

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Climate Change and Ecosystem Management

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources	10%		10%	
102	Soil, Plant, Water, Nutrient Relationships	0%		10%	
122	Management and Control of Forest and Range Fires	15%		10%	
123	Management and Sustainability of Forest Resources	50%		50%	
132	Weather and Climate	15%		0%	
605	Natural Resource and Environmental Economics	10%		10%	
903	Communication, Education, and Information Delivery	0%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	1.0	0.0	8.0	0.0
Actual Paid	0.7	0.0	5.2	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
39156	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
18311	0	32758	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
127758	0	704051	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and outreach strategies will include a database and data management system necessary for:

- Forest stand characterization of the Alaska boreal and coastal rain forest
- Long-term ecosystem monitoring and GIS modeling of the taiga forest dynamics
- Model predictive relationships between weather factors and growth of climate sensitive forest species in Alaska
- Remote sensing to investigate landscape level responses in response to burn severity within black spruce ecosystems in Alaska
- Land-based data sets to correlate animal distributions on the landscape with remote images
- Precipitation control on soil moisture and its effect on boreal forest growth and carbon balance
- Agricultural land characterization including soils and crop types
- Compilation of a database on agricultural production of crops and crop residues

High latitude soil research over the next five years will center on the following research topics and activities:

- Characterization of northern forest soils in boreal regions of Alaska in terms of the organic carbon pool and relationship with forest management practices
 - Soil carbon balance and nitrogen dynamics following disturbance by wildfire and logging
 - Soil respiration following wildfire in lowland black spruce, upland black spruce and mixed hardwoods
 - Evaluation of the relationship between local climate and soil carbon balance
- Research, education and outreach activities include:
- Land-based information correlation with remotely sensed images for forestry and agriculture
 - Geographic Information Systems
 - Maps and spatial data sets of long-term value
 - Climate change adaptation as it relates to communities

2. Brief description of the target audience

The target audience includes producers and consumers, communities and small business entrepreneurs, individuals and groups concerned about the quality of the Alaska environment, public resource agencies, public and private resource managers, other faculty and researchers, and undergraduate and graduate students. Our efforts will be directed toward environmentally and

economically sustainable development and conservation of our natural resources that will benefit all citizens and help them adapt and become resilient as the climate changes. Advisors and the target audience include: Alaska Board of Forestry, Society of American Foresters and the Alaska Northern Forest Cooperative. Specifically, this program will provide new information on soil properties and classification to the USDA Natural Resource Conservation Service, the USDA Forest Service, the Alaska Department of Natural Resources, borough governments and Alaska Native corporations. Information on the impact of fires on soil organic matter will assist the Department of Natural Resources Division of Forestry and private landowners and managers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	442	0	39	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2014
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	4	4

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Output 1. Soils research will concentrate on the classification of permafrost soils, soil carbon properties in relation to climate change and soil disturbance dynamics in upland and lowland forest ecosystems. Publications are output measures.

Year	Actual
2014	3

Output #2

Output Measure

- Output 2. Long-term forest productivity data sets will be converted to formats compatible with existing megadata systems for compatibility with long-term ecological research, fire management and forest disturbance dynamics. Outputs measured will be publications and data sets converted.

Year	Actual
2014	14

Output #3

Output Measure

- Output 3. Development of data sets providing information on wildlife and domestic (traditional and alternative) livestock impact on rangelands will continue. Output measures will be data sets developed and publications.
Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Output 4. Curricula that train future and present land managers in ecosystem stability and geospatial technology will be developed and implemented. Output measure will be curricula implemented.

Year	Actual
2014	2

Output #5

Output Measure

- Output 5. Research related to product development to include timber products and nontimber products including energy will continue. Forest management specific to fuel/energy demand will be initiated. Measurable outputs will be publications and business starts.

Year	Actual
2014	0

Output #6

Output Measure

- Output 6. Recreation opportunities are important in urban and rural forests and are a part of ecosystem services. Recreation management in northern ecosystems is a part of management of ecosystems research. Measurable outputs are publications.

Year	Actual
2014	2

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Outcome 1. Increase knowledge of arctic and subarctic soils and forest productivity among peer scientists, managers and governments. Knowledge outcome measures will be publications, conferences and workshops.
2	Outcome 2. Increase animal producer and wildlife manager knowledge on range use and animal impact. Measurable outcomes are publications, workshops and conferences.
3	Outcome 3. Increase knowledge through classroom and field course delivery. The outcome measures will be curricula delivered and number of students reached.
4	Outcome 4. Increase community and individual knowledge on the impact of climate change in northern ecosystems and effects on cultural lifeways, economies and individual well-being. Outcome measures will be publications, workshops and conferences.
5	Outcome 5. Provide research information that leads to product development and recreational opportunities. Outcome measures will be publications, business starts, conferences and workshops.
6	Outcome 6: Demonstrate effective collaboration between research and Extension to resolve issues.
7	Outcome 7: Increase knowledge of the impact of climate change in northern ecosystems that will affect economies and individual well-being. Outcome measures will be publications, workshops and conferences.

Outcome #1

1. Outcome Measures

Outcome 1. Increase knowledge of arctic and subarctic soils and forest productivity among peer scientists, managers and governments. Knowledge outcome measures will be publications, conferences and workshops.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Subarctic and Arctic climates are warming at a more rapid rate than climates in the lower 48 states. In Alaska, temperatures including both low air and soil temperatures are the most limiting factor to agronomic crops.

What has been done

In order to redefine soil temperature regimes and soil temperature classes in "Soil Taxonomy," which is necessary to better differentiate subarctic and arctic soils, climate parameters were collected from NOAA annual reports from 20 sites across the arctic and subarctic regions of Alaska. Two farms were visited in central Alaska to gather information about the farming history of the area and to assess soil quality after 30 years of land clearing.

Results

This research provides the mean monthly air temperature, mean annual air temperature, growing degree days, frost-free days, mean annual soil temperature, mean summer soil temperature, mean winter soil temperature, mean annual precipitation, annual snow depth, and mean July growing degree days based on 30 years of climatic records. This data will be important if air and soil temperatures continue to warm as projected. This could result in an increase in growing degree days as well as increase the diversity of crops that can be grown.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

Outcome #2

1. Outcome Measures

Outcome 2. Increase animal producer and wildlife manager knowledge on range use and animal impact. Measurable outcomes are publications, workshops and conferences.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Outcome 3. Increase knowledge through classroom and field course delivery. The outcome measures will be curricula delivered and number of students reached.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	44

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Field courses take UAF students beyond the textbook to delve into the grit, grime and glory of the world of Alaska's resources. Hands-on experiences enrich the learning process and create lasting impact on students.

What has been done

The Issues in High Latitude Management course covers over 1,000 road miles in 10 days, providing students better understanding of resources in Alaska and how they are managed from agriculture to fishing to mining and management of public lands. Speakers talk about their jobs and issues and controversies in their fields. The Permafrost Soils field course is also a 10-day trip that goes in the other direction, traveling from the boreal forest in Fairbanks north into the arctic tundra. It attracts students and researchers from national and international universities for the purpose of reviewing soil-forming factors of the subarctic and arctic regions of Alaska with a leading expert in northern soils.

Results

The impact of field courses is reflected in student evaluations and comments. Of the management course, one student said, "This was the best class I ever had. I recommend it to everyone. I wouldn't change a thing." Another stated, "Honestly, I didn't stop learning day and night for 10 days, not only about the environment but the people. I made a ton of friends." Of the soils course, one of the 31 visiting Chinese students said, "This was a rare opportunity. I learned so much from this journey. The professor's teaching was so good and I appreciate it so much. I hope more Chinese students will come."

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
123	Management and Sustainability of Forest Resources
132	Weather and Climate

Outcome #4

1. Outcome Measures

Outcome 4. Increase community and individual knowledge on the impact of climate change in northern ecosystems and effects on cultural lifeways, economies and individual well-being. Outcome measures will be publications, workshops and conferences.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	13

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Over the past 50 years, Alaska has warmed at more than twice the rate of the rest of the United States. Climate changes affect our residents in many ways. Changes in temperature and moisture can trigger changes such as sea level rise, modified patterns of storms, flooding or fire and changes to migration routes, breeding behavior or survival of fish and game. It is important that Alaskans become informed about potential changes due to climate change and to prepare for severe weather events.

What has been done

Agents have presented workshops on climate change and emergency preparedness and what to do after flooding in 13 communities, including communities affected by there Yukon River flooding in 2014 or threatened by flooding. Additionally, they met with local emergency planning representatives in two communities. Altogether, presentations reached 244 Alaskans, including 85 teenagers at camps and schools. Three publications were developed on responses to wind events, flooding, wildfires and tsunamis. An agent also coordinated events in Homer and Seward that emphasized community preparedness and prepared a "disaster cookout" to demonstrate food storage and preparation during a disaster.

Results

Alaskans received information about resources to respond to extreme weather events as a result of climate change and natural disasters. Resources were developed to make available to help communities respond in the case of future emergencies. Both enhanced citizen preparedness. Community emergency planning representatives were advised of resources.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
132	Weather and Climate
903	Communication, Education, and Information Delivery

Outcome #5

1. Outcome Measures

Outcome 5. Provide research information that leads to product development and recreational opportunities. Outcome measures will be publications, business starts, conferences and workshops.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #6

1. Outcome Measures

Outcome 6: Demonstrate effective collaboration between research and Extension to resolve issues.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The university chancellor called a forestry researcher and an Extension agent in for consultation about dying trees. Noting that the tops of trees were affected, they explained that warming temperatures were probably causing the trees to experience dieback. Most boreal trees lack the ability to function at high temperatures. Birch and white spruce are adapted to cold climate and become stressed when the temperature sizzles. Physiologically, boreal trees have a switch that turns off when it gets hot. The foresters suspected that last summer's record number of 80-degree and warmer days and below normal precipitation could have caused a caving in of the xylem in the trees.

What has been done

Birch trees get water to their upper crowns through evapotranspiration, a process in which molecules stick together in a column flowing through tube-like xylem cells. The force tugging the water column up from the soil through the tree and out into the air can be enormous, especially

on a hot day. Stressed trees can get substantial relief if extensive watering is done during times of excessive heat.

Results

This was an excellent opportunity to demonstrate to the campus AFES research and Extension in action. After consultation and diagnosis, the recommendation in this case was that the ailing 60- to 100-year-old birches needed to be cut down and replaced with Siberian fir, Siberian larch or Siberian pine, species that grow well in full sunlight at this latitude. Deep watering during warmer days was recommended to prevent early dieback in other trees on campus.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
123	Management and Sustainability of Forest Resources

Outcome #7

1. Outcome Measures

Outcome 7: Increase knowledge of the impact of climate change in northern ecosystems that will affect economies and individual well-being. Outcome measures will be publications, workshops and conferences.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	14

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Due to concern about the increasing demand for wood for firewood and pellet stoves and the slowing of the growth of the boreal forest, the State of Alaska has partnered with AFES researchers to reassess biomass potential in the boreal forest. The boreal forest is the largest biome in the world, with only six species of trees. One research site contains 8,600 acres. It is the site of the greatest concentration of forestry research in Alaska. The lowest rates of growth in 2,000 years are occurring in the Fairbanks area due to heat and dryness while in western Alaska trees are growing rapidly.

What has been done

Doctoral student Miho Morimoto studied the harvest activities and reforestation in the Fairbanks, Tok and Delta Junction areas by first thoroughly examining existing databases. She then sampled 27 harvest units to study regeneration over the long term comparing techniques and observing that scarification increased stem numbers.

Results

These findings will be used by the state Division of Forestry, which now has a better understanding of forest growth and will be able to create best management practices for a sustained yield program. Miho Morimoto will defend her Ph.D. thesis this spring.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Alaska is experiencing impacts of the changing climate in the degradation of sea ice, the ecology of the boreal forest and its ice-impregnated northern soils. This influences the focus of ecosystem management in coming years. Policy and regulation and competing public priorities affect land use and management of forests and rangelands. Programmatic challenges will occur as consideration is given to the management of the forests for fuels to mitigate demands on petroleum and coal supplies. A continuing rise in transportation costs is effecting regional and local management for energy and other local wood products. Finally, as demographics of the population change and the forest industry moves toward management with a specific product objective, as well as an objective of sustainable and resilient northern ecosystems, the demand for continuing adult education and higher education to fill workforce vacancies or new positions is increasing. In this program area, AFES has lost two faculty positions and anticipated retirements will not be replaced in the near future. This severely impacts research and education. Continuing budget cuts as a result of the reduction in oil revenues have also resulted in the loss of funding for faculty and staff salaries.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluations for research are conducted through peer reviewed publications, work load assessments and university oversight.

Key Items of Evaluation