AgroBorealis

Volume 26, Number 2, Summer/Fall 1994

The Annual Report

School of Agriculture and Land Resources Management
Agricultural and Forestry Experiment Station

University of Alaska Fairbanks

SCHOOL OF AGRICULTURE & LAND RESOURCES MANAGEMENT
AGRICULTURAL & FORESTRY EXPERIMENT STATION

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Office of the Dean & Director

The Honorable Walter J. Hickel
Governor of Alaska
P.O. Box 110001
Juneau, Alaska 99811-0001

Dear Sir:

I submit herewith the annual report from the Agricultural and Forestry Experiment Station, School of Agriculture and Land Resources Management, University of Alaska Fairbanks, for the period ending December 31, 1993. This is done in accordance with an act of the Congress, approved March 2, 1887, entitled "An act to establish agricultural experiment stations, in connection with the agricultural colleges established in the several states under the provisions of an act approved July 2, 1862, and under the acts supplementary thereto," and also of the act of the Alaska Territorial Legislature, approved March 12, 1935, accepting the provisions of the act of Congress.

Very respectfully,

James V. Drew
Director

Fairbanks, Alaska
June 30, 1994

AFES Statement of Purpose

The research objective of the Alaska Agricultural and Forestry Experiment Station (AFES) is to provide new information to manage renewable resources at high latitudes, and to improve technology for enhancing the economic well-being 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.

The research of experiment station scientists is published in scientific journals, experiment station bulletins, circulars, conference proceedings, books, and our own magazine, Agroborealis. *Scientists disseminate their findings through conferences, professional journals, workshops, and other public information programs.*

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

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UNIVERSITY OF ALASKA FAIRBANKS

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In this issue

In this issue

About the front and back covers:
In 1987 the Fairbanks Agricultural and Forestry Experiment Station's horticultural demonstration garden became a botanical garden. It was renamed the Georgeson Botanical Garden in honor of Charles Christian Georgeson, who established Alaska's agricultural experiment stations. The first of those stations was established in Sitka in 1898. Agriculture is still a growing industry in Alaska today (AFES photos by Pat Wagner).

**Reprints of the front cover are available for purchase as a postcard at the Georgeson Botanical Garden gift shop located at the Fairbanks experiment farm, West Tanana Drive, UAF.*

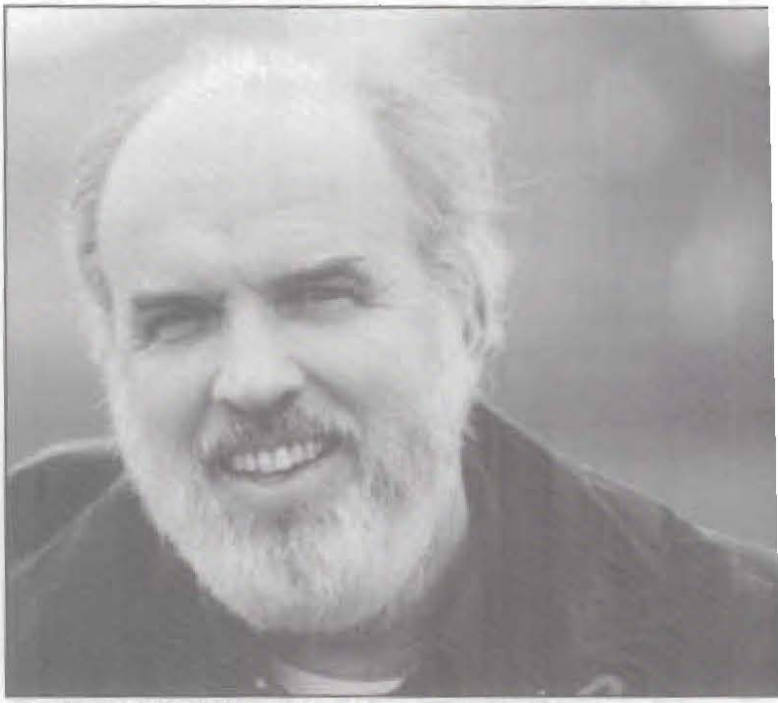
This publication is printed on recycled paper

Guest opinion

Biodiversity

Forest managers need to consider all elements, address range of situations

by: Dr. Edmond C. Packee
Associate Professor of Forest Management



Dr. Edmond C. Packee (Photo by Dr. Charlie Knight).

"Biological Diversity: Can we live without it?" reads the front page headline of the April/May 1994 issue of *The Trumpeter*, the newsletter of the Wisconsin Metro Audubon Society.

Obviously, the answer is no. Look at the living organisms upon which we depend for food, shelter, clothing, medicine, and personal enjoyment. Even Alaska's great deposits of oil, gas, and coal are the result of past biological diversity. Of concern to me as a forester is the need for a basic understanding of what biological diversity is.

A task force of The Society of American Foresters in 1991 defined biological diversity as: "The variety and abundance of species, their genetic composition, and the communities, ecosystems, and landscapes in which they occur. It also refers to ecological structures, functions, and processes at all of these levels. Biological diversity occurs at spatial scales that range from local through regional to global."

In *The Diversity of Life*, noted Harvard Professor Edward O. Wilson defined biological diversity or biodiversity as "The variety of organisms considered at all levels, from genetic variants belonging to the same species through arrays of species to arrays of genera, families, and still higher taxonomic levels; includes the variety of ecosystems which comprise both communities of organisms within particular habitats and the physical conditions under which they live."

These definitions represent both applied and pure science and include three basic components: living organisms—genetic and species richness; ecological processes and structures—nutrient cycling, disturbance, life and death; landscape—arrangement of communities across the land or in the water. Biodiversity is more than "species richness."

Managing for biodiversity is more than managing for a single species or group of species. We must give processes and structure equal attention.

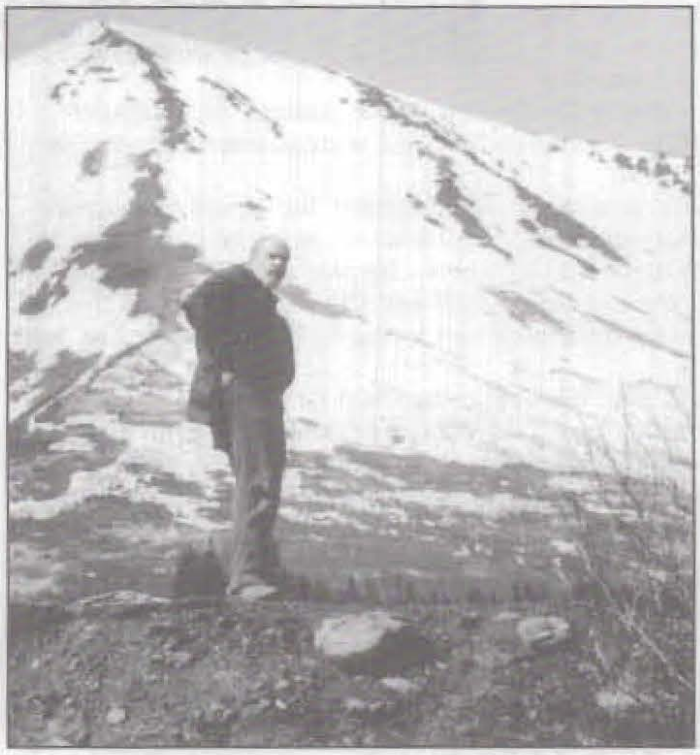
How can we make general statements about specific treatments when the ecosystems differ? We must recognize the place of each ecosystem in the landscape and how the components vary from one place to another. For example, it is evident that tropical forests are vastly different from Alaska forests. While the two can be compared, they cannot be treated with a broad brush as equal. They are different in terms of species richness and processes. Likewise, Alaska's forests differ.

Alaska essentially has two types of forests: a Coastal Forest, dominated by Sitka spruce and western and mountain hemlocks, and a Northern Forest, dominated by white or black spruce, aspen, or paper birch. These forests can be subdivided further. If we examine the Coastal Forest around Ketchikan, we see it as much richer in tree and shrub species and wildlife than that of Kodiak and Afognak. Likewise the species assemblages of the Northern Forest on the Kenai Peninsula are distinct from those of the Yukon-Tanana drainage.

Forest processes also differ between the two regions. Disturbance, that is responsible for the mosaic of communities across the landscape, is a major component of the Northern Forest. Fire is often considered the cause or process of disturbance. But, is it?

Natural fire—fire caused by lightning—is relatively infrequent on the Kenai Peninsula compared to the Yukon–Tanana where more than 1,000 strikes can occur in a single day. Meanwhile spruce beetles appear to be an important disturbance on the Kenai and, to date, a less serious disturbing agent in the Yukon-Tanana. In the upper layers of the drier soils of the Kenai, I commonly find small pieces of charcoal. Without lightning-caused fires, how did the charcoal get there? Did Kenai Natives use fire to achieve management objectives? Are spruce beetles the alternative to fire? Are they the result of the exclusion of fire? Does fire follow spruce beetle? These are biodiversity questions of great importance because they address process. Process is essential to the functioning of ecosystems. When we manage, we want to take advantage of processes.

We can manage forests for products and services and still maintain biodiversity. First, though, we must accept the idea that forests are forever changing. Change is evident in the Coastal Forest. Old-growth, conifer rainforest is not and never was present everywhere unless you use artificial and static definitions provided by the human mind. Forests, dominated by cottonwood, follow receding glaciers, such as the Bering and Exit; cottonwood forests are abundant in major valleys such as the Stikine; aspen occurs on recently deglaciated sites near Haines; Alaska cedar on more than 530,000 acres are dying or dead. Young forests provide stand structures that favor some organisms and not others. The same can be said for old-growth forests. Sometimes, a mosaic is necessary to provide optimum habitat. If resource managers decide to manage with an emphasis on old-growth, they are not necessarily managing for biodiversity. Instead they would be managing only for that fragment of biodiversity associated with old-growth.



Dr. Edmond C. Packee exploring nature's classroom (Photo by Dr. Charlie Knight).

Now let's look at the Northern Forest. Should we manage Tanana Valley forests primarily for white spruce? If we did, we would exclude fire and thus ignore biodiversity in terms of the natural landscape mosaic, species richness, and process. Hardwoods such as willow, aspen, and paper birch provide habitat for many organisms such as bacteria, fungi, neotropical birds and moose and are important to nutrient cycling and soil modification. Tall shrub stages and mixed stands of conifer and birch are important for many neotropical migrant birds, but may not be as attractive to year-round resident birds.

Managing solely for white spruce can meet some biodiversity goals—such as old-growth—but it addresses only a fragment of biodiversity—a particular stage of forest development and stand structure. I believe managing white spruce on a cyclic basis that includes the hardwood stages and a spruce dominated stage addresses a wider range of biodiversity situations indefinitely.

To manage for biodiversity, forest managers must recognize and attempt to emulate processes and structures as they attempt to produce goods and services for society. I am not suggesting that the processes be duplicated exactly; even nature varies from place to place. However, we must recognize how our treatments vary from the natural processes. Selection harvests can emulate gap disturbances; clearcutting with burning can emulate natural burns. Accepting hardwoods in white spruce stands increases biodiversity. Ensuring that seed for reforestation is from a wide genetic base and is well matched to site conditions is better for diversity than selecting seed from a very small population of "genetically superior" trees. Deliberately allowing large spruce beetle infestations to grow to excessive, possibly unnatural size, ignores biodiversity. Large fires are generally unacceptable; how do large areas of beetle kill differ from fire in terms of species richness and ecosystem processes? "Do nothing" attitudes can permit unacceptable changes to the landscape and associated biodiversity losses.

Carefully planned management prescriptions can produce stands of specific structures that benefit biodiversity—stands of mixed species, with a closed hardwood overstory, with snags, or with old-growth characteristics. We must add biodiversity to our management objectives. After all, we can lean on Mother Nature without breaking the ecosystem. ❑

Frank J. Wooding

2/1/41—3/31/94

Frank J. Wooding, 53, longtime Fairbanks resident and Emeritus Professor of Agronomy at the University of Alaska Fairbanks, Agricultural and Forestry Experiment Station, died unexpectedly of a heart attack March 31 at Fairbanks Memorial Hospital. He was born Feb. 1, 1941 in Pontiac, Ill., and grew up on a family farm near Chenoa. Frank attended the University of Illinois, earning a B.S. in agronomy in 1963. He earned his M.S. in 1966 and Ph.D. in 1969 in soil science from Kansas State University. While in Manhattan, he met Josefina "Josie" Bautista, also a graduate student at KSU and formerly of College, Laguna, Philippines. They married in 1964. In 1970, he and his family moved to University Park, Pa., where he spent a year as a post-doctoral fellow. From there they moved to Fairbanks where Frank was an assistant professor of agronomy at the University of Alaska Institute of Agricultural Science, now the Agricultural and Forestry Experiment Station. He retired with the rank of professor and professor emeritus of agronomy in August 1993.

Frank made numerous contributions to the knowledge of appropriate crop and soil management practices under subarctic conditions. His many recommendations on cereal grain and turfgrass varieties, fertilizer management practices, and other crop and soil management practices are widely used. His work verified that vast areas of Alaska, stretching from Bristol Bay to the Upper Yukon River Valley, have soils and climate suitable for agriculture. He was the first to show boron responses on agronomic crops in Alaska. Frank influenced numerous students through his teachings. He also served as head for the Department of Plant, Animal, and Soil Sciences for six years. Frank never lost his farm boy personality and love for working with plants and soil. His garden and lawn were among the best in Fairbanks.

Frank was active in and supportive of the church, Catholic schools and community. He served on numerous committees and was involved in several ministries at Sacred Heart Cathedral and held the position of Grand Knight and other offices in the local chapter of the Knights of Columbus. He was an avid golfer and baseball fan; when not working he could often be found at the Fairbanks Golf and Country Club or at the ballpark watching the Goldpanners play baseball. Frank was a dedicated and loving husband and father, and a valued friend to many people. He will be missed by us all.

Frank was preceded in death by his father, Frank Sr., and son, Eric. He is survived by his wife, Josie, of Fairbanks; son, Christopher of Fremont, Calif.; daughter, Robin, of Hanover, N.H.; sister, Joyce, of Dallas, and mother, Laura, of Chenoa, Ill. ❑

—by: Dr. Stephen Sparrow—

Photo captions:
Dr. Frank Wooding, above, at his retirement ceremony Aug. 5, 1993 (Photo by Diana Cochran).
Left, Dr. Wooding and his wife, "Josie" at a HIPOW auction benefiting the Catholic schools in Fairbanks (courtesy family).

SALRM alumni
Where are they, what are they doing?

Michael A. Abels, *Fairbanks, AK*
1980, B.S. NRM; Field Operations Manager/Acting Supervisor Toolik Field Station, Institute of Arctic Biology

Timothy A. Balch, *Carlisle Springs, PA*
1989, B.S. NRM; Natural Resource Specialist, Pennsylvania Department of Transportation, Bureau of Environmental Quality

Susan J. Brook, *Gustavus, AK*
1983, M.S. NRM; Project Analyst, Office of the Governor, State of Alaska

Jerry L. Brossia, *Anchorage, AK*
1974, M.S; State Pipeline Coordinator, Department of Natural Resources

James K. Burau, *Tahoe City, CA*
1981, B.S. NRM; Attorney at Law
"I am an attorney licensed to practice in California and Nevada. I practice primarily real estate, environmental and business law."

Peter W. Carey, *Christchurch, New Zealand*
1982, B.S. NRM; Post-Doctoral Research Associate, Zoology Dept. University of Canterbury
"Presently working on various research projects investigating behavioral ecology of seals and penguins, and lecturing on expedition–style tours to Antarctica."

Leigh A. (Grunwald) Carlson, *Fairbanks, AK*
1980, B.S. NRM; Natural Resource Officer, AK Department of Natural Resources, Division of Land

Richard E. Deck, *Fairbanks, AK*
1986, B.S. Wildlife Management; Biological Science Technician, USDA-Agricultural Research Service

Gena M. Delucchi, *Fairbanks, AK*
1983, M.S. NRM; Extension Agent, University of Alaska Fairbanks

Susan K. Detwiler, *Anchorage, AK*
1990, M.S; USF&WS Biologist

Susan A. (Whitting) Dickinson, *Ketchikan, AK*
1990, B.S. NRM; Acting City Administrator, City of Saxman
"Husband: John, son: Alec, 14, and daughter: Ariana, 13."

Teresa J. (Zimmerman) Dunham, *Anchorage, AK*
1994, B.S. NRM; Department of Natural Resources
"Spouse: Kevin Dunham, children: Curt, 16, Kara, 14, and Eric, 9."

Ramona L. (Jones) Finnoff, *Fairbanks, AK*
1984, B.S. NRM; Owner, ABEC's Alaska Adventures

Kathleen S. (M°Glynn) Greer, *Battleground, WA*
1977, B.S. NRM; Owner, Wild Irish Design
"My husband, Steve, is a pilot for American Airlines and flies international routes. My two daughters are Erin, 10, and Kelly, 5. I own a custom sewing and embroidery business that allows me to spend time with my family."

Steven P. Hall, *Kodiak, AK*
1992, B.S. NRM; Fish and Wildlife Protection, Alaska State Troopers

Leonard Z. Hanson, *Fairbanks, AK*
1990, B.S. NRM; Ranger/Bio-technician, National Park Service
"Fourth field season with the Park Service. Ranger with Bering Land Bridge National Preserve 1991 and 1992; assistance to the subsistence coordinator, Denali National Park and Preserve, 1993 and 1994."

Trudy T. Heffernan, *Fairbanks, AK*
1987, M.S. NRM; Owner, Evergreen Enterprises
"After five years as administrative director with Northern Alaska Environmental Center, I started my own business as special events coordinator and fundraiser."

Thomas D. Hennigan, *Georgetown, NY*
1983, B.S. NRM; M.S. Education, Syracuse University, 1987; Teacher, K-12
"Wife: Jennifer; children: Tommy and Katey, 5-year-old twins, Hannah Joelle, 4, and Julia Anne, 17 months."

Deborah M. (Brown) Hinchey, *Anchorage, AK*
1985, M.S. Horticulture; Owner, Debbie's Horticulture Service
"Spouse: Ken. President, Board of Directors, Alaska Botanical Garden, Inc. Cathy Wright—UAF grad—several others and I, established and obtained a 110+ acre site and organized the Alaska Botanical Garden in Anchorage. It now has a membership of approximately 400 families. Winner of the Mann Leiser Memorial Community Service Award, 1992, given by the Alaska Horticulture Association. Named to Who's Who in the West, 1993."

Joseph P. Holland, *Seward, AK*
1986, B.S. NRM; Pilot, Seward Forest Products
"Private pilot and commercial pilot certificates, airline transport pilot and instrument ratings."

Jill S. (Thayer) Holmgren, *Fairbanks, AK*
1979 & 1982, B.S. & M.S. Owner, Aunty Gravity
"After graduation I worked in natural resource education as the cooperative extension agent for southern Southeast Alaska, based in Sitka. My husband, Jonathan, and I have 3-year-old twins. Currently my occupation is raising children and spending time in my art and craft business, Aunty Gravity."

Louis R. Howard Jr., *Eagle River, AK*
1985, B.S. NRM; Environmental Specialist, State of Alaska
"Spouse: Marla (Allers), 1984 graduate of UAF with BBA in Business-Marketing."

Christine L. Johnson, *Twin Falls, ID*
1994, M.S. Soil Science. Extension Support Specialist, Twin Falls Research and Extension Center, University of Idaho

Nichelle W. Jones, *Fairbanks, AK*
1990, NRM. Surface Protection Specialist

Marianne Karraker, *Grand Canyon, AZ*
1987 & 1992, B.S. & M.S. NRM; Park Ranger, National Park Service
"Work as head coach for Grand Canyon High School girls' basketball team; also as an interpretive ranger giving programs for visitors and providing information and assistance. Married Grand Canyon River Ranger, Jim Traub, in March 1994."

Kevin G. Keplinger, *N. Canton, OH*
1982, B.S. NRM; Owner, Keplinger's Nursery

Robert L. Layne, *Fairbanks, AK*
1986, B.S. NRM; Natural Resource Officer, DNR

David E. Liebersbach, *Fairbanks, AK*
1988, B.S. NRM; Chief of Renewable Resources, BLM, Arctic District Office

Vincent T. Mathews, *Anchorage, AK*
1990, M.S. NRM; Subsistence Regulations Specialist, USF&WS

Bob D. Mattson, *Juneau, AK*
1979 & 1985, B.S. & M.S. Environmental Specialist, DEC, Juneau District Office
"Married to UAF alumni Maria (Byrnes); we spent nearly three years teaching English in Japan. I am a member of the National Ski Patrol and am serving a second term on the Alaska State Parks Juneau Advisory Board. One of the better projects I was involved in was the 1992 Home Hazardous Waste barge. My office hitched a ride on a scrap metal barge and collected home hazardous waste from the small towns of northern southeast, most which have never had hazardous waste removed. The towns were Skagway, Gustavus (home of SALRM alumni Susan Brooks), Pelican, Elfin Cove, Hoonah, Tenakee and Yakutat."

Leafy F. McBride, *Fairbanks, AK*
1992, M.S. NRM; Promotion Coordinator, KUAC TV/FM

Richard M. Montagna, *McGrath, AK*
1981. Self Employed
"Recently returned from a two-year teaching position at Hefei University of Technology in the People's Republic of China."

Rod Moore, *Arlington, VA*
1976, B.S. NRM; Minority Counsel, Subcommittee on Fisheries Management, U.S. House of Representatives
"Have been working on natural resource issues with the U.S. House of Representatives for more than 17–years longer than most members of Congress. Recently finished rewriting the Marine Mammal Protection Act. The Magnuson Fishery Conservation and Management Act is next."

Laura J. Noland, *Fairbanks, AK*
1986, NRM; Environmental Specialist, DEC

Leo A. Olesen, *Salcha, AK*
1973, B.S. NRM; V.P., Subarctic Construction Inc.
"Wife: Donna Reilly Olesen, sons: Ian, 16, and Alex, 13, daughter: Darcy, 13."

Carolyn L. Pennington-Chapin, *Fairbanks, AK*
1990, B.S. NRM; M.S. Ag & Extension Education, Michigan State University, 1992, Interim Recruitment Coordinator, SALRM
"Husband: Greg Chapin."

Joni L. Piercy, *Anchorage, AK*
1987, B.S. NRM; Geographic Information System Specialist, National Park Service

Stephanie K. Pike, *Fairbanks, AK*
1992, NRM forestry option; Biological Science Technician, Institute of Northern Forestry

William "Bud" Rice Jr., *Anchorage, AK*
1987, M.S. NRM. Environmental Protection Specialist, National Park Service
"Managed contract for environmental impact statement on proposed Katmai Scientific Drilling Operation, got camera ready draft prepared then proposal was withdrawn. Working on oil spill contingency plans for Alaska coastal parks. Continue to work with Exxon Valdez Oil Spill Restoration work groups evaluating habitat in Kenai Fjords National Park for potential acquisition."

Katharine Richardson, *Fairbanks, AK*
1993, M.S. NRM

Robert J. Ritchie, *Fairbanks, AK*
1976, M.S. NRM; President, Alaska Biological Research, Inc.
"Co-founded private environmental research firm in 1977. Company has grown to 20 professionals representing disciplines such as ecology, wildlife management, restoration planning, bioremediation and radar ornithology. Expanded to conduct work in Western U.S., Minnesota and New York. ABR's investment and research strategies follow strong social and environmental guidelines. We support volunteerism and resource conservation in our offices and were the recipients of ADEC's Pollution Prevention Award in 1991."

Jeffery A Roach, *Tok, AK*
1987, B.S. NRM; Outdoor Recreation Planner, BLM

Randy R. Rogers, *Fairbanks, AK*
1991, M.S. NRM; DEC
"Wife: Liz Peltola; daughter: Teal, 20 months. Constructed a new energy efficient home in Fairbanks. Current president of the board of directors for the Northern Alaska Environmental Center."

William K. Saari, *Fairbanks, AK*
1991, NRM/Forestry; Physical Science Technician, USDA-Agricultural Research Service

John D. Shaw, *Fort Bragg, NC*
1992, B.S. NRM; Forester/Computer Specialist, U.S. Army
"I currently maintain and operate a geographic information system for the Natural Resources Branch, Directorate of Public Works and Environment, Fort Bragg, N.C. My wife, Robin, is assigned to Fort Bragg as a company commander in the 82nd Airborne Division. The fort encompasses 165,000 acres and is the world's busiest military facility with more than

45,000 troops. Land use is intense. GIS is used to support training, forest and endangered species management, wild fire control, prescribed burning, erosion control and conservation projects. I will return to UAF this summer to defend my M.S. thesis on growth of balsam poplar/black cottonwood and to participate in the Society of American Foresters National Convention."

Roselynn (Ressa) Smith, *Fairbanks, AK*
1991, M.S.; Natural Resource Officer, AK Coastal Management Program
"Husband, Jim, will complete his graduate studies in psychiatric rehabilitation from Boston University in August. Two boys: Galen, 6 ½, and Owen, 4."

Cydne L. (Graybeal) Smith, *Cannonville, UT*
1983 B.S. NRM.; Utah State Park Ranger

Tom S. Smith, *King Salmon, AK*
1987, M.S. Wildlife Research Ecologist, National Biological Survey, Katmai National Park
"Completed Ph.D. at BYU in Utah in 1992 on mountain sheep ecology; currently am a grizzly/brown bear biologist. Wife, Cynthia, graduated in 1989 from UAF with a teaching degree. We have two children Michael and Melissa. One of my career high points was being a student at the SALRM,...some of the finest folks I've yet to meet!"

Brad Sworts, *Palmer, AK*
1985; Natural Resource Officer II, DNR Division of Land, Southcentral Region Office
"Spouse: Lori Restad, Child: Kirsten Ann."

Scott N. Taylor, *Fairbanks, AK*
1982 & 1988, B.S. & M.S. NRM; Executive Director, UA Foundation, UAF
"Spouse: Janet Taylor, 1976 UAF grad with MAT; children: Chris, 12, Bryan, 9, and Jessie, 6."

Dorothy (Heller) Thompson, *Fairbanks, AK*
1958, B.S. Biology & 1979, M.S. NRM; Retired

Richard B. Tobin, *Baker City, OR*
1987, M.S.; Recreation Staff Officer, USDA Forest Service
"After 10 years of living Outside we'll be returning to visit Alaska this summer. Northeast Oregon is remarkably similar to Fairbanks in its people, geography and climate; we think often of our friends and good times at UAF."

Steve Trickett, *Wasilla, AK*
1981, B.S. NRM; Natural Resource Officer, Division of Agriculture

Charles E. Trowbridge, *Cordova, AK*
1987, B.S. NRM; Fishery Biologist, AK Dept. of Fish & Game

Steve E. Ulvi, *Fairbanks, AK*
1991, B.S. NRM; Subsistence Manager, US National Park Service, Gates of the Arctic
"Wife: Lynette M. Roberts; children: Lena and Eli. I am currently serving on the Board of Directors, Northern Alaska Environmental Center and Board of Advisors, SALRM/AFES."

Mark D. Veit, *Anchorage, AK*
1980, NRM; Operations Supervisor, Alyeska Pipeline Service Co.
"Spouse: Debra; daughters: Monica, 5½, Lindsey, 2. I am the operations supervisor at Pump Station No. 1 on the trans-Alaska pipeline in Prudhoe Bay. I also perform independent consulting in hydrology. Debra is self-employed in accounting and bookkeeping."

Moses M. Villalobos, *Fairbanks, AK*
1987, B.S. NRM; Fire/Police Dept. Fairbanks International Airport
"Wife, Peggy; daughters, Alexa and Ciara."

Richard E. Warren, *Kensington, NH*
1979, B.S. NRM; Licensed Site Prof, R.E.W. Environmental Consultants
"Established R.E.W. Environmental Consultants in 1990. Company focus is subsurface hazardous cleanup, geotech investigations, and environmental auditing. Wife, Leslie Ann; children, Jocelyn, Nichole, and Jeff."

Kate L. Wedemeyer, *Anchorage, AK*
1984, M.S. NRM; Fisheries Biologist, USFS
"Presently serving as president–elect of the Alaska Chapter of the American Fisheries Society which was recently recognized as the outstanding chapter in North America."

Shann C. Weston, *Portland, OR*
1984, M.S. NRM; Wildlife Education Coordinator, Oregon Dept. of Fish and Wildlife
"Husband, Steve Porten; children, Mariya, 8, and Elena, 6."

Richard D. Wilhelm, *Petersburg, VA*
1982, M.S. NRM; Project Director, Richmond Redevelopment Housing Authority

Dave Williams, *Fairbanks, AK*
1987, NRM/Forestry; Reforestation Administrator, State Division of Forestry

Janet L. Willie, *Bethel, ME*
1984, B.S. NRM; Certified Massage Therapist, Riverside Therapeutics
"Certified massage therapist and yoga teacher. I also guide sea kayaking courses."

Catherine I. Wright, *Eagle River, AK*
1990, M.S. Horticulturist; Alaska Plant Materials Ctr.
"Husband, Dave Leet, mechanical engineer, UAF 1989, B.S."

Timothy L. Zimmerman, *Fairbanks, AK*
1985, NRM; Lab Technician, Alyeska Pipeline Service Co., Pump Station # 8
"Spouse, Cynthia , B.A. Education, 1985, UAF. Children: William, 4, and Kathryn, 1. I Measure North Slope crude oil to, and returning from, the refineries of North Pole. Previously worked for ARCO in their Kuparuk Laboratory, and in Fairbanks at the Northern Testing Laboratories."

Note: The SALRM would like to maintain contact with all our alumni. When something of significance happens in your life, drop us a line and tell us about it, we'll tell your fellow alumni. Likewise, if you didn't respond this time, please do it in the future by writing to: SALRM, Dean; P.O. Box 757200; Fairbanks, AK 99775-7200. Thanks to all who responded to our questionnaire.

Interior has fertile agriculture history; flowering future

by: Donna Gindle
Editor/Publications Supervisor

Do you like Alaska-grown tomatoes? How about potatoes, strawberries and corn ripened by the midnight sun? Ever stop to think about agriculture in Alaska? How did it get here? Who had the foresight to realize that the opportunities were as rich as the gold that miners came seeking? And what impact does the Agricultural and Forestry Experiment Station have in this community?

The Interior's agriculture history can be traced back more than 100 years to the missionaries who grew gardens along the Yukon River. The Interior's first agricultural experiment station was located in Rampart. Closer to home, local residents petitioned the Secretary of Agriculture to establish an experiment station in the Tanana Valley 89-years ago.

"With a considerable amount of persuasion from members of the Fairbanks Chamber of Commerce, the director of Alaska Agricultural Experiment Stations, Charles Georgeson, selected 1,393.97 acres located nearly midway between Chena and Fairbanks," according to a newspaper article written at the time. "The land was chosen because of its size and proximity to this transportation corridor as well as the availability of good soils for farming and its close proximity to the homesteaders."

Dr. Patricia Holloway, AFES horticulturist, explained that agriculture's initial efforts focused on cultivating grains, grasses and potatoes, but there were always plots of vegetables, flowers, fruits and landscape ornamentals.

In the 1960s Dr. Arvo Kallio became the first full-time horticulturist in Fairbanks. He is responsible for breeding 'Yukon Chief' corn, 'Early Tanana' tomatoes, 'Pioneer' strawberries, and 'Alaska 6467' cabbage. In the70s, horticulturist Dr. Don Dinkel, experimented with everything from artichokes to zucchini and pioneered the use of polyethylene mulches for vegetable production. He also expanded annual flower experiments. Dr. Roscoe Taylor developed barley varieties and Dr. Curtis Dearborn developed strawberry and potato varieties that are still in big demand in Alaska and Canada. In fact, almost every plant variety—vegetable, fruit or grain—used in the Interior, has been tested at the Fairbanks AFES farm.

The Interior's agricultural experiment station is still rich and growing.

"Like those before us, we still conduct research to continue discovering the crops that will grow best, we develop production techniques and share this information with the people in the community," Holloway said.

Today the Georgeson Botanical Garden showcases much of that research. In 1987, Dr. Holloway transitioned the horticultural demonstration garden to a landscaped botanical garden. The transition occurred in part, she said, to accommodate the increased public use as more than 50,000 people visit the garden annually.

The annual flower display demonstrates the wide range of varieties which can be grown locally. The garden features recommended varieties and tests new ones. When working with flowers and plants, Holloway, and horticulturists Pat Wagner and Grant Matheke, evaluate new cultivars on the market usually at the request of seed companies. They then report their evaluations to commercial companies as well as home gardeners.

"We figure out what the company or the person is actually looking for when they send us seeds to evaluate. For instance, they might want to know the quantity and quality of flowers, how well the plant stands up to adverse conditions like rain or frost, how well and how long the flower blooms and if any diseases appear.

"We are also an official display garden for the All America Selection program," Holloway said. "This is a promotion set up years ago, where U. S. plant breeders can submit seed of annual flowers and vegetables to grow in official test gardens. These gardens have rigorous standards and are located throughout the nation. Outstanding performers at all test sites are given the All American Selection award. Seeds from the winners are then sent to display gardens a year before they are commercially available. This year, for instance, we are testing 1995 winners."

The GBG staff and volunteers usually test all the All American Selections, except for the ones they know won't do well unless grown in the greenhouse, said Holloway.

Besides doing research, the GBG staff and volunteers work directly with the public, greenhouse operators, and commercial growers. They share information, accept research requests, and work one-on-one with people as the need arises.

"People call and ask us questions about certain

varieties, cultivation techniques, sources of seed and equipment and methods of pest control. Although we try not to compete with commercial growers, sometimes we have seeds they don't. If this happens we may give samples to the growers," Holloway said.

"A few years ago, we received a collection of chives and onions from Novsibirsk, Siberia. They grew so well in the GBG that I sent seed packets to commercial growers so they could offer these plants to their customers. We sell some seeds from the garden but when someone starts selling them commercially we stop."

Holloway said she sees her role in the community as promoting the horticulture industry. She does this through a variety of mini-classes taught at various times and days throughout the summer, guided tours of the garden, and a concerted effort to publish research results and get them out to the public. They also go out to the greenhouses and work with the operators on an individual basis.

"Grant is an expert on strawberries and roses and has worked with Gordon Herreid from Pearl Creek Farms and with Happy Creek Greenhouse. Likewise Pat Wagner is an expert on annual flowers, pesticides and biocontrols. She constantly experiments and tries new things and answers questions from people.

"Some of the questions people ask us provide us with research topics. If I have the time and money and they ask questions that answers aren't available, we can try to set up research to determine the answers."

In such a case, graduate student Ouina Rutledge recently completed a two-year study of wild flower seed mixes for Nauriaq Gardens, a Fairbanks company specializing in Alaska wildflower seed mixes.

"This work was part of a five-year study where we are evaluating Nauriaq's mix against others. We will make recommendations to improve the mix which will ensure the public gets a better product.

"Another time Lee Risse, Risse's Greenhouse, was awarded a landscaping contract for Fairbanks International Airport. The contract called for wood-chip mulches. Lee asked us if wood chips made a good mulch. We weren't sure, so Lee got the airport to go with a different mulch and we began a research project. Although it took us five years to answer Lee's question, we did it. Our research showed the wood-chip mulch cools the soils and this interferes with nutrient uptake. Plants survived but were stunted and poorly colored. We determined it wasn't suitable for landscapes."

The experiment station horticulturists have also worked with Fred Meyer's when they had problems with house plants, and they worked with numerous landscaping firms from Anchorage and Seattle after the firms receive local landscape contracts.

Perhaps one of the biggest, ongoing projects is the *Checklist of Landscape Plant Materials for the Tanana Valley*. Holloway, Matheke and Wagner began compiling this list in 1991 and invite local gardeners, commercial growers, extension and research horticulturists to comment on the list annually.

The result is a comprehensive checklist that includes information on all plant material ever evaluated. And it's always evolving. The list is divided into three sections: plants most reliable—should work well in the Interior; plants most challenging—site characteristics, given some conditions, should be fine; plants worth testing—plants that somewhere in the valley someone has had luck with, use if you want to do testing.

Like the list she is compiling, Holloway is on a constant learning pursuit. And she knows where her most valuable informational outlet is.

"I don't operate under the conception that we at UAF know everything. I have been working in this area for only 20 years. There are people who have 40 and 50 years experience. I know that I need to listen to them. At least once a year I visit local greenhouses to see what they are growing, and what I might need to put in the greenhouse. So many of the greenhouse operators have such vast amounts of knowledge, there's not much I can tell them. However, I know they can sure teach me things.

"And that's the way it is suppose to be. We learn and give to the public, they learn and give back to us. It's the only way we can be successful." ❑

In the 1960s horticulturists worked with corn, tomatoes, strawberries and cabbage (AFES photo).

Stress and glycogen levels

When animals are handled and transported to slaughter, muscle glycogen is used as an energy source. The muscle also uses glycogen after slaughter in the transformation to meat. If adequate amounts of glycogen are not present in muscle tissue, then the tissue will not reach the desired pH of about 5.6, and a condition called dark-cutting may occur. Although this information is available in domestic cattle, there is no information on farmed cervine species such as wapiti. When completed this study will determine glycogen levels in muscle of farmed wapiti from slaughter to approximately 48 hours post slaughter.

•Jennifer Alhaus, Allan Schaefer and Lyle Renecker

Managing cattle, maximizing forage

The Angus x Hereford cattle at Palmer were bred in May so they would calve in late March. I shifted the herd to a fall-calving scheme in August. Fall-calving cows lactate when they are in excellent condition from being on pasture and lactate during winter taking full advantage of the nutrients in the harvested forage. The first fall calves were born August 1991. Calves are weaned before going to pasture and graze the duration of the summer. They are placed in the feedlot in early October and slaughtered in January, saving about 50 percent on grain. The free choice hay intake by beef cows for fall and spring calving is 2.5 percent of body weight, but fall calving cows use winter forage more efficiently because they are providing for calves.

•Ben Bruce

Drought stressed seed

Seed tubers of 10 varieties of potatoes were produced under irrigated and nonirrigated conditions in 1991 and 1992. These seeds were planted in replicated trials in 1992 and 1993 respectively. We did not observe any differences in productivity between plots of the various varieties seeded with tubers produced under irrigated and nonirrigated conditions. This observation indicates drought stress has no effect on potato seed quality.

•Donald Carling

Comparing potato varieties

Total yields of 44 varieties of potatoes evaluated in the field in 1993 averaged 19.9 tons per acre in irrigated trials and 8.5 tons per acre in nonirrigated trials. Yields of US #1 tubers were 16.5 and 5.4 tons per acre in the irrigated and nonirrigated trials respectively. Top yielding varieties in the irrigated trials included Gold Coin, Red Pontiac, Chieftain, Green Mountain, Alaska 114, and Acadia Russet. The most commonly grown commercial varieties, Bake-King and Shepody, yielded 15.9 and 15.4 tons per acre of US #1 tubers respectively. In nonirrigated trials the top yielding varieties were Green Mountain, Gold Coin, Kennebec, and Russet Burbank. Shepody and Bake-King yielded 7.5 and 6.3 tons per acre of US #1 tubers respectively under nonirrigated conditions. Average yields in the 1993 irrigated trials were comparable to those of 1992 and 1991 but about one ton less than the five-year averages. Nonirrigated trial yield averages were the lowest in the 12 years we have conducted the trials.

•Donald Carling

Resisting disease in potatoes

I evaluated 24 transgenically altered lines of potato for resistance to Rhizoctonia disease in 1993. I inoculated plants with a mixture of isolates of Rhizoctonia solani to maximize disease development and damage. Due to poor seed quality, emergence was low, plant vigor was highly variable, and significant differences among treatments were not observed. Selected lines from this group of 24 will be revaluated in 1994.

•Donald Carling

Controlling sulfur scab

In 1992 we applied elemental sulfur to a commercial farmers potato field, expecting the treatment to lower soil pH and as a result reduce the incidence of the disease common scab. However, soil tests run on samples collected in 1993 indicated a minimal change in soil pH. We will plant potatoes on these plots in 1994, and at harvest collect samples and grade for common scab symptoms, and test the soil. It is anticipated that plots treated with sulfur will have a lower soil pH and a lower incidence of common scab symptoms.

•Donald Carling and James Walworth

Controlling weed with metam sodium

Weeds are one of the most serious problems for Alaska's commercial vegetable growers. Mechanical methods of weed control are inadequate, hand weeding is time consuming and expensive, and effective chemical herbicides are not available. We are evaluating metam sodium—a biocide used as a soil sterilant in many agricultural production systems—as an herbicide for use by Alaska vegetable growers. Preliminary evidence indicates that when applied by shanking to a depth of eight to 10 inches at a rate of 100 gallons per acre during a fallow year, metam sodium eliminated most weed seeds from the soil profile. We are monitoring weed populations in the years following treatment with metam sodium.

•Donald Carling, Jeffery Conn and James Walworth

Verlan Cochran and Dr. Jeff Conn USDA,-ARS scientists in front of the CO_2 chambers at the Fairbanks Agricultural and Forestry Experiment Station (Photo by Keith Swarner).

Characterizing rhizoctonia solani

We characterized a new anastomosis group (AG–II) of Rhizoctonia solani which was found in Western Australia where it causes a disease in lupine and wheat, and in Arkansas where it attacks rice and soybean. We don't yet know its worldwide distribution or its significance as a plant pathogen. Although AG–II has not been found in Alaska, its existence will add perspective to taxonomic, genetic and disease studies here and elsewhere.

•Donald Carling, Craig Rothrock, Gordon MacNish and Mark Sweetingham

Barley and green manured fababeans

Green manured legumes can reduce the use of commercial nitrogen fertilizer. However, a study conducted near Delta Junction found that green manured fababeans decomposed too slowly to adequately supply a succeeding barley crop. An additional 20 pounds of nitrogen were required for maximum yields. Nitrogen in the green manure contributed more than 40 pounds of nitrogen to barley the second year. Growers planning to use green manure to reduce their dependence on commercial fertilizer should supplement the green manure with commercial fertilizer and also take two or more years to realize the full benefits of green manure.

•Verlan Cochran, Stephen Sparrow and Sharon Schlentner

Nitrous oxide and methane flux

Atmospheric concentrations of nitrous oxide and methane are increasing. Both gases are radiatively active and contribute to global warming. Oxidation of ammonium fertilizer is a major source of nitrous oxide in tropical and temperate climate. Studies conducted at Fairbanks and Delta Junction found that the Interior's cold soils slow the oxidation process but do not stop it. Thus, over the growing season, about the same amount of nitrous oxide is emitted as reported in temperate climates. This is between 0.2 and 0.5 percent of the nitrogen applied as urea or other ammoniacal fertilizers. We found that both barley stubble and green manure increased the emissions of nitrous oxide from urea. Microorganisms in well aerated soils consume methane but may be inhibited by ammonium-based fertilizer. Field and laboratory studies show that methane consumption may be temporarily inhibited after applying urea, but the seasonal amount consumed is the same with or without urea fertilizer. We attributed this lack of inhibition in field soils to the finding that much of the consumption occurs at depths beneath that affected by urea application. Likewise, we have seen no effect of tillage, crop residue management practices, or nitrogen fertilizer rate on field measurements of methane consumption.

•Verlan Cochran, Ellen Sparrow, Sharon Schlentner and Stephen Sparrow

Carbon dioxide study

We built a field facility for studying effects of CO_2 on plants in the subarctic. USDA–Agricultural Research Service researchers and support staff designed and built the facility with help from the UAF farm crew. Atmospheric CO_2 levels have risen from an estimated 270 parts per million before the start of the industrial revolution to the current 355 ppm due primarily to burning of fossil fuels. Atmospheric CO_2 levels are expected to double by the middle of the next century. Many agricultural plants yield more and use less water when grown at elevated CO_2 levels. However, since most of the previous work was conducted in the far south, researchers are not certain how plants will respond to CO_2 at northern latitudes where air temperatures are lower and days are long. Our facility consists of a 26-ton carbon dioxide storage tank, 14 open-topped chambers that are 10 feet in diameter, equipment for metering CO_2 into the chamber fans and monitoring CO_2 contents in the chambers. We will grow potatoes (variety Shepody) at two and $1^1/_2$ times ambient atmospheric CO_2 levels. We are collecting data on growth rate, water use, photosynthesis, carbon allocation, root mass and distribution, soil respiration, yield and carbon to nitrogen ratios. We will grow Datal and Steptoe barley in several other chambers at ambient and two times CO_2 levels to determine whether there are differences between varieties adapted to subarctic conditions and varieties adapted to warmer, drier climates in their response to increased CO_2 levels. In growth chamber experiments, I found that Datal barley flowered one week earlier at two times the CO_2 level than at ambient concentrations. If this result holds true in the field, it may be possible to grow barley in areas with shorter growing seasons.

•Jeffery Conn

Controlling foxtail barley

This study seeks to control foxtail barley with glyphosate at the Delta Junction Field Research Site. Foxtail barley

is a serious weed problem in pastures and in barley fields where tillage is reduced to decrease soil erosion. The fish hook–like structures that are part of the flowering head of this species can work into mouth tissues and cause infections in livestock eating it or contaminated hay. A similar problem exists in sled dogs that come into contact with it through barley straw originating from fields contaminated with foxtail barley. Barley yields are severely reduced by competition with foxtail barley. It is difficult to chemically control foxtail barley in a barley crop since the crop and weed are closely related and both are adversely affected by the herbicides that would control foxtail barley. Thus, foxtail barley is best controlled during a fallow year when barley is not present. Glyphosate can be used to control foxtail barley during fallow. It is a systemic, nonselective herbicide with low mammalian and bird toxicity. For best results, the herbicide must be applied when translocation to roots is occurring so that the herbicide is carried underground to kill the roots of the weed. If the roots or perennating organs are not killed, the weed can resprout and cause another infestation. To determine the optimum time to apply glyphosate we applied it to different foxtail barley stands every two weeks during the 1992 and 1993 growing seasons using one quart per acre and one–half quart per acre. Foxtail barley control from the half–quart applications was inadequate on all application dates. We achieved excellent control with one quart rate in early June or after August 15.

•*Jeffery Conn*

Herbicide persistence

Besides increasing yields, irrigating potatoes may decrease persistence of herbicides. Metribuzin and linuron, two herbicides commonly used by Alaska potato farmers to control weeds, can persist in soil for several years and injure subsequent crops such as lettuce and cabbage. Since herbicides degradation is faster under moist than under dry soil conditions, we conducted experiments to determine if degradation of metribuzin increased when potatoes were irrigated. We planted Bake King potatoes and applied metribuzin either immediately after planting or just prior to potato emergence. Plots were either irrigated by impact sprinkler to keep soil matric potentials above–1 atmosphere (as determined with tensiometers) or were not irrigated. We chemically extracted soil samples in the fall prior to soil freeze and determined metribuzin levels using gas chromatography. Metribuzin levels at the growing season end were lower when potatoes were irrigated.

•*Jeffery Conn*

Processing velvet antlers

We fabricated a boiler unit from a steel drum in an attempt to dry velvet antlers from reindeer (using the dipping and oven drying technique). Moisture loss of the velvet antlers varied from 49 to 64 percent with stage of development and green weight (calcification). Results of this project will be published in an AFES circular.

•*Ray Grover and Lyle Renecker*

Glacial till succession

Mycorrhizae, symbioses between certain fungi and plant roots which help the plant absorb soil nutrients and moisture, may aid succession by helping plants establish on deglaciated land. Ectomycorrhizae have been found on two–year–old naturally occurring seedlings on the Exit Glacier outwash plain near Seward. Normally ectomycorrhizae are associated with more–developed soils with greater organic matter content. Different mycorrhizal form on different plant species, and these types differ in several successional stages. Inoculation of transplants of selected plant species with material from different successional stages also resulted in various mycorrhizal types.

•*Dot Helm*

Studying Usibelli vegetation

Usibelli Coal Mine uses the most recent knowledge and plant materials to continue improving revegetation on their mined sites. I initiated a study in 1991 to evaluate growth of grass species on different growth media on south–facing slopes for cover, nutrient absorption and decomposition. I monitor nutrient levels of soils, roots, and aboveground plant parts of selected species to identify nutrient movement. Mesh litter bags containing material from several species have been placed in the field and are being monitored for mass loss each year to evaluate decomposition of different grasses. Grasses that decompose more readily may help reestablish nutrient cycling more quickly.

•*Dot Helm*

Reestablishing woody browse

I evaluated seven woody plant species selected for availability, ease of propagation and suitability for moose habitat on four growth media selected for their biological properties beginning in 1989. Plant growth continued to be good after five years on three soils from paper birch and white spruce forest, upland meadow, and lowland meadow sites but was still poor on the gravel overburden site. Willows have been the most productive species. Outplanted cuttings have grown sufficiently to overcome most competition from bluejoint regenerating from rhizomes.

•*Dot Helm*

Reclaiming abandoned placer mine

Several state agencies, miners from the Circle Mining District, and I are cooperating on a project to reclaim an abandoned placer mine along the Steese Highway so that natural vegetation can colonize the site. We inventoried vegetation that had colonized the site after

abandonment in the mid-1980s but before the reclamation in 1993. Willows had extensively colonized the tops of some of the uncompacted tailings. Plants closer to the floodplain were smaller and soil nutrient levels were lower. We will monitor effects of natural colonization and low-cost revegetation treatments.

•Dot Helm

Monitoring abandoned coal mine

The Alaska Division of Mining is reclaiming coal mines abandoned prior to 1977 when the Surface Mining Control and Reclamation Act was passed. I am helping monitor some of these sites to determine the success of various reclamation techniques. Results from one mine indicate that plant growth was greatest where nutrients were lowest and the area was sheltered, possibly indicating that wind and desiccation are a greater concern than nutrients on this site. Results of other studies are being synthesized to make recommendations for future reclamation.

•Dot Helm

Sow in fall, reap in summer

Homeowners and commercial landscapers trying to establish a wildflower meadow should sow seeds in fall for best results in the Fairbanks area. Fall sowing provides good stand establishment for both native and non-native wildflower seed mixes and eliminates the need for irrigation to promote good seed germination. The non-native seed mixes provided a spectacular color display during the first two seasons, but species diversity declined after the first season as annuals and non-hardy perennials died. Alaska wildflowers with the greatest potential in a wildflower mix include strawberry spinach, wild chamomile, Jacob's ladder, wild sweetpea, alpine arnica, arctic lupine and Siberian aster.

•Patricia Holloway and Ouina Rutledge

Experimenting with mixes

Direct-seeded annual flower mixes can produce an abundance of flowers in Fairbanks' gardens. The 13 commercial and experimental mixes began to bloom by mid July following a May 20 sowing date. The public preferred two mixes: Pat Wagner's Experimental Mix and Wildflower Carpet No. 12 (Park Seed Co.) Qualities of a good mix included medium plant height, an even stand with a variety of flower colors, absence of lodging, sustained seasonal interest and potential for cut flower production.

•Patricia Holloway and Patricia Wagner

Do tomatoes and alcohol mix?

Can agrimethanol technology work in Alaska? Research in California and Arizona proved that diluted solutions of methanol (wood alcohol) sprayed on plants can increase growth of tomatoes, cole crops and strawberries by as much as 50 percent. Methanol promotes the production of carbon dioxide which, in turn, increases photosynthesis on hot, sunny days. Researchers tested this new technology by spraying 'Subarctic 25' tomatoes with a 10 or 20 percent solution of methanol. Although slight increases in yield were measured, total yield of green and ripe fruit did not differ significantly between methanol-treated and control plants. Researchers also sprayed methanol on the famous giant cabbage, 'O-S Cross', but no super giant cabbages resulted.

•Patricia Holloway and Patricia Wagner

A pig's diet

I conducted a study with 25 (Yorkshire x Hampshire) pigs (56 pounds) to determine the effect of increasing dietary levels of salmon meal (62.5 percent C.P., 13.5 percent E.E., 4.0 percent lysine) as 0, 25, 50, 75 and 100 percent replacement for crude protein supplied by soybean oil meal (47.5 percent C.P.) in Datal barley based growing-finishing diets. Diets were balanced for vitamins and minerals and dietary protein was formulated at 15 percent until pigs reached 143 pounds and then changed to 13 percent crude protein until they weighed 227 pounds. The rate of gain was significantly reduced for pigs fed 100 percent replacement of soybean meal compared to the barley-soybean meal control but feed conversion was not effected by dietary level of salmon meal. We didn't notice any significant differences in carcass grade or backfat levels of pigs fed the five diet treatments.

•Fredric Husby

Pork a la salmon

Sensory evaluation of fresh pork chops and cured hams by Dr. Ruthann Swanson indicated that a fishy off-flavor was detected in samples from pigs on the 50 percent and greater salmon meal diets. Pork from the 25 percent diet was preferable to the control diet. The 50 percent replacement level of soybean meal corresponded to 4.85 and 3.4 percent dietary salmon meal for the growing and finishing periods, respectively. The level of salmon meal in the 25 percent diet was 2.65 percent in the grower phase and 1.85 percent in the finishing phase. Salmon meal should be restricted to 2.7 percent of the diet for growing-finishing swine.

•Fredric Husby

Using municipal sludge

Current mining laws require a reclamation plan to address landscaping and revegetating after mining ceases. When reclaiming rocky mine tailings, the ability of the soil to provide nutrients, hold water, and otherwise sustain plant life is a major concern. We began this study in the fall on the site of the Ryan Lode Mine at Ester to evaluate the use of municipal sludge as a soil amendment and nutrient source in reclamation. We used a random complete block design with four replica-

tions and tilled applications of 0, 5, 15, 50, and 100 tons of dry sludge per acre into the top six inches of mine tailings. We filled polyethylene bags with mixtures of soil and sludge in proportions equal to field applications and buried them at depths of one and six inches in each plot to measure sludge decomposition in cold soil during the first year following application. We divided each plot into four subplots which were randomly planted to 'Nugget' Kentucky bluegrass, 'Arctared' red fescue, 'Nortran' tufted hairgrass or 'Norcoast' Bering hairgrass.

•*Charles Knight*

Alternative crops

I initiated a three-year field study at three sites, near Fairbanks, North Pole and Delta Junction to evaluate alternative crops for spring planting and identify varieties which will reach maturity in the short growing season. We collected plant samples and recorded growth rates and percent ground cover weekly for each crop at each location. We also plot biomass accumulation and percent ground cover against growing degree days to determine the rates of maturity and heat requirements for each crop. From this data and historical weather records, we can make predictions about the probability of a crop reaching maturity in any given year and the likely response of that crop to possible global warming.

Additionally, we are planting small test plots, larger production fields of sunflowers, canola, buckwheat and canary grass in conjunction with farmers in the North Pole and Delta Junction areas to determine field scale production costs, yields, crop quality and marketability.

•*Charlie Knight*

Red and alsike clover quality

We measured red and alsike clover quality throughout the growing season to find the best harvest times for optimum quality. Clover digestibility was high throughout the first (May through July) and second (July through August) growth periods. Digestibility was 10 percent higher than reported elsewhere in the U.S. Crude protein was low all summer. Protein levels were generally higher than nitrogen fertilized grass, but lower than expected for legumes. Yields were high and plants did not exhibit signs of nitrogen deficiency, so we're not sure why the protein content was lower.

•*Michael Panciera*

Establishing red clover

We often use companion crops to control weeds during the establishment year of a perennial crop. Information from the Lower 48 indicates that the perennial will establish more quickly without a companion crop such as oats or barley. Our studies at Point MacKenzie confirmed this. Red clover grew quickly and produced more forage without a companion crop. Oats, annual ryegrass, and fodder rape reduced weed growth, but red clover establishment and growth was better when it was planted alone. Companion crops may help establish other perennials or meet livestock feed needs.

•*Michael Panciera*

Red clover growth and development

We studied red clover varieties from different locations to compare the growth of adapted and non-adapted plants in Alaska. The best adapted variety—Alaskland—grew slowly the first year, but most of the plants survived and it produced high yields in subsequent years. The poorly adapted variety from Florida grew well the first year, producing several times as much as Alaskland. Most of the plants died over winter and yields were low in following years. It is particularly important to use well-adapted varieties of perennial crops. In this and other studies, poorly adapted perennials have produced enough forage to be considered a viable annual crop.

•*Michael Panciera*

Wetland properties

I monitored the wetland properties of selected soils in Interior and Southcentral Alaska. The hydric soil property is one of the three components of the wetland criteria. Based on field study and monitoring, the hydric soils criteria listed in the 1989 Federal Wetland Manual do not adequately describe the field conditions in Alaska. Morphological features, such as mottles, in some soils in the Matanuska Valley do not reflect soil wetness, rather a relict feature of the past. In some soils, the saturation and reduction periods fall beyond the growing season of June 1 to August 31. It is common in subarctic regions that such saturation always occurs in late spring due to melting snow and thawing of seasonal frost, and in late summer or early fall due to rainfall. The actual growing season as indicated by redox measurement and phenological studies extends from late spring to late fall.

•*Chien-Lu Ping*

Soil environment

Along with researchers from the National Park Service

Dr. Dot Helm discusses the impact of moose browsing on the establishment of woody species (Photo by Dr. Charles Knight).

and the National Biological Survey, I am monitoring the soil environmental parameters of the Rock Creek Watershed of the Denali National Park. We are trying to characterize the soil environments of different vegetation communities and to establish baseline data for comparison of climatic and technogenic changes. This past year we installed monitoring devices in key mapping units (ecosystems).

•Chien-Lu Ping

Soil organic matter

The objectives of the project are to assess the quantity and quality of soil organic matter (SOM) and to test the roles of the active fractions of SOM in CO_2 and CH_4 production in the arctic ecosystem. I took soil samples from Alaska's arctic slopes and assessed the quantity and quality of soil organic matter by using the tandem XAD resin technique. The average carbon content of SOM is 55 percent. Soil organic carbon was fractionated into humic acids, fulvic acids, low-molecular-weight acids, hydrophobic neutrals and hydrophylic neutrals. The last three categories were hypothesized to be the active fractions subject to rapid turnover and to be predecessors of CO_2 and CH_4. The total carbon contents in the organic horizons ranges from 26 to 43 percent; in the active layers (A and B horizons) from 3 to 19 percent; and in the upper permafrost layers (Cf) from 3 to 12 percent. More than 53 to 60 percent of the total organic carbon is extractable by NaOH solution and most of the extractable carbons are in the forms of humic acids. The active fraction accounts for 25 to 40 percent of the total extractable carbon, i.e. only 10 to 20 percent of the total soil organic carbon is chemically active. We will assess the bioreactivity of the SOM and different carbon fractions, and correlate the chemical reactivity with the bioreactivity of these carbon fractions.

•Chien-Lu Ping

Classifying, interpreting permafrost soils

The dominant soil forming process in permafrost soils is cryogenesis. Soil horizons are often distorted and discontinuous because of cryoturbation. Cryogenesis results in granular and platy structures in the upper solum and angular blocky or prismatic structures above the permafrost. Soils formed in recent alluvium are not cryoturbated; cryogenic processes result in ice lenses and platy structure. Soils formed in hummocks and polygons have contrasting properties in the same pedon. Mineral soils form in the center of hummocks and polygons; organic soils develop in troughs. Permafrost perches water during the growing season, which results in a saturated zone with redoximorphic features. Ice contents in the upper permafrost range from 60 percent to nearly pure ice in the case of ice wedges and ground ice. In the zones of continuous permafrost in Alaska, soils formed under tundra or tussock-tundra are generally cryoturbated. The mean annual soil temperature (MAST) ranges from –4 to –10°C, the mean temperature at 25 centimeters during the growing season is seldom above 5°C. In the zone of discontinuous permafrost, soils formed under forest or forest-tundra are less cryoturbated. The MAST ranges from 2°C (without permafrost) to –4°C. The permafrost table may lower below the control section following disturbance of the natural vegetation. To correctly address the cryogenic nature of permafrost soils and to provide better interpretations, a new Gelisol order is proposed to be the 12th order of Soil Taxonomy.

•Chien-Lu Ping

Gravel vegetation project

This project provides rehabilitating guidelines for gravel fill sites in Alaska's arctic. Gravel fill, five to seven feet thick, is commonly used for roads and pads during exploration and production of oil and gas. We examined the effectiveness of reducing gravel thicknesses to two feet, adding a minimum of three inches of topsoil, tilling, and artificially capturing snow to provide winter protection for plants. We searched for native flora adapted to colonizing gravel. Periodically, we examine abandoned National Petroleum Reserve exploration sites, and record the progress of revegetation applications of the 1970s. This lets us document vegetation conditions and evaluate the long-term usefulness of the seeded grasses.

Indigenous plant species and manipulations tests of gravel fill on the BP Put River No. 1 pad at Prudhoe Bay is a 10-year project with three separate seedings and two unseeded controls in each experimental unit. Indigenous plant seeds were collected during the autumn and seeded the next spring. That was to have been repeated three times, beginning in 1990. Due to the region's lack of natural seed production in 1991, there was insufficient seed for the third application until 1993.

Hand collection of indigenous seeds can only be used to introduce these species on small areas of gravel fill. Natural expansion must occupy the remaining portion. This is in contrast to seeding all the barren gravel at one time. Determining how to improve the habitat (gravel fill) to accelerate natural spread is as important as suitable species selection. Indigenous plants have the capacity to eventually occupy such sites. Regional soil profiles clearly show that gravel and silt deposits have naturally buried tundra communities many times , and native flora were able to reclaim these disturbances and form peat and wet sedge tundra on such sites. Time required for such recovery is unknown.

Time is an indispensable component of revegetation. Long-term vegetation conditions are largely affected by what is done when the site is abandoned. For the surest natural recovery of arctic tundra, it is more important for plant communities to develop (trend) in a positive direction than be at a specific stage (condition)

on a given date. In some instances, the very best revegetation intentions may have delayed the natural recovery. Seeding entire pads to grass, as was done in the National Petroleum Reserve, provided plant canopy cover relatively quickly, but only as a single species stand. Although this met the revegetation criterion, the vegetation trend for tundra recovery appears stymied. Unseeded plots adjacent to seeded plots in the Prudhoe Bay area are being invaded relatively rapidly by self-perpetuating species. This means that meeting short term revegetation objectives can significantly influence the long-term goal. The findings provide an alternative for tundra revegetation. Redirecting short-term revegetation objectives to enhance possibilities for long term goals may be the least costly option.

•Jay McKendrick

Cattle feed substitute

Alaska grown whole-seed canola can be substituted for imported soybean meal and tallow in dairy cattle diets. Cows fed four pounds of canola per cow per day produced more milk than cows fed no canola. However, cows fed two pounds had the highest milk production per unit of feed consumed. Diets containing canola may be more expensive; therefore both milk and feed costs should be considered when deciding if canola is an economical alternative. Alaska grown canola is currently being included as a feed mix with barley, and sold both in feed stores and to local dairy producers.

•Kirsten Randall, Stephen Dofing and Donald Brainard

Farmed wapiti fed salmon meal

Salmon meal is an important by-product of Alaska's commercial fish industry. It is potentially important in productive ruminant rations because of bypass protein properties. However, marine oil deposits in tissue may occur if animals are fed great amounts. In this study, we performed energy and protein balance trials on 12 wapiti year-old cows fed either a ration using soy meal or Alaska salmon meal as the major source of protein. In addition, 12 wapiti yearlings were fed either a diet of whole barley, oats, wheat and soymeal and free choice alfalfa cubes or a pelleted alfalfa-concentrate ration that was offered free choice and used salmon meal as the major source of protein. Animals were fed these diets for approximately 80 days and then slaughtered. Muscle and fat tissues will be examined for fatty acids, omega-3 fatty acid, and nutrient content. Tissues from each animal will be subject to taste panel analysis.

•Todd Ree, Lyle Renecker and Robert Hudson

Will wapiti eat electrolyte pellets?

A patented formula of an electrolyte pellet was offered to a group of wapiti bulls before slaughter to reduce dark-cutting in meat. Before this product can be an effective treatment, it must be accepted by the animal. In this study, the wapiti rapidly consumed the electrolyte pellets which now permits researchers to determine if the pellet can help maintain a high meat quality by mitigating the effects of stress.

•Lyle Renecker

Game operation facilities

An important element of successful game management is an operational handling facility which lets animals flow smoothly and mitigates injury and stress to both man and stock. We are helping producers in Nenana, Kodiak, Point MacKenzie, Stebbins, and Delta Junction design functional farm layouts and or handling facilities.

•Lyle Renecker

Weighing Seward Peninsula reindeer

Live weights are important indicators of nutritional status, productivity, and ultimately, reproductive success of reindeer. We monitored and recorded body weights of Seward Peninsula reindeer. This data will help herders assess the animals' conditions.

•Lyle Renecker

Reindeer range productivity

We have completed the field work of this joint study with the National Park Service and are now analyzing the data. Information on plant composition and plant cover from monitored transects will be combined with a computer Geographic Information System database to update ecosite descriptions. Vegetation collected from clip plots along the transects will be separated by species to estimate summer plant productivity. We determined summer food habits of reindeer on the range of Mr. Clifford Weyiouanna by collecting fresh fecal samples.

•Lyle Renecker

Brucellosis monitoring

We blood sampled 145 reindeer on the Seward Peninsula and tested for brucellosis. Five animals tested sero positive. We also vaccinated the reindeer against brucellosis.

•Lyle Renecker

Examining reindeer genetics

There has always been the question of variability among the Alaska reindeer populations and the degree of influence from caribou. This study used molecular genetics to determine if differences exist among reindeer on Hagemeister and Nunivak islands, and the Seward Peninsula. We will analyze the data in 1994.

•Lyle Renecker and Matt Cronin

Effecting preslaughter stress

Preslaughter stress may induce a condition called

dark-cutting in cattle. Studies have shown that animals treated with a special electrolyte pellet and or soluble powder negates this condition. In this study, wapiti yearlings were fed an electrolyte pellet 24 hours prior to slaughter. Six hours before, and at the time of slaughter, we drew blood from each animal and will analyze the samples to determine the influence of handling and transportation on animal stress. The information may help reduce dark-cutting of meat and percent shrinkage, and improve handling procedures.

•Allan Schaefer, John Church and Lyle Renecker

Cardboard soil

Can cardboard, a major component of Alaska's solid waste, be applied directly to the soil and will it increase the organic matter content of the soil, improving its physical and chemical properties? Our preliminary experiment in 1993 sought to determine the rate of cardboard decomposition in agricultural soil and the effects on crops. We added cardboard, shredded into one-to-two-inch pieces, to soil at the Fairbanks Experiment Farm at rates of eight and 20 tons per acre and incorporated it into the top four inches of soil. We planted barley and monitored its growth and measured decomposition rates. In the plots containing cardboard, barley germinated and grew poorly. Decomposition occurred at three inches but not at the soil surface. Results indicate that it may not be feasible to grow crops on soil during the year of application, especially if high rates are used. Future experiments will determine if adding cardboard affects long-term crop growth and the effects of application times and rates.

•Stephen Sparrow and Darleen Masiak

Studying perennial legumes

What are the long-term persistence, herbage yield, nitrogen fixation, and effects on certain soil properties by several perennial legume crops under various soil and climate conditions in Alaska? We established plots at Point MacKenzie in 1992 and at Fairbanks and Delta Junction in 1993 to answer these questions. At Point MacKenzie, survival for birdsfoot trefoil was poor and we had no harvests. For other legumes, second year forage yields range from 1.2 tons per acre for Kenstar red clover to 3.2 tons per acre for Altaswede red clover, with yields for alsike clovers falling between the two red clovers. At Fairbanks, first year forage yields for Peace alfalfa was 2.2 tons per acre and for Altaswede red clover was 1.8 tons per acre. Stands for other legume species were so poor that we did not collect yield data. At Delta Junction, forage yields ranged from 0.5 tons per acre for Peace alfalfa to 1.3 tons per acre for Aurora alsike clover. We have not completed plant N analyses, therefore N-fixation values have not been calculated. There was no effect of cropping on soil microbial biomass or soil aggregate stability.

•Stephen Sparrow and Michael Panciera

Nitrogen-fixing plants on the bison range

This project seeks to determine the feasibility of using nitrogen-fixing plants to improve forage quality of the Delta Bison Range. We planted several species of nitrogen-fixing plants, mostly forage legumes, at several locations on the range. First year yields of several of the forage legumes were good and bison acceptance was good. Although we haven't completed forage quality analyses, our observations indicate that several species overwintered successfully, but it was too early in the season to quantify winter survival. We will continue monitoring plots.

•Stephen Sparrow and Michael Panciera

Hagemeister Island reindeer

Reindeer were introduced to Hagemeister Island in the mid 1960s. Since then, populations have fluctuated from 76 to 1,530 animals. During the winter of 1991-92, a die-off of animals occurred and the U.S. Fish & Wildlife Service decided to remove all reindeer from the island. In a cooperative study with the USF&WS, we initiated a project to better understand the biology of this reindeer population. These animals were thought to have overgrazed their winter lichen range, yet were reproductively successful, and appeared to enter autumn with good fat tissue stores. However, breeding season and subsequent peak calving season appeared to be delayed by about four weeks. This study attempts to synthesize factors such as food habits, molecular genetics, the reproductive cycle, timing of environmental catastrophes, and seasonal weight dynamics to establish facts.

•Raphaela Stimmelmayr and Lyle Renecker

Brucellosis testing

Researchers helped relocate reindeer from Hagemeister Island that were destined for Project Hope, in Point MacKenize. We sampled, centrifuged and card-tested blood for *Brucella suis biovar IV* from reindeer to be shipped. All tested sero negative.

•Raphaela Stimmelmayr and Lyle Renecker

Analyzing wild game nutrients

We are analyzing the nutritional properties of state-inspected reindeer meat collected from Bering Sea Reindeer Products on Nunivak Island and federally inspected wapiti meat. We are testing for protein, fatty acids, cholesterol, omega-3 fatty acids, vitamins, minerals, ash, energy, and total fats. This data will impact the marketability of the meat product.

•Teresa Tomany-Renecker, Todd Ree, Allan Schaefer, Robert Hudson and Lyle Renecker

Reindeer carcass composition

We purchased 24 reindeer carcasses of varying age and sex from Bering Sea Reindeer Product's on Nunivak

Ray Grover, research aide, works with the reindeer (Photo by J. Stephen Lay).

Island. We first estimated the animal's age by cementum annuli. Then we dissected half of each carcass into the three tissue compartments of fat, lean tissue, and bone and performed wholesale and retail cutability tests on the other half of the carcass. Professional sensory panel analysis, pH, and shear force tests were performed. We will now compile the analysis.

•Teresa Tomany-Renecker, Lyle Renecker and Kenneth Krieg

Enhanced reindeer inspection

Bering Sea Reindeer Products donated 10 complete male reindeer, ranging from $1^1/_2$ to $3^1/_2$ years old. We took two retail cuts from the neck and shoulder of each carcass. One cut from each location will be a control and the other subjected to treatment by a Jaccard-a commercial meat tenderizing machine. A professional sensory panel will analyze the meat for color, tenderness, juiciness and flavor. Additionally, we will measure the shear force which indicates the tenderness of the meat. When samples are available, a cross-species comparison of Jaccard vs. non-Jaccard inspected meat from reindeer, bison, caribou, elk, and musk oxen meat will also be performed.

•Teresa Tomany-Renecker, Lyle Renecker, Douglas Drum and Allan Schaefer

Carcass composition study

Bering Sea Reindeer Products donated 10 reindeer carcasses from young intact male animals ranging from $1^1/_2$ to $3^1/_2$ years. We collected blood within 10 minutes after death, the blood samples were centrifuged, the serum collected and frozen for later analysis of blood chemistry. We recorded kill times and took serial pH readings from the time the carcasses reached the abattoir through 24 hours postmortem. Meat color was evaluated with a Minolta Chroma-Meter II color meter, on the longissimus dorsi muscle at the 10^{th} rib, 24 hours postmortem, and 30 minutes after ribbing. The majority of pH readings ranged approximately 5.2 to 5.4, and readings from the color meter indicated that this meat was darker in color than meat from various domestic species used commercially. We dissected the carcasses into lean tissue, bone, and the three compartments of fat-subcutaneous, intermuscular, and interperitoneal. Lean tissue and fat samples were taken for later analysis of nutrient and fatty acid composition. Femur samples were taken for mineral analysis and an overall assessment of animal condition using a bone marrow index.

•Teresa Tomany-Renecker, Lyle Renecker, Kenneth Krieg, Allan Schaefer and Douglas Drum

Establishing biological parameters

We studied 24 wapiti bull calves to establish various biological parameters and the effect of age on meat quality. The calves have been grouped, and are being slaughtered serially at the respective ages of 11, 14, 18, 21, and 23 months of age. In addition, 12 more wapiti ranging from two-to-six-years old will also be slaughtered.

Prior to transport to slaughter, we collect blood samples and later analyze them and compare the chemistry profiles between groups as well as to that of domestic slaughter species of similar age. We also evaluate the color and take pH readings serially from death to 72 hours postmortem, weigh internal organs, the hide, head, and legs, take muscle samples and have a professional sensory panel evaluate them. In addition, each sample will also be tested for shear force. Half of each carcass will be dissected into lean tissue, bone, and the three compartments of fat (subcutaneous, intermuscular, and interperitoneal).

•Teresa Tomany-Renecker, Lyle Renecker and Allan Schaefer

Forest Sciences

Moose browsing impacts hardwoods

Data analyses confirm that moose significantly impact height and diameter growth of balsam poplar and aspen in the Susitna Valley. Mean heights of "escaped" poplars were 250 to 350 percent greater than those of browsed crop trees; the difference for aspen was 207 to 332 percent. Mean butt (six-inches aboveground) diameters of "escaped" poplars were 160 to 259 percent larger than those of browsed crop trees; the difference was 140 to 180 percent for aspen. High moose populations in a particular area can prevent or greatly delay development of adequately stocked poplar and aspen stands and speed the conversion of hardwood dominated sites to white or black spruce. Manipulating browsing pressure is important to successfully regenerate these hardwoods. Alternatively, where spruce is the desired forest crop, moose browsing can be the release mechanism to free spruce from hardwood competition.

•*Jonathan Andrews and Edmond C. Packee*

Managing LTER data

Information managers developed a site catalog and database of Bonanza Creek information and a means of getting information into the catalog. This should ensure that data continues to be properly documented and archived. We investigated various software tools to streamline access to research information. Computer and network resources were fine-tuned to provide connected researchers transparent access to on-line information. We are working on an all-inclusive site database and a user-friendly interface to this database.

•*Darrell Blodgett*

Simulating leads to management system

Simulations of the effects of forest harvest on forest floor temperature and soil frost indicate that when wind speeds are moderate to high there may be little difference between air temperature and forest floor surface temperatures. In addition, the effects of forest canopy removal on soil thaw rates depend upon the moisture content and depth of the forest floor material. The relation between forest canopy removal and soil temperature is an important link in understanding the cause-and-effect chain involved in deforestation, climate change, and forest management. The objective is to interface a watershed and microclimate model with a geographic information system as an interactive tool for landscape level, ecosystem management.

•*John D. Fox Jr.*

Studying the Sound

The forest on the west fiord wall that forms the scenic backdrop to the Columbia Glacier in Prince William Sound is the northernmost, well-developed old-growth example of coastal rainforest in western North America. A study at the Columbia Glacier-Granite Cove Research Natural Area compared forest growth adjacent to deep fiord water that remains ice-free year round and forests along the shore of the cove which experiences winter ice. The fiord wall forest contains western hemlock and Sitka spruce trees more than four feet in diameter with the age of dominant older trees typically less than 250 years. The cove forest, at the same elevation about a mile away, has mountain hemlock and a few Sitka spruce trees with the largest trees seldom more than 33 inches in diameter. Granite Cove trees are all ages, but 5 percent or more are between 300 and 350 years old. Tree rings from both stands show a similar pattern of year-to-year climate response. The fiord wall forest apparently achieves a higher forest growth rate than expected for the type. This is due in part because it is south facing and warmer, but especially because of the warmth rising from deep seawater. Trees in both stands have multiple branched crowns caused by repeated top breakage under enormous loads of snow.

•*Glenn Juday*

Temperatures trends

Temperature trends in Central Alaska show a marked tendency to rise and fall in an 11-year cycle that largely coincides with the solar sunspot cycle of the same length. Recent advances in studies of the sun, the earth's climate, and the upper atmosphere confirm an earlier finding of regular warming and cooling according to this pattern. Shorter solar cycles are correlated with warming and longer solar cycles with cooling. We do not know how the solar cycle controls earthly temperature trends, but a new theory proposes that the solar wind, which increases during solar sunspot peaks, changes the upper atmosphere to allow more solar energy to the earth's surface. The cycle of solar sunspot numbers roughly correlates with events such as the date of ice breakup on Interior rivers and even the total extent of forest fires in Alaska. The last solar cycle peak was in 1991. The temperature trend for Interior Alaska (warm and cold periods are certain to happen along the way) is for cooling until the mid-1990s and new highs again about the year 2002.

•*Glenn Juday*

How does the forest grow?

White spruce trees on the more productive upland sites near Fairbanks grow in a dry landscape. When we examined tree-ring records in the Bonanza Creek LTER study area they showed that greatest periods of average stand-wide tree growth reduction in the 20th century happened in the year (sometimes two years) following dry summers. White spruce store up growth reserves for the next season, so their growth is often best predicted by events in the previous growing season. The most severe stand growth reduction results when there are two consecutive dry summers. Stand growth as a whole is actually better in cooler years and worse in warmer years. One to three years following a wet year, stand growth is excellent. A detailed examination of a balanced sample of trees showed that nearly all the growth reduction occurred in the largest and fastest growing trees. Forest managers, consequently, should consider soil moisture when managing mature white spruce on warmer low elevation sites. However, the effect of potential global warming on precipitation may be more important to Interior Alaska forest growth than increases in temperature.

•*Glenn Juday*

Treefall directions affect life cycle

Treefall is an important part of the overall life cycle of the coastal Alaska forest because it opens up the canopy allowing tree regeneration and understory growth and it places large logs on the forest floor. Small-scale disturbances, caused by the death of one to a dozen trees, are the most common form of natural disturbance in uplands. We conducted a study of small-scale disturbance regimes in the coastal rainforest of northern Southeast Alaska and found that often there are two or even three predominant directions of treefall in a stand. The direction can reveal important information about their environment. Sites around Juneau and Sitka show that treefall direction can be related to slope (trees tend to fall downhill) and to southeast gales and bora winds. The characteristic mosaic of dense canopy and small openings provides for the regeneration of native species in rough proportion to their occurrence in the natural forest. Large-scale clearcut harvest management does not produce the same conditions.

•*Glenn Juday and Robert Ott*

Individual tree volume tables

We continued collecting bark thickness and outside bark diameter measurements, emphasizing white spruce. Sample size exceeds 1,500 white spruce. We constructed the first provisional regional volume tables for a subsample of 450 trees from the Kenai Peninsula. Once sampling is complete, we will construct final statewide or regional volume tables. The growth and yield work on balsam poplar will provide volume tables.

•*Tom Malone and Edmond C. Packee*

The future of forest products

As technical advisor to the Alaska delegation of the Heilongjiang/Alaska Forestry, Economic, Trade and Technology Cooperation Commission, I participated in the 1993 Harbin exchange. Alaska participants prepared a "State of Alaska Report" and developed potential forest products' trade contacts and opportunities.

•*Edmond C. Packee*

Silvicultural systems

Alaska forests belong to the Northern Forest or Coastal Forest formations. We divided each formation into "forest vegetation zones" based on overstory and understory vegetation and climatic or soil features and published this information in our newsletter, *Forest Science Notes*. Silvicultural prescriptions and, especially, systems prepared for one zone may be applicable or require adaptation for use in another zone. A silvicultural system is a planned treatment program for tending, removing and replacing crops with new crops. Within the Northern Forest, basic regeneration methods to encourage a specific species or combinations have now been refined for the known forest cover types. We further refined the idea of three climatic zones.

•*Edmond C. Packee*

Managing forests for biodiversity

We set up a spreadsheet for the species listed in *Birds of Alaska* and began reviewing literature to better define habitat requirements of each terrestrial species. Preliminary findings suggest that the mosaic of Northern Forest cover types, especially early seral stages, provide essential habitat combinations for many neotropical birds. This habitat mosaic or diversity is caused by natural disturbances including fire, insect epidemics, windthrow, and flooding. Silvicultural practices are potential alternatives to natural disturbances to maintain this habitat mosaic. A similar approach has been initiated for the vascular plants of Alaska. We entered trees, shrubs, primitive vascular plants and monocots. The data will also be used to confirm the presence of forest vegetation zones.

•*Edmond C. Packee*

Summary of Alaska forest inventories

We continued our effort to complete summaries of Alaska forest inventories. Preliminary data was provided, upon request, to local planners. Our goal is to complete the summaries during Winter 1994-95.

•*Edmond C. Packee*

Reforestation stocking standards

August survival of conifer seedlings one year after planting in the Tok Levels-of-Growing-Stock study exceeded expectations, especially after the hard freeze and wet snow one month after planting in September

1992. Percent survival of white spruce was 98; black spruce, 98.6; lodgepole pine (nonnative to the area), 95.8; and tamarack (nonnative to the area), 95.3. This demonstrates that late summer planting on well-prepared sites with quality planting techniques can be highly successful. However, mortality of these seedlings will increase with time. Thus we will measure these plots annually for the next four years and periodically thereafter for the next 60 years to determine volume yields, natural mortality rates and changes in stand structure. It is essential to establish operational trials addressing time of planting. We need to carefully track seedling survival in operational plantations as well.

•*Edmond C. Packee*

Forest health

The number of spruce stands infested by spruce beetle since the late 1980s is currently estimated at 800,000 acres. Spruce beetle affects more than timber. It also affects recreational opportunities, wildlife habitat, fisheries (riparian zone processes) and water flow. Timber value of beetle-killed, dry trees drops to about 10 or 15 percent of green value. In conjunction with other state and private forestry agencies, I began developing approaches to good forest sanitation. This should keep the woods free of unnecessary large number of bugs.

•*Edmond C. Packee*

Site index

Site index is an indirect measure of forest productivity; it is the height a tree reaches at a particular age under forest conditions. A site index curve is a curvilinear line that represents the height of the site tree at various ages. Development of site index curves or equations requires stem analysis of trees selected from a variety of sites. We developed the first set of balsam poplar site index curves for Alaska during 1993. We counted and measured rings on sections removed from aspen and black spruce; 19 aspen sites (76 trees) for a total effort to date of 62 sites and 11 black spruce sites (44 trees) for a total effort to date of 26 sites.

•*Edmond C. Packee*

Nutrients and growth

We estimated the nutrient content and biomass of aboveground annual production, and nutrient content of total aboveground biomass of 14–year–old assemblages of plants developing on harvested white spruce sites. We then compared it to values previously measured in mature white spruce stands. The aboveground biomass of 14-year-old aspen clumps was three times higher than the aboveground production of mature white spruce stands while the aboveground production of other plant communities regenerating in the clearcuts was lower or equivalent. The nutrient content was greater in all regenerating communities except for those developing where harvesting operations had removed the forest floor. The amount of nutrient incorporated in current aboveground biomass was five times greater in aspen than in mature white spruce stands. These observations suggest that the development of aspen after clear-cutting contributes to the acceleration of nutrient cycling. The development of other herbaceous communities during the same period after clear-cutting was accompanied by much lower nutrient cycling rates in the aboveground vegetation.

•*David Pare and Keith Van Cleve*

Growth and yield of balsam poplar

We measured height, crown length, bark thickness and stem diameter of 267 balsam poplar, including the subspecies, western black cottonwood, from 66 locations. We removed cross-sections and measured annual growth rings and used the rings to model tree growth and volume for any age prior to felling. We used the height and age data to develop polymorphic site index equations: one for north of the Alaska Range and two for south of the range. We built equations to predict individual tree cubic-foot volumes to any minimum top-diameter and to predict diameter along the stem. We described and sampled the soil at 42 locations. Physical and chemical analyses on 280 soil samples suggest that solum thickness, dominant texture, sedimentation rates, and availability of groundwater are major factors controlling productivity. More than one-half of the locations had buried organic horizons.

•*John Shaw and Edmond C. Packee*

LTER progresses

The National Science Foundation sponsored Bonanza Creek (BNZ) Long-Term Ecological Research (LTER) program is developing an understanding of processes that control forest ecosystem development and how they change as forests develop in upland and floodplain landscapes encountered in Interior Alaska. Ecosystem growth occurs in decades and centuries. Therefore, research evaluates controls of forest growth and development on the same scales and deals with the within and among-year variations in environmental factors that may dramatically alter ecosystem development.

Remote sensing, using Synthetic Aperture Radar (SAR), proved useful in determining freeze-thaw events, leaf-out and leaf-fall time of forest vegetation as well as river flooding and ice jam locations. Using the LTER sites and adjacent upland locations for ground truth, we developed vegetation type and plant biomass maps from SAR images of the Tanana Valley State Forest. We analyzed the long-term record supplied by tree growth rings which provided us a window to past control of forest development important in understanding the present and future environment to forest growth.

Recent field measurements indicate that, on average, fine tree root production accounts for more than half the forest stand production and that coniferous

forests allocate more production to root systems than deciduous forests. Estimates range from 32 to 49 percent for deciduous and 57 to 78 percent for coniferous forests. The decay of fine roots appears slower than that reported for temperate latitude soils probably because of cooler temperatures in Interior soils.

Foliar phosphorus concentrations in white spruce, paper birch and balsam poplar were found to be nearly twice as high in forests developing on the floodplain of the Tanana River. Upland forest soils generally are slightly acidic while floodplain soils are neutral to alkaline and contain abundant sources of calcium. We interpret the difference in leaf phosphorus concentrations to reflect favorable pH for phosphorus availability in upland soils. Phosphorus availability in floodplain soils is controlled by the presence of calcium and insoluble calcium phosphates.

•Keith Van Cleve

Does fire regenerate forests?

Can Interior Alaska forests successfully maintain their current species diversity and overall ecosystem production without fire? A recent study at a burn area at the site of the 1983 Rosie Creek fire demonstrated one example of fire's importance to forest regeneration on soil fertility and early growth of planted white spruce seedlings. This study showed the positive effects of fire for site fertility and the potential benefits for forest regeneration. The results illustrate the importance of fire as a natural control in forest ecosystem development. Interior Alaska forests have developed in concert with disturbances such as fire. The challenge for foresters is to learn to use fire as a tool to produce these beneficial effects to sustain ecosystem productivity.

•Keith Van Cleve, Ted Dyrness and Leslie Viereck

Supporting nutrient growth

Soil, climate, topography, biota and time are the principal controlling factors in soil development and the structure, health, productivity, and evolution of forest ecosystems. Our research has shown the importance of soil in ecosystem processes depends largely on its organic carbon compounds. Soil organic carbon presents a continuum of chemical composition from forest floor and root detritus to highly processed humus and organo–mineral complexes. Under natural conditions, accumulation rates of organic carbon and soil development are controlled by climate and gradual changes in biota. Disturbance alters accumulation patterns. Organic carbon buffers disturbance from fire or forest harvesting and maintains element supply while the next generation of vegetation is established. It also buffers seasonal fluctuations in nutrient supply for plant growth. This research provides a fundamental understanding of soil as a source of water and nutrients supporting forest growth.

•Keith Van Cleve and Robert Powers

Managing forests, maximizing landscape

Sedimentation in streams caused by timber harvesting and associated road building can be a major forest management problem. Forest managers need a synoptic tool that allows them to monitor exposed soils from a landscape perspective so they can better plan timing and location of timber harvests and minimize the impact on the watershed. Aerial photography is not an efficient option since hundreds of photos may be needed for complete coverage. Digital satellite imagery may be a preferred alternative. A single satellite image covers thousands of hectares and may be more cost-effective. I compared three different satellite sensors for classifying exposed soil and non-soil areas: SPOT panchromatic data, SPOT multispectral data, and Landsat Thematic Mapper data. The mean overall classification accuracy for all three exceeded 85 percent. Omission errors of misclassifying reference exposed soil areas, derived from aerial photography, were consistently less than 5 percent. Because SPOT panchromatic data had the lowest spectral resolution, classification with these data had the highest commission errors of misclassifying bright non-soil areas incorrectly as exposed soil areas. All three digital processes were accurate enough to be applied in forest management planning.

•Dave Verbyla

Clearcutting deer habitat

Clearcutting may improve deer habitat in Southeast Alaska by creating habitat edges and increasing browse production. By using a computerized geographic information system (GIS), I analyzed habitat selection of 18 radio-collared Sitka black-tailed deer. Deer home ranges contained significantly higher percentages of recent clearcuts than the entire study area, and home ranges had significantly higher clearcut edge densities than randomly located polygons. Deer relocation points were also significantly closer to the nearest clearcut, old growth forest edge than randomly located points. However, as clearcut size increased beyond 100 hectares, deer relocation density and the proportion of clearcut occupied by deer home ranges decreased dramatically. Therefore, foresters managing for deer habitat should restrict clearcuts to small areas. Because old-growth forests are critical winter habitat during heavy snowfall years, managers should maximize old growth and clearcut edges by maintaining a matrix of old growth forests with a mosaic of small clearcuts harvested in long-term to maintain a suite of successional stages among clearcuts within any given area.

•Dave Verbyla

Alaska greening

The pattern of Interior Alaska greening, as seen from satellites imaging from outer space, may be useful in mapping the climatic zones of the Interior. There are

relatively few weather stations in this area, and most are located on river floodplains. Yet data from these weather stations can be used with weekly greening data acquired from satellites to map climatic zones. Such information is critical for predicting possible changes due to climate warming, for predicting and monitoring the spread of insect infestations, and for mapping climate within the uplands of the Interior.

•*Dave Verbyla*

Classifying accurately

The accuracy of any vegetation class map can be assessed using conventional statistical tests. However, the estimated accuracy can be biased depending upon how the ground-truth or reference data are acquired. Classification accuracy estimates will be conservative if the reference data and the classification are not perfectly spatially co-registered or if the reference data is interpreted using a minimum mapping unit that is large relative to the classified data. Optimistic estimates of classification accuracy are likely if reference data are restricted to training sample areas or if reference data are restricted to the center of polygons or the center of homogeneous areas. Because of the potential for bias in estimating the classification accuracy of a vegetation map, details such as map rectification root mean squared (RMS) error, reference data minimum mapping unit, and reference data sampling details should be included with any statement of map classification accuracy.

•*Dave Verbyla*

Forest stand structure on Kenai Lowlands

During 1993, we sampled seven stands, three plots per stand, of spruce beetle infested stands of "Lutz spruce,"—a natural hybrid between Sitka spruce and white spruce. The stands are located on the Kenai Lowlands, on the west side of the Kenai Peninsula. The current database includes 831 trees and seven soil profiles. Depending on the stand, 6 to 59 percent of the trees were dead with most mortality caused by the beetle. Stand ages ranged from 100 to 240 years. Trees per acre ranged from 300 to 480. Soils data confirm opportunities for summer harvesting.

•*Michelle Weston and Edmond C. Packee*

Studying spruce, alder interacting

White spruce is the most important timber species in the boreal forest of Alaska; green alder is that forest's primary nitrogen fixer. This study is examining the competitive and facilitative interactions of these two species and their effects on the soil over 20 years. After four growing seasons, the growth of the white spruce is significantly affected by plant density, but there is no effect of the alder on spruce growth or soil chemistry.

•*Tricia Wurtz*

Can domestic geese control weeds?

We completed a two-year study of the use of domestic geese for weed control, comparing the use of geese with a herbicide and with hand control. Geese controlled a variety of weed species and were most effective against quackgrass. However, grazing selected for unpalatable weed species, so that after two years plots weeded only by geese had 25 times more cover of unpalatable species than plots with no weed control. Domestic geese can not be relied upon as the sole method of weed control; they must be used in combination with other methods.

•*Tricia Wurtz and Michele Hebert*

Plant-growth model

We presented a model allocating plant growth between root and shoot compartments based on the uncoupled uptake of above- and below-ground nutrients. It is hypothesized that potential plant growth resulting from carbon uptake aboveground may not be balanced with potential growth resulting from belowground nutritional uptake. Additionally, only the maximum photosynthetic rate is a function of foliar nitrogen content. The nitrogen productivity concept is used to model plant growth with the ratio of nitrogen productivity to carbon gain being the determining factor for carbon allocation between above- and below-ground components. We compared the predicated patterns of growth and root and shoot development to laboratory data sets. The actual growth above and belowground was highly correlated with the theoretical predictions.

•*John Yarie and John Olson*

Sugar or sawdust?

We investigated changes in foliar chemistry resulting from changes in activity of the forest floor microbial community that is a function of moisture availability, microbial energy supply, nitrogen availability and landscape position (upland vs. floodplain). This study was designed as a portion of the test of the following hypotheses: first, microorganisms in the forest floor are limited by energy which becomes less available as succession advances; and second, resource availability through succession controls plant growth and the distribution of carbon and nutrients among above-ground, below-ground, and forest floor components.

Three nutrient amendment treatments, addition of sugar, sawdust and nitrogen fertilizer (NH_4NO_3), were applied to a series of seven successional (three upland and four floodplain) sites. We found foliar phosphorus concentrations higher in the upland sites than on the floodplain. No consistent differences were reported between successional stages within a landscape unit. Sugar or sawdust treatment decreased foliar nutrient concentrations although sugar produced more significant differences. However, significant increases were also found. Fertilizer tended to increase foliar nitrogen

concentrations. Changes in nutrient ratios (C:N and N:P) were tied to the change in the individual components of either ratio.

Sugar treatments decreased foliar nitrogen except for white spruce, while fertilizer tended to increase foliar nitrogen. In the second year following treatment there was not an increase in foliar nitrogen concentration. It is anticipated that the modeling work we do in the future should replicate the trends in foliar nitrogen concentration and show a clear connection between treatment application, dynamics of forest floor decomposition and foliar nutrient content.

•John Yarie and Keith Van Cleve

Predicting disturbances

We addressed the effect of microbial energy supply and low level nitrogen fertilization on microbial respiration, nitrogen mineralization and tree foliar chemistry through field manipulations and modeling analysis. Sugar, sawdust and nitrogen fertilizer were added to a series of upland and floodplain successional communities in Interior Alaska and we measured forest floor respiration and tree foliage chemistry the year prior to treatment and for two years following treatment. We used the ecosystem models LINKAGES and CENTURY to duplicate the short-term field measurements and to extend the predicted effects to a longer time period. Ecosystem structure and function simulated by both models were consistent with field measurements of upland hardwood and mature spruce control stands. Neither model accurately predicted the effects of large scale disturbance to the treated sites.

•John Yarie, William Pulliam, Keith Van Cleve and Bob Schlentner

LTER grows, future discussed

By: Dr. Keith Van Cleve
Professor of Forestry

The Bonanza Creek (BNZ) Long Term Ecological Research (LTER) program has developed a mechanistic understanding of site-level processes and how they change through forest succession in upland and floodplain landscapes that represent a portion of Interior Alaska. Recently we submitted a proposal to the National Science Foundation to augment this research. In the proposal we outlined a plan to regionalize our understanding of interactions among landscape components and to evaluate process dynamics across major components of the landscape that we have not dealt with at the core BNZ site. The augmented research would expand the basic ecosystem modeling to a geographic perspective. Expanded disciplinary scope through terrestrial-riparian, wetland, latitudinal and elevational treeline and disturbance due to insect herbivores will contribute to the fundamental understanding of ecosystem structure and function and to the regionalization efforts. Temporal analysis, through geomorphological, paleoecological, and modeling studies will add the time dimension and will provide us with a holistic understanding of the taiga and its response to altered climate.

The addition of Caribou Poker Creek Research Watershed (CPCRW) provides the BNZ LTER access to headwater streams (first through third order) and a mid-sized river (the Chatanika River, fifth order) as well as uplands nearing 2,789 feet (850 meter) elevation. A proposed satellite site near Nome Creek, approximately 15.5 miles (25 kilometers) north of CPCRW, adds study sites at elevational treeline and alpine tundra to 4,996 feet (1,500 meter) elevation. As well, we plan to begin a dialogue with resource economists to link the concept of ecological footprint and human carrying capacity to ecosystem research.

The proposed work includes process studies of the interface between terrestrial and aquatic ecosystems, vegetation dynamics at treeline locations, affects of disturbance due to large-scale insect outbreaks, development of a long-time scale site history with paleoecological studies, and work on ecosystem function in wetlands. Paleoecological research will initiate the development of an extended site history which will address floodplain dynamics, treeline migration, and long-term fire dynamics in Alaska. Extension of the work to a regional basis (taiga of Interior Alaska) will involve a magatransect from the BNZ LTER site to the Arctic LTER site at Toolik Lake, remote sensing, and mesoscale climate modeling.

Tom Malone, research technician, and SALRM/AFES advisory member, Michael Meehan, walk through part of the LTER area (AFES photo).

Resources Management

Resolving conflicts

Conflicts between the state and federal governments stifle resource management and lead to costly litigation. Research addressing the federal constitutional property clause, the state's public trust doctrine, the equal footing doctrine and the federal navigational servitude has led to the development of possible legal theory and standards which could consistently and predictably resolve conflicts in natural resources management.

•*Harry Bader*

Environmental impact on fisheries

The North Pacific contains some of the world's richest fisheries and climate change can affect their productivity. While some fish stocks may be adversely affected, others may benefit from the changes. This study is developing a framework for bioeconomic modeling of the impacts of environmental variation on North Pacific walleye pollack and Pacific whiting. The approach relies on the development of models that relate the dynamics of exploited populations to the physical environment, and relate the value of the fishery to the abundance and mix of species harvested.

•*Josh Greenberg*

Snow crab international outlook

The Alaska snow crab fishery has undergone unprecedented growth in recent years, becoming the most valuable in the United States. However, fishermen were concerned that continued growth in production would saturate world markets and lead to a collapse in prices. This study developed the first economic model of the international Alaska snow crab market. The results from the model suggest that these markets are healthy and should be able to support future industry growth.

•*Josh Greenberg*

Changes in the air and water

Alaska fisheries are poised for a revolutionary change in the way they are managed. Federal managers have approved a management system based on individual transferable quotas (ITQs) in the Alaska halibut and black cod fisheries. Plans are being developed for the Alaska ground and crab fisheries. ITQs are, in essence, private property rights to a share of harvest, which the owner is free to use or sell. Privatizing the fisheries will fundamentally change their character, with dramatic consequences to participants. This study examines the potential ramifications of ITQ management in Alaska crab fisheries—who will gain and who will loose. The analysis focuses on possible affects to the Alaska fleets, shore based communities, and state government revenues.

•*Josh Greenberg*

Outdoor recreation planning

The outdoor recreation management project analyzed agency recreation plans to determine if they were specific enough to direct long range planning. I looked to see if there were enough details so that any reasonable person could implement the intent of the plan. Preliminary analysis of the data suggest that, in general, there is enough specific information to create a standardized outcome. Where the plan wasn't adequately specific, the general prescriptions reflected the personality of the manager with no intent to avoid accountability during implementation. I have developed preliminary questionnaires that will be used in wilderness recreation management and have sent them out for review.

•*Alan Jubenville*

Alaska's agricultural industry

An overview of agricultural activities in selected areas of the circumpolar north provides background for a circumpolar development model in the post-industrial period. Focus is on Alaska, the Southeastern Canadian Clay Belts, the Yukon Territory, Southwestern Canada and Eastern Siberia. Agriculture in these areas is or has been peripheral to an industrialized core. Peripheral, frontier agriculture begins in disconnected nodes (Stage I: subsistence) which expand (Stage II: commercial/local); interconnect (Stage III: regional product movement); and finally begin regional and international trade (Stage IV: regional/international agricul-

Dr. Josh and Andrea Greenberg prepare a picnic during the NRM 295 outing (Photo by Dr. Charlie Knight).

ture). Typically, peripheral agricultural development is not supported by core governments. None of these areas has moved beyond Stage III. The Yukon Territory is the least developed, remaining in Stage II.

•Carol Lewis and Roger Pearson

Alaska agricultural tours

Detailed studies of five agricultural regions in Alaska provide profiles of agriculture's beginning as early as 1903 and as late as 1983. We have currently completed two regions, both near urban Fairbanks. Booklets provide the motoring tourist and interested residents with an opportunity to view these agricultural areas using a detailed milepost. Local establishments are highlighted and a brief history of the area is provided. We are now documenting the three remaining regions located in Interior and Southcentral Alaska.

•Carol Lewis and Roger Pearson

Direct markets

After we examined the characteristics of farmers' markets and roadside stands we made recommendations to participants in direct markets for enhancing their marketing program. We also produced a "Meet You at the Market" brochure that highlights the Tanana Valley Farmers Market and the Alaska Grown program. Residents and tourists can obtain information on when to buy Alaska grown fruits and vegetables from a special publication in a placemat format. There is a detailed table showing what to look for when purchasing fruits and vegetables, how to store them, and the length of time they can be stored to insure top flavor and quality.

•Carol Lewis and Ruthann Swanson

Russian-American exchange

Activities in joint research and student exchange are continuing under the five-year exchange program between the Agricultural and Forestry Experiment Station (AFES) and the Russian Academy of Agricultural Science, Siberian Branch (RAAS/SB). One student from RAAS/SB and the State University of the Russian Academy of Sciences in Novosibirsk is pursuing doctorate work in resource economics within the School of Agriculture and Land Resources Management. His research considers salmon return and escapement in the Yukon River drainage. An undergraduate student from the State University at Ulmsk and a graduate student from the State University of the Russian Academy of Sciences in Novosibirsk studied here during the 1993-1994 academic year.

•Carol Lewis

Rural economic model

A regional economic model of rural Alaska communities focuses on the linkage of the cash and non-cash sectors. A critical component of the model is the time spent in pursuit of subsistence activities. This information will be used in developing production functions formulation using household production theory. We have formulated questions to ask village residents to obtain the appropriate information. We know that the concept of time for indigenous people is not necessarily that of western cultures. We are also aware that village residents are not receptive to "being studied" if they don't have input and access to research results. Consequently, we are developing economic models with villages and Native organizations and will provide results in a format that is useful and usable. In conjunction with our data-gathering efforts, an educational program for high schools is being developed. The objective is to incorporate indigenous peoples' traditional knowledge and management practices into western economic theory. The work of 1st Nations Development Institute, an indigenous peoples' advocacy group, is providing the background for this work.

•Josh Greenberg, Carol Lewis and Hans Geier

Rob Leach, NRM graduate student, shows students how to make and maintain a compost pile during a composting class he led for the Georgeson Botanical Garden (Photo by Keith Swarner).

Agricultural products' quality

Research and service are combined with instruction in the classroom providing an experiential learning experience for students in NRM 310: Agricultural Concepts. Students participate in a sensory panel and use real-world research data to develop a marketing strategy and a logo for Alaska agricultural products. The results of the panel studies are published, when appropriate, in peer-reviewed journals bringing research results to appropriate professional clientele. Producers are involved with the research, present their business program and their products in a class lecture, and receive a user-oriented contract report and copies of the students' marketing strategies and logos. To date, we have studied honey, carrots, barley pancake mix, and salsa. Student logos and marketing strategies have been used by the producers.

•Ruthann Swanson, Carol Lewis and Josh Greenberg

Publications

January 1993—December 1993

Journal Articles

Title	Authors	Where Published
Classification and regression tree analysis for assessing hazard of pine mortality caused by heterobasion annosum	F.A. Baker, D.L. Verbyla, C.S. Hodges, Jr., E.W. Ross	*Plant Disease.* 77:136-139
The Alaska salmon enhancement program: a cost/benefit analysis	J. Boyce, M. Herrmann, D. Bischak, J.A. Greenberg	*Marine Resource Economics.* 8:293-312
Fertilizer placement and crop row spacing to maximize small grain yields and reduce weed interference	V.L. Cochran, J.S. Conn, B.S. Sharratt	*Soil Sci. (Trends in Agric. Sci.)* 1:1-7
Fertilizer placement for conventional and no-tillage barley in the subarctic	V.L. Cochran, S.F. Schlentner	*Soil Sci. Soc. Am.* 56:1973-1978
Computer based data management system for commercial reindeer and game farm production	D.S.Blodgett, A.W. Clark, L.A. Renecker, R.A. Dieterich, W.N. Thompson	*Rangifer.* 13:121-126
Growth and development of uniculm and conventional-tillering barley lines	S.M. Dofing, M.G. Karlsson	*Agron. J.* 85:58-61
Malting quality of uniculm and conventional-tillering near-isogenic barley lines	S.M. Dofing	*Cereal Research Communications* 22:33-35
Control of surface soil chemistry in early-successional floodplain soils along the Tanana River, Interior Alaska	C.T. Dyrness, K. Van Cleve	*Can. J. For. Res.* 23:979-944
Nitrogen fertilization of irrigated russet potatoes in Southcentral Alaska	R.G. Gavlak, W.L. Campbell, J.L. Walworth, C.L. Johnson, J.E. Muniz, T.A. Tindall	*Am. Potato J.* 70:571-578
Use of soil transfer for reforestation on abandoned mined lands in Alaska. I. Effects of soil transfer and phosphorus on growth and mycorrhizal formation by Populus balsamifera	D.J. Helm, D.E. Carling	*Mycorrhiza.* 3:97-106
Use of soil transfer for reforestation on abandoned mined lands in Alaska. II. Effects of soil transfers from different successional stages on growth and mycorrhizal formation by *Populus balsamifera* and *Alnus crispa*	D.J. Helm, D.E. Carling	*Mycorrhiza.* 3:107-114
Mulches for landscape plantings in Interior Alaska	P.S. Holloway	*Am. Nurseryman.* 178:8:107-112

Title	Authors	Where Published
Denitrification and nitrogen fixation in floodplain successional soils along the Tanana River, Interior Alaska	K.M. Klingensmith, K. Van Cleve	*Can. J. For. Res.* 23:956-963
Patterns of nitrogen mineralization and nitrification in floodplain successional soils of Interior Alaska	K.M. Klingensmith, K. Van Cleve	*Can. J. For. Res.* 23:964-969
Urea nitrogen budget for a subarctic agricultural soil	C.W. Knight, S.D. Sparrow	*Soil Science Society Am. J.* 57:1138-1144
Decomposition and N mineralization from legume and nonlegume crop residues in subarctic soil	R.T. Koenig, V.L. Cochran	*Biol. Fert. Soil.* 17:269-275
Characterization of Rhizoctonia solani AG-8 from bare patches by pectic isozyme (*zymogram*) and anastomosis technique	G.C. MacNish, D.E. Carling, K.A. Brainard	*Phytopathology.* 83:922-927
Calcium carbonate precipitation-dissolution along a plant primary successional sequence on the Tanana River floodplain of Interior Alaska	G.M. Marion, K. Van Cleve, C.T. Dyrness	*Can. J. For. Res.* 23:923-927
The soil chemical environment along a forest primary successional sequence on the Tanana River floodplain, Interior Alaska	G.M. Marion, K. Van Cleve, C.T. Dyrness, C.H. Black	*Can. J. For. Res.* 23:914-922
Agricultural and economic reform in Russia agribusiness	Y.A. Novoselov, A.Y. Streletsky, C.E. Lewis, J.A. Greenberg	*Agribusiness: An International J.* 9:6:623-630
Aboveground biomass production and nutrient accumulation on postharvested white spruce sites in Interior Alaska	D. Pare, K. Van Cleve	*Can. J. For. Res.* 23:1233-1239
Soil nutrient availability and relationships with aboveground biomass production on postharvested upland white spruce sites in Interior Alaska	D. Pare, K. Van Cleve	*Can. J. For. Res.* 23:1223-1232
Record-keeping, management decisions, and productivity of extensive reindeer herding on the Seward Peninsula, Alaska	L.A. Renecker, C.L. Chetkiewicz	*Rangifer.* 13:5-13
Occurrence of Rhizoctonia solani (*Thanatephorus cucumeris*) AG-7 in Arkansas	C.S. Rothrock, S.A. Winter, P.M. Kinney, D.E. Carling	*Plant Disease.* 77:1262
Skip row and equidistant-row planting with nitrogen placement in barley: yield, nitrogen uptake and root density	B.S. Sharratt, V.L. Cochran	*Agron. J.* 85:246-250
Herbage yield and nitrogen accumulation by seven legume crops on acid and neutral soils in a subarctic environment	S.D. Sparrow, V.L. Cochran, E.B. Sparrow	*Can J. Plant Sci.* 73:1037-1045
Phosphorus and nitrogen dynamics during field incubations in forest and fallow subarctic soils	E.B. Sparrow, S.D. Sparrow, V.L. Cochran	*Biol. Fert. Soils.* 16:243-248
Characterization of populations of Rhizoctonia solani AG-3 from potato and tobacco	J. Stevens-Johnk, R.K. Jones, H.D. Shew, D.E. Carling	*Phytopathology.* 83:844-858
Alaskan direct-market consumers: perception of organic produce	R.B. Swanson, C.E. Lewis	*Home Economics Research J.* 22:2:138-155

Title	Authors	Where Published
Premium honeys: response of sensory panelists	R.B. Swanson , C.E. Lewis	*Food quality and preference* 3:215-221
Conclusions on the role of salt-affected soils in primary succession on the Tanana River floodplain, Interior Alaska	K. Van Cleve, J. Yarie, L.A. Viereck, C.T. Dyrness	*Can. J. For. Res.* 23:1015-1018
Control of soil development on the Tanana River floodplain, Interior Alaska	K. Van Cleve, C.T. Dyrness, G.M. Marion, R. Erickson	*Can. J. For. Res.* 23:941-955
Introduction and overview of a study dealing with the role of salt-affected soils in primary succession on the Tanana River floodplain, Interior Alaska	K. Van Cleve, L.A. Viereck, G.M. Marion	*Can. J. For. Res.* 23:879-888
Nitrogen mineralization and nitrification in successional ecosystems on the Tanana River floodplain, Interior Alaska	K. Van Cleve, J. Yarie, R. Erickson, C.T. Dyrness	*Can. J. For. Res.* 23:970-978
Climate of the Tanana River floodplain near Fairbanks, Alaska	L.A. Viereck, K. Van Cleve, P.C. Adams, R.E. Schlentner	*Can. J. For. Res.* 23:899-913
A compendium of tissue nutrient concentrations for field-grown potatoes	J.L. Walworth, J.E. Muniz	*Am. Potato J.* 70:579-597
Effects of forest management on environmental parameters related to successional development along the Tanana River, Interior Alaska	J. Yarie	*Can. J. For. Res.* 23:928-940
Soil solution chemistry in relation to forest succession on the Tanana River Floodplain of Interior Alaska	J. Yarie, K. Van Cleve, C. T. Dyrness, L. Oliver, J. Levison, R. Erickson	*Can. J. For. Res.* 23:928-940

Book or Chapters in Book

Book or Chapter Title	Authors	Book Title, Authors, & Publishers
Problem solving and decision making in the context of administrative law	H.R. Bader	*Outdoor Recreation Management*, A.J. Jubenville & B. Twight
Causes of reindeer calf mortality on the Seward Peninsula, Alaska	C. Chetkiewicz, L.A. Renecker	*Wildlife ranching: a celebration of diversity.* Pretoria, Republic of South Africa
Radio-collaring neonate reindeer in Alaska	C.L. Chetkiewicz, L.A. Renecker, G.L. Finstad	*Wildlife ranching: a celebration of diversity.* Pretoria, Republic of South Africa
Residue effects on soil micro- and macro-organisms	V.L. Cochran, S.D. Sparrow, E.B. Sparrow	*Managing agricultural residues.* P.W. Unger (ed.). Lewis Publishers. Boca Raton, FL.
Productivity and management of reindeer populations (Rangifer tarandus), Seward Peninsula, Alaska	Mcintyre, H.C.H., L.A. Renecker, M. Sousa	*Wildlife ranching: a celebration of diversity.* Pretoria, Republic of South Africa
Outdoor recreation management: theory and application (3rd ed.)	A.J. Jubenville, B. Twight	Venture Publishing, Inc.
Fractionation, characterization and comparison of bulk soil organic substances and water soluble soil interstitial constituents in selected Cryosols of Alaska	R.L. Malcolm, K. Kennedy, C.L. Ping, G.J. Michaelson	*Advances in soil science*, B.A. Steward (ed.). Lewis Publishers, Chelsea, MI

Book or Chapter Title	Authors	Book Title, Authors, & Publishers
The prominence of Japan in the Alaska king crab fishery	S.C. Matulich, J.A. Greenberg, R.C. Mittelhammer	*Understanding the Japanese food and agrimarket: a multifaceted opportunity*
Fractionation and carbon balance of soil organic matter in selected Cryosols	C.L Ping, G.J. Michaelson, R.L. Malcolm	*Advances in Soil Science*, B.A. Steward (ed.). Lewis Publishers, Chelsea, MI
The wildlife ranching symposium: history, structure, achievements, goals and implications for wildlife management	L.A. Renecker, R. Valdez	*Wildlife ranching: a celebration of diversity.* Pretoria, Republic of South Africa

*AFES Bulletins

Title	Authors	AFES Publication No.
Fescue grasses differ greatly in adaptation, winterhardiness, and therefore usefulness in Southcentral Alaska	L.J. Klebesadel	Bul. 92
Bromegrass in Alaska II. Autumn food-reserves storage, freeze tolerance, and dry matter concentration in overwintering tissues as related to winter survival of latitudinal ecotypes	L.J. Klebesadel	Bul. 93
Winter survival of grasses and legumes in subarctic Alaska as related to winter survival of latitudinal ecotypes	L.J. Klebesadel	Bul. 94
Effects of daily photoperiod/nyctoperiod and temperature on autumn development of crown buds, freeze tolerance, and storage of food reserves in latitudinal ecotypes of biennial white sweetclover	L.J. Klebesadel	Bul. 95
Bromegrass in Alaska. III. Effects of planting dates, and time of seeding-year forage yields and quality, winter survival, and second-year spring forage yield	L.J. Klebesadel	Bul. 96
Winterhardiness and agronomic performance of wildryes (*Elmus species*) compared with other grasses in Alaska, and responses of Siberian wildrye to management practices	L.J. Klebesadel	Bul. 97

*AFES Circulars

Title	Authors	AFES Publication No.
Potato variety performance, Alaska 1992	D.E. Carling, P.C. Kroenung	Cir. 95
Management and medical aspects of reindeer farming: examining the basics	R.A. Dieterich	Cir. 96
Design for a portable reindeer crush	G. Finstad, L. Renecker	Cir. 94
Annual and perennial landscape plant evaluations 1992	P.J. Wagner, P.S. Holloway, G.E.M. Matheke, S. Berry	Cir. 93

*AFES Miscellaneous Publications

Title	Authors	AFES Publication No.
Meet you at the market	Staff	Misc. Pub. 93-2
Fairbanks Research Center		Misc. Pub. 93-3

Title	Authors	AFES Publication No.
Delta Junction Field Research Site		Misc. Pub. 93-4
Palmer Research Center		Misc. Pub. 93-5
Alaska agricultural tours: Eielson Agricultural Project	C.E. Lewis, R.W. Pearson	Misc. Pub. 93-6

Research Progress Reports

Title	Authors	Report to:
Row spacing by cultivar effect on storage cabbage yield and quality	R.G. Gavlak, J.L. Walworth	Tennessee Valley Authority
Wet soil monitoring project	C.L. Ping	USDA-Soil Conservation Service National Soil Survey Center
Soil fertility for head lettuce:nitrogen and phosphorus	J.L. Walworth, R.G. Gavlak	Tennessee Valley Authority

Proceedings

Title	Authors	Published In:
Computer generation of breeding beef and feedlot cattle nutrient requirements	L.B. Bruce, M.T. Panciera	5th International Conference on Computers in Agriculture, Orlando, FL. pp. 145-149
Summary and resolutions: joint Russian-American seminar on cryopedology and global change	D. Gilichinsky, C.L. Ping	Post-seminar Proceedings, Joint Russian-American Seminar on Cryopedology and Global Change. Moscow, Russia. pp. 6–8
Determination of the amount of carbon in highly cryoturbated soils	J.M. Kimble, C. Tarnocai, C.L. Ping, R. Ahrens, C.A.S. Smith, J.P. Moore, W. Lynn	Post-seminar Proceedings, Joint Russian-American Seminar on Cryopedology and Global Change. Moscow, Russia. pp. 277–291
The use of zymogram and anastomosis techniques to determine relationships between isolates of R. solani AG-8	G.C. MacNish, D.E. Carling	Australasian Society of Plant Pathology. Hobart, Tasmania. p. 15
Comparison of Russian, U.S., and Canadian classification of selected tundra and taiga soils in NE Russia	G.G. Mazhitova, C.L. Ping, S.V. Gubin, J.P. Moore, C.A.S. Smith	Post-seminar Proceedings, Joint Russian-American Seminar on Cryopedology and Global Change. Moscow, Russia. pp. 29-38
Warm permafrost soils in Interior Alaska	J.P. Moore, D.K. Swanson, C.L. Ping	Post-seminar Proceedings, Joint Russian-American Seminar on Cryopedology and Global Change. Moscow, Russia. pp. 104–111
Seasonal changes in forage quality of red and alsike clovers in Southcentral Alaska	M.T. Panciera, B.A. Tillman	American Forage and Grassland Council. Lancaster, PA. V. 3 pp. 224–228
Redoximorphic features in permafrost soils	C.L. Ping, W.C. Lynn, C.A.S. Smith	Post-seminar Proceedings, Joint Russian-American Seminar on Cryopedology and Global Change. Moscow, Russia. pp. 233-244
Soil classification and climatic zones of Alaska	C.L. Ping, J.P. Moore	6th International Conference on Permafrost. Beijing, China. V. 1 pp. 517–522
Maintaining genetic integrity in the industry's elk herds	L.A. Renecker	Rocky Mountain Elk Foundation Wildlife Professionals Symp. Reno, Nevada. pp. 18–35

Title	Authors	Published In:
Overview of the western domesticated elk farming industry	L.A. Renecker	Rocky Mountain Elk Foundation Wildlife Professionals Symp. Reno, Nevada. pp. 102–105
University of Alaska research: production of a commercially-viable Alaskan wildflower mix	O. Rutledge, P.S. Holloway	12th Alaska Greenhouse and Nursery Conference. Soldotna, AK. pp. 58-70
Overview of wildlife farming and ranching in North America	J.G. Teer, L.A. Renecker, R. J. Hudson	Trans. 58th North American Wildlife & Natural Resources Conference. pp. 448–459
Evaluation of SPOT panchromatic digital imagery for updating road locations	D.L. Verbyla, R. Jazouli, D. L. Murphy	ASPRS/ASCM Annual Convention V. 2 pp. 408-414

Contract Reports

Title	Authors	Contracting Agency
Revegetation on Two Bull Ridge, progress report 1991–1992	D.J. Helm	Usibelli Coal Mine
An international marketing model for Alaskan salmon	M. Herrmann, J.A. Greenberg	Alaska Senate Special Committee on Domestic and International Commercial Fisheries
1993 observations of 1991 revegetation sites, eastern operating area—Prudhoe Bay, Alaska	J.D McKendrick, P.D.J. Smith, B. Elder, R. Hoffman, B. Gerkin, B.F. Collver, S. Jones, C. Brown	ARCO Alaska, Inc.
1993 progress report Surfcote landfill site revegetation project—Prudhoe Bay, Alaska	J.D. McKendrick, P.D.J. Smith, B. Elder, R. Hoffman, B. Gerkin, B.F. Collver, S. Jones, C. Brown	ARCO Alaska, Inc.
Gravel vegetation project quarterly report for October, November, and December 1992	J.D. McKendrick	BP Exploration (Alaska), Inc.
Gravel vegetation project quarterly report for January, February, and March 1993	J.D. McKendrick	BP Exploration (Alaska), Inc.
Gravel vegetation project quarterly report for April, May, and June 1993	J.D. McKendrick	BP Exploration (Alaska), Inc.
Gravel vegetation project quarterly report for July, August, and September 1993	J.D. McKendrick	BP Exploration (Alaska), Inc.
Interim data report on sampling at Seabee Test Wellsite No. 1 and Umiat Test Wellsite No. 5 the National Petroleum Reserve in Alaska	J.D. McKendrick, G.L. Turner, P.C. Scorup, W.E. Fiscus	BP Exploration (Alaska), Inc.
Investigation of revegetation problems X-Pad flare pit western operating unit—Prudhoe Bay Oil Field	J.D. McKendrick, P.D.J. Smith	BP Exploration (Alaska), Inc.
Transplanting Arctophila fulva to create emergent vegetation habitats in Arctic Alaska. North Slope habitat series Arctophila fulva	J.D. McKendrick	BP Exploration (Alaska), Inc.
Reindeer farming in Alaska: management and production	L.A . Renecker	US Fish & Wildlife Service

Title	Authors	Contracting Agency
Techniques to reduce death loss in relocated reindeer	L.A. Renecker	Final report for ASTF Project No. 90-2-122
Surface disturbance revegetation/ rehabilitation plan M/V	P.D.J. Smith, J.D. McKendrick	DHI Consulting Engineers

Thesis and Student Professional Papers

Title	Authors
More in our image: settlement structure in Interior Alaskan Athabascan village	E.D. Barker
Effects of cold tolerant tri chidermo on *pythium* spp	C. Chin
Reindeer calf survival and productivity on the Seward Peninsula, Alaska	C. Chetkiewicz
Managing natural resources in Alaska: a curriculum for rural Alaskan upper elementary and middle grade classrooms	R.K. Childers
Scenic viewpoints along Alaska Highway: a study of management and use	M. Karraker
Use of touch screen for interpretive programming	L.F. McBride
Alaska wolves 1981–1991: some political and philosophical sources of conflict	K. Richardson

AFES Newsletters, Notes, & Magazines

Title	Publishing Frequency	Subscription Information
Agroborealis	semiannually	*Agroborealis*, University of Alaska Fairbanks, PO Box 757200, Fairbanks, AK 99775-7200
Georgeson Botanical Garden Review	quarterly	Georgeson Botanical Garden, University of Alaska Fairbanks, PO Box 757200, Fairbanks, AK 99775-7200
Georgeson Botanical Garden Notes	as needed	Georgeson Botanical Garden, University of Alska Fairbanks, PO Box 757200, Fairbanks, AK 99775-7200
Reindeer Report	as needed	Reindeer Research Program, University of Alaska Fairbanks, PO Box 757200, Fairbanks, AK 99775-7200

Miscellaneous Publications

Title	Authors	Where Published
"Beginning again" by David Ehrenfeld: a review	J. D. Fox, Jr.	*J. For.* 91:9:41
Handbook: Senior thesis in natural resources management	P.S. Holloway	
Rhizoctonia disease of potato	R. Loria, R.H. Leiner, D.E. Carling	CES, Cornell University, No. 726

Title	Authors	Where Published
International correlation meeting on permafrost-affected soils: guide book—Alaska portion	J.P. Moore, D.K. Swanson, C.A. Fox, C.L. Ping	USDA-Soil Conservation Service, Lincoln, NE
Supplemental data to international correlation meeting on permafrost-affected soils: guide book—Alaska portion	Y.L. Shur, G.J. Michaelson, C.L. Ping	USDA-Soil Conservation Service, Lincoln, NE
Landsat mid-Infrared data and GIS in regional surface soil-moisture assessment	D.L. Verbyla	Water Resources. Bul. 29:309-311

Abstracts

Title	Authors	Where Published
Gelisols: a new proposed order for permafrost-affected soils	J.P. Bockheim, C.L. Ping, J.P. Moore, J.M. Kimble	*Agron. Abstr.* p. 294
Habitat use by caribou and migratory geese in Sagavanirktok River Delta, North Slope, Alaska	L.B. Bruce, M.T. Panciera	Society for Range Management Meetings. No. 171
Use of the category 3 anastomosis reaction to detect clonal relationships among isolates of Rhizoctonia solani AG-8	D.E. Carling, G.C. MacNish, K.A. Brainard	6th International Congress of Plant Pathology. Montreal Canada. p.132
Morphology and hydrology of five seasonally set soils in Southcentral Alaska	M.H. Clark, C.L. Ping	*Agron. Abstr.* p. 347
Effect of cropping sequence, green manure, and N fertilizer on nitrous oxide and methane flux	V.L. Cochran, S.F. Schlentner, S.D. Sparrow	*Agron. Abstr.* p. 244
Effects of tillage on vertical distribution and persistence of metribuzin and linuron and cabbage and lettuce survival and yield in Alaska	J. S. Conn, R.E. Deck, J. S. Cameron	Weed Sci. Soc. Am. Abstr. p. 89
Leaching potential of metribuzin under irrigated and dryland conditions in Alaska	J.S. Conn, N.R. Werdin, W.A. Koskinen, J.S. Graham, R.E. Deck	Weed Sci. Soc. Am. Abstr. p. 78
Reclamation, succession, and mycorrhizae in Alaska	D.J. Helm	2nd EPA Placer Mine Reclamation Workshop. No. 3
Spore viability and germination of endangered Aleutian shield-fern, *Polystichum aleuticum*	P.S. Holloway, D. J. Boyd	*HortScience*. 28:7:645
Utilization of salmon marine by-products in early-weaned pig diets	F.M. Husby, W.I. Hugh, R.L. Harrold	*J. Anim. Sci.* (Suppl. 1):169 (Abstr.)
Age structure and growth history of a boreal white spruce forest	G.P. Juday	1993 All Scientists Meeting, Long Term Ecological Research network. Estes Park, Colorado Posted on internet
Natural diversity management and the life cycle of an Alaskan boreal white spruce ecosystem: insights from Bonanza Creek LTER	G.P. Juday	20th Natural Areas Conference. University of Maine, Orono. p. 29
Pattern of forest succession following drastic ice retreat at Columbia Glacier and Glacier Bay	G.P. Juday	3rd Glacier Bay Science Symposium. Glacier Bay National Park, Alaska. p. 97

Title	Authors	Where Published
Fate of symetric and asymetric triazines in silt loam soils	W.A. Koskinen, J.S. Conn, B.A. Sorenson	Abstr. Intern. Environ. Anal. Chem. p. 17
Relationship between zymogram and anastomosis groups	G.C. MacNish, D.E. Carling, K.A. Brainard	6th International Congress of Plant Pathology. Montreal Canada. p. 130
Spread of clones of Rhizoctonia solani AG-8 in Australia	G.C. MacNish, D.E. Carling, K.A. Brainard	6th International Congress of Plant Pathology. Montreal Canada. p. 137
Fractionation of dissolved organic carbon in soil interstitial water of a cryogenic soil in Alaska	G.J. Michaelson, C.L. Ping, R.L. Malcolm	*Agron. Abstr.* p. 231-232
The soil data layer in arctic ecological studies	J.P. Moore, C.L. Ping	44th Arctic Science Conference Program and Proceedings. p. 31
Computer-aided evaluation of forage management: forage manager	M.T. Panciera, L.B. Bruce, R.G. Gavlak	*J. of Natural Resources and Life Sciences Education.* 22:163
Seasonal nutrient composition of sedges on the Sagavanirktok River Delta, North Slope.	M.T. Panciera, L.B. Bruce	Society of Range Management International Meetings. No. 196
Soil characteristics of the upper Edoma Formation, NE Russia	C.L. Ping, S. Gubin, G.G. Mazhitova, Y.L. Shur	23rd Annual Arctic Workshop Program and Abstracts. p. 63
Isolation of Rhizoctonia solani (*Thanatephorus cucumeris*) AG-7 from soil in Arkansas	C.S. Rothrock, S.A. Winter, P.M. Kinney, D.E. Carling	6th International Congress of Plant Pathology. Montreal Canada. p. 152
Possible new anastomosis group of Rhizoctonia solani (*Thanatephorus cucumeris*)	C.S. Rothrock, D.E. Carling, S.A. Winter, P.M. Kinney, K.A. Brainard	*Phytopathology.* 83:844-858
The natural analog method and prediction of global warming impact on the arctic ecosystems	Y.L. Shur, C.L. Ping, R.A. Kreig, E.S. Melnikov	44th Arctic Science Conference Program and Proceedings. Whitehorse, YT, Canada. p. 31
Effect of soil management and depth on methane consumption in subarctic agricultural soils	E.B. Sparrow, V.L. Cochran	*Agron. Abstr.* p. 260
Preliminary results of reindeer mortality on Hagemeister Island, Alaska during the winter 1991–1992	R. Stimmelmayr, L.A. Renecker	Proc. of Am. Assoc. of Zoological Veterinarians, Louis, MO. p. 422
Reindeer production in Alaska: tradition versus meat quality and product development	T.A Tomany, L.A. Renecker	5th World Wilderness Conference. Tromso, Norway. p. 1
Processing effects on digestibility of sled dog diets containing hulless barley	K. Ulz, F.M. Husby	*J. Anim. Sci.* Sci. 71 (Suppl. 1):164 (Abstr.)
Evaluation of fish bone meals as fertilizers	J.L. Walworth, R.G. Gavlak, D.E. Carling	*Agron. Abstr.* p. 291
Leaching potential of metribuzin and its metabolites in subarctic soils under irrigated potato production	N. R. Werdin, J. S. Conn, W.A. Koskinen	*J. Minn. Acad. Sci.* 57:41

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'93 research funding

Grants and Special Funds; July 1, 1992 – June 30, 1993

National Science Foundation	
Dot Helm	Patch Formation, Mycorrhizal Colonization During Succession on Glacial Till
Keith Van Cleve	LTER: Successional Processes in Taiga Forests of Interior Alaska
Chien-Lu Ping	Effects of Global Warming on Carbon Cycling in Arctic Soils
United States Department of Agriculture	
James Drew	Morrill-Nelson Funds for Food and Agricultural Higher Education
Keith Van Cleve	Long-Term Monitoring, Bonanza Creek Experimental Forest LTER Sites
Donald Carling	Evaluation of Metam Sodium for Weed Control in Alaska Vegetable Production
Jenifer McBeath	Cooperative Agriculture Pest Survey
Chien-Lu Ping	Wet Soils Monitoring Studies in Alaska; *(SCS funding also)*
Verlan Cochran	Research Support Agreement
John Yarie	Carbon Balance of the Alaska Boreal Forest
Carol Lewis	An Inclusive Regional Economic Model for Rural Alaska
Stephen Doling	Agronomic Value of Two Genes Conferring Limited Tillering in Barley
Tricia Wurtz	Spruce and Alder Interactions
Alaska Department of Natural Resources	
G. Allen Mitchell	FY93 Ag Development and Statistical Reporting
Anthony Gasbarro	Forest Reforestation Program—GIS Student
G. Allen Mitchell	Pesticide Storage Facility Cooperative Agreement
Anthony Gasbarro	Forest Research Program FY93
Alaska Department of Administration	
G. Allen Mitchell	Senior Community Service Employment Program
Alaska Science and Technology Foundation	
Charles Knight	Development of Rotational Crops and Markets
Stephen Sparrow	Use of N-Fixing Plants to Improve Forage Quality of Delta Bison Range
Stephen Doling	Use of Alaska-Grown Canola in Dairy Cattle Diets
Patricia Holloway	Evaluation of Wildflower Seed Mixes for Interior Alaska
Usibelli Coal Mine, Inc.	
Dot Helm	Usibelli Vegetation Studies
Dot Helm	Revegetation Studies on Two Bull Ridge
National Park Service	
Dot Helm	Vegetation Succession Near Exit Glacier
Lyle Renecker	Automation of Resource Data on the Seward Peninsula *(BLM and SCS funding also)*
BP Exploration (Alaska), Inc.	
Jay McKendrick	Gravel Vegetation Studies
Jay McKendrick	Arctophila Revegetation
Fred C. Gloeckner Foundation, Inc.	
Meriam Karlsson	Controlling Flower Formation in *Primula vulgaris* by Environmental Factors
Idemitsu Alaska, Inc.	
Dot Helm	Continuation of Moose Browse and Grass Revegetation Studies

Alaska Department of Fish and Game	
Joshua Greenberg	Economic Impacts of Alternative Pot Limits in King and Tanner Crab Fisheries
U. S. Army Corps of Engineers	
James Levison	Chena River Lakes Flood Control Project
U. S. Fish & Wildlife Service	
Chien-Lu Ping	Coastal Habitat Classification of Izembek National Wildlife Refuge
Lyle Renecker	Seasonal Change in Body Condition, Occupational Lifestyle of Reindeer on Hagemeister Island
Federal Aviation Administration	
Carol Lewis	Aviation Career Education Academy 1992
University of Alaska Natural Resources Fund	
Stephen Dofing	Continuation of a Program in Plant Breeding and Genetics
U. S. Environmental Protection Agency	
James Walworth	Evaluation of Alternative Nutrient Sources as a Pollution Prevention Strategy
Tricia Wurtz	Domestic Geese to Control Weeds for Agricultural and Forestry Applications in AK
Department of Environmental Conservation	
Dot Helm	Abandoned Placer Mined Land Reclamation
University of Alaska Foundation	
Patricia Holloway	Georgeson Botanical Garden
Fairbanks Private Industry Council	
Patricia Holloway	Job Training Partnership Act
Bedding Plants Foundation, Inc.	
Meriam Karlsson	Supplemental Irradiance During Primula Seedling Development

Formula Funds; July 1, 1992 – June 30, 1993

Hatch General; USDA	
Donald Carling	Potato Variety Comparisons and Evaluations of Rhizoctonia Disease on Potato
Leroy Bruce	Management of Alaska Beef Cattle to Maximize Forage Use
Ruthann Swanson	Quality Assessment of Alaskan Reindeer
Michael Panciera	Maximizing Forage Quality at Northern Latitudes
Patricia Holloway	Propagation and Cultivation of Alaska Native Plants
Meriam Karlsson	Effects of Irradiance and Temperature of Growth and Development of Greenhouse Produced Plants
Jay McKendrick	Vegetating Man-made Gravel Structures within Arctic Wetland Plant Communities
Chien-Lu Ping	Classification and Interpretation of Permafrost Soils in Alaska
James Walworth	Improving Soil Fertility for Potatoes and Lettuce in Alaska
Stephen Sparrow	Nitrogen Fixation, Herbage Yield and Persistence of Perennial Legumes in Interior Alaska
Carol Lewis	Alaska's Agricultural Industry: A Microsystem of the Circumpolar North
G. Allen Mitchell	Palmer Administration
Hatch Regional; USDA	
Fredric Husby	Characteristics and Feed Value of Barley and Western Protein Supplements for Swine
Alan Jubenville	Benefits and Costs in Natural Resource Planning
Stephen Dofing	Plant Genetic Resource Conservation and Utilization
James Drew	Regional Research Planning and Coordination, Western Region
Jenifer McBeath	Biological Suppression of Soil-Borne Plant Pathogens
McIntire-Stennis; USDA	
John D. Fox, Jr.	Simulating the Effects of Forest Harvest on Soil Freezing and Thawing
Keith Van Cleve	Forest Floor Organic Matter Chemistry as a Control of Plant Element Supply in Interior AK Forests
John Yarie	Prediction of Landscape Level Effects of Global Change on the Alaskan Boreal Forest
Edmond Packee	Determination of the Growth and Yield Potential of Northern Forest Species in Alaska

Financial Statement

Expenditures — July 1992 through June 1993

The following is a statement of expenditures of federal and state funds for the fiscal year beginning July 1, 1992 and ending June 30, 1993 (FY 93).

		(% of total)
Federal		
Hatch General Formula Funds	$ 878,045	12.6
Hatch Regional Formula Funds	135,274	2.0
USDA–Agricultural Research Service	132,997	1.9
McIntire–Stennis Formula Funds	356,464	5.1
Other Grants and Contracts	1,264,413	18.2
State Funds	4,193,790	60.2
Total	$ 6,960,983	100.0%

Gardening in the Panther Patch

Elsa Weabold, left, and Rochelle Hanscom, right, prepare the soil for planting; while Jan Hanscom and Steven Rampke pose by their garden sign. Jan Hanscom, AFES research technician, volunteers her time to work with the kids as a 4-H club leader.

"I want these kids to be more in touch with the Earth, and through that, with their environment. I want them to learn they can beautify their environment," Hanscom said. She is also involved with Life Lab, which teaches children at Denali Elementary science through gardening skills in an integrated curriculum (Photos by Donna Gindle).

Professional staff profile

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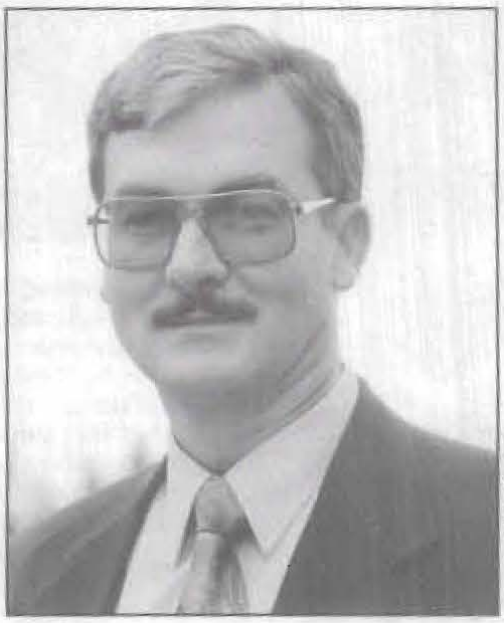

Congratulations to Dr. Charles Knight on his promotion to associate professor and for receiving tenure this spring (Photo by J. Stephen Lay).

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Harry Bader was awarded the teaching award of merit by the National Association of Colleges and Teachers of Agriculture and the School of Agriculture and Land Resources Management students (Photo by Charles Knight).

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