AgroBorealis

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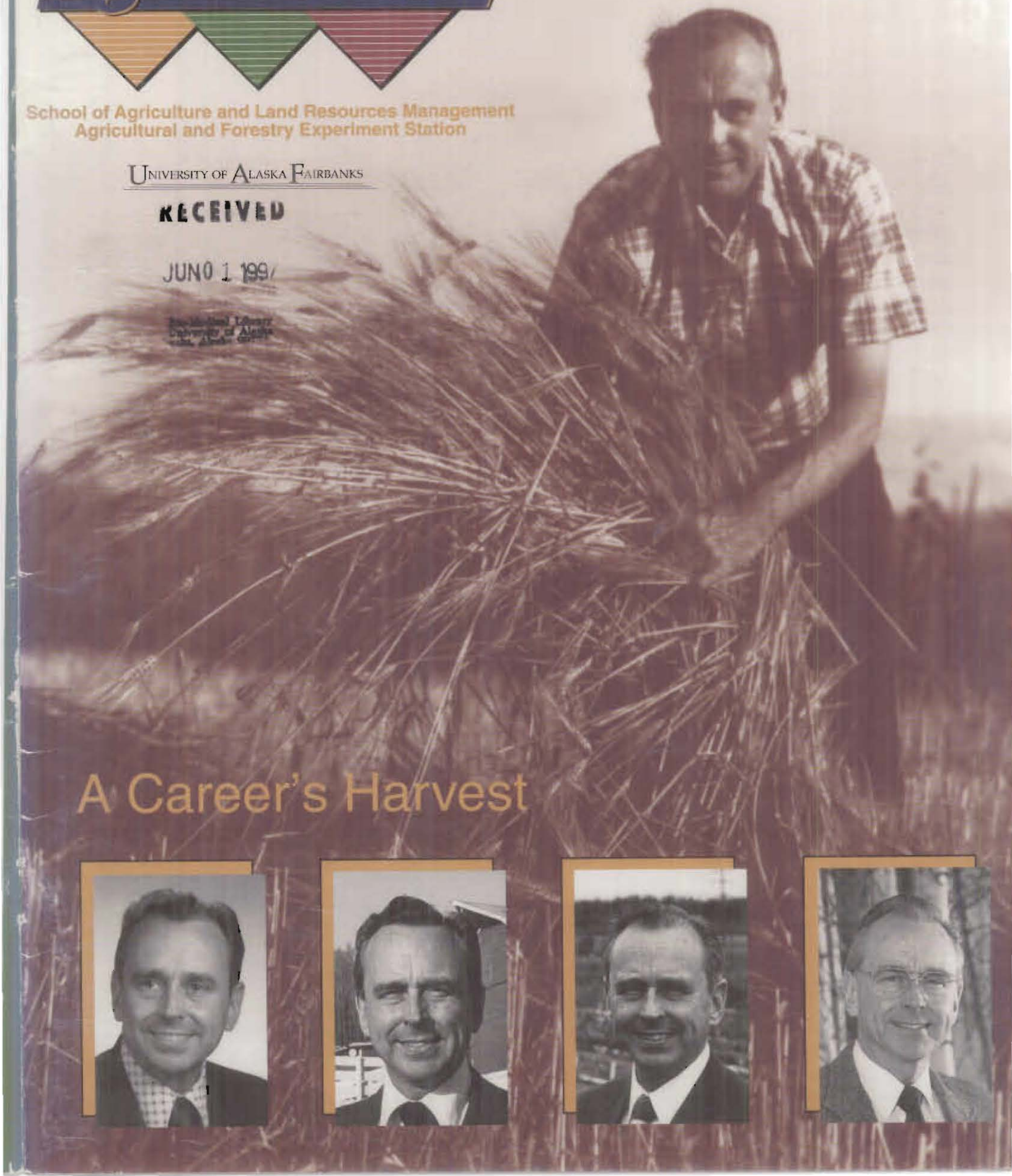
School of Agriculture and Land Resources Management
Agricultural and Forestry Experiment Station

University of Alaska Fairbanks



A Career's Harvest

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Agricultural & Forestry Experiment Station

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Office of the Dean & Director

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, 1994. This is done in accordance with an act of the Congress, approved March 2, 1887, entitled "An act to establish agricultural experiment stations, in connection with the agricultural colleges established in the several states under the provisions of an act approved July 2, 1862, and under the acts supplementary thereto," and also of the act of the Alaska Territorial Legislature, approved March 12, 1935, accepting the provisions of the act of Congress.

Very respectfully,

James V. Drew

James V. Drew
Director

Fairbanks, Alaska
June 30, 1995

AFES Statement of Purpose

The research objective of the Alaska Agricultural and Forestry Experiment Station (AFES) is to provide new information to manage renewable resources at high latitudes, and to improve technology for enhancing the economic well-being and quality of life at these latitudes. While foresters, farmers, and land managers use our research results, all Alaskans benefit from the wise use of land resources. Our research projects are in response to requests from producers, industries, and state and federal agencies for information in plant, animal, and soil sciences, forest sciences and resources management.

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

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

AgroBorealis

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EDITORIAL STAFF

Dean, SALRM; Director, AFES ..... **Dr. James V. Drew**
Communications Manager ..... **J. Stephen Lay**
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At this welcome page you will find links to information about SALRM and AFES, about our undergraduate and graduate programs, and about our research.

This magazine was printed at a cost of $1.16 per copy by A. T. Publishing and Printing Inc., in Anchorage, Alaska.

KTVF's Volunteer Recognition

Grant Matheke, Pat Wagner *and* ***Dr. Pat Holloway*** *were recognized as the Volunteer Managers of the Month for April 1995. Fairbanks businesses, Channel 11 KTVF, and reporter Mike Schultz oversee the program that recognizes outstanding community volunteer managers. Holloway said more than 100 people volunteer to work in the botanical gardens. "We wouldn't be here without them," she said. "Our volunteers put in more than 1,000 hours each summer." (photo by Donna Gindle)*

Harvesting a career

Dean, Director retires after 20

by: Donna Gindle
Publications Supervisor/Editor

In 1955, a young graduate student made his first trip to Alaska never suspecting what impact that "Territory" would have on his life. Forty years later, Dr. James V. Drew reflected on a career that has taken him to the pinnacles of success as well as the top of the world.

Soft spoken, articulate, intelligent, personable and extremely humble, the 64-year-old collegiate dean will bid farewell to a career of academia, leadership and community service on August 31. The Dean of the School of Agriculture and Land Resources Management and the Director of the Agricultural and Forestry Experiment Station, Dr. Drew shared the victories and frustrations that marked his career.

Born Sept. 21, 1930, Drew grew up on a small dairy farm in Cresskill, N.J. and studied agriculture with a pre-forestry option at Rutgers University. The Korean War and the military draft were looming over Drew's future as he prepared to graduate so he volunteered for the United States Air Force. In 1952, Drew began military service and was subsequently selected for pilot training.

"By the time I finished pilot training, the Korean War was over and the government was cutting back the military, as they typically do when wars end," he said.

The young lieutenant accepted an early-out offer from the Air Force, joined the New Jersey Air National Guard, and returned to graduate school at Rutgers.

"I had no money other than the GI bill, so the Guard provided me with a little extra money at the time," Drew said.

He also felt that serving his country was the right thing to do. So for 24 years, Drew spent at least one weekend a month and fulfilled a two-week annual commitment with both the New Jersey and the Nebraska Air National Guard. He flew such classics as the T-6, T-33, and P-51 and moved into the jet age piloting the F-86E, RF-84F and the RF-4C Phantom. He retired from the ANG as a lieutenant colonel.

While the sky was his weekend workplace, the land was his chosen profession. And the soil was what brought him to Alaska when his major professor at Rutgers received an Office of Naval Research contract to do soil survey research on the North Slope. During the summers between 1955 and 1958, Drew made the first soil map of Barrow, studied soils along the Jago River, and became the first person to survey the soils along the Sagavanirktok River. His research took him along what would, in 20 years, be the Prudhoe Bay pipeline route.

"Four of us spent two summers floating down the Sagavanirktok River, stopping about every 10 miles to map the soils and vegetation. After the end of the first summer we were bringing all our samples and findings back to Barrow. On the way we stopped at Umiat to have breakfast with a radio operator (at that time, Wien Airlines operated a nondirectional beacon from there) at his Quonset hut. We had stored all our supplies and equipment in another Quonset hut. While we were eating breakfast, an oil line broke in that second hut and it burned up. We lost all our field samples and notes and had to return the next year and do it all again."

In 1956, Drew married Marilyn Smith of Powell, Wyo. and in 1957 he graduated with his Ph.D. from Rutgers University. They moved west when Dr. Drew joined the agronomy faculty at the University of Nebraska-Lincoln. While at UNL his research in soil science led to his election as a Fellow in the American Society of Agronomy, the Soil Science Society of America, and the American Association for the Advancement of Science. Drew also served as the dean of UNL's graduate college.

In 1975 Dr. Drew packed up his family—Marilyn, Lisa, Kelly and Michael—and returned to Alaska as the newly-hired director of the Agricultural Experiment Station. In 1976, he was appointed Dean, SALRM.

Dr. Drew said the highlights of the past 20 years were the development of several state agriculture projects initiated under the Hammond administration, the creation of the School of Agriculture and Land Resources Management, the incorporation of the School with the Agricultural and Forestry Experiment Station, and the integration of the teaching and research components.

"In the late 1970s, the state government was interested in developing renewable resource industries in Alaska. The idea was that a substantial amount of wealth was coming to the state with oil, but it would eventually be gone. We needed to develop industries such as agriculture and forestry so that we would have a more diversified economy when the oil wealth began to decline.

Dr. Drew at a glance

Family:
Wife: Marilyn
Children: Lisa, Kelly and Michael

Professional affiliations and honors:
- Ph.D. Rutgers University, 1957
- American Society of Agronomy Fellow; American Association for the Advancement of Science Fellow
- Dean, SALRM and Director, AFES: 1976–1995
- Lieutenant Colonel, ANG, retired

Civic Organizations:
- Fairbanks Chamber of Commerce, Member and former Chairman of the Board
- Fairbanks Rotary Club
- Resource Development Council, Board Member
- Alaska State Chamber, Member
- Interior Alaska Economic Development Council, Board Member
- Alaska Reforestation Council, Chairman
- Tanana Valley Fair Board, former Chairman

"This was an exciting time to be part of the university and the experiment station," the director reflected. "We had legislative support. We built our program and increased our faculty.

"In 1974 and 75 the university prepared an academic development plan. When I first got here, the majority of experiment station research was in Palmer and a fairly large contingent of USDA-ARS (Agricultural Research Service) scientists was there. The ARS eventually closed the Palmer operation and, because of agricultural development in Delta Junction, moved three positions to Fairbanks. The ARS researchers were to develop technology for conservation tillage necessary to farm the land at Delta and protect it from wind and water erosion.

"As we moved into the 80s, the state changed focus and the thrust to develop agriculture declined. The state ended up with a substantial amount of income from oil revenues which translated into an increase in the number of state jobs, which in turn provided an economic base for other service businesses within the state. Consequently, those businesses plus the major defense expenditures provided an economic base that was very good for a number of years. As that base enhanced itself some of the enthusiasm for developing other industries—such as mining, forestry or farming—declined," Drew said chronicling the history of the tougher times of late.

"Then we came to 1987 when the price of oil declined. We became concerned about maintaining the level of state employment. More recently, of course, the production itself has begun to decline, and now we are concerned about where the state will get the revenue to run all its programs. As a result, we see continual cutbacks in state and university employment. So there is suddenly interest again in developing a more diversified economy. Look at the Delta Junction area. People essentially forgot about farming during the days of substantial oil revenues. But with the downsizing of Fort Greely, plus the reduction of oil revenues to the state, we have renewed interest."

In recent years, Dr. Drew and the faculty and staff of SALRM/AFES have literally had to fight to maintain their existence. In 1992, the university administration recommended dismantling the school, transferring the faculty to other departments and combining AFES with another institute. That recommendation failed. The following year, though, the administration tried, again unsuccessfully, to lease a major portion of the Fairbanks Experiment Farm for commercial development.

"This would have eliminated our field laboratory where we do research in both agriculture and forestry," explained Drew.

Having survived the two earlier blows, the School didn't fare so well in the 1994 program assessment. The assessment committee recommended, and the Board of Regents accepted, combining SALRM with the School of Management, and the School of Mineral Engineering, and forming the College of Resources Development and Management. Details for the merger are still being worked out.

"Those events are the result of a reduction in funding for the university, and a decrease in our faculty. What this means is that we will not be able to have the multi-disciplinary approach to problems in agriculture and forestry that we did in the mid-80s. It will be reflected in less output of research and service for our constituents."

As Dr. Drew prepares to turn over the reigns of the School and the Experiment Station, what does he forecast for the School?

"Forecasting is very difficult, particularly if it involves the future. As for me, I'll have to wait until I 'get there to see' what I will do in retirement," he said glancing around at two walls of bookshelves, overflowing with the results of more than two decades of his and his colleagues works. "I have lots of things to wrap up and sort out and no time to give thought to what I will do in my retirement."

His options are many. One possibility, he said, is doing a little flight instructing. Drew keeps his medical and aeronautical ratings current and still owns a Piper Arrow. His wife, Marilyn, began flying lessons recently after she retired from her successful career as a Realtor and will soon be ready to solo.

Maybe it's time for this man that many describe as the consummate gentleman, to turn his eyes skyward again, and let his dreams take flight.

There's not a doubt that he'll soar.

Weekend Warrior—Dr. James Drew, aka 1st Lt. Drew, pictured here with fellow members of the 119th Fighter Squadron, New Jersey ANG, in front of the P-51 Mustang. Dr. Drew retired from the Air National Guard after 24 years of service. (courtesy photo)

Reflections

Dr. Drew shares thoughts on agricultural development, views on Alaska's resources

Dr. James V. Drew at a public appearance. (photo by J. Stephen Lay)

When Dr. James V. Drew retires August 31, he will take 20 years of corporate knowledge with him. However, before packing it all in, the Director of the Agricultural and Forestry Experiment Station and Dean of the School of Agriculture and Land Resources Management shared a few of his thoughts on various subjects. Following is an excerpt from a recent interview.

Is agriculture a viable industry for Alaska?

Yes it is. But, agriculture is not an easy industry to develop in Alaska because it requires that a fairly substantial amount of land be put in private hands and changed or altered from its present condition. Taking land from public ownership and putting it in private hands is difficult to do in any country where land is not already in private ownership. Certainly that is one of the most significant problems the former Soviet Union has in trying to develop a free market economy.

Over the past few decades, though, a fair amount of land has been put into private ownership through both the Delta and Point MacKenzie agricultural projects—although Point MacKenzie is different because the land title became clouded by the lawsuit involving the Mental Health Trust.

If agriculture and forestry are viable industries, why doesn't the state develop long-term goals in this direction?

My bookshelf is filled with plans. None of the long-term plans were ever carried out for the long term, though. The various steps were not followed through, or were reduced or stopped after three or four years. Typically, those actions occurred because of changes in national or international economics, or people who held elected offices within the state.

The state has never carried any of those plans forward to the point where agricultural industries appeared to be credible. For many years the forest industry was a viable force in Southeast Alaska. Even it has come into difficulty in recent years because of the conflict with environmental concerns of how logging would disrupt tourism or fishing. Consequently the forestry industry has been reduced.

Our society today lives in suburbia and, for the most part, we are involved in service businesses and industries such as defense, education, construction, merchandising, law, dentistry, medicine, or banking. As a society moves from an industrial society to a post-industrial society, that is to be expected. But we still need production because without mining, agriculture, and forestry it is difficult to create new wealth. We can enhance wealth by making our operations more efficient, but it takes the development of resources to create new wealth.

I think we have a major problem that stems from a decline in the understanding on the part of suburbia America about the way wealth is created from natural resources. We certainly have a major sociological and demographic change within the U. S. over the last 50 to 100 years which has removed most of our citizens from proximity to the soil or the forest in pursuing their livelihood. As a result their attitudes toward the development of resources are now more colored by perceptions of the use of those resources for recreation than they are towards the use of those resources in creating commodities.

What about other natural resources development?

Certainly Alaska has potential for both the production of wood products and agricultural products. If there's any doubt, just look at the northern Scandinavian countries of Sweden and Finland. While we are not a precise analogue of those countries, we still have a great potential. The same holds true for agriculture. There are certain commodities that are well adapted for production in Alaska such as barley and forages for livestock, rapeseed for use as an oilseed crop, potatoes for use as a food crop, and a number of cool season vegetables.

The major problem we have in both agriculture and forestry is that our industries are so small that we don't have the economies of scale or the developed infrastructure necessary to make them as economically viable as they should be. Therefore, people in the production areas of forestry and agriculture have to rely on, to some extent, state loan programs and other limited financing sources which, in turn, limit the growth of the industry.

People have talked about Alaska's potential for agriculture and forestry for many years. I have references that go back to the early 1900s. When neither venture comes to fruition, the conclusion that is drawn is that it's too cold, or that the trees don't grow fast enough, or that crops just can't produce. Of course that's not the case for varieties that are adapted to Alaska. It's the lack of economy of scale and the lack of an infrastructure. We take these for granted in other states where they already exist,

and we also find it difficult to create them here in the absence of very large front-end investments. We haven't been willing to do that either.

The mid-80s heralded the interest in Interior Alaska's potential forestry development. Fairbanks Senator Bettye Fahrenkamp advocated steps to develop a forest industry. She and others worked to establish the Tanana Valley State Forest. It was originally proposed as a multiple-use forest including renewable resources to develop a forest industry.

What are your thoughts on the Board of Regents-mandated formation of the new College of Resources Development and Management?

On the positive side, this new college could give enhanced visibility to all areas of resource development on the campus. If this could lead to enhanced budgets and more faculty within each area, we could grow to a unit that would be better able to meet the needs of the forest and agricultural industries within the state.

The possible down side, though, is a reduction in the visibility for agriculture and forestry on campus. This, in turn, would lead to less support.

The bottom line is that what the university eventually becomes is going to be a function of what the state becomes. If people of the state—through their elected representatives and governor—elect to develop agricultural and forest industries within the state to diversify the economy and keep it from being a one sector economy, oil for example, then there is a good chance that agriculture and forestry programs will grow. The same holds true for mining. I believe that if the state as a state and society as people in the state elect to move ahead with development programs, then it is easy to justify the need for research and instruction in needed applied sciences. If, on the other hand, the industries are kept small, then regardless of the amount of money the state has, it will be difficult to justify the investments in research and teaching in these applied sciences.

What do you think will become of the School?

It's hard to predict because it depends on many, many things over which we have no control. For example, only a few years before the state initiated its agricultural development program in the mid-70s, the club of Rome told the world we would run out of food in the next decade and that everybody would starve in the 1980s. A 1977 issue of *Time* magazine carried a cover article with the headline, 'Food as a Weapon.' This article suggested that the U. S. could use food as a weapon in international diplomacy, in much the same way the Arabs were using oil. In other words, the world would be so dependent on the U. S. for food that we could embargo it and bring other countries to their knees just as the Arabs brought us to our knees by cutting back oil production. Obviously if we had national or world interest in food production in that same way, it would tend to spur interest in agriculture in Alaska.

What happened, though, was just after agricultural development got started here in the early 80s, the U. S. had a major recession in the agriculture sector, and this led to such acts as farmers shooting bankers in Minnesota. In the midwest farmers were losing the farms that had been in their families for four generations. When that happened, of course, there was less enthusiasm for developing agriculture in Alaska.

In recent years, environmental concerns have become important, especially in regard to forestry. It will probably be some time before those concerns are sorted out and before our society decides what we can do with respect to wood products while maintaining the kind of environment we want for recreation and wildlife habitat. We will have to experience conditions in old growth stands that ultimately lead to something pretty devastating like diseases, spruce bark beetle infestations, spruce budworm infestations or wildfires, before we begin to implement management plans that take into consideration all those factors.

So where does all this leave Alaska?

Something has always happened to keep Alaska going.

Alaska had difficult times maintaining itself at all—even as a territory—until World War II when it was the recipient of a lot of defense and construction money because of its strategic location. There were buildups of military bases and the construction of the Alaska Highway. Airports were constructed in the state to send lend-lease airplanes to Russia, and to provide access to rural villages.

After World War II, things began to wind down as bases started closing, but then the Korean War started. That's when Alaska became an important point for troop and supply movements to Korea and, later, Vietnam. The large open spaces in Alaska provided areas for military training activities that would have been difficult in other states. Those activities all brought money into the state so it really wasn't necessary to develop agriculture and forestry. Even mining began to be less important as we moved into military buildups. Vietnam was just winding down when the Prudhoe Bay discovery was made. The oil discovery brought in massive construction funds initially, and then provided tremendous amounts of money itself which in turn created more and more state positions.

"... we still need production because without mining, agriculture, and forestry it is difficult to create new wealth. We can enhance wealth by making our operations more efficient, but it takes the development ... to create new wealth."

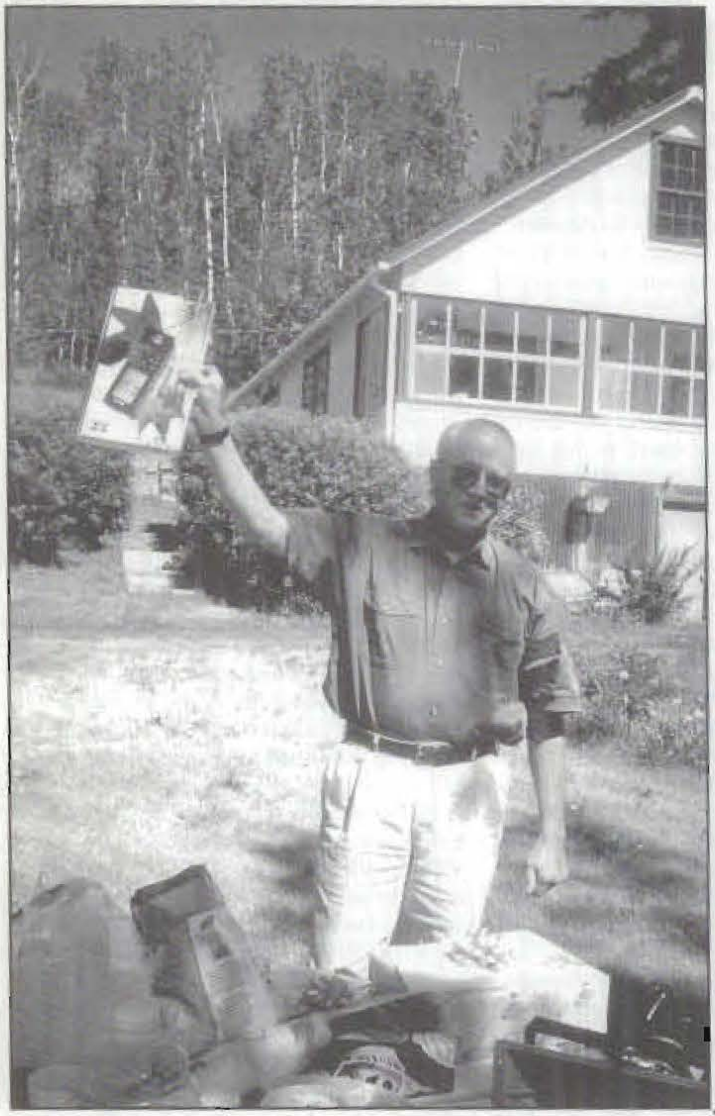
A recent issue of the *Alaska Journal of Commerce* said that Alaska has more government employees per capita than any other state. That's all been possible because of the great wealth that has come in through oil resources. Now as oil resources begin to decline or become more difficult to extract, or if oil prices should decrease then the state has no option but to cut back on much of the funding for state agencies, state construction, and the university.

What will happen next is hard to tell. Certainly mining is on the upswing now. The development of AMEX's Fort Knox mine here in Fairbanks is a great addition to the creation of new wealth in the Interior. While there seems to be some concerns in the fishing industry in Alaska as evidenced by the conflict between the Canadians and Alaska, it looks as though fishing will still retain a significant part of the state's economic activity.

I have to go back to what I said earlier. Much of what happens will depend on government leadership, and economic events will either tend to foster or retard the use of the different resources. Alaska is known as a resource state, which is true; there are large amounts of timber, agricultural soil, minerals and oil here. The dilemma is that access to them is very limited which means that extracting or using these resources becomes very expensive which means it's hard for Alaska resources to compete with those in other states. Other places have more fully developed transportation systems and population distribution.

I think with time, and if the world becomes more dependent upon Alaska's resources, we will see more development occur. This development will continue to be moderated somewhat by strong environmental concerns but it's primarily a matter of time.

Good-bye! Van Cleve, Hartman retire



Forest sciences leader bids farewell after 28-plus years

Dr. Keith Van Cleve, professor of forestry soils, recently retired after more than 28 years at the University of Alaska Fairbanks. The former AFES Forest Sciences Department Head was born March 31, 1936.

"One of the most satisfying aspects of my career at UAF has been the opportunity to develop cooperative research programs with colleagues in other departments and institutes within the university, with government agencies closely associated with UAF and with colleagues at other universities," Van Cleve said. "Collectively, we have been able to develop an information base and understanding of northern boreal forest ecosystem structure and function that is fundamental to wise management of this renewable resource. An additional rewarding aspect of these programs has been the success of students and colleagues with their professional aspirations."

Exec officer sails to retirement

Chick Hartman is heeding the call of the water since his recent retirement from the University of Alaska Fairbanks. Hartman, the executive officer for the School of Agriculture and Land Resources Management from 1978 through 1995, worked at the university for 28 years. He began his career as a research engineer and hydrologist at the Institute of Water Resources. He earned a bachelor of arts degree from Rutgers University in 1964 and a bachelor of science degree from UAF in 1967.

Hartman and his wife, Jean, are looking forward to boating in the summer and traveling to the sunny shores of Mexico in the winter. They have two children Christopher, 25, and Laura, 22. Chris is working towards his Ph.D. at the University of Illinois, and Laura recently graduated from UAF. She is currently pursuing a master's degree in geography at New Mexico State University in Las Cruces.

NRM 310: Agricultural Concepts

by: Dr. Carol E. Lewis
Professor, Resources Management

Students are learning marketing principles through their taste buds. The School of Agriculture and Land Resources Management's NRM 310—Agricultural Concepts—is designed to teach students consumer marketing principles and help entrepreneurs in Alaska's agricultural industry.

Students develop marketing strategies and craft logos for Alaska products. They and other volunteers participate in sensory panels where they might describe a similar product, complete a demographics questionnaire, provide information on their shopping habits and views on organic products, the Alaska Grown program, and healthy eating habits.

Dr. Joshua Greenberg, Dr. Ruthann Swanson (formerly of UAF), Cathy Birklid and I prepared a marketing research report from sensory and questionnaire information for each product. From this report, students learn to use scientific methods in marketing research and the informational and analytical processes required before a product reaches the grocers' shelves. Student teams then take the information and develop a marketing strategy and a product logo which they present to an evaluating panel composed of the instructors, product producers (when possible) and professionals from the local art and advertising community. The UAF's Susan Burroughs and Kerry Stanford, and members of the art and graphics community in Fairbanks, lent their professional expertise and advice.

Local farmers and processors provide the products needed for the course. The marketing research reports, marketing strategies and logos are then prepared for them. Producers and processors can use the information to promote special attributes of the product, confident in the knowledge that their claims are supported by UAF research.

Since 1990, students in NRM 310 have provided information on honey, carrots, barley pancake mix, Alaska salsa, and tomatoes. Producers in the Fairbanks area supplied the honey, salsa, and tomatoes, the carrots and barley pancake mix came from Palmer and the Matanuska Valley.

Alaska honey

Honey consumption in the United States has increased since the 1980s. A small segment of this growing market is exotic, premium-priced, gourmet honeys produced from only one flower such as fireweed, clover, or orange blossoms, or blended from different flowers from a specific geographic region such as Alaska wildflower honey. Alaska producers have entered the gourmet honey market. In 1994, approximately 800 bee colonies in Alaska produced about 30,000 pounds of honey.

Methods

In Spring 1991 we evaluated five honeys: Alaska wildflower, fireweed/clover, and fireweed (all harvested in 1990), Alaska synthetic honey (manufactured from fireweed, clover and sugar), and one non-Alaska, mass-produced fireweed honey. The panelists tasted the samples to determine if they were acceptable. They were told each honey's price per pound and asked if they would buy it. Moisture content, viscosity, pH and color similarity were measured to determine the honeys' physical similarities.

Results

Panelists preferred the Alaska wildflower, mass produced fireweed, and Alaska fireweed/clover. When panelists were told the prices of the honeys, they said they would purchase the lower-priced, mass-produced fireweed rather than the Alaska honeys.

The honeys were similar in physical characteristics. All but the Alaska synthetic were below the maximum moisture limit of 18.6 percent set by USDA for the top two grades. The Alaska synthetic's moisture content of 19.4 percent made it appear thin or more liquid. The Alaska fireweed was the most viscous. All the honeys were in the acid end of the pH range (3.42—6.10). The honeys were

lighter than the typical amber color found in grocery stores. Alaska wildflower and mass-produced fireweed were a light amber while the Alaska fireweed was clear.

Questionnaire answers revealed that most thought honey sold in specialty shops was higher quality than honey sold in supermarkets. Those purchasing honey for gifts were less price conscious and more conscious of the production location than those purchasing honey to eat. Alaska honeys are marketed primarily through farmers' markets, gift and gourmet shops, and health food stores. The higher prices may not be a problem to shoppers in these outlets.

Alaska fireweed honey has characteristics desired by the baking industry which could provide an opportunity for Alaskans to sell bulk quantities. Overall, the honey industry in Alaska shows promise, the premium honey market has been entered and the bulk market is a possibility.

Carrots

"Alaska vegetables are sweeter than those from outside," is a comment often made by Alaskans. There was no scientific evidence to support this claim until 1992 when Dr. Ruthann Swanson and I conducted the carrot sensory panel.

Methods

We evaluated five carrots from the Matanuska Valley (two—Nantes and Ingot—were organically grown and Nantes, Pioneer Nantes, and Processor IV were grown using chemicals), and one (a chemically-grown Imperator type) from western Washington. The Imperator type served as a basis for comparison.

Panelists evaluated the appearance, texture, and flavor of cut carrots. Before tasting, they were asked to describe their ideal carrot. All participants answered a questionnaire about their food shopping patterns, perception of fresh produce, and consumption and purchase of carrots. They were also asked if they would purchase the same samples when they were displayed as loose, topped carrots in baskets.

We enrolled the help of a lab to perform Beta-carotene (vitamin A) and sugar analyses. Beta-carotene affects color with the higher content increasing color intensity.

Results

We compared the acceptability results from the taste test to the participants description of their ideal carrot. All the carrot samples closely resembled the ideal carrot. Alaska's two organically grown varieties were rated lowest. The cut surfaces were dull and slightly white speckled which consumers associate with older carrots that are not fresh. A uniform, reddish-orange color was important to the panelists. The ideal carrot was more firm and crisp in texture and more juicy, and less chewy and woody than those sampled. Compared to the ideal described, the Alaska carrots were moderately acceptable. The Washington carrot was farthest from the ideal. All were less sweet than the ideal and considered more bitter and oily.

Panelists were most willing to purchase Nantes and Ingot organic carrots. The Washington carrot was followed by Pioneer Nantes in preference. Processor was the least likely to be purchased. Beta-carotene content was similar for all the carrots. Carotene is highly variable in a carrot reflected by its differences in color. Alaska carrots had a higher total sugar content (5 to 6 percent) than the Washington carrot (2.5 percent).

"NRM 310—Agricultural Concepts—is designed to teach students consumer marketing principles and help entrepreneurs in Alaska's agricultural industry.

Students develop marketing strategies and craft logos for Alaska products. They and other volunteers participate in sensory panels where they might describe a similar product, complete a demographics questionnaire, provide information on their shopping habits and views on organic products, the Alaska Grown program, and healthy eating habits."

Dr. Carol Lewis

Color and flavor were most important to these participants. Shape, size, and color are indicators of flavor because carrots cannot be tasted before purchase. Shape and size influenced purchase decisions, but there was no reference to flavor. Large diameter carrots, like Processor IV, are hard to bite and cut. The slender tips of the Imperators and the chemically grown Nantes break when peeling. The slender, uniform size, blunt-tipped, organically grown varieties had an appealing shape. Price mattered to these panelists who were aware of "Alaska Grown" products and read labels.

We feel that Alaska-grown carrots can compete successfully if we emphasize their hidden attribute: sweetness. The "Alaska Grown" label will make the carrots stand out; however, the price must be competitive. Carrots are a staple food and price is important.

Barley pancakes

Quality, nutrition, health, taste and safety are important to today's consumer. Barley, considered by most to be a healthy grain, is used increasingly in a variety of foods. It is natural, then, that an Alaskan entrepreneur would try a nutritious pancake mix using one of Alaska's leading products.

Methods

In 1993, the Agricultural Concepts class evaluated *Alaskan Barley Trailcakes Mix* and provided marketing information. A focus group of six individuals also offered marketing suggestions. Sensory panelists—sampling two pancakes—determined overall quality (appearance, texture, and flavor) of pancakes prepared according to manufacturer's directions. A questionnaire explored marketing ideas and whether organic growing techniques, geographic location, and healthy ingredients make a difference in purchasing patterns.

Results

Three-quarters of the participants ranked the barley pancakes about average in appearance, 65 percent rated the flavor as acceptable, and several panelists said that if this were labeled a "healthy" product they would have rated

it higher. The texture was rated acceptable by 69 percent. Some would have preferred a thicker pancake, but this can easily be changed by adding less water to the mix. Sixty percent indicated they would eat these pancakes occasionally. This reflected the panelists' opinion of the mix as well as the number of times they ate pancakes.

The questionnaire revealed that barley was considered equally or more nutritious than other whole grains and 74 percent thought it had a unique flavor. Approximately 30 percent of the panelists had purchased organic foods (mostly grains or grain based) within the last year. They were also aware of the "Alaska Grown" program; 90 percent purchased locally produced products when available and approximately 88 percent read labels to determine processing methods and nutritive content of foods. Seventy-four percent of these panelists were willing to pay 10 percent more for foods contributing to a healthy diet. More than half, 56 percent, would pay an additional 10 percent for a processed product produced in Alaska. If a health claim was added, this number would increase to 88 percent. Panelists were least willing to pay more for a product labeled organic.

The focus group described the product as grainy and nutty in flavor with a crunchy texture. They liked the "just add water" feature of the mix. Six months was a preferred storage time. Storing the product in the refrigerator was acceptable because the product contained whole grains. The group suggested the product be placed on the grocery shelf near similar items. They also thought it could be sold in health food stores. Nutritious with "low-fat, high-fiber" labels rather than "healthy" would prompt this group to pay more for the product; organic would not. They agreed, the name should bring an image of Alaska to mind and "Alaska produced" should be highlighted along with low fat, high fiber.

Salsa

Salsas—the "taste that pleases by irritating"—are **hot** in the United States so why not in Alaska? Salsas could be an important value-added product for Alaska's tomato producers, since growers can use green tomatoes, and tomatoes that do not grade No. 1 in this product.

Methods

The 1993 Agricultural Concepts class evaluated Alaska salsa to determine its appearance, texture, and flavor appeal. Because there are regional differences in salsas and preference for salsas, a second test group in Knoxville, Tenn. evaluated the Alaska product and a Tennessee product. All panelists were asked to describe their ideal salsa before they tasted the products. After panelists tasted the products, they evaluated appearance, texture, and flavor.

Hot salsas have a chemical heat created by capsaicin found in red peppers; milder salsas have strong tomato, onion, and pepper flavors without the heat. The Alaska salsa was identified by the producer as one with medium intensity that he controlled by using dried red pepper. It was a shelf-stable item processed in a hot-water bath. The tomatoes, onions, and green peppers were grown in Alaska. The heat intensity of the Tennessee salsa was also identified as medium. It was controlled by the processor adding jalepenos and sold refrigerated. A questionnaire asked how geographic descriptions on the label affected panelists' salsa choices and what ingredients they preferred in a salsa.

Results

The ideal salsa for panelists from Alaska and Tennessee was a thick, juicy salsa in the medium-to-hot range with distinguishable ingredients. Alaskans preferred a chunkier, less-red salsa than their Tennessee counterparts.

All panelists agreed the Alaska salsa was less juicy and red in appearance than the ideal. The texture was close to the ideal for Alaska panelists, while Tennessee panelists found it too thick and chunky. All panelists thought the flavor was not hot, spicy or fresh, saying it was too sweet, acidic, and tomato-like. Overall, 84 percent of the Alaska panelists and 78 percent of the Tennessee panelists placed the Alaska salsa just above midpoint on a six-point scale from unacceptable to very acceptable.

Chemical analysis agreed with opinions of the panelists on juiciness. The pH of the Alaska sample was 5.0, the Tennessee sample 5.7. Panelist judged the Alaska salsa too acidic.

Consumers use geographic location to differentiate products; consequently, more than 30 states use a geographic promotion campaign. The influence on a fresh salsa product is not known, although geographic origin

Cathy Brooks, state 4-H program specialist, fills out a questionnaire. (photo by Donna Gindle)

Sensory panelists Margaret Krize and Lola Oliver. (photo by Donna Gindle)

is increasingly used on both fresh and processed food. More than half the panelists thought that products originating from California, Washington, and Alaska were high quality. Approximately 30 percent of the Alaska and Tennessee panelists read labels to determine product origin. A geographic label was most useful on fresh products (88 percent), followed by chilled products (84 percent) and canned or frozen products (67 percent). The panelists agreed that a label specifying geographic location is advantageous in marketing.

The bottom line is that a spicy, relatively hot, red and chunky, fresh salsa could be a hot seller and provide a value-added opportunity for Alaska's tomato producers.

Tomatoes

Alaska's tomato producers are increasingly supplying the demand for fresh, high–quality tomatoes during the growing season. Greenhouses extend the season so shoppers can enjoy the product both in early spring and late fall.

Methods

The 1994 Agricultural Concepts class evaluated tomatoes produced in Fairbanks' greenhouses to determine consumer acceptance. The Alaska tomatoes were compared to tomatoes from other states that carried a producer label, and to generic tomatoes that were not labeled. The panelists were asked to describe their ideal tomato and participate in a taste test rating appearance, texture, and flavor. The participants did not know where the tomatoes were grown.

The panelists were also asked if they would be willing to buy the tomatoes and their opinion about the tomatoes' appearance. We used the same tomatoes as those in the taste test, but labels were used to determine if labeling made a difference. The generic non-Alaska tomato had no label. The Alaska tomato carried the producer's label in one display and the "Alaska Grown" logo in another. The non-Alaska labeled tomato was displayed with and without the label. Three tomatoes of each type were arranged in round, wicker baskets to simulate a grocer display. The panelists were informed that all the tomatoes were the same price but were not given the amount.

Results

The panelists' ideal tomato is uniform in color and red, firm and juicy, and sweet with some tartness. They would accept some pulpiness or seediness, but the tomato could not be mushy, dry, or have a tough skin.

The labeled and the generic non-Alaska tomatoes were judged less uniform and red, duller, and not as smooth skinned as the ideal. The Alaska tomato was judged higher than the ideal in these characteristics. The generic tomato appeared to be the most green shouldered. The texture of all the sampled tomatoes was not as firm as the panelists preferred, and was pulpier and more seedy. The labeled and the generic non-Alaska tomatoes were considered a great deal less juicy than the ideal, while the Alaska tomato approximated the ideal. All the tomatoes were considered less mushy, dry, or tough skinned; the Alaska tomato a great deal less. The flavor of the Alaska tomato came close to the ideal. All the tomatoes were less sweet and tart as well as more bitter, greasy, and oily. The generic non-Alaska and the Alaska samples were about as salty as these panelists wanted; the labeled non-Alaska tomato was less salty.

Panelists' opinions about appearance were almost the same when they were asked if they would buy the tomatoes as it was when they were asked about appearance in the taste test. Both the "Alaska Grown" and producer–labeled Alaska tomatoes were redder than the ideal; all others were approximately the same. All had less green shoulders. The non-Alaska labeled and unlabeled tomatoes did not have the smooth skinned appearance these panelists liked. Judgment of appearance was reflected in likelihood to purchase for these panelists, but there was no apparent effect of labeling on their purchasing decisions.

Sugars, acids, and their interactions are important to sweetness, sourness, and overall tomato flavor intensity. High acids and low sugars produce a tart tomato while low acids and high sugars produce a bland product. If both are low, the tomato is flavorless and flat.

The tested tomatoes all had higher sugar ratios and lower acid ratios than typically found in red tomatoes. These would tend to be blander but sweet. The panel opinions reflected the chemical analyses. These panelists preferred a sweet tomato but also wanted a somewhat tart flavor. The overall acidity of the Alaska tomato may have contributed to it being closer to the ideal than the non-Alaska tomatoes.

The questionnaire showed that taste, firmness, and color were most important to more than 95 percent of the participants. Size and shape mattered to slightly more than 60 percent, while 95 percent considered flavor and freshness important. Brand name (82.8 percent) and packaging (62.1 percent) were not important and only 12.1 percent considered the producing area important. These participants read labels (66.7 percent).

Alaskan consumers want their tomato to be a uniform–red color, sweet and somewhat tart, and juicy and firm textured. Labeling and "Alaska Grown" logos will not overcome these desirable characteristics.

Research achievements

Plant, Animal and Soil Sciences

Brucellosis research

Research to control brucellosis continued in the Seward Peninsula reindeer herds. We identified several research priorities at a reindeer brucellosis conference held in July 1994. Reindeer herds are being serologically monitored for brucellosis, with serum from known status animals used for further evaluation of serologic tests. We are evaluating the serologic tests with assistance from the USDA and the Texas State Federal Laboratory. We are also cooperating with the USDA on developing a cost-benefit analysis for brucellosis control and eradication and further vaccine research. The current vaccine was used in most Seward Peninsula herds, and herders reported a decrease in reindeer with symptoms of the disease. One of the major goals for the 1995 reindeer handling season is to begin vaccinating new herds and test herds which have previously not been subject to a brucellosis control program, including the St. Lawrence Island herd.
•*Julia Bevins*

Reindeer herd health

The UAF Reindeer Research Program continued work that focused on improving herd health. Aspects of this program include warble fly control, improving fawn and adult reindeer survival, reducing stress at handlings, brucellosis control, and consulting with herders. This program is implemented under veterinary supervision.
•*Julia Bevins*

Comparing potatoes, evaluating Rhizoctonia

Average production of cultivars of potatoes evaluated in Southcentral Alaska's Matanuska Valley in 1994 was below the five-year average in irrigated trials by more than 1.8 tons/acre and below the five year average in nonirrigated trials by more than 3 tons/A. Rainfall was well below the long-term average for this area, although it exceeded rainfall during the 1993 growing season. Average temperatures were also higher than the long-term average. There was 117 days between the planting and harvesting of potatoes in 1994 and no killing frosts occurred during that period. The average yield in irrigated trials across the 45 cultivars was 14.7 and 19.4 tons/A for the US #1 and total categories respectively. The top yielding irrigated cultivar was Kennebec (22.8 tons/A US #1), followed closely by Green Mountain, Gold Coin, and Chieftain. Average yield in nonirrigated trials across varieties was 4.5 and 6.6 tons/A for the US #1 and total categories respectively. The top yielding nonirrigated cultivar was Shepody (8.6 tons/A US #1) followed by Kennebec, IditaRed, and Bake-King.
•*Donald E. Carling*

Evaluating transgenic potatoes

We evaluated 10 transgenically altered lines of potato for resistance to Rhizoctonia disease in 1994. These lines were selected from the 24 lines evaluated in 1993. Some of these transgenic lines show higher levels of resistance to Rhizoctonia disease than parental controls, although it is not yet certain that the differences are commercially significant. We will evaluate five lines in 1995 under two different levels of disease pressure.
•*Donald E. Carling*

Evaluating metam sodium for weed control

We treated field plots with 0, 25, 50 or 100 gallons/acre of a 32.7 percent solution of metam sodium in late July, placing the chemical into the soil with shanks at a depth of approximately eight inches, and approximately six-inches apart. Four replicates of tarped and nontarped treatments at each rate were included. Weed seed kill, as determined by weed emergence four weeks after treatment, indicated the two lower rates were inadequate for eliminating weed seeds. No weed seeds had germinated in plots treated with the two high rates. Tarping made no difference in weed seed emergence. By the following growing season the same trends in weed seed development were apparent. The two higher rates essentially eliminated weeds, whereas the lower rates provided inadequate control. Metam sodium appeared to kill all weed seeds indiscriminately, but maybe less effective against perennial weed like quackgrass (*Agropyron repens*).
•*Donald E. Carling, James L. Walworth and Jeffery Conn*

Measuring greenhouse gas flux

Methane and nitrous oxide are radiatively active gases that contribute to global warming. Well-drained arable soils normally consume methane but laboratory studies have shown that ammoniacal fertilizer interferes with this process. However, three years of field testing has failed to confirm this in Interior Alaska. We found that methane consumption occurs to a depth of about 1.5 feet and ammoniacal based fertilizer does not move more then a few inches into the soil. Thus, the fertilizer affected only a small portion of the soil and the rest of the soil appears to compensate for that loss of activity. Field studies at Fairbanks and Delta Junction, Alaska showed that the organisms consuming methane are sensitive to high water content early in the spring and to very dry soil that occurs during the summer months. Management practices, such as long term no-tillage that stores more water, reduced methane consumption at planting but increased consumption during mid- and late-summer due to more soil water. The net result was greater methane consumption over the whole season.

Nitrous oxide is produced during the oxidation of ammonium to nitrate in well-aerated soils and during the reduction of nitrate the dinitrogen gas in compacted or poorly drained soils. We conducted field studies on well-drained soils, and nitrous oxide production was primarily the result of the oxidative process. We found that about 0.1 to 0.4 percent of the nitrogen applied as urea was lost as nitrous oxide and not affected by tillage practices. We also found, in a long term study, that keeping crop residues on the field increased nitrous oxide emissions over that where the residues were removed after each harvest. We attribute this to greater organic nitrogen in the soil from decayed plant material, and

that the increase in nitrous oxide was from greater mineralization of that nitrogen.
Verlan Cochran and Sharon Schlentner

Examining bacterial ring rot

In potatoes, bacterial ring rot (BRR) disease, caused by *Clavibacter michiganense* subsp. *sepedonicum* (CMS), is manifested as wilt and tuber rot. CMS infection can be expressed in severe symptoms. It can also occur as a latent infection, and BRR diseased plants are symptomless, which makes disease difficult to detect visually. The purpose of this project is to study the correlations between CMS population levels in potato plants and the BRR symptom expression under Alaska environmental conditions. Results of the two-year study indicated that CMS was detectable in the lower stem 42 days after planting, with appearance in the stolon, middle stem, and top stem after 50, 60 and 70 days, respectively. Under warmer, greenhouse conditions, symptoms of BRR occurred about 10 days earlier than in the field, and were more severe. We found several bacteria species isolated from the potato plants capable of inhibiting the growth of CMS and interfering with the symptom expression of BRR.
Ming Di and Jenifer McBeath

Studying barley breeding

The objective of this study was to determine the relationships among agronomic characteristics of barley and their potential for use in breeding programs. Developmental traits, including time to heading, time to maturity, grain fill duration, grain fill rate, heads/area, kernels/head, and weight/kernel were measured in 16 barley varieties for three years. Time to heading exerted a greater influence on early maturity than did grain fill rate or grain fill duration. The number of kernels/head influenced grain yield more than the number of heads/area and weight/kernel. We concluded that early-maturing, high-yielding varieties would most likely be obtained by selecting for early maturity and late heading dates.
Stephen Dofing

Testing uniculm barley plant

Barley farmers in Alaska often face the problem of late developing tillers, which delay harvest and lower grain quality. The uniculm plant type, however, produces a single head/plant and, therefore is free of late-developing tillers. We evaluated five uniculm varieties planted at three seeding rates varieties in Palmer and Fairbanks for two years. The uniculm plant type resulted in more uniform maturity; however, grain yield was significantly reduced. This was due to a sharp reduction in kernels/head as seeding rate increased. Therefore, the uniculm plant type does not appear promising for use in Alaska.
Stephen Dofing and Charles Knight

Developing tip-burn resistant lettuce

Tip-burn, a localized calcium deficiency that occurs at the tips and margins of plant leaves, is a major problem in lettuce production, and has a negative impact on Alaska lettuce production. Manifestation of tip-burn is controlled both by environmental conditions, and by plant genetics. Variety development and selection is a primary tool for managing tip-burn. By growing lettuce genotypes obtained from the Mediterranean region under conditions that favor tip-burn, and making selections of tip-burn resistant progeny, we hope to produce an improved green leaf lettuce variety. Genotypes currently undergoing evaluation appear to have superior tip-burn resistance compared to commercially-grown varieties.
Stephen Dofing and James Walworth

Establishing productivity parameters

The reindeer research program initiated a uniform data collection and record keeping system to incorporate all the reindeer herds on the Seward Peninsula and St. Lawrence Island. Uniform data collection parameters are needed to monitor long-term trends in nutrition, productivity, and health of the herds. The data collection system allows comparisons between herds to evaluate range productivity, research projects, and management strategies. Many of the reindeer corrals are in remote locations accessible only by boat, airplane, snow machine, or ATV. Heavy or shock and weather-sensitive equipment cannot be used in these locations. Portable electronic scales, computers, and other equipment were evaluated and used to collect antler and calf weights, fecundity, and herd demographics.
Greg Finstad

Crooked calf disease

Crooked calf disease is skeletal deformities that may develop if cows eat certain members of the *Lupinus* species between day 40 and 70 of gestation. In Alaska there are four perennial species of lupine: arctic lupine (*Lupinus arctucus* subsp. *arcticus*), Nootka lupine (*L. nootkatensis* var. *nootkatensis*), large-leaved lupine (*L. polyphyllus* var. *polyphyllus*), and Yukon lupine (*L. kuschei*). Teratogenic lupines contain quinolizidine and piperidine alkaloids. There are three major quinolizidine alkaloids: sparteine, lupanine, and anagyrine. The piperidine alkaloid is ammodendrine. The principal alkaloid responsible for crooked calf disease is anagyrine. There have been reported cases of congenital defects on Kodiak Island, Alaska, in cattle that may be associated with the consumption of *Lupinus*. The objective of this study was to determine if the alkaloids responsible for crooked calf disease are present in lupine in Alaska. A botanical collection of arctic, Nootka, and large-leaved lupine was made in July 1994 at Eagle Summit, Delta Junction, Homer, and Kodiak Island. We randomly collected 10 entire plants of each species from each site for botanical identification and chemical analysis. We measured the total alkaloid level and the percent of individual alkaloids for stem, pods, and root parts of arctic and Nootka lupine. Anagyrine, the only quinolizidine alkaloid known to cause crooked calf disease in experimental feed trails was not present in arctic nor the Nootka lupine collected in Alaska. This may indicate that another alkaloid in lupine, or the combination of another poisonous plant, may be responsible for Alaska's crooked calf disease. Not all lupine are teratogenic. Nevertheless, the high incidence of crooked calf disease on Kodiak Island may indicate that another quinolizidine alkaloid—other than anagyrine—may be responsible for the disease.
Ray Grover Jr., Lyle Renecker, Kip Panter and Keith Van Cleve

Reindeer and the GIS

We began integrating geographic data on soils, vegetation, elevation, slope, and aspect with range allotment information and reindeer records. We'll merge the data to create a tool for facilitating management decisions and answering research questions. Ongoing range productivity studies will supplement existing vegetation data and provide greater resolution for answering questions about seasonal productivity.
Owen Guthrie

Usibelli vegetation studies

Usibelli Coal Mine has funded several inventory and revegetation studies over the last decade so they can continue improving revegetation on their mined sites. In 1991 I began

evaluating growth of grass species on different growth media on windy, south-facing slopes for cover, nutrient absorption, and decomposition. Nutrient levels of soils, roots, and aboveground plant parts of selected species were monitored to identify nutrient movement. Norcoast Bering hairgrass (*Deschampsia beringensis*) and Nortran tufted hairgrass (*Deschampsia caespitosa*) had the greatest cover on fertilized portions of the plots at the end of 1994. Currently, little vegetative ground cover exists on any unfertilized plot portions. Native colonization was greatest on plots seeded with legumes and consisted mostly of herbaceous species that follow disturbances. Local colonization was low on the sandstone and the A+B horizon materials unless we used an organic mat. Aspen sprouted from root fragments where we used an organic mat.
•*Dot Helm*

Soils studies

During the summer of 1994 we evaluated vegetation and soils on native and previously-mined sites to identify potential resources for reclamation in the Nolan Creek area near Wiseman in the Brooks Range. Native vegetation in the area consisted primarily of white spruce forests, open low shrub birch—ericaceous shrublands, and open white spruce—paper birch stands. Vegetation on disturbed sites with mineral soils was usually dominated by feltleaf willow and other species typical of floodplains. Soils under native vegetation typically had pH values <7 while mineral soils of disturbed sites had pH values >7. Extractable P was low in all sites as a results of high Ca levels tying it up. Native plant species have colonized old (greater than 50 years) mine workings, recently (less than 10 years) abandoned, or recently reclaimed areas. Some newer sites have about 18 percent cover of natural woody plants already, although some have mostly grasses.
•*Dot Helm*

Reclaiming coal mines

The Alaska Division of Mining is reclaiming coal mines abandoned prior to 1977 when the Surface Mining Control and Reclamation Act was passed. We are assessing on-site natural resources before reclamation to determine if existing growth media or plants can be used to facilitate reclamation and then make suggestions to the Division of Mining, the funding agency.
•*Dot Helm*

Establishing woody plants

This study evaluates longer-term (five to 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 is substantially better on the three soil-material sites compared with the glacial till site for the first six years. Large, broadleafed colonizers such as cow parsnip have out competed transplants on some growth media while transplants established themselves above the native colonizers on most plots. We collected twig, leaf, and soil samples in 1994 to assess plant tissue and soil nutrient status. Preliminary results indicate that plant tissue nutrients on the disturbed site are similar to those of local plants.

Soil was transferred to introduce mycorrhizal inocula to Sitka alder seedlings in 1990 on an active coal mine site near Healy. Inocula were obtained from a paper birch and white spruce forest with Sitka alder understory (expected to have appropriate microorganisms) and from a black spruce forest with ericaceous shrub understory (would not have appropriate microorganisms). We monitored these plants for height since 1990 and in 1994 took root samples from these transplants and native colonizers to determine the mycorrhizal colonization after five years.

We are monitoring seedling colonization and seed rain on an abandoned placer mine that is 100 miles northeast of Fairbanks and was reclaimed in 1993. The seed rain during 1994 was low except under existing plants. Natural colonizers included feltleaf willow, dwarf fireweed, wild rhubarb, and a few unidentified seedlings. We also planted feltleaf willow cuttings at three heights above the water and three times during the growing season to assess their survival and growth.
•*Dot Helm*

Patch formation, mycorrhizal colonization

One objective of this study was to document mycorrhizal

Grant Matheke, horticulturist, instructs University Park Elementary students from Mrs. Angaiak's second-grade class on the finer points of planting vegetables. Each year SALRM faculty and staff volunteer to work with school children. (photos by Valerie Hendrickson)

types on key woody plant species (black cottonwood, Sitka alder, and Sitka spruce) across a primary successional chronosequence following glacial retreat. Mycorrhizae are symbioses between certain fungi and plant roots which help the plant absorb soil nutrients, especially phosphorus, and moisture. Sampled individuals included young seedlings as well as native trees where available. We transplanted indoor-grown plants in varying stages to evaluate what mycorrhizae may form on uniform-aged plants. More than 20 ectomycorrhizal types were described from native plants in this area. Some types were found only in the youngest stands while other mycorrhizal types were found only in the oldest stands. The mycorrhizal types formed on black cottonwood differed among the successional stages for the first 100 years (barren, isolated plants, patchy, alder, cottonwood stages). Significant differences across vegetation types did not occur for the other species although mycorrhizal types tended to differ for each plant species. Fewer types formed on the transplants than on the native plants.

•Dot Helm

Enhancing plant disease resistance

The purpose of this study is to enhance disease resistance in crops through plant genetic engineering. In the past three years, we constructed several gene fusion cassettes containing an antibacterial gene and successfully transformed tobacco and potato plants with these gene constructs. Preliminary pathogenicity tests showed that transgenic plants containing the gene fusion cassettes exhibited extremely high levels of resistance to bacterial diseases.

•Yong Huang and Jenifer H. McBeath

Expressing the bean promoter gene

We inoculated transgenic tobacco plants containing the bean chalcone synthase (CHS8)-beta-glucuronidase (GUS) gene fusion with compatible (K60) and incompatible (B1) strains of *Pseudomonas solanacearum* to study the functional properties of the CHS8 gene during the wilt symptom development and the hypersensitive reaction in tobacco. Our results showed that rapid induction of the CHS8 gene in transgenic tobacco by bacterial infection indicated that expression of the CHS8 promoter in response to pathogen infection is maintained in tobacco. This distinctive patterns of GUS expression elicited by K60 and B1 suggest that interactions between tobacco and two bacterial strains are differentially recognized for stress induction of defense genes.

•Yong Huang and Jenifer H. McBeath

Gene-fighting bacteria

The purpose of this project is to study the functional properties of the *Arabidopsis* phenylalanine ammonia-lyase promoter gene (PAL1) with the beta-glucuronidase reporter gene (GUS) in response to bacterial infection. We observed that the expression of PAL1-GUS in transgenic tobacco was rapidly induced in response to challenges from *Pseudomonas solanacearum*, a bacterial pathogen capable of causing brown rot in potatoes and wilt disease in many other crops. Two representative strains of *P. solanacearum* used in this study are K 60 and B1. K 60 is a wildtype strain and strain B1 is an avirulent mutant capable of inducing the hypersensitive reactions. The distinctive patterns of GUS expression elicited by K60 and B1 on transgenic tobacco plants indicated that PAL-controlled phenylpropane metabolism may play a role in regulating resistance and susceptible responses.

•Yong Huang and Jenifer H. McBeath

Barley, protein supplements for swine

We conducted a study with 60 (Yorkshire and Hampshire) pigs (52 pounds) to determine the effect of whole canola seed 'Tobin' (18.5 percent C.P., 40 percent fat, 1.2 percent lysine) at 0, 5, 10 and 15 percent dietary levels as a weight/weight replacement for soybean meal in barley based growing-finishing diets. Protein and lysine were formulated at 15 and 0.7 percent for the grower and 13 and 0.6 percent for the finisher diets, respectively. Both the rate and efficiency of gains were significantly reduced at the 15 percent supplement and results indicated that the maximum acceptable dietary level for growing-finishing pigs should not exceed 10 percent. Alaska's swine producers could replace imported soybean meal with whole canola seed when canola is priced at 60 percent the delivered value of soybean meal.

•Fredric Husby

Flatfish meal study

We conducted a study to determine the effect of a low-ash, low-fat flatfish meal as a protein replacement for soybean meal and dried whey in barley based early-weaned pig diets. Flatfish meal contained arrowtooth flounder and was minced, deboned, and cooked for 100 seconds at 200°F, oil removed by a 3-phase decanter, dried at 240°F for 30 seconds. Barley diets were formulated to contain 21 percent C.P., 1.2 percent lysine, 20 percent dried whey, and equalized at 4 percent fat with corn oil. Forty-five pigs weaned at 21 days were placed on a barley-soybean 20 percent dried whey control, and then four test diets that contained flatfish meal with 20, 10, 5, and 0 percent dried whey. After four weeks, average daily gains of the control were significantly less than the 10 percent whey diet. Flatfish meal could replace all the soybean meal and dried whey and barley as the sole grain source at 79 percent had no reduction in gains, intake or feed conversion. This study indicates that barley can be successfully used at greater levels than previously published in scientific literature and that high quality marine by-products may replace expensive dried whey in early-weaned pig diets.

•Fredric Husby

Light affects petunia growth

We grew petunias at 15 hours day length. At the beginning or ending 90 minutes of the day, the plants were exposed to light qualities simulating the natural changes in light during sunrise and sunset. Flowering was delayed approximately 10 days when sunrise conditions were simulated in the morning at 60°F. Sunrise conditions at night, or sunset conditions either in the morning or end of day did not affect rate of flowering compared to natural daylight all day. The petunias grew about two inches shorter when given simulated natural sunrise conditions during 90 minutes in the morning or sunset conditions during 90 minutes at the end of the day. Simulated sunset conditions during the initial 90 minutes of the day or sunrise conditions at the end of the day resulted in petunias similar in height as plants grown at natural daylight throughout the day.

•Meriam Karlsson

Flowering in Alpine violets

We grew alpine violets (cyclamen) at 68°F and eight or 16 hours day length. We adjusted the light intensity to provide the same total amount of light during the eight or 16 hours each day and dropped the temperature to 60°F after nine weeks. Time required for flowering varied between six and seven months from seeding. Plants grown at high light (approximately 1,000 foot-candles during 16 hours or 2,000 foot-

candles during eight hours) flowered faster than plants grown at lower light. The flowering response to light intensity was similar at eight and 16 hours day length. These findings suggest flowering in Alpine violet is a response to the amount of light each day rather than to the specific length of the day.
•Meriam Karlsson and Jan Hanscom

Fieldpea performance test

Fieldpeas are desirable in Alaska for several reasons: the seed can be used as a high protein animal feed, the immature plants can be cut as a high quality hay or silage crop. Since peas are legumes, they use nitrogen from the atmosphere and do not require much fertilizer. In 1994, we started participating in regional fieldpea varietal performance tests coordinated by the Alberta Special Crops and Horticultural Research Center. Test locations included several sites in Alberta, the Peace River Area of British Columbia, and the Fairbanks, North Pole, and Delta Junction areas of Alaska and we evaluated 25 varieties in Alaska. Although seed and forage yields are major considerations in evaluating varieties, early maturity is essential if seed is to be produced locally. Earliest varieties reached maturity in 86 days and produced average seed yields of approximately 2,500 pounds per acre.
•Charles Knight

Alternative crops

In addition to barley and oats, farmers in Alaska need a selection of alternative crops which can be grown in crop rotations to help break cycles of weeds, insects, and diseases. Oilseeds and specialty (niche) crops are particularly desirable since they usually command higher prices than cereal grains. We evaluated varieties of canola, flax, sunflower, canary seed, buckwheat, wheat, oats, hulless oats, barley, and hulless barley for yield, quality, and maturity at locations near Fairbanks, North Pole, and Delta Junction. We collected whole-plant samples weekly during the growing season and analyzed them to determine the rate of biomass accumulation and nutrient uptake. Growing degree days were recorded to determine the heat unit requirement for each crop. From this data and historical weather records, we will attempt to predict the probability of each crop reaching maturity at various locations in any given year.

Additionally, we are working with area farmers to develop practices which will ensure early maturity and improve the quality of crops. An oilseed crusher was recently imported and will soon be erected. This will let us process oilseed crops locally and pursue markets for value-added products.
•Charles Knight

Mineland reclamation using biosolids

Biosolids (recycled municipal sewage sludge) were evaluated as a soil amendment on mine tailings at the Ryan Lode Mine near Ester, Alaska. Application rates were 0, 5, 15, 50, and 100 tons dry biosolids per acre. Four grasses ('Nugget' Kentucky bluegrass, 'Arctared' red fescue, 'Nortran' tufted hairgrass, and 'Norcoast' Bering hairgrass) were seeded over the treated area. During the first growing season, the best grass coverage was produced by Arctared fescue on sites which received either 15 or 50 tons of biosolids per acre. Soil samples from the field plots and samples incubated in polyethylene bags in the field showed that approximately 28 percent of the organic nitrogen mineralized from the biosolids and was available for plant uptake during the year of application.
•Charles Knight

Steven Becker, a recent graduate of SALRM, shows a group of school children through the swine barn. (photo by Valerie Hendrickson)

Evaluating fungus on potatoes

Trichoderma atroviride is a fungus found in Alaska that is capable of parasitizing a wide range of plant disease-causing fungi. This study seeks to evaluate the efficacy of controlling *Rhizoctonia solani* with four isolates of *T. atroviride* under potato field conditions. My collaborators in this project were Dr. M. Sun and Ms. E. Carpenter at the University of Montana. We found that the infestation of *R. solani* in 1994 was generally low, but Russet Burbank potatoes treated with mutant 453 displayed significantly fewer lesions at the lower stems of the potato plants. In addition, potato plants treated with *T. atroviride* seemed to produce fewer malformed, knobby potato tubers. Results from Montana field trials were consistent with three years of field observations in Alaska.

The government of New Zealand has granted a patent of *T. atroviride* and an approval of the International Application Published Under the Patent Cooperation Treaty.
•Jenifer H. McBeath

Controlling agents

We evaluated the potential use of this mycoparasite as a biological control agent of *V. dahliae*, which causes wilt diseases on alfalfa, cotton, potato, strawberry and many major crops, under laboratory conditions. Five isolates (two wild types and three mutants) of *T. atroviride* were found capable of inhibiting the growth and development of five *V. dahliae* strains, obtained from Illinois and California. Penetration of mycelia of *T. atroviride* into the mycelia and microsclerotia of *V. dahliae* was observed. *T. atroviride* appeared to cause the lyses of conidia, mycelia, and microsclerotia of *V. dahliae*. Although all five isolates of *T. atroviride* were capable of controlling the *V. dahliae* strains tested, certain *T. atroviride* isolates were discovered to be more effective than others.
•Jenifer H. McBeath

Evaluating lettuce tip burn

Tip burn, a disease caused by calcium deficiency, is one of the most important disease on lettuce in Alaska. The rapid growth of lettuce due to the extremely long day-length during the growing season makes lettuce particularly prone to this disease. Basal rot, which is caused by *Sclerotinia sclerotiorum*, can be very severe under certain environmental conditions. Damage to lettuce production caused by these diseases has caused great economic losses to lettuce farmers. We found all treatments such as applications of calcium in soil or top

dressing to be ineffective. We initiated a lettuce variety trial in 1991, in collaboration with Ms. P. Giaugue (lettuce farmer) and Mr. P. Sorreal (lettuce breeder, Harris Moran Co.). In 1994, we evaluated more than 60 lettuce varieties and breeding lines. Disease occurrences of tip burn on lettuce was fairly severe; several head lettuce varieties showed marked resistance to this disease. Infestation of *S. sclerotiorum* on lettuce was very light.

• *Jenifer H. McBeath*

Studying rice bacterial blight

The objective of this project is to develop a routine screening method for the exotic, bacterial blight disease threatening the United States rice crop. Bacterial blight of rice, caused by *Xanthomonas oryzae*, is a major disease of rice throughout Asia and much of the world. It is one of the most dreaded diseases to rice growing regions in the United States. In California a strict quarantine is enforced. In 1989, a low virulence strain of *X. oryzae* of rice was reported in Texas. However, discrepancies in its characteristics make it questionable to identify the Texas strain as *X. oryzae*. In 1994, in collaboration with Dr. Schaad at USDA-ARS, Foreign Disease-weed Science Research in Maryland, results of pathogenicity tests indicated that Texas strains are probably not *X. oryzae*. We are also establishing routine methods for disease detection to prevent introduction of the pathogen through contaminated seeds. Alaska's harsh environmental conditions and geographic isolation make it an excellent site to study and contain tropical exotic pests.

•*Jenifer H. McBeath and Ming Di*

Developing Alaska seed potatoes

Geographic isolation and harsh winters provide Alaska distinct advantages in the production of premium quality seed potatoes which are free from major viruses, bacterial ring rot, late blight (A1 and A2 strains) and golden nematodes. This project seeks 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 recognition of this potential, the Alaska Farm Bureau unanimously passed resolutions in 1991, 1992, 1993, 1994 and 1995 to support the establishment of a potato project. This project was approved by the Governor and the Alaska State Legislature in 1994. In the summer of 1994, we conducted a trial run and collected more than one million samples from seed lots of 12 farms and the Alaska Plant Materials Center. We found no presence of late blight and bacterial ring rot disease in any of the tested fields. We also found some 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. This is the first time in Alaska history that potato disease diagnoses were conducted with such thoroughness, intensity and large scope. Last August, in technical talks between Taiwan and the United States, Taiwan agreed to import Alaska seed potatoes. An inspector visited Alaska in July 1995 to confirm the existence of phytosanitary conditions.

•*Jenifer H. McBeath and Yong Huang*

Controlling diseases in petunia

Sclerotinia sclerotiorum, which causes crown and stem rot, is the most common disease on petunia and many herbaceous ornamental plants in Alaska. Symptoms of this disease include drying and wilting of stems and leaves. Large, flat, black sclerotia are often visible in the decayed stems. The disease often results in the death of the whole plant. Because this fungus can survive in soil (in the form of sclerotia) for a long time and is resistant to many fungicides, this disease is extremely difficult to control. *Trichoderma atroviride* has been found, under laboratory conditions, to be effective in parasitizing *S. sclerotiorum* and causing the lyses of mycelia and sclerotia. The purpose of this study is to search for an effective and environmentally benign method of control for this disease. Treatments in this experiment included a blank control, a Chipco treatment (fungicide control) and two *T. atroviride* treatments (a drench and a foliar spray). In the first year of this study, no significant differences were found in any of the treatments.

•*Jenifer H. McBeath and Patricia Wagner*

Gravel vegetation project

We obtained point canopy cover, basal cover, and species composition data during the 1993 growing season and analyzed to measure the effects from snow fencing, cellulose fiber mulching, adding three-inches of topsoil, tillage, gravel thickness, and varying seed application and composition. All seeded vascular plant species were indigenous to the Prudhoe Bay, Alaska region, the site of this experiment. Snow fencing (two feet) increased the canopy and basal cover of grasses at the expense of forbs. The cellulose mulch application also increased the canopy cover for grasses, but had no measurable affect on forbs. Topsoil increased basal and canopy cover for forbs and shrubs, with the grass response eclipsing that from forbs. Tillage improved canopy cover for grasses and had no measurable effect on either basal cover of grasses and forbs or forb canopy cover. Grass canopy cover was inversely related to gravel thickness (2, 3, and 5 feet). Gravel thickness had no measurable influence on either grass basal cover or forb canopy and basal cover. Vascular plant species composition data revealed similar results. Conditions favoring grasses were often detrimental to forbs, due most likely to competition between the two growth forms. Voluntary colonization by moss was markedly enhanced by snow fence protection, increasing from 0.5 to 9 percent cover.

Similarly, top soil improved moss cover from 0.7 to 9 percent. Moss cover declined with increasing gravel thickness. Cellulose mulch improved moss cover, but tillage had no effect. Composition and quantity of seed applications strongly affected the early characteristics of plant colonies on gravel fill. Based on previous studies in the area, there can be significant long-term effects from the species composition of seed mixtures applied during revegetation.

These preliminary results indicate sheltering from snow fencing, adding minimal quantities of top soil and mulch have positive effects, particularly for grasses. Gravel thickness is a negative factor, for most plant species. However, gravel thickness should not be viewed hopelessly, because after three years cover from moss and vascular plants averaged 28 percent on the thickest gravel fill. If a community predominated by forbs is a management objective, then attention must be given to seed mixtures and application rates. A high percentage of grass and a heavy application rate of grass seed favors grasses at the expense of forbs.

•*Jay McKendrick*

Grass, legume persistence and snow cover

Many forage species are not sufficiently winterhardy to be widely recommended in Alaska. Orchardgrass (*Dactylis*

glomerata), reed canarygrass (*Phalaris arundinacea*), red clover (*Trifolium pratense*), and alsike clover (*Trifolium hybridum*) are not regarded as winterhardy, but they do survive in some areas of the state. Winterkill has not been observed during the past six years at the Point MacKenize research site, but snow cover has adequately kept soil temperatures near 30° F. Snow cover is an important factor affecting the survival of perennial forage plants at specific locations in Alaska.
•*Michael T. Panciera and Beth Tillman*

Red, alsike clover forage quality

Forage legumes are widely used for livestock feed because they are high in protein and digestibility. While forage legumes are not widely used in Alaska, red and alsike clovers (*Trifolium pratense* and *T. hybridum*) survived well and produced excellent yields in areas that have consistent snow cover during the winter months. The quality of these crops was high during most of the growing season. In vitro dry matter digestibility (IVDMD) ranged from 68 to 81 percent, crude protein (CP) values were 13 to 23 percent, and acid detergent fiber (ADF) levels were 10 to 24 percent. In the first growth of spring, all measures indicated a steady decline from early June to early July when flowering occurred. The plots were clipped off and allowed to regrow. Unlike the first growth, CP levels were stable during regrowth in August. Energy levels declined during regrowth as indicated by reductions in IVDMD and an increase in ADF.
•*Michael T. Panciera and Beth Tillman*

Managing alfalfa seeding year harvest

We established alfalfa (*Medicago sativa*) stands at Point MacKenzie, Fairbanks, and Delta Junction to determine the effects of seeding year harvest date on storage of root reserves and on winter survival. Plants were dug in October of the seeding year and we measured total nonstructural carbohydrates in the roots as an indication of food reserve storage. Stands that were cut in early to mid September had the lowest reserves (23.9 percent), while cutting in early to mid August resulted in higher levels (27.3 percent). The highest reserves were found in stands that were not cut and those that were cut late in September (28.8 percent). Stand density and yield will be measured in the year after seeding.
•*Michael Panciera and Stephen D. Sparrow*

Wet soils monitoring

Seasonally and continuously wet soils are extensive in the Matanuska and Susitna valleys and have important water quality values. This study correlated hydrologic and morphologic characteristics of four representative soils of the area. Soil properties measured included depth to water table, soil water tension, redox potentials, soil temperature and snow depth. A correlation exists between depth of seasonal high water table and redoxmorphic features (mottles) in the poorly drained soils. High water tables during spring correspond to periods of maximum recharge from snow and during the late summer and fall from increased precipitation. Well-drained soils near Palmer have redoxmorphic features that appear to have formed under unsaturated conditions. We observed iron reductions, as indicated by low redox potentials, at soil temperatures below 40°F at all sites.
• *Chien-Lu Ping and Mark H. Clark*

Soil monitoring in Denali Park

The objectives of this study are: (1) to characterize the soil resources in the Rock Creek Watershed and evaluate its sensitivity to internal change and its relationship to vegetation communities; (2) to establish a baseline of soil characteristics as a reference value to measure future (long-term) environmental changes; (3) to set the Rock Creek Watershed monitoring network as a pilot project to test the monitoring system and to expand to other in-park watersheds and interface with out-of-park works; and (4) to transfer the data for management interpretations.

During the last two field sessions we monitored soil and air temperatures, soil biochemical reaction probes, soil water, solar radiation, wind speed and direction, relative humidity, and snow depth. The data collected add to the understanding of relationships between soil environments and vegetation communities in Interior Alaska. We monitored four vegetation communities: permafrost, forest, shrub tundra, and alpine tundra. The permafrost temperature is only slightly below the freezing point; 30.5°F. The permafrost is easily subject to environmental changes.
•*Chien-Lu Ping and Greg Probst*

Stream water quality

The objectives of the project are: (1) to collect baseline data of the dissolved organic carbon (DOC) and nutrient concentrations in soil solutions of different vegetation communities, (2) to measure the flow rate of soil water and discharge rate into the stream, (3) to relate the stream water chemistry to the nutrient levels of soil water and ground water, and (4) to determine the stream primary productivity. During the 1994 field season, areas significant in soil water discharge were identified and water sampling protocols were tested. Mapping Unit 4 was identified as the most significant; a wetland unit on 30 percent slope with vegetation dominated by alders and willows and the soil saturated during most of the growing season.
•*Chien-Lu Ping, Alexander Milner and Lisa M. Popovics*

Permafrost soils study

Soil morphology and characterization were studied in northern Alaska, NW Canada and NE Russia. A total of 50 soil plots were sampled from 1990 to 1994. The perennially frozen tundra soils generally have active layers ranging from 12 to 25 inches as controlled by drainage, aspect of slopes, and vegetation types. Thus, cryopedogenesis becomes one of the dominant soil processes on the landform-pattern ground complexes. Soils characteristics are ruptured organic horizons, warped or discontinuous soil horizons, and frost churning of organic matter into mineral horizons due to cryoturbation. Granular structures often dominate the surface horizons and platy structures due to ice lens formation dominating the subsurface horizons. The Ataxitic (ice-rich) structures are common to intermediate layers immediately above the permafrost horizons. Due to the unique nature of the permafrost soils, cryogenesis is recognized as the dominant soil forming process and a new Gelisol Order has been proposed to the U.S. soil classification system—Soil Taxonomy—to accommodate the cryogenic soils in the world.
•*Chien-Lu Ping, Yuri Shur and John Kimble*

Arctic soil organic matter

The study seeks to determine the carbon storage and their quality in relation to methane gas flux in Alaska's arctic tundra. We hypothesize that the major sources of CO_2 and CH_4 production are the active fractions in soil organic matter. We expect the composition, quantity and quality of the active and inactive organic carbon fractions and their turnover rates to be closely related to gas flux of different arctic ecosystems. The total organic carbon (TOC) content of the soils generally decreases with depth except for an increase in the upper per-

mafrost layer. This increase results from cryoturbation and carbon sequestration due to rising permafrost table. The carbon sequestered in the permafrost layers would contribute to the biogeochemical reactions leading to gas fluxes upon climatic warming. The distribution of the TOC and their extractability reflect the combined effects of vegetation and landform in the arctic environment.

•Chien-Lu Ping, Gary Michaelson, Ronald Malcolm, Wendy Loya

Perennial legumes

Much information is available on short-term yields and nitrogen fixation capabilities of forage legume crops in Alaska, but information on long-term persistence, yield, nitrogen (N) fixation, and effects on soil properties in Alaska is lacking. To obtain this information, we established forage plots at Point MacKenzie, in 1992 and at Delta Junction and Fairbanks in 1993. At Point MacKenzie 'Au Dewey' birdsfoot trefoil did not survive. Yields for other forage legumes were: 2.5 tons/acre for 'Aurora' alsike clover, 3.0 tons/acre for 'Tetra' alsike clover, 2.8 tons/acre for 'Kenstar' red clover, 2.6 tons/acre for 'Altaswede' red clover, and 2.4 tons/acre for 'Norcen' birdsfoot trefoil. These values compare to an average forage yield of 3.8 tons/acre for 'Engmo' timothy.

At Delta Junction, poor stands of cicer milkvetch and birdvetch were obtained and alsike clover and red clover did not survive the winter in adequate amounts for harvest. Therefore, we harvested only 'Peace' alfalfa, 'Nugget' Kentucky bluegrass, and 'Otal' barley (an annual crop). Forage yields of Peace alfalfa averaged only 0.2 tons/acre as compared to 0.7 tons/acre for bluegrass and 0.8 tons/acre for barley. Delta Junction experienced extremely dry conditions in 1994.

At Fairbanks, poor stands were obtained for cicer milkvetch, birdvetch, and alsike clover in 1993 and were not harvested in 1994. Peace alfalfa and Altaswede red clover both showed excellent survival through the 1993-94 winter and produced high amounts of growth in 1994. Peace alfalfa produced 3.8 tons of forage/acre and Altaswede red clover produced 5.2 tons/acre. This compares to forage yields of 2.4 tons/acre for Nugget Kentucky bluegrass and 2.3 tons/acre for Otal barley. Plant tissue N analyses have not yet been completed, so we have not yet determined N fixation values for the forage legume crops. However, legume forages which received N fertilizer did not yield any higher than those that did not, indicating that N fixation was adequate to produce good growth at Fairbanks and Point MacKenzie. Soil microbial biomass, which is sometimes used as an index of soil quality, was generally slightly higher in soils from the forage legume plots than from bluegrass, barley, or fallow plots. Wet soil aggregate stability, an index of the structural stability of the soil, was hardly affected by any of the treatments.

•Stephen D. Sparrow and Michael T. Panciera

Nitrogen-fixing plants

The Delta Junction Bison Range (DJBR) was established to provide late summer forage for the Delta bison herd to discourage them from entering farmers' fields and damaging crops before harvest. This has been only partially successful. Maintaining high quality forage has been difficult, partly because of lack of funds for proper fertilization and mowing schedules. This resulted in poor growth of the introduced forage grasses and invasion of bluejoint, a low quality, weedy grass. Nitrogen (N) fixing plants, including legumes, do not require fertilizer nitrogen. Forage legumes also produce high quality, highly palatable forage, and many of them remain green late into the fall. Therefore, if forage legumes could be worked into the management regime for the DJBR, we potentially could reduce fertilizer costs and improve forage quality. To test the feasibility of using forage legumes in the DJBR, we planted several types of legumes at several locations on the range in 1991 and 1993. Native Alaska legumes generally had good survival but were difficult to establish and produced low yields. In areas not protected from winter winds, introduced legumes survived poorly. In an area protected from winter winds and hence under snow cover during winter, red clover, kura clover, and alfalfa survived quite well, despite heavy grazing by bison in August 1993. The snow cover provided winter protection and spring moisture which probably improved growth since soils in the area have low water holding capacities and 1994 was an extremely dry year. We harvested in early August, about the time the bison normally return to the DJBR from their summer range. In 1994, red clover produced an average of 1.2 tons of forage/acre with 13 percent protein and alfalfa 0.8 tons/acre with 10 percent protein. Yields for kura clover were less than 0.3 tons/acre. Bromegrass planted at the same site and fertilized with N yielded 2 tons of forage/acre with 7 percent protein and Kentucky bluegrass yielded 1.3 tons/acre with 12 percent protein. The low protein content in the alfalfa was probably due to poor adaptation to the acidic soils of the area. Dry conditions probably limited N fixation by red clover, hence the fairly low protein content. Results of this study indicate that using forage legumes is not feasible for most of the DJBR, which is open and exposed to winter winds. Red clover may be useful in protected areas of the range. We will continue monitoring the plots for at least one more year.

•Stephen D. Sparrow and Michael T. Panciera

Managing bluejoint

Bluejoint (*Calamagrostis canadensis*), a native Alaskan grass, is a serious weed on the Delta Junction Bison Range (DJBR) because it out competes the introduced forage grasses. Although bluejoint produces good quality forage early in the growing season, its forage quality decreases rapidly as the season progresses, and by the time the Delta bison herd returns to the DJBR in late summer, its forage quality and palatability has decreased and the bison do not graze it. This is part of the reason that the range has had limited success in providing high quality bison forage. Herbicide use is not an option for controlling bluejoint on the DJBR. The Alaska Department of Fish and Game has attempted to control bluejoint on the DJBR through burning and occasional mowing, but with limited success. We began a preliminary trial in 1994 to determine proper nitrogen (N) fertilization and mowing regimes to either control the growth of or improve the late season quality of bluejoint. Several combinations of single or split applications of N fertilizer and several mowing regimes were imposed on a native bluejoint stand at the AFES Delta Junction Field Research Site. Nitrogen fertilization resulted in improved bluejoint forage quality early in the season, but quality was poor late in the season, even with mid- or late-season applications of N fertilizer. Mid-season mowing resulted in slight improvement of forage quality of regrowth as compared to uncut grass. Little regrowth occurred following two or three cuttings. We will determine winter survival and growth in the season subsequent to the different mowing regimes during the 1995 growing season.

•Stephen D. Sparrow and Michael T. Panciera

Nutrient requirements for bioremediation

Soil-borne petroleum contaminants can be biologically oxidized to carbon dioxide through the process of bioremediation. Reduced organic carbon in petroleum provides soil microor-

ganisms (mainly bacteria) a source of energy, but other nutrients such as nitrogen and phosphorus must be provided separately. The rate of petroleum attenuation through bioremediation can be maximized by providing nutrients at optimum levels. We have conducted laboratory studies to systematically determine optimum levels of nitrogen and phosphorus for bioremediation of Alaskan soils. Bioremediation of Prudhoe Bay crude oil in an Alaska soil was maximized when Mehlich 3 extractable phosphorus was at least 60 parts per million. Inorganic soil nitrogen levels of 400 ppm maximized petroleum disappearance, but either higher or lower application rates slowed bioremediation.
James Walworth

Nitrogen effects on head lettuce

Efficient use of fertilizer nitrogen reduces crop production costs and minimizes environmental risk from nitrate contamination of surface and ground waters. Nitrogen supply to crop plants is comprised of soil nitrogen and added fertilizer nitrogen. To determine optimum nitrogen fertilizer rates, one must account for existing soil nitrogen through soil nitrogen tests. This project sought to calibrate fertilizer nitrogen recommendations for head lettuce production with respect to the level of soil nitrogen. Over four years of field research, we found that head lettuce is adversely affected by residual soil nitrogen levels above approximately 20 parts per million. Rather than contributing to the lettuce crop, residual soil nitrogen limits head lettuce growth. We have not yet determined the cause for this unusual behavior.
James Walworth and Donald Carling

Tuber-setting properties

Potatoes form and develop tubers in response to genetic coding and environmental influences. Commercial profitability can be maximized by producing tubers of uniform size. Therefore, it is useful to understand tuber setting and development patterns of various potato varieties under local environmental conditions, and to know the influence of specific environmental factors. For two years, we monitored tuber formation processes in eight varieties of field-grown potatoes by removing plants weekly and measuring and counting all tubers at each monitoring interval. This study was conducted both on potatoes receiving adequate water and on moisture-stressed plants. We found that the plants set tubers in a cyclical pattern that is variety dependent, but not affected by moisture stress and that strategies of adjustment to water stress are varietal.
James Walworth and Donald Carling

Using fish bone meals as fertilizers

Fish bone meals, by-products of the fish processing industry in Alaska, are rich in nitrogen and phosphorus. These waste materials, separated during processing from finer fish by-products, contain too much solid material to be useful in animal feeds. We have evaluated the use of several Alaskan fish bone meals as fertilizers. Their composition ranges from 5.4 percent to 7.8 percent of total nitrogen and 4.2 percent to 9.9 percent of total phosphorus, dependent mainly on the species of fish. Because nitrogen is released slowly from the fish bone meals, they may have the potential to reduce nitrogen leaching from the soil. We evaluated white cod and herring bone meals in field studies to determine the rate of nutrient release and to measure nitrogen loss. The fish bone meals released nitrogen and phosphorus too slowly for head lettuce, a short-season crop (yields were reduced approximately 25 percent compared to inorganic fertilizers). In potatoes, a slower-growing crop, bone meals were more suitable, resulting in yields 10 percent to 14 percent lower than inorganic fertilizers. Nitrogen leaching was not substantially reduced through the use of fish bone meals.
James Walworth and Raymond Gavlak

Treating, reusing municipal sludge

Municipal sewage treatment plants produce sewage sludge, or biosolids, as a product of the sewage digestion process. The dewatered sludge poses a disposal problem for affected communities. Acceptable disposal methods include incineration, disposal in an approved landfill, or application to soils. The last method is clearly the least expensive, although potential problems include contaminating the environment with nitrate-nitrogen, heavy metals, or pathogens. With proper management none of these problems should be serious. We undertook this study to measure the first-year rate of nitrogen release from municipal sludges under Alaska conditions so proper land application rates can be determined. Sludges from Wasilla (anaerobically digested) and Fairbanks (aerobically digested) were applied to soil in Palmer and in Fairbanks. The organic nitrogen in the Fairbanks sludge was released rapidly (58 percent under Fairbanks conditions, 60 percent under Palmer conditions), whereas the Wasilla sludge decomposed slowly (4 percent and 7 percent of the nitrogen released under Fairbanks and Palmer conditions, respectively). The results indicate the importance of evaluating individual municipal sludges to determine proper land application rates
James Walworth and Charles Knight

Dr. Knight: Outstanding Adviser

Congratulations Dr. Charles Knight, associate professor of agronomy, for being chosen as a 1994–1995 Outstanding Adviser Award recipient. Students and faculty nominate advisers who demonstrate excellence in areas such as helping students set goals or increasing a student's understanding of the importance of a college education. (file photo)

Moose browsing impacts hardwoods

Data analyses completed. Master thesis is being written.
•*Jonathan Andrews and Edmond C. Packee*

Monitoring boreal wetlands

Boreal wetlands are important as wildlife habitat, as areas of high primary productivity, and as ecological "cleansing" zones. These wetlands may be a major source of atmospheric methane (CH_4)—a significant greenhouse gas. Research in North American arctic and boreal regions has shown strong linkages between level of inundation, type of plant community, and methane efflux. We use radar image data to examine and define the different patterns of inundation in the Tanana Flats. Since radar can "see" through clouds, and the satellite passes over Alaska on a regular cycle, radar data from four different times during the growing season is being used. The basic strategy is to map classes of flooding patterns over time (radar is excellent for detecting flooded areas) and then test whether these inundation classes are correlated with wetland vegetation types.
•*Andrew Balser, Dave Verbyla and Cindy Williams*

Tanana River floodplain paleohydrology

We studied the paleohydrology of the Tanana River floodplain in the vicinity of the Bonanza Creek Experimental Forest LTER site using the radio carbon dating technique. By examining buried soils and flood alluvium at a number of sites, we investigated the age of islands and channels in the River and Holocene flood history of the river. Some forested islands and anastomizing channels have been stable for hundreds or even thousands of years while others changed rapidly. Flood frequencies have fluctuated in response to small climatic shifts during the last 2,500 years. The development of soils and the pattern of vegetation succession near the Tanana River reflect the age of underlying islands and terraces.
•*James Beget and Owen Mason*

Permafrost history, paleoclimates

The modern distribution of permafrost and periglacial landforms and deposits in central Alaska reflects the long-term climatic fluctuations during the Quaternary. Shifts in Pleistocene climate in Alaska are reconstructed by studying the stratigraphy of permafrost preserved in loess. These deposits are dated using radiocarbon, tephorochronology, and cosmogenic isotopic methods. Over the last 150,000 years the pattern of climate changes in Alaska closely followed the global pattern as recorded in ice cores and marine sediments. The Alaska data helps to precisely date several important climatic transitions, providing constraint on models of the rate and mechanisms of global climatic change during the Pleistocene.
•*James Beget and Kurt Yuengling*

Insects, white spruce ecosystems

The effects of insect outbreaks on host trees range from decreased tree growth and increased production of associated vegetation, to high levels of tree and stand mortality. The forest insects capable of causing changes in white spruce ecosystems are the spruce budworms (*Choristoneura fumiferana, C. orae*), spruce beetles (*Dendroctonus rufipennis*) and the engraver beetle (*Ips perturbatus*).

The overmature nature of many of the white spruce stands across the LTER site makes them susceptible to forest pest infestation. We first observed noticeable populations of budworm in the upland mature to overmature white spruce at the LTER site in July 1989. The budworm populations increased through 1991, decreased in 1992 and increased in 1993. From 1990 through 1994 high numbers of larvae were detected on all sizes of spruce from two-year old seedlings to mature trees in older floodplain and upland stands. Successive heavy defoliation in 1991 and 1992 caused top-kill in trees and mortality in seedlings and saplings. Mature spruce that were previously defoliated did not produce new growth in the upper part of the crown in 1992 and 1993, but new growth was evident in 1994. Small amounts of tree mortality were observed from spruce and engravers beetles in 1993.

Flight traps were used to assess budworm population densities in 1993 and 1994. *Choristoneura fumiferana* was generally more abundant than *C. orae* in both the upland and floodplain sites. Although the number of budworm was higher in floodplain spruce stands, larvae size, especially of females, was greater in upland spruce stands. Grass production was lower in upland compared with floodplain spruce ecosystems.

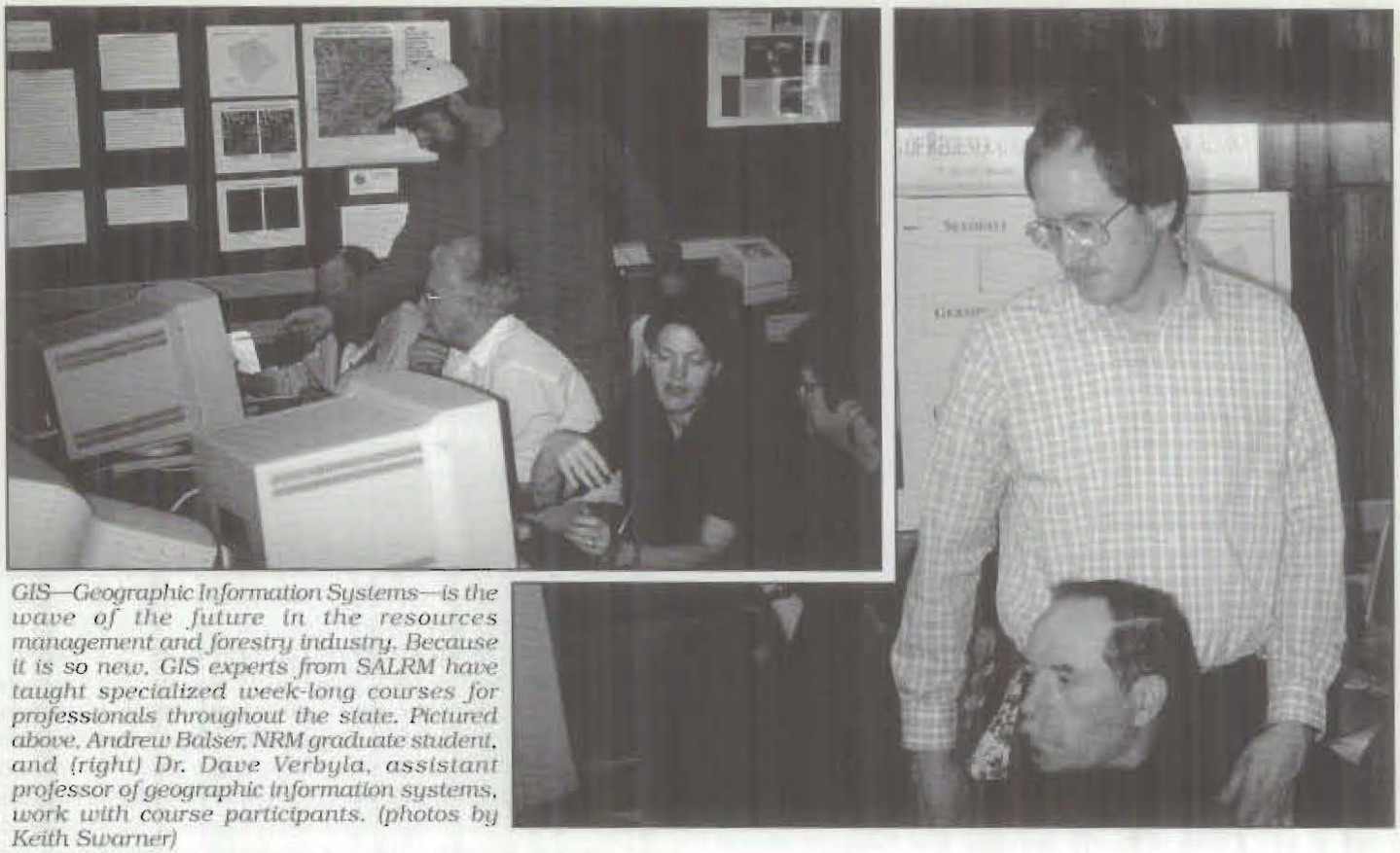
Successive years of budworm defoliation resulted in reduced radial growth in spruce. Because of the overmature status and current markedly reduced vigor of these forests, they probably will not recover their pre-infestation growth rates.
•*Rex Cates and Keith Van Cleve*

Forest mapping

Satellite imagery may be more cost-effective compared to aerial photography for forest mapping in Alaska. It may take thousands of aerial photographs to cover the area covered by one Landsat Thematic Mapper Scene. Since satellite data are digital, computer processing can be used to efficiently map forest vegetation across large areas. However, since satellite data are values representing reflection of solar radiation, topography can significantly influence these values. By using a grid of elevation values, we demonstrated a significant improvement in the accuracy of vegetation maps derived from satellite data. The basic strategy was to create two zones of topographic variability using the grid of elevation values. Then the satellite data were used to predict vegetation types within each of the zones. Finally, the digital vegetation maps from the two zones were combined and printed for accuracy assessment.
•*Tim Hammond and Dave Verbyla*

Alaska's climate

Temperature and precipitation data from weather stations in Alaska and western Canada were analyzed using spatial statistics to estimate mean annual and mean growing season temperature and mean annual and mean growing season precipitation values on a 6.21 mile (10 km) lattice in Alaska. These values were used to produce 30 annual ecoclimatic



GIS—Geographic Information Systems—is the wave of the future in the resources management and forestry industry. Because it is so new, GIS experts from SALRM have taught specialized week-long courses for professionals throughout the state. Pictured above, Andrew Balser, NRM graduate student, and (right) Dr. Dave Verbyla, assistant professor of geographic information systems, work with course participants. (photos by Keith Swarner)

regions and 29 growing season ecoclimatic regions for the state, as well as to estimate average temperature and precipitation values for each region. The regions were compared with maximum greenness (NDVI) values produced from Advanced Very High Resolution Radiometer (AVHRR) satellite imagery. The regions alone can not be used to predict vegetation distribution, but are a valuable new source of information for those interested in parameterizing ecological models with temperature and precipitation state factor values.
•Tim Hammond and John Yarie

White spruce forest structure

I analyzed data from forest monitoring reference stands in 13 older white spruce stands in seven proposed or established Research Natural Areas (RNAs) across central Alaska. The sites sampled included serpentinite, limestone, hot springs, clear water river floodplain, dune, and deep loess; nearly all were unglaciated. Floodplain high terraces and low elevation south slopes with deep loess accumulations are typical environments supporting large older white spruce stands. Plot sizes ranged from 27 by 27 yards to 55 by 55 yards, and total area sampled was 2.78 acres. Oldest dominant white spruce trees were generally greater than 150 years of age (oldest 320 years), but trees older than 200 years were not abundant, apparently because of wildfires on upland sites. Total stand basal area generally approached 0.40 percent of the plot surface area in stands fully stocked with trees. Largest diameter white spruce trees in the stands were generally between 16 to 24 inches, and the height of dominant trees was generally greater than 66 feet with more productive sites supporting a few trees of 98 feet. During the 20th century the mean radial growth of dominant trees on the most productive sites has been between 0.04 to 0.06 inches per year.
•Glenn Juday

Forest structure database

We compiled, archived, and analyzed data from forest monitoring reference plots in 22 forest reference stands established between 1978 and 1991 in 12 proposed or established Research Natural Areas in the Chugach and Tongass National Forests. The sites sampled were all low elevation and mostly highly productive, including several riparian Sitka spruce sites, karst landscapes, steep fiord walls, a coastal staircase site, and recent glacial recession sites. Data was consolidated in spreadsheets, text files, and graphic files and archived on the Bonanza Creek LTER database in Fairbanks and the forest database in Corvallis, Oregon. Hard copies are maintained in Corvallis, Fairbanks, and the Forest Service Regional Office in Juneau. Riparian Sitka spruce sites are the most productive coastal forest sites and support the largest trees in the database. Riparian sites supported stands with an average basal area of over 0.83 percent of plot surface area, and dominant trees well over 79 inches in diameter and 197 feet tall. Remonitoring indicated rapid death and regeneration of western hemlock on upland sites. Most dominant western hemlock trees were 250 years old or less, a few were older than 300 years, and only a few were older than 400 years.
•Glenn Juday

Oil spill restoration area ecosystem

I prepared a synthesis of the ecosystems of the area affected by the 1989 *Exxon Valdez* oil spill for the oil spill restoration program, based on published literature and restoration program documents. The marine and shoreline ecosystems of the North Gulf of Alaska are broadly similar over most of the area affected by the spill, but some of the shorelines and upland landforms are distinctive and they affect their adjacent marine waters in unique ways. I adapted and described a regional classification of segments of shoreline and their

associated landscapes and marine waters. The regions are 1) Prince William Sound, 2) Cook Inlet and Outer Kenai Coast, and 3) Kodiak Archipelago and Alaska Peninsula. The regions are a useful way to understand the spill area because physical and biological differences between the regions are present, the physical and chemical properties of the spilled oil changed as it traveled further from the initial spill site, and land ownership, resource uses, local economies, and community ways of life vary considerably across the spill area. As crowding of the human population into the world's coastal zones and degradation of the natural systems of coastal areas around the world continues, the relative value and rarity of the of the North Gulf of Alaska coastal and marine ecosystem increases steadily. The spill set in motion different ecological and social processes across the affected area, some of which will continue to influence it for a long time.
Glenn Juday

Global boreal forest

I reviewed global literature on the boreal forest to develop an overview of this extensive and increasingly important resource. The boreal forest region occupies about 17 percent of the earth's land surface area. I defined boreal forest as the circumpolar belt of the far northern hemisphere dominated by a limited number of species of pine, spruce, larch, fir, birch, and poplar, with conifers dominant from a larger landscape perspective. The boreal forests of North America and Eurasia display a number of similarities, and even share some plant and animal species. I combined various vegetation mapping systems into a map of North American and Eurasian boreal forest that uses a comparable system of three boreal forest units. The forest-tundra occupies the northernmost unit, the sparse northern taiga (Eurasian name) or lichen woodland (North American name) is further south, and middle and southern taiga (Eurasia) or closed forest (North America) is the southernmost unit. Information from this project has been used in an encyclopedia article, input to state government, research planning, and graduate studies.
Glenn Juday

Wind patterns, tree blowdown

Understanding wind patterns and their influence on treefall direction is important for many aspects of forest management. A large-scale wind pattern map was revised and improved for a 275,000 acre study area on northeast Chichagof Island in the Tongass National Forest of southeast Alaska. Evidence of wind direction was determined from treefall direction around the perimeter of clearcuts, treefall direction in natural blowdowns, and from tree crown growth patterns. The principal direction of wind in this study area was from the southeast, but evidence was observed of secondary winds from the north. These results are consistent with an analysis of 41 years of wind direction data in the region. Interpretation of the map indicated that winds move in a complex but predictable pattern over the landscape, largely determined by the predominant direction of storm winds interacting with topography. Stands at particular risk for blowdown were located on slopes exposed to storm winds and parts of the landscape where winds were compressed or funneled. Significant changes of wind direction by topography were observed.
Robert Ott, Tim Garvey and Glenn Juday

Analyzing treefall direction

The direction of individual treefalls within a largely intact forest can give important information about the direction of destructive winds at a site-specific level. We measured treefall direction in a sample of large dead trees associated with recent canopy openings and a sample of uprooted trees of all sizes and ages. We compared treefall direction to predominant wind direction as determined by tree crown growth using circular statistics. Results established that the direction trees fell on level sites was closely aligned with the direction of storm winds. However, on sites with steep slopes exposed to winds there were three distinct populations of treefalls: 1) trees that fell downhill due to gravity, snow loading, soil movement, etc.; 2) trees that fell in the same direction as destructive winds; and 3) trees that fell in directions suggesting an interaction of wind and slope. Tree size also influenced treefall direction, with larger dominant trees being the most reliable guide to wind direction. Single treefall directions must be used with caution and a good understanding of the context to interpret wind direction at the site or landscape levels.
Robert Ott and Glenn Juday

Clearcuts versus blowdowns

The characteristics of natural blowdowns offer a guide for developing sustainable timber harvest practices. We studied the effects of clearcutting versus large-scale natural tree blowdowns on northeast Chichagof Island in the Tongass National Forest. Results were preliminary because stands were either young (seven to 17 years old) clearcuts or middle aged (100 to 165 years old) wind-originated. In young clearcut-originated stands species richness appears to peak in the final stages of high light environments just before a forest canopy develops. We encountered an average of 27 species at 15 to 17 years since cutting. Tree sapling density (average of 317 stems per acre) and seedling cover were also greatest in the older clearcuts. In clearcuts 75 percent of log surface area and 88 percent of stump surface area was the result of timber harvest. Middle aged wind-originated stands supported a dense forest canopy with an average of 15 species. In wind-originated stands tree sapling density was low (13 stems per acre) and seedling cover was present only in trace amounts. A majority of logs in wind-originated stands (85 percent of log surface area) probably originated from trees that were blown over by the winds that originated the current forest stands. Stump surface area was mostly made up of trees that died in the original blowdowns (69 percent), but included younger trees of the current stands that died in competition (25 percent) since a new forest canopy developed.
Robert Ott and Glenn Juday

Individual tree volume tables

Sampling of spruce continued emphasizing the Copper River area while paper birch sampling began and will include more than 250 trees used for site index analyses. Balsam poplar which includes western black cottonwood tables were completed as part of a thesis; in addition to standard tables, tables based on form class were also developed.
Tom Malone and Edmond C. Packee

Future of forest products

During 1994, log shortages in British Columbia and the Pacific Northwest caused substantial price increases in spruce saw logs and pulp logs. Markets for Alaska spruce saw logs developed in Oregon and pulp logs were marketed in British Columbia. A similar development occurred for spruce and lodgepole pine from the Yukon Territory where logs were trucked to mills 400 or more miles.
Edmond C. Packee

Silvicultural systems

A major concern in a silvicultural system is gaining adequate regeneration, that is both numbers per acre and a free to grow condition. Season of planting may significantly impact survival and growth. Fall 1994 survival of the Tok Levels-of-Growing-Stock study planting of mid-August 1992 of white spruce, black spruce, tamarack, and lodgepole pine exceeds 90 percent. This despite the early severe cold and heavy snow the September following planting and the drought conditions following growing season. Albeit, one study site, the excellent survival merits further investigation into the feasibility of late summer planting.
•Edmond C. Packee

Managing forests for biodiversity

Additional forest management effort concentrated on the Tanana Valley. The bird species' list was sorted to address only the species found in the Tanana Valley. Similarly, researchers developed plant, mammal, fish, and amphibian lists. No species found at lower elevations or in forested areas of the Tanana Valley are endangered or threatened. Some consider the Townsend warbler (*Dendroica townsendi*) to be at risk due to habitat changes in its breeding range. A review of the literature is underway; preliminary efforts suggest that this bird uses both spruce and mixed hardwood-conifer cover types. In the mixed cover types, habitat use may depend on some spruce extending above the general canopy.
•Edmond C. Packee

Summarizing Alaska forest inventories

Efforts to summarize agency inventories continued.
•Edmond C. Packee

Reforestation stocking standards

The second fall survival of late-summer planted conifer (black spruce, white spruce, tamarack, and lodgepole seedlings) continued exceeding expectations (greater than 90 percent survival). The decrease in survival during the second year suggests that two year survival values will underestimate long-term survival and success of operational planted trees. Survival will be assessed annually for the next three years.
•Edmond C. Packee

Forest health

Spruce beetle infestation now exceeds more than 1 million acres. Acceptable approaches to good sanitation depend upon several crucial items including: a) definition of forest health, ecosystem health, unacceptable infestation level, b) determination of infestation impacts on wildlife and fish, water quality and flow, recreation (activities and aesthetics); and c) costs in lost values. Currently, I am supporting the lead effort of others as well as developing clear definitions and interpretations of essential definitions.
•Edmond C. Packee

Site index

Statewide and regional balsam poplar site index curves were published as part of a masters of science thesis. Curve sets for north and south of the Alaska Range were significantly different. Curves for floodplain sites on the Susitna River need further refinement. Work on other species continues.
•Edmond C. Packee

Growth, yield of balsam poplar

John Shaw successfully defended his master's thesis on the growth and yield of balsam poplar (including the subspecies, western black cottonwood). Thesis provides information on site index, site characteristics, site index, individual tree volume equations, and taper equations.
•Edmond C. Packee

Kenai lowlands forest stand

During 1994 researchers sampled two additional spruce stands (three plots per stand) and collected cones from each site to quantify the gradient of hybridization from Sitka spruce to white spruce. Soil chemical and physical analyses were completed. Data are currently being analyzed as part of a master's thesis.
•Edmond C. Packee

Permanent sample plots

In June 1994, with partial financial support from the Alaska Department of Natural Resources Division of Forestry, we began installing permanent sample plots. Researchers using the plots will: a) determine growth rates of trees for various kinds of stands and sites, b) define mortality patterns, c) determine "ingrowth" of seedlings and saplings, and describe changes in stand structure. The one-tenth acre plots will be remeasured every five years. Early emphasis is on mixed hardwood-white spruce stands within the Tanana Valley. We drafted an initial procedures manual, located 80 potential sites, and established a limited number of plots.
•Edmond C. Packee

Forest succession

The transition from alder (*Alnus tenuifolia*) to balsam poplar (*Populus balsamifera*) is a critical turning point in primary succession on the Tanana River floodplain. Changes in plant species result in large changes in N cycling. N-fixation and nitrification decrease and the system becomes N-limited with NH_4 dominating the inorganic N pool. Balsam poplar contains large quantities of tannins and low-molecular weight phenolic compounds. We evaluated the mechanism by which this transition in N cycling occurs and the role of poplar chemicals in controlling the transition. Results indicate that during the alder-poplar transition, soil microbes go from C to N limited, causing the shift from an open N-cycle to a tight one. Poplar tannins inhibit N-fixation in alder. Poplar tannins also inhibit microbial activity, including N-mineralization. Poplar low-molecular weight phenolics, on the other hand, are a good microbial energy source and induce N-immobilization. Both by inhibiting gross mineralization and stimulating immobilization, balsam poplar may reduce soil N-availability and thereby gain a competitive advantage, allowing it to enter the forest canopy and succeed alder.
•Joshua Schimel and Keith Van Cleve

Digital remote sensing primer

Multivariate covariance matrix, Fourier power spectrum texture measure, principal component eigenvalues,...these are typical terms in "introductory" remote sensing texts. Such terms can intimidate anyone who wants to begin learning about digital remote sensing. This primer introduces basic digital remote sensing using simple examples from natural resource applications. The primer is designed as a self-study workbook with exercises (and solutions) at the end of each chapter.
•Dave Verbyla

Mapping active wildfires

Every day the University of Alaska Fairbanks receives satellite images covering the entire state of Alaska. One of the channels from the satellite sensor is a thermal channel that is especially heat sensitive. This satellite system is used suc-

cessfully in large, remote areas such as the tropics to detect and map wildfires. However, such a system has not been adequately tested for high latitude regions where problems such as lack of night imagery in the summer, cooler fires, and cloud conditions differ compared to the tropics. We are testing whether these problems are significant in producing daily fire maps in Alaska.
•Dave Verbyla

Bias in vegetation maps?

How accurate is that vegetation map? A forester might look at the map and see that most of the commercial white spruce stands were correctly mapped, while a moose biologist might notice that significant areas of willow have been incorrectly mapped as black spruce. These two managers would differ in their conclusions about the vegetation map accuracy. Therefore a more objective, quantitative method of assessing the accuracy of vegetation maps has been developed. However, the estimate of map accuracy depends on how validation data are sampled. This estimate can be significantly biased. Conservative bias means that the actual accuracy of the map is better than the quantitative estimate. For example, we have demonstrated that a map can be theoretically 100 percent accurate and yet it might be quantitatively assessed as being less than 50 percent accurate if validation data are sampled using conventional methods.
•Dave Verbyla and Tim Hammond

Studying spruce, alder interaction

This is the fourth growing season for this long-term study. Patterns of growth among white spruce and green alder continue to shift as individuals become larger and begin to compete with neighboring plants. To date, there is a simple positive correlation between the diameter growth of spruce trees and spacing. The relationship between height growth and spacing is more complex, however. Trees with the most available area grew the least in height; the best height growth was observed in trees at intermediate spacings. The presence of alder in a plot did not significantly impact the growth of spruce in that plot. A study of alder reproductive output began in 1994. Age at which seed was first produced was dramatically affected by spacing, with far fewer closely-spaced alders producing seed than widely-spaced. Following the 1994 growing season, all seeds and cones were collected from trees that had first produced seed in 1993 (their second year's reproductive output). For the 43 trees in this sample, there was no relationship between reproductive output and spacing. In 1994, several hundred more alders began to produce seed; a relationship between density and amount of seed produced will likely be observable by the end of 1995.
•Tricia L. Wurtz

Tree foliar chemistry

Changes in foliar chemistry resulting from changes in forest floor and mineral soil moisture availability, forest floor microbial energy supply, and nitrogen availability were investigated across the successional sequences in both upland and floodplain landscape positions. We applied three amendments, sugar, sawdust and nitrogen fertilizer (NH_4NO_3), to a series of three upland and four floodplain successional sites. The sugar and sawdust treatments were designed to increase the carbon:nitrogen ratio (C/N) of the forest floor to values typical of black spruce sites (C/N = 50). The nitrogen fertilizer treatment was designed to equal estimated yearly N mineralization in an attempt to double available nitrogen in the forest floor. A moisture exclusion treatment was designed to remove all summer rainfall from the treatment plots. Foliar phosphorus concentrations were higher in the upland sites than on the floodplain. We found no consistent differences among successional stages within a landscape unit. The effect of either sugar or sawdust treatment was decreased foliar phosphorus concentrations. Sugar produced more significant differences than sawdust. Sugar treatments decreased foliar nitrogen except for white spruce, while fertilizer tended to increase foliar nitrogen. In the second year following treatment there was no increase in foliar nitrogen concentration resulting from fertilizer treatment.
•John Yarie and Keith Van Cleve

Rob Leach demonstrates proper handling procedures during a course he taught on composting at the Georgeson Botanical Gardens. Leach worked on a composting project for his master's thesis. (photo by Keith Swarner)

Resources Management

Course work

I continued conducting research in the fields of both natural resources law and field ecology while teaching four courses during the spring semester. All courses related to environmental, wildlife and natural resources law. The legal research component centered upon analysis of the legal concept of sustained yield and intensive management for terrestrial game species. The ecological research focused on soil-plant interactions in sub-arctic alpine tundra as well as developing an index for measuring anthropogenic disturbance effects in xeric alpine zones.
•Harry Bader

Rural economic models

We began developing a community and economic profile for the villages of Grayling, Anvik, Shageluk, and Holy Cross. This publication is an intermediate product in the ongoing rural regional economic modelling effort and it examines the cash economy for the four villages and compares it to that of the Yukon-Koyukuk Census Region as well as Alaska and the United States economies. The U.S. Department of Commerce Bureau of Economic Analysis database and the 1990 Census provide basic data. Because this data does not contain detailed information to describe community economies in Alaska, it

has been amplified by our data. We examined the subsistence economy using information from a report published by the Tanana Chiefs Conference, Inc. for U.S. Fish and Wildlife Service. Because we need a more complete description incorporating time spent by rural residents in subsistence practices, we will complete a regional economic model from the literature, oral histories, and interviews. We are continuing work in other communities including Nome and Delta Junction.

•Joshua Greenberg, Carol E. Lewis and Hans Geier

The equilibrium theory

I continued work on outdoor recreation management focusing on developing a conceptual model for managing natural resources for recreation. I completed a review and analysis of the management literature to better understand the strengths and weaknesses of the historical models of recreational carrying capacity and limits of acceptable change. Based on this review, a new model was synthesized to overcome deficiencies of other models. Carrying capacity then becomes the recreational use pattern created by the managerial programs applied to the area. The use pattern has both social and ecological impacts. The stabilized relationship between the recreational opportunity provided by management and the resulting pattern of use is described as an equilibrium; hence the new model is called *The Equilibrium Theory.*

•Alan Jubenville

Testing the theory

In June 1994, we began a five-year project to test parts of the synthesized model on forest recreational environments. We started the perfunctory phase in July to determine the best site to conduct the territoriality study of recreational environments and chose the Gulkana River during the king salmon run because of the intense competition for limited recreational sties. Observational data will be collected during the 1995 field season.

•Alan Jubenville

Summer, winter recreational impacts

Kathy Tietz, a graduate student, completed the data collection portion of her study of impacts of recreational use on ground vegetation. She included both summer and winter use patterns and their impacts. In 1995 she will measure how fast the site recovers from the imposed impacts. This study helps assess impacts of specific forest recreational use patterns under the Equilibrium Theory.

•Alan Jubenville

Composting yard waste

Rob Leach completed a study, part of a master of science thesis in Natural Resources Management, considering the feasibility of composting yard waste in the city of Fairbanks. The study considered using separate collection and existing yard waste composting technology as an alternative to comingled collection and landfill disposal of residential yard waste. A questionnaire queried city residents about their interest in such a program and their current methods of yard-waste disposal. A pilot pick-up program determined amount of yard waste that could be collected and its composition. Costs of a separate collection program were also detailed. The study concluded that it is not feasible from a cost standpoint to use city personnel for separate collection of yard waste. However, successful continuation of a private yard waste collection service can significantly reduce labor required for city refuse collection and reduce additions to the landfill. The city can also help by encouraging residents to participate in home composting and to use mulching lawn mowers.

•Rob Leach and Carol E. Lewis

Russian-American exchange

Activities in joint research and student exchange continued under the five-year exchange program between the Agricultural and Forestry Experiment Station (AFES) and the Russian Academy of Agricultural Science, Siberian Branch (RAAS/SB). One student who obtained his undergraduate degree from the State University of the Russian Academy of Sciences in Novosibirsk completed his masters in resource economics with the School of Agriculture and Land Resources Management (SALRM) and the School of Management. His thesis addressed salmon return and escapement in the Yukon River drainage. He is pursuing his Ph.D. developing an optimization model for the salmon fishery in the Yukon River Drainage.

•Carol E. Lewis and Joshua Greenberg

Agricultural products' quality

Research, service, and instruction are combined in a unique experiential approach to presenting agricultural concepts. Students in NRM 310: Agricultural Concepts participate in a sensory panel using real-world research data to develop a marketing strategy and a logo for Alaska agricultural products. The results of the panel studies are published, when appropriate, in peer-reviewed journals bringing research results to professional clientele. Producers are involved in applied work and represent their business program and products to the class. The class prepares marketing strategies and logos (some of which have been used by businesses) for the products. To date we have studied honey, carrots, barley pancake mix, salsa, and tomatoes.

•Carol E. Lewis and Joshua Greenberg

Alaska agricultural tours

Detailed studies of five agricultural regions in Alaska, published as experiment station brochures, provide residents and tourists with the opportunity to view Alaska's agriculture in self-guided tours. We began preparing two new pamphlets providing mileposts for tours in the Delta Junction area. They will highlight one of the two state-supported agricultural projects in Alaska, the Delta Agricultural Project begun in 1978, and an older agricultural area near Delta Junction that began in the mid 1950s with a state homesteading program.

•Carol E. Lewis and Roger W. Pearson

Marketing cooperatives in Alaska

The Department of Resources Management and the Alaska Division of Agriculture are cooperating on a project funded by the USDA Rural Business and Cooperative Development Service. The objective is to provide education and services to groups of producers interested in marketing cooperatives. Work began with Delta Junction producers who are interested in marketing raw milk and oilseed products. There is a recognized need to expand market opportunities for Interior Alaska dairy farmers to enable them to expand their herds, and the potential availability of an oilseed crushing plant means there is a need to investigate not only markets for edible oils and oilseed meal for animal feed, but also markets for industrial oils. Non-food uses include biodiesel fuel, crop oil, and dust control for gravel roads. The team is continuing to provide assistance to other cooperative ventures including a boat haul out in Wrangell, and an organic vegetable marketing cooperative.

•Carol E. Lewis, Hans Geier, Joshua Greenberg and Ed Arobio

Faculty Publications

January 1994—December 1994

Journal Articles

Title	Authors	Where Published
New directions in the Alaska king crab industry	J.A. Greenberg, S.C. Matulich, R.C. Mittelhammer, M. Herrmann	*Agribusiness: An International J.* 10:2:167-178
Podzolization in ultramafic materials in southeast Alaska	E.B. Alexander, C.L. Ping, P. Krosse	*Soil Science.* 157:46-52
Cemented ultramafic till beneath a Podzol in southeast Alaska	E.B. Alexander, R.C. Graham, C.L. Ping	*Soil Science.* 157:53-58
An analysis of the potential impact of public trust doctrine on the sovereign's use of its eminent domain power	H.R. Bader	*Hamline Law Review.* 18:50-63
Potential legal standards for resolving the R.S. 2477 right of way crisis	H.R. Bader	*Pace Environmental Law Review.* 11:485
Characterization of anastomosis group-11 (AG-11) of rhizoctonia solani	D.E. Carling, C.S. Rothrock, G.C. MacNish, M.W. Sweetingham, K.A. Brainard, S.A. Winter	*Phytopathology.* 84:1387-1393
Malting quality of uniculm and conventional tillering near-isogenic barley lines	S.M. Doffing	*Cereal Res. Com.* 22:33-35
Variation for grain fill characteristics in northern-adapted barley cultivars	S.M. Doffing, C.W. Knight	*Acta Agricultur* Scandinavica.* 44:88-93
Yield component compensation in uniculm barley lines	S.M. Doffing, C.W. Knight	*Agron. J.* 86:273-276
Calculated Angstrom's turbidity coefficients for Fairbanks	J.D. Fox	*J. Climate.* 7:10:1506-1512
The Russian salmon industry: Alaska's next big threat	J.A. Greenberg, M. Herrmann, T. Johnson, A. Streletsky	*Agribusiness: An International J.* 10:3:241-258
Allocative consequences of pot limits in the Bristol Bay red king crab fishery: an economic analysis	J.A. Greenberg, M. Herrmann	*North American J. Fisheries Management.* 14:2:307-317
Establishment of moose browse on four growth media on a proposed mine site in southcentral Alaska	D.J. Helm	*Restoration Ecology.* 2:3:64-179
A revenue analysis of the Alaska pink salmon fishery	M. Herrmann, J.A. Greenberg	*North American J. Fisheries Management.* 14:3:537:549
Buried soils on Seward Peninsula: a window into the paleoenvironment of the Bering Land Bridge	C.M. Hoefle, C.L. Ping, D. Mann, M.E. Edwards	*Current Research in Pleistocene.* 11:134-136

Title	Authors	Where Published
Differential activation of the bean chalcone synthase gene in transgenic tobacco by compatible and incompatible strains of Pseudomonas solanacearum	Y. Huang, J.H. McBeath	*Plant Science.* 103:41-49
Bacterial induced activation of an Arabidopsis phenylalanine ammonia-lyase promoter in transgenic tobacco plants	Y. Huang, J.H. McBeath	*Plant Science.* 98:25-35
Evaluation of SPOT panchromatic digital imagery for updating road locations in a harvested forest area	R. Jazouli, D.L.Verbyla, D. L. Murphy	*Photogrammetric Engineering and Remote Sensing.* 60:1449-145
A model of chrysanthemum stem elongation	M.G. Karlsson, R.D. Heins	*J. Amer. Soc. Hort. Science.* 119:403-407
Decomposition and N mineralization from legume and non-legume crop residues in a subarctic soil	R.T. Koenig, V.L. Cochran	*Biol. Fert. Soil.* 17:269-275
Characterization of a rhizoctonia *(Waitea circinata)* isolated from Alaskan agricultural soils	R.H. Leiner, D.E. Carling	*Plant Dis.* 78:385-388
Anastomosis group (AG) affinity of pectic isozyme (Zymogram) groups (ZG) of Rhizoctonia solani from the Western Australian cereal belt	G.C. MacNish, D.E. Carling, M.W.Sweetingham, K.A. Brainard	*Mycological Research.* 98:1368-1375
Comparison of Russian, American, and Candadian classification of selected tundra and taiga soils in N.E. Russia	G.G. Mazhitova, C.L. Ping, P. Krosse	*Pochvovedeniye.* 12:26-33
Prevalence and pathogenicity of anastomosis groups of Rhizoctonia solani from wheat and sugar beet in Texas	C.M. Rush, D.E. Carling, R.M. Harveson, J.T. Mathieson	*Plant Dis.* 78:349-352
Record interior Alaska snowfall effect on tree breakage	G.R. Sampson, T.L. Wurtz	*Northern J. App. Forestry.* 11(4):138-140
Restructured reindeer steak quality as affected by antioxidants and frozen storage	R.B. Swanson, M.P. Penfield, C.L. Dorko, R.F. Baron	*J. Food Sci.* 59(4): 716-719
Conservative bias in classification accuracy due to pixel-by-pixel comparison of classified images with reference grids	D.L. Verbyla, T.O. Hammond	*International J. Remote Sensing.* 16(3):581-587

Book or Chapters in Book

Book or Chapter Title	Authors	Book Title, Editors, & Publishers
Broadleaf forest (129-130); Low scrub shrub birch-ericaceous (134-135); White spruce-paper birch (139-140)	D.J. Helm	*Rangeland cover types of the United States.* Society for Range Management, Denver, CO.
Light, temperature and carbon dioxide	M. Karlsson, R. Larson	*Bedding plant IV, a manual on the culture of bedding plants as a greenhouse crop.* E.J. Holcomb (ed.). Ball Publishing, Batavia, IL.
The prominence of Japan in the Alaska king crab fishery	S.C. Matulich, J.A. Greenberg, R.C. Mittelhammer	*Understanding the Japanese food and agri market: a multifaceted opportunity.* A.D. O'Rourke (ed.) Hayworth Press Inc., NY. pp. 137-157
Computer simulation models and expert systems for predicting productivity decline	M. Proe, M. Rauscher, J. Yarie	*Impacts of harvesting on long-term site productivity.* W.J. Dyck, D. Cole, N.B. Comerford (ed.) Chapman & Hall, NY.
Geographic information systems	D.L. Verbyla	*Introduction to forest and renewable resources.* G.W. Sharpe, C.W. Hendee, W. F. Sharpe, J. C. Hendee. (eds.) McGraw Hill, Inc., NY.
The Alaska region	J.C. Zasada, E.C. Packee	*Regional silviculture of the United States.* J. Barrett (ed.). John Wiley & Sons, Inc., NY.

*AFES Bulletins

Title	Authors	AFES Publication No.
Responses of biennial sweetclovers of diverse latitudinal adaptation to various management procedures in Alaska	L.J. Klebesadel	Bul. 98
Comparative winterhardiness of cultivated and nativeAlaskan grasses, and forage yield and quality as influenced by harvest schedules and frequencies, and rates of applied nitrogen	L.J. Klebesadel	Bul. 99
Rates and methods of application of nitrogen and phosphorus for commercial field production of head lettuce in southcentral Alaska	J.L. Walworth, D.E. Carling	Bul. 100
Winterhardiness, forage production, and persistance of introduced and native grasses and legumes in Southcentral Alaska	L.J. Klebesadel	Bul. 101
Bromegrass in Alaska. IV. Effects of various schedules and frequencies of harvest on forage yields and quality and on subsequent winter survival of several strains	L.J. Klebesadel	Bul. 102

*AFES Circulars

Title	Authors	AFES Publication No.
Annual flower and perennial landscape plant evaluations 1993	P.J. Wagner, P.S. Holloway, G.E.M. Matheke, S. Berry, E. Barbour	Cir. 98
Potato variety performance, Alaska 1993	D.E. Carling, P.C. Kroenung	Cir. 97
Production and processing of reindeer velvet antler	R. Grover, L. A. Renecker	Cir. 99
Reindeer calf productivity and survival on the Seward Peninsula, Alaska	C.L.B. Chetkiewicz, L.A. Renecker	Cir. 100

*AFES Miscellaneous Publications

Title	Authors	AFES Publication No.
Alaskan vegetables and fruits	C.E. Lewis, M. Hebert, R.B. Swanson	Misc. Pub. 90-2 (revised)

Research Progress Reports

Title	Authors	AFES Publication No.
Use of Alaska-grown whole-seed canola in dairy cattle diets: Year 1	K. Randall, S.M. Dofing, D.J. Brainard	RPR 30
Wildflower seed mixes for Interior Alaska	O.C. Rutledge, P.S. Holloway	RPR 31
Alternative grain and oilseed crops for interior	C.W. Knight	RPR 32
Potential of metam sodium as an herbicide for use by vegetable growers in Alaska	D.E. Carling, J.S. Conn, J.L. Walworth	RPR 33

Proceedings

Title	Authors	Published In:
Gelisols: a new proposed order for permafrost-affected soils	J.G. Bockheim, C.L. Ping, J.P. Moore, J.M. Kimble	International Correlation Meeting on Permafrost-Affected Soils. NWT and YT, Canada, and Alaska, USA. Lincoln, NE. pp. 25-44
Computer generation of breeding beef and feedlot cattle nutrient requirements	L.B. Bruce, M.T. Panciera	Sixth International Conference on Computers in Agricultural Extension Programs. Lake Buena Vista, FL.

Title	Authors	Published In:
Potato production in Alaska	D.E. Carling	First Circumpolar Agricultural Conference, Whitehorse, YT, Canada.
Dry matter production and N fixation by fababeans interseeded with oats	V.L. Cochran	First Circumpolar Agriculture Conference, Whitehorse, YT, Canada.
Germplasm resources for circumpolar regions	S.M. Doling	First Circumpolar Agricultural Conference, Whitehorse, YT, Canada. pp. 91-92
Subsistence fisheries in Alaska: conflicts within a multiple use resource	H. Geier, J.A. Greenberg, M. Herrmann	Sixth Conference of the International Institute of Fisheries Economics and Trade. IFREMER. pp. 1212-1219
Some economic impacts of pot limits in the Bristol Bay red king crab fisheries	J.A. Greenberg, M. Herrmann	International Symposium on Management Strategies for Exploited Fish Populations. Alaska Sea Grant. pp. 705-721
The Alaska king crab industry—an industry in transition	J.A. Greenberg, S.C. Matulich, M. Herrmann	Sixth Conference of the International Institute of Fisheries Economics and Trade. IFREMER. pp. 609-616
Why the Alaska salmon prices crashed	M. Herrmann, J.A. Greenberg	Sixth Conference of the International Institute of Fisheries Economics and Trade. IFREMER. pp. 129-137
Understanding the effects of light on plant growth	M.G. Karlsson	13th Alaska Greenhouse and Nursery Conference. pp. 35-49
Effects of barley cultivars and volume-weight on dry matter intake, daily gain and feed conversion in feedlot lambs	K.L. Krieg, F.M. Husby	First Circumpolar Agricultural Conference, Whitehorse, YT, Canada. pp. 19-21
Barley production in the circumpolar north: effects of conservation tillage and crop residue management	C.E. Lewis, B.J. Pierson, C.W. Knight	First Circumpolar Agricultural Conference, Whitehorse, YT, Canada. pp. 103-110
Biogenic wetlands–distinctive features of cool climates	J.D. McKendrick	20th Annual Conference on Wetlands Restoration & Creation. Tampa, FL. pp. 164-170
Climatic and soil resources for agriculture in Alaska	C.L. Ping, J.P. Moore, J.M. Kimble	First Circumpolar Agricultural Conference. Whitehorse, YT, Canada. pp. 209-213
Permafrost dynamics and soil formation in interior Alaska	Y.L. Shur, C.L. Ping	International Correlation Meeting on Permafrost-Affected Soils. NWT and YT, Canada, and Alaska, USA. Lincoln, NE. pp. 112-117
Seedling-year growth and nitrogen accumulation by N-fertilized and non-N-fertilized legumes in interior Alaska	S.D. Sparrow, M.T. Panciera	First Circumpolar Agricultural Conference, Whitehorse, YT, Canada. pp. 123-127
The Columbia Glacier ecosystem in southern Alaska	S.L. Stephenson, G.A. Laursen, J.C. Landolt, G.P. Juday, E.C. Bernard	Proceedings of the West Virginia Academy of Science, Morgantown, WV. 66:39
Aquatic fungi in streams of the Granite Cove Research Natural Area in southern Alaska	S.L. Stephenson, T. Dubey, G.A. Laursen, G.P. Juday	Proceedings of the West Virginia Academy of Science, Morgantown, WV. 66:10
Breeding barley for northwestern North America	R.J. Wolfe, S.M. Doling	First Circumpolar Agricultural Conference, Whitehorse, YT, Canada. pp. 137-139

Contract Reports

Title	Authors	Contracting Agency:
Identification and analysis of Wiseman community area subsistence use patterns	H.R. Bader	National Park Service
Individual transferable pot quotas in the BSAI crab fisheries	J.A. Greenberg, M. Herrmann, K. Criddle	North Pacific Fisheries Management Council. Anchorage, AK

Title	Authors	Contracting Agency:
Revegetation studies on Two Bull Ridge	D.J. Helm	Usibelli Coal Mine, Inc.
Wishbone Hill revegetation trials, Year 4 (1992) results,browse and grass results	D.J. Helm	Idemitsu-Alaska
Abandoned placer mined land reclamation, Birch Creek - Mile 101 Steese Highway, 1993 (Year 1) progress report	D.J. Helm	Alaska Dept. of Environmental Conservation
Abandoned coal mined land revegetation evaluation, Diamond Mine, 1993	D.J. Helm	Alaska Division of Mining, Abandoned Mined Land Program
Ecosystems and the Exxon Valdez oil spill area.	G.P. Juday	Exxon Valdez Oil Spill Trustee Council
Boreal Forests (Taiga).	G.P. Juday	Encyclopaedia Brittanica
USDA Forest Service Alaska Region Research Natural Area Reference Stand Monitoring Data Base	G.P. Juday	USDA Forest Service (Data posted in the Forestry Sciences Laboratory On-line Computer Data Archive,Corvallis, Oregon)
Progress report August 1993 revegetation work Eastern Operating Area, Prudhoe Bay Unit	J.D. McKendrick, P.D.J. Smith, B. Elder, R. Hoffman, B. Gerkin, B.F. Collver, S. Jones, C. Brown	ARCO Alaska, Inc.
Long-term gravel vegetation project quarterly report for January, February, and March, 1994	J.D. McKendrick	BP Exploration (Alaska), Inc.
Long-term gravel vegetation project quarterly report for April, May, and June, 1994	J.D. McKendrick	BP Exploration (Alaska), Inc.
Long-term gravel vegetation project quarterly report for July, August, and September, 1994	J.D. McKendrick	BP Exploration (Alaska), Inc.
Independent review of wildlife management and conservation biology on the Tongass National Forest	E.C. Packee, D.J. Golden, P.K. Shepherd, E.P. Stephens	Alaska Dept. of Commerce & Economic Development
Preliminary investigations of hydric soil hydrology and morphology, Alaska	C.L. Ping, Y.L. Shur, G.J. Michaelson, M.H. Clark	USDA-Soil Conservation Service
Salsa: response of sensory panelists	R.B. Swanson, C.E. Lewis	O'Dell Enterprises

Theses and Student Professional Papers

Title	Authors
Regional economic modelling in Rural AK: accounting for "non-market behavior"	Hans Geier
Landfill siting in Fairbanks North Star Borough: integrating the technical and the human aspects in the planning process	Birgit Njastad
Evaluation of wildflower seed mixes for Interior Alaska	Ouina Rutledge
Fate of Metasystax-R2 in Alaskan soils	Bethany Schulz
A subsistence study of the Wiseman area, Alaska	Carol Scott
Growth and yield of *Populus* in Alaska	John Shaw
Ecology of reindeer on Hagemeister Island, Alaska	Raphaela Stimmelmayr

AFES Newsletters, Notes, & Magazines

Title	Publishing Frequency	Subscription Information
Agroborealis	semiannually	Agroborealis, University of Alaska Fairbanks, P.O. Box 757200 Fairbanks, AK 99775-7200

Title	Publishing Frequency	Subscription Information
Georgeson Botanical Garden Review	quarterly	Georgeson Botanical Garden University of Alaska Fairbanks P.O. Box 757200 Fairbanks, AK 99775-7200
Georgeson Botanical Garden Notes	as needed	Georgeson Botanical Garden University of Alaska Fairbanks P.O. Box 757200 Fairbanks, AK 99775-7200
Forest Science Notes	as needed	Forest Sciences Dept./SALRM University of Alaska Fairbanks P.O. Box 757200 Fairbanks, AK 99775-7200
The Natural Resources News	quarterly	Resources Management Dept./SALRM University of Alaska Fairbanks P.O. Box 757200 Fairbanks, AK 99775-7200

Miscellaneous Publications

Title	Authors	Where Published
GIS-based program aids wildlife and timber management	K. Chang, D.L.Verbyla, J. J. Yeo, Z. Li	*GIS World*. 7:40-43
Canola — an oilseed crop for Alaska	C.W. Knight	*Alaska Magazine*. October 1994
Long-term habitat and biological changes on disturbances at oil and gas exploration and development sites in arctic Alaska: report on field studies, 1984-91, the National Petroleum Reserve in Alaska, Sagavanirktok River Valley, and Prudhoe Bay Oil Field	J.D. McKendrick, P.C. Scorup, W.E. Fiscus, G.L. Turner	Northern Alaska Research Studies, BP Exploration (Alaska), Inc., Environmental and Regulatory Affairs Department, Anchorage, AK.
Biodiversity. Forest managers need to consider all elements, address range of situations (guest opinion).	E.C. Packee	*Agroborealis* 26(2):4-5
Examining Alaska's forest vegetation zones	E.C. Packee	*Forest Sciences Notes* No. 1
Guidelines on tolerances, limitations, and risks associated with the use of forage legumes in Alaska	M.T. Panciera, S.D. Sparrow	Crop Production and Soil Management Series, Alaska Cooperative Extension Publication # 100G-00247A
Examining a part of the forest ecosystem puzzle	T.L. Wurtz	*Agroborealis* 26(1):22-23

Abstracts

Title	Authors	Where Published
Modifications in the proposed Gelisol Order for classifying permafrost-affected soils	J.G. Bockheim, J.M. Kimble J.P. Moore, C.L. Ping	*Agron. Abstr.* p. 331
Sensory evaluation of fresh loin and cured ham roasts from hogs fed different levels of salmon meal	J.M. Brownlee, R.B. Swanson, F.M. Husby, M.P. Penfield, H.D. Loveday	Amer. Meat Sci. Assn. Ann. Meeting (Poster and Abstr.)
The occurrence of tuft reactions in *Rhizoctonia solani* AG-3	D.E. Carling, G.C. MacNish, K.A. Brainard	Fifth International Mycological Congress, Vancouver, B.C., Canada
Analysis of humic substances from soil and water by C-13 methodology	C.E. Clapp, M.H.B. Hayes, R.L. Malcolm, M.F. Layese, C.L. Ping	Seventh International Meeting of the International Humic Substances Society
Application of hydric soils criteria to four soils in southcentral Alaska	M.H. Clark, C.L. Ping	*Agron. Abstr.* p. 415
Long-term tillage in the subarctic: greenhouse gases	V.L. Cochran, E.B. Sparrow, C.W.Knight	*Agron. Abstr.* 86:354
Rooting volume effects on barley CO_2 response Long-term tillage in the subarctic: weed seed bank	J.S. Conn, V.L. Cochran R.E. Deck, J.S. Conn, V.L. Cochran	*Agron. Abstr.* p. 143 *Agron. Abstr.* p. 354
Variation in grain fill rate and associated characters in spring barley	S.M. Dofing, C.W. Knight	*Agron. Abstr.* 86:102
Natural colonization by plants and mycorrhizae on recently deglaciated lands	D.J. Helm, E.B. Allen	45th Arctic Science Conference-Bridges of Science between North America and the Russian Far East, Anchorage, AK. p. 49

Title	Authors	Where Published
Paleosols on Seward Peninsula, Northwest Alaska: paleoenvironmental reconstruction of the late-Pleistocene Bering Land Bridge	C.M. Hoefle, C.L. Ping	*Agron. Abstr.* p. 333
Pedological investigations of the late-Pleistocene Bering Land Bridge	C. Hoefle, C.L. Ping, D. Mann, M.E. Edwards	45th Arctic Science Conference–Bridges of Science between North America and the Russian Far East, Anchorage, AK. Abstract book 2. p. 18
Buried soils on Seward Peninsula: a window into the paleoenvironment of the Bering Land Bridge	C. Hoefle, C.L. Ping, D. Mann, J. Kimble	24th Arctic Workshop, University of Colorado, Boulder. p. 35
Cecropin-mediated disease resistance in transgenic tobacco plants	Y. Huang, M. Di, L. Owens, J.H. McBeath	*Phytopathology*. 84:1100
Differential activation of the bean chalcone synthase gene in transgenic tobacco by compatible and incompatible strains of Pseudomonas solanacearum	Y. Huang, J.H. McBeath	*Phytopathology*. 84:1108
Control of cyclamen development by irradiance and temperature	M.G. Karlsson, J.T. Hanscom	*Hort. Science*. 29(5):542-543
Osmotic priming to improve germination and seedling vigor in primula	M.G. Karlsson, J.W. Werner, J.T. Hanscom	24th International Horticultural Congress, Kyoto, Japan. P18-18, p. 214
Long-term tillage in the subarctic: crop responses	C.W. Knight, C.E. Lewis	*Agron. Abstr.* 86:354
Comparison of humic substances isolated from soils and waters by C-13 and N-15 methodology	M.F. Layese, C.E. Clapp M.H. B. Hayes, T.M. Hayes, R.L. Malcolm, C.L. Ping	*Agron. Abstr.* p. 281
Virulence of Streptomyces scabies on potato tubers and seedlings of other plants	R.H. Leiner, R. Loria, D.E. Carling	*Phytopathology*. 84:1169
Fractionation of soil organic matter from arctic Alaska soils	W.M. Loya, G.J. Michaelson, C.L. Ping, R.L. Malcolm	*Agron. Abstr.* p. 262
Tufting and anastomosis correlated in Rhizoctonia solani AG-8	G.C. MacNish, D.E. Carling, H.A. Yang	*Phytopathology*. 84:1169
Trichoderma atroviride, a potential biological control agent of verticillium dahliae	J.H. McBeath	*Phytopathology*. 84:1091
Aquic conditions in Andisols of the Northwest USA	P.A. McDaniel, J.H. Huddleston C.L. Ping, S.L. McGeehan	*Agron. Abstr.* p. 423
Modifying arctic revegetation to conform with changing objectives	J.D. McKendrick	North Slope Environmental Studies Conference, Anchorage, AK. p. 26
Strategies in arctic revegetation	J.D. McKendrick	Soil Science and Bioreclamation. Alaska Geological Society short course, Anchorage,
Fractionation of dissolved organic carbon in leachates from arctic Alaska soils	G.J. Michaelson, C.L. Ping W.M. Loya, R.L. Malcolm	*Agron. Abstr.* p. 262
Influence of nitrogen fertilization on methane and nitrous oxide fluxes in subarctic, temperate, and tropical grasslands	A.R. Mosier, J.A. Delgado, V.L. Cochran, D.W. Valentine	*Agron. Abstr.* p. 275
Morphological characteristics of selected cryogenic soils	C.L. Ping, Y.L. Shur	*Agron. Abstr.* p. 334
Morphogenesis and classifcation of soils associated with LAII flux study sites in North Slope, AK	C.L. Ping, Y.L. Shur J.M Kimble	24th Arctic Workshop, University of Colorado, Boulder. pp. 70-71
Soil resource inventory and long-term monitoring in cold soils	G.T. Probst, C.L. Ping	*Agron. Abstr.* p. 380
Cryogenic structure of permafrost-affected soils	Y.L. Shur, C.L. Ping, T. Zhestkova	*Agron. Abstr.* p. 334
The spatial and temporal variations of the active layer depth	Y.L. Shur, C.L. Ping	*Agron. Abstr.* p. 334
Development of ice-cored terminal moraines	Y.L. Shur, G.J. Michaelson, C.L. Ping, W.D. Harrison, N.G. Moskalenko	45th Arctic Science Conference–Bridges of Science between North America and the Russian Far East. Abstract Book 1. p. 216
Thermal response in permafrost to surface clearing in subarctic environments	C.A.S. Smith, C.L. Ping	*Agron. Abstr.* p. 347
Relationship of methane consumption with soil water	E.B. Sparrow, V.L. Cochran	*Agron. Abstr.* p. 286
Long-term tillage in the subarctic: soil properties	S.D. Sparrow, E.B. Sparrow, V.L. Cochran, C.W. Knight	*Agron. Abstr.* 86:354

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FY 95 research funding

Grants and Special Funds; July 1, 1994– June 30, 1995

National Science Foundation	
Dot Helm	Patch formation, mycorrhizal colonization during succession on glacial till
Keith Van Cleve	LTER: successional processes in taiga forests of Interior Alaska
Chien-Lu Ping	Effects of global warming on carbon cycling in arctic soils
Chien-Lu Ping	LAII flux study
National Biological Survey	
Chien-Lu Ping	Rock Creek watershed
Chien-Lu Ping	Rock Creek water quality
United States Department of Agriculture	
James Drew	Morrill-Nelson funds for food and agricultural higher education
Keith Van Cleve	Long-term monitoring, Bonanza Creek Experimental Forest LTER sites
Donald Carling	Evaluation of metam sodium for weed control in Alaska vegetable production
Jenifer McBeath	Cooperative agriculture pest survey
Chien-Lu Ping	Wet soils monitoring studies in Alaska; *(SCS funding also)*
Verlan Cochran	Research support agreement
John Yarie	Carbon balance of the Alaska boreal forest
Carol Lewis	An inclusive regional economic model for rural Alaska
Stephen Doling	Agronomic value of two genes conferring limited tillering in barley
Verlan Cochran	Goose population dynamics
Carol Lewis	Alaska marketing co-ops
James Drew	Alaska's forest trees
Tricia Wurtz	Spruce and alder interactions
Glenn Juday	Columbia Glacier
Glenn Juday	Chichagof Island
Alaska Department of Natural Resources	
G. Allen Mitchell	Ag development and statistical reporting
Anthony Gasbarro	Forestry students
Anthony Gasbarro	Forest reforestation program—GIS student
Dot Helm	Abandoned mines land
Alaska Department of Administration	
G. Allen Mitchell	Senior community service employment program
Alaska Science and Technology Foundation	
Charles Knight	Development of rotational crops and markets
Stephen Sparrow	Use of N-fixing plants to improve forage quality of Delta Bison Range
Patricia Holloway	Evaluation of wildflower seed mixes for Interior Alaska
Usibelli Coal Mine, Inc.	
Dot Helm	Usibelli vegetation studies
Dot Helm	Revegetation studies on Two Bull Ridge
Dot Helm	Gold Run Pass
BP Exploration (Alaska), Inc.	
Jay McKendrick	Gravel vegetation studies
Tri-Con Mining Inc.	
Dot Helm	Revegetation studies Silverado Mines
Weston & Sampson Engineers	
James Walworth	Bioremediation
Frito-Lay	
Donald Carling	Potato tests for Frito-Lay
Silverado Mines Inc.	
Dot Helm	Nolan Creek revegetation
Alaska Department of Fish and Game	
Joshua Greenberg	Economic impacts of alternative pot limits in king and tanner crab fisheries

U. S. Army Corps of Engineers	
Tobi Campanella	Chena River Lakes flood control project
Charles Knight	Municipal sludge–Fairbanks
National Oceanic and Atmospheric Administration	
Joshua Greenberg	Crab management policies
Bureau of Land Management	
Alan Jubenville	BLM cooperative agreement—Dalton Highway
Department of Transportation	
Alan Jubenville	DOT cooperative agreement—Dalton Highway
University Corporation for Atmospheric Research	
John Yarie	Climatological analyses
University of Alaska Natural Resources Fund	
Stephen Dofing	Continuation of a program in plant breeding and genetics
Harry Bader	Determination of recreational impacts to subarctic xeric alpine tundra resources
Jenifer McBeath	Support of potato industry in AK
Dave Verbyla	Monitoring boreal wetlands
Dave Verbyla	Development of an Alaskan wildfire detection and mapping system
MAPCO Alaska Petroleum Inc	
Pat Holloway	Multi-media showcase
Dave Verbyla	GIS teaching lab
Department of Environmental Conservation	
Dot Helm	Abandoned placer mined land reclamation
University of Alaska Foundation	
Patricia Holloway	Georgeson Botanical Garden
UAF Center for Global Change & Arctic System Research	
Andrew Balser	Monitoring boreal wetlands

Formula Funds; July 1, 1994—June 30, 1995

Hatch General; USDA	
Donald Carling	Potato variety comparisons and evaluations of rhizoctonia disease on potato
Leroy Bruce	Management of Alaska beef cattle to maximize forage use
Ruthann Swanson	Quality assessment of Alaskan reindeer
Michael Panciera	Maximizing forage quality at northern latitudes
Patricia Holloway	Propagation and cultivation of Alaska native plants
Meriam Karlsson	Effects of irradiance and temperature of growth and development of greenhouse produced plants
Jay McKendrick	Vegetating man-made gravel structures within arctic wetland plant communities
Chien-Lu Ping	Classification and interpretation of permafrost soils in Alaska
James Walworth	Improving soil fertility for potatoes and lettuce in Alaska
Stephen Sparrow	Nitrogen fixation, herbage yield and persistence of perennial legumes in Interior Alaska
Carol Lewis	Alaska's agricultural industry: a microsystem of the circumpolar north
G. Allen Mitchell	Palmer administration
Meriam Karlsson	Environmental plant physiology of greenhouse produced crops
Hatch Regional; USDA	
Fredric Husby	Characteristics and feed value of barley and western protein supplements for swine
Stephen Dofing	Plant genetic resource conservation and utilization
James Drew	Regional research planning and coordination, western region
Jenifer McBeath	Biological suppression of soil-borne plant pathogens
McIntire-Stennis; USDA	
John D. Fox, Jr.	Simulating the effects of forest harvest on soil freezing and thawing
Keith Van Cleve	Forest floor organic matter chemistry as a control of plant element supply in interior AK forests
John Yarie	Prediction of landscape level effects of global change on the Alaskan boreal forest
Edmond Packee	Determination of the growth and yield potential of northern forest species in Alaska
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 and strategies for management
John Yarie	Mechanisms of change in forest floor decomposition and element supply in successional forests of AK

Financial Statement

Expenditures — July 1993 through June 1994

The following is a statement of expenditures of federal and state funds for the fiscal year beginning July 1, 1993 and ending June 30, 1994 (FY 94). NOTE: This is not an accounting document.

		(percent of total)
FEDERAL		
Hatch General Formula Funds	$ 702,704	9.8
Hatch Regional Formula Funds	133,688	1.8
McIntire–Stennis Formula Funds	312,925	4.3
USDA–Agricultural Research Service	157,093	2.2
OTHER GRANTS AND CONTRACTS	1,315,914	18.3
STATE APPROPRIATION/PROGRAM RECEIPTS	4,582,758	63.6
TOTAL	$7,205,082	100.0 percent

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Robert B. Weeden, Professor of Resources Management

Where are they now?

Former animal scientist goes to the dogs

Dr. Arthur L. Brundage, professor of animal science emeritus, has accepted a three-year term on the editorial board of *The Professional Animal Scientists*, published by the American Registry of Professional Animal Scientists. A charter member of ARPAS, Dr. Brundage is currently the only member from Alaska and is certified in dairy cattle and companion animals in genetics and animal breeding and other disciplines. The goal of ARPAS is to publish results of research that have a more-or-less direct application, as contrasted with the more basic research papers published in the *Journals of Animal, Dairy, and Poultry Science*. After retiring in 1985, Brundage "went to the dogs," trading primary responsibility for the dairy research program at the Palmer Experiment Station for a continuing interest in raising and competing with purebred dogs in American Kennel Club dog shows and obedience trials. At this time, three Old English sheepdogs and four bearded collies share their home with Art and Helen. During the 1994 fall semester, Brundage *(pictured right)* returned to the classroom to give guest lectures in genetics and animal breeding in two animal science classes at the Matanuska-Susitna Community College.

(courtesy photo)

Dr. McBeath's potato research draws international interest

DR. JENIFER H. MCBEATH, plant pathologist, received international recognition for her work overseeing disease-free seed potatoes recently. In June, Dr. Tyng-Guang Chou, Taiwanese ministry of economic affairs, visited potato-growing farms in Alaska to inspect seed potatoes, certify that they are disease free, and review the seed potato quality-control program which McBeath administers. Seed potatoes can demand higher prices than can potatoes destined for the dinner table. And Alaska seems to be one of only a few, if indeed not the only, location where Taiwan's virus-free seed potatoes standards can be met. Chou was pleased with his findings saying Alaska is the only foreign source of seed potatoes he is recommending to allow into his country.

Achievements, activities, news

Partners in research

Dr. Stephen D. Sparrow, professor of agronomy, and Dr. Joselito Arocena, University of Northern British Columbia, received a $6,000 award through the UAF-UNBC Joint International Research Award competition for their research project, *Weathering of Mica in the Rhizosphere as Influenced by Root Temperature.* Researchers said that mica is a natural source of potassium. Soils in Alaska, British Columbia, and the Yukon Territory are rich in mica but deficient in potassium. The researchers will study the breakdown of mica as influenced by microorganisms in cold climate to try and understand the weathering of potassium rich minerals in northern soils.

A partnership was formed last year between UAF and UNBC to create research opportunities for studies of northern, circumpolar and Pacific Rim topics.

Public broadcasting support

The School of Agriculture and Land Resources Management faculty, staff and students raised $2,000 during March to contribute to KUAC, the University of Alaska Fairbanks public broadcasting station. SALRM's contribution will sponsor a science program. **darleen masiak** and **Barb Pierson,** fund-raising coordinators, said they were pleased with the excellent support and hope to hold an annual fundraiser to coincide with KUACs spring festival.

On display

Agricultural lab assistant and artist, **darleen masiak**, joined Anchorage photographer Rene Dolan Haag, in an art exhibition at the Alaskaland gallery in May. masiak displayed six large metal sculptures and woodcuts. Art critic Mary Beth Michaels in an article for the *Fairbanks Daily News-Miner* said, "Her work is so energetic that, as you stand in front of it, you can almost see forests grow, clouds sweep by, mountains rise and crumble and glaciers flow." masiak prints, paints, and sculpts metal.

Travel grant

Jennifer Pugin, NRM graduate student, earned a grant from the Alaska Quaternary Center, University of Alaska Museum, to travel to the 2nd Circumpolar Agricultural Conference to be held September 4 through 7 in Tromsø, Norway. Pugin earned the grant for her abstract, "Do geese increase nitrogen availability and productivity in barley fields?"

Published

Dr. Edmond Packee, associate professor of forest management, and Dr. John Zasada, formerly of the Institute of Northern Forestry, coauthored the chapter, "Alaska Region" for the newly revised edition of *Regional Silviculture of the United States*, a standard forestry reference and text used in the United States.

Developing studies

Christina Young, an NRM graduate student, recently earned the $2,000 Alaska Visitors Association's Statewide Scholarship. The scholarship will help her complete her master's degree in land management and business with emphasis on the travel industry. Young is coordinating a project in Delta Junction developing links between agriculture and tourism in an effort to stimulate the community's economy.

1995 Graduates

Congratulations to the 1995 graduates of the School of Agriculture and Land Resources Management:

Master of Science: **Ming Di, Paul Kroenung, Robert Leach, John Shaw, Raphaela Stimmelmayr,** and **Patricia Willebrand.**

Bachelor of Science: **Steven Becker, James Duff, Mary Gleason, Ingrid Kacher, Paul Keech, Deborah Koons, David Maddux, Margaret Matthew, Travis Powell,** and **William Rasor.**

Thank you...

To Dr. James V. Drew for the leadership and commitment he has given SALRM and AFES for the past 20 years.