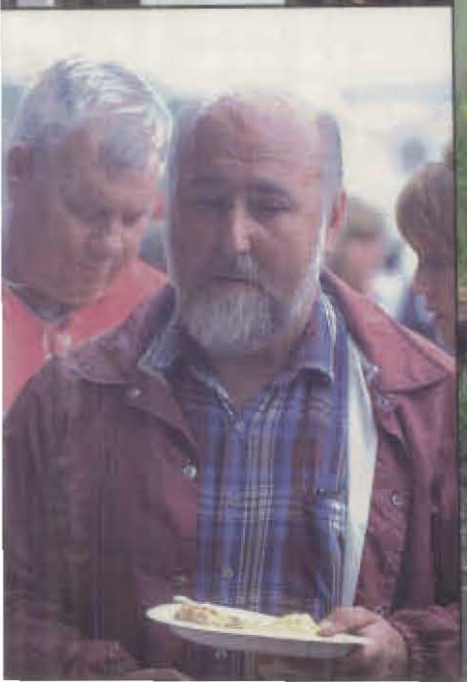
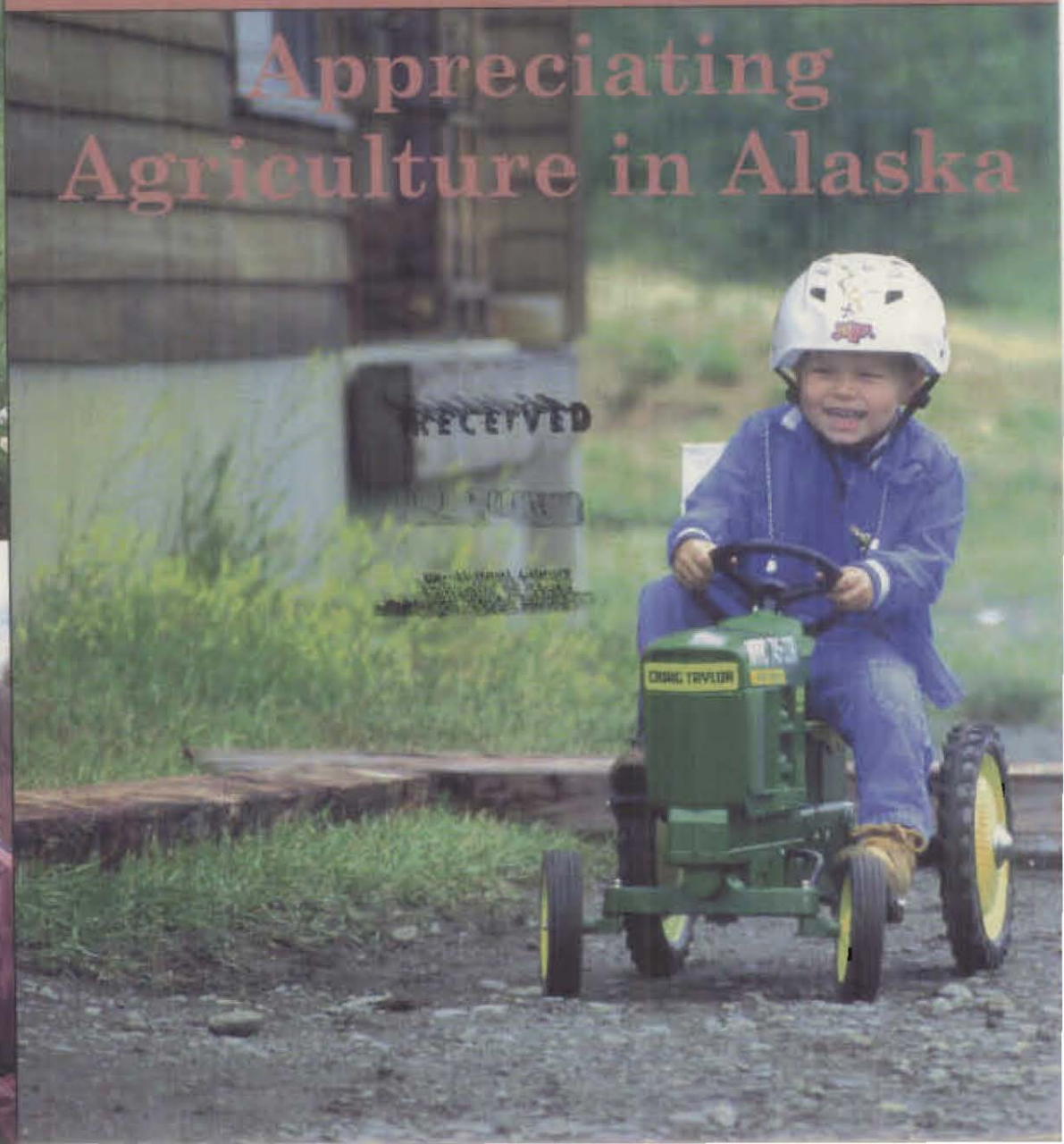


AgroBorealis

School of Agriculture and Land Resources Management
Agricultural and Forestry Experiment Station
Vol. 29, No. 2: The Annual Report
Summer/Fall 1997

Appreciating Agriculture in Alaska



AFES Acting Director | Palmer Research Center | 533 E. Fireweed | Palmer, AK 99645

June 30, 1997

The Honorable Tony Knowles
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, 1996. This is done in accordance with an act of Congress, approved March 2, 1887, entitled "An act to establish agricultural experiment stations, in connection with the agricultural 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,

G. Allen Mitchell

G. Allen Mitchell
Acting Director

AFES Statement of Purpose

The Alaska Agricultural and Forestry Experiment Station (AFES) provides new information to manage renewable resources at high latitudes, and to improve technology for enhancing the economic 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.

Experiment station scientists publish research in scientific journals, conference proceedings, books, and in experiment station bulletins, circulars, newsletters, research progress reports, and miscellaneous publications. Scientists also disseminate their findings through conferences, public presentations, workshops, and other public information programs.

Administratively, AFES is an integral part of the School of 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.

AgroBorealis

EDITORIAL STAFF

Agroborealis is published by the Agricultural and Forestry Experiment Station, University of Alaska Fairbanks. A written request will include you on the mailing list. The address is: PUBLICATIONS; AFES; P.O. BOX 757200; FAIRBANKS, AK, 99775–7200; or E–mail: fynrpub@aurora.alaska.edu

Agroborealis Contents

Vol. 29, No. 2
ISSN: 0002–1822
Summer 1997

The *Agroborealis* was published by A & T Publishing in Anchorage, Alaska at $1.00 per copy.

About the cover. More than a thousand people helped celebrate Agriculture in Alaska recently (see related story on page 6). Pictured from left to right are: Wendy Redman, vice president for university relations, Senator Lyda Green and Janey Wineinger; an unidentified future farmer during the tractor races; Phil Smith, seed grower from the Mat–Su Valley, gets ready to sample the Alaska meal; and an unidentified young girl participates in the flower planting. (Photos by Jay McKendrick and Fred Husby)

Editor's Note: Dr. Jay McKendrick wishes to acknowledge BP's ***Dr. Christopher J. Herlugson*** for his contributions to McKendrick's 25 years of research. Herlugson's name was omitted in the last *Agroborealis*.

State of the Station, School address

by: Dr. Fred Husby, Acting Dean CNRDM & SALRM Director
Dr. Stephen Sparrow, Head, PASS

Each year as we prepare our Annual Report edition of the *Agroborealis*, we reflect on what we have accomplished and focus on our upcoming challenges. While the School of Agriculture and Land Resources Management and the Agricultural and Forestry Experiment Station are continuing to meet the challenges for Alaskans, we must admit the times have been tough.

As a brief overview, SALRM is divided into three academic departments: Forest Sciences; Plant, Animal and Soil Sciences, and Resources Management. The research component of the School is administered through the Alaska Agricultural and Forestry Experiment Station with the main research location at the Fairbanks Research Center, the Forest Soils Laboratory, and the Palmer Research Center. Experiment farms are located in Fairbanks and Palmer with additional research conducted at satellite sites at the Delta Junction Research Site, Point MacKenzie Research Site, Nome Reindeer Research Site, and the Bonanza Creek Experimental Forest. The School currently has 25 faculty with responsibilities in research, teaching and service.

Both federal and state funds are used for research. State funding is through the state's general fund and the Alaska Science and Technology Foundation; federal formula funding is from the USDA. Hatch (agriculture), McIntire–Stennis (forestry), and APHIS (plant and animal health). Researchers also receive grants and contracts from federal and state agencies, and private sources. Instruction is funded through the state and scholarships

As most of our readers are probably aware, the University of Alaska has experienced, and continues to experience, severe budget cuts. Some of our programs, including the food science, dairy science, and beef science programs have been totally eliminated because of those cuts.

Similarly, many of our faculty positions, resulting from retirement and resignations, have not been replaced. The positions and the year we lost them are: Professor of Agronomy, 1987; Associate Professor of Economics, 1989; Assistant Professor of Agricultural Engineering, 1990; Assistant Professor of Animal Science, 1992; Professor of Agronomy, 1993; Associate Professor of Agricultural Education, 1993; Associate Professor of Animal Science, 1994; Associate Professor of Food Science, 1994; Dean and Director, 1995; and Associate Professor of Extension–Forestry, 1995.

In 1995 the USDA–ARS closed its Alaska operations, resulting in the loss of affiliate faculty positions of Soil Scientist/Research Leader, Weed Scientist, Soil Scientist, and Soil Physicist. In 1996, the Institute of Northern Forestry closed and the SALRM lost affiliate faculty positions in entomology, fire science, watershed, ecology (2), genetics, wood products and silviculture. With the loss of this federal component for research in agriculture and severe reduction in forestry research, the 25 faculty in SALRM represent the last research unit in Alaska responsible for research and instruction in natural resources.

On top of the severe budget reductions to SALRM, there are other clouds on the horizon for Alaska's agriculture. They include a proposal to eliminate the Division of Agriculture and changes in administering the Alaska Revolving Loan Fund.

However, we also are optimistic about agriculture's future in the state. Farm cash receipts have steadily increased over the last 15 years while the number of farms have decreased. Future potential developments include putting the Conservation Reservation Program (CRP) land back into production, resolving the Point MacKenzie/Mental Health Trust Lands, and having a slaughterhouse and commercial oilseed crusher in Delta Junction.

Some important research accomplishments that positively affect Alaska's economy include:

- Alaska marine by-products as feed and fertilizer with $2–$3 million benefit to the seafood industry,
- Livestock diets which use Alaskan products and resulted in up to 50% feed costs savings,
- Revegetation research that has produced $70 million savings for miners and oil companies,
- Wind erosion control and soil moisture conservation,
- Export of virus–free seed potatoes,
- Increased productivity of saleable reindeer products,
- Developing canola cultural practices, and
- Cultural practices for overwintering perennial plants.

Despite our budget woes, this is an exciting time. Next year will be the centennial of the agricultural experiment station, first located in Sitka. In 1998, we will also host the Circumpolar Agriculture Conference in Anchorage Oct. 19–22. Meanwhile, SALRM has merged with the Schools of Management and Mineral Engineering to form the College of Natural Resources Development and Management. The CNRDM has the role of providing research and instruction related to the state's resource based economy. In all we do, we remain committed to Alaska and Alaskans.

Researchers to develop megatransect in Alaska

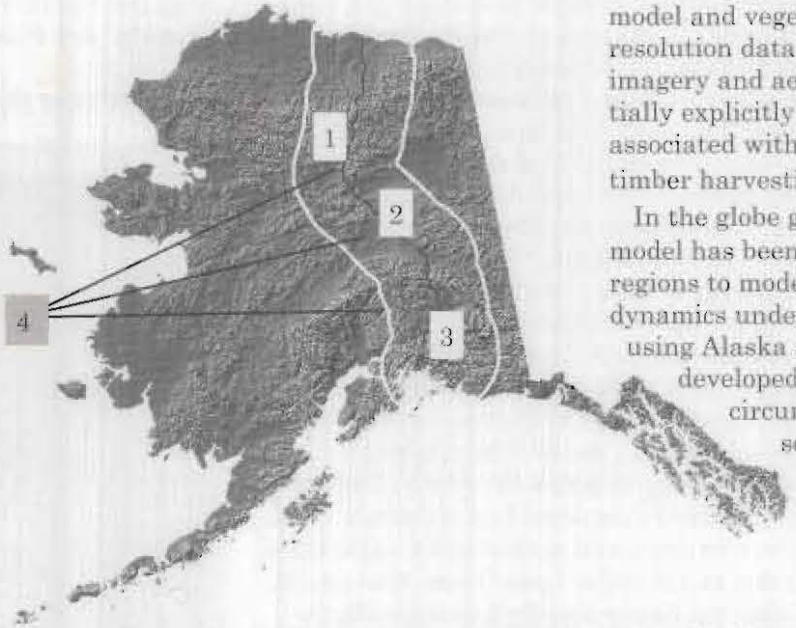
Researchers: Dave Maguire, Dave Verbyla, Scott Armruster and Kick Peterson

With global climate change and resource development, the land cover of the circumpolar north is likely to change significantly during the next few decades due to climate warming, increased wildfire frequency and intensity, infestations of insects such as bark beetles and spruce budworm, and increased logging activity. To model the potential impact of inevitable land cover changes associated with climate warming, we are building a 300–km wide megatransect from Valdez to Prudhoe Bay using nested remotely sensed imagery. This project is funded by the NASA Land Cover Land Use Change Research Program to investigate the implications of land–cover change throughout the globe. We are using historic satellite data and aerial photographs to document past cover changes along the megatransect.

We are using current satellite images 1) over the Copper River Basin to model the spatial distribution of bark beetle-killed spruce stands, 2) over the Tanana Valley to model the spatial distribution of fires and harvest units, and 3) over the White Mountains and south slope Brooks Range to model transition from taiga forest to tundras as climate warms. The overall goal of this project is to use a global terrestrial ecosystem model to model ecosystem disturbance and recovery under climate warming scenarios and to estimate the consequences of these changes to global carbon cycle.

In the Alaska map graphic, the megatransect is 300–km wide and extends from Valdez north to Prudhoe Bay. Researchers are developing a terrain model and vegetation information from 1 km resolution data. They use finer resolution satellite imagery and aerial photography to develop spatially explicitly data about land cover changes associated with wild fire, insect outbreaks, and timber harvesting.

In the globe graphic, the terrestrial ecosystem model has been applied globally for temperate regions to model transient carbon and nitrogen dynamics under climate warming scenarios. By using Alaska as a study area, the model will be developed to make predictions about the circumpolar north under global warming scenarios. This graphic highlights Alaska as part of the circumpolar taiga and tundra biomes.



This graphics shows the: 1) Potential land cover change associated with climate change on the south slope of the Brooks Range; 2) Land cover change associated with timber harvest in the Tanana Valley; 3) Land cover change associated with bark beetle infestation in the Copper River Valley; and 4) Land cover change associated with fires in these areas

Photos: (left) Senator Lyda Green and Natural Resources Commissioner John Shively; (center) Representative Joe Ryan; and (right) Jalmer Kerttula, former director of agriculture and Wendy Redman vice president for university relations

Photos: (above) Ben VanderWeele, potato and vegetable producer; AFES researchers Drs. Don Carling, Steve Dofing and Fred Husby; and (right) Jeff Warner, research technician, and Dr. Allen Mitchell, AFES acting director

Alaskans appreciate agriculture, enjoy day

More than a thousand Alaskans gathered to show their appreciation for agriculture July 12 at Palmer's Agricultural Experiment Station. This day gave Alaska producers a chance to showcase their vegetables, flowers, farming techniques, and skills for a crowd that included visitors, politicians, and local dignitaries. The Fun Day was hosted by the Agricultural and Forestry Experiment Station, the Alaska Cooperative Extension, and friends of Alaska agriculture.

Highlights of the day–long event included: flower planting for kids age two to five, horseshoe throwing, cow milking, an Alaska Railroad Kids Tractor event, wagon rides, visits to the Agricultural and Forestry Experiment Station's field plots, cow chip toss, watermelon races, and a visit to the reindeer farm. Experts demonstrated sheep dogging, tractor plowing, mulch layering, horseshoe making, clog dancing and karate. Les Hawkins' Rascal Band provided music.

The activities were supplemented with an Alaska–size barbecue that included homemade coleslaw, potato salad, baked beans, barbecue beef and pork, peas, carrots, rhubarb crisp and double chocolate yogurt. According to the *Frontiersman's* (July 16, 1997) Mat–Su Mouth, " This was the delicious offering of the gentle 'ag' folks ...to demonstrate how important agriculture is to both our economy and our belly....All this delicious food was grown here in Alaska and made its way from the fields...to the kitchens...to the tables and oh–so happily...to our tummys *(sic)*."

Guest speakers included the Alaska Department of Natural Resources Commissioner, John Shively, who discussed agriculture's importance to Alaska, and Senator Lyda Green who emphasized that the future for Alaska's agriculture requires hard work and cooperation.

—Photos by Jay McKendrick and Fred Husby—

Activities and food were plentiful at the Alaska Ag Appreciation Day held in Palmer recently. Tubs of coleslaw (above) made with Alaska grown cabbage, were just part of the day's menu. Gene Williams (top right) gives fun day participants a close–up view of a reindeer. Noelle Williams (below) demonstrates sheepdog herding techniques and Janet McCullough takes two young people on a horse drawn wagon ride around the farm grounds. Ted Pyrah (right) demonstrates mulch layering in a corn field.

—Photos by Jay McKendrick and Fred Husby—

Plants that weren't tough enough

by Pat Holloway, Associate Professor of Horticulture
Pat Wagner, Horticulture Research Technician

Any researcher working in the far north is well aware of the beneficial attributes of snow as an insulating blanket for both plants and small animals. We learned in graphic detail just how important snow is in Alaska during the winter of 1995–96. The total accumulation of snow through late January 1996 was only 6 inches (15.2cm). During that time the minimum winter air temperature recorded at the Fairbanks Experiment Farm reached –43°F (–42°C) in December and –48°F (–44°C) in January. Thirty–three percent of the experimental plants in the Georgeson Botanical Garden research test plots were killed by this combination of low temperatures and little snow (Table 1).

Damage could have been caused by extreme desiccation of plant crowns and roots, frost heaving or direct freezing damage to the plant cells. Many Asiatic hybrid lilies were killed by voles tunneling into the soil and munching on the bulbs. Plants either were killed outright or showed severe damage. Some columbines, crabapples, grape hyacinths and lilies leafed out or emerged in midsummer, but subsequent survival is doubtful. Some mountain ash and crabapple trees leafed out in spring, then died in midsummer, an indication of severe root damage. Some damage may not become apparent for years. For instance, cells killed by winter injury can be open wounds for entry of pathogens. A tree branch that rots and falls off 10 years from now may have begun dying during the winter of 95–96.

Damage from the winter of 95–96 was not limited to the Experiment Farm. Gardeners and horticulturists throughout Interior and Southcentral Alaska reported significant losses. Like our experience at the Garden, losses were unpredictable and varied. Nearly everyone reported losses of shasta daisies and maltese cross. However, we experienced total loss of many cultivars of peonies, while other gardeners had no losses. One Fairbanksan reported total loss of a wide variety of shrub roses, whereas roses at the Botanical Garden were not killed. The Alaska Botanical Garden in Anchorage, reported 43% loss of herbaceous perennials in their Perennial and Demonstration Gardens.

Even more interesting than the tremendous death toll, was the incredible diversity of plants that died. Plant losses included species from as far south as latitude 41°N (Nebraska) as well as Alaska native plants. Introduced species that had survived for more than 50 years at the Experiment Farm died, whereas species native to such places as Turkestan, Iowa, Austria, New York and Italy survived without damage. No patterns of survival emerged from this "test winter." Latitude of origin was meaningless as was taxonomic associations, plant form (woody, herbaceous, etc.) and traditional cold hardiness zone designations.

This winter served to emphasize just how little we know about plant hardiness in Interior Alaska's landscapes. One thing is certain: The plants listed below will now come with a warning—needs snow cover to survive!

Table 1. Perennials in the GBG research test plots that survived at least one winter but were killed during the winter of 1995–96 because of inadequate snow cover.

Achillea borealis – native yarrow
Achillea Ptarmica– sneezewort
Achillea taygetea 'Debutante' – yarrow
Ampelopsis glandulosa var. *brevipedunculata* – porceline vine
Amsonia Tabernaemontana var. *salififolia*
Anemone Halleri – Haller anemone
Aquilegia 'Mckana Giant Hybrids'– columbine
Aquilegia 'Nora Barlow' – columbine
Aquilegia atrata – columbine
Aquilegia Buergerana – columbine
Aquilegia canadensis – wild columbine
Aquilegia formosa – Sitka columbine
Aquilegia glandulosa
Aquilegia pyrenaica – Pyrenees columbine
Aquilegia sp. – Berdsk columbine
Aquilegia 'Dynasty' – columbine
Aquilegia vulgaris – garden columbine
Aquilegia vulgaris 'Michael Stromminger' – garden columbine
Arabis caucasica – wall rock cress
Arnica alpina – alpine arnica
Asplenium scolopendrium – Hart's tongue fern
Aster ptarmicoides– white upland aster
Berberis koreana x *Thunbergii* 'Emerald Carousel'–hybrid
Calamagrostis acutiflora var. *stricta* – feather reed grass
Calamagrostis arundinacea 'Karl Foerster'
Campanula alliariifolia
Campanula glomerata superba
Carex Grayi
Chelone Lyonii
Chrysanthemum coccineum – 'Robinson's Dark Crimson'
Chrysanthemum leucanthemum – ox–eye daisy
Cimicifuga racemosa – black cohosh
Crocus chrysanthus 'Princess Beatrix'
Crocus chrysanthus 'Snow Bunting'
Crocus Tomasinianus 'Ruby Giant'
Crocus versicolor 'Picturatus'

Table 1 *continued...*

Delphinium x Belladonna 'Improved'
Deschampsia caespitosa 'Goldgehaenge' – tufted hairgrass
Dianthus 'Ipswich Pinks Mix'
Dianthus carthusianorum – carthusian pink
Dianthus deltoides – maiden pink
Dianthus deltoides – maiden Pink
Digitalis x *sibirica* – Siberian foxglove
Dryopteris arguta – coastal wood fern
Dryopteris dilatata 'Jimmy Dyce'
Dryopteris dilatata 'Lepidota cristata'
Dryopteris filix-mas 'Undulata Robusta' – male fern
Elaeagnus angustifolia 'King's Red' – Russian olive
Erigeron 'Pink Jewel'
Festuca calesiaca 'Glauca' – Swiss fescue
Galium odoratum – sweet woodruff
Gentiana Freyniana
Gypsophila paniculata 'Snow White' – baby's breath
Helinium autumnale 'Red and Gold Hybrids' – autumn sunspray
Heuchera 'Purple Palace' – coral bells
Heuchera x brizoides 'Firefly' – coral bells
Iris missouriensis – western blue flag
Iris Pseudacorus
Iris sibirica – Siberian iris
Leontopodium alpinum – edelweiss
Liatris aspera
Liatris borealis
Liatris punctata
Liatris pycnostachya
Lilium 'America' – Asiatic hybrid lily
Lilium 'Corsica' – Asiatic hybrid lily
Lilium 'Crete' – Asiatic hybrid lily
Lilium 'Crinson Beauty' – Asiatic hybrid lily
Lilium 'Pink Perfection' – Asiatic hybrid lily
Lilium canadense – Canada lily
Lilium Henryi
Lilium Martagon 'Mix' – Martagon lily
Lilium regale
Lilium speciosum 'Rubrum' – showy Japanese lily
Lilium superbum – turk's cap lily
Linaria alpina
Lonicera hybrida 'Honey Rose' – honeysuckle
Lychnis chalcedonica – Maltese cross
Lychnis Flos-cuculi – cuckoo flower
Lychnis Flos-jovi – flower-of-jove
Lychnis viscaria
Macleaya microcarpa – plume poppy
Mahonia repens – dwarf mahonia
Malva churinskaya
Mentha suaveolens – applemint
Monarda didyma – bee balm
Muscari 'Early Giant'– grape hyacinth
Muscari armeniacum – grape hyacinth
Muscari botryoides 'Album' – grape hyacinth
Muscari Tubergenianum
Myrrhis odorata – sweet cicely
Papaver alboroseum – portage poppy
Parthenocissus inserta
Penstemon Digitalis
Phacelia sericea
Physalis Alkekengi (Franchetii) – Chinese lantern plant
Physostegia virginiana – obedience
Poa alpina "Gruening' – alpine bluegrass
Polemonium caeruleum 'Cashmerianum'
Polemonium caeruleum var. *lactaeum* – white polemonium
Polemonium reptans – creeping polemonium
Polemonium reptans 'Blue Pearl'
Polemonium reptans var. *villosum*
Polystichum acrostichoides – Christmas fern
Potentilla megalantha
Potentilla recta
Potentilla x 'Melton Fire'
Prunus sp. – Manchurian apricot
Prunus tenella – dwarf Russian almond
Salix alba 'Argentea' – white willow
Salix purpurea 'Leicestershire Dicks' – purple osier
Securinega suffruticosa
Sedum acre – golden carpet
Silene Schafta
Silphium perfoliatum – cup plant
Spiraea 'Fair Queen'
Stachys grandiflora
Stachys officinalis – betony
Tanacetum vulgare – common tansy
Thalictrum dioicum – early meadow rue
Tiarella cordifolia – foamflower
Tulipa Batalinii
Tulipa Batalinii 'Bright Gem'
Tulipa Clusiana
Veronica alpina

Photo by Cal White

Perennials at the Georgeson Botanical Garden

Research Achievements

Plant, Animal and Soil Sciences

Brucellosis Research

The UAF reindeer research program was able to more intensively sample Seward Peninsula reindeer herds in 1996, with more than 600 samples taken from reindeer which had not been previously vaccinated. Infection rates of brucellosis ranged from 0–20%. The Stebbins herd, which had never been tested, yielded no positive tests out of 120 reindeer sampled. We were not able to attend the reindeer handling at St. Lawrence Island due to poor weather conditions, but will continue with sampling of this herd in 1997 for the purposes of brucellosis–free certification. Reindeer herders have given their support to further research on a vaccine which will allow serologic discrimination between vaccinated and infected reindeer. This will help tremendously in monitoring brucellosis and shipping live reindeer.

• Julia Bevins

Barley Breeding and Research

Bulk progenies of several breeding families were advanced in 1996 as part of the barley breeding program. Progenies consisted of crosses between Alaska–developed varieties including Otal, Datal, and Thual, with promising lines developed in Scandinavia. Crosses were made with the objective of developing 1) a covered barley variety with higher grain yield and maturity at least as early as Otal, and 2) a naked barley variety with earlier maturity and better straw strength than Thual. Line selection will begin in several of these crosses in 1998.

Studies comparing maturity date as determined by color observation and percent grain moisture at harvest showed that either could be used to identify early–maturing varieties. Apparently, the varieties studied had similar rates of grain moisture loss during maturation.

Because the production of late–developing tillers that fail to mature influences the productivity of barley in Alaska, the potential of limited tillering is being studied. Plants have been developed that contain a mutant gene that produces a single head per plant, which results in extremely early maturity, but unacceptably low grain yield. Selection is underway to increase the head size of these plants. Additionally, lines that contain another mutant gene that produces two to four tillers per plant are under development and may offer a compromise between high yield potential and early maturity.

The inheritance of grain fill rate was studied in a group of barley lines adapted to Alaska. Grain fill rate was under genetic control, but because top–performing lines had rapid grain fill rates, it would probably be difficult to improve the grain fill rate of these lines. Top lines tended to have relatively long planting–to–heading periods, apparently necessary to produce sufficient photosynthetic area for high grain yield.

• Stephen M. Dofing

Spinach Seed Production Potential

Environmental conditions in Southcentral Alaska were evaluated for producing spinach seed. Spinach, a day–length sensitive plant, requires long days to stimulate flowering and relatively cool temperatures to maximize seed production. Several parent lines of spinach were grown in the field and spinach seed was produced. It was determined that Southcentral Alaska has conditions suitable for producing spinach seed.

• Stephen Dofing, James Walworth, and Donald Carling

Determining Blood Serum Trace-Mineral Levels in Reindeer

Little is known about the trace element requirements for reindeer. Current research is establishing baseline data on trace element blood serum levels of western Alaska reindeer in conjunction with trace element levels in available forages. Baselines can identify requirements for minerals such as zinc, phosphorous, iron, magnesium, copper, calcium, and selenium. These nutritional requirements are essential for formulating diets of intensively managed reindeer. Low grade deficiencies or toxic levels of minerals may depress growth rate and decrease productivity. Proper supplementation or changes in grazing practices may alleviate problems.

• Greg Finstad

Soil and Plant Relationships Affecting Reindeer Productivity

Velvet antlers and meat are commercial products of Alaska's reindeer industry. Variations in antler and body growth have been observed

between animals of adjoining ranges. Range characteristics are believed to be responsible for these variations. Reindeer in Alaska forage year round over large ranges with minimal influence by herders. Spring and early summer forage provides the essential protein and minerals needed for body and antler growth. Diet and habitat selection and its effect of productivity was investigated in reindeer herds located at White Mountain and Brevig Mission, Alaska. Microhistological analysis of reindeer feces was used to identify primary spring, summer, and autumn forage species– primarily sedges, willows and forbs. Forage plants were sampled throughout the growing season and analyzed for nitrogen, fiber, trace and macro minerals. Levels of stable isotopes of nitrogen and carbon were used to determine nitrogen flow and carbon levels in reindeer forage plants.
•Greg Finstad

Radiotelemetry Determines Habitat Usage of Seward Peninsula Reindeer

Range utilization by Seward Peninsula reindeer was investigated through the use of radiotelemetry. Radio–collared reindeer are located throughout the year with the use of fixed wing aircraft. Seasonal patterns of movement and habitat selection were monitored to identify and evaluate critical foraging areas. Ground crews traveled to foraging locations to survey plant community compositions and monitor usage by reindeer. This data will be used to identify critical foraging habitats and long term usage patterns. Reindeer herders and land managers can use this information to implement optimal grazing plans.
•Greg Finstad

Developing a Reindeer Growth Model

Summer and winter body weights of adult male, female, and castrated reindeer have been collected on the Seward Peninsula since 1984. A regression model, including categorical variables of season, sex, and all interaction terms, was developed to assist the herd manager in making culling decisions. Yearling females averaged 125 pounds increasing to a 210 pound winter weight and a 180 pound summer weight at age 10. Yearling males averaged 142 pounds increasing to a 230 pound winter weight and a 285 summer weight at age seven. Yearling steers averaged 150 pounds increasing to a 270 pound winter weight and a 265 pound summer weight at age seven. Age–related rates of gain can be used to determine optimal slaughter age to maximize meat yield.
•Greg Finstad

Usibelli Revegetation Studies

A study was initiated in 1991 to evaluate grass growth on different growth media on windy, south–facing slopes for cover, nutrient absorption, and decomposition. An additional study was implemented in 1995 to assess the effects of fertilization for varying numbers of years. The sixth and second year of plant cover and soil nutrient data were obtained for those two studies in 1996.

Norcoast Bering hairgrass (*Deschampsia beringensis*), a cultivar developed at the Agricultural and Forestry Experiment Station, has maintained better cover than most other species on the once–fertilized plots. Cover of many other species has declined substantially on these plots. Native colonization was greatest on plots seeded with legumes and consisted mostly of herbaceous species that follow disturbances, such as fireweed (*Epilobium angustifolium*) and bluejoint reedgrass (*Calamagrostis canadensis*), although Bebb willow (*Salix bebbiana*) and paper birch (*Betula papyrifera*) also colonized these plots. Aspen (*Populus tremuloides*) sprouted from root fragments where an organic mat was used. Twice–fertilized plots had almost complete cover while the once–fertilized plots had only 60 to 80% cover, which might be beneficial where native colonization is more important than erosion control. Arctared and Norcoast provided more than their share of the cover after two years when testing new seed mixes.
•Dot Helm

Silverado Revegetation Studies

Work continued on revegetation trials begun in 1995 to assess plant species and fertilizers that would be appropriate for placer mines in the Upper Koyukuk region. Species tested included Norcoast Bering hairgrass (*Deschampsia beringensis*), Nortran tufted hairgrass (*Deschampsia caespitosa*), Alyeska polargrass (*Arctagrostis latifolia*), Gruening alpine bluegrass (*Poa alpina*), Arctared red fescue (*Festuca rubra*), Tundra bluegrass (*Poa glauca*), and Alsike clover (*Trifolium hybridum*). All species except the Alsike clover were selected because of suitability to the environment as well as neighboring land uses in the Gates of the Arctic National Park and Preserve. The clover was used because in previous studies it facilitated natural colonization and then died.

Four seed mixes were also tested in plots as well as in the actual revegetation of the site. All species and mixes, except the alpine bluegrass and clover grew well in the fall seedings (greater than 80% cover). In contrast, the spring seedings had less than 40% cover, partly because of the shorter growing season. The fall seedings had already started

growing when the spring seedings were just being planted. Grass cover increased substantially when phosphorus fertilizer (any amount) was applied, but responded very little to nitrogen. Natural colonization is also being documented on reclaimed exploration trails as well as in the main mine area.
• Dot Helm

Establishing Woody Plants on Disturbed Lands

The objectives of this study include evaluating longer–term (5–10 years) effects of growth media or mycorrhizal inoculum on woody plant growth and natural colonization on three mined sites. The southernmost site, a proposed coal mine near Palmer, contains woody cuttings and seedlings planted in 1989 on four growth media: three soil materials and glacial till (overburden) material. Plant growth has been substantially better on the three soil–material sites compared with the glacial till site for the first eight years. Height growth for many species is beginning to slow on one growth medium.

Soil was transferred from native vegetation to the root zone of greenhouse–grown Sitka alder (*Alnus sinuata*) in 1990 to introduce mycorrhizal inocula from an active coal mine reclamation project near Healy. Inocula were obtained from a paper birch (*Betula papyrifera*) – white spruce (*Picea glauca*) forest with Sitka alder understory (expected to have appropriate microorganisms) and from a black spruce (*Picea mariana*) forest with ericaceous shrub understory (would not have appropriate microorganisms). These plants have been monitored for height since 1990.

Seedling colonization is being monitored on an abandoned placer mine located 100 miles northeast of Fairbanks and reclaimed in 1993. Rooted and unrooted feltleaf willow (*Salix alaxensis*) cuttings were planted at three heights above the water and three times during the growing season to assess their survival and growth. Rooted cuttings survived much better than unrooted cuttings in most cases (53% versus less than 5%) with the exception of a low elevation site protected by a small levee. Best survival occurred for cuttings transplanted early in the year (60% in June versus 44% in August). This could be partly a factor of the unusual June rains and somewhat drier July and August. Survival was better at lower elevations and from earlier plantings. However, plant heights were greater at higher elevations and least at the lowest elevations. This resulted from the later icing in the floodplain, and longer growing season on top of the tailings piles.

It was determined during grass variety trials that the best grass species were Norcoast Bering hairgrass (*Deschampsia beringensis*) and Arctared red fescue (*Festuca rubra*). June seedings were best in the first year because of their longer growing season, but the July seedings have increased their cover and are stable through the third year. The June seedings started to decline in cover during the third year, probably due to fertilizer being depleted.
• Dot Helm

Germinating Seeds of Alaska Burnet

Three species of burnet (*Sanguisorba* spp.) native to Alaska have potential as ornamentals in wildflower gardens, perennial flower plantings and roadside revegetation projects. Seed germination tests were conducted to identify optimum germination in relation to temperature and light. The greatest percentage germination in shortest number of days occurred at 77°F for all three species within a 40° to 86°F test range. *Sanguisorba stipulata* did not germinate at 40°F, and both *S. stipulata* and *S. menziesii* showed less than 50% germination at 86°F. Seeds of all species germinated as well in darkness as in light.
• Patricia S. Holloway and Grant E.M. Matheke

Low Snowfall Causes Winterkill in Perennial Ornamentals

Total accumulation of snowfall through late January 1996 was six inches. From October 1995 through January 1996, winter air temperatures reached –48°F. The lack of insulating snow cover combined with low air temperatures caused a loss of 30% of the perennials at the Georgeson Botanical Garden. Plant losses ranged from "reliably hardy" species such as *Lonicera tatarica* that have been grown in the Interior for more than 50 years to native plants. Genera that were particularly vulnerable to winterkill included *Aquilegia, Crocus, Dianthus, Iris, Lilium, Lychnis, Muscari, Polemonium* and *Tulipa*. See pages eight and nine for more information.
• Patricia S. Holloway and Patricia J. Wagner

Effects of *Trichoderma atroviride* on *Phytophthora cactorum*

Isolates of *P. cactorum*, causal agent of root rot diseases in ginseng, were obtained from the laboratory of Dr. Parke (University of Wisconsin). Results of dual culture and other laboratory tests indicated that *T. atroviride* is an effective mycoparasite of *P. cactorum*. At the macroscopic level, the expansion of the *P. cactorum* colony was arrested upon contact with the mycelia of *T. cactorum*, and as the mycoparasitism progressed, the entire *P. cactorum* colony was destroyed by the *T. atroviride*. Microscopically, the hyphae of *T. atroviride* were observed to penetrate the hyphae of *P. cactorum* and cause lysis of the vegetative hyphae of the pathogen.
• Yong Huang and Jenifer. H. McBeath

Inhibiting Effects of Tabtoxin on Expression of Plant Disease Genes

Transgenic tobacco plants carrying either the Arabidopsis phenylalanine ammonia lyase (PAL) - glucuronidase (GUS) or bean chalcone synthase (CHS) -GUS gene fusions were inoculated with *Pseudomonas syringae* pv. *tabaci* strains 11528R (Tox+) and 11528R (del[tbl]2) (Tox-) to study the effect of tabtoxin on expression of PAL and CHS genes. The results showed that both genes were differentially activated in response to inoculation with 11528R and 11528R (del[tbl]2) by measuring GUS activity in transgenic tobacco. The temporal induction pattern established by 11528R (del[tbl]2) showed a higher magnitude and peak expression of GUS activity than that elicited by 11528R. Results from spatial pattern analysis indicated that induction of PAL and CHS genes by both 11528R (del[tbl]2) and 11528R is localized to areas surrounding bacterial infiltration. However, strong enhancement of PAL and CHS gene expression was observed at the edge of these areas in transgenic tobacco leaves infiltrated with 11528R (del[tbl]2) but not with 11528R. Expression of CHS and PAL genes in transgenic tobacco leaves treated with heat-killed cells of 11528R (del[tbl]2) or 11528R showed an elevated but identical induction pattern. Our results suggest that tabtoxin plays an important role in inhibiting expression of CHS and PAL genes in tobacco plants.

• Yong Huang and Jenifer H. McBeath

Evaluating and Improving Barley Feed

Two studies were conducted to determine the feeding value and digestibility of whole full–fat canola seed in early weaned pig diets. In the first study, 50 Landrace X Yorkshire pigs (14.5 pounds) were allotted at 21 days of age to compare growth and feed performance with canola (Tobin) seed at 4 or 8% and two physical forms (ground versus whole) in barley diets. There was a tendency for reduced gains and poorer feed performance at 8% but no difference was related to physical form. Results would indicate that whole canola seed should not exceed 4% of the diet and performance would not be improved by grinding. Six 21 day–old Yorkshire X Landrace barrows were allotted to start diets {21% crude protein (C.P.), 1.1 % Lysine} that contained 0, 10, and 15% whole canola (Tobin) seed in a 3x3 Latin Square to determine the digestibility of canola seed. Dry matter, C.P., ether extract (E.E.) digestibilities were 46, 59, and 39%, respectively. The digestible energy was 1,553 calories per pound.

• Fred Husby and Garret Perney

Seed Germination of Pasqueflower

Seeds from 10 populations of pasqueflower (*Pulsatilla patens*) with origins from Colorado to Alaska were germinated at temperatures ranging from 40°F to 77°F. Optimum germination (greatest percentage) occurred at 77°F regardless of seed origin. Seeds from Alaska germinated at 40°F, whereas seeds from other locations did not. Although the optimum germination occurred at high temperatures for all populations, the Alaska seeds showed a broader range of germination temperatures, indicating an adaptation to cold soils.

• Sarah Johns and Patricia S. Holloway

Fertilizing Lettuce, Tomato and Petunia Transplants

Five different commercial fertilizers (Peters Peat–Lite Special® 15–16–17, Fison TechniGro® 16–17–17 Plus, 20–9–20 Plus, 17–5–24 Plus, and 15–0–15 Plus) were used to study the importance of phosphorous for lettuce, tomato and petunia transplants. The growing substrate was Sunshine® Mix. The amount and rate of growth were similar for transplants grown with 15–16–17, 16–17–17, or 20–9–20. Slow growth, low flower number and plant weights were observed for plants grown with 17–5–24 or 15–0–15. Using 17–5–24 or 15–0–15 to produce transplants cannot be recommended. The lower level of phosphorus in 20–9–20 did not, however, cause adverse plant growth.

• Meriam Karlsson

Control of Flowering in Windflower

Flowering in windflower (*Anemone coronaria* L.) was studied at 54°, 60°, and 68°F and 8, 12, and 16 hours day length. Flowering was first observed 19 weeks from seeding at 16 hours day length and 60°F. Five additional days were required at 54°F and 15 more days at 68°F compared to 60°F for flowering. The number of leaves at flowering increased from nine at 54°F to 12 at 60°F and 15 at 68°F.

• Meriam Karlsson

Control of Flowering in Cyclamen

Cyclamen (Florist's cyclamen, Alpine violet) was grown at 68°F and 16 hours day length for 16 weeks. Plants were then placed at conditions with 60 or 68°F and 8, 12, or 16 hours day length. The development and appearance of the first open flower was faster at 60°F than 68°F. The length of the day did not alter the rate of flowering. On average, 79 days from starting the different temperatures and day lengths were required for flowering at 60°F and 87 days at 68°F.

• Meriam Karlsson

Canola Production

Eight varieties of Polish canola (*Brassica rapa*), 'AC Sunshine', 'Colt', 'Eldorado', 'Goldrush', 'Horizon', 'Maverick', 'Reward', and 'Tobin', and one variety of Argentine canola (*Brassica napus*) 'Sprite' were planted at three locations in Interior Alaska. Crop emergence was late and early growth was slow due to weather that was cooler and drier than normal during May and June. All varieties of Polish canola ripened at Delta Junction and North Pole. The Fairbanks location was extremely dry and none of the varieties ripened. Argentine canola is later maturing than Polish canola and the variety 'Sprite' did not fully mature at any location. Seed yields were not significantly different among the Polish varieties and averaged 0.39 tons per acre at Delta Junction and 1.4 tons per acre at North Pole.

A private party is in the process of erecting a used canola crusher in Alaska and several farmers associated with the Deltana Community Corporation planted field scale tests of canola in 1996. Yields were low and results were mixed, but interest is still high and further tests using irrigation are planned for 1997.
•*Charles Knight*

Small Grain Variety Trials

Early maturing varieties of spring planted small grains from Alaska, Canada, Norway and Finland were evaluated at three locations in Interior Alaska. Seed yield and date of maturity were the primary evaluation criteria. Among feed barley varieties, 'Otal' had the highest consistent yield at all locations, producing an average of 1.63 tons per acre. Among spring oat varieties, yields of 'Toral', 'Cascade' and 'Calibre' were approximately equal with an average of 2.1 tons per acre.

In response to microbrewery demands for an Alaska produced malting barley, evaluations of early maturing malting barley varieties were expanded in 1996. The varieties, 'B 1215', 'B 1602', 'C&V Expt.', 'Duel', 'Harrington', 'Stander' and 'Stetson' were evaluated. Highest yields were obtained with 'Duel', however, test weights were low due to the short growing season. At the Fairbanks location, 'B 1215', C&V Expt.' and 'Harrington' produced test weights of 48 pounds per bushel or greater and had an average yield of 2.28 tons per acre. Evaluations of malting barley varieties will continue in the future with the goal of finding an early maturing variety which will consistently produce high quality seed.
•*Charles Knight*

Vitamin B_1 and Transplant Roots

Solutions of vitamin B_1 are sold in garden centers as soil drenches to promote rapid growth of newly transplanted seedlings. Vitamin B_1 supposedly promotes root growth which, in turn, aids in rapid seedling establishment. This hypothesis was tested using 'Hero Yellow' marigolds grown in cell packs in the greenhouse. Root growth was not greater in vitamin B_1 treatments applied with and without a liquid fertilizer as opposed to plants receiving a water drench. No differences in growth of roots, shoots, and leaves were detectable with the vitamin B_1 or fertilizer treatments. The value of vitamin B_1 drenches is questionable.
•*Collin Lichtenberger and Patricia S. Holloway*

Controlling Fungus on Potatoes

Trichoderma atroviride is a fungus found in Alaska that is capable of parasitizing a wide range of plant pathogenic fungi. In a three year field study conducted previously in Alaska, *T. atroviride* was found to be equal to or better than chemical fungicides in controlling black scurf disease of potatoes caused by *Rhizoctonia solani*. The purpose of this study is to evaluate the efficacy of four isolates of T. atroviride under conditions different from Alaska. This is the third year of this study. My collaborators in this project were Dr. M. Sun and Ms. E. Carpenter, Potato Laboratory, Montana State University, Bozeman, Mont.

Trials were conducted under large acreage commercial field settings in Ronan and Columbia Falls, Mont., testing the efficacies of *T. atroviride* for controlling *R. solani* of potatoes. To simplify the application for producers, an equal proportion of *Trichoderma atroviride* isolate CHS 861, CHS 901, Biotype 453, and Biotype 603, were blended to form one variable. The other variable included Topsin M chemical control and two binucleate *Rhizoctonia* isolates. All of the variables were applied as seed treatments. Materials were given to the collaborating potato growers to incorporate in their potato planting.

The record cold and wet weather in the spring seriously affected the planting and performance of the potatoes in the trials. Because of the large scale of the trials, considerable variations were found in soil types, soil moisture level, etc. among treatments. Furthermore, the blank control was inadvertently left out of the trial by potato growers. Consequently, results were inconclusive.
•*Jenifer H. McBeath*

Evaluating Lettuce Varieties

Tip burn, a physiological disease caused by a calcium deficiency, is one of the most important diseases on lettuce in Alaska. The rapid growth of lettuce due to the long day length during the growing season makes lettuce particularly prone to this

disease. Basal rot, caused by *Sclerotinia sclerotiorum*, and grey mold, caused by *Botrytis cinerea*, can also be severe under certain environmental conditions. Damage to lettuce production caused by these diseases has resulted in great economic losses to lettuce farmers each year. Treatments such as applying calcium to the soil or as a top dressing were all found to be ineffective. A lettuce variety trial was initiated in 1991, in collaboration with Ms. P. Giauque (lettuce farmer) and Mr. P. Sorreal (lettuce breeder, Harris Moran Co.). In 1996, 32 lettuce varieties and breeding lines were evaluated. Disease occurrences of tip burn on lettuce was moderately severe; several head lettuce varieties showed marked resistance to this disease. Infestation of *Botrytis cinerea* and *S. sclerotiorum* were fairly mild on lettuce. Several varieties and breeding lines were found to possess fairly good resistance to these diseases.

·Jenifer H. McBeath

Effects of *Trichoderma atroviride* on *Phytophthora infestans*

Effects of *Trichoderma atroviride* on the growth and development of *Phytophthora infestans* (A1 and A2 strains) were studied. Two isolates of A1 and A2 strain and an isolate of A2 strain of *P. infestans* were obtained from Dr. Fry (Cornell University). An A2 isolate of *P. infestans* was provided by Dr. Nelson (University of Arizona).

Results of dual culture and other laboratory tests indicated that *Trichoderma atroviride* is an effective mycoparasite of *P. infestans*. At the macroscopic level, the expansion of the *P. infestans* colony was arrested upon contact with the mycelia of *T. atroviride*, and as the mycoparasitism progressed, the entire *P. infestans* colony was destroyed by the *T. atroviride*. Microscopically, the hyphae of *T. atroviride* were observed to penetrate the hyphae of *P. infestans* and cause lysis of the vegetative hyphae of the pathogen. Although *T. atroviride* hyphae penetrated into the sporangia of the *P. infestans* and displaced the cell contents, the cell walls of sporangiophore and sporangia appeared to be intact.

·Jenifer H. McBeath

Alaska Seed Potatoes for Export

Geographic isolation and harsh winters provide Alaska distinct advantages in producing premium quality seed potatoes which are free from major viruses, bacterial ring rot, late blight (A1 and A2 strains) and golden nematodes. The objective of this project is to develop premium quality seed potatoes for export to other states and countries. It will benefit potato growers directly as well as help diversify the state's economy (and reduce federal deficits caused by trade imbalances). In the summer of 1996, 700,000 data points were collected from seed lots at nine farms. We found no presence of late blight and bacterial ring rot disease in any of the fields we tested. We also found six potato farms completely free of virus disease, which supports the thesis that it is possible to produce virus–free potatoes in Alaska. We found no evidence of virus transmission by insect vectors. It seems that contaminated seed potatoes are the primary source of virus diseases in Alaska. In February 1996, a special permit was granted from the People's Republic of China for a trial shipload of premium Alaska seed potatoes to China. In September 1996 a three member Chinese Delegation conducted a 10 day, pre–sale inspection in Alaska. In November 1996, 660 pounds of premium quality Alaska seed potatoes were shipped to Taiwan for trial.

·Jenifer H. McBeath and Yong Huang

Vegetating Gravel Structures

The experiment began in 1989 with restructuring an exploration gravel pad to test effects of gravel thickness, a small topsoil application, capturing snow, and seeding with native plant species collected in the Prudhoe Bay vicinity. Three–inch deep topsoil was the most beneficial treatment, increasing vascular plant canopy cover from 32% without topsoil to 56% with topsoil after six growing seasons. Moss cover increased from 3% without topsoil to 39% with topsoil. Increasing gravel thickness reduced moss and grass cover and had less influence on forb cover. Benefits from snow fencing were confined to the first three to five growing seasons. Average canopy cover increased from 0 to 66% in six years. *Puccinellia langeana* (a native alkaligrass) was the most competitive grass in early stand development. After six growing seasons, this species appeared to be declining in vigor, indicating it was being replaced by other species. Grasses began sexual reproduction (seed development) after two growing seasons. Perennial forbs required four to six growing seasons to begin seed production. Seed applications were 0, 40, 80, and 880 seeds per square foot. The higher applications resulted in dense grass stands early in the experiment, and these dense grass stands competed heavily with forb species, reducing plant diversity.

Geese, ground squirrels, and small birds have been observed feeding on foliage and seeds in the test plots, indicating a functional plant community was forming. The moss development indicates soil building processes are also beginning. The experiment demonstrates the potential for revegetation of gravel fill in Alaska's arctic oil fields. Other studies are

underway to test effectiveness of using various waste products from the oil field operations to enhance gravel as a medium to support tundra plant growth.
·Jay D. McKendrick

Long–term Tundra Revegetation

The project objective is to permanently mark and document test plots and photopoints of experiments previously conducted across Alaska's North Slope to provide long–term documentation of vegetation changes in tundra. Revegetation experiments which began in 1972 were usually concluded after three years, but the most useful information from these tests materialized after 10 or more years. Interpretations from some of these long–term observations caused us to reverse earlier conclusions and significantly changed our recommendations for rehabilitating damaged tundra. Plant species and seed and fertilizer applications recommended in the mid–1970s have proven inappropriate for certain habitats over the long–term if natural tundra restoration is the primary objective. It is believed that more valuable information, which will assist those involved with tundra revegetation, can be obtained from these experiments in the future. Photo records illustrate the re–invasion of tundra plants on damaged sites where no revegetation efforts were used, indicating the profound but poorly recognized natural resilience for the biota in this environment. Documenting these responses should prove valuable for future resource developments in the region by indicating options to accelerate tundra rehabilitation processes and that disturbances have a greater natural potential for recovery than generally acknowledged.
·Jay D. McKendrick

Grass Clipping Mulches Control Weeds

'Provider' bush beans and 'Celebrity Red Morn' petunias were grown in plots mulched with fresh grass clippings or in unmulched plots. Mulch was applied beginning June 10 and continued weekly to maintain a three–inch mulch layer. Weed control on mulched plots was excellent. Total seasonal maintenance labor was reduced by 17 minutes on the 48 square foot petunia plots. Maintenance on the 200 square foot bean plots was reduced by 30 minutes with the grass mulch. Yield of snap beans and flowering on petunias did not differ between mulched and unmulched plots.
·Grant Matheke, Thekla Johnson, Kathy Seim, and Cathy Egan

Rate of Moisture Loss from Cut Forage

Drying conditions during first cutting (mid to late June) were highly favorable. Cut grass dried to 20% moisture in 2.5 to 5.5 days, due to low humidity, high temperatures and a lack of clouds. Second cutting grass did not reach 20% moisture over an eight day drying period. Rainfall was lower than normal during the second cutting, but high humidity, lowering temperatures, and cloudy weather prevailed. These studies will continue for several years, so the economic consequences of management decisions can be evaluated.
·Michael T. Panciera

Establishing Minimum Tillage Forage

Preliminary studies suggested that minimum tillage would be effective for small–seeded forage crops. A minimum tillage drill was constructed and initial testing was completed during 1996. The drill will be used to test the responses to minimum tillage planting for bromegrass, timothy, clovers, and brassica crops in 1997.
·Michael T. Panciera

Kentucky Bluegrass Seed Production

'Nugget' Kentucky bluegrass is one of the best varieties of turfgrass for Alaska. The characteristics that make it a good sod crop create problems for seed production. Seed yields decline rapidly as the stand thickens. An on–farm trial was established in Delta Junction to determine whether nitrogen rates and clipping management will affect the productive life of stands used for seed production.
·Michael T. Panciera and Stephen D. Sparrow

Cutting Date Effects on Alfalfa

Alfalfa planted in 1994 was subjected to different cutting treatments for two years. The timing of second cutting was very important in both yield and survival. Stands that were cut between mid–August and mid–September had the lowest yields, plant numbers, and root reserves. This study is being conducted at Point MacKenzie, Fairbanks, and Delta Junction. Over the past two years winter conditions have been severe enough to cause extensive winterkill. More studies are needed to determine the best cutting management for alfalfa in Alaska.
·Michael T. Panciera and Stephen D. Sparrow

Permafrost Soils Characteristics

The Arctic is the region of greatest expected change due to its large soil carbon stores and extensive wetlands. Therefore, it could act as a large positive feedback to global warming. The specific objectives of this study are to characterize the morphological, chemical, and physical properties of the cryogenic soils, and to estimate the carbon storage in soils of different ecosystems. Soils were

studied along a north–south transect in the Kuparuk River Basin of Arctic Alaska. [Soil pits were selected to represent major land cover classes. Each pit was excavated to 3 feet wide and at least 3 feet deep unless the permafrost layer was deeper than 3 feet or excavation was limited by bedrock. Soil profiles were described and sampled according to the Soil Survey Manual. Special attention was paid to the cryogenic structures, ice content, and depth of permafrost tables. Soil samples were analyzed according to the USDA National Soil Survey Laboratory procedures.]

Soils on the coastal plain with wet, nonacidic tundra vegetation are poorly to very poorly drained. Soil occurring on low-centered polygons or waterways have 6 to 10 inches of organic material and on flat or high-centered polygons have less than 15 inches organic layers over fluvial deposits. These soils have an alkaline reaction due to carbonates deposit on the soil surface. Ice wedges are common and their volume increases from younger (low-centered polygon) to older (flat polygon) sites. Ice lenses are also common but are weakly developed and coarser than in the tundra soils. Soil textures are peat and muck in the organic layers and sandy or coarse loamy in the mineral substratum.

There are two major soil groups on the glaciated foothills south of the coastal plain. Moist, nonacidic tundra soils formed in calcareous loess over glacial till along the northern fringe of the foothills. Moist, acidic tundra soils formed in loess over glacial till, extending from south of the nonacidic tundra zone to the footslopes of the Brooks Range. Both of these types of soils have strongly developed cryogenic profiles. Ice wedges and strongly developed fine ice lenses in subsoils are common. The surface organic layer consist of partially to well decomposed organic matter. The subsoils are loamy or silty and are generally gleyed or strongly mottled suggesting a fluctuating water table and reduction with the rise and fall of permafrost. The upper permafrost layers have mucky silty loam texture and well developed ataxic structures (ice-rich). The continuous buried organic horizon under the cryoturbated organic material in the lower active layer suggests a paleo-origin which has been modified by the cryogenisis.

Soils along the water tracts and drainages are very poorly drained, and inundated during most of the growing season. The submerged organic layer is dominantly muck overlying a strongly gleyed mineral subsoil. Soils formed in depressions and valley bottoms are dominantly organic with peat and muck layers exceeding 20 inches. Due to their landscape positions, these soils are stratified with thin layers of mineral soils.

Soils on the sparsely vegetated upland and alpine tundra do not have permafrost within 3 feet of the surface. The seasonal freeze–thaw cycle has resulted in strongly developed granular and platy structures in the B horizons. The organic matter accumulation rate is very low. These soils generally have a redder hue due to well-drained conditions. Soils along the major river channels also lack permafrost within 3 feet of the surface. These soils are coarse-textured and excessively drained. Under shrubby vegetation cover, humus accumulation has produced an A horizon, generally less than 8 inches thick.

• C.L. Ping

Soil Environment Monitoring

The objectives of this study are to monitor the soil temperature, water table, and soil reduction–oxidation potentials, and to relate these measurements to the hydric soils criteria used for wetland delineation. Four sites were selected along a landscape sequence including bottom land, footslopes and toeslopes in a watershed on Douglas Island in Southeast Alaska. The monitoring sites were selected because an oxyhydric condition was suspected in the area. Based on first year's results, the soils experienced both saturated and reduced conditions during the growing season, thus they meet the hydric soils criteria. There are two separate water tables identified; an unconfined one in the upper 3 feet conditioned by surface infiltration and a confined one in the underling glacial till. There seems to be little exchange between the two aquifers.

• C.L. Ping and D. D'Amore

Characteristics of Soil Organic Matter in Permafrost Soils

The objectives of this project are to estimate the quantity and quality of soil organic matter in Arctic tundra soils and to relate those parameters to trace gas flux in the Arctic tundra ecosystems. Permafrost soils account for 13% of the total land surface but they store nearly 30% of the total terrestrial carbon. Carbon storage in the coastal marsh and depressions, in the upland moist tundra, and in the foothills range from 200 to 270, 115 to 230, and 30 to 115 pounds carbon per cubic yard, respectively. These data indicated that the previously reported amount of carbon storage in the Arctic tundra was underestimated by a factor of two. The upland tundra soils have buried organic horizons indicating the presence of paleosol with carbon-14 isotope (^{14}C) dating of 7 to 8000 years before present. The delta^{13}C values range from –27 to –32 $^{0}/_{00}$ indicating the dominance of C–3 plants in early Holocene. The bioactivity of soil organic matter was first assessed by chemical extraction with dilute alkali solution. In organic soils, less than 30% of the total carbon

are extractable (soluble) because it is less decomposed as compared with the mineral horizon in which more than 50% are extractable. The carbon content of soil organic matter ranges from 24 to 52% which is lower than the 58% in soils of the temperate region. The dominant components in the extractable fraction is humic acids, followed by neutrals, fulvic acids, and low molecular weight acids. Most of the nonextractable fraction are hemicelluloses and cellulose.

• C.L. Ping and G.J. Michaelson

Annual Forage Crops

The objectives of this study were to determine the forage yield and quality of forage peas and vetches grown in monoculture and intercropped with oats at various nitrogen (N) fertilizer levels, to estimate the N fixation potential of peas and vetches, and to provide an economic comparison among these crops with forage crops currently grown in Alaska. Treatments consisted of monoculture oats fertilized at five N rates and 'Lana' purple vetch, common vetch, 'Carneval' peas, and 'Trapper' peas in monoculture and intercropped with oats at two N rates. The study was done at four locations: Delta Junction, Fairbanks, and Nenana in Interior Alaska and Point MacKenzie in Southcentral Alaska. Vetches gave very low yields at all locations. Yields at Point MacKenzie were low (usually less than one ton per acre) with little difference among treatments. This was likely due to water stress at that location. Yields at all Interior locations were much higher than at Point MacKenzie, often exceeding two tons per acre and occasionally reaching four tons per acre. At Delta Junction, oat yields for all but the zero N treatment exceeded pea or intercropped oat–pea yields. This was, in part, due to moose grazing on the pea pods. At Fairbanks and Nenana, total dry matter yields for oat–peas without N fertilizer were usually slightly lower than for fertilized, monocropped oats, but protein yields were higher for the oat–pea mixtures. Forage quality analyses other than protein are underway.

• Stephen D. Sparrow and Jeffrey B. Midguard

Soil and Crop Management Practices

The purpose of this experiment was to study the long–term effects of various soil and crop management practices on dry matter yield, plant protein, nitrogen fixation, and soil biological, chemical, and physical properties. Plots were established at Point MacKenzie in Southcentral Alaska in 1991 and at Delta Junction and Fairbanks in Interior Alaska in 1992 and were monitored for five growing seasons. Crops included perennial forage legumes, perennial grasses, annual grains, and a non–cropped fallow treatment. Each plot was split with one part receiving an annual application of nitrogen (N) fertilizer and the other part receiving no N fertilizer. Above and below ground plant dry matter yields and plant N concentrations were measured each year for each species. Soil properties measured included organic carbon (C), total N, pH, microbial biomass C, and wet aggregate stability. Survival of legumes was poor at Delta Junction, with all but alfalfa dying off during the first winter. Alfalfa persisted throughout the study, but stands and hence yields were poor. At Point MacKenzie, long–term survival of red clover was quite good. At Fairbanks, survival of red clover and alfalfa was good, and high yields were obtained throughout the study. Nitrogen fertilization resulted in dramatic yield increases for non–legume crops. Some legumes showed no response or negative response to N fertilizer, indicating that they were able to fix adequate amounts of atmospheric N. Total soil C and N did not change substantially during the course of the experiment. By the end of the study, wet aggregate stability was highest in the perennial crops and lowest in fallow. Soil microbial biomass C was highly variable with no consistent trends evident except that values tended to be highest in soils cropped to perennial legumes.

• Stephen D. Sparrow and Michael T. Panciera

Managing Bluejoint

Bluejoint grass (*Calamagrostis canadensis*), a native Alaska grass, can be a serious weed on pasture land in Alaska because it often outcompetes introduced forage grasses. Bluejoint produces fairly good quality forage early in the growing season, but the quality decreases rapidly as the season progresses. Often, using herbicides is not an option for controlling bluejoint. The purpose of this study was to determine if various mowing treatments, combined with various nitrogen (N) fertilizer treatments, would improve the late season forage quality of bluejoint or control its growth thus allowing more desirable species to grow. Fertilizer treatments included no N fertilizer, N fertilizer applied once at the beginning of the growing season, or split applications where N fertilizer was applied once early in the season and again when first mowed. Mowing treatments included none, single or triple cuttings done at different times during the growing season. The study was done near Delta Junction. In both 1995 and 1996, addition of N fertilizer resulted in substantial yield increases but only small increases in late season forage quality indices. Mowing in June resulted in a fair amount of regrowth; mowing in mid–July or later resulted in little regrowth of bluejoint.

• Stephen D. Sparrow and Michael T. Panciera

Microbial Degradation of Hydrocarbons

Principles developed in laboratory studies have been applied to a petroleum–contaminated North Slope gravel pad. The pad, which is composed of coarse sand, holds very little water, and was expected to be sensitive to over–fertilization. Fertilizer treatments applied in the field revealed that whereas bioremediation could be stimulated with a small (1.4 ounces per pound) application of nitrogen, slightly larger applications (2.8 or 4.2 ounces per pound) inhibited bioremediation. Soil receiving 4.2 ounces nitrogen per pound showed less microbial activity than soil that was not fertilized.
•James Walworth and Joan Braddock

Tuber–Setting Properties of Potatoes

Potato tuber formation and development is affected by genetics and environment. One environmental factor affecting tuber formation is nitrogen supply. We are evaluating the impact of nitrogen supply on several varieties of potatoes by removing plants weekly throughout the growing season and measuring and counting all tubers at each monitoring interval. We have found that increasing nitrogen supply to the plants increases vine size and tuber production, but does not delay tuber initiation or development. In some varieties, however, high levels of nitrogen fertilizer can increase production of oversized tubers which are of lesser value than medium–sized tubers.
•James Walworth and Donald Carling

Head Lettuce Variety Trial

Fifteen head lettuce varieties were evaluated in replicated trials and in two on–farm observation trials in 1996. Three field planting dates were used, corresponding to early, intermediate, and late planting dates of commercial growers. Traits measured included head size and weight, tip–burn resistance, percentage of heads with defects, and days to harvest. When combined with data obtained in 1995, Tiber had the highest level of tip–burn resistance, 20% above the mean of all varieties tested. Its head size, however, was larger than desired, and will limit its production in Alaska. Other varieties having desirable size, tip–burn resistance, and low percentage of head defects were Premier and Pybas 142E.
•James Walworth, Don Carling, and Steve Dofing

Bioremediation of Petroleum Contaminated Cold Region Soils

Through this research, optimum soil nitrogen levels for restoring petroleum–contaminated soil have been related to both soluble soil nitrogen and soil water content. In dry soils, where inorganic nitrogen is dissolved in a relatively small quantity of soil water, microbial populations can be adversely affected by modest levels of nitrogen fertilizer, and bioremediation can be inhibited. We have developed a simple method for calculating maximal fertilizer application levels.
•James Walworth, Mike Reynolds (USA–CRREL), and Craig Woolard (UAA)

A Nutrient Source for Bioremediation

Nitrous oxide, a nitrogen–containing gas, is being tested as a fertilizer for bioremediation systems. Effectiveness of this form of nitrogen has not previously been established. We have demonstrated that biological degradation of soil petroleum is stimulated and nitrous oxide consumed when nitrous oxide is added to contaminated soils. If further testing confirms these findings, nitrous oxide could become an alternative to the use of solid or liquid nitrogen fertilizers in bioremediation systems.
•James Walworth and Craig Woolard

Evaluating Weed Control Options

Vapam (metam sodium) and basamid (dazomet) are being evaluated for weed control in potato and vegetable production rotations. Both materials are soil sterilants and kill weed seeds as well as growing plants. These materials are being used as one–time treatments to reduce weed populations to manageable levels. After their use, annual weeds in vegetable fields can be controlled through traditional manual techniques. Our studies indicate that use of vapam or basamid can reduce overall weed control costs, improve weed control, and reduce the annual use of herbicides. Vapam is currently labeled for this use, whereas basamid is not yet labeled for use in food crop production.
•James Walworth and Donald Carling

The Use of Alaskan Fish Meal as a Nutrient Source for Bioremediation

Fish bonemeal, a processing by-product, has been tested as a fertilizer for bioremediation of petroleum–contaminated soils. Fish bonemeal is rich in nitrogen and phosphorus which it releases as it decomposes. This provides nutrition for soil microbes that degrade petroleum over a long time. This research was conducted to measure rates of nutrient release under various soil conditions and to evaluate behavior of bonemeal in petroleum–contaminated soil. Laboratory tests indicate that fish bonemeal can be an effective fertilizer for restoring contaminated soils.
•Craig Woolard (UAA) and James Walworth

Spruce Responds to River Discharge

We examined the relationship between white spruce radial growth rates and Tanana River discharge (amount of water per unit of time) at the Bonanza Creek Experimental Forest Long–Term Ecological Research site (LTER). We obtained cross–sections of white spruce stumps from a recent harvest, and cored more than 100 white spruce trees growing on the Tanana River floodplain. Unlike upland trees, floodplain spruce growth did not respond to summer temperatures and responded less to precipitation. Although the ring–widths did not reflect flood events, the analyses did detect a relationship between river discharge rates and white spruce radial growth. Discharge rates on the glacier fed Tanana River increase with temperature as well as precipitation. Although hot dry weather limits the growth of white spruce in upland areas, these same weather conditions can increase river discharge, thus preventing reduced growth rates of floodplain trees. These results suggest that floodplain spruce sites are productive for fundamentally different reasons than upland sites.

• Phyllis Adams and Glenn Juday

White Spruce Growth is Consistent with Increased Climatic Stress

White spruce wood sections from Bonanza Creek LTER site were analyzed by two unconventional techniques. Passing an x–ray beam through wood measures its density, and year–to–year variations in density are related to the climate. Wood produced each year incorporates different amounts of stable isotopes (chemical variants of elements that differ only by the number of neutrons). Other studies have established that an increase in the amount of the carbon–13 isotope (^{13}C) compared to the normal carbon–12 in a plant's tissue is a measure of moisture stress. We correlated stable isotope and density values with Fairbanks monthly temperature and precipitation data. While previous studies in Alaska have established good correlations of tree–ring width with multi–year climate indices, our results are based on correlation of wood properties with climate in the year the ring was formed. Other studies have demonstrated that the maximum density of latewood in a tree ring indicates moisture stress. The maximum density of latewood in the LTER sample during the period 1909–1981 was highly correlated with warm May and August temperatures. Density has reached extreme high values in the last few years measured. ^{13}C enrichment was negatively correlated with growth year precipitation and positively correlated with summer temperature. Recent delta ^{13}C enrichment (about one part per thousand) is the highest recorded in the 20th century. Both density and isotope measurements establish that since the late 1970s white spruce trees are experiencing extreme levels of climatically driven stress.

• Valerie Barber and Glenn Juday

Detecting Wildfires

We started testing three different methods for detecting actively burning wildfires in Interior Alaska using daily Advanced Very High Resolution Radiomenter (AVHRR) satellite data. We are using 1995/96 satellite imagery with known fire locations obtained from the Alaska Fire Service to evaluate which method is best to use in Alaska. Previous research on fire detection using AVHRR data has been mostly from lower latitudes. Unique problems at high latitudes include no darkness during the summer and reflection in the thermal band from glacial deposits.

• Steve Boles and Dave Verbyla

Modeling Landscape Level Management

Previous efforts centered on developing a water balance model that could be applied at the landscape level by virtue of its hierarchical structure of "segments", running from a stream reach or link to the watershed divide, which in turn is subdivided into "elevational zones". A watershed of any size could be represented as coarsely as one segment and one elevation zone, or as finely as biophysical data and computer memory allowed. Current work is focused on translating this mainframe Fortran program into a cross-platform personal computer format with a convenient graphic user interface. In addition, improved soil surface temperature algorithms are being experimented with since surface temperature is a key controller in soil freezing and thawing and is responsive to canopy coverage. The efforts to link the model to a Geographic Informa-

tion System have not been successful to date but new approaches will be tried.
·John D. Fox, Jr.

Estimating Growing Seasons

We started a project using 10–day .62–mile AVHRR satellite data to develop a growing season map for the circumpolar north portion of the globe. We will use daily AVHRR data to develop a growing season map for arctic and subarctic Alaska. The growing season map will be validated using weather station data, elevation data, and other satellite data.
·Heather Goldman and Dave Verbyla

Tree–ring Evidence of Climatic Warming Stress in Alaska

The radial growth history of white spruce was measured at Fort Richardson (n = 197 trees) near Anchorage and at five stands in Bonanza Creek LTER near Fairbanks (n= 68, 70, 40, 38, 50). All responded to an abrupt change in climate since the late 1970s, although the response varies according to region, stand history, and site conditions. The spruce grew more with greater precipitation in all stands, more with warmer summers at Fort Richardson, and less during warmer summers and more with cooler summers in the LTER stands. Radial growth of the Fort Richardson sample was accelerating in response to warming when a massive bark beetle epidemic, probably related to climatic warming, caused widespread tree mortality. In the LTER stands monitored, snow breakage events in 1989 to 1991 triggered bark beetle attacks that occurred as tree growth was slowing markedly due to warming and drying. A three–year radial growth reduction from 1993 to 1995 caused by a spruce budworm outbreak is unique in the 200–year record, supporting the view that outbreak levels of this insect are caused by recent climate warming. All other one and two year LTER growth reductions are clearly correlated with climatic events.
·Glenn Juday

Irrigation Changes Spruce Growth

White spruce trees growing on low elevation upland sites in natural forests of the Tanana Valley produce smaller tree–rings in warm summers and larger rings in cool summers. This is opposite from what is generally expected in a cold boreal region. We tested the hypothesis that supplying moisture would reverse this effect and produce a pattern of larger ring–widths in warmer summers for trees under lawn irrigation. We cored and measured tree–rings collected on the UAF Chancellor's lawn, the Noel Wein Library, the Fort Wainwright golf course, and a private residence. At the first two sites, trees were irrigated for their entire lives and had larger rings in warm summers. At the second two locations, ring–widths for the samples were compared for at least 20 years under irrigation and 20 years without irrigation. In nearly all cases at the second two sites the trees went from smaller rings in warmer summers during the period of no irrigation to larger rings in warm summers during the period of irrigation. Nearly all the effect of greater ring growth in warm summers under irrigation was found in June alone. These results establish that white spruce is severely moisture stressed in this part of Alaska. Forest management treatments that prevent intense competition for water should especially benefit white spruce stand growth.
·Glenn Juday and Samantha Lown

Measuring Plant Productivity

Estimating the amount of plant growth on the earth is important for earth system science and global change studies. Most of the estimates of global production have been based on computer models adjusted by satellite–derived Normalized Difference Vegetation Index (NDVI) or "greenness" measurements of the difference in light hitting the earth's surface and the light reflected off the earth. Investigators are using several years satellite measurements to identify trends in the year–to–year difference in satellite readings, making it important to verify the satellite–based computer model estimates with on–the–ground measurements. A number of non–biological factors, such as switching among the satellites providing the readings and time of day the readings are taken, can influence the results. We used large–scale records of agricultural crop production and tree–ring measurements of birch and white spruce over the period 1982–90 to test model and satellite estimates of global production. Among the four models tested, the model FASIR adjusted NDVI readings to produce the most accurate values. The upward trend of NDVI–based estimates of global plant production in the model CASA have led some investigators to suggest that global warming or carbon–dioxide enrichment of the atmosphere have increased worldwide plant growth. Our results, however, show that the amount of increase that CASA predicts has not been measured on the ground. A systematic trend in the NDVI data caused by a change in the time of day that the satellite readings are taken must be removed to obtain accurate estimates of global production, so global warming cannot have produced the amount of effect estimate by some models.
·Glenn Juday, Carolyn Malmstrom, Matthew Thompson, James Randerson, and Christopher Field

Individual Tree Volume Tables

Accurate individual tree volumes is essentially for property owners, industry, and research. Sampling of white spruce essential was completed during 1996. A review of the sample suggests additional trees from the eastern edge of the state is desirable. Additionally, there is still a need to sample large trees. One stand scheduled to be harvested in mid– or late–1997 has been identified with trees greater than 130 feet high, the manager of the land was contacted and is agreeable to sampling. A regional set of tables for the Kenai Peninsula is planned for summer 1997. Sampling of tree and bark measurements for other species continues.

·Edmond C. Packee

Forest Productivity

Site index curves for balsam poplar/western black cottonwood in northern and southcentral Alaska are done. Selecting sample sites for black spruce is completed; field sampling should be completed in 1997.

·Edmond C. Packee

Forest Products

Export markets (British Columbia, Washington, Oregon, and Asia) for Alaska round logs have been improving since mid–1996. New buyers have expressed interest in logs, chips, and some value–added products. Pulp inventories remained higher than anticipated through 1996, however. The pulp mill at Ketchikan announced its intent to close in early 1997; this removed a within–state value–added facility that included shipping round logs from the Kenai Peninsula. The bark beetle epidemic continues to reduce the stumpage values and end product options for spruce logs. A shortage of hardwood fiber for pulp is predicted to hit Pacific northwest states within the next five to 10 years; indicating potential opportunities for marketing Alaska hardwoods in that region.

·Edmond C. Packee

Silvicultural Systems

In Fall 1996, survival and growth of the Tok Levels–of–Growing Stock (LOGS) were again assessed. This was the fourth year standard assessment. Survival for white spruce, black spruce, and tamarack continues to exceed 90%; for the three species combined, only one seedling died. This was not the case with lodgepole pine where more than 60% suffered damage and high mortality; detailed analysis of the mortality will not be carried out until the 1997 assessment is complete. The three species survival data analysis was completed by an NRM student for a B.S. thesis. Because of damage noted in the Bonanza Creek LOGS study, assessment procedures were changed to be more inclusive with a full fall assessment. Preliminary results suggest spruce gall aphid attack is less severe on some white spruce trees than most other trees. Browsing damage to lateral buds, occasional terminal buds, and small lateral branches was noted on many spruce trees. Initially, this was thought to be due to the spruce grouse, but later observations suggest that red squirrels are the culprit. As a result of this damage pattern, internodal distance measurements were begun on all spruce between the fifth and tenth years.

·Edmond C. Packee

Managing Forests for Biodiversity

A major concern in managing for biodiversity is how to define biodiversity and quantify impacts on it. Disciplines, agencies, and organizations define biodiversity differently. This creates confusion among the public as well as land managers. During 1996 and continuing into 1997, regular weekly meetings were held under the aegis of a non–government organization to try to reach a consensus on what biodiversity means in Alaska. A basic division exists as to whether the concept should be ecology based or biota–based. The ecologic–based definition takes into account both the living and nonliving components of an ecosystem; whereas, the biota–based definition emphasizes almost exclusively species richness and genetic variability and states that these are measures of the nonliving components. For land management to effectively achieve stated goals, the ecological definition is essential. In attempting to measure biodiversity, it is physically impossible to inventory every species on a site. The concepts of "keystone species," a species that is central to maintaining the integrity of the ecosystem, and "indicator species", a species with such a narrow ecological tolerance or amplitude that its presence or absence is a reliable indicator of environmental conditions, are essential to managing for biodiversity. The bark beetle and the moose can be considered keystone species because if their populations are allowed to increase and stay at very high levels, they can significantly impact forest stand structure, processes, and other species. The Townsend warbler, solely dependent upon dense white spruce for nest sites, is an indicator of spruce forest health; if the spruce are missing, the warbler will be missing as well. Unfortunately, no one species is a keystone species or an indicator species.

·Edmond C. Packee

Reforestation Stocking Standards

A search of the literature was begun in 1996 to investigate the effects of initial espacement on growth and yield of Alaskan spruce. Levels–of–Growing–Stock studies (plantations or spacings of natural stands) were found for white spruce, black spruce, and Sitka spruce. Survival curves were quite similar. Stems per acre from currently used white spruce yield tables appear to parallel the espacement curves. This strongly supports, for white spruce and expands to black and Sitka spruce, the previous conclusion that currently accepted initial stocking of 450 tree per acre is too low.
• Edmond C. Packee

Forest Health

Northern forest health conditions continue to decline. The spruce beetle has decimated entire drainages in the Copper River Basin, including the Klutina and Chitna rivers, and has severely impacted most of the white spruce forest on the west side of the Kenai Peninsula including the salmon–rich Kenai River system. Efforts during the past year emphasized the bark beetles' impact and has involved participation in three workshops to disseminate information. We are changing the focus from the beetle to the impacts of the beetle, sudden and long–term defoliation and mortality of spruce trees, and the development of approaches to ecosystem restoration. Presentation and publication of these results are planned for 1997. During 1996, root decay fungi became more obvious factors in forest health; efforts were begun to emphasize that root rot and windthrow had to be separated. Presence of root decay infection centers must be identified so better regeneration prescriptions can be made. Conifer root decay centers also provide a stimulus for mixed–species management.
• Edmond C. Packee

Permanent Sample Plots

An additional 21 sample plots were established in 1996. Three plots were established in the unthinned portion of the white spruce seed production area at Tok. All pre–1996 data have been checked for errors and a clean set of data now exist. During 1996, increased effort was made to establish sample plots in pure stands and expand the plot system into the Copper River Valley. Expansion into the Copper River Valley has been requested by both Native and state land managers. A grant was awarded to support this expansion over the next two years.
• Edmond C. Packee

A 40–Year Record of White Spruce

The periodic nature of white spruce cone and seed production is well known in both the literature and forest management experience, but the factors that trigger these infrequent cone crops is not well documented. We developed a nearly 40 year record of white spruce reproduction for the Fairbanks area in Interior Alaska using overlapping cone and seed production records combined into a derived index value. The index provides a measure of the availability of seed for potential natural regeneration. Good to excellent seed crops occurred up to 12 years apart and a full 28 years separate the exceptionally large crops of 1958 and 1987. Successive year–to–year large cone crops years did not occur in this record, although large crops occurred in 1970 and 1972. We investigated the influence of precipitation and temperature on critical stages and events of the 17– to 18–month white spruce reproductive cycle throughout the long–term seed and cone index record. Climatically initiated drought stress appears to be an important factor in cone crop initiation, as indicated by both weather records and radial growth records. Other subsequent events, such as spring frost, can play a decisive role in cone and seed crop success or abundance.
• Scott Rupp, Glenn Juday, John Zasada, Leslie Viereck, and Phyllis Adams

Image Processing With GIS

Point, line and polygon themes have been the backbone of most Geographical Information Systems applications. Images and grids have only recently been available for use with popular ArcView and Arc/Info GIS systems. We completed a 12 chapter workbook to help GIS users who want to learn how to use images from a GIS perspective. The workbook contains ArcView and ARC/INFO exercises on image display, 3–D surface display, map scanning, remote sensing, map projection and datums, image rectification, unsupervised classification, supervised classification, accuracy assessment, grid operations, and system tips and tricks.
• Dave Verbyla and Karl Chang

A Geographic Forest Ecosystem Dynamics Model Integrated Within a GIS

Modeling the biology of forest ecosystems has been devoted to a combination of theoretical and empirical approaches representing the function of a forest ecosystem generally within an undefined spatial context. Moving to a large spatial context will require the use of theoretical representations

of critical ecosystem functions that can be represented on an individual cell basis. It should then be possible to vary the size of the smallest cell from 10.8 square feet to 247 acres.

A forest ecosystem dynamics model was developed that is based on the nitrogen productivity concept for forest growth; litterfall quality and microbial efficiency for forest floor decomposition. Climate and ecosystem level disturbances will be handled as restricted stochastic processes. The restriction will be based on known state factor relationships. The state factors are used to describe a broad scale classification of the landscape to define basic limitations for the randomly derived driving variables used in the model.

The model has been programed as an ARC/INFO AML within the GRID package. The current version of the model has been verified as functional from an individual tree basis (10.8 square feet cell size) in a number of forest types found in Interior Alaska. Verification on a landscape scale (2.47 acres cell size) is difficult because of a lack of detailed data that can be used from a landscape perspective.

•John Yarie

N–Productivity of Alaska Tree Species

The nitrogen productivity (N–productivity) concept represents one approach for developing algorithms for expansion from the individual tree to stand or landscape levels of estimating of primary production across the earth's surface. A simple equation based on the N–productivity concept can be used to estimate plant production from the individual tree to stand level geographic units. Maximum N–productivity equations were developed for balsam poplar, white birch, and white spruce on an individual tree basis for the taiga of Interior Alaska. Maximum N–productivity equations were also developed for aspen, balsam poplar, and white spruce on a unit area basis in square meters. A single equation for all species sampled and individual stands was developed on a unit area basis. The calculated productivity for test stands was in close agreement to the measured productivity from the landscape perspective. The set of equations presented can be used for calculation of taiga forest productivity in a geographic model developed within a GIS software package in which the landscape unit is an integral part of the model structure.

•John Yarie

Resources Management

Bosnia Deforestation and Commercial Timber Assessment

Final ground assessments in Bosnia were completed with the protection of NATO forces. Data was corrected for geometric warping and assessed for postwar deforestation. Results show deforestation in Bosnia due to war activities is mostly in small acreages concentrated around villages but taken all together it is significant. The final report will be used to focus efforts of international reconstruction and reclamation efforts in Bosnia by the United Nations and the World Bank.

•Harry Bader and Dara Fell

Developing Recreational Trails

Recently U.S. federal agencies decided to expand recreational trail and road works in Alaska. We sampled vegetation and identified soil characteristics on Porcupine Dome in Interior Alaska to assess the impact of recreational trail development in subarctic, alpine environments. There was a reduction in species richness and an increase in percent vegetative cover by woody species and forbs. Findings were consistent with arctic tundra under similar disturbances.

•Harry Bader

Regional Economic Modeling

In this study a regional economic model of the Norton Sound Red King crab fishery was developed to evaluate the economic impact of regulatory changes to the Norton Sound red king crab fishery. A recent change in the fishery's regulations led to a fundamental change in the way the fishery is prosecuted. The original fleet of long distance, highly capitalized vessels was replaced by small local vessels primarily from the Nome and Yukon Delta regions. The localization of the fleet has not only created direct employment opportunities for the local residents but also contributed to the local economy in general. The results of the regional economic model indicate that the 1994 fishery, an industry in its infancy, was able to contribute over one-half million dollars in income to an economically depressed region of Alaska where few local industries exist and

the prospects for developing new industries are dim. Furthermore, model results suggest the regional economic contribution nearly doubled in 1995.
•Joshua Greenberg, Bill Natcher, Mark Herrmann

Evaluating the Economics of Pot Limits in the Adak Brown King Crab Fishery

This study focused on an economic evaluation of the proposed pot limits for the Adak brown king crab fishery. Among the reasons cited for considering pot limits has been a concern that declining fishery harvests indicate declining stock abundance. There is also concern that the large number of pots carried by some vessels keep smaller operations out of productive fishing grounds. However study results indicated that due to specific fishery characteristics, pot limits were not advisable and in fact may be harmful to the future productivity of the fishery.
•Joshua Greenberg and Mark Herrmann

Effects of Management Policies in Alaska Crab Fisheries

The past two decades have been a period of tumultuous change in Alaska's crab fisheries. This period has seen dramatic expansions and declines in crab stocks accompanied throughout by a rapidly growing commercial harvesting sector. Fishery managers have been challenged to develop management strategies that protect the crab stocks while supporting the commercial fishing industry. This study focuses on the two most commercially valuable Alaska crab fisheries, the Bristol Bay red king crab fishery and the Bering Sea snow crab fishery. The analysis is intended to provide fishery managers and industry participants with insights into effects or possible effects of various management strategies and assist future fisheries management.
•Joshua Greenberg

Studying Recreational Territories

A change in the pattern of fishing on Alaska's Gulkana River was noted in the previous year. In the earlier pattern of use, fishermen would "capture" the primary fishing holes by setting up elaborate territories and defending them. Thus, people would compete for the limited number of primary holes (places where the king salmon would hold prior to moving up stream). Once a primary hole was "captured", the party would stay there for their two to three day visit.

The new pattern is to fish nearly all primary and secondary holes for a short period and then move on. The anglers then camp wherever they are at the end of the day. This past year's observational data both confirmed this new pattern and tested the "softness" of the new territories in terms of either minimally defending them or moving on when others invaded the area. This "softness" was confirmed. Cooperative is more descriptive of the new style of territory. It was interesting that several primary holes did not have anyone camping on them during the July 4th weekend—a period of peak use and competition for fishing.

New fishing regulations for 1997 may encourage more use during times when guides are not allowed to use the river. The observations for 1997 will focus on these times.
•Alan Jubenville

Advancing Extreme Life Systems

The problems of obtaining adequate pure drinking water and disposing of liquid and solid waste in the Arctic have led to unsanitary and socially unacceptable conditions. Advanced Life Systems for Extreme Environments (ALSEE) provides a solution by applying NASA–developed technologies in a holistic approach to eliminate the honey bucket and open lagoon.

Discussions are continuing with state government and Ilisagvik College in the North Slope Borough. We are emphasizing the controlled environment agriculture component of the project. Plants and finfish (talapia) are an important part of water purification systems. Additionally, they provide fresh vegetables and flowers in an area where both are of poor quality and expensive. Nutrition is very important in remote villages and availability of fresh, high quality products may help improve diets. There is also a unique marketing opportunity for vegetables, flowers, and finfish from the frozen north.
•Carol E. Lewis and David L. Bubenheim

Marketing Cooperatives in Alaska

The objective of this project is to educate and develop services for producers and processors interested in forming marketing cooperatives. We began our work in Delta Junction with several dairy farmers. We also worked with Wrangell residents interested in a boat haul–out and dry dock, and an artists cooperative. Most recently, sponsored by the Alaska Economic Development Center, we went to Unalaska to help the Unalaska Fisherman's Association begin a cooperative to lease a multifunction seafood processing plant. The latter was the only group who formed a cooperative to accomplish their objective.

Cooperatives are often misunderstood as a vehicle that can be used to obtain grants. Our group strongly emphasizes that a cooperative is a

business. It is only as strong as its members because the members own the cooperative. Therefore, the members must understand their own businesses, their own business objectives, and their own financial, cash and product flow status before they enter into a cooperative business with others. Importantly, the group that wants to act cooperatively must have a very specific objective and the objective must be within the means of the group to accomplish. The Unalaska group knew their own situations, they had a very simple objective: process finfish in the round and export them in an existing marketing chain. The objective was well within the means of the group. The Unalaska Fisherman's Association should be on their way to success.

• Carol E. Lewis, Annette Johnson, Hans Geier

Alaska Grown Products

The classroom is used as a part of testing consumer acceptance of Alaska Grown products. In NRM 310: Agricultural Concepts, we have conducted sensory panels, prepared marketing strategies, and created logos for Alaska honey, carrots, barley, pancake mix, salsa, and tomatoes. Most recently we included processed seafood products. Pollock fillets enhanced with a whey product only and a combination of a whey and sodium injection were evaluated by classes in Fairbanks and Palmer and within the general populace in Anchorage, Fairbanks, and Palmer. The objective of the injection was to firm the fish fillets making them acceptable for use in the frozen, breaded fillet market. The fillets we served were steamed in trays to eliminate any confounding taste from breading. The preferred mix was the combination of whey and sodium. The product is a predecessor to injecting arrowtooth flounder. This flounder is a soft fish which presently has a low market value. When it is used at all it is used in surimi.

• Carol E. Lewis, John M. French, Joshua A. Greenberg

Mining and Forestry Joint Agreement

Negotiations, begun in early 1995 between the University of Alaska and Massachusetts Institute of Technology, have culminated in a preliminary memorandum of agreement between the two institutions to develop research and demonstration projects in forestry and mining. The objective is to use advanced technologies to enhance the value–added timber industry in Alaska and to develop either 'smaller' or more remote mineral deposits that are not now feasible to mine. In both industries where supply sources are remote, energy is a major cost factor. Waste is also a problem. The two institutions will use their knowledge of raw material supplies, technology development, and community economic development to enhance technology and technology transfer to industry in Alaska.

• Carol E. Lewis and Robert Trent

Economic Feasibility Studies

A 'recipe' for conducting and completing economic feasibility studies was developed and tested through two economic feasibility studies completed for the cities of Wrangell and Shaktoolik. The first determined that a boat haul–out and dry dock could be constructed and operated in Wrangell with a slight margin of profitability if favorable loan rates could be obtained. The second determined that it was not feasible to construct a combined fish and reindeer processing plant in Shaktoolik primarily because of uncertainty in supply of reindeer and competition in fish processing. Research results showed that the community must want to pursue economic development and community members must be an integral part of the planning and implementation. The researcher must be cognizant of the community economic and lifestyle profile. Finally, the plan the community and researcher complete must be realistic in its expectations. The researcher should not lead the community into believing it can complete a project just because it wants to do so.

• Christina A. Young (Bell) and Carol E. Lewis

Faculty Publications

January 1996–December 1996

Journal Articles

Title	Author(s)	Published In
The National Soil Survey Center database for permafrost–affected soils (gelisols)	Bockheim, J.G., J.M. Kimble, C.L. Ping	*Soil Survey Horizon* 37:111–119
Near–isogenic analysis of uniculm and conventional–tillering near–isogenic barley lines	Dofing, S.M.	*Crop Sci.* 36:1523–1526
Tiller initiation and survival in barley as influenced by cultivar and management	Dofing, S.M.	*Cereal Res. Com.* 24:485–490
Spatial prediction of climatic state factor regions in Alaska	Hammond, T., J. Yarie	*Ecoscience* 3:490–501
Mycorrhizal chronosequence near Exit Glacier, Alaska	Helm, D.J., E.B. Allen, J.M. Trappe	*Canadian Journal of Botany* 74:1496–1506
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Properties and soil development of late–Pleistocene paleosols from Seward Peninsula, northwest Alaska	Hoefle, C., C.L. Ping	*Geoderma* 71: 219–243
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Trail and Site Management Are the Key to Untrammeled Wilderness	Jubenville, A.	*International Journal of Wilderness* 1(2):23–24
Cooperatives on the Last Frontier	Lewis, C.E., H. Geier, A.L. Arobio, C.A. Young, J.A. Greenberg	*Rural Cooperatives* 63(6):13–17
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Control of petunia *Sclerotinia* stem rot with *Trichoderma atroviride*	McBeath, J.H., G. Matheke, P. Wagner	*Phytopathology* 86:S37

Title	Author(s)	Published In
Carbon storage and distribution in tundra soils of Arctic Alaska, USA	Michaelson, G.J., C.L. Ping, J.M. Kimble	*Arctic Alp. Res.* 28:414–42
Comparative estimates of fine root production in successional taiga forests on the Alaskan Interior	Ruess, R.W., K. Van Cleve, J. Yarie, L.A. Viereck	*Canadian Journal of Forest Research* 26:1326–1336
Regions of the genome that affect agronomic performance in two–row barley	Tinker, N.A., D.E. Mather, B.G. Rossnagel, K.J. Kasha, A. Kleinhofs, P.M. Hayes, D.E. Falk, T. Ferguson, L.P Shugar, W.G. Legge, R.B. Irvine, T.M. Choo, K.G. Briggs, S.E. Ullrich, J.D. Franckowiak, T.K. Blake, R.J. Graf, S.M. Dofing, M.A. Saghai Maroof, G.J. Scoles, D. Hoffman, L.S. Dahleen, A. Kilian, F. Chen, R.M. Biyashev, D.A. Kudrna, B.J. Steffenson	*Crop Sci.* 36:1053–1062
Remote sensing clearcut areas within a forested watershed: Comparison of SPOT HRV Panchromatic, SPOT HRV multi–spectral, and Landsat Thematic Mapper data	Verbyla, D.J., C.A. Richardson	*J. of Soil and Water Conservation* 51(5):423–427
Registration of 'AC Albright' barley	Wolfe, R.I., S.M. Dofing, J.G.N. Davidson, P.J. Clarke	*Crop Sci.* 36:1407
Effects of carbon, fertilizer and drought on foliar nutrient concentrations of taiga tree species in interior Alaska	Yarie, J., K. Van Cleve	*Ecological Applications* 6:815–827

AFES Bulletin

Title	Author(s)	AFES Publication No.
Bromegrass in Alaska: Heading and seed production as influenced by time and rate of nitrogen fertilization, sod disturbance and aftermath management	Klebesadel, L.J.	Bul. 103

AFES Circulars

Title	Author(s)	AFES Publication No.
Potato Variety Performance, Alaska 1995	Carling, D.E., G.A. Gallagher	Cir. 107
Head lettuce variety performance, Matanuska Valley, Alaska 1995	Carling, D.E., S.M. Dofing, J.L. Walworth	Cir. 106
Head lettuce variety performance, Matanuska Valley, Alaska 1996	Dofing, S.M., J.L. Walworth, D.E. Carling	Cir. 108
Annual Flower & Perennial Landscape Plant Evaluation 1995	Wagner, P.J., P.S. Holloway, G.E.M. Matheke, T. MacDonald, E. Van Wyhe	Cir. 105

Research Progress Reports

Title	Author(s)	AFES Publication No.
Use of Alaska–grown whole–seed canola in dairy cattle diets: Year 3	Randall, K.R., S.M. Dofing, D.J. Brainard	RPR No. 35

Proceedings

Title	Author(s)	Published In
Optical and radar satellite classifications of wetlands within the Tanana Flats	Balser, A.Q., D.L. Verbyla	Proceedings of the 32nd Alaska Surveying and Mapping Conference, Anchorage, Ak. pp. 1–9
Near–isogenic analysis of uniculm and conventional–tillering barley lines	Doring, S.M.	Proc. of the Fifth International Oat Conference & Seventh International Barley Genetics Symposium, Saskatoon, Canada. July 30–Aug. 6. p. 617–619
Revegetation for coal mines with different site conditions and goals in Alaska	Helm, D.	Planning, Rehabilitation and Treatment of Disturbed Lands. Seventh Billings Symposium, March 17–23. Billings, Mont. p. 213–220
Planning and planting procedures for placer and open pit mining sites: An analysis of successful reclamation activities	Helm, D.	Integrated Mining and Reclamation Short Course, April 15–17, Reno, Nev. Tab 11
Gravel pad restoration on Alaska's North Slope	Herlugson, C.J., J.D. McKendrick, J.A. Parnell	International Conference on Health, Safety & Environment, New Orleans, La, June 9–12. Society of Petroleum Engineers. pp. 51–57
Climate change and effects of tree growth as evidenced by tree–ring data from Alaska	Jacoby, G.C., R.D. D'Arrigo, G.P. Juday	Proceedings of 7th Conference of the International Boreal Forest Research Association, August 19–23. St. Petersburg, Russia
Vegetation recolonization on salt–damaged soil in Arctic Alaska	McKendrick, J.D.	Proceedings High Altitude Revegetation Workshop No. 12, Feb. 21–23. Information Series No. 83. Resources Research Institute, Fort Collins. p. 25–37
Rehabilitating Arctic tundra in Alaska	McKendrick, J.D.	North American Water and Environment Congress & Destructive Water (CD ROM) 6 pp
Economic evaluation of super exclusive designation for the summer Norton Sound red king crab fishery	Natcher, B., J.A. Greenberg, M. Herrmann	Proceedings of the International Symposium on Biology, Management, and Economics of Crabs from High Latitude Habitats. Fairbanks, Alaska
Topographic control of a spectral leaf area index	Verbyla, D.L.	Proceedings of the 32nd Alaska Surveying and Mapping Conference. Anchorage, Ak. pp. 153–161
A forest ecosystem dynamics model integrated within a GIS	Yarie, J.	Proceedings, Third International Conference/Workshop on Integrating GIS and Environmental Modeling, Santa Fe, NM, Jan. 21–26. CD and online*

* http://www.ncgia.ucsh.edu/conf/SANTA_FE_CD-ROM/main.html

Title	Author(s)	Published In
Carbon balance of the Alaskan boreal forest	Yarie, J., T. Hammond	Proceedings 1995 Meeting of the Northern Global Change Program. USDA Forest Service Northeastern Exp. Sta. GTR NE–214 pg. 271

Contract Reports

Title	Author(s)	Contracting Agency
Economic Considerations of Alternative Management Measures in the Alaska Red King Crab and Snow Crab Fisheries	Greenberg, J.A., M. Herrmann, N. Mollett	Final Report: the National Marine Fisheries Service, Saltonstall–Kennedy Grant Program. Juneau, Alaska, June
Two Bull Revegetation Trials 1995 Progress Report	Helm, D.	Prepared for Usibelli Coal Mine, Inc. 78 pp
Two Bull Baseline Vegetation Inventory Summary	Helm, D.	Prepared for Usibelli Coal Mine, Inc. 12 pp
Rock Creek Water Quality Vegetation Report	Helm, D.	Prepared for National Biological Service. 31 pp
Synthesis of revegetation studies at Usibelli Coal Mine	Helm, D.	Prepared for Usibelli Coal Mine, Inc. 21 pp.
Nolan Creek revegetation report initial year 1995	Helm, D.	Prepared for Silverado Mines (U.S.) 29 pp
Biodiversity survey of Clear Air Station, Alaska (Final)	LaGory, K., G.P. Juday, P.W.C. Paton, R.A. Ott, A.M. Wildman, J.K. Sarles	Environmental Assessment Division, Argonne National Laboratory. December. 38 pp + appendices
Long–term gravel vegetation project quarterly report for October, November, December 1995	McKendrick, J.D.	BP Exploration (Alaska), Inc., Anchorage, Alaska. 5 pp
1995 X Pad restoration progress report, Executive Summary with soil & plant data	McKendrick, J.D.	BP Exploration (Alaska), Inc., 5 pp. + appendices & photos
Fourth through sixth year (1993–95) results from gravel revegetation tests on BP Put River No. 1 Pad	McKendrick, J.D.	BP Exploration (Alaska), Inc., Anchorage, Alaska. 22 pp
Long–term gravel vegetation project quarterly report for April, May, & June, 1996	McKendrick, J.D.	BP Exploration (Alaska), Inc., Anchorage, Alaska. 7 pp
Reevaluation of graveled tundra and sandy soil revegetation: Eastern Operating Area Prudhoe Bay, Alaska: A photographic record of vegetation changes over time	McKendrick, J.D.	ARCO Alaska, Inc., Prudhoe Bay, Alaska. 163 pp. + appendix
Long–term gravel vegetation project quarterly report for July, August, & September, 1996	McKendrick, J.D.	BP Exploration (Alaska), Inc., Anchorage, Alaska. 6 pp

Title	Author(s)	Contracting Agency
Long–term gravel vegetation project quarterly report for October, November, December, 1996	McKendrick, J.D.	BP Exploration (Alaska), Inc., Anchorage, Alaska. 4 pp. + Appendix
The fundamentals of designing negotiating teams	Todd, Susan	A report distributed by CDR Associates, Boulder, Colo.
The use of Alaskan fish meal as a nutrient source for bioremediation	Woolard, C.R., J.L. Walworth, K.C. Harris	Third Quarterly Progress Report to the Alaska Science and Technology Foundation, March 15. 9 pp
The use of Alaskan fish meal as a nutrient source for bioremediation	Woolard, C.R., J.L. Walworth, K.C. Harris	Final Report to the Alaska Science and Technology Foundation, Nov. 15. 44 pp
Shaktoolik economic feasibility study for fish and reindeer processing	Young, C.A., C.E. Lewis	City of Shaktoolik, 30pp

Miscellaneous Publications

Title	Authors	Published In
Climate reconstructions and changes in Alaskan boreal forests as determined by tree rings	Barber, V., G.P. Juday, B.P Finney	47th Arctic Division Science Conference, AAAS. 19–21 Sept. 1996, Girdwood, Alaska. p. 11
Bryophyte and lichen flora of the Alaska boreal forest including species potentially sensitive to forest management	Burke, T., G.P. Juday	47th Arctic Division Science Conference, AAAS. 19–21 Sept. 1996, Girdwood, Alaska. p. 17
Differences in biodiversity of logged vs. Burned sites in interior Alaska	Juday ,G.P., D.C. Rees	47th Arctic Division Science Conference, AAAS. 19–21 Sept., Girdwood, Alaska. p. 17
Tree–ring evidence of climatic warming in south–central Alaska; coincident with recent tree mortality	Juday ,G.P., S.A. Marler	47th Arctic Division Science Conference, AAAS. 19–21 Sept., Girdwood, Alaska. p. 11
Boreal Forests (Taiga)	Juday, G.P.	*The Biosphere and Concepts of Ecology*. Vol. 14 Encyclopedia Britannica. 15th edition. pp. 1210–1216
A new but widely–used height control tool, DIF is easy to implement if you understand the basics of how it works.	Karlsson, M.G.	*GrowerTalks Magazine* 59(9):48, 50, 52, 54
The importance of day length and light level for flowering in cyclamen	Karlsson, M.G.	*Society of American Florists GrowerNotes* 1(1):6–7
Temperature, light and day length for flowering primula	Karlsson, M.G.	*Professional Plant Growers Association News* 26(5):10–11
Alaska seed potato disease testing and export project	McBeath, J.H.	*Alaska Farm's Bureau AFB Newsletter* 26:13–15

Title	Author(s)	Published In
Preliminary investigations of hydric soil hydrology	Ping, C.L., M. Clark, G. Michaelson	Preliminary Investigations of Hydric Soil Hydrology in the United States. Wetlands Research Program technical Report WRP–DE–13, US ARMY Corps of Engineers, p. 142–152
Image processing workshop: A GIS perspective	Verbyla, D.L.	Workbook for 1–day workshop at Alaska Surveying and Mapping Conference, Anchorage, AK. 98 pp
Use of Alaskan fish processing by–products as nutrient sources for bioremediation	Woolard, C.R., J.L. Walworth, K. Harris	Alaska Science and Technology Transfer Document. 3 pp

Theses/Student Professional Papers

Title	Author
Classification accuracy and detail of the Tanana Flats wetlands complex	Balser, Andrew
The nutritive value of whole and ground full fat canola seeds for growing pigs	Bregendahl, Kristjan
Assessing deforestation in Bosnia using remote sensing and a geographic information system	Fell, Dara
Techniques for improving the accuracy of forest maps derived from landsat TM imagery	Hammond, Timothy
Fractionation of organic matter from Arctic soils in Alaska	Loya, Wendy
Visitor use patterns and impacts: Dalton Highway, Alaska	Robbe, Greg
Standardized trampling in Interior Alaska taiga ecosystem: Impact evaluation	Tietz, Kathy
Discussion of the needs and uses of feasibility studies within rural communities of Alaska	Young, Christina A.

AFES Newsletters, Notes & Magazines

Title	Author(s)	Publication Information
The Georgeson Botanical Garden Review	P.S. Holloway	Vol 5, No. 1
The Georgeson Botanical Garden Review	P.S. Holloway	Vol 5, No. 2
The Georgeson Botanical Garden Review	P.S. Holloway	Vol 5, No. 3

Abstracts

Title	Author(s)	Published In
Mycorrhizal and plant community development on recently deglaciated terrain, Exit Glacier, Alaska	Helm, D.J., E.B. Allen, and J.M. Trappe	First International Conference on Mycorrhizae, August 4–9, 1996, Berkeley, California. p. 61–62
Growth response of upland white spruce in Bonanza Creek LTER in central Alaska indicates unprecedented stress consistent with climatic warming	Juday, G.P., R. Barry	1996 Annual Combined Meeting, Ecological Society of America. August 10–14, Providence, R.I. p. 222
Flowering in Primula as affected by day and night temperatures	Karlsson, M.G.	*HortScience* 31(4):680

Title	Authors	Published In
Control of *Ranunculus asiaticus* flowering by photoperiod and temperature	Karlsson, M.G.	*HortScience* 31(4):681
Control of flowering in petunia by photoperiod and irradiance	Karlsson, M.G.	*HortScience* 31(4):681
Photoperiod and irradiance affect flowering in four cultivars of pansy	Karlsson, M.G.	*HortScience* 31(4):681
Dynamics of permafrost table and soil formation	Ping, C.L.	*Agronomy Abstracts* 1996:261
Characterization of soil organic matter by stable isotopes and radiocarbon ages of selected soils in Arctic Alaska	Ping, C.L., G.J. Michaelson, A. Cherkinsky, R.L. Malcolm	Abstract of The Eighth International Humic Substances Conference, September 8–13, Wroclaw, Poland
Rhizosphere treatment of contaminated soils: Initial field results	Reynolds, C.M., J.L. Walworth, B.A. Koenen, J.B. Carnahan	*Agronomy Abstracts* 1996:230
Soil nutrient analyses and their application to bioremediation	Walworth, J.L., C.R. Woolard	Proceedings of the Alaska Association of Environmental Professionals Eighth Annual Meeting
Assessing nitrogen requirements in bioremediation systems	Walworth, J.L., C.R. Woolard, C.M. Reynolds	*Agronomy Abstracts* 1996:339
Supplying nutrients for bioremediation with fish processing by–products	Woolard, C.R., J.L. Walworth, K.C. Harris	*Agronomy Abstracts* 1996:339

Alaska to host 3rd Circumpolar Agricultural Conference in 1998

Plan now to attend the 3rd Circumpolar Agricultural Conference in Anchorage, Alaska October 19–22, 1998. The conference, "Challenges for Globalization", will focus on northern development, and issues related to high–latitude agriculture. Farmers, herders, researchers, educators and policymakers will be attending from Alaska, Canada, Russia, Norway, Sweden, Finland, Greenland, Iceland and other countries.

According to conference organizers, the conference will provide a unique forum for the consideration of the needs and strategies peculiar to fitting agriculture into the development efforts of northern areas. Agriculture in the broadest sense, including cropping, herding, aquaculture, forestry, revegetation, controlled environments and nurseries, is central to a stable rural economy everywhere. These endeavors all contribute a firm base to more symbiotic resource pursuits like mining, fishing, tourism and oil extraction.

The first two circumpolar agriculture conferences concentrated on policies, problems and plants peculiar to high latitudes. This third conference will build on this foundation by discussing ways to integrate our production and markets into the global economy, while retaining our environmental sensitivity and cultural nuances.

People who are interested in attending the conference will have a variety of ways to receive information and communicate with conference organizers.

- To communicate via electronic mail, please address correspondence to: fynrpub@aurora.alaska.edu
- Visit the Web site for conference information at: http://www.lter.uaf.edu/~salrm/cac.html
- Address mail to: SALRM/AFES Conference Coordinator; P. O. Box 757200; Fairbanks, AK 99775–7200

FY 97 research funding

Grants and Special Funds; July 1, 1996– June 30, 1997

National Science Foundation

Don Carling ..... Australia cooperative research
Chien–Lu Ping ..... LAII flux study
John Yarie ..... LTER: Successional processes in taiga forests of Interior Alaska

National Biological Survey

Chien–Lu Ping ..... Rock Creek watershed
Chien–Lu Ping ..... Rock Creek water quality

United States Department of Agriculture

Donald Carling ..... Evaluation of metam sodium for weed control in Alaska vegetable production
Jeff Conn ..... Goose population dynamics
James Drew ..... Alaska's forest trees
Jenifer McBeath ..... Cooperative agriculture pest survey
Chien–Lu Ping ..... Wet soils monitoring studies in Alaska; *(SCS funding also)*
Tricia Wurtz ..... Spruce and alder interactions
John Yarie ..... Carbon balance of the Alaska boreal forest

Oregon State University

Jeff Conn ..... Leaf cellulose

Bedding Plants Foundation, Inc.

Meriam Karlsson ..... Temperature and day length requirements for flowering and development of *Ranunculus*

USDA Forest Service

John Yarie ..... Forestry research

Environmental Protection Agency

Elena Sparrow ..... Global change environmental education project

University of Nebraska Lincoln

David Valentine ..... Modeling of methane

Alaska Bureau of Land Management

Dot Helm ..... Thompson pup revegetation monitoring, placer mine research

USDA–CREES

Donald Carling ..... Mating reaction and molecular characteristics in *Rhizoctonia solani* Ag–3 and Ag–8
Donald Carling ..... Screening accession of *Solanum* ssp.
Donald Carling ..... Alaska's NAPIAP program

Alaska Department of Natural Resources

Tobi Campanella ..... Forestry students
Tobi Campanella ..... Forestry GIS project
Dot Helm ..... Abandoned mined lands reclamation program
Jenifer McBeath ..... Virus free seed potatoes
Allen Mitchell, Dot Helm,
Jay McKendrick, Chien–Lu Ping ..... Alaska coal mining reclamation handbook

Alaska Science and Technology Foundation

Stephen Sparrow ..... Use of N–fixing plants to improve forage quality of Delta Bison Range
Jenifer McBeath ..... Seed potato

Usibelli Coal Mine, Inc.

Dot Helm ..... Usibelli vegetation studies
Dot Helm ..... Revegetation studies on Two Bull Ridge

BP Exploration (Alaska), Inc.

Jay McKendrick ..... Gravel vegetation studies

Frito–Lay

Donald Carling ..... Potato tests for Frito–Lay

Silverado Mines Inc.

Dot Helm ..... Nolan Creek revegetation

U. S. Army Corps of Engineers

Tobi Campanella ..... Chena Lakes project
James Walworth ..... Optimizing bioremediation of petroleum contaminated cold region soils

University of Alaska Natural Resources Fund

Harry Bader ..... Determination of recreational impacts to subarctic xeric alpine tundra resources
Stephen Doring ..... Continuation of a program in plant breeding and genetics
Jenifer McBeath ..... Support of potato industry in AK
J. McBeath, M. Karlsson ..... Cultivation of ginseng in AK
Glenn Juday ..... Study of recent climatic stress on white spruce
Edmond Packee ..... Establishment of permanent sample plots for monitoring forest health, growth, and change in the Copper River drainage
Stephen Sparrow ..... Alaska hosts the third circumpolar agricultural conference
Stephen Sparrow ..... Agronomic and economic evaluation of forage crops for AK
S. Sparrow, S. Becker ..... Mycorrhizal inoculation techniques
Jay McKendrick ..... Recording tundra recovery on AK's oil exploration sites NPR–A
David Verbyla ..... Estimating growing season length
Dave Verbyla ..... Development of an Alaskan wildfire detection and mapping system
D. Verbyla, A. Balser ..... Monitoring boreal wetlands

MAPCO Alaska Petroleum Inc

Susan Todd ..... Powerbook for classroom delivery
Dave Verbyla ..... Enhancement of GIS Lab

University of Alaska Foundation

Patricia Holloway ..... Georgeson Botanical Garden

Fairbanks Private Industry Council

Pat Holloway ..... Summer youth employment

Golden Valley Electric Association

Edmond Packee ..... Vegetation management options

Fred Gloeckner Foundation, Inc.

Meriam Karlsson ..... Growth and development of cyclamen
Meriam Karlsson ..... Day and night temperature requirements for cyclamen

Formula Funds; July 1, 1996—June 30, 1997

Hatch General; USDA

Harry Bader	Comparative legal analysis of private property use and regulation in the rural U.S.
Michael Panciera	Maximizing forage quality at northern latitudes
Meriam Karlsson	Effects of irradiance, temperature of growth and development of greenhouse produced plants
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
G. Allen Mitchell	Palmer administration
Meriam Karlsson	Environmental plant physiology of greenhouse produced crops
Carol Lewis	Marketing Alaska's agricultural and processed seafood products
Charlie Knight	Alternative crops for the subarctic
Don Carling	Evaluation of production practices, cultivars, and some diseases of potato and vegetables
Pat Holloway	Horticulture crop production for AK
Joshua Greenberg	Regional economic modeling for rural AK
Jay McKendrick	Long–term responses to tundra revegetation experiments, Arctic, AK

Hatch Regional; USDA

Fredric Husby	Characteristics and feed value of barley and western protein supplements for swine
G. Allen Mitchell	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
Edmond Packee	Determination of the growth and yield potential of northern forest species in Alaska
Edmond Packee	Tree species growth and yield and site productivity of the Alaska northern forest
Alan Jubenville	Territoriality in forest recreational settings in Alaska
Dot Helm	Ecosystem for establishment of wood plants on disturbed lands
Dave Verbyla	Development of an Alaskan AVHRR wildland fire detection and mapping system
Glenn Juday	Forest biodiversity resources in AK: identification, monitoring, strategies for management
John Yarie	Mechanisms of change in forest floor decomposition, element supply in successional forests of AK

Financial Statement

Expenditures — July 1995 through June 1996

The following is a statement of expenditures of federal and state funds for the fiscal year beginning July 1, 1995 and ending June 30, 1996 (FY 96). NOTE: This is not an accounting document.

Federal		(percent of total)
Hatch General Formula Funds	$ 848,522	13.1
Hatch Regional Formula Funds	173,233	2.7
McIntire–Stennis Formula Funds	467,345	7.2
Other Grants and Contracts	1,075,794	16.6
State Appropriation/Program Receipts	3,906,047	60.4
Total	$6,470,941	100.0 percent

Professional staff profile

John Alden, Affiliate Associate Professor of Forestry, University of New Hampshire '58, B.S.; Oregon State University '71, Ph. D.

Harry R. Bader, Associate Professor of Natural Resources Law; Washington State University '84, B.A.; Harvard Law School '88, J.D.

Larry Burke, Farm Superintendent; University of Idaho '66, B.S.

Tobi Campanella, Acting Fiscal Officer; University of Alaska '93, A.A.

Rudy Candler, Laboratory Supervisor; Colorado State University '67, B.S.; University of Alaska '74, M.S.; '87, Ph.D.

Donald E. Carling, Professor of Horticulture; St. Cloud State University, Minnesota '67, B.A.; University of Missouri–Columbia '69, M.S., '75, Ph.D.

Stephen M. Dofing, Associate Professor of Agronomy; Kansas State University '78, B.S.; University of Nebraska '80, M.S., '83, Ph.D.

Warren E. Fiscus, Research Associate

John D. Fox, Jr., Associate Professor of Land Resources; Trinity College '68, B.S.; University of Washington '70, M.S., '76, Ph.D.

Donna Gindle, Publications Supervisor; University of Alaska Fairbanks '89, B.A.; '96, M.A.

Joshua A. Greenberg, Associate Professor of Resource Economics; University of Connecticut '82, B.S.; University of Alaska Fairbanks '84, M.S.; Washington State University '90, Ph.D.

Dorothy J. Helm, Research Professor of Vegetation Ecology; University of Delaware '69, B.S.; University of Michigan '70, M.S.; Colorado State University '77, M.S., '81, Ph.D.

Patricia S. Holloway, Associate Professor of Horticulture; Millersville University of Pennsylvania '73, B.A.; Washington State University '76, M.S.; University of Minnesota '82, Ph.D.

Yong Huang, Research Associate; University of Wisconsin, Madison, Ph.D.

Fredric M. Husby, Professor of Animal Science, Acting Director, School of Agriculture and Land Resources Management, and Acting Dean, College of Natural Resource Development and Management; Washington State University '66, B.S., '69, M.S., '74, Ph.D.

Alan Jubenville, Professor of Resources Management; North Carolina State College of Agriculture and Engineering '62, B.S.; West Virginia University '64, M.S.; University of Montana '70, Ph.D.

Glenn P. Juday, Associate Professor of Forest Ecology; Purdue University '72, B.S.; Oregon State University '76, Ph.D.

Meriam G. Karlsson, Associate Professor of Horticulture; The Swedish University of Agricultural Sciences '79, B.S.; Michigan State University '84, M.S., '87, Ph.D.

Charles W. Knight, Associate Professor of Agronomy; Kansas State University '70, B.S., '71, M.S.; University of Alaska Fairbanks '88, Ph.D.

James Levison, Acting Business Manager; University of Alaska Fairbanks '79, B.S.

Carol E. Lewis, Professor of Resources Management; University of Florida '62, B.S.; '64, M.S.; Georgetown University '70, Ph.D.; University of Alaska Fairbanks '76, M.B.A.

Jenifer H. McBeath, Professor of Plant Pathology; National Taiwan University, '65, B.S.; University of California, Davis '70, M.S.; Rutgers University '74, Ph.D.

Jay D. McKendrick, Professor of Agronomy; University of Idaho '63, B.S., '66, M.S.; Kansas State University '71, Ph.D.

Gary J. Michaelson, Research Associate; University of Arizona '74, B.S.; Iowa State University '81, M.S.

G. Allen Mitchell, Acting Director–AFES, and Associate Professor of Agronomy; University of California, Riverside '71, B.S., '73, M.S., '77, Ph.D.

Edmond C. Packee, Associate Professor of Forest Management; University of Montana '62, B.S.; Yale University '63, M.F.; University of Minnesota '76, Ph.D.

Michael T. Panciera, Associate Professor of Agronomy; University of Guelph '77, B.S., '79, M.S.; Pennsylvania State University '82, Ph.D.

Garrett W. Perney, Herder; Cal Poly San Luis Obispo '90, B.S.

Barbara J. Pierson, Student Affairs Coordinator; Montana State University '77, B.S., '85, M.S.

Chien–Lu Ping, Professor of Agronomy, Soil Scientist; Chung–Hsin University, Taiwan '65, B.S.; Washington State University '73, M.S., '76, Ph.D.

Peter C. Scorup, Research Associate; Colorado State University '66, B.S.

Drew H. Shain, Assistant Professor of Animal Science (Reindeer); University of Wyoming '83, B.S.; '86, M.S.; University of Nebraska '96, Ph.D.

Elena B. Sparrow, Affiliate Associate Professor of Soil Microbiology; University of the Philippines '62, B.S.; Cornell University '66, M.S.; Colorado State University '73, Ph.D.

Stephen D. Sparrow, Jr., Professor of Agronomy; North Carolina State University '69, B.S.; Colorado State University '73, M.S.; University of Minnesota '81, Ph.D.

Susan Todd, Assistant Professor of Regional and Land Use Planning; Bryn Mawr '75, B.A.; University of Michigan '79, M.R.P.; University of Michigan '95, Ph.D.

David L. Verbyla, Associate Professor of Geographic Information Systems; Rutgers University '79, B.S.; Michigan State University '82, M.S.; Utah State University '88, Ph.D.

James L. Walworth, Associate Professor of Soil Fertility/Horticulture; University of Wisconsin '76, B.S., '80, M.S.; University of Georgia '85, Ph.D.

John A. Yarie, Professor of Silviculture; West Virginia University '71, B.S.; University of Maine '74, M.S.; University of British Columbia '78, Ph.D.

Emeriti

Arthur L. Brundage, Professor of Animal Science

Robert A. Dieterich, Professor of Veterinary Science

Don H. Dinkel, Professor of Plant Physiology

James V. Drew, Dean of SALRM, Director of AFES, and Professor of Agronomy

Anthony F. Gasbarro, Associate Professor of Forestry Extension

Alan C. Epps, Professor of Natural Resources

Leslie J. Klebesadel, Professor of Agronomy

Charles E. Logsdon, Professor of Plant Pathology

William W. Mitchell, Professor of Agronomy

Bonita J. Neiland, Professor of Land Resources and Botany

Sigmund H. Restad, Assistant Director, Alaska AFES

Wayne C. Thomas, Professor of Economics

Keith Van Cleve, Professor of Forestry (Soils)

Robert B.Weeden, Professor of Resources Management

Achievements, activities, news

AFES/SALRM long-timers

The following employees received awards through the Employee Longevity Recognition Program:

Thirty years: Mary Boyd

Twenty years: Robert Schlentner

Fifteen years: Donald Carling, Greg Finstad, Glenn Juday, Stephen Sparrow

Ten Years: Donald Gossett, Stephen Spores

Five Years: Kathyrn Brainard, James Erickson, Debra Hagen

SALRM students excel

Chancellor's List

Doug Adkins, Brian Charlton, Grant Mecozzi, Amy Morowski, Rochelle Pigors, and Jerry Soplanda

Dean's List

Rebecca Kelleyhouse, Samantha Lown, Jacqueline Meumann, Anthony Payne, Eric Peterson, Marylou Richard, Susanne Trillhose, Emily Voshell, Heather Wells, and Charlene Zappa

Faculty promotions

Two AFES faculty were promoted to full professor. Dr. John **Yarie** was promoted to Professor of Silviculture and Dr. Dot **Helm** was promoted to Research Professor of Vegetation Ecology.

1997 SALRM graduates

Congratulations to the 1997 School of Agriculture and Land Resources Management graduates :

PH.D.: Robert A. Ott

MASTERS OF SCIENCE: Christina (Young) Bell, Kristjan Bregendahl, Dara M. Fell, Andrew Balser, Timothy Hammond, Wendy Loya, Greg Robbe, and Kathryn Tietz

BACHELOR OF SCIENCE: Gordon L. Amundson, Jason P. Downing, Stephanie A. Gibby-Saito, Larry F. Gilbert, Daniel A. Hall, Tyrone E. Hippe, Jamie Hollingsworth, Colin Barnard, Jennifer Clark, Christopher Janak, Elias L. Kelly, Samantha Lown, Jacqueline Meumann, Alan Peck, Jennifer Kauntz, David Thompson, Mary L. Wright, and Cheryl Wickstrom

Retiring: AFES staff move on

K.C. Christensen began working for AFES in July 1982 as a field hand. He worked in the dairy barn for a winter and then in maintenance before becoming the expeditor for the Palmer Experiment Station. Christensen says the best part of his job was, "Working with the different departments and finding out what they did, and being able to find necessary items in an emergency." His retirement plans include taking a vacation with wife Charlene and then looking for another job.

K.C. Christensen

Bob Schlentner worked as a technician and field supervisor at the Forest Soils Laboratory in Fairbanks for approximately 29 years. Schlentner worked hard and plays even harder according to forest soils supervisor, Lola Oliver.

Schlentner has tried his hand at dog mushing (including early Iditarod races) and prefers riding his bicycle than driving his car. For his retirement, Schlentner plans to spend a lot of time on his boat in Valdez.

Bob and Sharon Schlentner

J. Stephen Lay, communications manager for the Alaska Cooperative Extension and former publications supervisor for the Agricultural and Forestry Experiment Station, retired from the University of Alaska Fairbanks April 1. Lay earned a B. A. from Trinity University in 1969 and an M. A. from The Ohio State University in 1988. He and his family have moved to Lacey, Wash. where Lay hopes to work a little, travel to exotic locations, and have fun.

Lay was involved in the Agricultural Educators in Education, the Society of Professional Journalists/Sigma Delta Chi: Secretary (1987) and President-elect (1989) for the Farthest North Chapter; Fairbanks Press Club; College Rotary; and cofounder and member of the Fairbanks Public Relations Round Table.

J. Stephen Lay (right)

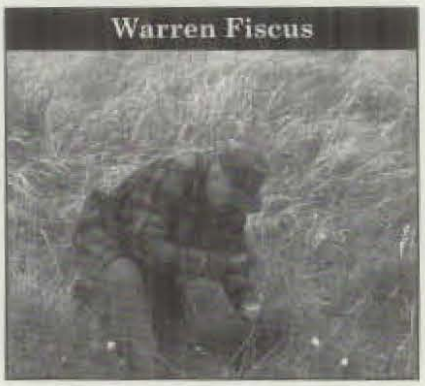
Don Brainard is probably one of the Experiment Station's better traveled employees. In 1968 he worked in the Agricultural and Forestry Experiment Station's dairy barn at Fairbanks station. From 1973 to 1979 Brainard was farm superintendent at the Homer Red Meat Center and then he moved to Palmer.

Brainard is retiring from his herdsman position to start a small hay operation and to spend more time fishing and hunting. "The best part of my job was having objective standards to measure progress. There was a great sense of accomplishment from putting milk in the tank," he said.

Don Brainard *(second to left)*

Warren Fiscus joined the AFES in 1988 to assist with Dr. Jay McKendrick's revegetation studies on the North Slope. He developed site maps and engineering drawings for gravel revegetation plots and supervised their construction. Fiscus designed and crafted a mechanical seed harvester to collect native plant seeds efficiently and without damage. His artistic talents were used to compile hundreds of botanical illustrations of native plants.

Fiscus's future plans will include many back country adventures on his track vehicle, "the Bombardier." His accomplishments distinguish him as a singular contributor to our North Slope research, said Dr. Jay McKendrick.



Warren Fiscus

1998: AFES Celebrates a Century

The Agricultural and Forestry Experiment Station first opened its doors in Sitka, Alaska in 1898 as a USDA federal research station.

A Look Back:

In this 1960s photo, AFES researcher Dr. Don Dinkel captures his daughter helping in the garden (AFES file photo)