draft of the project report with preliminary conclusions was completed, and a reviewed final report will be ready for publication in spring 2008 as part of the requirements for an MS degree from the Department of Civil and Environmental Engineering at UAF.

impact

We quantified the effects of knots on bending strength, tension parallel to the grain strength, and flexural stiffness in dimension size lumber of Alaska-grown yellow cedar and Sitka spruce. Strength and stiffness ratios were determined for the tested specimens and compared, where data was available, to existing models or previous studies on other species. New models for strength and stiffness ratios for these species were developed utilizing additional predictor variables. We determined that timber species, among other factors, is an important variable in determining knot effects on mechanical properties of lumber. We also concluded that current models to describe knot effects in lumber are not necessarily accurate for the two Alaska species tested, and that testing to develop species-specific strength and stiffness ratio models for knots in lumber would be appropriate.

Alaska birch project

Valerie Barber, Nancy Bigelow, Janice Dawe, Kevin Curtis; Pavel Krasutsky (Univ. of Minnesota Duluth)

purpose

The Alaska birch tree project is a cooperative research effort between UAF, University of Minnesota Duluth, and Ketchikan Wood Technology Center (KWTC). It is an interdisciplinary project to study the physical/mechanical properties, birch bark chemistry, dendroclimatology, genetics, and systematics/evolution of Alaska birch.

approach

Three trees were harvested from each of eight sites in southcentral and interior Alaska in 2006 and from each of six sites in 2007 in eastern Alaska. Stems with leaves were collected from different heights for leaf, seed, pollen, and DNA analyses. Leaves, reproductive material, and tree cores were collected and cataloged for these trees and from at least three other standing trees in each of the plots. The trees were documented (and tagged) for location, stature, diameter, general health, and surrounding vegetation. A plot description was conducted, noting elevation, aspect, vegetation, and site characteristics.

progress

In July 2007, five sites were chosen in eastern Alaska including the Haines area. Three trees and all accompanying samples and data were collected in the Haines area. Another site was identified on the western side of Tok and another on the Tok cut-off. Two more sites were determined southeast of Delta and north of Delta. A total of fifteen trees were cut and shipped to KWTC where they were milled into lumber and dried, for testing and grading purposes.

Bark from each tree was sent to the University of Minnesota-Duluth for chemical analysis. A bark sample was collected from each of the harvested trees, and chemical extractives were performed to determine levels of key compounds important for nutraceutical, cosmetic, and pharmaceutical applications.

The disks and tree cores were processed and ring widths measured on all trees from 2006 and 2007.

Voucher specimens were collected from 90 trees among 17 sites identified in 2006 and 2007. These 17 sites are the same as those used for the log and bark collection (above), with the addition of two new sites, one on the Taylor Highway near Tok and the other at Rainbow Lake on the Kenai Peninsula. The new sites were chosen either because they were in unusual settings or because the trees had unusual leaf or bark characteristics.

We identified at least three trees at each site that would be used for repeated voucher collections. Leaves and bark were collected from all sites (a minimum of three trees at each site). Pollen and seeds were collected from most sites, except for those in the Haines and Kenai Peninsula regions. In all, we collected 63 leaf and bark samples, 53 pollen samples, and 70 seed samples.

Analyses included leaf, seed, bract, and pollen measurements. Leaf and bract analysis (measurements and other characteristics) are (among others such as bark color and stature) key features that should help separate *B. neoalaskana* from *B. kenaica* and *B. papyrifera*, as well as indicate hybridizations with shrub birch, *B. nana* and *B. glandulosa*; seed and pollen measurements may also be characteristic, but this is still untested. Preliminary results of the seed measurements indicate that there is greater variability in the seeds between the trees at a single site than between the sites.

The only site that had markedly different seeds is Rainbow Lake, probably because this site contains hybrids between tree and shrub birches.

impact

A chemical analysis on the outer bark shows promising results. Triterpenoids, with anti- cancer and immunostimulation properties, showed higher concentrations in the Fairbanks samples (32 percent) as compared to Wasilla (20 percent) and higher than Lower 48 trees. Betulin, a powdery substance in the outer bark of birch, has been shown to help wounds heal faster and cut inflammation, and is easily converted to betulinic acid, which possesses a wide spectrum of biological and pharmacological activities, with antimalarial, anti-inflammatory, anti-HIV, and anti-tumor activity. Betulin concentrations in the Fairbanks samples were twice as high as Wasilla samples, and both are higher than Lower 48 birch. In conjunction with this study, the logs were milled, dried, graded, and yield measured at KWTC. All results of the birch study combined should help to characterize birch in Alaska and identify new hybrid taxa, which may help explain the differences found in chemical composition. The study of these bioactive compounds continues to unravel with potential pharmaceutical and nutraceutical applications that will impact the use of native Alaskan birch in new value-added products.

This study has provided training and research opportunities for three high school students through the Alaska Statewide High School Science Symposium. During the 2006–2007 school year, Willie Via of West Valley High School in Fairbanks, quantitatively analyzed a suite of nine leaf measurements from all 2006 field season trees. His findings provide statistical evidence of three leaf characters which appear correlated with betulin content in the trees sampled. If broadened, this approach holds promise for establishing morphologic markers for high betulin trees. During 2007–2008, Rachel Kaplan, also of West Valley High School, quantitatively studied leaves from the 2007 field collections. Her findings show an apparent north-to-south cline: a gradual change in the morphology of *B. neoalaskana* leaves at the eastern edge of the species' distribution in Alaska. The cline appears to be reinforced by ongoing hybridization and introgression between *B. neoalaskana* and shrub birch (*B. nana* and *B. glandulosa*). The third student, Charlotte Anne (Annie) Bender, did a research project concerning the taxonomic traits of lenticels, specifically in birch trees. She concluded that although lenticels showed variances in a tree, it only related to specific traits, such as tree location (based on the lenticels' length and width in comparison to the cardinal directions). The title of the project was Lenticels: More Than a Chamber for Gas Exchange? These findings await further testing, and correlation with bark chemical analysis from the same trees.

Woodwinds

Carolyn Levings, **Valerie Barber**

purpose

Suitable alternative hardwoods may grow in Alaska and elsewhere in the contiguous US and Canada for the manufacture of the bells for the bassoon. Our ultimate goal is to produce a list of woods and associated tone qualities that are appropriate for bassoon.

approach

Since maple is the wood of choice for making bassoon bells, we are collecting different species of maple from different ecosystems and will determine protocols and standards by which to measure the acoustical properties and associated physical properties of maplewood. After this base is established, we will collect hardwood from Alaska species and compare them to maple. This is part of a PhD dissertation.

progress

In summer 2007, wood samples were collected from harvested logs of seven different maple species (A*cer saccharinum, A. rubrum, A. negundo, A. glabrum, A grandidentatum, A. nigrum*, and *A. leucoderme*), from state parks in Oklahoma and Rio Grande National Forest in Colorado, Coconino National Forest in Arizona, Lincoln National Forest in New Mexico, other state parks in Oklahoma, Ouachita National Forest, and Ozark National Forest in Arkansas.

Wood samples were also collected from Alaska birch from the eastern range as part of the Alaska Birch Project.

impact

The survey and characterization of the acoustical properties of maples for use in bassoon-making may assist instrument makers using these woods, and the evaluation of birch and other Alaska hardwood species for similar properties may open potential new value-added markets for Alaska hardwoods.

policy & planning

Environmental assessment of geyser basins

Kenneth A. Barrick

purpose

Geyser basins are globally rare and subject to damage or extinction from energy development activities. The project was undertaken to provide environmental managers with a framework to provide comprehensive environmental assessment of the few remaining geyser basins in the world, including recreation, scientific, economic and national heritage values.

approach

The project relies on library scholarship and known examples of geyser basin decline and extinction from New Zealand, Iceland, and the US.

progress/results

Library research was conducted and a manuscript was prepared for publication in an academic journal.

impact

The project will provide a basis for understanding the societal value of the world's remaining geyser basins. The potential negative impacts on the hydrothermal features of geyser basins is summarized as an aid to protecting geysers from potential development impacts, including from nearby

Grand Prismatic Springs in New Zealand. Geyser basins such as these have great value for recreation, energy development, and scientific study; however, the hydrothermal reservoirs that supply them need protection from development impacts that may cause their damage or extinction.

—PHOTO BY KENNETH A. BARRICK

geothermal energy development. The summary provides lines of evidence that will be useful in the protection of the remaining geyser basins around the world, including Yellowstone National Park, US.

Protecting the geyser basins of Yellowstone National Park

Kenneth A. Barrick

purpose

The project was undertaken to provide environmental managers with a framework to understand the potential environmental and geothermal energy conflicts on the border of Yellowstone National Park, and to propose a "Geyser Protection Area" across the hydrothermal reservoir(s) that supply the park's geyser basins.

approach

The project relies on library scholarship and known examples of geothermal energy proposals on the Island Park and Corwin Springs Known Geothermal Resource Areas, which are located adjacent to Yellowstone.

progress/results

Guidelines were developed for a comprehensive new Yellowstone "Geyser Protection Area" based on the known examples of geyser decline and extinction around the world. Library research was conducted and a manuscript prepared for publication in an academic journal.

impact

The longstanding controversy regarding the potential development of geothermal energy wells adjacent to Yellowstone National Park are summarized to assist environmental managers' understanding of the need to protect the hydrothermal reservoirs that supply the park's geysers and hot springs. Geyser protection guidelines will provide a basis for updating regulations. The potential negative impacts of geyser and hot spring research involving intrusive sampling techniques are outlined, including geothermal research wells and lowering sampling equipment down the underground plumbing of geysers.

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

Spring 2007 saw the initial operation of a new structure to redirect water from a divergent tributary stream into Harding Lake. Channel icing obstructed flow paths but some water from snowmelt and summer rainfall runoff did flow to the lake. We documented that the lake held its level over the summer but then declined under the ice during the first half of winter. A spreadsheet version of a monthly lake water balance model was run using precipitation, pan evaporation, and runoff data from nearby weather and runoff stations for 1950–2007. The simulation was calibrated with two lake level measurements, one in 1978 and one in 2006, assuming the diversion of the feeder stream occurred in 1968. A ground water outflow coefficient was the main calibration parameter. The final value of this coefficient was consistent with the hydraulic characteristics of the known aquifer material. Model testing was carried out with measured lake levels not used in the calibration process. The model underestimated lake levels in 1985 but performed well for the summer months of 2004–2007. Uncertainty remains for winter conditions.

impact

This project has provided documentation of lake decline and information for the planning of the rechanneling project. At the end of 2007 I made a presentation to the Alaska Section of the American Water Resources Association summarizing information gathered on the historic lake levels at Harding Lake, and on model projections. Focus now will shift on documenting the recovery of the lake to the target level and on estimating how long it will take the lake to reach that level under different inflow scenarios. Information that I have collected has been shared with members of management agencies and the Harding Lake Watershed Council. This information is being used by the Alaska Department of Fish & Game, the Natural Resources Conservation Service, and the Salcha-Delta Soil and Water Conservation District in designing and planning for a control structure on the divergent stream.

International Polar Year: Impacts of high-latitude climate change on ecosystem services and society

F.S. Chapin, III (IAB); **Gary Kofinas, T. Scott Rupp**

purpose and approach

Arctic environmental and ecological changes have had profound social impacts on indigenous and nonindigenous people because of both the large magnitude of changes and the generally strong dependence on renewable resources that characterize northern societies. Ecosystem services, which are 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 policy makers and the public with a firm foundation for policy formulation and change. The goals of this proposed research are to (1) document the current status and trends in ecosystem services in the Arctic and the boreal forest, (2) project future trends in these services; and (3) assess the societal consequences of altered ecosystem services.

progress

This project is just beginning, with a focus on coordinating field logistics and development of the modeling framework to project future trends in ecosystem services. The modeling component of this study began fall 2007 and will not be fully implemented until 2008.

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.

When laws affecting the environment conflict: focus on public lands

Julie Lurman Joly

purpose

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

approach

Four aspects of federal and state law and policy were examined:

1. the potential for direct conflict between the state's Intensive Management statute and the enabling legislation for certain federal land management agencies;

2. the US Fish & Wildlife Service's failure to meet its obligations under the Migratory Bird Treaty Act to provide regulatory guidance to agencies on the matter of incidental takes;

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

4. assisted migration (currently being debated by conservation biologists), a method of dealing with increasingly endangered flora and fauna in a time of climate change.

progress

1. After an analysis of the applicable statutes and case law was completed it was clear that the conflict in question is impairing the National Park Service's ability to meet its statutory goals and that it should preempt these rules on NPS lands. This manuscript was published in the December 2007 issue of the *Alaska Law Review*.

2. This work analyzes why agencies continue to violate the statute, what they are risking, and suggests regulatory changes for Fish & Wildlife that could correct this regulatory gap. This manuscript was published in December 2007 in *Journal of Land Use and Environmental Law*.

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 will be published in spring 2008 in *Ocean and Coastal Law Journal.*

4. An analysis of the existing legal support and legal obstacles to such a course of action is underway.

impact

1. This research may keep federal land managers from running afoul of the law and risking expensive and time-consuming legal challenges. It should provide federal land managers with a clearer understanding of their duties and responsibilities and provide state managers with a better understanding of the laws that constrain their federal counterparts.

2. This work will be of interest to all federal land and wildlife managers who deal with migratory birds, particularly in Alaska.

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.

4. As the concept of assisted migration becomes a topic of intense interest 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.

Factors influencing large wildland fire suppression expenditures

J. Liang; D.E. Calkin, K.M. Gebert (USFS, 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. A paper was published on our results in *International Journal of Wildland Fire*.

impact

The results suggested that efforts to contain federal suppression expenditures need to focus on the highly complex, politically sensitive topic of wildfires on private land.

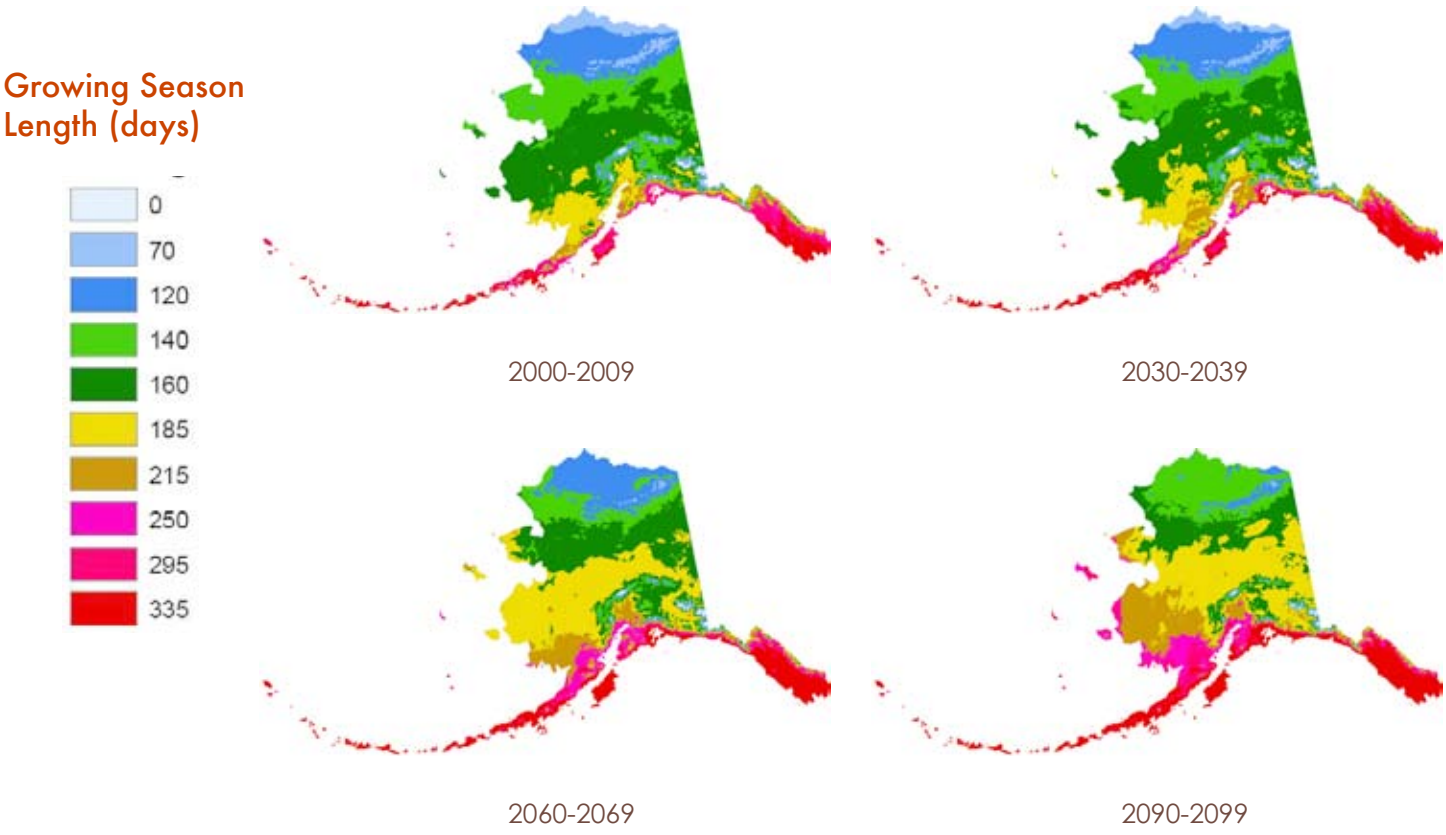
Scenarios Network for Alaska Planning

T. Scott Rupp, Nancy Fresco, Mark Olson, Tim Glaser, Anna Springsteen; Sarah Trainor (Institute of Northern Engineering); numerous other Univ. of Alaska 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 regarding ocean navigation, pipelines, roads, urban expansion, community relocation, management of fisheries and wildlife, etc.

The Scenarios Network for Alaska Planning (SNAP, www.snap.uaf.edu, housed within the UA Geography Program) is a collaborative network, whose mission is 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 (IPY), and supported by the 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.



Maps from the SNAP report to Governor Palin's Sub-cabinet on Climate Change, showing projected season changes.
—COURTESY SNAP

progress

A wide range of SNAP projects is already in progress. SNAP is providing data for the Governor's Sub-cabinet on Climate Change and the Interior Issues Council's Climate Change Task Force. SNAP and the Wilderness Society have completed projections for climate change in the Yukon Flats area. In collaboration with the US Fish and Wildlife Service, SNAP is assessing landscape connectivity in the context of climate change, and also developing projections of growing-season length and water availability. Other SNAP collaborators include the US Forest Service Northwest Research Station, the National Marine Fisheries Service Habitat Conservation Division Alaska Region, municipal hydropower utilities managers, the Nature Conservancy, and the North Slope Borough.

SNAP is working with Google employees to create a Google Earth (KML) interface for SNAP maps, so stakeholders can easily view climate projections and associated information from their homes or offices; and schoolchildren can use these maps as part of a hands-on Google project. The first of these interactive maps is now on the SNAP website.

impact

SNAP is a pragmatic plan to facilitate integration of UA's world-class high-latitude research capabilities and deliver timely information and interpretation of climatic, ecological, and economic change. 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 IPY. 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.

Is it possible to "green" the UAF campus?

Susan Todd

purpose

Students across the country are starting to "vote with their feet" by choosing colleges that have a clear commitment to sustainability. According to a survey of 10,300 college applicants and parents, *The Princeton Review* found that "63 percent would value having information about a college's commitment to the environment and that it would impact their decision to apply or attend the school." (*The Maneater*, Michelle Hagopian, May 2, 2008, www.themaneater.com/stories/2008/5/2/princeton-review-rank-sustainability-practices-col/)

The environmental component of sustainability is based on the fundamental rules of conservation that were recommended long before global warming was a concern.

Those fundamentals are:

• Reduce dependence on non-renewable, non-recyclable materials, as these will run out.

• Harvest renewable resources no faster than they can be renewed, or they will also run out.

• Produce wastes no faster than nature can absorb or break them down, or we will poison our own "nest."

This project examined the need to adapt UAF's policies to make the campus more environmentally sustainable.

approach

One of the first questions addressed was whether UAF needed to prepare a sustainability plan. A quick survey of students and faculty uncovered some compelling answers:

• UAF is on the frontlines of climate change; the Arctic is experiencing greater rates of warming than other regions. Since we are the nation's only arctic university, it is appropriate that UAF take a leading role in the effort to reduce greenhouse gases.

• Our remote location, and that of Alaska's villages, makes us more vulnerable to the disruptive effects of increases in energy prices.

• UAF's energy consumption contributes to local air pollution and the rising global pool of greenhouse gases.

• We should do more than just research and teach about sustainability. UAF should be setting an example; we should be leaders in this area, not followers.

• We can save money.

• Green buildings, sunlight, plants, and natural areas promote a sense of wellbeing and enhance learning and productivity.

progress

With the assistance of students in the natural resources management program, this project completed the following:

• Determined that there are compelling reasons for creating a UAF sustainability plan.

• Conducted a preliminary sustainability audit (how much coal does UAF use? How much CO_2 does the power plant emit? How much paper, aluminum cans, and plastic bottles do we use? How much do we recycle, etc.?)

• Reviewed the literature and campus websites to document what other campuses are doing to demonstrate their commitment to sustainability.

• Prepared a PowerPoint presentation summarizing the recommendations of the students.

• Prepared a draft plan of actions UAF might take to become more sustainable.

• In the context of a larger effort by UAF administration, the students presented this information to a campus-wide committee to consider in developing a final UAF campus sustainability plan.

impact

It is expected that many of the recommendations included in the draft will be adopted by UAF. The students' presentation of their recommendations can be viewed at YouTube. (www.youtube.com/watch?v=a2zT0XNZ5pk)

recreation

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

Peter J. Fix, Jennifer Stegmann

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 onsite survey and were given a more detailed survey to return by mail.

progress

During summer 2007, 633 onsite surveys were completed. Data analysis is in progress.

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.

Alaska residents statistics program

Peter J. Fix, Quinn Tracy

purpose

This study assessed travel and recreation patterns of Alaska residents, barriers to participation in outdoor recreation, desired recreation development (or lack thereof), and attitudes and values regarding natural resource management. This study was conducted in cooperation with several federal and state agencies (the US Department of the Interior's Bureau of Land Management, National Park Service, Fish & Wildlife Service; US Department of Agriculture Forest Service; Alaska Department of Transportation and Public Facilities, State Parks, and Fish & Game). The resulting information will be incorporated into their planning processes.

approach

Information was gathered using a mail survey. The state was stratified into five regions and samples drawn from each region.

progress

The survey achieved an overall response rate of 27 percent (2,264 surveys completed). A non-response test indicated nonrespondents were similar to respondents. Data analysis is in progress.

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.

AFES Pub. No. MP 2008-07 fysnras@uaf.edu • 907.474.7083

Caribou genetics and management

M.A. Cronin; M.D. MacNeil (USDA); J.C. Patton (Purdue University); S. Haskell, W.B. Ballard (Texas Tech University); 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 and progress

To assess herd interactions, genetic variation will be determined. Fieldwork, including observations of caribou distribution and behavior in and around northern Alaska oil fields, has been done to assess potential effects. New molecular markers from cattle will be applied to Alaska caribou in 2008.

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.

Grizzly bear genetics

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

purpose

This project assesses grizzly bear demography and genetic variation in North America.

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 existing 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 rates among subpopulations as estimated with molecular allele frequencies.

Polar bear genetics

M.A. Cronin; S.A. Amstrup (US Geological Survey); K. Scribner (Michigan State University)

purpose

This project aims to improve understanding of polar bear demographics, with particular emphasis on potential changes due to climate change.

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). Manuscripts are being prepared for publication.

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.

Polar bear sow in the Arctic National Wildlife Refuge, October 2007.

—photo by Alan D. Wilson, Wikimedia, Creative Commons Attribution ShareAlike 3.0 License

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Thunder Chip potato chip factory, one of the tour stops for the NRM 290 class, in Anchorage.
—PHOTO BY MATTHEW HELT

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Basil growing in a greenhouse in the Fairbanks area, summer 2007.
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