

**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%	
	<b>Total</b>	100%		100%	

**V(C). Planned Program (Inputs)**

**1. Actual amount of FTE/SYs expended this Program**

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	1.0	0.0	10.0	0.0
Actual Paid Professional	1.1	0.0	9.2	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
59871	0	116732	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
41463	0	113985	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
267165	0	2150382	0

## V(D). Planned Program (Activity)

### 1. Brief description of the Activity

Research and outreach strategies produced or updated data base 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.
- Discovery of and complete 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 controls on soil moisture recharge and its effect on boreal forest growth and carbon balance.
- Agricultural land characterization including soils and crop types.
- Compilation of a data base on agricultural production of crops and crop residues.
- Cold soils classifications and monitoring

High latitude soil research centered 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.
- Soils characterization for agricultural crop production.

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 audiences include 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: Statewide Board of Advisors, CES Advisory Council, Alaska Board of Forestry, Society of American Foresters, Alaska Farm Bureau, and the Alaska Northern Forest Cooperative, USDA Natural Resource Conservation Service, the USDA Forest Service, the Alaska Department of Natural Resources, borough governments, and Alaska Native corporations. Information on 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?**

AFES/CES agent works on the multistate Cooperative eXtension Community of Practice on climate, forests and woodlands to write content

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	201	35000	0	0

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

**Patent Applications Submitted**

Year: 2013  
 Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
<b>Actual</b>	0	14	14

**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.

<b>Year</b>	<b>Actual</b>
2013	15

**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.

<b>Year</b>	<b>Actual</b>
2013	75

**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.

<b>Year</b>	<b>Actual</b>
2013	1

**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.

<b>Year</b>	<b>Actual</b>
2013	6

**Output #5**

**Output Measure**

- Output 5. Climate change will affect northern forest ecosystems that will impact economic development of communities and will have cultural implications as well on communities and individuals. Causes and effects of change on ecosystems and reverberations felt by communities and individuals will be investigated. The measured output will be publications.

<b>Year</b>	<b>Actual</b>
2013	0

**Output #6**

**Output Measure**

- Output 6. 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. Measureable outputs will be publications and business starts.

<b>Year</b>	<b>Actual</b>
2013	0

**Output #7**

**Output Measure**

- Output 7. 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.  
Not reporting on this Output for this Annual Report

**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: Increase environmental collaborations between K-12 teachers, students and university educators through outreach. Outcome measure is the number of students or educators who increased their knowledge through outreach.
7	Outcome 7: Increase knowledge and experience of future forestry professionals. Measure was number of attendees.
8	Outcome 8: Increase knowledge of boreal forest and its adaptability to climate change.

## **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**

<b>Year</b>	<b>Actual</b>
2013	4

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

As the Arctic warms, greenhouse gases, such as methane and carbon dioxide, are released from thawing permafrost faster and at significantly higher levels than previous estimates. Northern soils hold around 1,700 billion gigatons of organic carbon, around four times more than all the carbon ever emitted by modern human activity and twice as much as is now in the atmosphere, according to the latest estimate.

#### **What has been done**

Collaboration, between local, national and international scientists working with graduate students, is addressing the inclusion of missing information from current models to create a large-scale predictive model. By integrating data from previous models with expert predictions the authors will have a frame of reference for scientists studying all aspects of climate change. Permafrost thaw will release approximately the same amount of carbon as deforestation. However, the effect of thawing permafrost on climate will be 2.5 times greater because emissions include methane, a more powerful greenhouse gas than carbon dioxide.

#### **Results**

Due to the seriousness of the issue and the need for more research, the Vulnerability of Permafrost Carbon Research Coordination Network (RCN) was formed. It is a NSF-funded synthesis project that promotes collaborative research. Ninety scientists attended the last meeting and data collected during the annual 10-day field trip to the Arctic is helping inform data collections and publications.

### **4. Associated Knowledge Areas**

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<b>KA Code</b>	<b>Knowledge Area</b>
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- 122 Management and Control of Forest and Range Fires
- 123 Management and Sustainability of Forest Resources

## **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 Extension
- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

Encouraging connections between K-12 students, higher education students and researchers is proving to be an excellent method of engagement in the process of instilling a love for life-long learning.

#### **What has been done**

One of our Peace Corps Master's International students, with an engineering undergraduate degree, became involved in the birch sap OneTree Project. The student researched and applied the reverse osmosis process to increase the concentration of sugar in birch sap by reducing the water content of sap with a redesigned machine. Although now teaching in Egypt, before leaving the country two UAF engineering students were enlisted to upgrade the machine.

#### **Results**

For their practicum the engineering students will upgrade the design so that it will run on a continuous loop. Even though the equipment has to be restarted now, junior high students are using it as part of the STEAM/OneTree science and math project. This exciting project shows the value of collaboration between K-12 and university students and research, extension and education personnel.

#### 4. Associated Knowledge Areas

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

#### 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
- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2013	0

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

Scientists collecting data see a changing boreal forest ecosystem as climate warming impacts Alaska. The Long Term Ecological Research site at Bonanza Creek contains 8,600 acres. It is the site of the greatest concentration of forestry research in Alaska. The optimum forest growth period was from 1915 to the 1960s. Right now 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**

Forest plots throughout the state are sampled, aerial photographs taken and databases updated to monitor post-fire growth and environmental sensitivity to climate change including insect infestation. Baseline data is used by many scientists and much is accessible through the Long-Term Ecological Research Bonanza Creek website. <http://www.lter.uaf.edu/>.

## Results

Warm temperature anomalies are closely related to fire disturbance and white spruce reproduction, and to spruce bark beetle disturbance in Alaska. The main mode by which climate change may affect the forests of Alaska is not likely to be through effects on the existing generation of living trees, however severe they may be, but rather through effects on the next generation of forest vegetation that now is being assembled and sifted through various ecological processes. If climate-driven change continues, long before the new forest characteristics such as stem density, growth rates, and others confront managers and the public with forest change as an accomplished fact, it should be possible to detect, and thus plan for and adapt to a changing forest resource. This data is being used to inform managers and the public concerning changing forest characteristics such as stem density, growth rates and water stress enabling them to plan and adapt to changing forest resources.

## 4. Associated Knowledge Areas

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

## 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.

Not Reporting on this Outcome Measure

## Outcome #6

### 1. Outcome Measures

Outcome 6: Increase environmental collaborations between K-12 teachers, students and university educators through outreach. Outcome measure is the number of students or educators who increased their knowledge through outreach.

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2013	1016

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Hooking children on science through art is a natural offshoot of the OneTree Program. Art serves as the invitation to explore STEAM (science, technology, engineering, art and math) skills in a natural way. The hallmark of the work is active learning.

#### What has been done

BAKLAP funding leveraged by federal funds helped OneTree gather a talented pool of graduate students who work as service learners in the classrooms. The K-12 outreach program has been working with teachers since 2009 and has reached thousands of students. OneTree worked with students and teachers to plant 1,500 to 2,000 birch seedlings. Students not only grow and plant seedlings, they measure, count leaves, tap birch trees for sap for syrup and other products and create art and products based on the trees. It gives students a connection to the real world.

#### Results

This year 850 students participated from 8 schools, 16 K-12 teachers were trained from 12 schools and estimates from summer programs for children participating exceeds 150. The beauty of the program is its ability to reach teachers who love science and those who may be hesitant about teaching it but realize the value of it to their students. Four core instructional methods are integrative curriculum, K-12 professional development, peer teaching, and community collaborations.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

### Outcome #7

#### 1. Outcome Measures

Outcome 7: Increase knowledge and experience of future forestry professionals. Measure was number of attendees.

#### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

#### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2013	125

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Attracting higher education students to natural resource careers is increasingly difficult. The Forest Sports Festival provides a fun way to increase visibility as well as provide faculty, staff and students across UAF a very Alaskan way to get acquainted, compete or collaborate in forestry-related activities.

#### What has been done

Faculty members and students in the Department of Forest Sciences and BECRU, a cooperative between the USDA Forest Service PNW Research Station and the University of Alaska, developed the competition as a way to commemorate old-fashioned forest festivals. High technology tools are the norm for today's forest professions and the festival pays tribute to a time when traditional woods activities were the basis for work and play, and even survival.

#### Results

The 16th annual Farthest North Forest Sports Festival drew record numbers this fall with over 100 competitors, both at the Fairbanks Experiment Farm and Ballaine Lake. Competitions were held using lumberjack skills including log rolling, bow saw and crosscut sawing and ax throwing. Even though the weather was brisk in early October, birling (staying upright on a log in the lake) was the hilarious focus. The campfire building served two purposes warming those who fell in and providing a competition.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

#### Outcome #8

##### 1. Outcome Measures

Outcome 8: Increase knowledge of boreal forest and its adaptability to climate change.

##### 2. Associated Institution Types

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	5

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

The state and federally funded Boreal Alaska - Learning, Adaptation and Production project is being used to upgrade Alaska forest research and to assist in the development of management practices to improve the value of Alaska's forests in the face of a rapidly changing ecosystem.

**What has been done**

In the first field season, the scientist and graduate students measured, staked and tagged mainly white spruce and birch trees on 66 acres of remote boreal forest. Four state reports and 1 federal report have been submitted.

**Results**

The boreal forest is the largest forested biome on Earth and accounts for approximately one third of Earth's total forest area. In Alaska it occupies some 60-70% of the land area yet contains only six species of trees. Its condition directly impacts the climate of our state and nation. It is also a great source of wood for biomass. State legislators toured the research area and approved their investment. Now that the data is being collected and the forest measured, the Division of Forestry will have a better understanding of what is growing and will be able to create best management practices.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
122	Management and Control of Forest and Range Fires
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**

Due to university downsizing and low student numbers, several forestry research positions have not been replaced.

The production of oil has decreased and the revenues to the state have changed. Funding stream losses are negatively affecting higher education. Until revenues are replaced, research support through the state will be less than previously enjoyed.

Extension published a series of six climate change projections for different regions of Alaska, but the scientist was not funded with Smith-Lever dollars and so his work is not reflected in this report. Additional publications from him included tools for planners, online climate scenario tools and wildfires.

Alaskans, in large part, become involved in climate change adaptation only when changes directly impact their lives. As climate change impacts to Alaska's resources and infrastructure become more evident and directly impact Alaskans, there will be greater interest in CES climate change programs. AFES/CES forestry specialist is preparing to teach workshops to rural communities on climate change and how to assess future vulnerabilities and determine risk.

## **V(I). Planned Program (Evaluation Studies)**

### **Evaluation Results**

Evaluative results are in databases of participating researchers.

### **Key Items of Evaluation**