Annual Report 2013

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

Agricultural & Forestry Experiment Station

Mingchu Zhang checking canola variety trial plots at the Fairbanks Experiment Farm. AFES photo by Nancy Tarnai

2013 HIGHLIGHTS

FOREST FEST DRAWS RECORD NUMBERS

The 16th annual Farthest North Forest Sports Festival drew a record number of participants in October, both at the Fairbanks Experiment Farm and Ballaine Lake.

The lumberjack-stye competition was hosted by SNRAS's forest sciences department and the student group Resource Management Society. A special thanks this year went to Northland Wood and Herbert Baxter for donating all the wood needed for the events.

Besides the large number of attendees, this event was notable for some other memorable moments. The massive birling log floated away and was nearly across the lake before the foresters decided it needed rescuing. Take-charge bystanders Rebecca Finger, Sophie Gilbert and Timothy Bartholomaus raced to a nearby house and borrowed a canoe. They rescued the log just in time for the birling competition.

Volunteers retrieve the birling log after it drifted away.

The overall winning team was decided with an extra event, pounding nails into a log. The three-way tie between the Wood Chips, Schaeffer Cox Freedom Riders and the Lumber Jerks was broken when Pete Buist of the Wood Chips pounded the nails in 14.40 seconds.

It was another successful event, with happy competitors, observers and volunteers.

Alice Orlich and Pete Buist were named Belle and Bull of the Woods.

CONTENTS:

LETTER FROM THE INTERIM DEAN & INTERIM DIRECTOR:

December 16, 2014

The Honorable Bill Walker
Governor of Alaska
P.O. Box 110001
Juneau, Alaska 99811-0001

Dear Governor Walker:

I submit herewith the annual reports from the Agricultural and Forestry Experiment Station, School of Natural Resources and Agricultural Sciences, University of Alaska Fairbanks, for the period ending December 31, 2013. 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 and by broad subject, focusing on geography, high-latitude agriculture, forest sciences, and the interaction of humans and the environment. Research conducted by our graduate and undergraduate students plays an important role in these grants and the impact they make on Alaska.

Very respectfully,

Stephen P. Sparrow
Interim Dean and Interim 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.

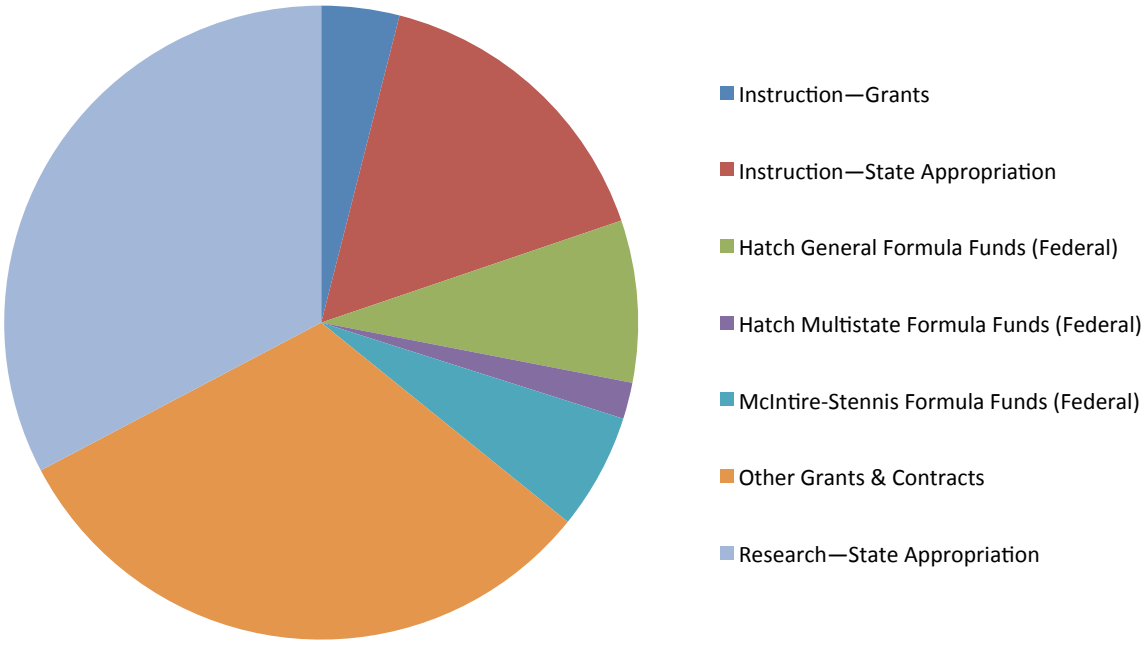
Administratively, AFES is an integral part of the School of Natural Resources and Agricultural Sciences at the University of Alaska Fairbanks. This association provides a direct link between research and teaching. Scientists who conduct research at the experiment station also teach, sharing their expertise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

FY14 Statement of Expenditures: July 2013 through June 2014

The following statement of expenditures of federal and state funds for the fiscal year beginning July 1, 2013 and ending June 30, 2014 (FY 14) is not an accounting document.

INSTRUCTION—GRANTS:	**$**	**344,993.00**
INSTRUCTION—STATE APPROPRIATION:	**$**	**1,371,389.00**
HATCH GENERAL FORMULA FUNDS (FEDERAL):	**$**	**716,707.00**
HATCH MULTISTATE FORMULA FUNDS (FEDERAL):	**$**	**161,244.00**
MCINTIRE-STENNIS FORMULA FUNDS (FEDERAL):	**$**	**512,590.00**
OTHER GRANTS & CONTRACTS:	**$**	**2,729,873.00**
RESEARCH—STATE APPROPRIATION:	**$**	**2,838,745.00**

TOTAL: $8,675,901.00



FUNDING AND GRANTS

Grant Funds for 2013

GRANTS & CONTRACTS / SPECIAL FUNDS

TITLE	PI	FUNDING AGENCY
Wood Utilization Research Year 10	Barber	USDA National Institute of Food & Agriculture Special Grant
Nenana Log Cabin Building Workshop	Barber	Program Income
Stooling Beds	Barber	Alaska Department of Natural Resources
Holistic Integration for Arctic Coastal-Marine Sustainability (HIACMS)	Brigham	State of Alaska
Alaska Stand-Alone Gas Pipeline	Cronin	State of Alaska
Alaska Wildlife Genetic and the Endangered Species: Wolf genetics; Steller Sea lion Genetics	Cronin	Alaska Department of Fish & Game
Comparing Vitamin and Mineral Concentrations in Reindeer in New York and Alaska	Finstad	Cornell University
Reindeer Range Management and Monitoring	Finstad	Bureau of Land Management
Enhanced Range Management of Reindeer	Finstad	Natural Resources Conservation Service
NRCS Reindeer Collar Program	Finstad	Natural Resources Conservation Service
Reindeer Meat Production Workshop	Finstad	Bureau of Indian Affairs
Research in Residence	Fix	National Park Service – Denali National Park
Investigating Social and Spatial Aspects of Sport Hunting in Western Noatak National Preserve	Fix	National Park Service
UAF BLM Benefit Benefit-Based Management	Fix	Bureau of Land Management
CHL — Children's Healthy Living	Greenberg	University of Hawaii
Matanuska Sports Turf Field	Harris	UA Foundation
Tundra in Transition	Harris	Fish and Wildlife Service
Long-Term Ecological Research (LTER) 7	Hollingsworth	National Science Foundation
GBG Children's Garden, UA Foundation	Holloway	UA Foundation
GBG Ohleson Family Garden	Holloway	UA Foundation
GBG Endowment	Holloway	UA Foundation
GBG Research Survival FY13 Capital	Holloway	UA Foundation
Drew Amphitheater Foundation Research	Holloway	UA Foundation
Fire History, Climate-Tree Growth Relations, and Caribou Lichen Range In the BLM White Mountains in Central Alaska	Juday	Bureau of Land Management
Boreal Alaska – Learning, Adaptation, and Production (BAKLAP)	Juday	State of Alaska
Long-Term Ecological Research (LTER) 7	Juday	National Science Foundation
Sustainable Horticulture Research	Karlsson	UA Foundation
FFA Foundation	Karlsson	UA Foundation
AGA Operations	Kennedy	National Geographic
Documenting Traditional Knowledge of Migratory Behavior	Kofinas	National Park Service
Long-Term Ecological Research (LTER) 7	Kofinas	National Science Foundation

Oil & Gas Development Impacts, AFES	Kofinas	USDI Minerals Management Services
Haines Growth & Yield	Malone	Department of Natural Resources
Afognak Island Sample Plots	Malone	Afognak Native Corporation
Model of Glacier Bay's Late Pleistocene Coastline	Mann	National Park Service
Impacts of Climate Change-Induced Geomorphic Instability on Cultural Resources in Gates of the Arctic National Park	Mann	National Park Service
Impacts of Past Warming	Mann	Bureau of Land Management
Predicting the Effects of Climate Change Based on Past Occurrences of Climate Warming in the National Petroleum Reserve Alaska (NPRA)	Mann	Bureau of Land Management
Native People, Harbor Seals & Glacial History	Mann	National Science Foundation
Trade Barriers Surrounding Export	McBeath	USDA Foreign Agricultural Service
Soil Carbon in Ice Wedges	Ping	Argonne National Laboratory
Monitoring Permafrost Degradation	Ping	Natural Resources Conservation Service
Argonne National Lab/UAF Soil Carbon Field Campaign to Arctic Coastal Plain	Ping	Argonne National Laboratory
Rapid Carbon Assessment (RaCA) in Alaska	Ping	Natural Resources Conservation Service
Strategies for Livestock Production	Rowell/Shipka	USDA National Institute of Food & Agriculture
Emissions Testing — Haines	Soria	City of Haines
Biodiesel Production in Guam	Soria	University of Guam
MAPTEACH — SNRAS & GI	Sparrow, Elena	US Department of Education
Educating Alaska Agriculture Professionals	Sparrow, S.	Utah State University
Circumpolar Agriculture Conference	Sparrow	Program Income
Soil Nutrient Testing in Delta	Sparrow	Salcha-Big Delta Soil and Water Conservation District
Long-Term Ecological Research (LTER) 7	Valentine	National Science Foundation
Long-Term Ecological Research (LTER) 7	Verbyla	National Science Foundation
Lake Surface Area in KVNP	Verbyla	National Park Service
Long-Term Ecological Research (LTER) 7	Yarie	National Science Foundation
Whitehorse Biochars	Zhang	Yukon College - Northern Research Institute
RITA Ice Rich Cut Slopes	Zhang	US Dept of Transportation

FORMULA FUNDING, FEDERAL OCT 1 TO SEPT 30 FISCAL YEAR 2014-----ALL USDA- NATIONAL INSTITUTE OF FOOD AND AGRICULTURE

TITLE	PROJECT #	PI
Hatch General		
Commercial Reindeer Meat Production	ALK-10-08	Finstad
Outdoor Recreation, Parks and Other Green Environments: Understanding Human and Community Benefits and Mechanisms	ALK 13-02	Fix
Evapotranspiration from Boreal Forest	ALK-05-04	Fox
Natural Resources & Economic Sustainability	ALK -08-02	Greenberg
Production of Livestock on Small Acreages in Alaska: Defining the Alaska Animal Unit and Effective Distribution of Grazing Activities	ALK 10-03	Harris

Horticultural Crop Production for Alaska	ALK-08-01	Holloway
Laws Affecting Environment	ALK -05-01	Joly
Legal Conflicts in Natural Resources Management and the Implications of Climate Change	ALK 10-05	Joly
Controlled Environment Horticulture for Alaska	ALK -07-06	Karlsson
Alaska High Tunnel Greenhouse	ALK 14-01	Karlsson
Wetland Protection and Hydric Soils Monitoring in Volcanic Ash Derived Soils in Alaska	ALK -09-02	Ping
Alaska Coastal Rainforest	ALK 13-01	Sparrow/Rupp
Lignocellulosic Energy Crops	ALK-08-03	Sparrow
Hatch Research Coordination	ALK-11-04	Sparrow
Issues in Resource Planning in Alaska	ALK-09-01	Todd
Selecting Alternative Agronomic Crops for Alaska	ALK-08-06	Zhang
Hatch Multistate		
Balancing Natural Resource Recreation Management, Human Well-Being and Community Resilience	ALK-09-07	Fix
Outdoor Recreation, Parks, and Other Green Environments: Understanding Human and Community Benefits and Mechanisms	ALK13-02	Fix
Rangeland Fragmentation W 1192	ALK-07-07	Harris
Commercial GreenhouseProduction: Component and System Development NE-1035	ALK-09-05	Karlsson
Reproductive Performance, W 2112	ALK-12-03	Shipka/Rowell
Multistate Research Coordination, Western Region	ALK-99-05	Sparrow
Nitrogen Mineralization NC 1032	ALK-07-08	Zhang
Regional Administration W-106	ALK-99-05	Sparrow
McIntire-Stennis		
Survival, Adaptation, and Production (BAKSAP) — Knowledge and Strategies in a Regime of Biome Shift	ALK-13-04	Juday/Dawe
Climate Sensitivity of Tree Growth: Strategies for Management	ALK-07-12	Juday
Developing biomass pyrolysis drop-in fuels and chemical feedstocks	ALK 10-10	Soria
McIntire-Stennis Forestry Cooperative Research	ALK-11-05	Sparrow
Sensitivity of Carbon Budgets and Nutrient Dynamics in Boreal Forest Soil	ALK-07-11	Valentine
Landscape Fire Interactions in Black Spruce	ALK-05-03	Verbyla
Remotely Sensed Vegetation Index	ALK 10-09	Verbyla
The Dynamics of Forest Growth	ALK-06-04	Yarie
Measurement & Management of Boreal Forest Under Risks	ALK-09-08	Yarie
Adaptive Management Plan for the University Forest	ALK 12-01	Yarie

STUDENTS

Bachelor's Degrees

CHRISTINE E. BUTCHER
B.S., Geography: Geographic Information Science and Technology

MITCHELL EMERSON CHANDLER
B.S., Natural Resources Management: Plant, Animal, and Soil Sciences

ERIKA EDGAR
B.S., Geography: Environmental Studies

NATHAN JEFFERY HEERINGA
B.S., Natural Resources Management: High Latitude Agriculture

JENNIFER LYNN LUTZE
B.S., Natural Resources Management

SHANNON RAE PEARCE
B.S., Natural Resources Management: Plant, Animal, and Soil Sciences

CURT WAYNE PUFFER
B.A., Geography

BLAINE SISSON
B.A., Geography: Landscape Analysis and Climate Change Studies

JONATHAN ROBERT SMITH
B.A., Geography

JASON MARK THEIS
B.S., Geography: Geographic Information Science and Technology

NICOLE D. WELLS
B.S., Natural Resources Management: Plant, Animal, and Soil Sciences; Wildlife Biology (cum laude)

ANNEMARIE BRIDGET WHITE
B.S., Natural Resources Management: Forestry

Master's Degrees

GARRETT LAMBERT ALTMANN
M.S., Natural Resources Management

CARSON ALAN BAUGHAM
M.S., Natural Resources Management

SUNNY MONIQUE CASTILLO
M.S., Natural Resources Management

WINSLOW D. HANSEN
M.S., Natural Resources Management

HEIDI L. HATCHER
M.S., Natural Resources Management

BRETT MATTHEW PARKS
M.S., Interdisciplinary Program

JAMES W. SHEWMAKE II
M.S., Natural Resources Management

NICOLE Y. SWENSON
M.S., Natural Resources Management

DEGREES OFFERED

BACHELOR'S DEGREES:
- Bachelor of Arts in Geography
- Bachelor of Science in Natural Resources Management
- Bachelor of Science in Geography

MASTER'S DEGREES:
- Master of Science in Natural Resources Management
- Master of Natural Resources Management and Geography

DOCTORAL DEGREES:
- Doctor of Philosophy in Natural Resources and Sustainability
- Interdisciplinary Doctor of Philosophy*

**coordinated with the Graduate School*

Graduation: the balloon release celebrating the new graduates and their triumphant success after years of hard work. *AFES photo by Nancy Tarnai*

Five-year statistics: number of students enrolled, 2009-2013 (majors)

ACADEMIC YEAR	PH.D. (SUSTAINABILITY)	PH.D. (INTERDISCIPLINARY)	MS NRM	MS / MA (INTERDISC.)	MNRM&G	BS GEOGRAPHY	BA GEOGRAPHY	BS NRM
2009	2	11	34	1	0	25	25	65
2010	7	10	36	4	7	34	26	71
2011	13	6	30	3 MS / 1 MA	3	16	14	54
2012	15	8	23	2 MS / 1 MA	3	22	20	51
2013	13	5	28	3 MS / 2 MA	4	17	11	49

Doctoral Degrees

CINDY E. FABBRI

Ph.D., Natural Resources and Sustainability

Thesis: A Model for Sustainability Science in Higher Education: Water Research, Science and Sustainability Literacy and Community Adaptive Capacity

Major Professor: Elena Sparrow

KIMBERLY ANNE CAMILLE MAHER

Ph.D., Interdisciplinary Studies

Thesis: Birch, Berries, and the Boreal Forest: Activities and Impacts of Harvesting Non-Timber Forest Products in Interior Alaska.

Major Professor: Glenn Juday

Erika Edgar and Christine Butcher each graduated with a bachelor of science degree in geography.

RESEARCH AT SNRAS AND AFES

THE NEW MARITIME ARCTIC: GLOBAL CONNECTIONS AND COMPLEX CHALLENGES

Lawson W. Brigham

Abstract: Early in the 21st century, the "New" Maritime Arctic is experiencing an unprecedented mix of globalization, regional climate change, and geopolitics. Together these drivers are forcing significant change in this once-remote region at the top of the world. The Arctic is understood to be a large storehouse of yet-untapped natural resources, and exploration and development have accelerated to where the region is set to be a key player in the global economy. Marine access is also changing in response to the profound transformation of Arctic sea ice. Substantial increases in Arctic marine access will present continuing challenges to the existing legal and regulatory structures that address marine safety and environmental protection and pose new regional security challenges. The ongoing UNCLOS process for delimitation of the outer continental shelf in the Arctic Ocean also presents unique issues that may take decades to resolve. The Arctic Council, the intergovernmental forum of the eight Arctic states, conducted an Arctic Marine Shipping Assessment (2005-09), approved by the Arctic ministers, which established a framework strategy to address the protection of Arctic people and the marine environment in response to broad increases in marine use. Key progress has been made by the Arctic states in dealing with response to Arctic search and rescue and oil spill response and preparedness. Key prevention issues are being addressed at the International Maritime Organization but these efforts have not kept pace with the expanding marine operations throughout the Arctic Ocean. All of these new connections and challenges will require historic levels of cooperation among the Arctic states, and broad engagement of the Arctic community with the rest of the globe.

BISON AND CATTLE GENETICS

Matthew Cronin, N. Vu, M.D. MacNeil, V. Leesburg, H. Blackburn and J. Derr

Purpose: Two subspecies of bison have been designated: wood bison and plains bison. Both subspecies occur in Alaska. The subspecies are not well established scientifically; our purpose was to assess the genetic variation within and between the bison subspecies and compare them with cattle breeds and subspecies.

Approach: We quantified genetic variation with thirty-four microsatellite DNA markers from the cattle gene map for wood bison, plains bison, breeds of the taurine and indicine cattle subspecies, and feral cattle from Chirikof Island. We calculated genetic distances and estimated the genetic relationships of wood bison and plains bison and the cattle breeds with Bayesian clustering analyses. This study was done in collaboration with cattle geneticists with USDA and Texas A&M University.

Progress: We completed lab and data analysis of 34 microsatellite loci for 136 plains bison from nine herds, 65 wood bison from three herds, 244 taurine cattle from 14 breeds, and 53 indicine cattle from two breeds. Wood bison and plains bison are not supported as subspecies with these data and other genetic data that we reference. A report was submitted to the Alaska Department of Fish and Game in 2011 and a paper was published in 2013. Additional tissue samples from Alaska plains bison were collected in 2013 and will be collected in 2014.

Impact: Wood bison are listed as endangered in the Endangered Species Act (ESA) and there are plans to establish wild populations in Interior Alaska. The lack of support for wood bison and plains bison as subspecies means that the wood bison subspecies ESA listing is not valid. If wood bison are removed from the ESA list, they could potentially be reintroduced in Alaska without concern over restrictions on other land uses. This would establish another wild herd of bison in Alaska. The genetic data have potential utility for improved bison management across North America involving use of all bison genetic resources to maximize genetic diversity and fitness in wild and domestic herds. The US Department of Agriculture National Animal Germplasm Program is interested in this issue because of their objective of using genetic resources of livestock including bison.

Grants/Funding: Alaska Department of Fish and Game, Alaska Terrestrial Genetics

ENDANGERED SPECIES ACT SCIENCE AND MANAGEMENT

Matthew Cronin

Purpose: 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 for ESA listing, assessment of threatened or endangered status, and possible management actions to achieve specific objectives. Information is disseminated to policy makers and managers. Collaboration with state and federal agencies is part of this effort.

Progress: From 2004 to 2013, information has been provided to the Alaska governor's office, the Attorney General, state legislators, state agencies, the public media, and the natural resource industries on several Alaska ESA issues and species, including polar bears, brown bears, bison, beluga whales, Steller sea lions, sea otters, eiders, loons, goshawks, wolves, and species in the other states. Review and assessment of scientific and management documents has been done for several of these species. Unpublished essays and comments on ESA listings have been written in 2013.

Impact: This work allows policy makers, managers, and the public to better understand the science being used in ESA issues.

Grants/Funding: Alaska Department of Commerce, Community, and Economic Development, ESA in Alaska—Mammal Genetics and the natural resources funding from the Alaska Legislature to SNRAS.

POLAR BEAR, BLACK BEAR, AND BROWN BEAR GENETICS

Matthew Cronin, R.J. Baker, M.M. McDonough, H. Huyn (Texas Tech University), J.F. Medrano, G. Rincon, A. Cánovas, A. Islas-Trejo (UC Davis), M.D. MacNeil (Delta G), S. Crockford (Pacific Identifications), R. Meredith (Montclair State University)

Purpose: This project assesses the genetic relationships, phylogeny, and divergence times of the three species of bears in North America. Polar bears worldwide and brown bears in the lower 48 states are listed under the Endangered Species Act (ESA). The survival of polar bears during past cool and warm geological periods is relevant to predicted future impacts to the species from climate change. Estimation of the divergence time of polar bears from ancestral brown bears indicates how long polar bears have been a species. This will allow identification of past warm and cool periods to which polar bears have been exposed, and better inform predictions of the species' future considering climate change. We are collaborating with genome scientists at University of California Davis, and paleontologists in British Columbia and at the US Geological Survey and Montclair State University on this project.

Approach: Molecular genetics technology is used to quantify the phylogeny and genetic relationships of bears in North America. The project includes:

a. A review of the fossil record of polar bears and marine mammals and climate of the Arctic and North Pacific Ocean over the last 200,000 years.

b. An assessment of genetic variation of microsatellite DNA of brown and polar bears across North America and polar bears worldwide. This project was in collaboration with USDA.

c. A study of genetic variation of amplified fragment length polymorphism and mitochondrial DNA sequences in polar, brown, and black bears. This project was in collaboration with Texas Tech University.

d. A study of genome variation including single nucleotide polymorphisms (SNP) in polar, brown, and black bears. Phylogeny and divergence time of the species was estimated with ultra-conserved elements derived from genome sequences. Other nuclear DNA sequences were also analyzed. This study is in collaboration with the University of California Davis and Montclair State University.

Progress: A report was submitted to DCCED on the review of the fossil record of polar bears and marine mammals and climate of the Arctic and North Pacific Ocean over the last 200,000 years.

a. Three papers were published on the genetic variation of microsatellite DNA, amplified fragment length polymorphisms, mitochondrial DNA, single nucleotide polymorphisms (SNP), and genome ultra-conserved element DNA sequences of brown bears across North America and polar bears worldwide. This study showed the three species have separate gene pools, and an approximate divergence time of 1.2 million years for brown and polar bears.

Impact: The project provides a review of the history of polar bears and their relationship to brown and black bears. The genetic data show extant polar, brown, and black bears have separate gene pools with no evidence of hybridization. The estimate of the time of divergence of polar bears and brown bears (1.2 million years) means that polar bears have been exposed to several previous warm and cool periods. This is relevant to predictions of the species being endangered with extinction and its listing under the ESA.

Grants/Funding: Alaska Department of Commerce, Community, and Economic Development, ESA in Alaska—Mammal Genetics

WOLF GENETICS

M.A. Cronin, J.F. Medrano, G. Rincon, A. Cánovas, A. Islas-Trejo (University of California Davis), R. Meredith (Montclair State University), M.D. MacNeil ,V. Leesburg (USDA)

Purpose: This project assesses wolf genetics and taxonomy. Wolves in southeast Alaska have been designated as a subspecies (the Alexander Archipelago wolf). The subspecies has been petitioned for listing under the Endangered Species Act (ESA). It is not clear it is a legitimate subspecies. The wolves on Prince of Wales Island (POW) are also being petitioned for listing as an endangered distinct population segment (DPS). This project will assess the subspecies status of the wolves in southeast Alaska, and the genetic relationships of the wolves on POW to other wolves. Wolves from southeast Alaska will be compared to wolves across North America, and with coyotes and dogs for an overall phylogenetic and population genetic assessment.

Approach: Cronin and the UC Davis team are using molecular genetics technology to quantify the genetic relationships of wolves in southeast Alaska and wolves and coyotes across North America. We genotyped several hundred wolves with the canine 171,000 single nucleotide polymorphisms (SNP) system with Geneseek Inc. Data analysis is being done with the University of California Davis genomics laboratory. Genetic distances and relationships among wolf populations will be quantified and compared to those among dog breeds.

Progress: Tissue samples from several hundred wolves were collected in 2012 with the help of Alaska Department of Fish and Game and other agencies. We determined 171,000 SNP genotypes for 77 wolves, two coyotes, and one dog in 2012. SNP data for dog breeds was obtained from collaborators. A report was completed and submitted to the Alaska Department of Fish and Game in 2013. Data analyses and manuscript preparation was done in 2013 and will be completed in 2014.

Impact: The project will provide quantitative information on the genetic relationships and subspecies status of wolves in southeast Alaska

and the DPS status of wolves on POW. This information will be relevant to the legitimacy of the ESA listing petition and wolf management.

Grants/Funding: Alaska Department of Fish and Game

A NEARCTIC PARASITE IN A PALEARCTIC HOST

G.G. Verocai, M. Lejeune, and S. J. Kutz (University of Calgary), **G. L. Finstad** (Reindeer Research Program, University of Alaska)

Abstract: Domestic reindeer (*Rangifer tarandus tarandus*) were introduced into Alaska in the late 19th century. Reindeer producers implement a herd health management plan that includes treatments for internal parasites.

Researchers surveyed a reindeer herd not recently treated with an anti-parasitic to determine if the treatment programs were cost effective. Reindeer from an untreated herd were found to be infected (likely from incidental contact) with an indigenous parasite found in caribou.

Grants/Funding: Hatch

RURAL ALASKA NATIVES PARTICIPATE IN USDA-APPROVED REINDEER SLAUGHTER WORKSHOP

Greg Finstad and George Aguiar (Reindeer Research Program, University of Alaska)

Abstract: Community members of villages on the Seward Peninsula are interested in adding value to the sale of reindeer meat products. Field-slaughtered reindeer meat can be sold locally but commands a lower price than a USDA-inspected product.

Residents of Stebbins and Nome participated in a workshop conducted by Delta Meat And Sausage and the University of Alaska Fairbanks to demonstrate the infrastructure and processing needed to conduct an approved USDA slaughter of reindeer.

Knowledge gained at the workshop will be used by community members to evaluate whether or not to invest in the mobile slaughter units and training programs to slaughter reindeer under USDA inspection. In turn, the availability of USDA-inspected reindeer meat will open up new markets and generate income in economically disadvantaged rural villages of Alaska.

Grants/Funding: Bureau of Indian Affairs

FIRE HISTORY OF THE BLM WHITE MOUNTAINS IN ALASKA

Thomas Grant, Ryan Jess, **Glenn Juday** (University of Alaska Fairbanks), and Jim Herriges (BLM)

Purpose: A study of fire history in the Steese National Conservation Area and White Mountains National Recreation Area is investigating lichen used by caribou for forage and the relationship of forest age, structure, and fire history to lichen production and caribou habitat use. Data from this project is being archived in the US Forest Service's online Research Data Archive (http://www.fs.usda.gov/rds/archive/) with funding from the Joint Fire Science Program (JFSP). The data will be publicly accessible and available.

Approach: The project in 2013 involved organizing and analyzing data from tree ring samples (cores and tree disks) and fire scar samples.

Progress: Currently, 400 sites have been sampled in the study areas by BLM and the UAF team since 2001. A total of 56 sites were sampled before and after the extensive 2004 and 2005 wildfires in the areas. As of 2013, more than 134 trees from 47 sites were measured to add to the tree ring data base assembled from two previous studies.

Impact: The entire measured tree data base is being examined for patterns in the growth responses of white and black spruce to climate variability and past fire regimes

Grants/Funding: Bureau of Land Management, USDA, NIFA

LEGAL CONFLICTS IN NATURAL RESOURCES MANAGEMENT AND THE IMPLICATIONS OF CLIMATE CHANGE

Julie Lurman Joly

Purpose/Approach: Federal and state land and resource managers are required to act within a prescribed statutory and regulatory framework that is intended to guide their decision making. Unfortunately, many of the laws and policies at issue demand contrary actions or work at cross purposes, making management that is consistent with these laws very difficult. The first goal of this work is to identify situations in which laws or policies with conflicting purposes or methodologies are in place and analyze that legal conflict in order to understand how it is manifested and what its practical consequences are and perhaps to recommend changes or revised interpretations that avoid or eliminate the conflict. The second goal is to analyze the ability of the existing legal framework to absorb the changing physical reality being caused by climate change. The final goal is to incorporate the analyses and conclusions drawn from this research and bring them into my classrooms. This work resulted in the following manuscript: Julie Lurman Joly. 2013. Climate adaptation strategies are limited by outdated legal interpretations." *George Wright Forum* 30: 45-49.

Impact: This work will benefit land managers and resource professionals in the pursuit of their assigned goals. Additionally, this work will help the public to better understand their rights and responsibilities, and the legal limitations guiding the various agencies tasked with managing lands and resources. By expanding the available literature and providing comprehensive materials on certain key issues, the knowledge base available to the legal community will also be augmented. Finally, legislators and regulators, who strive to avoid or ameliorate such conflicts, may also find this work useful. The conclusions that are drawn from this work will help managers and decision makers understand where the legal flexibility lie and where there are insurmountable gaps in the current framework that will need to be filled by new legislation. It will also be important for resource users to understand the constraints on the system and the managers in order to promote trust, cooperation, and where necessary, patience, as the regulatory system plays catch-up to our scientific understanding and the impacts being experienced.

Grants/Funding: Hatch

BOREAL ALASKA: LEARNING, ADAPTATION AND PRODUCTION (BAKLAP) 2013

Glenn Juday, **Jan Dawe, Tom Grant**, Ryan Jess, Miho Morimoto, Andrew Allaby, Dashiell Feierabend

Abstract: The goals of BAKLAP are to (1) upgrade Alaska forest research facilities and management practices in order to improve the value of Alaska's forests in meeting the rapidly expanding demand for wood biomass energy in a changing environment and (2) improve science, technology, engineering, and mathematics (STEM) teaching and learning outcomes by developing a model integrated K-12 curriculum grounded in hands-on experience with the Alaska boreal forest through inquiry science and art.

Approach/Progress: Project BAKLAP has established a strong working relationship with the Alaska Division of Forestry and reports three times annually to the Alaska Board of Forestry. BAKLAP conducted the first systematic assessment of long-term forest growth on state timber harvest units in Interior Alaska. BAKLAP identified regions of increasing and decreasing forest growth potential as a result of recent changes in climate. Forest research plots have been rehabilitated and made useable, providing a strong foundation for sustained yield forest management.

Impact: BAKLAP has a strong partnership with the Fairbanks North Star Borough School District,and has worked with 850 K-12 students and 40 K-12 teachers. BAKLAP has developed customized lesson plans, blended learning platforms, entrepreneurial activities, professional development courses, and numerous tree growth experiments. The project's "service learning" model places university undergraduate and graduate students in K-12 classrooms, which has doubled the number of students BAKLAP can reach.

BAKLAP is sponsoring one Ph.D. student and three master's student thesis projects and is working to archive data on 29 forestry research installations. BAKLAP has completed a comprehensive collection and reorganization of a forest photo monitoring series of more than 16,000 photos taken three times annually at fixed monitoring stations since 2008. BAKLAP has produced three scientific manuscripts to date, including a comprehensive review of climate sensitivity of white spruce growth on the major river floodplains where biomass harvest is expected to be greatest. The project has produced 72 GIS data layers from research installations. BAKLAP is working with the Alaska Division of Forestry to convene a Science and Technical Committee to review reforestation standards for the boreal forest regions of southcentral and interior Alaska.

Grants/Funding: Alaska DNR BAKLAP Project, USDA NIFA (McIntire Stennis)

Students measure spruce trees in the boreal forest

THE RESERVE WEST MONITORING STUDY: FROM POST-FIRE SITE TO NEW FOREST

Glenn Juday, Ryan Jess, Dashiel Fierabend

Abstract: After the 1983 Rosie Creek Fire, a forest reference stand network was established in the Bonanza Creek Experimental Forest. Reference stands are 1.0 hectare (2.47 acre) or larger plots of forest that are monitored on a long-term basis.

Approach: The Reserve West reference stand was a 200-year-old white spruce forest at the time of the 1983 fire. Since 1988, all white spruce in the hectare have been mapped and measured annually. In 2013, a total of 2,251 white spruce were measured. For the first time since 1999, broadleaf trees (aspen, Alaska birch, alder) were measured, with a total of 1,532 stems encountered across 40 percent of the plot. Measurements taken include total height, current year's height growth, and diameter at the base of the tree and at breast height (137 cm). Each spruce tree is also evaluated for the condition of the leader (many are nipped by squirrels), presence of spruce budworm, amount of canopy shade and other characteristics.

Progress/Impact: All white spruce were measured in the fall of 2013, for the 27th consecutive year: the 1,816 white spruce trees were taller than 50 cm in height averaged 3.9 cm in basal diameter. The summer of 2013 got off to a slow start; ice breakup on the Tanana River was the second latest since 1917. Spruce at Reserve West were carrying a good load of foliage needles, particularly because of the cool and moist summer of 2012, which provided substantial relief from the moisture stress of the frequent warm summers of the last 30 years. The summer of 2013 was hot and dry, with a record number of days with temperatures 80°F or warmer. In the fall of 2013, after this rapid change from cool/moist to hot dry conditions, many white spruce shed excess older (2- to 7-year-old) needles that are a liability during periods of extreme

moisture stress. This phenomenon is termed "needle dumping," and it may become more common as a response to increasing temperatures in this part of the boreal forest.

Grants/funding: Alaska DNR BAKLAP Project, USDA NIFA (McIntire Stennis)

PHOTO MONITORING IN ALASKA BOREAL FOREST REFERENCE STANDS AT BONANZA CREEK EXPERIMENTAL FOREST

Glen Juday, Ryan Jess

Abstract: During the 2013 field season, 2,756 monitoring photos were taken at fixed stations and views at the six reference stands, with an additional 174 general view photos. The photos were taken on 18 days in three seasonal sets. The first set was taken after snowmelt but before leaf-out, the second during midsummer full leaf condition, and the third set after deciduous leaf fall but before snow accumulation.

Some fall photos were repeated because the deciduous leaves were retained late in the fall (at least in the last several decades) and it was assumed that fall photos with partial leaf retention would be preferable to photos with snow pack. In reality snow pack accumulation held off to a record-tying late date of October 31, so some fall photos were retaken with full leaf drop, but at the latest date in the 26 years of monitoring in the reference stand record.

Impact: A total of 30.9 GB of digital photos were added in 2013 to the collection. Late in the quarter, the BAKLAP team began a process of checking the entire collection of 15K photos for quality and standardizing the naming to make automated searches more feasible and specific.

Grants/Funding: Alaska DNR BAKLAP Project, USDA NIFA (McIntire Stennis), NSF Bonanza Creek LTER

FIELD PERFORMANCE OF TRANSPLANTS GROWN USING LIGHT EMITTING DIODES

Meriam Karlsson, Cameron WIllingham

Abstract: Sunflowers and snap beans were seeded in a greenhouse and allowed to develop under light emitting diodes (LEDs) or natural light supplemented with high-pressure sodium irradiance. The snap beans were grown using LED panels with red supplemented with 20 percent blue LEDs. In addition to red/blue LEDs, sunflowers were also grown under white LEDs, or a combination of LEDs using 50 percent red, 10 percent orange-red, 10 percent orange, 10 percent white and 20 percent blue. Following germination, the seedlings were grown for seven days under the various light sources.

Preliminary results suggest the various types of LEDs support similar growth and development as natural greenhouse conditions, without significant carry-over effects on field performance. Days to flower from transplanting were 50 days for the sunflower ProCut Bicolor independent of treatment. For the sunflower Sunbright Supreme, transplants receiving short days during the propagation stage flowered earlier, at 70 days rather than the 78 days for sunflowers grown at 16 daily hours during propagation. The French filet-type green beans Concador, Stayton and Velour, and the traditional Provider were included. Despite producing the least number of bean pods, Provider had the largest yield. The weight of picked beans for a one-meter length of the raised bed was 8.85 kg for Provider followed by Stayton (7.80 kg), Velour (5.42 kg), and Concador (4.18 kg). Although the yield varied among cultivars, there was no difference between snap beans started under greenhouse conditions or LEDs. The monochromatic LEDs did not alter growth, flower formation or yield compared to natural greenhouse light conditions. LEDs appear to be a good substitute for natural or other types of light during the transplant stage of sunflowers and green beans.

Grants/Funding: Hatch

VOICES OF THE CARIBOU PEOPLE: A PARTICIPATORY VIDEOGRAPHY METHOD TO DOCUMENT AND SHARE LOCAL KNOWLEDGE FROM THE NORTH AMERICAN HUMAN-RANGIFER SYSTEMS.

Archana Bali , **Gary P. Kofinas**

Abstract: *Voices of the Caribou People* is a participatory videography project for documenting and sharing the local knowledge of caribou-user communities about social-ecological changes. The project was conducted in partnership with indigenous people who share a long and close relationship with caribou and self-identify as the "Caribou People."

The Caribou People wanted to share their knowledge, experiences, challenges, and coping strategies with other indigenous communities and with scientists and wildlife managers. Six communities in the North American Arctic participated in the project, with 99 people interviewed about the ecological, cultural, spiritual, and nutritional aspects of their relationship with caribou. The Caribou People wished to tell their stories with their own voices, without the filter of a researcher's interpretations of their messages. The communities defined three project goals — documentation, communication, and sharing of knowledge — and we identified methodological challenges associated with these goals. Through videography, we sought to overcome these challenges and accomplish community goals, which formed the basis for our project's evaluation. Participants reported changes and concerns ranging from impacts of oil and gas exploration, mining activities, nonlocal hunting, and high energy costs to impacts of climate-related conditions.

All interviews were made available in the public domain via the Internet for sharing. In the view of the communities, videography preserved their legacy and served as a repository of traditional knowledge in changing times; visual images were seen as a powerful medium to communicate with policy makers and the public at large and were seen as a preferred informal, unstructured approach. We have (1) described the approach of the Voices of the Caribou People project as a collaborative video methodology and (2) discussed the effectiveness of this method in meeting the goals of participatory research. General insights into the process of using videography as a participatory research tool to study social-ecological systems in partnership with indigenous communities have been provided.

LETTING THE LEADERS PASS: BARRIERS TO USING TRADITIONAL ECOLOGICAL KNOWLEDGE IN COMANAGEMENT AS THE BASIS OF FORMAL HUNTING REGULATIONS

E. Padilla, **Gary P. Kofinas.**

Abstract: We studied a case of failure in applying traditional ecological knowledge (TEK) in comanagement as the basis for formal hunting regulations. We based the study on the Porcupine Caribou (*Rangifer tarandus*) Herd "let the leaders pass" policy, established for the Dempster Highway of the Western Canadian Arctic, and identified conditions creating barriers in the successful application of TEK through comanagement. Stated as propositions, identified barriers are as follows: (1) The context-specific nature of TEK limits its application in resource management regulations; (2) changes in traditional authority systems, hunting technology, and the social organization of harvesting caribou affect the effectiveness of TEK approaches in a contemporary social setting; (3) indigenous efforts toward self-government and political autonomy limit regional comanagement consensus in a heterogeneous cultural landscape; and (4) the mismatch of agency enforcement of hunting regulations and TEK-based education is problematic. We analyzed the case through four historical phases of caribou management, complementing the study with a literature review of TEK and wildlife comanagement to explain why TEK integration of caribou leaders in regulatory resource management fell short of success. Identifying and understanding the social dynamics related to these barriers make apparent solutions for transforming the comanagement process.

LONG-TERM PATTERNS OF ABIOTIC DRIVERS OF MOSQUITO ACTIVITY WITHIN SUMMER RANGES OF NORTHERN ALASKA CARIBOU HERDS (1979-2009)

Archana Bali, Vladimir A. Alexeev, Robert G. White, Don E. Russell, A. David McGuire, **Gary P. Kofinas**

Abstract: None

CHANGING DAILY WIND SPEEDS ON ALASKA'S NORTH SLOPE: IMPLICATIONS FOR RURAL HUNTING OPPORTUNITIES

Winslow D. Hansen, Todd J. Brinkman, Mathew W. Leonawicz, F. Stuart Chapin, III, **Gary P. Kofinas**

Abstract: Because of their reliance on the harvest of fish and game, rural Alaska communities have experienced a variety of impacts from climate change, the effects of which are amplified at high latitudes. We collaborated with hunters from the coastal community of Wainwright, Alaska, to document their observations of environmental change (e.g., sea ice, wind, temperature) and the implications of those changes for opportunities to hunt bowhead whale (*Balaena mysticetus*) during spring and caribou (*Rangifer tarandus*) during summer. We integrated hunter observations on wind with statistical analysis of daily wind speed data collected in the nearby community of Barrow, Alaska, between 1971 and 2010 to characterize changes in the number of days with suitable hunting conditions. Hunters in Wainwright currently observe fewer days than in previous decades with wind conditions suitable for safely hunting bowhead whales and caribou. The statistical analysis of wind speed data supported these conclusions and suggested that the annual windows of opportunity for hunting each species have decreased by up to seven days since 1971. This study demonstrates the potential power of collaboration between local communities and researchers to characterize the societal impacts of climate change. Continued collaborative research with residents of rural northern Alaska communities could produce knowledge and develop tools to help rural Alaskans adapt to novel social-ecological conditions.

CUMULATIVE GEOECOLOGICAL EFFECTS OF 62 YEARS OF INFRASTRUCTURE AND CLIMATE CHANGE IN ICE-RICH PERMAFROST LANDSCAPES, PRUDHOE BAY OIL FIELD, ALASKA

M.K. Reynolds, K. J. A. Reynolds, Donald A .Walker, Jerry Brown, Kay R. Everett, Mikhail Kanevskiy, **Gary P. Kofinas,** Vladimir E. Romanovsky, Yuri Sur, Patrick Webber

Abstract: Many areas of the Arctic are simultaneously affected by rapid climate change and rapid industrial development. These areas are likely to increase in number and size as sea ice melts and abundant Arctic natural resources become more accessible. Documenting the changes that have already occurred is essential to inform management approaches to minimize the impacts of future activities. We determined the cumulative geoecological effects of 62 years (1949–2011) of infrastructure- and climate-related changes in the Prudhoe Bay oil field, the oldest and most extensive industrial complex in the Arctic and an area with extensive ice-rich permafrost that is extraordinarily sensitive to climate change. We demonstrated that thermokarst has recently affected broad areas of the entire region and that a sudden increase in the area affected began shortly after 1990, corresponding with a rapid rise in regional summer air temperatures and related permafrost temperatures. We also presented a conceptual model that describes how infrastructure-related factors, including road dust and roadside flooding, are contributing to more extensive thermokarst in areas adjacent to roads and gravel pads. We mapped the historical infrastructure changes for the Alaska North Slope oil fields for 10 dates from the initial oil discovery in 1968 to 2011. By 2010, over 34% of the intensively mapped area was affected by oil development. In addition, between 1990 and 2001, coincident with strong atmospheric warming during the 1990s, 19% of the remaining natural landscapes (excluding areas covered by infrastructure, lakes and river floodplains) exhibited expansion of thermokarst features that resulted in more abundant small ponds, greater microrelief, more active lakeshore erosion and increased landscape and habitat heterogeneity. This transition to a new geoecological regime will have impacts to wildlife habitat, local residents and industry.

CIRCUMARCTIC RANGIFER MONITORING AND ASSESSMENT (CARMA) NETWORK — ORIGINS, GOALS, ACCOMPLISHMENTS AND FUTURE

Don. E. Russell, **Gary Kofinas,** Anne Gunn, Robert G. White, Susan Kutz

Abstract: None

CARMA'S APPROACH FOR THE COLLABORATIVE AND INTER-DISCIPLINARY ASSESSMENT OF CUMULATIVE EFFECTS

Anne Gunn, Don E. Russell, Colin J. Daniel, Robert G. White, **Gary Kofinas**

Abstract: None

BALANCING THE CONSERVATION OF WILDLIFE HABITAT WITH SUBSISTENCE HUNTING ACCESS: A GEOSPATIAL-SCENARIO PLANNING FRAMEWORK

Colin Shanley, **Gary Kofinas,** Sanjay Payre

Abstract: Increased use of motorized vehicles for subsistence hunting has created a challenge for land managers trying to balance the conservation of wildlife habitat with the greater environmental impact of motorized access. We used an interdisciplinary approach to evaluate this challenge in a case study of subsistence moose (*Alces alces*) hunters who used off-highway vehicles (OHVs, e.g., four-wheelers) to access remote harvest areas in Yakutat, Alaska, and the conservation needs to sustain moose. We developed a resilience-based planning framework that combined methods from wildlife ecology, land-use mapping, and scenario planning. The study started at the community level by working with local hunters to evaluate their values and goals for subsistence moose hunting and identify thresholds of undesired change. This process served as the basis for evaluating how four road closure scenarios would effect the distribution of moose and hunters' access to moose harvest areas. The effect of roads and OHV routes on moose distribution was quantified in a previous study with a GIS-based resource selection function model. An index of access was quantified on a digitized map of harvest areas. The results of the scenario analyses suggest that a balance in the conservation of wildlife habitat and subsistence hunting access could be found in the spatial arrangement of routes that are outside of important moose habitat, but within reach of preferred harvest areas. This spatially explicit planning framework may prove useful in northern communities experiencing an increased use of motorized access for contemporary subsistence hunting practices.

RECOGNIZING THE ARRAY OF BENEFITS IN HARVESTING NON-TIMBER FOREST PRODUCTS: A CASE STUDY OF INSEPARABLE PROVISIONING AND CULTURAL ECOSYSTEM SERVICES IN INTERIOR ALASKA

Kimberley Maher, **Glenn Juday**

Abstract: Harvesting non-timber forest products (NTFPs) is a prevalent activity for residents living in the Alaska's boreal forest region. NTFPs are multidimensional ecosystem products; depending on how they are harvested and utilized, NTFPs provide both provisional and cultural benefits. We employed semi-structured interviews with experienced NTFP harvesters in the Tanana Valley in Interior Alaska to document their reflections on their harvesting experiences and used grounded theory techniques to analyze the transcripts. Prominent NTFPs harvested include wild berries, mushrooms, and firewood. Items are consumed fresh, preserved, incorporated in crafts, gifted, and used for energy. Harvesters have multiple motivations for participating in harvesting NTFPs. These motivations include acquiring resources, spending time outdoors, and being with family and friends. Harvesters receive both tangible and intangible benefits from their activities, including high-quality products that are otherwise unavailable or inaccessible, contributions to their household economy, improved mental health, a spiritual experience, and developing connections to the land, nature, and their culture. Due to the array of benefits from NTFPs, both in the Tanana Valley and in forested social-ecological systems elsewhere, it is critical to understand the dual roles of provisioning and cultural ecosystem services that NTFPs play in order to understand their value and contribution to livelihoods. A broader understanding of the ecosystem services that forests provide to the local communities will help resource managers and policy makers include NTFPs in management strategies and policies.

Grants/funding: National Science Foundation Resilience and Adaptation (IGERT) Program, University of Alaska Fairbanks; National Science Foundation Bonanza Creek Long Term Ecological Research (LTER), Alaska Department of Natural Resources

BONANZA CREEK HARDWOOD REMOVAL FROM MATURE MIXED STAND

Thomas Malone

Purpose: Determine the effect of hardwood removal and sanitation cut of white spruce on diameter growth and health of residual stand.

Approach: In 1986, a contractor removed all the mature hardwoods and defective white spruce trees from a 95-acre unit in Bonanza Creek Experimental Forest. After harvest, 50 one-tenth-acre circular plots were established to the monitor growth and health of the residual forest. Plots have been remeasured periodically since 1987.

Impact: This study provides information on the suitability and success of hardwood removal and sanitation cutting in mature mixed stands in Interior Alaska and looks at whether sanitation cutting, as a silvicultural prescription, is successful in improving diameter growth and quantity of clear wood of mature white spruce trees.

Progress: All 50 plots were remeasured in 2013. A 95-acre unit will be harvested in 2015.

Grants/Funding: McIntire-Stennis Act Fund ALK-03-12 and SNRAS Forest Growth and Yield Fund

COOPERATIVE ALASKA FOREST INVENTORY (CAFI)

Thomas Malone

Approach: The Cooperative Alaska Forest Inventory includes a system of permanent sample plots distributed across the northern forests of Alaska. Sites were selected to include a variety of forest stand conditions and land ownership. At each site selected, three 0.1 acre plots were established. At plot establishment and at each remeasurement, all trees were measured, regeneration was counted, site characteristics were recorded, and the understory vegetation was identified. Plots are remeasured every five years.

Progress: To date, 609 plots have been established at 203 sites. Tree measurement, site description, tree regeneration, and vegetation databases have been developed with all data collected since the project inception in 1994 through 2013. Thirty-one percent of the plots have been inventoried four times and 85 percent have been inventoried three times. The databases and CAFI user's manual are available at www.lter.uaf.edu.

Impact: Repeated periodic inventories on CAFI permanent plots provide long-term information for modeling forest dynamics,and to test and monitor large-scale environmental and climate change. CAFI data has been used to develop forest growth models, ground truth satellite imagery, estimate biomass per unit area, develop a Forest Vegetation Simulator, and detect and/or monitor forest pest activity.

Grants/Funding: McIntire-Stennis Act Fund ALK-03-12 and SNRAS Forest Growth and Yield Fund

LEVELS OF GROWING STOCK (LOGS) STUDY

Thomas Malone, John D. Shaw, Edmond C. Packee

Purpose: To establish tree plantations that provide land managers with information about early growth of trees and the best tree spacing to maximize site productivity.

Approach: Two plantations were established in Bonanza Creek near Fairbanks and near Tok. White spruce and tamarack were planted in the Bonanza Creek installation, which was established in 1986. White spruce, tamarack, black spruce, and lodgepole pine were planted in the Tok installation in 1992. The spacing at each installation is 4'x'4, 6'x6', 8'x'8, 10'x10', and 12'x12'. Measurement plots are 0.1 acre .and tree height was measured very year for the first 20 years, and is now measured every five years until harvest at year 100.

Impacts: This research project has provided land owner and managers with information about early seedling/sapling growth. It will help managers optimize operational planting costs and provide essential information for proper stand management and other ecological studies.

Progress: "Interior Alaska Levels of Growing Stock: Methods, Database, and Results" was written and is being reviewed internally. It will be submitted to the *Western Journal of Applied Forestry*, 2014.

Grants/Funding: McIntire-Stennis Act Fund ALK-03-12 and SNRAS Forest Growth and Yield Fund

TOTAL AND MERCHANTABLE CUBIC FOOT VOLUME OF WHITE SPRUCE IN ALASKA

Thomas Malone, Jingjing Liang, Edmond Packee

Purpose: To develop a model to accurately estimate the cubic foot volume of individual trees in Alaska. Multiple volume models were developed to estimate total and merchantable volume in cubic feet to a 2-inch, 4-inch, and 6-incn top.

Approach: An empirical regression model was calibrated for white spruce and a large sample size was collected in Interior and Southcentral Alaska. Geographic differences were tested to show that the model could be applied statewide. These multiple entry (diameter at breast height and height) models were developed for both inside and outside bark from a 6-inch stump.

Progress: Article is published.

Impact: The equations help land owners and managers perform forest inventory and economic analysis, determine allowable cut, and estimate individual tree volume. This research will also support potential studies on forest biomass, ecological diversity, and management of these tree species in Alaska.

Grants/Funding: McIntire-Stennis Act Fund ALK-03-12 and SNRAS Forest Growth and Yield Fund

COLLABORATIVE RESEARCH: HOW THE TIMING OF SUMMER PRECIPITATION AFFECTS THE RESPONSES OF BOREAL FOREST TO CLIMATE CHANGE

Daniel H. Mann

Objectives: Ecological processes at high latitudes are sensitive to changes in seasonal climate patterns. Because the growing season is short and seasonal transitions are rapid, small changes in the timing and amount of precipitation can have large impacts on tree growth. Wildland fires, which are the dominant disturbance agent in boreal forests, are also sensitive to the timing of summer precipitation. When the late summer rains are delayed — as they were in 2004 and 2005 — mega-fire seasons can occur in which >1.6 million ha burn. In this study we focus on the effects that changes in the timing of summer precipitation have on the boreal forest of Interior Alaska.

The overall goal of this project was to test the hypothesis that shifts in the seasonality and amount of warm-season precipitation are key drivers of this forest's responses to climate. We tested this hypothesis using three, interrelated approaches. First, we analyzed interactions between climate and tree growth (specifically ring width, ring density, and wood-isotope composition) at the coldest/wettest and the warmest/driest forested sites on the landscape. Second, we analyzed fire-climate relationships using new statistical approaches. Third, we used the results of this new parameterization of climate-fire relationships to improve the design of the forest model ALFRESCO (Rupp et al., 2007), which will then test additional hypotheses about the interconnections between future climate, tree growth, fire and their collective feedbacks to the regional forest cover.

Significance: High latitude regions are on the frontline of global climate

change (Wolken et al., 2011), and the circumboreal forest is of special concern because of the enormous amounts of carbon (C) it stores. Boreal forests cover some 16 million km^2 globally, and every year about 8% of the atmospheric pool of carbon cycles through them (McGuire et al., 2009). Altogether, boreal forests currently contain 10-20% of the world's vegetation carbon and are underlain by approximately 30% of the world's soil carbon. This abundant soil carbon has accumulated in boreal forests because decomposition rates are slow due to the wet, cold soils. Burning is a major pathway for carbon transfer from soil and biomass back to the atmosphere. To better predict the possible impacts of climate change on the boreal forest and its carbon stores, we need to know how climate affects both the fire regime and tree growth.

Incremental changes in spatiotemporal patterns of natural fires and tree growth are just part of a larger threat to boreal forests posed by rapid climate change. Some scientists think that boreal forests in general (Soja et al., 2007), and Interior Alaska's forests in particular (Beck et al., 2011), are approaching a major ecological regime shift involving the collapse of existing ecosystems and the emergence of new ones (Mann et al., 2012). We know that white spruce in Interior Alaska is sensitive to temperature-induced drought (Barber et al., 2004) and that recent warming has caused reductions in its growth throughout the region (Beck et al., 2011). Some workers have speculated that white spruce forests in Interior Alaska could be replaced by aspen parkland or grassland with a future temperature rise of just 2°C (Chapin et al., 2004). Based on a review of the key processes that structure the boreal forest and that are believed to be sensitive to warming temperature (e.g., fire regime, tree regeneration, thermokarst), Chapin et al., (2010) infer that "…the Alaskan boreal forest is on the cusp of potentially large nonlinear changes in structure and functioning."

Ecological regime shifts are predicated on the existence of abrupt thresholds within the biophysical processes that control ecosystem structure and function. Ecosystems undergoing a regime shift are pushed over a catastrophe fold by an environmental forcing agent such as a prolonged drought or a change in human land use (Scheffer, 2009). Nothing changes until some critical threshold is passed. We know now that wildland fires and summer climate are important in the structure and function of boreal forests, and it is well known that boreal forests are sensitive to warming temperature. What has never been quantified before are the nonlinear forms of these threshold-gated responses.

HOW CAN SUSTAINABLE INTEGRATED RESOURCE MANAGEMENT BE EFFECTIVELY IMPLEMENTED ACROSS A DIVERSE, MULTI-SCALE NETWORK? A CASE STUDY FROM BUA, FIJI

Susan Todd, Brooke McDavid

Abstract: Effective resource management requires a range of people and organizations to plan and take action together. These stakeholders relate and interact with each other through networks. This project will enable us to understand local information networks so they can be supported to promote effective communication and collaboration for natural resource management in Bua, Fiji.

Grants/Funding: Support from U.S. Peace Corps and the Wildlife Conservation Society H.

SOIL CARBON STOCKS IN ICE WEDGE POLYGONS

Chien-Lu Ping, Gary Michaelson, Julie Jastrow, Roser Matamala

Abstract: The purpose of this study is to evaluate the spatial heterogeneity of soil carbon in ice-wedge polygons. There are three kinds of ice wedge polygons identified in Arctic Alaska: low-centered, flat-centered and high centered. The profiles of the polygons were exposed by excavation to three meters. Patterns of organic matter distribution was described and recorded. Soil horizons were delineated and sampled and carbon content will be measured. In the first field season, 12 polygons were studied and sampled in Barrow. The ice contents of each polygon will be compared with geotechnical data. The results will be shared with other ecological study groups in the Barrow Ecological Observatory.

Grants/Funding: Department of Energy Argonne National Laboratory

RAPID CARBON ASSESSMENT

Chien-Lu Ping, Gary Michaelson

Abstract: There is demand for large amounts of good-quality, inexpensive soil data to be used for various soil assessments. Spectroscopy can offer a rapid, timely, inexpensive, non-destructive alternative to lab analysis. The purpose of this study is to develop a reliable, VNIR (visible-near infrared) method to test for carbon in crops and forest soils in Alaska. In the first year there were 36 sites and more than 1,000 soil pits were sampled in the Mat-Su valley area in Southcentral Alaska. Soil samples were analyzed for organic carbon content and scanned with a portable spectrometer. The preliminary results show that VNIR spectroscopy can be used to predict soil carbon content and improve calibrations for future soil assessments in the field. The field study and sampling will be expanded to the Kenai and Delta areas in the next field season. The project has supported a senior thesis research.

Grants/Funding: USDA, NRCS National Soil Survey Center

ALASKA SOIL CLASSIFICATION

Chien-Lu Ping, Gary Michaelson

Abstract: The purpose of this study is to investigate the genesis and classification of soil in Alaska. The experimental approach has been to interphase with other funded projects and collaborate with other institutes and agencies, especially the USDA-NRCS, to jointly conduct field campaigns to study and sample soils across the state of Alaska. Results of this project have contributed to the national carbon database and to both state and national soil characterization databases.

Grants/Funding: State of Alaska

WETLAND PROTECTION AND HYDRIC SOILS MONITORING IN VOLCANIC ASH-DERIVED SOILS IN ALASKA

Chien-Lu Ping, Gary Michaelson, Bronwen Wang

Abstract: The general objective of this research is to investigate hydric soil and related non-hydric soil properties and processes in tephra-derived soils in Alaska. This will be achieved by studying soil hydro-sequences (the wetter portions of toposequences) and focus on soil hydrology and soil processes. The resulting data should provide an improved understanding of wetland development in regions dominated by tephra-derived soils.

Volcanic ash soils formed in wetlands on Adak Island lack the morphology of hydric soils because of the high iron content. The use of IRIS and MRIS tubes proved effective in determining hydric soils in remote sites such as the Aleutian Islands. The findings of the study from the Matanuska-Susitna Valley area can be used to refine the NRCS soil map units in the survey area.

A book chapter describing wetland in Alaska is in press (CRC Press), and two manuscripts are underway with the cooperation of collaborators.

Grants/Funding: USDA Hatch

MONITORING PERMAFROST DEGRADATION AND SOIL CHANGE IN TEMPERATURE SENSITIVE GELISOLS IN WESTERN ALASKA

Chien-Lu Ping, Melissa Woodgate

Abstract: The purpose of this study is to evaluate the impact of rapidly occurring permafrost degradation on soil classification and mapping unit composition for the large MLRA 236 Bristol Bay-Northern Alaska Peninsula Lowlands area based on measured soil hydro-thermal monitoring and intensive soil/site characterization data collected across boundaries of degrading permafrost areas within the discontinuous permafrost zone. In the first field season, soils at each site and micro-site will be described and sampled according to protocols established for Gelisols by the PI (Ping) and also the USDA-NRCS field description and sampling procedures. A total of 120 soil horizon samples were taken from nine sites and all the samples are being analyzed at the Palmer Research Center Lab.

The study area was mapped as an area of discontinuous permafrost, but the field study indicated that permafrost was more extensive than previously speculated. The permafrost table was found at >two meters, likely the results of previous tundra fire. Palsas are found on gentle slopes with cyclic cycles of formation and deterioration.

Grants/Funding: USDA-NRCS National Soil Survey Center

REPRODUCTIVE MANAGEMENT FOR SUSTAINABLE HIGH-LATITUDE LIVESTOCK PRODUCTION

Milan Shipka, Jan Rowell, Cole Bures, John Blake

Abstract: To improve reproductive management in muskoxen with particular reference to calf survival and growth. The annual breeding activity of muskoxen from several decades identified widespread reproductive failure that could be related to reproductive management issues, especially herd inbreeding. In muskoxen, reproductive failure and the increasing incidence of stillbirths, abortions, and neonatal deaths have potential to be associated with the inbreeding coefficient of the offspring. Using historic and current herd records, the coefficients of inbreeding of individuals in or formerly a part of a muskox herd are being analyzed in order to determine any association with reproduction success, calf survival and calf growth rate. The inbreeding coefficient of individual animals from records of the UAF R.G. White Large Animal Research Station (LARS) will be compared between pregnancies resulting in normal calf births and pregnancies resulting in abortions, stillbirths, early neonatal death within 24 hours after birth. In addition, the coefficients of inbreeding of surviving individuals will be examined by regression analysis where growth rate during the first 150 days of life is the dependent variable and the animal's own coefficient of inbreeding is the independent variable. Historical records are being assessed to determine the individual coefficient of inbreeding, and hair samples have been collected and sent to the genetic service laboratory at University of California Davis to assess the capability of determination of relatedness of individual animals. Data analysis is in process to determine the association of degree of inbreeding to reproductive failure in the muskox herd at LARS.

Grants/Funding: Hatch

Muskox at the University of Alaska Robert White Large Animal Research Station

SUSTAINABLE LIVESTOCK PRODUCTION IN ALASKA

Milan Shipka, Jan Rowell

Abstract: The purpose of this project was to identify components and strategies necessary to define research priorities and develop programs in education and Extension for sustainable livestock production to improve food security in Alaska. The initial objectives were to:

- assess state of existing knowledge on ruminant livestock production in Alaska among Alaska professionals
- define existing constraints on livestock production (ecological, social, economic)
- develop a vision of sustainable livestock production to improve food security and the research, education, and Extension needs in Alaska

The original grant was used to host a conference in fall 2011 for livestock producers. This was an interactive meeting; a formal white paper documenting livestock producers' needs, knowledge gaps, and recommendations for future research was completed in 2013. The white paper serves as a record of stakeholder input on ideas, concerns, and priorities for the livestock food system in Alaska. Grazing systems were identified as a primary area of interest and in response we hosted a meeting/workshop that introduced ideas on sustainable grazing practices. In 2013 we followed that with a mini-workshop that delved into the nuts and bolts of shifting an existing farm to sustainable grazing practices. Outcomes and outputs of this project for 2013:

- A core group of individuals in the Fairbanks area are interested in developing sustainable grazing practices suitable to the north.
- We are implementing sustainable grazing practices as a demonstration project.
- The meetings provided core information for curriculum development in sustainable farming practices.
- Sustainable grazing practices were integrated in an M.S. student project beginning spring 2014.
- YouTube videos dealing with grazing and animal management in Alaska were developed: (http://www.youtube.com/watch?v=uSFeO4aN_0g; http://www.youtube.com/watch?v=J0lKGfrRe7I)

Grants/Funding: USDA NIFA Conference Grant and USDA SARE Grant

MONITORING SEASONS THROUGH GLOBAL LEARNING COMMUNITIES

Elena B. Sparrow, David L. Verbyla, Rebecca Boger, Leslie Gordon, Kim Morris, Martha R. Kopplin

Abstract: This project, also called Seasons and Biomes, is an inquiry-based project. The goals are to increase understanding of the Earth as a system and of science as process, and to build global learning communities. We developed measurement protocols for ice seasonality (freeze-up and break-up of lakes and rivers), frost tubes (depth of soil freezing), and mosquito larvae abundance as well as learning activities to help students understand science concepts and process in studying earth system/environmental science. We also developed a professional development (PD) workshop model for teachers that integrates science content, science process (measurement protocols from this project and the GLOBE program); best teaching practices such as inquiry, constructivism, alternative assessments, interdisciplinarity; and a systems approach.

We conducted numerous regional, national and international PD workshops for educators and engaged students in studying the timing and duration of seasonal and phenological events in their biomes in collaboration with scientists and local experts, including Native elders. Global learning communities formed through these workshops as well as through other collaborative projects such as the Mt. Kilimanjaro expedition, cross-continent videoconferences, a polar e-book writing project between schools in Alaska, Argentina and Australia, and the GS Pals project facilitated by GLOBE alumni. Results of the pre/post tests for educators on earth science content and pedagogy indicate a significant gain in knowledge and inquiry skills. Similar results were obtained for students from pre/post test, student work and teacher assessments. More than 1,600 educators in 51 countries have participated. Seasons and Biomes students are among the 1.5 million students who have contributed 23 million measurements to the GLOBE database (www.globe.gov). Students have also conducted their own science investigations and presented at state, national and international conferences.

Grants/Funding: National Science Foundation, Geosciences Division

LOCAL ATTITUDES ABOUT DEFORESTATION IN RURAL VILLAGES IN THE GAMBIA

Samantha Straus, **Susan Todd**

Abstract: Deforestation is spreading rapidly in The Gambia, Africa. Causes include shifting agriculture and the harvest of the few remaining trees for medicines and fire wood. This study will look at local attitudes regarding deforestation; it will assess the level of public awareness about the problem and possible solutions. Is the dwindling forest of concern to local people? What do they think are its primary causes? Are they aware of the consequences of deforestation over the long term? Would they want more trees growing in their area? What is standing in the way of planting trees?

Grant/Funding: U.S. Peace Corps

REMOTE SENSING OF FOREST PRODUCTIVITY TRENDS IN THE ALASKA BOREAL FOREST REGION

David Verbyla

Abstract: Climate warming has occurred in boreal Alaska over the past 30+ years with substantial changes in shallow lakes, wildfire frequency, and forest productivity. The purpose of this project is to use a remotely sensed vegetation index of forest productivity to monitor interannual and decadal-scale trends within the Alaska boreal forest. By documenting the trend in vegetation index values from the mid-1980s to 2013, it is possible to map where in boreal Alaska there have been significant increases ("greening trend") and decreases ("browning trend") in

forest productivity. The research has shown that much of boreal Alaska has experienced a significant decline in the remotely sensed vegetation index since the mid-1980s, likely due to factors associated with a warming climate including temperature-induced drought stress, insect infestations, and increased tree mortality due to drought. The next step is to compare interannual responses of the boreal forest landscapes to wet/drought years of 2003/2004, 2008/2009 and 2012/2013 at a finer spatial scale. Ultimately, this study will help predict what the future productivity of the Alaska boreal forest region may look like as climate warming continues.

Grants/Funding: USDA Forest Service, NSF LTER

ANNUAL REPORT FOR THE BIOCHAR FIELD RESULTS OF BROMEGRASS, BARLEY AND POTATO IN 2013

Mingchu Zhang, Robert M. Van Veldhuizen

Purpose: Food production and food security in the circumpolar north are important public concerns. Soil in the area is acidic and low in organic matter, which constrains food production in the region. Biochar has been proved to maintain soil fertility for food production in other climatic conditions (Sohi et al., 2010); however, a high rate is usually is required in order to benefit yield (reported by the International Biochar Initiative,Laufer and Timlison, 2012). To test the impact of biochar in the circumpolar north regions, an experiment was conducted to evaluate whether biochar actually promotes soil fertility in the soil in the Whitehorse region of Canada. The experiment started in 2011 and ended in 2013 and used bromegrass hay, barley, kale, carrots, and potatoes as the tested crops. This report looked at the field test results of 2013.

Approach: Three field experiments were conducted in Yukon, Canada with test crops of barley (*Hordeum vulgare* L.), potato (*Solanum tuberosum*), and bromegrass (*Bromopsis inermis* Leyss.). The biochar application was 10 metric tons per hectare. Plant biomass was harvested and weighed at the end of growing season. Mineral nutrients in the soil as well as in plant tissues were analyzed.

Progress: Field experiments have been successfully carried out in three locations in Whitehorse region of Canada. Yield data and plant tissue samples were collected and subject to statistical comparison to assess the impact of biochar and analyze for nutrient uptake. Along with the nutrient uptake, soil CEC and pH were also measured.

Results indicated that for bromegrass biomass, there was no statistical difference between biochar and non-biochar treatment. For nutrient concentration, there was no discernible trend between biochar and non-biochar treatments; however, N concentration was higher ($p = 0.03$) for the bromegass taken from the biochar treatment than from the non-biochar treatment. Iron concentration, in contrast, was higher ($p = 0.03$) for the bromegrass taken from the non-biochar treatment than from the biochar treatment. Statistically, no differences ($p > 0.05$) were found for other nutrients. As for the nutrient uptake of bromegrass, without the addition of biochar, bromegrass took more sodium and Cu from the soil compared to the bromegrass grown from the soil with biochar addition ($p = 0.008$). Statistically, there were no differences between the two treatments for other nutrients. The soil nutrient status from the bromegrass field showed that at a the depth of 0-15 cm, Mehlich 3 extractable potassium was higher ($p = 0.008$) in the non-biochar treatments compared to the biochar treatments. In contrast, the sodium concentration of biochar-treated soil was higher than that from non-biochar-treated soil. No statistical difference of nutrient concentration in soil was found for the other nutrients. Soil pH was higher ($p = 0.02$) in the biochar-treated soil compared to the non-biochar-treated soil. At a depth of 6-12 cm, both Mehlich 3 extractable Mg and Na were higher ($p = 0.03$) in the non-biochar-treated soil compared to the biochar-treated soil.

Results also indicated that in the case of barley biomass and nutrient concentration, there was statistically no difference between the two treatments for biomass and nutrient concentration. For nutrient uptake, barley took more Zn from non-biochar-treated soil as compared to the biochar-treated soil ($p = 0.01$). Statistically, no difference was found between the two treatments for the other nutrient uptake by barley. For soil chemical properties and nutrient status in barley fields, no statistical difference was found for the N, P, K, Ca, Mg concentration in soil between the biochar- and non-biochar-treated soils. Biochar-enhanced soil CEC as compared with the non-biochar treated soil ($p = 0.05$).

In addition, the research results showed that for potato biomass and nutrient concentration, there was statistically no difference between biochar and non-biochar treatments for above-ground biomass and tubers. Iron concentration was higher in potato tuber from biochar treatment compared to the non-biochar treatment. No statistical difference was found for the other nutrient concentrations. For nutrient uptake, like nutrient concentration in the above-ground tissue samples, biochar-treated plants took similar amounts of nutrients compared to the non-biochar-treated plants. Apparent nutrient uptake was higher for the non-biochar treatment; however, there existed large variation among the replicates that eliminated the statistical significance between the two treatments. For the potato tuber, it took more Ca and Cu from the non-biochar treatment compared to the biochar treatment. For impact on soil chemical properties and nutrient status, no statistical differences were found between the two treatments for all analytical items.

Impact: There were some positive impacts on soil properties with biochar application, but there were no yield response from biochar addition. In South America, where biochar is found to have a positive impact on soil productivity (i.e., terra preta), the soil has received long-term biochar application. Therefore, the current application might be too low to have an impact on soil productivity for the soils in the Whitehorse area. Having a large quantity of biochar application in a short time period can be difficult and costly. Continuous application of biochar is recommended.

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Grants/Funding: Yukon College Northern Research Institute

SELECTION, VARIETY TESTING, AND EVALUATION OF CULTURAL PRACTICES FOR ALTERNATIVE AGRONOMIC CROPS FOR ALASKA

Robert M. Van Veldhuizen, **Mingchu Zhang**

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 used variety trials for continued evaluation of spring six-row feed barley, six-row hulless barley, hard red spring wheat, and oilseeds including Polish canola and dwarf, open-pollinated sunflower. Varieties were selected from northern Canadian, European, and U.S. sources for testing against the standard Alaska varieties (Otal spring feed barley, Thual hulless barley, Ingal hard red spring wheat, and AC Sunbeam Polish canola) for early maturity and high yields. Replicated trials of all varieties were planted at all test locations.

Progress/results: The 2013 growing season started very late with a late spring snowfall recorded on May 18. Planting began after that date. Growing season temperatures were slightly cooler until the end of July then slightly warmer to the end of September at all locations compared to the long-term averages. The precipitation was significantly lower than the long-term average at all locations, which led to drought conditions. Small grain and oilseed yields and test weights were significantly lower than the long-term average for the Fairbanks and Delta Junction locations. Due to the late planting date, plants at the Palmer location were consumed by a large sandhill crane population during the growing season, and no data was collected. Because of the drought conditions, plants were shorter and percent lodging was lower than normal compared with the long-term average values. Average yields for both feed and hulless barley were equal or better than the standard test variety, Otal. Average yields for hard red spring wheat were also higher than the standard test variety, Ingal. Yields of yellow oats were about the same as the standard test variety 'Toral'. Yields for the open-pollinated Polish canola 'Deltana' were slightly lower than long-term averages as well as the standard test variety 'AC Sunbeam.' The drought conditions allowed for even ripening and an average percent green seed content of 2 percent without the need for a glyphosate application treatment. The dwarf, open-pollinated sunflower 'Midnight Sun-flower' resulted in yields that were slightly lower than the long-term average. For 2014, testing of spring-planted small grains and oilseed varieties will continue.

This spring was the beginning of large-scale testing and evaluation of hard red spring wheat breeding lines from the University of Saskatchewan Crop Development Centre and Washington State University. A seed increase from the previous year (F8 generation – CDC, F2 generation - WSU) resulted in enough seed for a full-scale replicated test of each breeding line at both the Fairbanks and Delta Junction locations (F9 generation – CDC, F3 generation - WSU). The drought resulted in equal to slightly lower yields compared with the parent lines. It also resulted, however, in the identification of additional agronomic traits for uniformity, standability, and ease of threshing to make continued selections of those lines that are better adapted for Alaska growing conditions. For 2014, testing and selection of hard red spring wheat breeding lines will continue.

Impact: There has been a continued interest in growing adapted small grains for human consumption in both large and small scale production in Alaska. This has led to the opening of a small scale flour mill in the Delta Junction area producing flour from Sunshine hulless barley (a 2009 AFES release). The research into the harvest method of spraying Polish canola with glyphosate continues to result in 2 percent green seed or less. The oil from this seed is suitable for use as human consumption or as a biofuel with the meal suitable for use in animal feeds as a substitute for imported soybean meal as the energy portion of the diet. This has stimulated interest in using Polish canola as a viable rotational crop for Alaska. Results from irrigation/dryland cultural practices and berm pile residue studies show an increased nutrient plant use efficiency and prevention of loss to the environment with the development of a best use management practice.

Barley field near Delta Junction, Alaska

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Brigham, L. American Polar Society 75th Anniversary Conference: "The Polar Regions in the 21st Century: Globalization, Climate Change and Geopolitics." Session address: "The New Maritime Arctic: Global Challenges & Opportunities." Panelist, maritime issues, "The Next 75 Years: The Influence of the Poles on the Earth of Tomorrow." Marine Biological Laboratory, Woods Hole, Mass. April 15–17, 2013.

Brigham, L. Hoover Institution, Workshop on the Challenges and Opportunities of Arctic Security. "The Arctic Marine Shipping Assessment: Continued Arctic State Policy Framework and The New Maritime Arctic: Implications of Globalization and Changing Marine Access." Stanford University, San Francisco, Calif. April 28–30, 2013.

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Brigham, L. Nippon Foundation and Ocean Policy Research Foundation Conference on the Northern Sea Route. Chair, major synthesis panel; invited lecture at the National Institute for Polar Research. Tokyo, Japan. Sept. 2–4, 2013.

Brigham, L. Invited Dohrs Annual Lecture: Challenges and Opportunities in the New Maritime Arctic; seminar with 40 graduate students on Arctic policy issues and international cooperation in the Arctic Council. University of Georgia, Geography Department. Athens, Georgia. Oct. 2–5, 2013.

Cronin, M.A. 2013. Endangered Species: Bison, Bears and Wolves: The Science and the Policy. Oral presentation to the Montana Association of Counties (Feb. 11, 2013), the Alaska Board of Forestry (Mar. 27, 2013), the Ranching Heritage Alliance (June 28, 2013),

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Qiviut, the soft underwool beneath the longer outer wool of a muskox, is stronger and warmer than sheep's wool and softer than cashmere wool.

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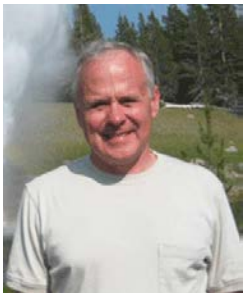

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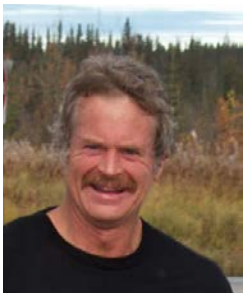

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