

AREERA PLAN OF WORK
ANNUAL REPORT OF ACCOMPLISHMENTS
AND RESULTS

Agricultural and Forestry Experiment Station
University of Alaska Fairbanks

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GOAL 1: An agricultural system that is highly competitive in the global economy.

Program 1. To produce new and value-added agricultural and forest products and commodities.

Overview: The University of Alaska Fairbanks School of Natural Resources and Agricultural Sciences and the Agricultural and Forestry Experiment Station (SNRAS/AFES) generates and disseminates knowledge to stakeholders for the successful management and development of land resources in Alaska. Certain general characteristics of the natural resource scene have to be recognized in planning a program of research and outreach in Alaska. Alaska is culturally diverse, with Alaska Native communities following traditional ways of life virtually side by side with modern sophisticated urban centers. Management and development of the natural resources of Alaska historically and presently have supported and stabilized the state’s economy. Alaska is both productive and diverse for its northern location with extensive petroleum, mineral, land, forest, and fishery resources. With \$65 per barrel oil and possible development of additional oil reserves and the proposed natural gas pipeline, Alaska’s economic future and probable population growth will likely result in renewed pressure on utilization of other natural resources along with concerns over multiple land uses. Population demographics near Alaska’s largest city, Anchorage, has shifted to the farmland north of the city and significant acreage of some of the best soils for agriculture in the state have been sold off for subdivisions and other non-farm uses. In spite of these developments, cash receipts for agriculture increased by 5 percent to \$53.0 million in 2004. Growers in the agricultural sector produce products primarily for in-state consumption including fresh market potatoes and vegetables, forages, grains, and other livestock feeds, greenhouse vegetables, flowers and ornamentals, and a variety of niche market crops. The latter include berries, reindeer products, and native plant materials.

The Agricultural and Forestry Experiment Station is a leader in maintaining the sustainability of the use development of agricultural, forestry, and other natural resources in the state of Alaska. These efforts are jointly funded by federal formula funds, state matching funds, and other state, federal, and private sector funds. The report that follows summarizes the accomplishments of SNRAS/AFES in terms of outcomes and impacts to our stakeholders.

Expenditures:

| | |
|---------------------|-----------|
| Hatch General: | \$578,474 |
| Hatch Multistate: | \$139,668 |
| Hatch Animal Health | \$ 3,956 |
| McIntire-Stennis: | \$114,569 |

State Match: \$924,233

Total FTE (SY): 7.7

PLANNED PROGRAMS

Key Theme: Greenhouse/Nursery Production

Innovative Use of Natural and Supplemental Light for High Latitude Crop Production

Alaska's position at northern latitudes results in extreme temperatures and light fluctuations. The amount, the type or quality, and the length of light during a day are essential components for plant productivity and crop yield. Controlled environment production systems and technologies offer diverse opportunities to extend the growing season, increase productivity, improve quality, and allow local production of previously considered unfeasible crops.

Accomplishments: (**ALK-00-09, NCR 101**) Compact lettuce transplants with well-developed root systems are desirable for field transplanting and high yields and quality. Three trials (February, April, and May) with varying ratios of supplemental/natural light, media surface color and texture, and constant temperature were evaluated for effects on transplant height and structure. The below-leaf stem segment was shortest using perlite and longest with black plastic or dark colored growth media. Perlite or white plastic mulch was most efficient at producing a desirable compact transplant. In other light-related studies, 'Pacino Gold' sunflower responded to long (16 hr) and short (8 hr) day lengths. Plants were placed at long days (LD, 16 hours) or short days (SD, 8 hours), 20 degrees C and 8 mol per day. At the 48 SD flowering, buds were minute in LD requiring 14 more days to flower. Plants started at LD and moved to SD after 1 to 3 weeks, flowered similar to the seat uninterrupted SD. Four initial LD weeks delayed flowering 7 days while 2 or 3 weeks of SD followed by LD hastened flowering 5 to 10 days. Plant height was 18 cm in SD and doubled from 20 to 40 cm with one to 4 initial LD weeks. Flower diameter varied from 9.8 to 16.4 cm and increased 0.18 cm for each cm of plant height. Opportunities producing short plants with large flowers are therefore limited.

Impact: Light conditions are fundamental to plant growth and crop productivity. During periods with limited or non-existing natural light in protected environments, an understanding of required type, amount and arrangement of supplemental lighting is vital to efficient production. Information generated in this project on expected crop response, development and production efficiency from various types of light sources is implemented in the planning, startup and running of a local geothermal driven greenhouse. Scheduling and timing crops to meet local marketing opportunities and demands necessitate reliable and predictive production throughout the year. As rate of development is highly dependent on light, knowing amount and levels of available production light provides local producers with opportunities to exactly forecast crop progression and harvest.

Controlled Environment Production of Small Fruits, Berries, Floral Crops, and Greenhouse Adapted Food Crops

Accomplishments: High plastic tunnels were erected in 2004 and modified for the 2005 growing season. Air and soil temperatures were recorded every 10 minutes in the high tunnel greenhouse and the adjacent field of the Fairbanks Experiment Farm. Air temperatures averaged 20.0 during

June, 18.1 during July and 14.9 degrees C during August for the field. The corresponding air temperatures in the high tunnel were 19.0, 19.5 and 16.7 degrees C. Soil temperatures averaged 17.9, 18.6 and 16.1 degrees C during the three months. Several green bean varieties (Dusky, Embassy, Roma II, Stayton and Venture) were grown and evaluated in the field and the high tunnel. The variety Embassy and Stayton had significantly higher yields in the high tunnel than the field. The total average yield of fresh beans for a 3 meter long row (approximately 20 plants) was 2,080 grams for Embassy in the high tunnel and 1,650 grams in the field. For Stayton, the yield was 2,570 grams in the tunnel and 1,775 grams in the field. For the other varieties, there was a trend although non-significant, for higher harvest in the tunnel compared to the unprotected field. The average yield of beans for a 3 meter-long row in the field and tunnel was close to 2,100 for Dusky, 2,300 for Roma II and 2,600 grams for Venture. An earlier planting date than the June 13 used in this study may have resulted in higher yields. Several sequential plantings can also be recommended in order to facilitate a continuous and longer harvest period of fresh beans. The long narrow beans of Stayton (average length 134 mm and width 6.5 mm) were especially well received and valued for the fresh market by wholesalers and consumers. The Italian flat beans of Roma II (average length 118 mm and width 13.3 mm) are suitable for stir frying and canning. The three remaining varieties are intermediate type beans suitable for fresh marketing averaging 134 mm in length and 8.7 mm in width. Other crops evaluated for high tunnel production included potatoes and various types of lettuce and salad greens. In general, both the field and high tunnel grown crops performed well. Leaf lettuce continued to grow well in the tunnel throughout the month of September as outside temperatures dropped and frost was experienced on several occasions.

Impact: Temporary low maintenance greenhouses or high tunnels are cost effective and provide opportunities to enhance and extend seasonal crop production. Most vegetables, herbs, berries, fruit and flower crops have not been evaluated for high tunnel production at latitudes as far north as Fairbanks. The results recorded in this project show crop and quality advantages of high tunnel use for intense field production. For producers interested in the highest possible yield and return from a designated field production area, high tunnels offer advantages for sequential multiple cropping and extension of the growing season. Green bean production in high tunnel greenhouses or other controlled environment systems is one opportunity to capture local market demands at a premium price for exceptionally high quality fresh produce.

Source of Federal Funds: Hatch General and Hatch Multistate
CSREES Special Grants

Scope of Impact: Multistate

Key Theme: Horticultural and Agronomic Field Crop Production

Horticultural Crop Production for Alaska

Accomplishments: (**ALK-01-11**) Plant evaluations at the Georgeson Botanical garden included 1526 woody perennials, herbaceous perennials, annual flowers, herbs and vegetables. Fourteen cultivars were added to the list of recommended vegetables: Chioggia beet, Marathon lettuce, Purple Haze and Rainbow carrot, Andes cauliflower, H-9 Little leaf and Sweeter Yet cucumber, Snowy eggplant, Cocarde and Merlot leaf lettuce, Blushing Beauty pepper, Papaya Pear summer squash, Eight Ball zucchini squash and Sunshine winter squash. All have consistent yields and high quality for home and market gardens. Prairie Fire

field tomatoes were grown in WalloWater and Kozy Coat water-filled hot caps with and without infra-red transmitting (IRT)polyethylene mulch to determine if any combination of soil and plant warming treatments would promote earlier and greater yields. The highest yields, four to eight times the control, were harvested from plants grown with either Kozy Coat or WalloWater hot caps plus the IRT mulch. Used alone without the IRT mulch, only the Kozy Coat hot cap promoted greater fruit yield. Control plants (bare soil, no hot caps) yielded 0.38 kg per plant, while the Kozy coat plus IRT yielded 2.96 kg per plant. Winter squash, Cornells Bush Delicata and TayBelle Hybrid produce few to no fruit under Alaska growing conditions. Seedlings were treated with 16 h dark photoperiod using black cloth or exposed to natural daylength conditions (6.75 h decreasing to 3.5 h) for 16 days beginning 16 May to learn if extending the dark period would induce female flower production and fruit yield. Both cultivars produced significantly greater number of female flowers and fruit with the dark treatment. Combined cultivars averaged 12.5 female flowers per plant with dark treatment and 2.5 flowers per plant with natural daylength. Fruit yield was 2.2 kg per plant under dark treatment and 0.58 kg per plant with natural daylength. Peony cultivars were evaluated as field grown cut flowers. The highest yielding cultivars that produce the greatest number of US No. 1 stems are: Sarah Bernhardt, Karl Rosenfeld, Louis VanHoutte, David Harum, Florence Bond, Therese, Shawnee Chief, Felix Crouse, Duchess de Nemours and Kansas.

Impact: Tomato field experiment was requested by TerraCopia, Inc (UT). The vegetable research is designed for small market gardeners and homeowners. It provides comparative trial information that is useful in developing regional truck farms and expanding produce choices as farmers markets. The annual and perennial flower trial research is used by seed companies, nurseries, growers, landscapers and home gardeners to identify hardy perennials, disease resistant annual flowers for home and commercial production. Specific trial information was requested by Johnnys Selected Seeds (ME), Territorial Seeds (OR), Pan American and Ball Seed Co.(IL), and Goldsmith Seeds (CA). Six commercial businesses in Alaska have planted trial plots of peonies for field cut flower production based upon the results of our peony research. One Fairbanks grower is selling peonies at the farmers market.

Source of Federal Funding: Hatch General
CSREES Special Grant

Scope of Impact: Alaska Specific

Field Grown Potato and Vegetable Crops

Potato, well adapted to generally cool conditions, constitutes an important part of the commercial vegetable industry in Alaska. To remain competitive, potato growers need to enhance productivity and quality while maintaining or reducing the cost of production. Alaska potato and vegetable growers have identified plant pests as the most important deterrents to increasing profits in recent years. In 2005, after a five-year absence, late blight again infested a number of grower fields in southcentral Alaska. Identification of disease resistant varieties, pest monitoring, weed control, integrated pest management, and biological control methods are the primary avenues of investigation being pursued by Alaska horticulture and plant pathology researchers.

Production Practices, Cultivars, and Disease of Potato and Other Horticultural Crops

Accomplishments: **(ALK-01-09)** Eleven replicated field trials of potatoes were conducted at the UAF Agricultural and Forestry Experiment Station Farm located near Palmer. Southcentral

Alaska had good weather for potato production with irrigation. Late Blight, a disease caused by *Phytophthora infestans*, was present in the Matanuska Valley in August and September, and some vine kill and tuber blight were noted. For the 2005 season, 22 cultivars were included in the irrigated potato yield trial. Green Mountain had the highest yield of marketable potatoes (US #1 grade) at 20.1 tons per acre. Of the 7 red-skinned cultivars included, Ida Rose had the highest yield of marketable potatoes at 19.9 tons per acre. Management optimization trials evaluated the effects of plant spacings on marketable yield of seven cultivars that are commercially grown in the region. The trend seen in all of the seven cultivars was higher marketable yield at spacings less than 11 inches between seed pieces in row. Closer spacing can increase yields, but net profit is also affected by greater cost for seed when plant density is greater. The average marketable yields were 21.5 tons per acre in these management trials.

Impacts: The management optimization trials and cultivar yield trials provide commercial growers with yield comparisons that will influence their seed purchasing decisions. Local production of potatoes is a benefit to the economy when consumers at grocery stores and local Farmers Markets can choose Alaska grown that is fresher by far. The diverse potatoes grown in the demonstration trial may give competitive marketing advantages to the early adapters of these varieties. The flame weeding information will enhance the small but growing organic market in the region. Results from applied studies are presented each year to the joint SAES/CES sponsored Potato and Vegetable Growers Conference. These presentations over the past 11 years have established recommended varieties of potatoes and vegetables grown by Alaska producers as well as providing production practices information.

Source of Federal Funds: Hatch General
CSREES Special Grants

Scope of Impacts: Alaska Specific

Cultivar Selection, Production Methods, and Market Quality of Vegetables in Alaska

Accomplishments: **(ALK 01-02)** Field trials of crisphead lettuce, green storage cabbage, and Brassica greens were planted to observe differences in yield and quality. Eleven cultivars of crisphead lettuce were grown in randomized complete block design on two commercial farms in the Matanuska Valley. In mid season and late season plantings, month-old seedlings were transplanted 12 inches apart in rows and harvested approximately 2 months later. Up to ten marketable heads from each of four replicates were weighed, measured for diameter, and rated for internal tipburn damage. As in 2004 trials, the cultivar Sniper was similar to the cultivar Alpha that is commonly planted on commercial farms. Other cultivars had varying degrees of tipburn damage, which was common on larger heads. For the second season, field trials on green storage cabbage compared 4 cultivars at 3 spacing treatments. The cabbage trials were planted at 2 locations and harvested in September or October for storage. Month-old seedlings were transplanted at 12, 14, and 16 inches apart in rows. As in 2004 trial, Gideon had larger head size but did not stay green in storage as long as the other cultivars. Gideon had 10-16% non-marketable heads after 6 weeks in storage. The cultivars Arena, Safekeeper II, and Survivor stayed green in storage through December and showed the trend for increased head size with increased spacing between plants. Field experiments on Brassica greens compared the yields of seven types (2 Asian greens, 4 kales, and red giant mustard) at two growth stages, baby leaves and large leaves. Young leaves of Brassica greens for specialty salad mixes were direct seeded at 2 seeds per inch in narrow rows and harvested when leaves were 4-6 inches long. For large

leaves, Brassica greens were direct seeded at one seed per 2 inch spacing in rows, thinned to 8 inches, and harvested when leaves were ready to put in bunches. Samples of leaves were dried and will be analyzed for mineral concentrations, including calcium. While field trials on leafy green vegetables were the main experiments, some research on white mold was done as part of collaboration with ARS scientist Dr. Lori Winton. A field collection of mycelium and apothecia of *Sclerotinia sclerotiorum* was made during August and September from 10 fields where vegetables are cultivated. Dr. Winton's data on microsatellite markers will be used to describe populations of *Sclerotinia* in Alaska.

Impact: As salads continue to be part of a balanced diet, production of leafy green vegetables can provide fresh plants for Alaskans and summer visitors. The window of local production ranges from early summer for baby greens and midsummer for crisphead lettuce, to several months after frost for green storage cabbage. The Alaskan Grown program "fresher by far" fostered by the Alaska Division of Agriculture and the Agricultural and Forestry Experiment Station has resulted in increased awareness of the benefits of locally grown produce over that shipped in from the lower 49 states.

Management Practices for Forage and Turfgrass at Northern Latitudes

Accomplishments: (**ALK-02-05**) Nonirrigated forage grass/legume (reed canarygrass/red clover; var. Palaton/var. Altaswede) trials involving seeding rates and nitrogen (N) rates and time of application continued at Palmer under climatic conditions that have resulted in severe summer and winter desiccation and stand reduction. In the four years of the study, a total of only three harvests were made with a maximum annual dry matter yield of 3.10 Mg/ha in 2003 and less than 1.0 Mg/ha in each of 2004 and 2005. Plots will be evaluated again in 2006, but it is unlikely that the trial will continue. Turfgrass: The winter of 2004-2005 marks the fourth overwintering evaluation of turfgrass cultivars. Since 2002, we have tested 37 turfgrass cultivars at the Matanuska Experiment Farm. On the sand-based green, three roughstalk bluegrasses (*Poa trivialis*) and two bentgrasses (*Agrostis* sp.) have winterkilled. One perennial bluegrass (*Poa reptans*; Trueputt var.) and five bentgrass cultivars have been eliminated because of late green up and becoming playable only after May 15 thus disqualifying them for serious consideration. The cultivars showing superior survival, early greenup, and overall quality include Nugget Kentucky bluegrass (KBG), 18th Green creeping bentgrass, Velvet bentgrass, Laser roughstalk bluegrass, and Penn G-6 creeping bentgrass. The on-site plots at the Settlers Bay Golf Course provided an evaluation at a location that, unlike the Matanuska location, enjoys winter-long snow cover most years. At that location, we have evaluated three bluegrasses (Nugget KBG, Supina bluegrass, and Laser roughstalk bluegrass) and five bentgrasses (SRO 1020, Colonial, Velvet, Penn G-6, and 18th Green). With snow cover, all cultivars survived the winter and demonstrated excellent green up by May 10. SRO 1020 was rated best for overall quality in early May. In mid-July, 18th Green and SR 1020 demonstrated near perfect quality (NTEP ratings of 8.6 and 8.3, respectively). All 24 cultivars entered in the fairway trial survived the first two winters. In 2003, winter damage resulted in bentgrass cultivars being slightly behind the bluegrasses, fescues, and native hairgrass greening up in spring; however, all were playable by May 10. In 2004, bentgrasses lagged significantly behind and did not green up until mid-June. In 2005, all the bentgrasses and some KBG cultivars were severely winter damaged. By June 10th, only seven of the 24 cultivars were playable (these included Alaska cultivars Nugget KBG, Arctared red fescue, and Nortran hairgrass and introduced Touchdown, SR2000, and Blueknight KBG. By July 1, only Velvet and Penncross among the bentgrasses had greater than 50 % live cover. In July 2005 we seeded a new green to three of the better performing cultivars (18th Green and Penn G6 bentgrass and Laser *Poa trivialis*). These will be utilized in 2006 for research on alternative management practices for northern latitudes.

Impact: This research has established a list of recommended cultivars for golf course greens and fairways and sports fields at northern latitudes. We are evaluating selected cultivars, turfgrass maintenance methodology, and use of protective winter covers on a demonstration green at the Settlers Bay Golf Course and on an Experiment Station green. Superintendents are changing turfgrass practices based on results from this project. Turfgrass for golf greens, fairways and sports fields is increasing in importance as the population of the state increases. Our work with varieties and management practices will be the first definitive work for this economically important and recreationally important crop.

Source of Federal Funds: Hatch General
CSREES Special Grants

Scope of Impact: Alaska Specific

Cicer Milkvetch, Forage Galega, and Lupinaster Clover as Potential Forage Crops for Alaska

Accomplishments: (**ALK-02-01**) We planted six cultivars of cicer milkvetch (*Astragalus cicer*) and one cultivar of forage galega (*Galega orientalis*) in variety test plots at Fairbanks and Delta Junction, Alaska in 2002. A harvest cutting date and height trial was established in 2002 for Oxley cicer milkvetch and Gale galega at Fairbanks. The Fairbanks plots were on neutral soils in an area where snow cover typically accumulates in winter. The plots at Delta Junction were on strongly acidic soils in an area where strong winds typically result in bare soils during most of the winter season. Seeds of lupinaster clover (*Trifolium lupinaster*) were limited to a few test rows planted at each location in 2002 and 2003. We harvested seeds from the small lupinaster test rows and planted them in plots at Fairbanks in 2004 and 2005. We hope to obtain yield and forage quality estimates from these plots in 2006. All of these crops are very slow to become established; thus, no harvests were obtained in 2002 or 2003 at Fairbanks. None of the crops survived at Delta Junction in large enough quantities for harvest in any year. At Fairbanks, all crops in the variety trial were harvested twice in 2004 and 2005. For the harvest management study, a uniform 1st harvest was made of all plots in mid-June; the 2nd harvest was done at times ranging from early July to mid-September and cutting heights varied from 5 to 15 cm. The mean total seasonal yield for Gale galega in the variety trial was 6.8 Mg/ha in 2004 and 5.7 Mg/ha in 2005. Yields for cicer milkvetch in the variety trials ranged from 6.3 to 6.9 Mg/ha in 2004 and from 2.7 to 5.6 Mg/ha in 2005. The yield decrease experienced in 2005 was due to a combination of weed infestation and stand deterioration. As expected in the harvest management trial, yields decreased with increased cutting height and increased as the season progressed. In the years following 2nd harvest management treatments, yields were generally higher for the high (15 cm) cut treatment compared to plots cut at 5 cm. Yield results following various previous year cut dates were inconclusive. Preliminary results of this work indicate that cicer milkvetch and forage galega may have potential as alternative forage crops in some areas in Alaska, but careful management will likely be required to maintain high productivity.

Impact: Conventional forage legumes in the southern 49 states (i.e. alfalfa) do not produce well in Interior Alaska because of lack of sufficient winterhardiness and, in some cases, low survival in acidic soils. Cicer milkvetch is a long-lived, rhizomatous high quality forage and is currently being utilized in British Columbia in regions where alfalfa production and feeding (bloating) is problematic. This project will provide farmers in central Alaska with expanded options by providing information about management of new legume forage crops.

Source of Federal Funds: Hatch General

Scope of Impact: Alaska Specific

Selection, Variety Testing, and Evaluation of Cultural Practices for Alternative Agronomic Crops in Alaska

Accomplishments: (**ALK-02-06**) Summer growing conditions at all three locations were excellent with heading and maturity occurring 3-5 days earlier than the long-term average. Plant height characteristics were slightly above the long-term average. A significant increase in lodging in Fairbanks resulted. All varieties were mature and ripe at harvest at all locations. Variety Trials: continued evaluation of the hulless barley (*Hordeum* sp.), hooded forage barley (*Hordeum* sp.), hulless oat (*Avena* sp.), and hard red spring wheat (*Triticum* sp.) previously selected from northern Canadian and U.S. sources for testing against the standard Alaskan varieties (Thual hulless barley, Weal hooded forage barley, Toral oat, and Ingal hard red spring wheat). Overall yields were as high, or higher than the long-term averages. Yields at Fairbanks were 4767 lbs/acre for 2-row hulless barley and 3248 lbs/acre for 6-row, Palmer yields were 1776 lbs/acre for 2-row and 1620 lbs/acre for 6-row, and yields for Delta Junction were 3600 lbs/acre for 2-row and 3792 lbs/acre for 6-row. A new 2-row feed barley from Iceland was tested this year. Yields were slightly lower than the 6-row feed barleys, 3642 lbs/acre vs. 4376 lbs/acre but matured 3-5 days earlier than 6-row varieties and due to its semi-dwarf plant height characteristics it had no lodging. 2-row hooded forage varieties had an average yield of 3989 lbs/acre at Fairbanks, 2264 lbs/acre in Palmer, and 4326 in Delta. Yields at all three locations were slightly greater than the standard Weal. Yields for hulless oat varieties were higher than the long-term average but still lower than the standard Toral. Yields at Fairbanks were 3371 lbs/acre, Palmer 1581 lbs/acre, and Delta Junction 3537 lbs/acre. Yields for hard red spring wheat varieties were greater than the standard Ingal at Fairbanks and close to equal at the other two locations. Average yields for Fairbanks were 4645 lbs/acre, Palmer 1689 lbs/acre, and Delta Junction 2381 lbs/acre. Barley breeding selections: one final selection from a hulled, 6-row, feed barley cross was made after harvest in 2004 for testing and eventual release as a named variety in winter of 2005-06. This final selection was compared with Otal, Finaska, and Albright for all plant growth characteristics. The new variety is 1-2 days later in maturity, has similar lodging resistance, and comparable yields. Average yields compared with standard feed barley varieties at Fairbanks were 4278 lbs/acre vs. 4376 lbs/acre, Palmer 1846 lbs/acre vs. 1661 lbs/acre, and Delta Junction 3364 lbs/acre vs. 3347 lbs/acre. 6 selections from a hulless, 6-row, barley cross were made from the 12 selections made in the fall of 2004. Selections were made based on the best characteristics for standability, yield, early maturity, and percent hulless seed. Average yields, and standability were greater than Thual, 3789 lbs/acre vs. 3298 lbs/acre at Fairbanks, 1740 lbs/acre vs. 1386 lbs/acre at the Palmer location, and 3972 lbs/acre vs. 3287 lbs/acre at the Delta Junction location. Average maturity occurred about 1-2 days earlier than Thual at all three locations. Percent hulless seed characteristics were greater than 90% for all 6 selections.

Impact: This study is a continuing collection of information that provides yearly updates on new and better adapted crop varieties, the response of agronomic crops to dryland farming conditions, and provides a database for local producers to determine the economic viability for those crops. Future studies of the effects of irrigation on these agronomic crops will broaden this information database. Seed collected from the 2004 selections were disseminated in the spring of 2005 to selected cooperators for testing in home gardens as a horticultural seed crop.

Source of Federal Funds: Hatch General

Scope of Impact: Alaska Specific

Key Theme: Marketing of Alaska Grown Products

Alaska Seed Growers' Assistance Program

The Alaska Seed Grower's Assistance Program is intended to coordinate seed production between producers and users. This work is a spin off of USDA-CSREES Special Grants Program. This will be done through specification development, user education and producer education by means of written documents and one-on-one farm assistance. The ultimate goal is efficient native seed production that meets demand in a balanced fashion. Demand will be encouraged through education, demonstration and specification.

Accomplishments: The objective for this program is to disseminate effective state-of-the-art Alaska native plant seed technology to potential and existing Alaska seed growers with an end result of enhancing commercial production of native plants in Alaska. To accomplish this, the Plant Materials Center (PMC) generates numerous products including informative plant flyers, public presentations, farm visits, individual consultations, seed evaluation, and written plant science information. During 2005, we published twelve new plant flyers, making a total of twenty-six interpretive, attractive, and very marketable publications available for Alaska native seed growers on the web. The 2005 publications represent some of the newly released germplasms collected from Alaska - tested and evaluated by PMC for many years. These are: Adak Germplasm arctic bluegrass, Andrew Bay Germplasm large-glume bluegrass, Casco Cove Germplasm beach lovage, Clam Lagoon Germplasm beach fleabane, Henderson Ridge Germplasm red fescue, Kotzebue Germplasm arctic wild chamomile, Lowell Point Germplasm meadow barley, Nelchina Germplasm spike trisetum, Teller Germplasm alpine bluegrass, Tin City Germplasm arctic bluegrass, Tok Germplasm Jakutsk snowparsley, and Twenty Mile Germplasm boreal yarrow. Our website now presents eighty-eight scanned publications in full text) originating from the thirty-five years of research and education. Also included in the topical listing are other publications by the PMC staff, which were copyrighted or published elsewhere. Other publications this year include an updated Native Plant Directory and the 2004 PMC Annual Report. Also new in 2005 are ten new professional exhibits to educate people on some of the PMCs major programs. Updated Field Maps were designed, along with photographic field labels (with the plants common, scientific, and cultivar name), enabling visitors (and workers) visually to evaluate more than 100 field-grown plants at the Center. On-going assistance to Alaska Seed Growers includes an educational List-Serve; visits to farmers in the Fairbanks, Kenai, and Matanuska Valley regions; seed testing (germination, purity, noxious, tetrazolium, moisture) of seed lots (652) from all over Alaska; and hundreds of digital pictures for illustration in our publications. Answers were provided daily covering the gamut of questions from what revegetation seed mixes to use where, how to propagate specific plants, plant regulations, noxious weed eradication, seeding rates, costs and availability of seed, landscape suggestions, and even identification of an alien moss invader for a local newspaper. The revegetation manual is in progress-many requests from agencies and contractors are speeding up its production. The rye experiment to evaluate the allelopathic effects on native grass seed production continued this year. The plant production manual is started with topics for each plant on techniques, planting times, harvest and seed processing included.

Impact: This program impacts Alaskans daily by providing expert advice, knowledge, and assistance to individuals, agencies, and permitting professionals. During a sample 2 week period we received inquiries from the AK Department of Transportation (Beach Wild Rye for Nome, AK and what seed mix should be used to revegetate a disturbed tundra area); NW Landscape Inc. (what native plants are appropriate for Privilof, AK); 3 individuals (what is the availability and

costs for various seed); and 2 agency individuals (information about grass native to the Aleutians, and plant regulations.) Web publications provide accurate information based on our 35 years of evaluations on native plants in Alaska. The Program continues educational and extension components through weekly summer farm tours. Two college interns spent this summer learning how we provide assistance to seed growers. One was featured nationally in the NRCS Plant Materials Program Seasonal Workers article (7/29/2005). One created plant identification markers for the farm tours, designed innovative exhibits, took hundreds of digital photographs for our publications, and scanned 88 full text publications for the web site. Another intern assisted our seed analyst in testing 112 seed lots for germination, purity, and moisture. Visits to existing and potential farmers of native seed enabled us to address questions concerning infestations of invasive weeds (candle grass, hawksbeard, white cockle, hemp nettle, chickweed, and foxtail) fertility management; and marketability. (http://www.dnr.state.ak.us/ag/ag_pmc.htm)

Source of Federal Funds: USDA-CSREES Special Grant

Scope of Impact: Alaska Specific

Key Theme: Traditional and Alternative Livestock Production

Reproductive Performance in Domestic Ruminants

Domestic livestock, both dairy and meat animals, continue to account for the highest cash receipts (excluding aquaculture); however, alternative species are making headway among producers. Research within AFES has largely centered on alternative livestock species such as reindeer, muskox, and bison in direct response to requests by the livestock producers of Alaska. The objectives of this project are to determine means of improving reproductive management of domestic and alternative ruminant livestock both on-farms and the Experiment Station. The Experiment Station owns a small reindeer herd and has access to other reindeer and muskox at the Institute of Arctic Biology Large Animal Research Unit. Traditional livestock operations are addressed through extension demonstration, on-farm research, and one-on-one consultation with producers.

Accomplishments: (**ALK-00-01, W-112**) Plasma samples were collected from 5 intact reindeer bulls fed Melengestrol acetate (MGA), 5 intact yearling reindeer males that served as positive controls and 5 yearling reindeer steers that served as negative controls. The use of MGA, a commercially available progestin based livestock feed additive, was investigated for use as a tool to reduce destructive and dangerous rutting behavior expressed by reindeer bulls during the breeding season. As stated previously, this project was stopped in early September 04 when it became clear that the MGA treated bulls showed no depression in rut associated aggression and all began courting estrous cows within 30 min of entering the test pen. Analysis of systemic testosterone, feed intake, body weight, behavioral observations indicated no difference between the MGA group and the positive (intact) group in any category. Archived plasma collected from 10 pregnant and 5 non-pregnant reindeer and from 21 muskoxen prior to and during the breeding season were assayed for leptin and IGF-1 providing preliminary information on leptin and IGF-1 levels in reindeer and muskoxen. 17 reindeer cows underwent estrous synchronization protocol and were bred during the fall of 2005 for use in a study to assess genetic markers in reindeer and to examine any association of DNA polymorphisms with milk yield, milk composition and calf growth rate, and the potential for use of these tools in selective breeding. Estrous synchronization protocol utilized CIDR-B modified according to manufacturer recommendations to fit the smaller reindeer vagina. CIDR were inserted and remained in the vagina for 7d. At the time of CIDR

removal, cows received PGF2=E1 and were placed in harem with a mature reindeer bull. All deer have been confirmed pregnant and are expected to calve in April and May. The modified bovine CIDR resulted in a mild vaginitis in all the reindeer. Although this responded to treatment and did not impair fertility, it is considered undesirable. Future studies will utilize the smaller goat CIDR. Study four involves 17 reindeer cows bred in two groups, one undergoing estrous synchronization protocol, as described above, early in the breeding season, representing early season breeding (n 3D 9), and the other undergoing estrous synchronization protocol, as described above, four weeks later, representing late season breeding (n 3D 8). All deer have been confirmed pregnant and are expected to calve in April and May. Since unsubstantiated reports have indicated that late breeding reindeer have a shorter gestation period, time of breeding will be correlated with gestation length to ascertain any relationship between these two aspects of reproductive function.

Impact: For intensively farmed reindeer, control of the breeding season is key for successful and safe management. Due to extreme aggression of rutting bulls, routine handling and feeding procedures become difficult and sometimes impossible during rut. Estrous synchronization is an excellent tool for truncating the harem period without compromising conception and pregnancy rates. Synchronized breeding results in calves that are born over a shorter period in the spring, creating a cohort of calves similar in age and size. This improves both labor and management efficiency associated with calving and neonatal husbandry. This is the first time leptin has been characterized in reindeer and muskoxen using a ruminant specific assay and represents the most complete endocrine data currently available in these species. Results of these studies can be used to improve reproductive efficiency on Alaskan livestock farms and ranches. Demonstrating the effectiveness of applying reproductive management techniques to diversified livestock provides the farmer low-cost tools without risking private stock. Not all technologies translate equally well from traditional livestock to more exotic species and our ability to identify those that are effective under Alaskan conditions enhances the producers ability to maximize productivity, and hence profits. The market value of the offspring (\$5000/muskox; \$1500/reindeer) is a significant portion of the income generated by the Alaskan diversified livestock industry.

Source of Federal Funds: Hatch General and Hatch Multistate
USDA Special Grants

Scope of Impact: Multistate

Spatially Modeling the Distribution of Beef Cattle and Reindeer on Ranges at High Latitudes

Alaska imports more than 90 percent of its food supply, including most red meat. With the current market structure, imported food is generally less expensive than Alaskan-grown food. This is principally caused by a lack of marketing and distribution infrastructures since existing ranching enterprises cannot support processing, distribution, and marketing investments. Much effort and research is currently being devoted to increasing production of meat animals, thereby stimulating economic development in Alaska.

Accomplishments: **(ALK-03-03)** Temperature data collected in 2004 was modeled using principle components analysis to create additional layers for our multi-criteria evaluation (MCE) modeling of cattle movements at the Matanuska Experiment Farm. Over 170 hours of visual/video-taped cattle observations were conducted during the summer of 2005. Data was transcribed from video-tapes and converted into a geodatabase. A random subset was extracted for model validation analysis while the remaining data was used to refine distribution models. Near-earth remote sensing was conducted twice during the summer with a tethered helium-filled blimp carrying two digital cameras. Remote sensed data was used to create GIS layers showing forage availability and quality for MCE modeling. In cooperation with Oregon State University, a

kinetic resource and environmental spatial system (KRESS) software package was further refined for analysis, modeling and verification of spatial data. This modeling package will be used to conduct the final analysis of our animal distribution study. A graduate student began a related animal distribution project using reindeer on the Seward Peninsula in spring 2005. The spatial locations of reindeer calving sites were mapped. Temperature data and other ancillary data relating to the study area were collected and are currently being mapped. This data set will be analyzed using the KRESS software.

The effects of compaction during baling, color of plastic wrap, and preservatives on the quality of haylage in Alaska

Most years, hay producers do not have sufficient dry weather to produce good quality hay. The production of fermented hay (haylage) is a viable solution that has not been investigated in Alaska.

Accomplishments: Haylage was baled using different levels of compaction, colors of plastic wrap, and with or without preservative. Self-recording thermistors were inserted into bales harvested at differing moisture levels. Bales are cored at two weeks, one month, three months and six months after baling. Samples were removed for chemical analysis using CHN analyzer and HPLC for fiber and fermentation products. Early results indicate that fermentation was incomplete across all treatments.

Impact: The economical production of quality feed for livestock is critical to the Alaska dairy and meat industries. Hay accounts for 88 percent of all animal feed grown in Alaska. Moisture damage, in most years, is a major source of spoilage costing growers hundreds of thousands of dollars. Early findings from this research are already being used by producers with excellent results.

Source of Federal Funds: Hatch General
USDA Special Grant
Scope of Impact: Multistate

Feed and Forage to Optimize Reindeer Production and Meat Quality

Accomplishments: (**ALK-98-07**) Reindeer meat can be produced in Alaska under a variety of management systems. Meat can reach the market where reindeer are raised intensively behind fence and fed a complete ration. The protein in the ration can be provided by either soybean meal exported to Alaska or locally produced fishmeal. Also meat can reach the market place from animals raised extensively where they are allowed to freely forage on native tundra vegetation. This project aims to compare attributes of meat produced from free ranging or intensively managed animals using a fishmeal or soybean meal based diet. Traditionally, reindeer meat in Alaska is produced from free-ranging animals. Formulating a low-cost, balanced reindeer diet from locally produced components is crucial for the development of complementary reindeer meat production on farms. Typically, soybean meal is used as a protein supplement in ruminant diets, but soybeans cannot be grown in Alaska. Alaska's fishing industry creates byproducts such as fishmeal that could be used as a protein source in reindeer diets, but its effect on quality attributes of the meat is unknown. Our objective was to evaluate effects of the various diets on sensory and technological properties related to the eating quality of reindeer meat. Seven reindeer steers at the University of Alaska's reindeer farm were fed a 16% crude protein diet based on either 6.8% soybean meal (n=3) or 3.0% fishmeal (n=4) for 12 weeks and then slaughtered at a

USDA approved abattoir. Four adult free-ranging reindeer were slaughtered on the Seward Peninsula, Alaska. Loin muscle was excised and evaluated for tenderness (Warner-Bratzler (WB) shear force values), cooking loss and sensory characteristics using a trained panel and a consumer test. No significant differences (p 0.05) were found comparing the three treatment groups for cooking loss (ranged from 21.6 - 23.2%) WB values (2.3 - 2.7 kg/cm²) or the trained panel's scores for juiciness, tenderness, meat flavor and off-flavor. The consumer test included samples from fishmeal fed and free-ranging reindeer. More consumers characterized the meat from free-ranging reindeer by various off-flavor attributes compared with the meat from fishmeal fed animals.

Impact: Consumers value the attributes of reindeer meat and are willing to pay a premium price. Reindeer meat is exceptionally tender. We could not find any negative effects on eating quality of reindeer meat from animals fed low levels of fishmeal. Fishmeal demonstrates promise as a cost-effective feed component for intensively managed reindeer operations in Alaska.

Source of Federal Funds: Hatch General
USDA Special Grant
Scope of Impact: Alaska Specific

Mineral Flux in Reindeer Animal Health

Accomplishments: (**ALK-03-07**) The consumption and bio-accumulation of trace minerals and metals by food producing animals is important for both animal health and food quality and safety. Mercury can enter the food chain in Alaska through many routes. Mercury could potentially accumulate in reindeer muscle tissue via the consumption of lichens or rations containing fish meal. Reindeer fed rations containing Alaskan produced fish meal have been found to have lower levels of mercury in hair than free ranging animals. Atmospheric deposition is responsible for the accumulation of mercury in lichens consumed by free ranging reindeer but concentrations in hair samples vary regionally across the Seward Peninsula. Hair samples were collected from reindeer on disparate ranges on the Seward Peninsula, Alaska to assess mercury accumulation in reindeer tissue. Samples were collected from reindeer near White Mountain and Teller, Alaska. Hair from these Seward Peninsula reindeer had mean levels of 55.3 ng/g. The results suggest that bioaccumulation of mercury in Seward Peninsula animals is well below levels considered a human health risk but differ significantly on a regional basis.

Impact: Determining the concentrations and sources of contaminants that could accumulate in food animals is important for both animal and human health. The results of this study indicate mercury levels in Seward Peninsula reindeer tissue are well below levels considered a human health risk but differ significantly by region. This suggests concentrations found in one region are unique and results cannot be extrapolated to neighboring regions. Samples must be collected and levels must be determined on an individual herd basis.

Key Theme: Forest Products

Forest Stand Characterization and Growth and Yield for Alaskan Northern Forest

Credible data and information are critical requirements for responsible forest management decision-making and financial investment. Much growth and yield data, currently available, are suspect, inadequate, or insufficiently precise. Goals are to quantify tree fiber production of Alaskan Northern Forest lands and to provide resource managers with appropriate equations,

tables, and graphs essential for basic, state-of-the-art forest resource management decision-making and stand prescriptions.

(ALK-03-12) Alaska Northern Forest Cooperative, initiated in 2003, revised compendium of Alaska Northern Forest research projects CD and sponsored 3-day workshop in Tok. Permanent Sample Plots (PSPs) are very important in characterizing stand and community species composition, structure, top height of forest canopy and understory species, tree regeneration, tree mortality, and soils. Since the inception of the program, in 1995, 558 PSP plots have been established. We have completed 5-yr measurement on 91 PSPs (31 sites), 10-yr measurement completed for 54 PSPs (18 sites); Site Indices was continued in 2005 with further progress with aspen and black spruce. Soil description and sampling to USDA-NRCS standards have been ongoing since 2002. Information regarding landform, topography, presence of permafrost, drainage class, texture, thickness of organic horizon, and rooting depth is being collected on as many PSPs as possible. Other work included Levels of Growing Stocks (LOGS) with the purpose of determining the effect of initial escapement or spacing on crop tree growth. 1) Bonanza Creek (white spruce) 19-year height & diameter measured; research paper on 15-yr results delayed and changed to 20-yr results; spruce gall aphid absent, spruce budworm present; 2) Tok (white & black spruce; tamarack; lodgepole pine) 13-year height measured and vigor assessed, minor cleaning, heavy mortality in black spruce and larch. Plantations relate empirical height/diameter to trees/acre; thus, help managers make cost effective prescriptions for planting, natural regeneration, and spacing; PSPs provide fiber yield, data on stand composition, structure, and succession for management and ecological modeling. A new project initiated in 2004 at the request of the Alaska State Forester began cataloging Forest Management Community Types that include overstory plant community types, understory plant community types, landscape description and soils units. Both soils and community types expand the ecologic knowledge of the Northern Forest, e.g., presence and growth of black spruce on dry ridges and sand dunes questions US Army Corps of Engineers use of it as a wetland indicator in Alaska. We will standardize land classification and prescription development and improvement forest resource management, reduce critical mistakes, and improve economic decision-making. Soils information complements the community type data set and identifies soils limiting factors and treatment hazards. Understory vegetation and soils, initiated integrating existing ecological data, PSP data, USDA Forest Service FIA data; in collaboration with Dr. C-L Ping (Black spruce forest soils project).

Impact: Alaska Northern Forest Cooperative is benefiting owners and managers through dialogue, collaboration, and the CD research compendium. 2005 workshop addressed small diameter tree utilization. SITE INDEX curves are used to assess forest land productivity to better manage forests, e.g., compare land for fiber production & investment purposes, prepare stand prescriptions for habitat, estimate biomass, & carbon sequestration. LOGS plantations relate empirical height/diameter to trees/acre; thus, help managers make cost effective prescriptions for planting, natural regeneration, and spacing; PSPs provide fiber yield, data on stand composition, structure, and succession for management and ecological modeling. Accurate cubic-foot TREE VOLUME EQUATIONS are critical tools for predicting stand volume (total & commercial), biomass, standing fuel, and carbon sequestration. Use of small trees and slash for PHYTOCHEMICALS can offset costs including fuels reduction programs and provide a profit and improve local economies. FOREST RESOURCE MANAGEMENT COMMUNITY TYPES will standardize land classification and prescription development and improvement forest resource management, reduce critical mistakes, and improve economic decision-making. Soils information complements the community type data set and identifies soils limiting factors and treatment hazards. Both soils and community types expand the ecologic knowledge of the

Northern Forest, e.g., presence and growth of black spruce on dry ridges and sand dunes questions US Army Corps of Engineers use of it as a wetland indicator in Alaska.

Impact: Alaska Northern Forest Cooperative already is benefiting forest resource owners and managers through dialogue, collaboration, and the draft research compendium. Site Index curves will be used to better manage forestland, e.g., compare land for fiber production & investment purposes, prepare stand prescriptions for habitat, estimate biomass & carbon sequestration. LOGS plantations relate empirical height/diameter to trees/acre; thus, help managers make cost effective prescriptions for planting, natural regeneration, and spacing. Early Height Growth data is critical to improve stand growth model accuracy and predict time for seedlings to reach breast height & free-to-grow status. In addition to fiber yield, PSPs provide data on stand composition, structure, and succession, important for forest management and ecological modeling. Accurate cubic-foot Tree Volume Equations are critical tools for predicting stand volume (total & commercial), biomass, standing fuel, and carbon sequestration. Sale of small trees and slash for Phytochemicals can offset management activities and even provide a profit and improve local economies. Forest Resource Management Community Types will standardize land classification and prescription development and improve forest resource management, reduce critical mistakes, and improve economic decision-making. Soils information complements the community type data set and identifies soils limiting factors and treatment hazards. Both soils and community types expand the ecologic knowledge of the Northern Forest.

Source of Federal Funding: McIntire-Stennis
USDA Special Grants

Scope of Impact: Alaska Specific

GOAL 4: Greater harmony between agriculture and the environment.

Program 2. To increase the research and knowledge base for environmental sciences, agriculture, and forestry including conserving and protecting ecosystem integrity and biodiversity.

Overview:

Alaska faces many choices, challenges and problems in the use of its natural resources. As with most western states, the relatively large land areas controlled by federal agencies, land use decisions are largely out of state and private industry control. Lands now owned by the state of Alaska and Alaska Native corporations were selected to provide an economic base of support for the population and economy of the state. The sustained productivity of this land base will remain a priority issue in Alaska's public policy. Both the people of Alaska and the United States as a whole have set high standards for the management of the state's resources, as reflected in strong cultural and emotional attachment to the land, national and international media interest, and strict adherence to state and federal laws. Research at the Agricultural and Forestry Experiment Station under Goal 4 in the last five year cycle has centered on opportunities to properly manage resources for long term sustainability requires the development and application of knowledge for resource development in an economically and environmentally protective manner. A significant portion of SNRAS/AFES research and education efforts are directed toward environmental issues raised by conflicts among multiple users, nonrenewable resource development, renewable

resource production, and economic and environmental sustainability. Hatch and McIntire-Stennis projects under this goal address these issues.

Expenditures:

| | |
|-------------------|-----------|
| Hatch General: | \$174,308 |
| Hatch Multistate: | \$0 |
| McIntire-Stennis: | \$404,477 |
| State Matching: | \$580,515 |
| Total FTE (SY) | 7.7 |

PLANNED PROGRAMS

Key Theme: Soil Carbon Flux, Permafrost Characteristics, and Nutrient Cycling

Very little information exists regarding the characteristics of soils associated with black spruce and a great need exists for a soils information baseline for modeling climate change, boreal forest management, and future soil inventory. An understanding of black spruce dominated sites is important for both ecological modeling and for land management.

Black Spruce Forest Soils in Boreal Regions of Alaska: Their Characterization, Organic Carbon Pool and Relationship to Forest Management

Accomplishments: **(ALK-03-02)** The physical environment and properties of soils formed under black spruce in the boreal region of Alaska were investigated. The study sites were selected to be associated with existing Permanent Sampling Plots and the Site Index Plots of the on-going Growth & Yield Program so the results of both studies can be tied together. A total of 33 soil pits were sampled since the beginning of the project. The black spruce plots, thus soils study sites, are on nearly all segment of the landform including ridge top, shoulder slope, back slope, footslope and flood plains with drainage from somewhat excessive to poorly. The slope ranges from steep to level. Although black spruce grows in all slope aspects, the dominant exposure on back slope is north where the soils are cold and often with permafrost. The parent material includes loess or volcanic ash over weathered Birch Creek schist or granite, volcanic ash over loess or sand dune deposit, and transported loess. Their morphological, physical and chemical properties were characterized. Organic horizon thickness ranged from 4-18 cm. on well-drained sites to > 30 cm. on poorly drained sites. Generally, soil pH increased with depth: from 4.0-6.0 in O horizons, 4.0-6.0 in A horizons, 5.0-7.0 in B horizons, and 7.0-8.0 in C horizons. Total soil carbon, generally, decreased sharply with depth from about 30-50% in O horizons to <1.0% in BC and C horizons. Wildfire is a common and frequent disturbance feature in black spruce forests in the western boreal region; thus, charcoal was found throughout the soil profiles with a concentration in surface and subsurface horizons. This charred material often leads to an overestimation of soil organic matter and yields a wide C:N ratio.

Impact: This study found that black spruce grows on almost all landforms in interior Alaska and on soils with a wide range of properties. Volcanic ash has been newly recognized as a result of this study as a critical element in maintaining forest productivity on eastern Tanana Valley uplands, because this ash layer holds more available water than underlying sand. We also found that charcoal and charred material resulting from forest fire often leads to overestimation of soil organic matter and yields a wide carbon-to-nitrogen ratio. This leads to overestimation of nitrogen need to the ecosystem. The soil properties investigated here will be used to interpret the factors affecting the forest growth and yield and also help to establish forest management guidelines.

Source of Federal Funds: Hatch General,
USDA-NRCS, and NSF

Scope of Impact: Multistate

Soil Carbon Balance and Nitrogen Dynamics Following Disturbance by Wildfire and Logging in Interior Alaskan Forests

Because boreal forest soils constitute a huge reservoir of carbon, a clearer understanding of the responses of boreal forest soil respiration to disturbance will be critical to successfully assessing its likely future role in atmospheric carbon balance. The expanding role of forestry in Alaska and in the circumpolar north requires a clearer understanding of the responses of boreal forest floor microbial dynamics to disturbance is a key to sustaining productivity over the long term.

Accomplishments: **(ALK-01-07)** The objective of this project is to examine the impacts on soil respiration and nutrient dynamics of two disturbance agents in interior Alaskan forests: fire, currently the dominant stand-initiating disturbance, and logging, currently of minor import by any measure (but potentially growing). The project began in the summer of 2001. From 2001-2004, we measured soil respiration in burned and unburned black spruce forest plots in the Caribou-Poker Creeks Research Watershed (CPCRW), the site of the 1999 Frostfire experimental wildfire. We had clearly showed that soil respiration declined and remained low following wildfire compared unburned stands, but dense growing vegetation had begun to cause increasing artifacts associated with plant photosynthesis and respiration. We began measuring respiration in a contrasting series of lowland black spruce sites burned during the Survey Line fire of 2001, and in 2005 collected our 3rd year of measurements there. Because the rock-free soils allowed installation of root exclusion collars, we have been able to distinguish heterotrophic and autotrophic respiration in this system. Although the data have been noisy, the relatively high degree of replication has nonetheless enabled us to show a statistically significant ($p < 0.05$) decrease in heterotrophic respiration in burned soils compared to unburned soils. This suggests that fire results in an overall decrease in organic matter decomposition despite generally more favorable physical conditions (moisture and temperature) for microbial activity. Related work by Sarah Masco (Valentine's finishing MS student) showed that respiration rates in laboratory incubations of burned and unburned forest floor samples (Oe and Oa) were comparable for most of the duration of the experiment. The exception was very early in the incubation when unburned soils respired nearly twice as rapidly as burned soils, suggesting a pool of rapidly mineralized carbon was present in unburned soils but absent in burned soils. As her samples were from the subsurface of the forest floor (i.e., no Oi), the only difference between burned and unburned soils was the presence in the former of recently senesced root litter. These results suggest that the rapid root turnover rates comprise a large fraction of heterotrophic soil respiration, and that wildfire reduces heterotrophic soil respiration by arresting this litter input.

Impact: The real impacts of this project will accrue primarily to the public via (especially Division of Forestry and Division of Lands). Projects management agencies, such as Alaska's Department of Natural Resources designed to sequester carbon and sell carbon credits are increasing in number. To work in Alaska, any such scheme must be based on a clear understanding of and accounting for the future role of Alaska's boreal forest soils in sequestering or releasing carbon under changing disturbance regimes. This project, in concert with other related projects at UAF, is helping to provide that understanding.

Source of Federal Funds: McIntire-Stennis and NSF funds.

Scope of Impact: Alaska Specific

Long-term Forest Ecosystem Monitoring and GIS Modeling of Taiga Forest Dynamics

A total understanding of the interaction between the environmental dynamics that regulate forest growth at the landscape scale in interior Alaska is just starting to develop. The purpose of this study is to develop a computer model on the functional aspects of forest ecosystem dynamics at a broad landscape scale in interior Alaska.

Accomplishments: (**ALK-01-01**) Work has continued on the preparation of five research papers that detail the analysis of seven major long-term studies focused on the relationship between forest stand density, nutrient availability and tree growth dynamics in interior Alaska. The studies include fertilization studies in a time sequence of aspen and birch forests, an NPK factorial fertilization study in aspen, a partial NPK factorial fertilization study in birch, a nitrogen rate study in birch, a combination thinning and fertilization study in two white spruce stands, environmental monitoring in black spruce stands and analysis of sugar, sawdust and drought treatments in key successional turning points in upland and floodplain successional sequences (LTER sites). The current duration of the studies has been 37 years in the upland stands and 15 years in the LTER study sites. Results indicate that young aspen stands were nutrient limited but this limitation disappeared as the stands grew older. Birch stands in most studies did not show a nutrient limitation. Although in the single application study birch growth did improve approximately 10 years after fertilization and a thinning treatment. It is not clear if the change in growth was the direct result of the fertilization treatment. White spruce stands showed increased growth for two years as a result of five years of fertilization. The combination of thinning and fertilization resulted in growth increases for 28 years during the 37-year study period. Low-level fertilization in the LTER sites started to show significant increases in growth 5 years after the start of the study. In these studies the fertilization level was designed to simply double the natural mineralization rate. Sugar and sawdust treatments resulted in growth decreases in the first two years after application and the drought treatments resulted in significant decreases in growth on floodplain sites as opposed to uplands. The opposite of what was expected. The complexity of ecosystem dynamics across the landscape is related to a differential structure and interaction of the process limiting factors. Fertilization may only increase tree growth if other major limiting factors (such as moisture) are satisfied. So a direct change in that factor, like irrigation in a dry environment, should increase growth up to the limit set by the next environmental factor, say nitrogen. However a change in the potential amplitude of a limiting factor, like thinning a forest stand to reduce the total water utilization on a site (an indirect change related to the limiting factor availability), may not augment the control of growth with comparable effectiveness that would be observed by irrigation (a direct change in the limiting factor availability). In the case of a forest stand a large number of growth limiting factors could be diminished as a result of thinning. Factors like nutrient availability would be increased as a result of reduced competition, greater site utilization by the remaining individual trees, and possibly increased nutrient turnover

in the soil environment. These factors may require several years to produce an increase in growth in the remaining trees.

Impact: Forest growth in interior Alaska is controlled by a number of well-defined environmental state factors. These growth-limiting factors include (1) soil and air temperature, (2) soil moisture dynamics, and (3) nutrient availability. The structure of these factors is also dependent on the topographic location of the ecosystem. For example on north facing slopes the temperature dynamics, both air and soil, will be the primary limiting controls on ecosystem processes and tree growth. On south facing slopes, temperature dynamics will control the length of the growing season, but soil moisture may then become the primary control once a threshold temperature has been reached. Understanding the functional structure of the ecosystem controls will then allow for a substantial increase in our ability to develop models to predict tree growth in the future especially with the continued influence of climate change in the boreal forest.

Source of Federal Funds: McIntire-Stennis and NSF funds.

Scope of Impact: Alaska Specific

Key Theme: Reclamation and revegetation of disturbed lands

Ectomycorrhizae on Disturbed Lands in Southcentral and Interior Alaska: A comparison of Regional Similarities and Differences (Project Terminated in July 2005)

Accomplishments: (**ALK-00-02, WCC-021**) Laboratory analyses in 2005 focused on the middle stages of Exit Glacier chronosequence sampled for the secondary objective of determining whether early-successional morphotypes are still present in mid-succession. With about 80% of the core samples processed and preliminary data analyses, we still see many of the early successional morphotypes in older stages, but are seeing some morphotypes that were not detected in studies focusing on early succession. While this extensive, rather than intensive, sampling across community ages does suggest some minor trends with age within these mature Populus (cottonwood) stands, successional trends among morphotypes are not as clear here as they were in younger stages. Most core samples contained a layer of litter (deciduous, needleleaf, or a mix), a horizon densely packed with roots and organic material (little mineral), and glacial outwash substrate. Differences among EM morphotype communities among the horizons do exist as might be expected with organic and mineral substrates. The vegetation composition across this chronosequence is dominated by Populus balsamifera ssp. trichocarpa with Picea sitchensis (Sitka spruce) being more common later in the succession. However, the cores were taken randomly near each point along the chronosequence transect, so the effects of the Populus dominate. This differed from the earlier study where the more intensive sampling was based on tree species in stages. In this chronosequence where the vegetation has relatively minor plant species or community composition changes once a mature Populus canopy is established, morphotypes detected changed little also.

Impact: As data on ectomycorrhizal (EM) colonization are accumulated across the various sites and building on previous studies, inoculum source and EMF species could be very important for inoculation in nurseries, greenhouses, or revegetation sites. The important factors in locating successful inocula seem to be association with plant species, their communities, and substrate more so than age of the plant community or latitude. Development of a common EM inoculum could provide a low-cost and environmentally friendlier substitute for use of chemical fertilizers to supply certain required nutrients, particularly phosphorus and micronutrients in the reclamation of disturbed lands.

Source of Federal Funds: McIntire-Stennis

Scope of Impact: Multistate

Key Theme: Plant Disease Control/Biocontrol

Managing Plant-Microbe Interactions in Soil to Promote Sustainable Agriculture

ALK-94-01 terminated in 2004; however, this research continues under the aegis of W-1147. Biological control agents are under study to improve the understanding of the underlying mechanism of mycoparasitism that affect plant pathogens.

Alaska's participation in W-1147 was discontinued in 2005.

Source of Federal Funding: Hatch Multistate

Scope of Impact: Multistate

Key Theme: Soil Health and Sustainable Agriculture

Yield and quality of barley and brome grass as affected by zero/minimum tillage, fertilizer rate, and cutting regimes

Accomplishments: **(ALK-04-03)** The objectives of the project are: 1) to determine optimal N fertilizer application rate and cutting frequency on yield and quality of brome grass hay; 2) to analyze barley yield from different tillage, straw management; and N fertilizer application rate since 1983; 3) to determine soil carbon quantity and quality affected by different land management and tillage; and 4) to quantify the potential mineralizable N in agricultural land under different management practices. In 2005, several major progresses have been made. In 2005, field experiment of brome grass with 0, 50, and 150 kg N/ha has been conducted. This is the continuation of the experiment in 2004. Five randomized hay and soil samples were taken at each sampling time (June 13, July 11, and August 9). Plant samples were analyzed for N, P K and S concentration, and neutral detergent fiber (NDF) and acid detergent fiber(ADF). Available nitrogen (NH₄-N + NO₃-N), and potential mineralizable N (soluble organic N, hot KCl N) in soil samples will be analyzed. The results showed that nitrogen concentration in plant samples increased as the rate of N application increased from 0 to 150 kg N/ha. However, there are little changes in ADF and NDF concentrations among N application rates for plant samples taken both in 2004 and 2005. The growth stage for the first cutting in 2005 was in booting stage and the second cutting was in heading stage (> 50% heading). Apparently, there was little difference in ADF and NDF concentrations between early and late cuttings in all three N application rates. In the long-term tillage research, results from 2003 soil samples showed that tillage has a tendency to impact soil bulk density at 0-5 cm depth, but not at the depth below that. Soil organic matter from 5 to 10 cm was increased (p < 0.06) with the straw retention, but not with the no-tillage treatment. No tillage treatment benefits barley yield, however, weed control is a constant problem in last 21 years in no tillage practice in sub-arctic area due to short in growing season and lack of options in rotational crops. In addition, soil physical properties have been studied (infiltration, penetration resistance, aggregate size distribution et al.) in the tillage research plots. The results were published in Soil and Tillage Research in 2005.

Impact: The results with bromegrass experiment showed that ADF and NDF concentrations after boosting stage cannot be changed even with high N application rate. Long day length in high altitude might hasten the conversion of nonstructural fiber in plant. The results in tillage research showed that no tillage benefits soil conservation and barley yield, but new strategies should be developed in order to manage weeds in no tillage practice.

Source of Federal Funds: Hatch General

Scope of Impact: Alaska Specific

Key Theme: Forest Protection

Using Remote Sensing to Investigate Landscape Fire Interactions in Black Spruce Ecosystems of Interior Alaska

Accomplishments: (**ALK-05-03**) We evaluated 13 remotely sensed indices across four wildfire burn sites in interior Alaska. The indices included single bands, band ratios, vegetation indices, and multivariate components. Each index was evaluated with post-burn and differenced pre/post-burn index values. The indices were evaluated by examining the correlation between each remotely sensed index and field-based Composite Burn Index (CBI) values. Radiant temperature was strongly correlated with field-based CBI when a post-fire image from autumn was used. Indices that used red and near-infrared bands performed poorly relative to indices that incorporated mid-infrared bands. The Normalized Burn Ratio (NBR), which incorporates near- and mid-infrared bands, was ranked within the top three indices for each of the four burns using post-burn images, and for three of the four burns using pre- and post-burn images. When indices were summed based on ranked correlations, the NBR was highest for both the post-burn and pre/post-burn approaches. The NBR had high correlations with the field-based CBI in closed needleleaf, mixed, and broadleaf forest classes. However, the NBR was useful as an index of burn severity only for forested sites. The correlation between NBR and field-based CBI was low in non-forested classes such as woodland, scrub, and herb land cover classes. We applied the NBR to prefire vegetation and the postfire vegetation response related to burn severity within a 1986 burn in interior Alaska. Vegetation was classified prior to the fire and 16 years after the fire, and a chronosequence of remotely sensed vegetation index values was analyzed as a surrogate of vegetation recovery. Remotely sensed burn severity varied by vegetation class, with needle-leaf forest classes experiencing higher burn severity than broadleaf forest or broadleaf shrubland classes. Burn severity varied by cover within needle-leaf classes. Elevation also had an influence on burn severity, presumably as a result of there being less fuel above the treeline. Several large broadleaf areas at the fire perimeter appeared to act as fire breaks. A remotely sensed vegetation index peaked 8/14 years after the fire, and increase in the vegetation index was highest within the highest burn severity class. Self-replacement appeared to be the dominant successional pathway, with prefire needle-leaf forest classes mostly succeeding to needle-leaf woodland and with prefire broadleaf forest mostly succeeding to broadleaf shrubland. Because the remotely sensed indices were based on reflected solar radiation, they are likely indicative of surface properties, such as canopy destruction and surface charring, rather than subsurface properties, such as postfire depth of organic soil. We sampled 22 sites during July 2005 from the 1986 burn to test whether there was a correlation between spruce regeneration and 1986 dNBR. There was no relationship. This supports our hypothesis that subsurface properties such as postfire depth of organic soil, and subsequent regeneration of *Picea* versus *Betula*, is not related to the dNBR burn severity index.

Impact: The Normalize Burn Ratio is being applied routinely in Alaska National Parks and National Wildlife Refuges to generate burn severity maps. Our research shows that this index is strongly correlated with above ground burn severity metrics such as canopy mortality and percent of scorched and torched trees. However the index did not perform in non-forested sites such as scrub, herb, and woodland classes. The post-fire depth of organic duff or exposure of mineral soil is an important seedbed characteristic that can control the regeneration of broadleafs versus spruce. Our preliminary research (sample of 22 sites) shows there was no relationship between the Normalized Burn Ratio and tree regeneration 19 years after a wildfire. Burn severity maps generated based on the Normalized Burn Ratio may be useful for general characterization of over story conditions such as canopy mortality. However, post-fire duff depth information (unrelated to the Normalized Burn Ratio) is critical in estimating impacts such as soil erosion, regeneration of important moose browse such as Salix/Populus, and regeneration of highly flammable black spruce stands.

Source of Federal Funds McIntire-Stennis

Scope of Impact Multistate

Key Theme: Forest Ecosystems and Biological Conservation and Diversity

The Response of Forest Ecology and Growth to Climate Variability in Alaska: Patterns, Controls, and Strategies for Management

Accomplishments: **ALK-01-08**) Tree rings have been used to reconstruct past climate, to estimate current carbon uptake, and to project future uptake of carbon from the atmosphere into forest ecosystems. We examined the tree ring growth (representing the majority of above-ground carbon uptake) of 938 trees from 8 stands, including 4 species around the circumpolar north. In response to northern high latitude climate warming of the last several decades these dominant trees show opposing growth trends. As temperatures warmed, some trees in the sample accelerated in growth and some declined at the same time. This means that the predictive relationship of temperature for tree growth is not stable, but it changes depending on the actual temperatures. Opposite growth trends occur in trees collected from the same site. As a result, averaging the growth of all trees at a single site (building a site chronology) mixes trees with accelerating and decreasing growth in recent decades, which degrades the predictive relationship of temperature to tree growth. The scientific literature reports an overall decrease in temperature sensitivity of site chronologies over recent decades in the high-latitudes. This project has now partly explained this decreased response of site chronologies to temperature as a consequence of the shift in the growth response of the individual trees that make up the site chronology. We developed a new approach involving the identification of responder chronologies in which each trees individual response to warming is determined explicitly in advance and then trees are grouped into positive-responding, negative-responding, and non-responding populations. We found that temperature sensitivity (accuracy of the temperature prediction of growth) has actually increased for most individual trees at these sites. Averages of responder chronologies are not affected by the decrease in temperature sensitivity of recent decades seen in site chronologies. Growth trends of individual trees across the entire circumpolar tree ring sample were consistent from the year 1700 until the warming in the last decades of the 20th century. This is consistent with a previous finding in this project that the emergence of opposite growth trends is a consequence of high temperatures that have crossed ecological thresholds. The shift to negative responses may relate to microsite responses of individual trees to temperature-induced drought stress and other factors. During the 20th century daily high temperatures from 1 May to 31 August

in central and southcentral Alaska increased only weakly, and modest autumn cooling occurred. Overnight low temperatures have generally increased more than 3 degrees C (about 6 degrees F). The warming has been especially effective in lengthening the growing season length, ranging from 50% (to 120 days) at Fairbanks to 100% at Talkeetna (to 120 days). The longer growing season has increased seasonal evapotranspiration resulting in enhanced soil drying and lowering of the water table. Warming decreased tree growth rates on many sites, triggered insect defoliation, and caused widespread fires which all decrease (above-ground) organic inputs to soils.

Impact: This projects finding that divergent growth trends occur across treelines of northern high latitudes and that the relationship of tree growth to temperatures has changed in the last part of the 20th century helps resolve one of the major questions in the field of tree ring studies. Tree rings are the main source of information about past temperatures on a yearly basis before instrument records. If past temperatures are reconstructed by calibrating recent tree growth to temperatures without the correction for divergent growth trends, past temperatures could appear, falsely, as too cold and recent warming would be overestimated. The new technique of calculating responder chronologies developed as part of this project avoids this problem, allowing reconstruction of more accurate past temperatures and thus more accurately calculating the rate of recent warming. It appears very likely that additional temperatures increases will induce additional negative growth responses at specific temperature thresholds for additional tree species and populations/ If these threshold changes occur under temperature increases then future tree growth and carbon uptake using existing techniques would be calculated, falsely, as too great. This project has offered a solution to these problems by recommending a fundamental adjustment or refinement in tree ring technique for climate reconstruction by testing for and building responder chronologies instead of site chronologies.

Source of Federal Funds: McIntire-Stennis and NSF Funds

Scope of Impact: Alaska Specific

Key Theme: Forest Management and Harvest

Stream Temperature Response to Timber Harvest Activities in Interior Alaska

Accomplishments: **(ALK-99-06 Terminated)** A comprehensive annotated literature review was compiled on ice thickness and ice-bridges. A layered freeze-thaw model was developed to account for ice thickness changes associated with either the build-up of ice bridge surfaces or with the removal or compaction of snow. Model analysis and the literature review have helped make a general recommendation that water depth be greater than 2 m. for ice-bridge sites and that upwelling areas be avoided. Literature review, modeling work, and stream water temperature data indicate a strong association between air temperature and water temperature for mid-sized to large streams and a systematic increase in temperature longitudinally from headwaters to mouth for small streams exposed to direct solar radiation. The SNTMP and SSTEMP models were found to be potentially useful for energy balance and stream network simulations. Simpler models were also useful but needed modifications to accommodate high latitude effects on maximum sun angles and day length.

Impact: Information gained to date has contributed to the development and passage of revised riparian management standards for interior Alaska and influenced on-going discussions of standards for south-central Alaska. Information was provided to the Science & Technology Committee of the AKDNR-DOF for their review of Regions II and III riparian standards. Written

commentary was provided to the review committee for Region II, stressing that buffer design must consider that water in streams is moving and therefore is not subjected to constant conditions throughout the day or length of stream. The importance of the pre-harvest temperature signature of a stream as a reference for impact assessment was stressed. In addition, the lack of significant contribution of buffers starting far from the bank or vegetation providing shade only at low sun angles was noted. In addition to a workshop for forest, fish, and water managers, and contributing to two additional presentations, the PI has provided a critical review of a stream temperature-timber harvest analysis done in Washington State. Response to the latter review resulted in significant improvements in that groups results and the general utility of their research. Finally, the techniques and models developed in this project related to soil freezing and thawing, may contribute to the assessment of climate change effects, fire effects, and vehicle impact on tundra stability, by providing a tool that integrates changes in vegetation, snow depth, and air temperature.

Source of Federal Funds: McIntire-Stennis Funds

Scope of Impact: Alaska Specific

Evapotranspiration from Boreal Forest Landscapes in Interior Alaska (New Project)

Accomplishments: In the first six months of this new project to investigate the suitability of methods for estimating evapotranspiration from boreal forest landscapes I have assembled and reviewed considerable literature, begun an analysis of historic data on pan evaporation from Fairbanks, Alaska, collected 15-minute lake level data for the 2005 ice-free period on Harding Lake, assembled 50 years of historic hydrometeorological data as representative input to a lake water-balance model, and performed a preliminary monthly water-balance analysis of Harding Lake (interior Alaska) for the past 50 years. At this time evaporative loss during the ice free season explains most but not all of the current lake level decline. Net groundwater seepage loss must be occurring in order to explain historic patterns. Model calibration indicates the magnitude of net groundwater loss to be in the order of 30 mm/month. Initial field measurements of lake level decline under ice-cover, and therefore without evaporative loss, support this model estimate. Further measurements are scheduled through the winter of 2005-2006 to confirm. Detailed analysis of summer lake level data remains to be done and should allow a more accurate estimate of lake evaporation.

Impact: Harding Lake is a major highway-accessible recreational setting in interior Alaska. The level of water in this lake declined dramatically in the 1970s and again from the early 1990s until the present. A federal habitat restoration project was recently approved which involves a water diversion scheme scheduled to be implemented this Spring (2006). The data collected to date and the preliminary analysis have been shared with the State of Alaska Dept. of Natural Resources, the U.S. Natural Resources Conservation Service, and the Salcha-Delta Soil & Water Conservation District, in order to enhance the managers understanding of Harding Lakes hydrology, improve on the diversion structure design, and help provide estimates of how long it will take for the lake level to rise to the target elevation. Modeling results should also be useful to Alaska Dept. of Fish & Game who will manage the lake level for pike habitat after the diversion of water to the lake takes place. The context and data for this project supported the following undergraduate research projects: Hall, Cassidee. 2005. Assessment of Harding Lake level changes through hydrologic modeling. A Senior Thesis presented in partial fulfillment of the B.S. degree in Natural Resources Management. December, 2005. Ranft, Richard. 2005. Does Harding Lake have a surface outflow? A Senior Thesis presented in partial fulfillment of the B.S. degree in Natural Resources Man

Source of Federal Funds: McIntire-Stennis Funds

Scope of Impact: Alaska Specific

Key Theme: Multi-Resources Planning and Policy

Innovative Methods of Involving the Public in Environmental Decisions (New Project)

A major objective of this project involves the development of a survey instrument to evaluate the perceived success of a public participation process (Objective 3). I presented the draft survey to other researchers at the annual conference for the International Association for Public Participation (IAP2) in October 2005. The draft survey was well received and it soon became part of a larger discussion of how we evaluate public participation: how do we measure its effectiveness? It was exciting to find so many people struggling with the same question, but we were also frustrated with the many different approaches that were proposed. Twelve of us decided to form a research committee to try to develop a common yardstick for measuring effectiveness. The committee includes researchers from England, Scotland, Canada, Australia and many states in the U.S. We are meeting by teleconference once per month and discussing the literature on the topic, which ranges from public health to community psychology to urban planning and resource management journals. As a result of this discussion, I am conducting a review of this much broader literature to identify common themes as well as areas where approaches differ markedly. This will provide the basis for a review article as well as a more comprehensive survey instrument.

Impact: This project helps resource management agencies 1) determine when and how to involve the public; 2) obtain feedback on how their public involvement efforts are working; 3) improve the efficiency of their public involvement activities. There have been many requests for the Fire in Alaska bulletin. It will soon also be available on the Experiment Station's website. It discusses the minimal involvement of the public in fire management planning to date and explains why agencies need to increase their public involvement efforts at all levels of fire management planning. It also discusses techniques that agencies could use to make such involvement as efficient, collegial and productive as possible. As a result of my research in this area, my senior-level planning class was asked to facilitate the public meetings on what could be done to improve the Alaska Fire Service's response to large fires near urban areas. The students received many compliments from both the public and from the Alaska Fire Service who felt that the meetings went very well as a result of our involvement. This was a strong step toward improving relations between fire management agencies and the general public and it would not have been possible without the benefit of this project.

GOAL 5: Enhance Economic Opportunity and Quality of Life for Americans

Overview:

Alaskans need assistance in removing barriers that limit their success and enhance their economic wellbeing. Research, extension, and education opportunities provided by the School of Natural Resources and Agricultural Sciences, the Agricultural and Forestry Experiment Station, and the Cooperative Extension Service play an important role in consideration of specific economic development project and marketing strategies.

Expenditures:

| | |
|-------------------|----------|
| Hatch General: | \$44,425 |
| Hatch Multistate: | \$0 |
| McIntire-Stennis: | \$0 |
| State Matching: | \$27,397 |
| FTE (SY) | 0.7 |

PLANNED PROGRAMS

Key Theme: Development of Regional Economic Models for Rural Alaska

Impact Analysis for Alaska Natural Resources

Because of shifting needs and the diversity of rural economic markets, impact analyses addressed under this project have, by necessity, also shifted. We added the Alaska snow crab impact analysis in 2002 then scaled it back in 2003 after withdrawal of the processors. The Alaska snow crab fishery, and other crab fisheries of the Bering Sea and Aleutian Islands, will be managed through a transferable quota program, that includes a harvester quota and for the first time in a U.S. fishery, a processor quota. In addition, a regionalization program will be included that is intended to protect fishery dependent communities by placing constraints on where harvested crab can be processed. The ongoing crab management research program presented here is intended to contribute to evaluation of this important new fishery rationalization program.

Accomplishments: **(ALK-01-10, WCC 109)** This year the Impact Analysis for Alaska Natural Resources continued its examination of the Alaska crab fisheries. Research this year focused on the Alaska snow crab fishery. An international snow crab equilibrium market model was constructed during this year that examines the relationship between snow crab harvests, prices and revenues. Specifically, the model focuses on the inter-linkages between Canadian and Alaskan snow crab supplies on price formation in the two major wholesale markets, Japan and the United States, and exvessel (dockside) prices. The model was specifically constructed to document the exvessel and wholesale prices and revenue responses to market conditions and to document the pre-crab rationalization market performance of the Alaskan snow crab fishery on

the eve of the historic implementation of harvester and processor quotas. Simulated Alaska snow crab exvessel revenues initially increase as landings grow reach a peak of \$131 million at 176 million pounds and then decline with further expansion of landings and then sharply decline with further expansion of landings. The effect of recent substantial growth of Canadian landings to the Alaska snow crab industry were also estimated through model simulations of industry economic performance given current high Canadian landings and at past lower landing levels. For example, the simulated decrease in the 2002 price (the last year for which inventory data was available) due to Canadian snow crab harvest being increased from its 1989 to 2002 level, is \$0.25 per pound or a decrease in total exvessel revenue of \$8.2 million to the Alaska crab industry. Also, at the lower Canadian snow crab harvest level, the model simulates an Alaskan snow crab exvessel revenue curve that is maximized at \$184 million. This simulated Alaskan snow crab exvessel revenue maximum is \$52 million greater than that achieved when Canadian snow crab harvest is set to its actual 2002 level. An economic evaluation of the reindeer industry to the Seward Peninsula was also completed during this year. This project had been initiated several years prior as part of a broader Human Dimensions of the Arctic System, National Science Foundation project that provided an integrated socio-economic, ecological assessment of the reindeer. This industry, which has been an important part of the Alaska Seward Peninsula economy for over a century, has been overwhelmed by an influx of caribou onto the Seward Peninsula. The economic study focused on the affects that this caribou presence on the Seward Peninsula has had to the industry.

Impact: There are two critical questions of Alaska industry participants that the snow crab market model was used to address: (1) how do changes in the scale of the Alaska fishery affect prices at all levels and exvessel revenue? and, (2) how are Alaskan exvessel prices and revenues affected by the scale of the Canadian snow crab fishery? To answer the first question a total exvessel revenue curve was estimated through model simulations. An economic input-output model of the Seward Peninsula region was constructed in this study to analyze the modern reindeer industrys economic role in the regional economy prior to and following the reindeer-caribou interaction. Impact scenarios were used to estimate the effect of the caribou on the regional economy through decreased output from the reindeer industry. The model results show a significant economic loss to an economically depressed region with few development opportunities. Results show a per annum negative impact of \$1.4 million on the regional economy with 11 non-operational reindeer herds. If reindeer-caribou interactions lead to complete elimination of the commercial reindeer industry on the Seward Peninsula, study results show the region would incur a total negative economic impact of more than \$17 million.

Source of Federal Funds: Hatch General, Hatch Multistate

Scope of Impact: Multistate and Alaska Specific

Total Expenditures (All Goals)

| | |
|-------------------|-------------|
| Hatch General: | \$797,207 |
| Hatch Multistate: | \$139,668 |
| McIntire-Stennis: | \$519,046 |
| State Matching: | \$1,532,147 |
| FTE (SY): | 16.1 |

Stakeholder Input Process

The following actions have been taken since the inception of the AREERA requirements to seek stakeholder input and participation in the research planning process for projects funded by Hatch, Hatch Multistate, and McIntire-Stennis federal formula funds.

- In 2000, the SNRAS/AFES Board of Advisor with the cooperation of SNRAS/AFES faculty and students developed and made available on the SNRAS/AFES web site, a strategic planning survey to solicit stakeholder input from all Alaska citizens including traditional stakeholders and underserved populations. The results of that survey were published as an Experiment Station Bulletin and are available on request.
- An abbreviated version of the input survey was made available in hard copy at various stakeholder-attended meetings around the state in 2001, 2002, 2003, 2004, and 2005. These meetings were attended by the Director and/or Associate Director of the Agricultural and Forestry Experiment Station and other representatives of AFES to answer questions and take comments and recommendations. These included:
 - 1) Farm Bureau Annual Meeting November 18, 2004 (Attendance ~ 37)
 - 2) The 2003 Alaska Ag Symposium November 19-20, 2004 (Attendance ~95)
 - 3) Greenhouse and Nursery Conference January 26-27, 2005 (Attendance ~110)
 - 4) Potato and Vegetable Growers Conference March 16-17, 2005 (Attendance ~ 100+)
 - 5) Alaska Reindeer Herders Association Meeting March 9, 2005. (Attendance ~30)

In 2001, results of the surveys are presented to the SNRAS/AFES Board of Advisors for use in their program assessment and recommendation process and continue to be reported at semi-annual Board meetings. Board of Advisors meetings were held March 29-30, 2001, October 25-26, 2001, May 1-2, 2002, November 21-22, 2002, April 16, 2003, December 4-5, 2003, April, 2004, October 27-28, 2004, and January 6-7, 2005. As in previous years, the participation of the B of A in the stakeholder input process included gaining input from stakeholders that individual B of A members represent.

Results of stakeholder input processes are presented to SNRAS/AFES faculty annually. The new Strategic Plan (“Working for Alaskans: A Wealth of Knowledge”, Strategic Plan 2004) was adopted by the faculty and the Board of Advisors in 2003 and published in 2004. Copies are available on request.

We also initiated a process in 2004 to develop a Matanuska Experiment Farm (MEF) Master Plan. The UAF Chancellor appointed a committee consisting of faculty, selected administrators and two members representing the community. A draft of the academic plan was presented to and rejected by the committee in 2005 and will be further refined in 2006.

Program Review Process

All new and revised Hatch General and McIntire-Stennis project proposals within the Agricultural and Forestry Experiment Station undergo scientific peer review using Hatch and McIntire-Stennis Administrative Manual's Appendix F "Essentials of a Project Proposal". All proposals are submitted to the Director of the Agricultural and Forestry Experiment Station. The peer review panel is composed of a minimum of three members and is appointed by the Director. The panel consists of competent authorities in the discipline of the proposal or related disciplines and will include at least one authority from a supporting discipline. Each reviewer completes a Peer Review Form consisting of specific criteria, provides other comments and suggestions, and makes a recommendation to the Director. Reviews are returned to the Director for transmittal to the author(s) of the proposal. The author(s) review all comments and recommendations of the reviewers and make adjustments or explanations. The Director reviews all comments and recommendations from the reviewers as well as the revised proposal. The signature of the Director on Form AD 416 submitted to USDA-CSREES will indicate approval of the project by the Director and will certify that the proposal has been recommended by a majority of the Peer Review Panel.

Scientific peer review of multistate projects are carried out for individual projects under the aegis of the Western Association of Agricultural Experiment Station Directors' and the Western Cooperative Extension's Regional Coordinating and Implementation Committee (RCIC). The specific review process can be found under Appendix C of the Supplementary Guidelines for Western Multistate Research and Integrated Research/Extension/Teaching "Peer Review Guidelines: Performance Standards and Operational Guidelines for State Agricultural Experiment Stations". This can be found on-line at <http://www.colostate.edu/Orgs/WAAESD>. Additional access to the multistate review process is available on the NIMSS website (<http://www.nimss.umd.edu>) established by SAES Directors.

Evaluation of the Success of Multi and Joint Activities

Alaska participates in the following multistate research and coordinating committees:

W-1147: Managing Plant-Microbe Interactions in Soil to Promote Sustainable Agriculture

W-112: Reproductive Performance in Domestic Ruminants

W-192: Rural Communities and Public Lands in the West: Impacts and Alternatives

NC-218: Assessing Soil N Availability in Regional Corn Cropping Systems

4-NRSP/IR4: A National Agricultural Program to Clear Pest Control Agents for Minor Uses.

NCR –101: Controlled Environment Technology and Uses

WCC-021: Revegetation and Stabilization of Deteriorated and Altered Lands

WCC-093: Western Region Soil Survey and Inventory

W-112:

Among the underserved populations that may benefit from multistate research are the Alaska Native reindeer herders in remote villages. One study being performed under the aegis of W-112 is related to the reindeer cow estrous activity and the impact of presence of male reindeer in that cycle. Research of this type is unique to this region and would not have been initiated without our participation in W-112. This program is also an Integrated Activity with Cooperative Extension. The member scientist has a joint appointment with Cooperative Extension and through Integrated Multistate involvement he brings back information that is disseminated in one-on-one contacts as well as sharing the information with CES agents throughout Alaska. **Impacts:** Results obtained from research conducted by W-112 participants advances knowledge of basic mechanisms that regulate reproduction in domestic animals. This knowledge is requisite for development of new and modification of current methods for regulating and enhancing reproductive processes. Crucial to the sustainability of production systems for domestic ruminants are the use of feed resources, improved reproductive performance, and production of high quality products. Elucidation of mechanisms by which nutrition impacts reproduction is central towards optimizing feed resources and determining beneficial and detrimental impacts of nutrition on livestock and, potentially, humans. Advances in the knowledge of mechanisms that mediate puberty, estrous cycles, ovulation and pregnancy provide the basis for continued development and testing of regimes to control timing of, and improvement of, ovulation rates, conception rates and birth of viable offspring. Participants in W-112 published 76 refereed journal articles during the past reporting period, many of which were derived from collaborative efforts initiated through the W-112 Regional Research Project. Collaborative effort has also resulted in the publication of a “Handbook of Estrous Synchronization” on the world wide web (www.oardc.ohio-state.edu/estroussynch) Collaborative projects planned for the coming year are listed below.

W-1147

Participation in W-1147 (formerly W-147) continued in 2005. Through involvement with W-1147, resources and knowledge from multistate and multidisciplinary colleagues, Alaska has benefited many-fold over working alone. Biological control of soil borne plant pathogens has made large strides over the past several years. Much of this success is due to activities of the members of W-147. Today the EPA lists more than 24 commercial biocontrol agents that are registered and commercially available in North America. Nearly all of them have been registered during the past five to ten years. However, most of these products are for seed and seedling diseases. W-1147 project is unique in emphasizing biological control of root diseases of mature crops, including avocado, citrus, wheat, and turfgrass, which are generally not treatable with chemicals or other

methods. **Impacts:** Alaska: *Trichoderma atroviride* is a cold tolerant fungus that parasitizes a wide range of plant pathogenic fungi. *T. atroviride* is very robust. Results of compatibility studies show that *T. atroviride* growth is not adversely affected by high concentrations of heavy metals. *T. atroviride* was found efficacious against *Armillaria* root rot on fruit trees. No further dieback was found on trees treated with *T. atroviride*. Treated trees are significantly taller with thicker trunks, larger and greener leaves than the untreated control.

Alaska terminated their participation in W1147 in 2005.

W-192:

The New Mexico component of the ranch value study underway in several states has been submitted to JARE (in for 2nd review). Arizona is planning on conducting a ranch values study also similar to those done in New Mexico and Idaho. A number of regionally funded projects (through the Fire Science Program involving USDA and USDI) are underway. The existing GAMS ranch-level model is being enhanced for this additional work. The A to Z Retained Ownership program has now been operating for 13 years in Idaho. This program has benefitted ranchers who have participated by garnering additional profits. Economic impact analyses related to federal livestock grazing have been completed for Park County, Wyoming. The Bighorn National Forest plan was revised with the help of Taylor (Wyoming). Analyses of economic impact of livestock grazing, oil and natural gas development and production, and recreation on the economy of the surrounding region were completed for two Resource Management Areas in Wyoming (Casper and Kemmerer). PILT (Payment in Lieu of Taxes) fact sheets were developed for each county in Wyoming. In Oregon, work has begun on beef cattle management to improve riparian areas and ranch economics. Additional work has been completed regarding the evaluation of social and economic impacts of public land policy. An evaluation of the control of Cheatgrass in the sagebrush biome has also been initiated. Work in the area of risk management ("www.rightrisk.org) has been undertaken in Arizona. Finally, the relationship between recent state predator control efforts on federal lands and the Alaska National Interest Lands Conservation Act (ANILCA) and National Environmental Policy Act has been examined. Several procedural oversights have been identified. **Impacts:** Ranch-level models were developed and used for a variety of purposes including (a) animal distribution practices, (b) profit maximizing treatments of western juniper using stochastic cattle prices and rainfall patterns, and (c) used in the revision of three National Forest plans in northeastern Oregon in order to best meet ecological, economic, and social needs of the region and country. Results of the White Pine and Eureka (Nevada) county studies have been used by the BLM and county governments in their Resource Planning process, particularly in relation to water allocation issues. An examination of the predator control processes consistent with the Alaska National Interest Lands Conservation Act and the National Environmental Policy Act will allow federal land managers in Alaska to avoid legal challenges. The multi-period GAMS LP model developed as part of this project continues to be used for policy analysis by several western states, particularly with respect to livestock distribution on rangeland. The conclusion of the ranch value research in New Mexico has been that both deeded and public land acreage adds to ranchland value irrespective the livestock

grazing capacity and income earning potential of the land. Empirical evidence does not support the traditional cost capitalization model.

The W192 technical committee will submit a new proposal to the RCIC in 2006 entitled “Economic, Social, and Ecological Issues of Rangeland Fragmentation that Affect Rangeland and Rural Communities”. (W_TEMP 1781)

NC-218:

Results on the Illinois Soil Nitrogen Test (ISNT), based on estimating amino sugar nitrogen (AS-N) content was presented for the third year from ongoing NC-218 research projects. As from the previous years results, this year's result continues to question the value of the ISNT as a predictor of in season N availability. In a positive note, the ISNT continues to show a strong correlation with total soil organic matter (SOM) suggesting that total SOM or some fraction of SOM may be useful in developing a modified INST or new method to estimate specific field fertilizer nitrogen recommendations. Temporal variation in ISNT values continued to be inconsistent and show nonsignificant relationships to fertilizer nitrogen applications at both nonresponsive and responsive sites at all sites being examined by NC-218 investigators. The ability of the INST to predict economic response of corn to N fertilizer continued to be a major issue discussed. The NC-218 members are of the opinion that the test in its current state will not be useful as a predictive tool to address issues over application of fertilizer nitrogen. Results showing the relationship of the enzyme B-glucosaminidase (NAGase) activity to N mineralization continued to show a strong relationship. Studies on the effect of tillage systems and residue management continued to show the strong relationship between NAGase and N mineralization. The results prompted discussion by the group to hypothesize that the determination of specific fractions of soil organic matter may be useful to predict N mineralization. Analysis of the NC-218 mineralization test data set continued on a 72 site-year database evaluating the effectiveness of a suite of mineralization quick tests in estimating potentially mineralizable N (PMN) as determined by long-term aerobic incubation. Variation in extractable N and PMN was analyzed in relation to previous crop and site manure history. C mineralization showed a strong influence on N mineralization. These results confirm the notion that a specific fraction of SOM is controlling N mineralization. Results from three N response experiments showed that the PSNT had greater potential for predicting optimum N rates for corn than the ISNT. Results with archived samples from numerous N response experiments showed that the INST is not capable of predicting corn N requirements. The INST appears to measure a constant fraction of the N in soil organic matter rather than reflecting the amounts of readily mineralizable N in soils.

Impacts: Development of more accurate nitrogen fertility tests is critical to addressing the need to maintain high levels of production that is economical and environmentally acceptable. NC218 has provided strong leadership in proposing, developing and testing new methods to assess N fertility in soils. Each member through their individual state efforts have contributed a great deal of information to outreach efforts to address efficient fertilizer nitrogen application to maintain crop yield and prevent environmental degradation. We continue in our efforts to develop soil tests that make it possible to

identify soils that require additional N inputs to improve crop growth and soils that are non-responsive and should not have recommended levels fertilizer N applied.

Integrated Research and Extension Activities

Alaska submitted Form CSREES-Waiver requesting a waiver for FY2000 Integrated Activities from Hatch Act Funds. CSREES granted the waiver and approved our projected Integrated Activities for the 2001-2004 and 2005-2006. The form CSREES-REPT reporting Integrated Activities for 2005 is included here.

Agronomic Crops and Soils

Integrated activities continue to address best management practices for production of livestock feed crops, primarily forages and small grains as well as investigating turfgrass cultivars and management practices. AFES researchers and CES agents continued collaborative work at Delta Junction, Fairbanks, Palmer, and the Kenai Peninsula. From the AFES perspective, these projects include applied research investigating alternative forage and cereal grain varieties, effects of tillage, fertilizer, and cutting regimes on crop and soil quality. In cooperation with Extension agents in Fairbanks, Delta Junction and the Kenai Peninsula AFES researchers provided a database for producers to determine the economic viability for these crops. Outreach publications included “ Forage Crop Variety Trials in the Tanana Valley”, “Performance of Agronomic Crop Varieties in Alaska”, and “Interpreting Feed Analysis of Alaska Forage Crops”.

Potato and Vegetable Crops

In 2005, AFES researchers and CES counterparts carried out applied research, demonstration, and outreach activities primarily related to variety selection, disease control and management, and invasive weed control. Two project leaders with split appointments in AFES/CES at Palmer evaluated potatoes, lettuce, and cabbage varieties, potato and vegetable management trials, comparison of overhead and drip tape irrigation on vegetables, soil moisture monitoring in transplanted lettuce, and proposed hoop house evaluations. The Fairbanks field horticulture research included peonies field trials offer opportunities for Alaskan producers with a blooming period in July and August offer potential cut flower markets of \$70,000 per acre. The horticulture researchers at the Palmer Research and Extension Center and Fairbanks Research Center working closely with CES agents in Palmer, Anchorage, Soldotna, Fairbanks, and Delta Junction provide the core for this working group. This information is presented annually to CES/AFES jointly sponsored workshops including: The Greenhouse and Nursery Conference, the Potato and Vegetable Growers Conference, Ag Symposium, and the Delta Farm Forum.

Greenhouse Management/Nursery

Research and demonstration efforts at the Georgeson Botanical Gardens evaluated woody perennials, herbaceous perennials, annual flowers, herbs and vegetables for survival and productivity at northern latitudes. The latter had a high degree of volunteer and extension involvement. Outreach efforts have included one-on-one contacts with growers and the

public, presentations at CES workshops, master gardener program, and the annual CES/AFES Alaska Greenhouse and Nursery Conference, and lay publications including: “Annual Flower Plant Evaluations”, “Peonies for field cut flower production: Second year growth”, “Vegetable cultivar trials”, and “Culture profile: flowering poppy anemone”. Leveraged funds through USDA special grants included work involving AFES horticulture researchers and CES food testing center to extend University research on the cultivation of wild and domestic plants to individuals interested in developing value-added food products.

Reindeer Production

Reindeer producers on the Seward Peninsula want to enhance their operations by delivering a high-quality product from animals slaughtered outside the winter months. AFES scientists continued to carry out a number of research and demonstration projects in cooperation with the CES on the Seward Peninsula. These include seasonal variation in carcass quality of reindeer from the Seward Peninsula, reproduction and disease management, and range management and reindeer nutrition. Reindeer have great potential for value added products and through cooperative work with Cooperative Extension’s food development program, it is being evaluated for consumer acceptance. The Extension livestock specialist works with AFES researchers and other agencies (i.e. NRCS, AFG, and BIA), and the herders themselves and facilitates annual meetings and workshops.

Animal Reproduction

The joint research animal scientist/livestock position (CES, 51%; AFES, 49%) addressed reproductive performance of ruminant animals under the aegis of multistate research (W-112) which addresses both traditional and alternative animal species. Most of this research and outreach is accomplished on-farm, directly involving the local extension agents and the producers. In 2005, outreach activities included a series of workshops around Alaska, including the more rural areas of the state covering topics that include environmental physiology, animal diseases, herd health management, reproductive physiology, and livestock handling equipment. Other outreach activities included presentations at Delta Farm Forum, and the Agricultural Symposium and presented his research at the Kawerak Reindeer Herders meetings in Nome. He was Alaska’s representative to the USDA Small Farms Program, Alaska State Johnes Disease Detection and Management Committee, and Alaska Scrapie Disease Certification Committee. His project has become the cornerstone of our Integrated Activities in livestock with Cooperative Extension. It encompasses all the desirable elements of a multistate, integrated research and extension activities.

Soil Quality /Nutrient Management

No Integrated Activities reported in 2005.

Forest Production/Protection

Alaska Cooperative Extension Service has a single Forestry Specialist who works cooperatively with AFES researchers both in applied research, demonstration, and dissemination of information on issues related to growth and yield. The AFES forester working in the area of growth and yield has worked cooperatively with CES and State and Private forestry in cooperation with the state Division of Forestry and the U.S. Forest Service.

Community and Rural Development

AFES resource planning researcher cooperated with CES land resource specialists and are developing a database of planning cases in Alaska. A new Hatch project “Innovative Methods of Involving the Public in Environmental Decisions” will involve CES and outreach efforts. In 2004, a interdisciplinary team was established to develop alternatives for management of the Alagnak River based on prior and new public meetings and written comments. This plan was completed in 2005. The National Park Service will use the plan to guide the management and use of the popular river corridor. The AFES Natural Resources Economist continued work cooperatively with CES on the reindeer industry economic impact analysis. This industry, which has been an important part of the Alaska Seward Peninsula economy for over a century, has been overwhelmed by and influx of caribou into that area and this study and outreach effort will report that impact to native herder groups.

**U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results
Actual Expenditures of Federal Funding for Multistate Extension and Integrated
Activities**

(Attach Brief Summaries)

Fiscal Year: 2005

Select Interim
One: **Final**

Institution: University of Alaska Fairbanks

State: Alaska

| | Integrated Activities (Hatch) | % | Multistate Extension Activities (Smith-Lever) | % | Integrated Activities (Smith-Lever) |
|---------------------------------------|----------------------------------------------|---|------------------------------------------------------------------|---|----------------------------------------------------|
| <i>Established Target %</i> | 4.0 | % | 3.0 | % | 5.5 |
| <i>This FY Allocation (from 1088)</i> | 797,207 | | 982,178 | | 982,178 |
| <i>This FY Target Amount</i> | 31,888 | | 29,465 | | 54,020 |

**Title of Planned Program
Activity**

| | | | | | |
|------------------------------------|-------|--|--|--|--------|
| Agronomic Crops and Soils | 8,639 | | | | 12,484 |
| Potato and Vegetable Crops | 6,335 | | | | 12,507 |
| Greenhouse Management/Nursery | 8,043 | | | | 7,968 |
| Reindeer Production | 7,389 | | | | 7,835 |
| Animal Reproduction | 8,140 | | | | 7,905 |
| Forest Production/Protection | 1,944 | | | | 0 |
| Other Integrated Activity | 3,632 | | | | 11,179 |
| Community and Rural Development | 0 | | | | 266 |

**Title of Planned Program
Activity**

| | | | | | |
|--------------------------------------|-----------------|--|-----------------|--|-----------------|
| National Meetings/Conferences | | | 5,101 | | |
| Regional WQ Project | | | 3,292 | | |
| Western Region SARE | | | 1,740 | | |
| Western Public Policy Ed. Committee | | | 724 | | |
| National 4H | | | 2,294 | | |
| Small Farms Committee | | | 3,502 | | |
| Western Ext. Leadership Devel. Conf. | | | 626 | | |
| Western Regional PLC | | | 2,294 | | |
| WRPP Diagnostic Network | | | 4,122 | | |
| Western Region IPM Center | | | 8,920 | | |
| Western Forestry Ext. WEB Ed. | | | 1,181 | | |
| Total | \$44,122 | | \$33,796 | | \$60,144 |
| Carryover | 0 | | 0 | | 0 |

Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays represented here accurately reflect allowable expenditures of Federal funds only in satisfying AREERA requirements.

— **Director CES** **Date**

— **Director AFES** **Date**