

Annual Report 2012



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

Meriam Karlsson in the controlled environment facility with "Sunny Smile" dwarf sunflowers, grown as part of a series of experiments to test crop response to light emitting diodes. See more on pp. 18-19. AFES photo by Nancy Tarnai.



RESEARCH HIGHLIGHTS

GARY KOFINAS: DOCUMENTING TRADITIONAL KNOWLEDGE OF MIGRATORY BEHAVIOR OF WESTERN ARCTIC HERD CARIBOU

Kofinas is looking into the longstanding concern among local subsistence users in the Northwest Arctic Region that non-local sport hunters dropped off by air taxis and transporters cause caribou to change their migration patterns. Local residents have stated at public meetings that human disturbance by sport hunters in areas of the Noatak National Preserve causes caribou to move away from local villages, making it difficult for local subsistence hunters to harvest the animals in the fall and to meet their needs. Over the past decade, the number of transporter flights into Noatak National Preserve has increased approximately 3-5% each year, meaning that an increasing number of non-local hunters are using the preserve during the short fall hunting season at the same time that local subsistence users are obtaining their winter meat.

Numerous biological studies have examined the impacts of human activity on caribou behavior, but there is very little documented local and traditional knowledge that addresses issues of disturbance from a cultural perspective. This results in planning and decision-making processes that rely heavily on scientific studies and overlook or discount information based on the observations, experiences and cultural practices of local people. To find out how caribou are affected by human activity, Kofinas and his fellow researchers are conducting semi-structured interviews with knowledgeable individuals of Noatak to identify activities that may influence caribou distribution and movements, including fall migration and where caribou cross major rivers. The interview format (including participatory mapping) was selected for its potential to capture more subtle and detailed information than a fixed survey or questionnaire, and to provide spatially explicit local and traditional knowledge.

SUSAN K. TODD: ISSUES IN RESOURCE PLANNING IN ALASKA

The wildlife conservancies of Namibia have been called one of the most significant innovations in conservation in the last 100 years. They enable indigenous people to benefit from the dangerous wildlife populations they live with on a daily basis. From July 2011 to July 2012 Todd lived in Namibia on a Fulbright sabbatical teaching at the Polytechnic of Namibia in Windhoek and studying wildlife management on communal conservancies around the country. This study will help those in other countries to implement similar programs by knowing what factors are most likely to make them successful. Todd is determining if there are some factors that may predict the financial success of conservancies, and examining similar possibilities in Alaska. Village corporations in Alaska are similar to the small business format of these conservancies, but ecotourism in the villages, while having some similarities to the efforts in Namibia, has important differences. For example, Stevens Village is raising plains bison in Delta and others are thinking about releasing wood bison on their lands. While trophy hunting is not well regarded in most villages in interior Alaska, in Namibia it has proven to have several advantages.

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LETTER FROM THE INTERIM DEAN & INTERIM DIRECTOR:

October 31, 2013

The Honorable Sean Parnell
Governor of Alaska
P.O. Box 110001
Juneau, Alaska 99811-0001

Dear Governor Parnell:

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, 2012. 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.

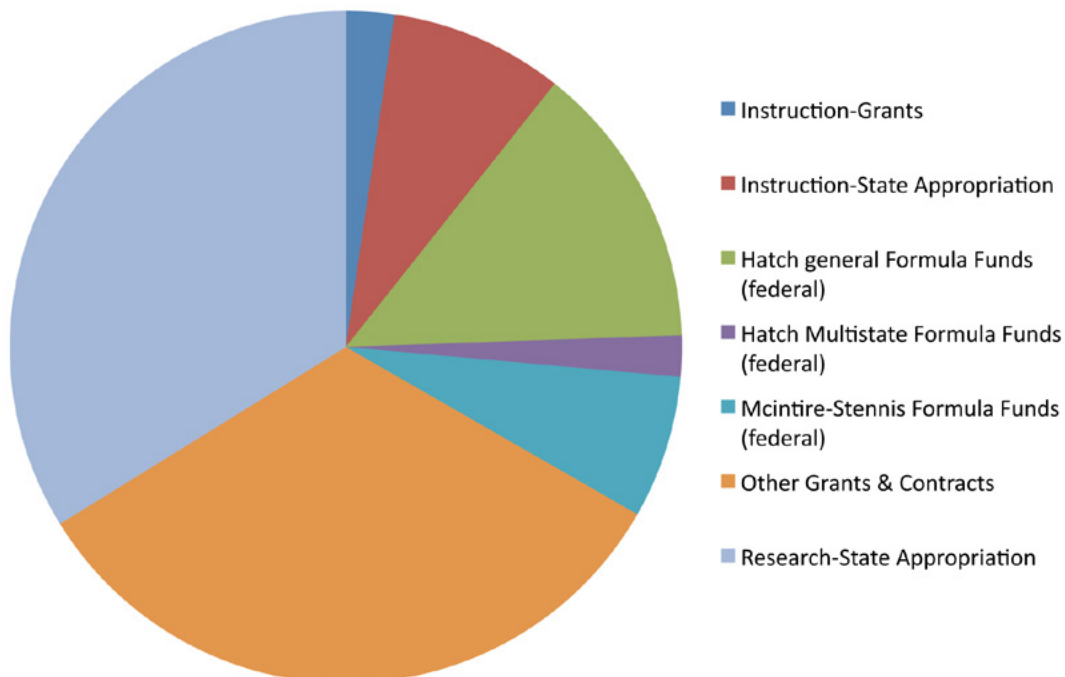
Administratively, AFES is an integral part of the School of Natural Resources and Agricultural Sciences at the University of Alaska Fairbanks. This association provides a direct link between research and teaching. Scientists who conduct research at the experiment station also teach, sharing their expertise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

FY 13 Statement of Expenditures: July 2012 through June 2013

The following statement of expenditures of federal and state funds for the fiscal year beginning July 1, 2012 and ending June 30, 2013 (FY 13) is not an accounting document.

| | |
|--|-----------------------|
| INSTRUCTION—GRANTS: | \$ 285,590.55 |
| INSTRUCTION—STATE APPROPRIATION: | \$1,024,703.29 |
| HATCH GENERAL FORMULA FUNDS (FEDERAL): | \$1,689,765.24 |
| HATCH MULTISTATE FORMULA FUNDS (FEDERAL): | \$ 242,653.18 |
| MCINTIRE-STENNIS FORMULA FUNDS (FEDERAL): | \$ 843,678.22 |
| OTHER GRANTS & CONTRACTS: | \$4,036,351.17 |
| RESEARCH—STATE APPROPRIATION: | \$4,150,506.11 |

TOTAL: \$12,273,247.76



FUNDING AND GRANTS

Grant Funds for 2012

GRANTS & CONTRACTS / SPECIAL FUNDS

| TITLE | PI | FUNDING AGENCY |
|--------------------------------------|----------|--|
| Project Income for FPP YR9, G6072 | Barber | Program Income Account |
| Forest Products Program - Year 9 | Barber | USDA CSREES |
| UAF Forest Products Program Year 10 | Barber | USDA National Institute of Food & Agriculture (NIFA) |
| Stooling Beds | Barber | Alaska Department of Natural Resources |
| Program Income Nenana Bldg Wrkshp | Barber | Program Income Account |
| Arctic Shipping: An Economic Develo | Brigham | State of AK Department of Commerce, Community & Economic Development |
| Gas Pipeline DEIS Review | Cronin | Alaska Gasline Development Corporation |
| ADF&G Sea Lion Genetics & Modelling | Cronin | Alaska Department of Fish & Game |
| Wolf Population Genetics | Cronin | Alaska Dept. of Fish & Game |
| Wolf Genetic Testing, FY13 suppleme | Cronin | Alaska Dept. of Fish & Game |
| BLM Range Management FY10 | Finstad | Bureau of Land Management |
| Enhanced Range MGMT of Reindeer | Finstad | Natural Resources Conservation Service (NRCS) |
| Reindeer Meat Production Workshop | Finstad | Bureau of Indian Affairs |
| NRCS Reindeer Collar Program 2011 | Finstad | Natural Resources Conservation Service |
| Seasonal Variations in Reindeer | Finstad | Cornell University |
| Monitoring Indicator in DNP | Fix | National Park Service |
| CESU Researcher in Residence Program | Fix | Nat'l Park Service - Denali Nat'l Park |
| CESU Army Corp Of Engineer Startup | Fix | Army Corps of Engineers |
| Estimating Visitor Use In Denali | Fix | National Park Service |
| BLM Benefits Based Management | Fix | Bureau of Land Management |
| ARRA NatureServe REAAK TO#2 SNAP | Fresco | NatureServe ARRA Umbrella |
| Matanuska Sports Turf Field | Harris | UA Foundation |
| GBG Children's Garden | Holloway | UA Foundation |
| Drew Amphitheater Foundation | Holloway | UA Foundation |
| GBG Foundation | Holloway | UA Foundation |
| D. Beistline Memorial Garden | Holloway | UA Foundation |
| GBG Ohleson Family Garden | Holloway | UA Foundation |
| GBG Endowment | Holloway | UA Foundation |
| Rasmuson Foundation Student Interns | Holloway | UA Foundation |
| GBG Research Survival FY13 Capital | Holloway | Alaska State Legislature Senate Finance Committee |
| 2010 Yukon River Basin Study | Juday | USDI Geological Survey |
| Fire History in the White Mountains | Juday | Bureau of Land Management |
| Boreal Alaska Learning BAKLAP | Juday | AK Department of Natural Resources |
| FFA Foundation Support | Karlsson | UA Foundation |
| Sustainable Horticulture Research | Karlsson | UA Foundation |
| AGA Strategic Planning | Kennedy | National Geographic Education Foundation |
| Alaska 2011/2012 Alliance Ops | Kennedy | National Geographic Education Foundation |

| | | |
|-------------------------------------|---------|---|
| Alaska 2012/2013 Alliance Ops | Kennedy | National Geographic Education Foundation |
| Oil & Gas Development Impacts | Kofinas | USDI Minerals Management Services |
| Knowledge of Migratory Behavior | Kofinas | National Park Service |
| Dean Discretionary Acct II - SNRAS | Lewis | UA Foundation |
| Seed Quality in Northern Latitudes | Lewis | USDA Agricultural Research Service |
| ADAP Regional Food Security Yr 22 | Lewis | University Of Hawaii |
| ADAP Year 23 AK Sub | Lewis | University Of Hawaii |
| Program Income 2012 ASITA Conf. | Lewis | Program Income Account |
| Afognak Island Sample Plots | Malone | Afognak Native Corporation |
| Haines State Forest Growth & Yield | Malone | AK Department of Natural Resources |
| SNAP: Warm-Season Precipitation | Mann | National Science Foundation |
| Relict Sand Dunes and Climate | Mann | US Fish & Wildlife Service |
| Create Model of Glacier Bay | Mann | National Park Service |
| CESU Impacts of Climate Change | Mann | National Park Service |
| Predicting Effects of Climate Chang | Mann | Bureau of Land Management |
| Glacial Retreat | Mann | National Science Foundation |
| Impacts of Past Warming Episodes | Mann | Bureau of Land Management |
| Photosanitary Test of Seed Potato | McBeath | Alaska Manufacturing Extension Partnership, Inc. |
| Overcoming Trade Barriers to China | McBeath | USDA Foreign Agricultural Service |
| Monitoring Permafrost Degradation | Ping | Natural Resources Conservation Svcs |
| Argonne Nat'l Lab/Field Carbon | Ping | Argonne National Lab |
| CESU-Rapid Carbon Assessment (RaCA) | Ping | Natural Resources Conservation Svcs |
| Soil Carbon Stocks in Ice Wedges | Ping | Argonne National Lab |
| Strategies for Livestock Production | Rowell | USDA - NIFA |
| Program Income for G7061 | Rowell | Program Income Account |
| Experimental Turf Putting Course | Scott | Mat-Su Health Foundation |
| Emissions Testing Haines Diesel Bio | Soria | Haines Borough |
| Biodiesel production in Guam | Soria | University of Guam |
| ANEP MAPTEACH | Sparrow | US Department of Education |
| Educating AK Ag Professionals | Sparrow | Utah State University |
| Soil Nutrient Testing in Delta | Sparrow | Salcha - Big Delta Soil and Water Conservation District |
| Program Income CAC Conference | Sparrow | Program Income Account |
| Dev UAF IPM Plan | Todd | USDA Forest Service |
| Projection of Forest Growth & Yield | Verbyla | USDA Forest Service (ALB) |
| Lake Surface Area at KVNP | Verbyla | National Park Service |
| Whitehorse Biochars | Zhang | Yukon College - Northern Research Institute |
| Evaluation of Nitrate Leaching | Zhang | Salcha - Big Delta Soil and Water Conservation District |
| Peony Production with Organics | Zhang | USDA Agricultural Research Service |
| Herbicide Carryover and Degradation | Zhang | USDA Agricultural Research Service |

FORMULA FUNDING, FEDERAL OCT 1 TO SEPT 30 FISCAL YEAR 2013-----ALL USDA- NATIONAL INSTITUTE OF FOOD AND AGRICULTURE

| Project # | TITLE | PI |
|----------------------|--|-----------|
| Hatch General | | |
| ALK-08-01 | Horticultural Crop Production for Alaska | Holloway |
| ALK-08-02 | Alaska Natural Resources and Economic Sustainability | Greenberg |

| | | |
|-------------------------|---|------------------------------------|
| ALK-08-04 | Season Extension for High Latitude Market Garden Production | Smeenk |
| ALK-08-06 | Selecting Alternative Agronomic Crops for Alaska | Zhang |
| ALK-09-01 | Issues in Resource Planning in Alaska | Todd |
| ALK-09-02 | Wetland Protection and Hydric Soils Monitoring in Volcanic Ash-derived Soils in Alaska | Ping |
| ALK-11-04 | Hatch Research Coordination | Sparrow |
| ALK-07-13 | Distribution, Transmission and Molecular Characterization of Potato Phytoplasmas in Alaska | McBeath |
| ALK-08-03 | Potential Perennial Lignocellulosic Energy Crops for Alaska | Sparrow |
| ALK-10-03 | Production of Livestock on Small Acreages in Alaska: Defining the Alaska Animal Unit and Effective Distribution of Grazing Activities | Harris |
| ALK-10-05 | Legal Conflicts in Natural Resources Management and the Implications of Climate Change | Joly |
| ALK-10-08 | Commercial Reindeer Meat Production | Finstad |
| Hatch Multistate | | |
| ALK-07-07 | Economic, Social and Ecological Issues of Rangeland Fragmentation that Affect Rangeland Sustainability and Rural Communities | Harris |
| ALK-09-05 | Commercial Greenhouse Production: Component and System Development | Karlsson |
| ALK-09-07 | Balancing Natural Resource Recreation Management, Human Well-Being, and Community Resilience | Fix |
| ALK-12-03 | Reproductive Performance in Domestic Ruminants | Shipka, Rowell |
| ALK-13-02 | Outdoor Recreation, Parks and Other Green Environments: Understanding Human and Community Benefits and Mechanisms | Fix |
| ALK-99-05 | Multistate Research Coordination, Western Region | Sparrow |
| McIntire-Stennis | | |
| ALK-07-11 | Sensitivity of Carbon Budgets & Nutrient Dynamics of Chronic Reduction of Soil Moisture Availability in Mid-successional Boreal Forests | Valentine |
| ALK-07-12 | Climate Sensitivity of Tree Growth and Forest Ecosystem Change in Alaska: Strategies for Management | Juday |
| ALK-09-08 | Measurement and Management of Alaska Boreal Forest Under Risks | Yarie |
| ALK-10-09 | Temporal Patterns of a Remotely Sensed Vegetation Index in Boreal Alaska | Verbyla |
| ALK-10-10 | Developing a Fast Assessment Method for Catalytically Upgrading Biomass Pyrolysis into Drop-in Fuels and Chemical Feedstocks | Soria |
| ALK-11-05 | McIntire-Stennis research coordination | Sparrow |
| ALK-12-01 | Adaptive Management Plan for the University Forest Tied to Current Monitoring & Experimental Manipulation & Environmental Controls | Yarie |
| ALK-13-01 | Alaska Coastal Rainforest Center | Sparrow/Rupp |
| ALK 99-01&05 | Formula Admin | Sparrow |
| Special Funds | | |
| ALK-10-07 | Identifying Strategies to Develop Sustainable Livestock Production in Alaska—AFRI Competitive Grant | Shipka, Rowell, Gerlach, Greenberg |
| ALK-10-04 | University of Alaska Fairbanks Forest Products 10—Special Grant | Barber |

STUDENTS

Baccalaureate Degrees

ADRIANA ELIZABETH AMAYA

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

MARCO DOUGLAS DELGADO

B.A., Geography

LAUREL ANNE GALE **

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

KELSEY ANNA GOBROSKI

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

BRYAN M. HAMEY

B.A., Geography

STEPHEN JOHN HANIK JR.

B.A., Geography; History

ALEXANDER SEBASTIAN KELLERHALS *

B.A., Geography

ERIC JOSEPH MERRILL

B.S., Natural Resources Management: Forestry

CHARLES L. PARR

B.S., Geography: Landscape Analysis and Climate Change Studies. Golden Key Honor Society

BRIAN CHRISTOPHER ROBERTSON

B.S., Natural Resources Management: High Latitude Agriculture

ERIK OLOF PETTER SOEDERSTROEM

magna cum laude, B.S., Geography: Landscape Analysis and Climate Change Studies. Honors Thesis Scholar

NICHOLAS JOSEPH TOYE

B.A., Geography

CHERISH YUKE

B.S., Natural Resources Management: High Latitude Agriculture

Master's Degrees

REBECCA ANN BAIRD *

M.S., Natural Resources Management.

B.S., University of Alaska Fairbanks, 2004.



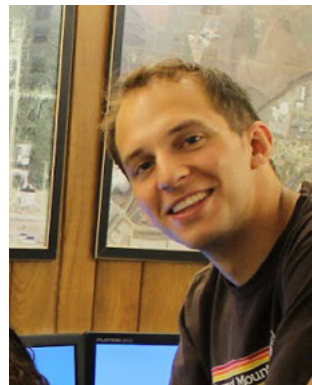
Kelsey Gobroski was named SNRAS's Outstanding Student in High-Latitude Agriculture in 2012, intending to go on to a career in science journalism. She minored in Russian and journalism and currently works at the UA Museum of the North.

—photo courtesy Kelsey Gobroski



Adrian Baer and Nina Schwinghammer in the fire-building event at the 16th annual Farthest North Forest Sports Festival.

—AFES photo by Nancy Tarnai



Charlie Parr intends to go on with his studies and is tutoring at UAF in Student Support Services. He chose geography because, he said, "You can really investigate any kind of problem at any scale. It's fascinating," he said. As a student the most important thing he learned, he said, was how to ask meaningful questions.

—AFES photo by Nancy Tarnai



Graduation: the balloon release celebrating the new graduates and their triumphant success after years of hard work.

—AFES photo by Nancy Tarnai

DEGREES OFFERED

BACHELORS' DEGREES

BACHELOR OF SCIENCE:

- Geography, options in environmental studies, landscape analysis and climate change studies, or geographic information science and technology
- Natural Resources Management, with options in high-latitude agriculture, forest sciences, or humans and the environment

BACHELOR OF ARTS:

- Geography

MASTERS' DEGREES:

- Master's of Science in Natural Resources Management
- Master of Natural Resources Management and Geography
- Interdisciplinary Master

DOCTORAL DEGREES:

- Doctor of Philosophy in Natural Resources and Sustainability
- Interdisciplinary Doctor of Philosophy*

*coordinated with the Graduate School

TINA M. BUXBAUM *

M.S., Natural Resources Management.

B.S., University of Alaska Fairbanks, 2003.

MARSHA HENDERSON

M.N.R.M.G., Natural Resources Management and Geography.

B.S., Humboldt State University (California), 1988.

KARA E. MOORE **

M.N.R.M.G., Natural Resources Management and Geography. Phi Kappa Phi Honor Society.

B.S., University of Alaska Fairbanks, 2002.

JOSEPHINE-MARY OSAFO-ADU SAM **

M.S., Natural Resources Management. Golden Key Honor Society.

B.A., Kwame Nkrumah University (Ghana), 2005.

MARY ELIZABETH PARENT **

M.S., Natural Resources Management.

B.S., University of Maine, 2009.

TRACY S. ROGERS *

M.S., Natural Resources Management.

B.A., University of Maryland Baltimore County, 2007.

* summer degree recipient

** december degree recipient



Josie Sam at graduation, receiving her master's degree in Natural Resources Management.

—AFES photo by Nancy Tamai

Tina Buxbaum in 2009. Buxbaum's master's thesis was "Pollination Biology of the Bog Blueberry, *Vaccinium Uliginosum* L., in Interior Alaska."



five-year statistics: number of students enrolled, 2008-2012 (majors)

| ACADEMIC YEAR | PHD (SUSTAINABILITY) | PHD (INTERDISCIPLINARY) | MS NRM | MS / MA (INTERDISC.) | MNRM&G | BS GEOGRAPHY | BA GEOGRAPHY | BS NRM |
|---------------|-------------------------|----------------------------|--------|-------------------------|--------|-----------------|-----------------|-----------|
| 2008 | 0 | 11 | 30 | 4 | 0 | 21 | 25 | 60 |
| 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 |

RESEARCH AT SNRAS AND AFES

Forest Sciences

BIOFUELS

BIOMASS STOOLING BEDS AND HYBRID POPLAR

Valerie Barber, Susan McNeil; Jeff Graham (Department of Natural Resources, Division of Forestry)

Purpose: Biomass projects are rapidly being developed throughout the state to provide heat and electricity in rural communities where fuel costs are high. Sustainable forest management and a fast-growing fuel supply will be important for each project's long-term success. We are studying the success rate of ten

different, fast-growing, hybrid poplar types from Saskatchewan and Alberta and are comparing the hybrid success rate with indigenous cottonwoods.

Approach: Hybrid poplar whips potted in the greenhouse spring 2011 were planted by the City of Palmer and the Matanuska-Susitna Borough along city streets and at recreational sites. Their success is monitored yearly, along with their annual growth rate. Two of the ten hybrid types didn't survive as the whips were too thin for rooting. We added local poplar in 2013 to compare with the hybrids.

Some of the hybrid trees were planted at local schools in late August 2012 to establish their roots before freeze-up. Schools were asked to

record hybrid type and location and given planting instructions. Sunny sites were recommended. Poplars do well in wet areas; the whips need to be watered the first year, but shouldn't need much care after that.

Progress: Many of the hybrid poplars are surviving year to year, which was unexpected. This year, the success rate of the hybrids is far surpassing the rate of growth of the native cottonwoods.

Impact: Canadian hybrids may be a viable option for growing biomass in Alaska. Hybrids should grow at a faster rate than native species, but that determination has not yet been made.

Grants/funding: Alaska Energy Authority, Emerging Technology, DNR Division of Forestry.

CATALYTICALLY UPGRADING BIO-OIL

J. Andres Soria, Theodore Dickerson

Purpose: To evaluate Alaska biomass for bio-oil upgrading into gasoline and diesel boiling point fluids.

Approach: Pyrolytic bio-oil was produced by thermochemical means using a laboratory scale, fixed-bed, auger-driven pyrolysis reactor. The bio-oil was transferred to a modified Parr Instruments 4740 vessel, pressurized with hydrogen in the presence of various catalysts and reacted at various temperatures.

Progress: Work using small-diameter alder has been completed and the products generated had diesel boiling point range characteristics, using unsupported catalysts.

Impact: Novel processing of native small-diameter biomass is helping guide the continuous development of second-generation technologies focused on undervalued wood resources in Alaska, with broader implications for the nation as a whole. This research, in particular from small-diameter trees, is addressing fundamental questions with regard to uses of Alaska biomass in untraditional value-added products.

Grants/funding: USDA Special Grant, WUR 10.

BIOMASS PRODUCTION POTENTIAL OF POPLAR AS A SHORT-ROTATION BIO-ENERGY CROP IN SOUTHCENTRAL ALASKA

Amanda G. Byrd, William E. Schnabel, Stephen D. Sparrow, darleen t. masiak

Purpose: Biomass may be a key component of renewable energy sources in Alaska's future, and may have the advantage of being cheaper than fossil fuels, especially in rural areas. It may also have the added benefit of net sequestration of carbon. However, there has been little study on management of biomass as an energy source in Alaska. We recently began a study on an experimental landfill cap at Elmendorf Air Force Base to determine the yield potential of poplars under semi-intensive management. The objectives are: 1) Estimate rate of

accumulation of aboveground biomass, both with and without supplemental nutrients added, and 2) Assess the feasibility of using biomass as an alternative to diesel fuel for rural Alaska.

Approach: The study site is part of an experimental municipal waste project at Elmendorf Air Force Base near Anchorage, used to evaluate the effect of trees on landfill cover water balance. Saplings (mostly poplars, *Populus balsamifera* or *P. balsamifera x trichocarpa*) were planted in 2005. In late winter 2011, we measured tree height, basal and breast-height diameter, and harvested all aboveground biomass. The area was divided into four equal-sized plots, two of which were treated with slow-release fertilizer to supply 100 lb nitrogen (90 kg /ha), 50 lb phosphorus, and 62 lb potassium. Aboveground biomass was measured at the end of the 2012 growing season to estimate regrowth potential of established poplars.

Progress: The poplar trees produced an aboveground dry biomass yield of 9.6 tons/ac (21.6 metric tons [Mt] per hectare) over six years or 1.6 tons/ac (3.6 Mt/ha) annually. Average tree biomass after six years was 6.6 lb (3 kg). Biomass of *P. balsamifera* accumulated at an average annual rate of 5,530 kg/ha/yr in the two years after harvest. The energy concentration of the harvested wood averaged 19,685kJ/kg for a total energy production of 217,715 MJ/ha after two years, which is equivalent to 5,700 liters of diesel fuel.

Impact: Ultimately, this study will provide information for Alaska communities that will help them decide whether to invest in growing poplars as biomass crops for energy use.

Grants/funding: US Air Force.

FOREST ECOLOGY

LICHENS, WILDFIRES, AND CLIMATE CHANGE IN INTERIOR ALASKA: A PRELIMINARY ASSESSMENT OF THE DRIVERS OF CARIBOU HABITAT QUALITY

Thomas Grant, Glenn Juday, Jim Herriges (Bureau of Land Management)

Purpose: Determine the relationship between forest age and lichen

abundance to assess and predict caribou habitat quality.

Approach: Sites were randomly selected across 2.2 million acres of BLM public lands and vegetation plots established to sample vegetation point cover, tree density and height classes. Gradient Boosting Machine analysis was applied.

Progress: An additional 120 plots were established in 2012 to add to 200+ sampled in 2001, 2002, 2007. All field data have been collected, and analysis is underway.

Impact: Prime caribou forage lichen abundance is associated with forest stand ages greater than 200 year old, elevations between 700-800m, and north-facing aspects. Fire-free refuges are becoming rare (24 percent of the study area has burned since 2004), reducing the area of old or mature spruce forests which produce caribou lichen forage.

Grants/funding: BLM.

FOREST GROWTH & HEALTH

GROWTH HISTORY AND HEALTH OF ASPEN IN INTERIOR ALASKA

Glenn Juday, Thomas Grant

Purpose: Determine the climate sensitivity and control over the growth of aspen.

Approach: We cut, sanded, and cross-dated tree disks from mature live trees, and measured tree rings. Tree growth and survival since 1988 were measured on a 1.0 hectare reference stand.

Progress: We collected and measured another 60 tree disks from 6 additional stands to add to the 117 disks from 7 stands. Two of the new stand collections were in the Copper River Basin, for comparison with results from interior Alaska.

Impact: Warm summers have significantly reduced the growth of sampled aspen, and leaf miner damage has further reduced growth. We were able to quantify the effect of aspen leaf miner damage on tree radial growth. Half the trees in the reference stand hectare died between 1988 and 2011.

Grants/funding: USGS, Alaska DNR, McIntire-Stennis Cooperative Forestry Research.

THE GRAND RIVER TRANSECT ALONG THE MAJOR RIVERS OF ALASKA

Glenn Juday; Claire Alix (University of Paris 1 Sorbonne); Thomas Grant

Purpose: Test the climatic controls over growth of white spruce growing on highly productive sites on glacial meltwater river floodplains and develop a master library of tree-ring chronologies in the main source area of driftwood to allow cross-dating.

Approach: We are comparing ring widths of 540 trees from 36 stands on the Tanana, Yukon, and Kuskokwim rivers.

Progress: We collected and measured tree cores from the final three stands and 32 trees. We calculated Cross Dating Index values and identified the positive vs. negative growth responses to monthly temperatures of each tree in the overall sample of 540.

Impact: Trees on the lower Yukon River sites are experiencing the most favorable temperatures for growth in their life spans, while trees in interior or upriver sites are experiencing the least favorable.

Grants/funding: USGS; McIntire-Stennis Cooperative Forestry Research, Alaska DNR; Centre National de la Recherche Scientifique (French National Center for Scientific Research).

TWENTY-FIVE YEARS OF MONITORING NATURAL FOREST REGENERATION AT RESERVE WEST

Glenn Juday

Purpose: Maintain a long-term measurement series of white spruce recruitment, survivorship, growth, and health following the 1983 Rosie Creek Fire in Bonanza Creek Experimental Forest.

Approach: All white spruce trees in a reference stand of 1.0 hectare have been mapped, measured, and examined for injury annually since 1988. Eight measurements are taken on each tree: base diameter, diameter at breast height (137 cm), total tree height, height growth in the current year, spruce budworm damage, shade class, animal damage to leader, and notes of special conditions.

Progress: In 2012, the 25th year of measurement, 2,271 white spruce trees remain alive, and they achieved a mean of 11.0 cm ht growth in 2012, for a mean total height of 186 cm.

Impact: This is one of the largest and longest-running annual plot-level forest measurement series in boreal Alaska, and provides unique insight into how forests develop in their early years. Results highlight key factors that influence forest development after fire, particularly tree-to-tree competition, drought, insect attack, mechanical damage, and animal browsing.

Grants/funding: McIntire-Stennis Cooperative Forestry Research; Bonanza Creek LTER NSF.

PHOTO MONITORING FOREST CHANGE IN INTERIOR ALASKA

Glenn Juday

Purpose: Document forest development, growth, and health in productive early and late successional stands representative of managed sites.

Approach: Repeated photography at permanent photo stations in the spring, summer, and fall.

Progress: Permanent ground photo monitoring at Bonanza Creek Experimental Forest (BCEF) in 2012 resulted in 2,068 pictures from 8 plots, totaling 17.5 GB.

Impact: The entire Bonanza Creek Experimental Forest photo monitoring project now includes pictures taken in 18 of the 23 years since inception in 1989, and annually since 2006. The collection is made up of 12,591 pictures totaling more than 83.7 GB. The project captures a rich visual record of many of the major changes in the boreal forest of central Alaska in the past quarter-century.

Grants/funding: McIntire-Stennis Cooperative Forestry Research; Alaska DNR.

FOREST GROWTH ALONG BLM-MANAGED WILD AND SCENIC CLEARWATER RIVERS

Glenn Juday

Purpose: Develop a master tree-ring width chronology to cross-date

historical cabins and determine the climate sensitivity of white spruce on clearwater rivers.

Approach: We sanded and measured tree cores collected from BLM expeditions.

Progress: All tree cores from three rivers were sanded and measured including Birch Creek (21 stands 124 trees), Beaver Creek (25 stands 205 trees), and Fortymile River (45 stands 359 trees).

Impact: The live tree chronologies allow cross-dating of historic structures when sufficient overlap is present. Distinctive ring width patterns are present.

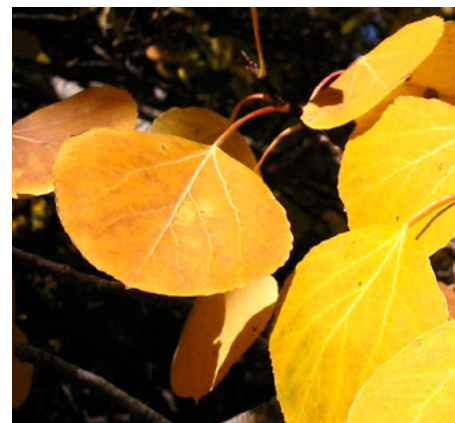
Grants/funding: BLM.

COOPERATIVE ALASKA FOREST INVENTORY (CAFI)

Thomas Malone

Purpose: To develop comprehensive databases of northern/boreal forest conditions and dynamics in Alaska. This project started in 1994.

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 ownerships. At each site, three 0.1 acre plots are established. At plot establishment and at each remeasurement all trees are measured, regeneration is counted, site characteristics are recorded, and understory vegetation is identified. Plots are remeasured every five years.



Populus tremuloides, or quaking aspen.

—Photo by Walter Siegmund, CC A-SA 3.0 Wikimedia.

Progress: To date 603 plots have been established at 201 sites. Tree measurement, site description, tree regeneration, and vegetation databases have been developed with all data collected since 1994. Twenty-two percent of the plots have been inventoried four 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, to ground truth satellite imagery, to estimate biomass per unit area, and to develop a Forest Vegetation Simulator.

Grant/funding: McIntire-Stennis; SNRAS Forest Growth and Yield Fund.

INFLUENCE OF PRECIPITATION TIMING ON TREE GROWTH IN UPLAND AND FLOODPLAIN FOREST ECOSYSTEMS IN INTERIOR ALASKA

J. Yarie

Purpose: To determine the influence of summer rainfall or spring snowmelt exclusion on the growth of trees in hardwood/conifer ecosystems in upland and floodplain locations.

Approach: Climate change dynamics will result in alteration of the seasonal precipitation dynamics (both quantity and form) in the boreal forest. In an attempt to investigate changes in forest growth resulting from precipitation changes a set of drought experiments was established. Rainfall and snowmelt exclusion covers were installed seasonally in replicate stands of upland birch/aspens (*Betula neolaskana* Sarg./*Populus tremuloides* Michx.) and floodplain balsam poplar/white spruce (*Populus balsamifera* L./*Picea glauca* (Moench) Voss). The covers were designed to prevent summer rainfall from entering the soil and recharging soil water during the growing season and to allow removal of the snowpack prior to the start of the snowmelt period.

Progress: Based on the average precipitation characteristics during

the study period, the summer rainfall exclusion reduced the annual inputs by 46% with a range from 22.7% to 72.1%.

Rainfall exclusion

Upland sites: Since 1992, upland sites showed only sporadic growth reduction for birch and balsam poplar. White spruce and aspen were not affected.

Floodplain sites: White spruce showed consistent reduction in growth due to treatment. Balsam poplar showed no differences.

Snowmelt exclusion

Upland sites: After four years of the spring snowmelt removal treatment in the upland sites, tree growth was significantly reduced in one, two, and three of the four treatment years for birch, white spruce, and aspen, respectively. Balsam poplar showed no differences. This result indicates the importance of total winter snowfall controlling the growth of upland tree species.

Floodplain sites: The three years of treatment on the floodplain sites resulted in no significant difference in tree growth for both white spruce and balsam poplar. This could be the result of spring river level dynamics tied to the floodplain sites. Major soil moisture recharge could easily be tied to the river level during the spring on the floodplain. Soil moisture estimates using TDR equipment showed a difference in soil moisture immediately after soil thaw. This is a good indication that the treatment is working.

Impact: In upland sites soil moisture recharge from melting snowpack 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. 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 due to 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. At this point it is difficult to speculate on the overall importance in spring snowmelt in the control of tree basal area growth. Additional years of treatment are necessary to clarify the results.

Grant/funding: LTER, McIntire-Stennis.

LOG DECOMPOSITION IN INTERIOR ALASKA

J. Yarie

Purpose: To document the decomposition dynamics of logs within interior Alaska. Logs are a significant carbon and organic matter input into the forest floor in natural forest ecosystems, and have implications on the carbon, organic matter, and nutrient dynamics of forest soils.

Approach: Fifteen logs were placed on the forest floor in forest stands for each major upland and floodplain vegetation type with six replications each. The species sampled were aspen (*Populus tremuloides* Michx.), birch (*Betula neolaskana* Sarg.), white spruce (*Picea glauca* (Moench) Voss), and black spruce (*Picea mariana* (Mill) B.S.P.) in upland locations, and alder (*Alnus tenuifolia* Nutt.), balsam poplar (*Populus balsamifera* L.), white spruce, and black spruce in floodplain locations. Sample locations were also established in recently burned upland and floodplain white and black spruce ecosystems. Individual logs will be sampled to monitor changes in log carbon, nutrient, cellulose, and lignin concentrations over the next century.

Progress: The initial results indicate that alder displayed the highest decomposition rates with only 25% of its original wood weight remaining after 15 years while floodplain white spruce and birch showed the slowest rates of decomposition with 61% and 67%, respectively, remaining after 15 years. Aspen, balsam poplar, and upland white spruce had 33%, 41%, and 54% of their wood weight remaining after 15 years of decomposition. Loss of the mass of carbon from the logs (wood and bark) ranged from 30% to 71%.

Impact: It is not yet clear what effect coarse woody debris has on the carbon dynamics of the taiga forest. However, it appears to take only a single

decade for the logs to lose half of their carbon. The results of this study will help to develop a clear picture of log decomposition dynamics on the carbon balance of forests in interior Alaska.

Grant/funding: LTER, McIntire-Stennis.

RELATIONSHIP OF TREE GROWTH TO ENVIRONMENTAL AND SOIL FERTILITY FACTORS FOR 44 YEARS IN INTERIOR ALASKA

J. Yarie, K. Van Cleve

Purpose: To maintain a long-term record of tree growth and climate data for an age sequence of forest stands.

Approach: Started in the late 1960s, fertilization and thinning studies were developed in birch, aspen, and white spruce forest types representing young, middle, and old-age classes in interior Alaska and are monitored for both climatic and tree growth on a yearly basis. The result is the development of a long-term data set related to the effects of fertilization and thinning on a number of age classes of the common forest types found in interior Alaska.

Progress: The comparative analysis of this large set of studies 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, the age structure of the vegetation, and stand density.

Grant/funding: McIntire-Stennis.

TIMBER EVALUATION

ALASKA POPULUS PROPERTIES

Valerie Barber, Susan McNeil

Purpose: A potentially commercial species in Alaska, *Populus balsamifera*, balsam poplar, is underutilized in Alaska and has the potential to promote industry growth in the forest products sector as it is a fast-growing tree. We examine some of the physical and mechanical properties of the species as well as saw log quality in relation to recovery, grade, and yield.

Approach: Balsam poplar logs will be measured for volume and tested acoustically for soundness and then milled, kiln dried, and planed for recovery, grade, and yield studies.

Progress: We collected 14 poplar trees from the Cook Inlet Region, Inc., land being cleared at the corner of Trunk Road and Palmer Wasilla Highway in April 2012. The trees were cut to logs of typical length and each log was measured for volume and acoustically tested. They were then milled into boards of different dimensions, typical of how they are cut in Alaska, and then kiln dried. They await planning and grading.

Impact: The results should help mills in determining economic value of an underutilized species and some value added processing.

Grants/funding: Wood Utilization Research Grant 2009.

TOTAL AND MERCHANTABLE CUBIC FOOT VOLUME OF WHITE SPRUCE, BIRCH, AND ASPEN IN ALASKA

Thomas Malone

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 ft³ volume to a 2-in, 4-in, and 6-in top.

Approach: I calibrated an empirical regression model for white spruce with a large sample size collected through

interior and southcentral Alaska, testing geographic differences to show that the model could be applied statewide. These multiple entry (dbh and height) models were developed for both inside and outside bark from a 6-in stump.

Progress: The white spruce portion of this study was completed. Land managers are currently using the white spruce models and an article was in press in 2012. Aspen and birch data are being analyzed.

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

Grant/funding: McIntire-Stennis; SNRAS Forest Growth and Yield Fund.

LEVELS OF GROWING STOCK (LOGS) STUDY

Thomas Malone

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 every year for the first 20 years and then every 5 years until harvest at year 100.

Impact: This research project has provided land owners 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.

Grants/funding: McIntire-Stennis; SNRAS Forest Growth and Yield Fund

NON-TIMBER FOREST PRODUCTS

ONETREE VALLEY AT THE ALASKA STATE FAIR AND PALMER MUSEUM

Valerie Barber (SNRAS/CES), Susan McNeil; Carmen Summerfield (Valley Arts Alliance)

Purpose: OneTree Valley aimed to show the unique value of local woodlands by demonstrating the volume, quality, and variety of work that can be made from just one tree. Often science and art are interrelated, and sometimes art projects can demonstrate science concepts more easily than just the science presentation alone.

Approach: One birch tree was selected from trees cleared for the new Trunk Road reconstruction. It was felled and transported to the Matanuska Experiment Farm. About 20 artists met there to determine what parts of the tree they wanted to use for their art pieces. The staff from the farm cut the tree as needed. Artists worked on the wood through the summer and exhibited their artwork at the Alaska State Fair UAF Forest Products Program booth in August.

Result: Some of the artists signed up for shifts to talk to the fairgoers about their work. Fairgoers cycled through, admired the artwork and filled out a wish card to go on the potted, live birch trees exhibited. There were also hands-on projects for children. After the fair, the exhibit was moved to the Palmer Museum of History & Art for a month. There was information for teachers, students, and parents interested in pursuing OneTree Valley in classrooms.

Impact: The OneTree Valley exhibit showed teachers the value of combining artwork with science to learn about trees. Community members associated with the Valley Arts Alliance worked closely with university staff to engage artists for the project. OneTree Valley could be taken to classrooms using Project Learning Tree curricula. We are currently working with Project Learning Tree on homeschool workshops and activities.

Grants/funding: USDA, Wood Utilization Research Grant 2010.

WORKING IN THE WOODS: BIRCH SYRUP PRODUCTION AS AN ALTERNATIVE LIFESTYLE

Kimberley Maher; Annette Watson (College of Charleston); **Glenn Juday**

Purpose: Examine workers' motivations for participating in the Alaska birch syrup industry during the 2007 sap season.

Approach and progress: On-site semi-structured interviews were conducted with workers, and then grounded theory techniques were used to analyze the transcripts. The study is complete.

Impact: Participants in the birch syrup industry were seeking an alternative to or a break from the traditional workforce. Many of the workers held other seasonal positions and were drawn to birch syrup production as a way to fill in their off-season with a unique experience.

Grants/funding: Alaska EPSCoR NSF, Bonanza Creek LTER NSF, UAF.

EFFECTS OF SPRING SAP HARVEST ON INCREMENT GROWTH OF ALASKA BIRCH *BETULA NEOALASKANA* AND IMPLICATIONS FOR THE SUSTAINABILITY OF THE SAP RESOURCE UNDER A CHANGING CLIMATE REGIME

Kimberley Maher, **Glenn Juday**

Purpose: Determine the effects of mechanical damage and sap removal from tapping for spring sap on the growth and vigor of Alaska birch.

Approach and progress: We compared annual increment growth of Alaska birch trees during three consecutive years of tapping and seven years post-tapping versus growth of controls in a general linear model. The study and analysis are complete.

Impact: There was no significant difference in growth between tapped and untapped trees, but annual variability was strongly significant. A temperature predictive index of eight mean monthly temperatures accounted for nearly two thirds of the annual variability in the growth.

Grants/funding: Alaska EPSCoR NSF, The Community Forestry &

Environmental Research Partnerships Program, Bonanza Creek LTER NSF, UAF.

HARVESTING NON-TIMBER FOREST PRODUCTS IN INTERIOR ALASKA

Kimberley Maher; Annette Watson (College of Charleston); **Glenn Juday**

Purpose: Assist resource managers providing for all resource users on public lands by documenting the type, level, and location of non-timber forest uses.

Approach and progress: We completed an analysis of a 2003 forest use survey containing data on households throughout interior Alaska identifying who is harvesting, what they are harvesting, quantities of harvest, and general locations of harvest activity.

Impact: Wild blueberries (38.5 percent of households) and firewood (25.0 percent of households) were reported harvested with greatest frequency. Correlations of harvesting activities and demographic data were statistically significant for some demographic data (e.g. education level and residency in urban, ex-urban, or rural communities) but not others (e.g. age, number of years residency in Alaska, household size, and household income).

Grants/funding: Alaska EPSCoR NSF, Community Forestry & Environmental Research Partnerships Program, Bonanza Creek LTER NSF, UAF.

MOTIVATIONS FOR PARTICIPATION AND BENEFITS FROM NON-TIMBER FOREST PRODUCT HARVESTING IN INTERIOR ALASKA

Kimberley Maher; Annette Watson (College of Charleston); **Glenn Juday**, **Val Barber**; Craig Gerlach (UAF Cross-Cultural Studies)

Purpose: Identify motivations for participation and the perceived benefits from non-timber forest product harvesting in interior Alaska.

Approach and progress: This study employed semi-structured interviews with experienced NTFP harvesters in the Tanana Valley, and then used grounded theory techniques to

analyze the transcripts. The study and analysis are complete.

Impact: Harvesters are seeking complex experiences with multiple motivations for participating in harvestings beyond going out and filling their berry buckets and wood sheds. These motivations include spending time outdoors, and spending time with family and friends while harvesting. Harvesters receive both tangible and intangible benefits from their activities such as high-quality products that are otherwise unavailable or inaccessible, a contribution to their household economy, improved mental health, a spiritual experience, and developing connections to the land, nature, and their culture.

Grants/funding: Alaska EPSCoR NSF, The Community Forestry & Environmental Research Partnerships Program, Bonanza Creek LTER NSF, NSF IGERT Resilience and Adaptation Program, the NSF GK-12 Fellowship xvii, UAF.

Geography

CARBON STORAGE

ENVIRONMENTAL CONTROLS OVER PEAT ACCUMULATION IN ARCTIC ALASKA

Baughman CA, Mann DH, Heiser PA (UAF); Kunz ML (BLM)

Purpose: Widespread accumulation of peat (paludification) began on Alaska's North Slope during the Pleistocene/Holocene transition starting ca. 12,000, and established this region as a carbon sink. This is in question today because of rapid climate change. Our project's focus is on the relationship between peat, microclimate, and topography in a portion of the Arctic Foothills 300-350 km south of Point Barrow on the northern flank of the Brooks Range.

Approach: We used a combination of remotely sensed data, field measurements, and a GIS to gather data regarding slope, aspect, elevation, near-ground temperature, soil moisture, temperature at the

organic/mineral horizon interface, solar radiation, upslope drainage area, and lastly, peat thickness.

Progress: Results show a significant inverse relationship between slope and peat thickness, with an increase in steepness accompanying a decrease in peat thickness. There is a less significant relationship between aspect and peat thickness. There is a significant positive relationship between peat thickness and July active layer thickness, indicating that peat thickness and belowground temperature regimes are highly correlated.

Impact: We estimated time to paludification to be 300–600 years. There appears to be a temporal threshold along the chronosequence at approximately 400 years. After this point the peat accumulation rate is near zero and statistically insignificant. This could indicate that landscapes in the Arctic Foothills approach a stable state with regard to peat development rather quickly on the geologic time scale and challenges the idea of continuous peat accumulation. Results from this project will inform a geospatial model linking peat dynamics to climate change in arctic Alaska.

IDENTIFICATION OF PREVIOUSLY UNRECOGNIZED TUNDRA FIRE EVENTS ON THE ARCTIC SLOPE OF ALASKA

Daniel H. Mann, David Verbyla; Benjamin M. Jones, David J. Selkowitz (USGS); Benjamin V. Gaglioti (USGS Alaska Science Center and UAF Water & Environmental Research Center); Christopher D. Arp (Water & Environmental Research Center); Amy L. Breen (UAF IARC); Mike L. Kunz (BLM); Philip E. Higuera (Univ. of Idaho College of Natural Resources) Guido Grosse, Vladimir E. Romanovsky (UAF Geophysical Institute); Donald A. Walker (UAF Institute of Arctic Biology)

Purpose: Tundra vegetation, peat, and frozen soils in the Arctic store large, globally significant amounts of labile carbon, and pulse disturbances, such as fire, play an important role in biogeochemical cycling. Tundra fires on the Arctic Slope of Alaska are reportedly rare over the period of historical recordkeeping as well as throughout the Holocene. Between 1950 and

2011, 26 fires have been identified and cumulatively these burned a land area of ~150,000 hectares. One fire, the Anaktuvuk River Fire of 2007, accounts for two-thirds of the historical burn area in this region and has prompted the notion that the northern Alaska tundra fire regime may be shifting as a result of amplified arctic climate change. Based on analysis of charcoal in lake sediments within the burn perimeter it has been labeled as an unprecedented event during the last 5,000 years. However, the historic and prehistoric context of tundra fires on the Arctic Slope remains poorly resolved due to the short duration of recordkeeping and the cryptic nature of charcoal dispersal and preservation in the paleoecological record. Is it possible that the Anaktuvuk River Fire falls within the natural range of variability in this system and that other large and potentially severe tundra fires occurred pre-1950 and other smaller yet undocumented fires occurred post-1950?

Approach and progress: To understand how post-fire vegetation succession and land surface changes could be used to identify potential prehistoric tundra fire events, we conducted studies on upland tussock tundra presumed not to have burned and similar upland-type settings in a chronosequence of past known tundra fire locations from 2007 (Anaktuvuk River Fire), 1993 (DCKN fire near Wainwright), and 1977 (Kokolik River Fire). Plot-level vegetation and polygonal ice wedge network microtopography surveys were conducted in each area. Using remotely sensed data and aerial surveys to identify potential prehistoric burn areas based on our field knowledge of post-fire vegetation succession and changes in land surface characteristics, the coupled analysis resulted in the identification and delineation of three potential tundra fire burn areas on the Arctic Slope that resulted from fires that occurred before 1950. Two of these fires are potentially very large (exceeding 50,000 ha) and one is quite small (300 ha), but was likely of high burn severity.

Impact: The Anaktuvuk River Fire alone was shown to have released an amount of carbon that was equivalent in magnitude to carbon storage in the entire tundra biome during the last

quarter of the twentieth century. If these recently identified large tundra fire events burned severely, they too likely affected the northern high latitude carbon budget. We identified an additional eight small fire events that occurred post-1950, yet were not captured in the historical fire database. Thus, it is likely that other such tundra fire events, both pre- and post-1950, have occurred on the Arctic Slope that remain unnoticed. Based on our initial results, the role and frequency of tundra fire as a disturbance to tundra ecosystems in northern Alaska may need to be reassessed.

RADIOCARBON AGE OFFSETS IN ARCTIC LAKE SEDIMENTS DESCRIBE THE VULNERABILITY OF PERMAFROST CARBON TO PAST CLIMATE WARMING

Benjamin Gaglioti, Benjamin M Jones (USGS); **Daniel H. Mann**; John Pohlman (Woods Hole Science Center USGS), Michael L. Kunz (BLM), Miriam Jones (Eastern Geology and Paleoclimate Center - USGS); Matthew J. Wooller (Alaska Quaternary Center, Water & Environmental Research Center)

Purpose: A warming climate in the future could release permafrost carbon as carbon dioxide and methane to the atmosphere, causing a positive feedback to climate warming. An effective approach to better understanding this problem is to observe how permafrost carbon dynamics responded to past warming events.

Approach: We use the sediment record of a lake basin in northern Alaska as a long-term archive for past permafrost carbon release from the surrounding watershed. The age of deposition and burial for an arctic lake sediment horizon is often younger than the carbon-14 (14C) age because of old 14C-depleted carbon eroded or leached from peat, soil, and thawing permafrost in the watershed. Changes in the magnitude between the age of deposition (“true age”) and the radiocarbon age of the bulk sediment from the same layer is the radiocarbon age-offset, which serves as a gauge for the relative amount of permafrost carbon released from the watershed.

Progress: We analyzed the sediments of Lake of the Pleistocene (LOP), a partially-drained lake basin located in the northern flank of the Brooks Range that contains continuously deposited sediments spanning the last 14,500 calendar years. The LOP watershed is underlain by continuous permafrost and contains extensive, frozen peatlands. We were able to excavate a wide swath of the former lakebed and collect hundreds of willow twigs and sediment samples to construct a high-resolution age-offset chronology. We dated well-preserved willow twigs that are directly blown into the lake to obtain a “true” 14C age and the age of bulk lake-sediment organic matter from the same layer that records the age of both primary productivity from within the lake and of the old dissolved and particulate organic carbon reworked from the watershed. Today, the radiocarbon age of the surface sediments of LOP is 2,000 calendar years old, which is roughly the same as the age offset during the Younger Dryas cold interval. During the warmer-than-present Holocene Thermal Maximum (~11,700-9,000 calendar years ago) age offsets nearly doubled to around 4,000 calendar years.

Impact: Because most of the deepest and oldest organic-rich soils in the LOP watershed are located in topographical lowlands in the northern Brooks Range region today, we hypothesize that these regions are where ancient organic matter was released during the Holocene Thermal Maximum. The thick peat that now covers these lowlands is insulating the permafrost and likely stabilizing permafrost carbon in the face of recent warming, causing lake sediment age offsets to be similar to those offsets during a period of relatively cold and unproductive soils. The vulnerability of permafrost carbon is evidenced by the limit of peat stabilization that was apparently crossed during the ~2–3°C of rapid warming that occurred at the end of the Younger Dryas.

High-Latitude Agriculture

BIOCHAR

BIOCHAR APPLICATIONS IN SUBARCTIC SOILS

J. Andres Soria, Sunny Castillo, **Chien-Lu Ping**, Gary Michelson

Purpose: To produce biochar from black spruce locally sourced in Alaska and evaluate its effect on soil microbial activity.

Approach: Biochar was produced by thermochemical means using a laboratory scale, fixed-bed, auger-driven pyrolysis reactor using 550°C temperatures and varying residence times. The biochar was then added in differing proportions to Alaska native soils collected in a forest environment and in an active agronomic field. The level of respiration from soil microorganisms was used as an indication of activity by the microbial community, which was evaluated under freeze-thaw conditions.

Progress: The production of biochar was completed and the freeze-thaw cycles were conducted using different biochar quantities. Further work is to be completed in 2013 for characterizing and establishing a response surface model to indicate the level of effect the biochar had on the microbial communities.

Impact: Biochar has been studied almost exclusively in temperate and tropical climates. This is a systematic study of its behavior in Alaska conditions, and if successful, could help reduce the volumes of agronomic inputs used and imported by farmers in the State.

Grants/funding: USDA Special Grant, WUR 10.

BIOCHAR RESEARCH IN 2012

Mingchu Zhang, Bob Van Veldhuizen

Purpose: To evaluate impact of biochar application in soil in the circumpolar

north. Soils in the circumpolar north typically experience low organic matter content, acidity, and poor soil fertility.

Approaches: In 2012, the experiments conducted for the project included 1) crop field experiments, 2) laboratory incubation to determine the impact of biochar on nutrient release in soil, 3) laboratory experiments to determine soil water holding capacity after biochar application, and 4) scanning electronic microscope examination of biochars. Three field experiments were conducted in Yukon, Canada, with test crops of barley (*Hordeum vulgare* L.), kale (*Brassica oleracea*), and bromegrass (*Bromopsis inermis* (Leyss.)). The biochar application was 10 metric tons per hectare. We harvested and weighed plant biomass at the end of growing season. Mineral nutrients in soil as well as in plant tissues was analyzed. We examined biochars with different feedstocks under an electronic microscope.

Progress and results: All experiments were conducted successfully. For all three crops, although the biochar-treated soil resulted in slightly higher yields, it was not a statistically significant difference.

Mineral uptake by plants differed among three crops. Mineral nutrient uptake for bromegrass varied among the minerals: application of biochar increased plant total uptake of sodium and manganese.

For barley and kale, there were no differences of mineral uptake between plants grown from biochar treated soil and ones without biochar.

Tissue mineral concentrations for most elements were similar between biochar-treated and non-biochar treated soil, except sodium concentration in bromegrass, which showed a high concentration for the tissue from nonbiochar treated soil. Unless a mineral nutrient is in deficiency, in general, mineral concentration in tissue changes little. It appeared that biochar application suppressed sodium concentration in bromegrass tissues.

For barley and kale, the mineral concentration between the treated and nontreated were not statistically different.

Scanning electronic microscope images

The biochar was examined under the scanning electronic microscope (SEM) for two scales: low resolution 200 μm at 100x and 20 μm at 1,000x. The low resolution depicted the overall structure of the biochar. The willow biochar was ground for the incubation experiment; no intact willow biochar was left. As for the biochars from other feedstocks, we used all intact biochars.

In the low-resolution ground willow biochar images, the cell structure and debris of cell walls can be clearly seen. With high resolution, the debris of the cell wall was magnified, showing a smooth surface, which might be due to loss of volatile materials inside the cells. During handling of the willow biochar, we noticed a large amount of dust. The willow biochar was purchased from a commercial biochar plant in Colorado. Commercial pyrolysis temperatures range from 600° to 1,400°C. At these higher temperatures, high molecular weight compounds escape as a part of syngas from wood-based biomass and more ash is produced. In the pyrolysis process, high temperatures result in less biochar production but more syngas. More materials are lost in the solid phase, and what is left is the wood cell structure. .

We also used biochars produced from Mr. Warren Zaku's farm, Yukon, Canada: wood chips, wood shavings, and horse manure biochar. The cell walls can be clearly seen from the images. In the biochar of wood shavings, one can see the misshaped cell wall due to the forces imposed on wood during the wood shaving processes. As for the horse manure, even though the grasses have passed through the digestion system of the horse, the plant structure and cell organization still can be seen.

All these biochars were produced in wood stoves in an open area. Based on the stages of wood burning, the temperature in the wood stove usually is around 500° to 550°C. The biochar produced in such temperature has low ash content and less syngas. We didn't experience high dust during the handling of these three biochars. Also, the surface of the cell walls of wood chip and wood shavings biochar were not very smooth. Possibly some organic

materials charred on the surface of the cell wall which otherwise could escape as syngas at higher temperature. Nevertheless, it was certain that we didn't experience much dust during the handling of these biochars in comparison with the commercial willow biochar. This further indicated that temperature for these biochars could be lower than the willow biochar.

Biochar produced in high pyrolysis temperature increases soil pH (due to ash content), and soil Mehlich I extractable phosphorus, but decreases in surface charges due to loss of aliphatic organic compounds.

Impact: Food security is of public concern in the circumpolar north. However, food production is constrained by poor soil fertility in the region. This project explores the possibility of biochar in improving soil productivity. There are enough shrubs available in the circumpolar north that can be used for producing biochar and generating energy (as syngas). Therefore, the results of this project will provide information on biochar uses in soil.

Grant/funding: Yukon Agriculture Association.

BIOMASS & BIOFUELS

LIQUEFACTION OF POTATOES USING SUPERCRITICAL WATER

Magdalena King, J. Andres Soria

Purpose: The project was designed to produce a high value chemical, 5 hydroxymethyl furfural (5HMF), using supercritical water and locally harvested potatoes.

Approach: Different potato varieties were collected from the Matanuska Experiment Farm and liquefied using pure water under supercritical conditions. The products of the hydrolysis reaction would be free sugars and furfural derivatives, including 5HMF.

Progress: The work was completed successfully, having produced 5HMF initially from every potato tested. However, the lack of chemical stability of the 5HMF was a challenge we could not resolve, wherein the compound once formed continued to react, eventually forming polymeric

structures that precipitated out of the solution. High quantities of 5HMF are possible, but stopping the condensation reactions was beyond the scope of the initial project.

Impact: Spoiled and non-commercial quality potatoes can be transformed into a high-value product using the approach used in this project; however, chemical stability of the end product is a major technical hurdle that needs to be addressed further.

Grants/funding: USDA ARS Seed Quality, Northern Latitudes: Biomass Study 2.

POTENTIAL PERENNIAL LIGNOCELLULOSIC 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, particularly in rural Alaska, has resulted in interest in local, renewable energy sources, including growing crops for bioenergy. The purpose of this research is to screen potential plant species, including trees, shrubs, and perennial grasses, as short-rotation, lignocellulosic energy crops for Alaska and to determine best management practices for efficiently producing bio-energy crops.

Approach: We used dormant cuttings to establish replicated plots of three native Alaska woody species, feltleaf willow (*Salix alaxensis*), Pacific willow (*S. lasiandra*), and balsam poplar (*Populus balsamifera*) at two locations (a well drained and a poorly drained site) at the Fairbanks Experiment Farm beginning in 2008 and 2009. Feltleaf willow spacing and coppicing timing trials were established in 2010. Numerous woody species and cultivars, including alders (*Alnus*), birch (*Betula*), hybrid poplars, and willows, were established in non-replicated plots or single rows in 2009, 2010, or 2011. We harvested woody species at the poorly-drained site for the first time in 2012.

Perennial grass plots established for other purposes were used for biomass trials beginning in Fairbanks in 2008 and at Delta Junction beginning in 2009. Carlton smooth bromegrass

(*Bromus inermis*), Nortran tufted hairgrass (*Deschampsia caespitosa*), and Wainwright slender wheatgrass (*Elymus trachycaulus*) were managed under three nitrogen (N) fertilizer rates (9, 45, 90 lb/ac; 10, 50, 100 kg N/ha) and three harvest regimes (two cuts per season, single harvest in fall, single harvest in early spring of succeeding year). We also established replicated plots of 14 perennial grass species at Fairbanks and Delta Junction in 2010. We harvested grass plots in each year of the study.

Progress and results: At Fairbanks, feltleaf willow dry matter yield at a moderately well drained site, four growing seasons after establishment, averaged 1.2 tons/ac (2.8 Mt/ha), balsam poplar averaged (0.8 tons/ac (1.9 Mt/ha), and Pacific willow yielded less than ½ ton/ac (< 1 Mt/ha). Also at Fairbanks but on a poorly drained soil, feltleaf willow averaged 2.9 tons/ac (6.5 Mt/ha), balsam poplar averaged 1.5 tons/ac (3.5 Mt/ha), and Pacific willow again produced ½ ton/ac (< 1 Mt/ha). Fall harvest grass yields at the high N rate, averaged over three years at Fairbanks, were 2.9 tons/ac (6.6 metric tons [Mt]) dry matter per ha for smooth bromegrass, 2.5 tons/ac (5.5 Mt/ha) for tufted hairgrass and 2.1 tons/ac (4.7 Mt/ha) for slender wheatgrass with all species showing a yield response up to the highest N rate. At Delta Junction dry matter yields for the fall harvest under the high N rate averaged over three years were: smooth bromegrass, 2.2 tons/ac (4.9 Mt/ha); tufted hairgrass, 1.8 tons/ac (4.1 Mt/ha), and slender wheatgrass, 1.4 tons/ac (3.4 Mt/ha). Yields for grasses overwintered intact and then harvested in spring at Fairbanks were 1.4 tons/ac (3.2 Mt/ha) for smooth bromegrass, 1.6 tons/ac (3.6 Mt/ha) for tufted hairgrass, and 1.6 tons/acre (3.6 Mt/ha) for slender wheatgrass. Spring harvests at Delta Junction produced 1.1 tons/ac (2.5 Mt/ha) for smooth bromegrass, 0.9 tons/ac (1.9 Mt/ha) for tufted hairgrass, and 1.1 tons/ac (2.4 Mt/ha) for slender wheatgrass. The overwinter yield loss at both locations indicates spring harvest is not likely a suitable practice for these locations. At both locations, harvesting twice (mid-season and at end of season) produced similar yields to a single harvest at the end of the growing season, indicating no advantage to a two-harvest

management regime. A three-year-old study comparing numerous grasses fertilized at 90 lb N/ac at Delta Junction showed highest dry matter yield for smooth bromegrass with an average annual yield of 2.3 tons/ac (5.0 Mt/ha); at Fairbanks on well drained soils, Siberian wildrye (*Elymus sibiricus*) produced the highest average annual yield at 2.1 ton/ac (4.8 Mt/ha); and at a poorly drained site at Fairbanks, reed canarygrass produced the highest average annual yield at 3.3 t/ac (7.4 Mt/ha) but with some plots exceeding 5 tons/ac (11 Mt/ha). Unfortunately, reed canarygrass (*Phalaris arundinacea*) has recently been recognized as an invasive weed in most parts of Alaska, and thus may not be suitable as a bio-energy crop. Results indicate higher annual yield potential for high-yielding grasses than for woody species in interior Alaska. However, no infrastructure exists in the area for processing grasses into biomass fuels.

Impact: This study is still fairly new; several data years, especially for woody species, are needed to draw useful conclusions. Ultimately, this study will provide information for Alaskan farmers and communities that will help them decide whether to invest in establishing short-rotation biomass crops for energy use.

Grants/funding: USDA-NIFA, Hatch, State of Alaska.

CONTROLLED ENVIRONMENTS: LIGHT EMITTING DIODES

OPPORTUNITIES USING LIGHT EMITTING DIODES (LEDs) TO PRODUCE HIGH QUALITY CROPS

Meriam Karlsson

Purpose: Energy efficient light emitting diodes (LEDs) show promise in replacing traditional light sources.

Approach: Panels of LEDs were used to condition transplants of the two petunia selections Wave Pink Spreading and Wave Purple Improved Spreading.

Progress: All petunias grew well, producing an abundance of flowers in field and in hanging baskets. Plants exposed to panels of red/blue or multi-colored (red, orange-red, orange, blue and white) LEDs appeared to quickly fill in, produce flowers early, and

outperform the conventionally grown petunias. At the end of the season, however, there were no apparent differences among plants in respect to size, branching, and flower numbers.

Impact: These findings suggest opportunities to condition transplants through limited exposure to LEDs for enhanced field establishment and early performance.

Grants/funding: Hatch, State of Alaska.

CONDITIONING STRAWBERRY PLANTS USING LIGHT EMITTING DIODES

Meriam Karlsson, Cameron Willingham

Purpose: Red/blue light emitting diodes (LEDs) are expected to result in compact plants with increased branching.

Approach: Four varieties, Aromas, Fern, Seascape, and Tribute, were selected for the study. Strawberry plants were grown under red/blue LEDs or natural greenhouse conditions prior to planting.

Result: There was no difference in yield between high tunnel and field locations or between initial growth under LEDs or natural greenhouse light. Fern had the highest seasonal yield at 16 oz per plant followed by Tribute, Aromas, and Seascape.

Impact: Preparing strawberry transplants using good light in a greenhouse or from LEDs is essential to ensure high field productivity.

Grants/funding: Hatch, State of Alaska.

USING LIGHT EMITTING DIODES FOR GROWING DWARF SUNFLOWERS

Meriam Karlsson, Cameron Willingham

Purpose: Studies are needed to identify crops where LEDs offer advantages. Increased energy efficiency, non-traditional lamp configurations, customized light qualities, long life expectancy, and reduced cost for disposal of light bulbs also add interest for using LEDs in greenhouse crop production.

Approach: Four types of LED panels were evaluated and compared to traditional high pressure sodium lamps in a greenhouse for growing the dwarf sunflower Sunny Smile.

Progress: Sunflowers under panels with red/blue, multi-, white or blue LEDs, flowered after 65 days compared to 58 days in the HPS greenhouse environment. Blue LEDs produced the tallest and the combination of red and blue LEDs the shortest plants. Since blue light is expected to produce short plants, this result was surprising. The explanation may be that blue light only acts in combination with other wavelengths and needs to be mixed with red, white, or multi-LEDs to produce short plants.

Impact: The differences observed here suggest opportunities for using light qualities of LEDs to control crop growth.

Grants/funding: Hatch, State of Alaska.

SUNFLOWER FIELD PERFORMANCE USING LIGHT EMITTING DIODES

Meriam Karlsson, Cameron Willingham

Purpose: Sunflower transplants were grown to evaluate if a narrow light spectrum from LEDs would influence subsequent growth and flowering.

Approach: Sunflowers were seeded and grown under LEDs or natural light in a greenhouse. The sunflowers were grown using panels of red and blue, white, or combined red, orange-red, orange, white and blue LEDs. Daily light was 8 or 16 hours. The seedlings were transplanted 7 days from germination to a field location.

Progress: The results suggest LEDs that provide sufficient light intensities support similar growth as natural greenhouse conditions without affecting field performance. Flowering averaged 50 days for ProCut Bicolor independent of treatment. For Sunbright Supreme, transplants receiving short days flowered 8 days earlier than the 78 days for those under long days.

Impact: Energy efficient LEDs are well suited to provide light during the seedling propagation stage of sunflowers.

Grants/funding: Hatch, State of Alaska.

CROPS: ALTERNATIVE

SELECTING ALTERNATIVE AGRONOMIC CROPS FOR ALASKA

Bob Van Veldhuizen, M. Zhang

Purpose: Rising oil prices and public pressure on reduction of greenhouse gas emissions have created demand for biofuels from agricultural crops (oil seeds, grasses, cereals, et al.). New agronomic niche varieties are constantly being developed. These new varieties possess important characteristics such as increased yield, disease and insect resistance, improved quality, and adaptation to the local growing conditions. Reliable information about these new varieties is important for Alaskan agricultural producers to meet the demand from local markets for niche crops. Our aim is to evaluate a variety of small grain cultivars for their adaptability in the Palmer, Delta Junction, and Fairbanks areas.

Approach: 1) Conduct a literature search on select northern adapted-varieties of malting and hullless barley; oilseeds such as Polish and early matured Argentine canola; yellow, oriental, and brown mustards; and camelina. We conducted field experiments in small plots (6 feet by 50 feet) at three sites. Data of daily weather information and soil temperature and moisture at root zones were collected. Physiologic growth stage information, plant height, lodging, and disease resistance for each plot are recorded. At harvest, yield and test weights for each plot were determined. We analyzed the data for relationships between maturity and yield versus heat units received, precipitation, etc. 2) Evaluate progeny of the cross between 'Thual' and 'Jo 1632'. Criteria for final selections of new varieties are early maturity, resistance to lodging, and high grain yield. 3) Continue to select sunwheat to increase genetic uniformity. The selection criteria are early maturity and uniformity in maturity. 4) Continue to select Polish canola adapted to Alaska climatic conditions.

Progress: It was another successful year in 2012 for the project. Overall, feed barley, hullless barley, malting barley, and spring wheat performed

better in Fairbanks as compared to Delta Junction and Palmer. Among the three locations, barley and spring wheat performed better in Fairbanks due to its high heat unit as compared to the other two. In comparison with the last 20 years, the heat unit in each month during the growing season in 2012 in Delta Junction was lower than the last 35-year average. The growing degree days required for heading and maturity were poorly related to the precipitation that occurred during the same period. However, compared with the heading, the correlation coefficient between precipitation and maturity was improved, indicating that late-season rain may have more of an effect than the growing degree days.

Work on selecting Polish canola suitable for Alaska climatic conditions was continued. Since canola is open pollinated, the selection was only conducted in the Delta Junction area because there were many other Brassica family vegetables around the Fairbanks test site. Average yields for Polish canola at Delta Junction were 1,358 lbs/acre, slightly higher than the standard test variety, AC Sunbeam. The importance of irrigation was also evaluated in the Delta Junction area for barley. The results of 2012 showed that irrigation increased yield of barley but not canola. Continuation of the variety trial/cultural practice for winter grains was done at the Delta Junction location only. Cultural practices included traditional seedbed preparation and stubble planting (in 6–8 inches of standing stubble) to determine the effectiveness for winter survival on various types of winter grains. There was no survival on any winter grain with either cultural practice at Delta Junction.

In cooperation with CES agents, the field days were held in summer 2012 in Delta Junction and Fairbanks test sites. We estimated that nearly 80 people participated in the field days at both sites.

Impact: Currently, 70 percent or more of the food consumed in the state is shipped in from Outside via ground, ocean, and air transportation. One incident of interrupting the Alaska Highway by flooding in Spring 2012 caused food shortages for the major cities along the highway systems.

Increase in crop production is a public concern for food security and safety. The results from this research will provide farmers with new small grain cultivars that are suited better for Alaska, thus increasing food security for Alaskans. This study provides yearly updates on new and better adapted crop varieties, the response of agronomic crops to dryland and irrigated farming conditions and harvest methods. It also provides a database for local producers to determine the economic viability for those crops. Future studies of the effects of irrigation on these agronomic crops will broaden this information database. In addition, we are developing new canola cultivars that will improve Alaska farming management and decrease farming costs by using canola as a rotational crop for weed control.

Also, we evaluate weather data in relationship with crop growth and yield, which will help to simulate Alaska farming under the scenario of climate change.

Grant/funding: Hatch, State of Alaska.

CROPS: BEANS

FIELD PRODUCTION OF BUSH BEANS

Meriam Karlsson, Cameron Willingham

Purpose: Earliness and yield of bush beans grown in a field location were compared with beans developing in the protection of a high tunnel.

Approach: The selected cultivars were Provider, a well-established green bean for northern conditions; Stayton, producing smaller diameter pods; and Gold Rush, a yellow wax-type snap bean. The beans were seeded in a greenhouse and transplanted seven days later in the field and high tunnel locations.

Progress: The high tunnel environment was beneficial with Provider producing the highest yield of more than 10 lbs. for a 3 feet long double row of beans. The high tunnel yield for Gold Rush and Stayton was 9 lbs. Under field conditions, the harvest was 8.7 lbs. for Provider and 7.3 lbs. for Gold Rush and Stayton. The average weight of individual pods was 0.24 ounces for Provider, 0.22 ounces for Gold

Rush, and 0.13 ounces for Stayton.

Impact: High tunnels are advantageous even during seasons of favorable weather conditions, for producing snap beans. In addition to promoting yields, a high tunnel environment often results in exceptional quality beans for capturing premium price on specialty markets.

Grants/funding: Hatch, State of Alaska.

CROPS: PEONIES

GRAY MOLD ON PEONIES IN ALASKA

Gary Chastagner, Katie Coats, Annie DeBauw (Washington State Univ., Puyallup Research & Extension Center); **Patricia S. Holloway**

Purpose: To identify isolates of gray mold, the most important disease of peonies in Alaska.

Approach and progress: A collaborative effort with Washington State University examined diseased peonies from eight commercial fields in Alaska and three fields in Washington. A portion of DNA, G3PDH, was isolated from the samples. Sequencing information for each isolate was compared to others as well as an international database (GenBank) for identification.

Impact: This research has shown that *Botrytis cinerea* (*B. fukeliana*) is the most common species of gray mold on peonies followed by *B. paeoniae* and at least four other unique isolates. Future research will clarify the identities of the disease, determine their prevalence in Alaska, how the diseases are spread and the efficacy of fungicides for management of these diseases. This study will eventually lead to management recommendations on more than 100 commercial peony fields in Alaska.

Funding: State of Alaska Division of Agriculture.

PEONY PHENOLOGY IN ALASKA

Patricia S. Holloway, Grant E.M. Matheke, Katie DiCristina

Purpose: Alaska's peony industry stretches from Fairbanks to Homer, east to Tok and Delta Junction and West to Naknek. The area is huge, the climate is

diverse, and the growing conditions are varied and challenging. This diversity allows Alaska peony growers to fill a three-month void in the specialty cut flower market by having peonies available from July through September. Elevation differences at sites, especially Homer, allow for local diversity that also stretches the season. Peony growers were interested in identifying just how diverse this state is and how measurable climatic conditions such as air temperature influence these differences. They are also interested in learning if phenological markers such as bud emergence and first color, etc, can be used in relation to thaw degree-day accumulation to predict bloom times.

Approach: We installed Hobo dataloggers at 10 peony farms around the state and asked growers to note the date of the following phenophases: first bud emergence on one of five 'Sarah Bernhardt' peonies; bud emergence on all five plants; date of first color; and date of first cutting. Data were compiled for all sites, and simple comparative graphs were compiled, thaw degree-days were calculated.

Progress: We found that degree-day accumulation was remarkably similar across the state. The number of degree-days accumulated for each phenophase (first cutting, first color, etc.) was also similar across sites. The hotter Fairbanks sites completed bud emergence to flowering in as little as 32 days, while the cooler coastal and south central sites took more than twice as long. The biggest difference occurred in the time between bud emergence on all plants and first color. Flowers growing in southcentral and coastal Alaska took up to four times longer to reach the first color stage than those in the Interior.

Impact: These data show that peonies are strongly influenced by air temperature. This project will help more than 100 peony growers across the state predict bloom dates and help coordinate exports of fresh cut flowers to the world.

Funding: Hatch, State of Alaska.

THE STATE OF THE ALASKA PEONY INDUSTRY 2012

Patricia S. Holloway, Kathleen Buchholz

Purpose: To track the growth and development of a new floral industry in Alaska.

Approach: Beginning in 2011, we began collecting industry statistics from statewide growers to track industry growth and predict future development.

Progress: Planting for commercial production began in 2004 in Fairbanks, Kenai, and Homer. By 2012, more than 100,000 roots have been planted by the 38 survey respondents. Sales of fresh cut stems more than doubled in 2012 from 2011 records. Sales to other states dominated the markets, and a small quantity were shipped internationally to Canada and Taiwan. More than 25,000 fresh cut peony stems were sold in 2012. Projected statewide harvest by 2015 is 1,010,000 fresh cut peony stems. The most frequently planted cultivar was 'Sarah Bernhardt'. Fifty-seven different cultivars were grown statewide. Ten growers reported commercial sales of fresh cut peonies. More than half of the sales were to Alaska pack houses and direct sales to consumers. Prices ranged from \$2.00 to \$10.00 per stem depending on the buyer. The highest average price was from florist sales.

Impact: Tracking the development of an industry is critical to the assessment of its success. Summarizing confidential grower information will provide baseline data that the industry can use to obtain funding, make business decisions, and promote itself.

Funding: Hatch, State of Alaska.

GROWTH PATTERNS IN PEONIES

Patricia Holloway, Melissa K. Pietila

Purpose: To measure growth through the early season and examine flower bud development as it progresses to cutting stage. This undergraduate research will help producers understand growth patterns, learn optimum cutting stages, and increase productivity of their commercial fields.

Approach: We collected daily measurements of shoot length from bud emergence in May through full bloom using five 'Sarah Bernhardt' peonies in Fairbanks, Alaska. We tabulated thaw degree-days to learn if there is a correlation between heat unit accumulation and growth.

Progress: There are three distinct phases in pre-flowering shoot growth of peonies: Stage 1: Slow, about one week from initial bud emergence (May 24), lasting about 6 days; Average daily growth, 1.2 cm; Stage 2: Rapid, lasting from Stage 1 until just before first color is visible, average daily growth 3.6 cm; and Stage 3: Flat, from first color to first cut (June 28) average daily growth: 0.2 cm.

Impact: Daily growth is not directly correlated with daily air temperature heating degree-days. Fresh weight increased from flower bud tight bud (stage 1) to loose bud (stage 4) stages. Dry weight increased through the petal "pop-up" stage (stage 2.5), then declined as the bud softened. Moisture content was variable across stages but showed a slight rise as the bud softened and matured. Flower buds lost dry matter after stage 2.5, but weight continued to climb.

Funding: Hatch, State of Alaska.

PEONY FLOWER PRODUCTION WITH ORGANIC AMENDMENTS

Mingchu Zhang, Bob Van Veldhuizen

Purpose: To determine the effectiveness of different fish byproducts on peony growth and nutrient uptake. Research was begun in 2001 at the University of Alaska Fairbanks to learn if specialty cut peonies could be grown in Alaska and sold during a time when world flower markets were nonexistent. In 2012, 26,000 fresh cut peony stems were sold in Alaska and exported to Taiwan, Canada, and to the flower trade in Hawaii and the contiguous 48 states. Yields are projected to be more than one million stems by 2014. Demand for Alaska peonies is expected to increase: Because of its northern latitude and cool summers, Alaska has fresh cut peonies from July through September, during a period when producers elsewhere cannot provide the blooms. With the expansion of the cut flower industry, Alaska peony growers want to know how they can effectively use fish byproducts for peony cut flower production. The Alaska coastal area is one of the peony production areas in the state. Fish byproducts are rich in plant nutrients,

and most of them are produced in the coastal areas. Previous experiments show that fish byproducts can be as effective as chemical fertilizers on field crop production (such as barley).

Approach: The experiment was conducted in the Georgeson Botanical Garden at the Fairbanks Experiment Farm of the Agricultural & Forestry Experiment Station at UAF. There were six treatments in the experiment: 1) control, 2) urea at 50 kg N/ha, 3) urea at 100 kg N/ha, 4) fish hydrolysate at 50 kg N/ha, 5) fish guts at 50 kg N/ha, and 6) fish compost at 50 kg N/ha. The nutrients were applied every year in June. Considering individual variation for the perennial peony, each treatment was replicated five times in a completely randomized manner. One-year-old peonies were selected for the experiment. Leaf color before peony blooming in June was measured using a Minolta chlorophyll meter in 10 readings. Fresh and dry plant biomass yield, and nutrient concentrations in plant tissue were measured. Total plant nutrient uptake was calculated by multiplying plant biomass with

Chimera peony, or dual color flowering peony, growing in a Luoyang, China, commercial peony garden. This cultivar dates to the Song dynasty (960–1279). Peonies form a part of the tourism trade in China.

Photo by Mingchu Zhang.



each nutrient concentration. The experiment started in May 2010 and ended in September 2012.

Progress: There was no discernible difference among all treatments in biomass production and nutrient concentration. The variation among the same treatment of different replicates was large. For example, the biomass in the control treatment varied from 48 to 135 grams in the 2012 growing season. Because of this biomass variation, the smaller plant tended to be higher in N concentration as compared to the larger plant. This nutrient variation caused by biomass appeared more strongly in N than other nutrients in plant tissue.

Leaf chlorophyll concentration measured in June was not statistically different among all six treatments. The lack of plant response to nutrient application in chlorophyll concentration could also be due to peony roots taking up nutrients from the soil and accumulating these nutrients in the roots. The growing season in interior Alaska starts in early May, and the peony flower harvested at early June. There is only one month between the peony growth and harvest. If peony plants use root-stored nutrients during that month, the response to nutrient application may not occur. The only occasion from which peony response to nutrient application could happen would be if plants cannot take up enough nutrients to store them in roots from June to the end of August (end of growing season). From this perspective, the tested peony plant may take enough nutrients and store them in the roots during that period. This indicates that the soil, even without any nutrient application, may have enough nutrients to satisfy the needs of the plants of two to three years of age. The normal peony growth curve shows an exponential increase in aboveground biomass in the fourth year after planting.

Impact: The impact of fish byproducts on perennial peony growth was not significantly different as compared to the plants receiving no nitrogen application. For perennial peonies, it may take more than three years before plants show a positive impact from using fish byproducts as nutrient sources.

Grant/funding: USDA, ARS, Hatch, State of Alaska.

CROPS: ZUCCHINI

ZUCCHINI PRODUCTION

Meriam Karlsson, Cameron Willingham

Purpose: Zucchini grown in a high tunnel was compared to plants developing in the adjacent field.

Approach: Bush Baby, Dunja, and Golden Glory were seeded in a greenhouse and 15 days later, the transplants were planted in field and high tunnel locations.

Progress: The first zucchini was harvested July 4 and harvest continued through September 8. The average yield per plant in the high tunnel environment was 20 lbs. for Bush Baby, 12.5 lbs. for Dunja, and 11 lbs. for Golden Glory. In the open field, the yield was at least 2 lbs. lower per plant. The size of each zucchini was similar in the high tunnel and the field. Bush Baby produced shorter but heavier zucchini at 5.6 inches and 10.3 ounces. The length was 7.3 inches with an average weight of 7.1 ounces for Dunja and 6.2 ounces for Golden Glory.

Impact: Although zucchini is a prolific producer, the high tunnel environment still increased the yield.

Grants/funding: Hatch, State of Alaska.

LIVESTOCK

EFFECTS OF SUPPLEMENTAL HAYLAGE ON REINDEER MEAT QUALITY

Greg Finstad, George Aguiar

Purpose: Using Alaska-grown forage for livestock production could help offset the rising cost associated with red meat production and have important health implications on meat quality.

Approach: 14 two-year-old steers were blocked into two groups by age and weight. One group was fed standard Reindeer Research Program winter milled ration ad lib while the other was fed limited milled ration and ad lib slender wheatgrass haylage for 6 weeks. Animals were weighed on a weekly basis.

Progress: Reindeer on the haylage diet did not gain or lose weight during the trial while animals on the milled ration gained weight. Loins were sent to University of Illinois Meat Lab for proximate analysis, sensory evaluation and amino acid profiles. Statistical analyses of results are pending.

Impact: The effects of supplemental feeding of haylage on animal production and meat quality will have implications in choice of feeding regime and cost to Alaska farmers.

Grants/Funding: Hatch, State of Alaska.

EFFECTS OF FREEZING ON REINDEER MEAT QUALITY

George Aguiar, **Greg Finstad**; Peter Bechtel (USDA /ARS); Eva Wiklund (National Union of the Swedish Sami People)

Purpose: Determine effects of freezing on reindeer meat quality. Frozen meat would provide a longer shelf life and more consistent supply, but the effects on meat quality are unknown.

Approach: Nine reindeer steers 30 months of age were raised and fed on a standard RRP balanced milled ration. Animals were slaughtered at a USDA-approved meat processing facility. Loins were removed from the carcasses for meat quality analysis at four different times (fresh, fresh frozen, 6 months, and 12 months).

Result: There were significant differences in rancidity, moisture, protein, ash and lipid content across time. However, there were no significant differences in shear force, or juiciness, important consumer properties and the off flavor attribute diminished with freezing.

Impact: Freezing and frozen storage of reindeer meat may retain and/or increase quality within some meat attributes, which may broaden the availability of reindeer meat outside the slaughtering season.

Grants/funding: Hatch, State of Alaska.

SEWARD PENINSULA RANGE MANAGEMENT

Greg Finstad, Darrell Blodgett

Purpose: Develop technology to better manage the reindeer ranges of the Seward Peninsula.

Approach: Five seasonal range attributes, ecological sites, forage protein, forage fiber, vascular plant production, and lichen production, were integrated with a mapping program using Google Earth™

Progress: Seasonal grazing attributes can be generated and displayed using maps on a designated website accessed by reindeer producers and land managers

Impact: Reindeer producers, land managers, agencies and researchers can now interpret complex grazing dynamics using an interactive mapping program on a designated website and server.

Grants/funding: State of Alaska, NRCS.

NATIONAL REINDEER PRODUCTION DATABASE

Greg Finstad, Darrell Blodgett

Purpose: Develop a national reindeer production database to evaluate the effectiveness of diverse diets and husbandry practices.

Approach: A designated website was developed for reindeer producers across the country to enter nutritional analysis of their reindeer diets and animal production data (calf weights, conception, recruitment rates) into a collective database.

Progress: A few producers have entered their herd and diet data and can now compare their nutritional regime and husbandry practices to those of other reindeer producers across the country. As the value of the system becomes apparent the hope is to entice a majority of reindeer producers to contribute to and use the database.

Impact: A national diet and production database will allow reindeer producers to compare the effectiveness of their ration configurations and husbandry practices to other producers

Grants/Funding: State of Alaska.

EXCLOSURES AND MONITORING SITES TO EVALUATE CHANGES IN VEGETATION AND LICHEN

COMMUNITIES ON THE SEWARD PENINSULA, ALASKA

Greg Finstad

Purpose: Develop a network of grazing exclosures and vegetation and lichen sites across the Seward Peninsula to monitor changes in vegetation and lichen communities due to grazing and climate change.

Approach: 12 of a network of 25 exclosures were erected across the southern reindeer ranges of the Seward Peninsula. The exclosures were engineered to “float” on top of the ground to minimize frost-jacking and other cryo-perturbation.

Progress: This collaborative effort among BLM, NRCS, reindeer producers, and the RRP begins long-term monitoring of landscape changes. Baseline vegetation and lichen percent cover and biomass were assessed at 6 of the 12 sites.

Impact: These sites will provide a means to objectively monitor vegetation changes across the Seward Peninsula due to climate change and ungulate grazing, offering a useful tool for range management to reindeer producers and land managers, as well as those studying the effects of climate change.

Grants/funding: State of Alaska, BLM.

RANGE SCIENCE INTERNSHIPS: SEWARD PENINSULA, ALASKA

Greg Finstad

Purpose: Develop an internship to educate future range scientists and land managers.

Approach: Four range science and natural resource management undergraduates were selected to assist with the construction of grazing exclosures and collection of baseline vegetation data for a range monitoring project. The students participated in lectures and training to become familiar with the unique tundra ecosystem.

Progress: A young cohort of range science and natural resource management undergraduates participated in an experiential learning program to become familiar with Alaska’s unique ecosystems and social dimensions. Undergraduate range

scientists from institutions outside Alaska can now identify reindeer forage plants and know how they are arranged in diverse vegetation communities across a tundra landscape. The students recognize the unique engineering challenges of the north and can incorporate this knowledge in designing and implementing range inventory and monitoring studies. The students interacted with Alaskan Natives in small rural villages so they were exposed to and became familiar working in Alaska's diverse cultural settings.

Impact: Many land managers and agency personnel employed in Alaska were educated outside the state and had limited knowledge of the unique properties of its ecosystems and the local people. Now future land managers and agency personnel can become familiar with the vagaries of Alaska before in-state employment.

Grants/funding: State of Alaska, BLM.

PRODUCTION OF LIVESTOCK ON SMALL ACREAGES IN ALASKA: DEFINING THE ALASKA ANIMAL UNIT AND EFFECTIVE DISTRIBUTION OF GRAZING ACTIVITIES

Norman Harris, Beth Hall, Jim Ericksen

Purpose: To educate individuals on the feed requirements for livestock under Alaska environmental conditions and how to better utilize the land base for producing healthier animals while maintaining ecosystem function.

Approach: This research uses feeding trials in the winter and GPS tracking of animals turned out on a small paddock, 6.7 ha, in the summer. During feeding trials, animals will be fed high-quality haylage. Each feeding trial will be conducted for 14 days using five animals. Weights and samples will be collected for offered forage and forage left after 24 hours of feeding. In the summer rapid-collection GPS collars are placed on the animals to collect positional data every second. After determining usage patterns, in following years, areas of the paddock will be treated using fertilizer, seeding of desirable species, or fire to determine the effect on animal distribution patterns.

Progress: During the summer distribution trials, GPS collars were placed on five heifers during three trial periods. Examination of the positional data identified three distinct patterns. Comparison of the GPS data with synchronized video recordings showed the patterns could be used to identify cattle activities as resting (standing or lying), travel, and grazing. Feeding trials started in December. The cattle seemed to react to the high winds at the research facility showing more activity than on calm days. We are currently analyzing the feeding trial data.

Impact: The main impact from this project thus far has been the adoption of the prototype GPS collar for similar studies in Oregon, Idaho, and California.

Grants/funding: USDA, Hatch, State of Alaska.

REPRODUCTIVE MANAGEMENT FOR SUSTAINABLE HIGH-LATITUDE LIVESTOCK PRODUCTION

Milan Shipka, Jan Rowell

Purpose: To improve reproductive management in reindeer and muskoxen. The annual monitoring of breeding activity in both reindeer and muskoxen from 2010–2012 identified widespread reproductive failure related to nutritional and reproductive management issues. In muskoxen, reproductive failure and the increasing incidence of stillbirths, abortions, and neonatal deaths has been definitely linked to a trace mineral deficiency.

Approach: Improved dietary inputs and feeding routine addressed nutritional management issues. Use of modified CIDR/radiotelemetry technology we have developed over the past decade, data on breeding and successful calf production contribute to the documentation of herd health recovery.

Progress: Data collected on embryo development has been combined with past data on the annual pattern of IGF1 secretion in reindeer and forms the basis for an alternative physiological mechanism that could result in shortened gestation length in late bred reindeer.

Results: Presented at the American Association for Animal Science

meeting in Bozeman, Montana 2013 and published in their proceedings.

Grant/funding: Hatch, State of Alaska.

SUSTAINABLE LIVESTOCK PRODUCTION IN ALASKA

Milan Shipka, Jan Rowell

Purpose: 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.

Approach: The initial objectives were:

- 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.

Progress: 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.

Results:

- 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

- implementing sustainable grazing practices integrated in an MS student project
- Alaska fiber producers joined the Sustainable Grazing Practices meeting in Palmer in 2012 and organized an Alaska Fiber Association. A mission of this group is to investigate options for in-state processing; they have asked for university assistance and involvement in these ongoing efforts.

Grant/funding: USDA Conference Grant 2011–2014.

SOILS & SOIL CARBON

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

C.L. Ping, G.J. Michaelson; B. Wang (USGS)

Purpose: To study the basic and hydric soil properties of volcanic ash-derived soils in remote areas of Alaska.

Approach: We formulated soil landscape and microtopography relationships through field investigation and using IRIS tubes to test soil reduction.

Progress:

Soil distribution on Adak Island:

In the remote island of Adak of the Aleutian Chain, soils formed in tephra are found strongly stratified over the past 12,000 years. Soils were investigated along a toposequence from the ridge top to the bottom lands. The mountains are characterized by undulating slopes. Grass dominates the microhigh positions, and the wet meadow dominates the microlow positions. The discontinuity of volcanic deposits from different ages serves as aquatards and created hydric soils in microlow topographic positions. Both MRIS and IRIS tubes were installed and both reacted within three days and three weeks, respectively. Soils formed in microhigh positions are classified as Haplocryands and those in microlow positions are Cryaquands.

Hydric soils in Upper Susitna Valley:

Spodosols formed in volcanic ash deposits are widespread in the Upper Susitna Valley, southcentral Alaska. Microtopography plays a controlling role in differentiating the well-drained Humicryods on microhigh positions and the somewhat poorly drained Cryaquods in the microlow positions. Soils in the microlows have low chroma (<2) and high values (>4) indicating hydric nature of the soils. However, upon repeated tests over three years, the soils do not react positively with α , α -dipyridyl, indicating the lack of ferrous iron. IRIS tubes were installed and no positive reaction was noted throughout the entire growing season for three years in a row. MRIS tubes were installed and over the growing season only 10 percent of the manganese was chipped away at the top 10 cm.

Impact: In remote islands such as the Aleutians, the intermittent deposits of volcanic ash resulted in highly stratified soil horizons and the texture discontinuity created aquatards that create poorly drained soils in microlows. Microtopography can be reasonably used as an indicator of hydric soils in these remote areas. The results from the soils study in the Upper Susitna Valley suggested that those soils monitored are likely oxyaquic and microtopography as an indicator needs further evaluation.

Grant/funding: USGS, Hatch, State of Alaska.

RAPID CARBON ASSESSMENT (RACA) IN ALASKA

C.L. Ping, G.J. Michaelson, Beth Hall, Melissa Dick; S. Nield T. Riebe (USDA-NRCS)

Purpose: To develop field methods for rapid assessment of soil organic carbon.

Approach: Sample soils from different land uses including forestry, crop, and pasture in southcentral Alaska and measure the soil carbon contents by lab method (high temperature combustion) and by Visible Near Infrared Spectrometer, then establish a correlation between the two methods.

Progress: In 2012 a total of 18 sites were selected and sampled in the Matanuska-Susitna Valley.

Impact: A quick field method will help policy makers to make rapid assessment of the carbon status in Alaska and also help farmers to understand the quality of their soils.

Grant/funding: USDA-NRCS.

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

C.L. Ping, Melissa Woodgate; S. Nield (USDS-NRCS)

Purpose: To monitor permafrost in areas where the status of permafrost changes periodically due to climate patterns affected by the interactions from the Pacific Ocean and Bering Sea.

Approach: To conduct field studies of soil morphological and physiochemical properties across different successional stages of landform and vegetation in selected areas in the Yukon River Delta.

Progress: In 2012 soils from 12 sites were sampled in lowlands near St. Marys in the Yukon River Delta. The study was conducted transecting the fluvial terraces along a chronological order. Vegetation community changes from marsh, willow to alder, and eventually sedge meadow and tundra. Tundra community formed at the last stage and permafrost cores were detected. Soil analysis was 40 percent completed.

Impact: The common concern is degradation of permafrost in southwest Alaska because of the relatively high permafrost temperature, at a fraction of a degree below freezing. However, this preliminary study indicates permafrost aggradation occurs as a result of vegetation succession.

Grant/funding: USDA-NRCS.

SOILS AND CARBON DYNAMICS ALONG AN ALTITUDE GRADIENT IN THE STEESE MOUNTAIN RANGE, ALASKA

C.L. Ping; Eric Geisler (USDI-BLM)

Purpose: To establish relationships between the soil-vegetation community with patterned ground features in the Steese Mountains area of interior Alaska.

Approach: We selected a total of 12 transects to study soil-vegetation community along an elevation gradient from the ridge top to the valley. Periglacial features were identified and soils associated with each type of patterned grounds were classified.

Progress: During 2012 we studied soils, vegetation communities, and landforms along 12 elevation gradients in the Steese Mountains. Periglacial features were found to dominate the upland positions and some extended to mid or lower slopes. Tundra vegetation dominates the ridge tops, mixed alpine tundra and shrubs dominate the shoulder and upper backslopes. Lower slopes are dominated by black spruce. Most soils are keyed out as Gelisols and gelic suborders of Inceptisols. Soil samples are being analyzed at the SNRAS Plant Tissue and Soils Analytic Laboratory in Palmer.

Impact: Results from this study would establish the different ecotones in this region and also contribute to the revision of Soil Taxonomy.

Grant/funding: USDI-BLM and Alaska State Soil Classification.

SOIL CARBON DISTRIBUTION IN ICE WEDGE POLYGONS ON ARCTIC COASTAL PLAINS, ALASKA

C.L. Ping, G.J. Michaelson; J. Jestrow, R. Matamala (DOE Argonne National Laboratory)

Purpose: To study soil organic carbon distribution in landscape dominated by ice wedge polygons.

Approach: Study the pattern of carbon distribution across the ice wedge polygon by dissecting the polygon and carefully delineate the cryoturbated soil horizons. Then sample soils according to the cryoturbated horizon and analyze carbon contents of each horizon.

Progress: In 2012 three low-center and three high-center ice wedge polygons were selected in northern Alaska and sampled. The soil samples are being analyzed at the Argonne National Laboratory.

Impact: This study would improve carbon assessment in arctic lowlands of Alaska, and the results can be

extended to other areas of the Arctic Coastal Plains in circumpolar regions.

Grant/funding: DOE Argonne National Laboratory.

CLASSIFICATION OF SOIL AFFECTED BY DEEP PERMAFROST IN WESTERN CHINA

C.L. Ping; H. Jiin, L. Zhao (Arid and Cold Region Environmental and Engineering Research Institute [CAREERI], Chinese Academy of Sciences)

Purpose: To field test the US soil classification system, Soil Taxonomy, to see if its categories cover soils formed in high plateaus such as the Qinghai-Tibet Plateau where the permafrost is generally deeper than two meters, which is beyond the requirement of Gelisols.

Approach: Study along an altitude transect and in different ecoregions of the plateau according to procedures outlined in the *USDA Soil Survey Manual* and the Gelisol sampling protocols established by C.L. Ping.

Progress: In 2012 soil morphological properties from 20 sites were studied along two transects in the Qilan Mountain region and eastern Qinghai Province of China. Most soils investigated have evidence of cryoturbation yet the permafrost table is often below two meters. Most of these soils key into the cryic and gelic suborders of Inceptisols. Soil samples are being analyzed by labs in China.

Impact: The study provides new data to revise or add new taxa to Soil Taxonomy.

Grant/funding: CAREERI, Alaska State Soil Classification.

Humans and the Environment

RECREATION

ESTIMATING VISITS TO DENALI NATIONAL PARK AND PRESERVE

Peter Fix; Andrew Ackerman (National Park Service); Ginny Fay (Inst. of Social

and Economic Research, Univ. of Alaska Anchorage)

Purpose: Estimates of total visits to National Park Service Units are critical for funding as well as visitor management. However, Denali National Park and Preserve has a challenge in estimating total visits as they do not have an entrance station as do parks in the Lower 48. Thus, the estimates of visits to Denali National Park and Preserve rely on a formula that extrapolates bus ticket sales to capture visits that do not include a bus ride. However, the basis for the formula is over 15 years old, was of limited sampling duration, and it was not clear if the formula was capturing visits or visitors. This project updated the assumptions of the visit estimation formula and ensures that it estimates visits and not visitors. Characteristics of the visits were also measured.

Approach: This project developed an extensive sampling approach to survey visitors at multiple possible exit points in the park. Visitors were asked if they took a bus trip on the sampled visit in the park. The total visits were estimated, along with the ratio of visits that took a bus trip to visits that did not.

Progress: The study has been completed and a project report published.

Impact: Results suggest annual recreation visits to the park are ~100,000 more than previously estimated. A key finding was a relatively high number of short-duration visits to the visitor center area for the purposes of gathering information: visits that utilize infrastructure, but were not necessarily previously accounted for.

Grants/funding: National Park Service.

FAIRBANKS RECREATION STUDY

Peter Fix

Purpose: The Bureau of Land Management recently completed a Draft Resource Management Plan (RMP) and Environmental Impact Statement for their Eastern Interior planning area, which includes the White Mountains National Recreation Area and Steese National Conservation Area. The recreation management section of the plan requires the identification of onsite

experiences sought by visitors, those that will be targeted by management to provide, and beneficial outcomes that occur over a longer period as the result of visitation to the site/management of the site. For each experience and outcome identified, a standard for level of attainment by visitors/community members is set. Earlier research identified onsite experiences and larger outcomes visitors felt were important with regard to their visit; that research was critical in the development of the RMP. This study replicated the earlier research to determine if there was a shift in important experiences/outcomes and if the proposed standards were being met.

Approach: We developed a survey, administered during the summer of 2011, asking about important experiences and beneficial outcomes. These experiences and outcomes were identified and compared to the potential standards.

Progress: The study has been completed and a project report published.

Impact: Results suggested, consistent with earlier research, the experiences related to solitude, enjoying nature, getting away from the usual demands of life, exploration, and being with family and friends were important. It appears the standards for these experiences are being met. The beneficial outcomes respondents associated with their visit included improved mental health, personal freedom, and a connection to nature. However, the level of attainment by visitors of these beneficial outcomes might be lower than the standards listed in the draft RMP. Further research should address the measurement of the beneficial outcomes in relation to the standards.

Grants/funding: Bureau of Land Management.

POLICY & LAW

ENDANGERED SPECIES ACT SCIENCE AND MANAGEMENT

M.A. 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 policymakers and managers. Collaboration with state and federal agencies is part of this effort.

Progress: From 2004 to 2012, 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, 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.

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

Grant/funding: Alaska Department of Commerce, Community, and Economic Development, ESA in Alaska—Mammal Genetics; Alaska Legislature / SNRAS—natural resources.

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

Julie Lurman Joly

Purpose: 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. My work has three goals:

(1) to identify situations in which laws or policies with conflicting purposes or methodologies are in place, to analyze that legal conflict in order to understand how it manifested and what its practical consequences are, and perhaps to recommend

changes or revised interpretations that avoid or eliminate the conflict.

(2) to analyze the existing legal framework's ability to absorb the changing physical reality being caused by climate change.

And (3) to incorporate the analyses and conclusions drawn from this research and bring them into my classrooms.

Approach: An examination of federal land management laws in light of climate change, and development of recommendations for their reinterpretation.

Progress: A manuscript, "Climate Adaptation Strategies are Limited by Outdated Legal Interpretations," was accepted for publication by the George Wright Forum and published in 2013.

Impact: This work will benefit land managers and resource professionals in the pursuit of their assigned goals. It 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 will help managers and decision makers understand where the legal flexibilities 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 managers, and 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: USDA, Hatch, State of Alaska.

WILDLIFE GENETICS

BELUGA WHALE GENETICS

M.A. Cronin

Purpose: Beluga whales in Cook Inlet, Alaska are listed as a distinct population segments (DPS) under the Endangered Species Act (ESA). This designation is based partially on genetic data. This project objective is to review and assess beluga stock genetics in Alaska.

Approach: I obtained genetic data from the literature and assessed the extent of genetic differentiation of beluga whales in Cook Inlet and other areas.

Progress: I completed a literature review and reanalysis of genetic data and submitted a report to the Department of Commerce.

Impact: This project is helping quantify genetic variation and stock differentiation of beluga whales in Alaska which is potentially useful in population management and policy formulation at the national and international levels. This is particularly important because beluga whales in Cook Inlet are listed in the Endangered Species Act.

Grant/funding: Alaska Department of Commerce, Community, and Economic Development, ESA in Alaska—Mammal Genetics.

BISON AND CATTLE GENETICS

M.A. Cronin; N. Vu (UAF); M.D. MacNeil, V. Leesburg, H. Blackburn, (USDA); J. Derr (Texas A&M Univ.)

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 34 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 2012 and a paper published in 2013.

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.

Grant/funding: Alaska Department of Fish and Game, AK Terrestrial Genetics.

POLAR BEAR, BLACK BEAR, AND BROWN BEAR GENETICS

M.A. Cronin; R.J. Baker, M.M. McDonough, H. Huyn (Texas Tech Univ.) J.F. Medrano, G. Rincon, A. Cánovas, A. Islas-Trejo (Univ. of California Davis); R. Meredith (Montclair Univ.)

Purpose: To assess 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 will indicate 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 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 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.
- 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.
- 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.
- 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 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 paper was published on an assessment of genetic variation of microsatellite DNA of brown bears across North America and polar bears worldwide. This study showed the three species have separate gene pools.

- The study of genetic variation of amplified fragment length polymorphism and mitochondrial in polar, brown, and black bears was completed.

- A study of genome and SNP variation in polar, brown, and black bears was completed. A divergence time of 1.34 million years was estimated for brown and polar bears. Additional nuclear DNA sequences were analyzed and described in a report.

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 (1.34 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.

Grant/funding: Alaska Department of Commerce, Community, and Economic Development, ESA in Alaska—Mammal Genetics.

STELLER SEA LION GENETICS

M.A. Cronin; N. Vu (UAF)

Purpose: to reassess the genetic structure of Steller sea lion stocks in Alaska.

Approach: Two stocks of Steller sea lions have been recognized in Alaska, an eastern and a western stock. These are each listed as distinct population segments (DPS) under the Endangered Species Act. The stocks are designated based on genetic and demographic data. We reviewed the literature and obtained genetic data to assess the extent of genetic differentiation of sea lions within and between stocks.

Progress: We completed a literature review and submitted a report for the Department of Commerce project. We expanded this for the Department of Fish and Game project and analyzed genetic data obtained from authors of published papers on sea lion genetics.

Impact: This project is helping quantify genetic variation and stock

differentiation of Alaska's Steller sea lions, which is potentially useful in population management and policy formulation at the national and international levels. This is particularly important because Steller sea lions are listed in the Endangered Species Act.

Grant/funding: Alaska Department of Fish and Game and 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 (Univ. of California Davis);

Purpose: To assess 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 that 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 will genotype several hundred wolves with the canine 171,000 single nucleotide polymorphisms (SNP) system with Geneseek Inc. Data analysis will be 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: I reviewed the literature on wolf genetics and collected samples with the help of Alaska Department of Fish and Game and other agencies from several hundred wolves in 2012. We determined 171,000 SNP genotypes for 77 wolves, two coyotes, and one dog in 2012. SNP data for dog breeds will be obtained from collaborators. Additional SNP lab and data analyses on wolves and coyotes are being done in 2013.

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.

Grant/funding: Alaska Department of Fish and Game.

Steller sea lions at a haul out near Amak Island in the Alaska Maritime National Wildlife Refuge.

Photo by Kevin Bell, US Fish and Wildlife Service.



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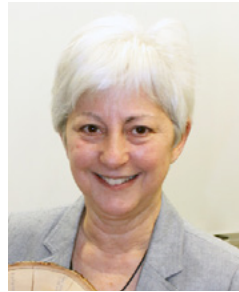


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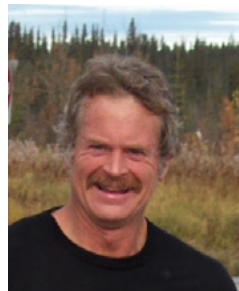


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