2014 Legislature TPS Report 61904v1

Agency: Department of Natural Resources

Project Title: **Project Type:** Planning and Research

BAK LAP: Upgrade Forest Research Installations for Wood Biomass Energy, Products, Science Education.

State Funding Requested: $700,000 **House District:** Fairbanks Areawide (1-5)
One-Time Need

Brief Project Description:

Boreal Alaska - Learning, Adaptation, Production (BAK LAP) - Updating state forest research installations to define best management practices to meet new forest product demands, particularly wood biomass energy. Concurrently implement Project OneTree Alaska for teaching K-12 math and science concepts by developing full-scale forest field facilities and project-based curriculum.

Funding Plan:

Total Project Cost:	$2,166,486
Funding Already Secured:	($1,466,486)
FY2015 State Funding Request:	($700,000)
Project Deficit:	$0

Funding Details:

FY 2013 $1,000,000 Capital Budget

Funding Details:

PHASE I - Establishment and initial survival: $488,454 ($395,454 State of Alaska capital appropriations in 1983, 84, 85, 86 and 90).

PHASE II - Survival and early growth: $200,000 (USGS revegetation scientist, 75% of time for 4 yrs).

PHASE III - Proof of concept: Relocation, georegistration, and canopy closure: $367,438 (USGS and UAF)

Detailed Project Description and Justification:

This is a proposal for a $700,000 capital appropriation from the Alaska Legislature to the Alaska Department of Natural Resources, Division of Forestry, to be contracted to the Agricultural and Forestry Experiment Station, University of Alaska Fairbanks. The purpose of the "Boreal Alaska Learning, Adaptation, and Production" (BAK LAP) project is to:

1.Upgrade Alaska forest research facilities, to improve the value of Alaska's forests in meeting the rapidly expanding demand for wood energy biomass in a changing environment, and to

2.Improve STEM teaching and learning outcomes by developing a model integrated K-12 curriculum based on hands-on experiences with the Alaskan boreal forest through inquiry science and art.

On September 20, 2013 the BAKLAP investigator team (Dr. Glenn Juday, Dr. Jan Dawe) conducted a 4 hour field investigation and report to the Alaska Interior Legislative delegation on project BAKLAP (see agenda -- Table FE X). At the end of the 2012 legislative session that funded BAKLAP at 60% of the requested amount, which represents the current appropriation of $1.0 mill. The legislators involved directed the BAKLAP proposers to conduct the project for a year and then

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$150,000 Approved

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report back for an evaluation of the project and the proposal for its completion. BAKLAP became fully operational in fall of 2012, so fall 2013 represented the 1-year milestone for reporting and evaluation.

Several legislators commented that the research being done and the data being collected would be extremely helpful in documenting to critical federal agencies Alaska is managing its forest resources in a responsible, beneficial, and sound scientific manner.

Project Description
BAK LAP will be carried out by two principal developments:
Updating and repurposing state forest research installations and establishing species trials. This upgrade will define and verify management techniques that best meet new forest product demands, particularly wood biomass energy, despite a shifting environment.

Integrating and implementing OneTree Alaska in K-12 classrooms and common garden trials. OneTree Alaska expands Alaska's K-12 standards-based science curriculum through collaborations among K-12 schools, the University of Alaska, and rural and urban communities with hands-on science learning and entrepreneurial skill development.

Research and Adaptation Facilities. The upgrades to state forest research installations will consist of new measurements, geo-referencing, permanent markings, and database development on a network of plots and stands previously established by state capital appropriations in the 1980s. The state of Alaska is principally responsible for providing these forestry facilities in boreal Alaska because the federal government terminated its main forestry research lab and program twenty years ago. Species and management practices that were appropriate for the circumstances of decades ago when the installations were established have not been verified for the new products and environment of today. Collecting these measurements and conducting evaluations will provide the basis for defining best management practices for the new products, especially biomass, in today's shifting environment. These facilities are essential to achieve local self-reliance in energy production using wood biomass and to avoid forest management practices likely to fail in Alaska's changing environment.

Education and Outreach Infrastructure. OneTree Alaska was originally designed as a short-term community outreach effort to demonstrate the diversity of products that could be produced from a single birch tree, and has become a much acclaimed partnership for teaching integrative K-12 curriculum. In OneTree Alaska, students learn by making products from forest resources and participating as citizen scientists in common garden (tests or trials of trees) research efforts.

The real-world experiences of working with trees and making products from them engages students and produces superior learning and retention of math and science skills, an area where Alaska educational outcomes are lagging. The demonstration phase of OneTree Alaska, which employs best educational practices for science and math, has generated a great deal of interest from communities, school districts, teachers and researchers. BAK LAP represents the next step in development of a full-scale set of facilities and project-based curriculum, aligned with federal and state science standards, and designed to meet 21st century workforce needs. BAK LAP was conceived as the perfect opportunity to address two critical state needs in one integrated project.

Budget

BAK LAP is a program to integrate researchers, educators, and forest managers with local forest using communities and biomass energy production. BAK LAP will be implemented in two components (1) Research and Adaptation (RAD) and (2)

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Education and Outreach (EOR). Both components involve direct interactions and linkages among schools, forest managers, and scientists. The BAK LAP program is based on a four-year time horizon. The budget is front-end loaded to rapidly identify best management practices from state forest research facilities for wood energy biomass and to broaden the impacts of OneTree Alaska's science education and entrepreneurial programs.

The appropriation to DNR will support a contract with the University of Alaska Fairbanks' (UAF) Agricultural and Forestry Experiment Station, which has a long history of establishing forest research facilities with DNR. The Experiment Station is responsible for data collection and analysis for a network of state forest research facilities including forest growth and yield, regeneration, and forest health. OneTree Alaska has been developed and implemented through UAF's School of Natural Resources and Agricultural Sciences and collaborations with numerous educators and volunteers. Once the state of Alaska funds the basic support for these facilities and measurements, a number of state priority needs will be met. In addition, this appropriation will establish a strong platform for obtaining larger, competitively funded education and research grants that will use and expand the basic work and facilities.

BAK LAP will be led by Dr. Glenn Juday (Professor of Forest Ecology UAF), who directed the successful Rosie Creek Fire Research project funded by a previous state capital appropriation in cooperation with DNR. The EOR and RAD components will be managed by Drs. Janice Dawe and Thomas A. Grant III, respectively. The BAK LAP appropriation request totals $700,000, approximately equally divided between the EOR and RAD components. As a contract with a state agency, state regulations provide for a 25% indirect cost recovery for UAF.

Personnel items include RAD work led by the Research and Adaptation Scientist and the following support staff: Forest Products Scientist, Tree Ring Specialist, two summer field technicians, and one graduate student in forest measurements.

The EOR work component includes a OneTree Alaska Program Director and the following support staff: Project Manager, two Lead Educators, and limited salary support for an Art Director, two Curriculum Development Co-Leads, Lead Trainer for summer teacher institute, and a Data Management Specialist. BAK LAP work will be performed on state-owned forest lands, in schools, and the University of Alaska Fairbanks. The travel budget provides support for on-site work at schools, collecting data at research facilities, meetings with state officials, and presenting results at scientific meetings. Services and supplies include classroom rental fees and insurance, research and tree measurement instruments, plot markers and aerial imagery,and hiring consultants with expertise in forest products.

Project Timeline:

Year 1 (FY 2013) - 40%
Year 2 (FY 2014) - 25%
Year 3 (FY 2015) - 25%
Year 4 (FY 2016) - 10%

Entity Responsible for the Ongoing Operation and Maintenance of this Project:

UAF, Alaska Division of Forestry, school districts

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Grant Recipient Contact Information:

Name:	Glenn Juday
Title:	Professor of Forest Ecology
Address:	4837 Palo Verde Avenue
	Fairbanks, Alaska 99709
Phone Number:	(907)479-3765
Email:	gpjuday@alaska.edu

Has this project been through a public review process at the local level and is it a community priority? ☐ Yes ☒ No

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ALASKA GATEWAY SCHOOL DISTRICT
P.O. BOX 226 TOK, AK 99780
907-883-5151 Fax: 907-883-5154
TODD POAGE, SUPERINTENDENT

February 3, 2012

Honorable Legislators
Alaska State Capitol
Juneau, AK 99801-1182

Dear Honorable Legislators,

I am writing this letter to ask for your support of UAF's Boreal Alaska – Learning, Adaptation, and Production (BAK LAP) capital proposal. This is an appropriation to DNR for work through the University of Alaska Fairbanks.

As the superintendent of the Alaska Gateway School District, I have witnessed the excitement and support for the installation of Tok School's woody biomass boiler. Heating Tok School with hazardous biomass from local forests has reduced operating costs and the possibility of nearby forest fires, which reduces potential fire fighting costs. Recently, the school district also began producing electricity by retrofitting the boiler to create steam and utilizing a low speed turbine. However, there are important questions about wood procurement and how much wood can be sustainably produced to keep facilities such as our operating over the long term.

The BAK LAP project is designed to show how to make state forest management sustainable while meeting the rapidly expanding demand for heat and electricity. Alaskans want to be responsible, independent citizens with local solutions to energy issues that promote the use of Alaska's forests. We need the answers that BAK LAP will provide thru this study. BAK LAP is also designed to teach students how to harvest and make forest products and work as citizen scientists in the forest. This hands-on approach makes school more relevant, improves learning, and makes the K-12 curriculum a better match to meet the needs of a 21st century workforce.

As an educator, I cannot overstate the importance of engaging children in relevant learning. The OneTree Alaska component of BAK LAP is a successful education and outreach program. It will be conducted as a key part of the forest research and management work to involve children in the use and oversight of our natural resources. BAK LAP will also produce a standards-based curriculum for teachers that include an institute offered during the summer. These curriculum and training activities are just the low-cost approaches that will assist schools in improving math and science programs and can be applied throughout the state.

I believe the BAK LAP program addresses high priority needs of the state: energy and education. The program takes the unique approach of integrating research with education to make it relevant and interesting for everyone. This collaborative approach to addressing high-energy costs and educational improvement are essential for our schools and should be funded by the state.

Respectfully,
Todd Poage
Todd Poage,
Superintendent

"THE GATEWAY TO LEARNING"

OneTree Alaska: STEM to STEAM
A K-20 Teacher-Scientist-Artist Community Partnership

Janice Dawe[1], Margo Klass[2], Zachary Meyers[3], Chris Pastro[4], Karen Stomberg[5]

OneTree Alaska's collaborative approach brings K-12 students and teachers together with scientists, professional artists, artisans, and government-based STEM professionals to investigate diverse aspects of the local boreal forest. Since the beginning of the project in summer 2009, program partners have developed four instructional methodologies: integrative K-12 curriculum, teacher professional development, peer teaching, and community collaborations. OneTree Alaska teachers find that introducing science and math concepts via STEAM (STEM plus Art) is highly effective in increasing student engagement and learning outcomes. As a community of learners, students, artists, and scientists have gained a deeper appreciation of the forest while working with local materials and making observations about the natural world. The project came to state legislators' attention following two art-science exhibitions in spring 2011 and the establishment of a long-term ecological monitoring (LTEM) site for citizen science training purposes that same year. Legislators funded the project as part of a three-year appropriation led by a university researcher investigating wood biomass energy on LTEM sites. The expanded teacher-scientist-community partnership, titled BAKLAP (Boreal Alaska: Learning, Adaptation, Production) advances an integrated program of empirical research, education, and outreach. As one of BAKLAP's first initiatives this spring, two courses are being offered: a K-12 teacher professional development course and a graduate student service-learning course. The two cohorts are beginning to meet monthly to discuss and plan activities that will take place throughout the year, implementing the OneTree philosophy both in- and outside the classroom. This partnership model spans multiple generations, helps develop youths' critical thinking skills, and fosters active youth//teacher/scientist/artist partnerships.

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[1] School of Natural Resources and Agricultural Sciences, University of Alaska Fairbanks, jcdawe@alaska.edu (poster presenter at ITSP Conference, Boston, February 15, 2013)

[2] Boreal House Art and Science Center, Fairbanks, Alaska

[3] School of Natural Resources and Agricultural Sciences, University of Alaska Fairbanks

[4] Fairbanks North Star Borough School District

[5] Fairbanks North Star Borough School District

OneTree Alaska: STEM to STEAM
A K-20 Teacher–Scientist–Artist Community Partnership

Making a field sketch during the STEAM Institute: Illustrated Botanical Books, a K-12 professional development course.

Dee teaching 6th-12th graders soil data collection in school district classrooms.

Participants in the STEAM Institute: Illustrated Botanical Books scan down the trail that inspired their book, TRAIL/TRAK.

Teacher and student build a birch tree model using one of the teaching kits developed in the UNSBSD Art Center.

K-12 teachers and graduate students plant seeds as part of the "From Seed to Tree" service learning course.

Using models of the original OneTree cores, 7th-8th graders learn about cross-dating and dendrochronology.

Boy Scouts plant birch saplings in the Generation OneTree Long-Term Ecological Monitoring plot.

Providing K-12 teachers opportunities to explore making books from birch materials.

Artwork created by teachers, scientists, and artists on display in the exhibit "Betula neoalaskana: Celebrating OneTree."

School of Natural Resources and Agricultural Sciences, University of Alaska Fairbanks
Project Dr. James Laney, Research Assistant Professor, Science Coordinator
February 5, 2015

TEACHERS

Place-based Education

STEAM (STEM + Art)
Integrative Curriculum Development

Interdisciplinary Professional Development

SCIENTISTS

Climate Change Research

Citizen Science Phenology Monitoring

"Boreal Alaska: Learning, Adaptation, Production" (BAKLAP)

ARTISTS

Art/Science Exhibitions

Art-making with Boreal Forest Resources

Artist Book Projects and Classes

John Coghill

Information Packet for Field Investigation of Project BAKLAP

(Boreal Alaska – Learning, Adaptation, and Production)

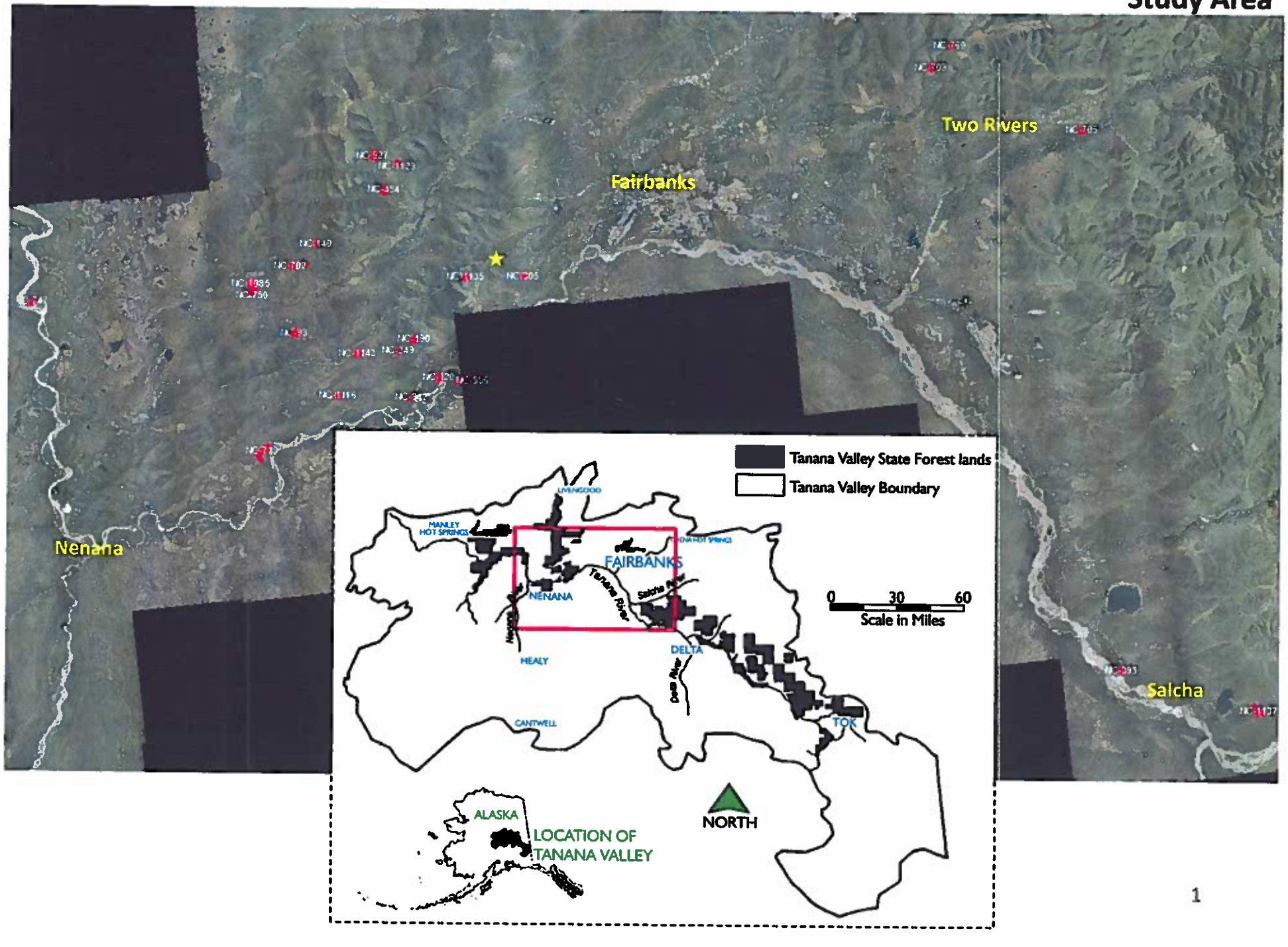
September 20, 2013

Glenn Juday, Professor of Forest Ecology, UAF School of Natural Resources and Agricultural Sciences (gpjuday@alaska.edu; 474-6717)

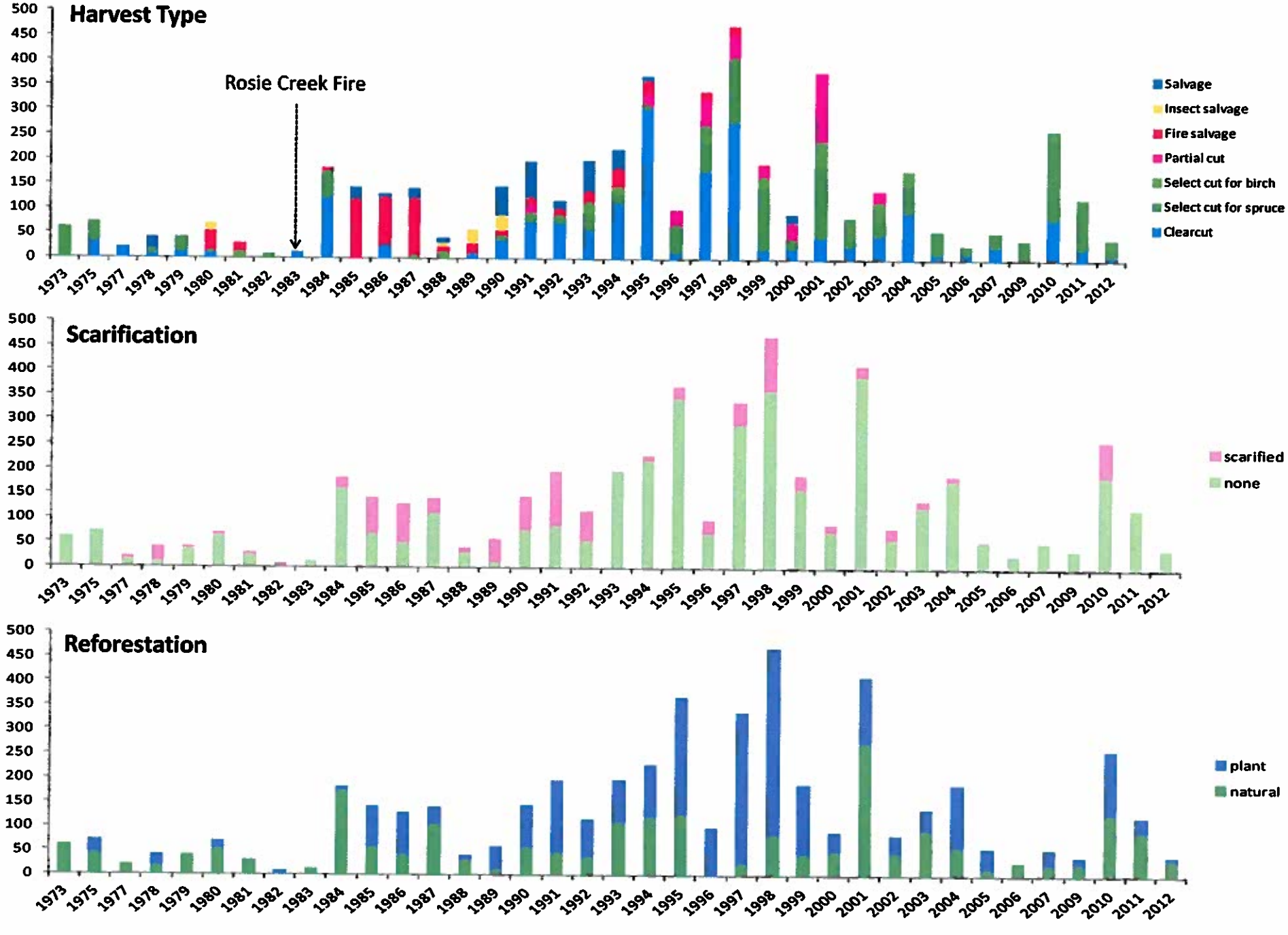
Miho Morimoto, Ph.D. Student, UAF School of Natural Resources and Agricultural Sciences (mmorimoto@alaska.edu)

Andrew Allaby, M.S. Student, UAF School of Natural Resources and Agricultural Sciences (aallaby@gmail.com)

Study Area


Two Rivers
Fairbanks
Nenana
Salcha
Tanana Valley State Forest lands
Tanana Valley Boundary
LIVENGOOD
MANLEY HOT SPRINGS
FAIRBANKS
NENANA
Tanana River
Salcha River
Nenana River
DELTA
HEALY
Delta River
CANTWELL
TOK
0 30 60
Scale in Miles
ALASKA
LOCATION OF TANANA VALLEY
NORTH

Transition of Harvest Area (ha) by Harvest, Scarification, and Reforestation Methods



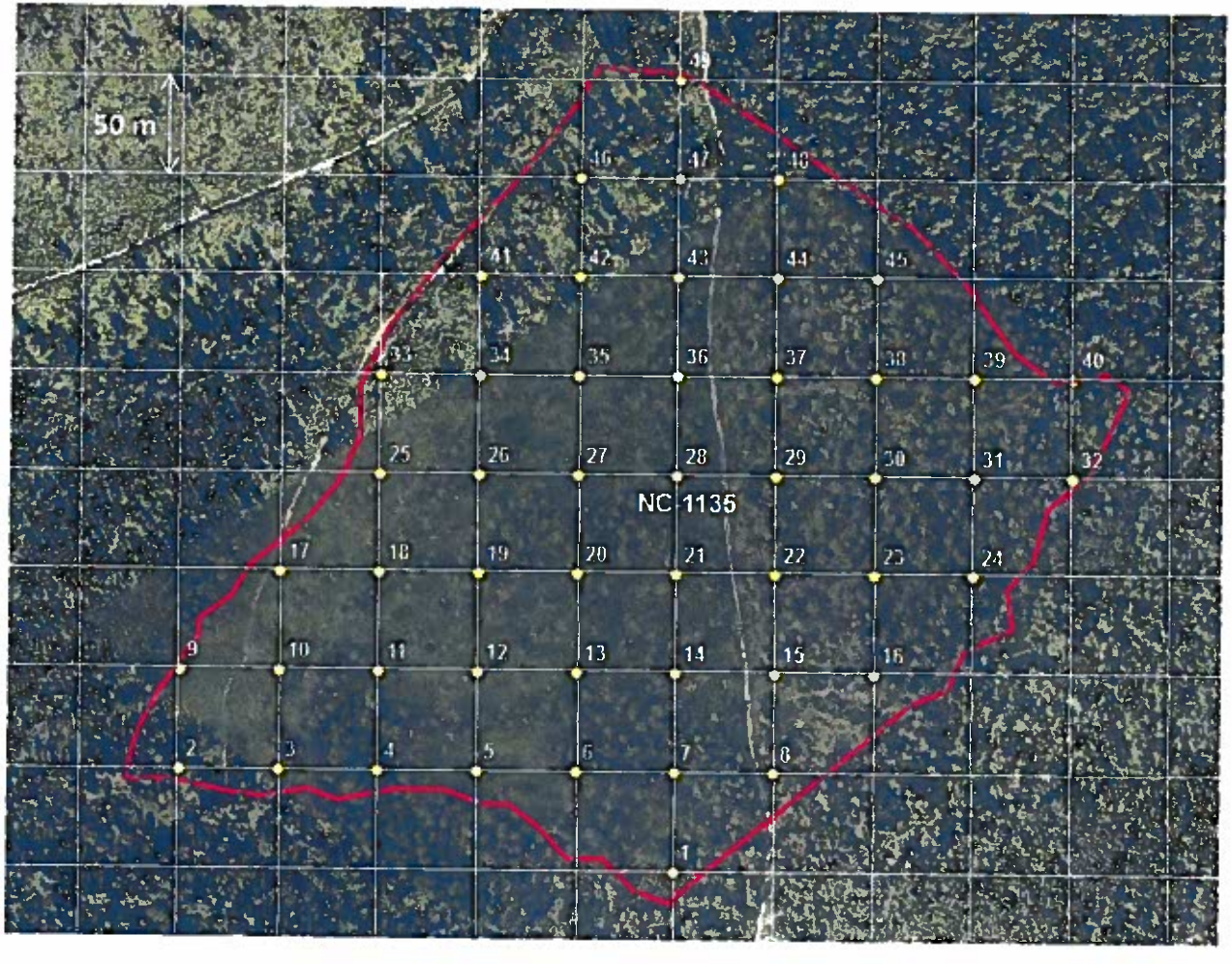
Sampling Units

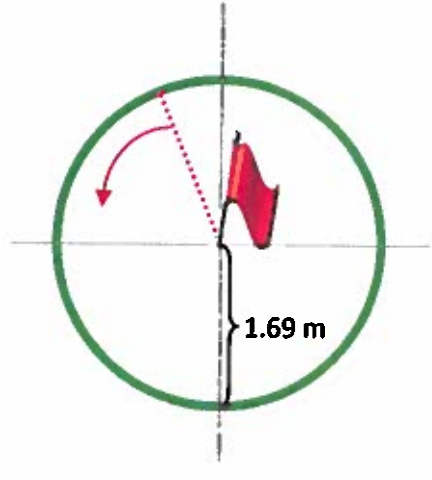
Unit	Location	# subplots	Adjusted # subplots[1]	Logged year	Harvest type	Scarification	Reforestation
NC-190	Bonanza ck	22	22	1977	clear cut	scarify	natural
NC-249	Bonanza ck	22	22	1980	clear cut	scarify	natural
NC-120	Bonanza ck	41	41	1975	partial cut	none	plant
NC-842	Bonanza ck	7	7	1992	partial cut	none	natural
NC-556	Bonanza ck	26	26	1986	clear cut	none	natural
NC-454	Cache Creek	87	44	1991	clear cut	scarify	plant
NC-927	Cache Creek	90	43	1998	partial cut	none	plant
NC-1129	Cache Creek	22	22	1999	partial cut	none	plant
NC-747	Nenana	31	31	1994	clear cut	none	plant
NC-733	Nenana Ridge	120	44	1992	clear cut	scarify	plant
NC-1116	Nenana Ridge	9	9	2003	clear cut	scarify	plant
NC-305	Rosie Creek	11	11	1987	partial cut	scarify	plant
NC-1035	Rosie Creek	49	49	2002	partial cut	none	plant
NC-279	Rosie Creek	21	21	1982	partial cut	scarify	plant
NC-93	Skinny	76	35	1975	clear cut	none	natural
NC-1143	Skinny	28	28	2004	partial cut	none	natural
NC-395	Ssalcha	21	21	1983	clear cut	none	natural
NC-740	Ssalcha	8	8	1991	clear cut	none	plant
NC-1137	Ssalcha	55	29	1997	partial cut	none	plant
NC-140	Standard ck	8	8	1979	clear cut	none	natural
NC-140	Standard ck	7	7	1982	clear cut	scarify	natural
NC-702	Standard ck	9	9	1993	clear cut	none	plant
NC-750	Standard ck	41	41	1995	clear cut	scarify	plant
NC-1085	Standard ck	94	47	1996	partial cut	scarify	plant
NC-1090	Standard ck	7	7	1999	partial cut	none	natural
NC-705	Two Rivers	44	44	1989	clear cut	scarify	plant
NC-709	Two Rivers	71	35	1991	partial cut	scarify	plant
NC-760	Two Rivers	13	13	1998	partial cut	none	natural
NC-368	Two Rivers	17	17	1983	clear cut	none	natural
NC-107	Two Rivers	20	20	1973	partial cut	none	natural

[1]in units calculated with more than 50 subplots, the number of subplots to be sampled was reduced to half

Grey = units visited but not sampled, NC-368 and NC-107 have not been logged, NC-279 was burned after harvest

Subplots Establishment

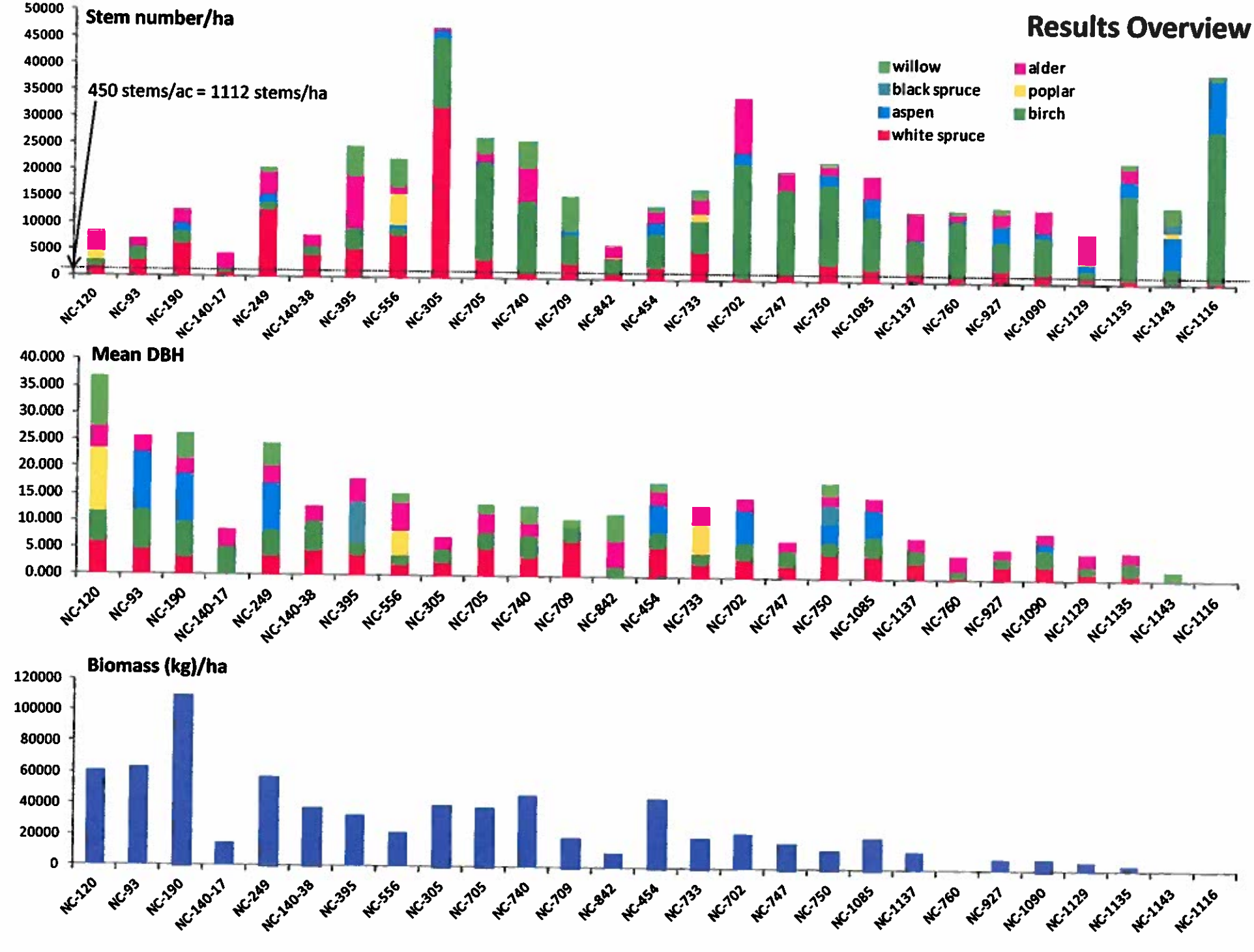




GRID

- Create 50 m × 50 m grid in the entire study area using fishnet tool in ArcGIS
- Export the coordinates of the points to Trimble Pro XT
- Every subplot will be sampled in units which have 50 subplots or less.
- Every 2nd or 3rd subplot will be sampled in units which have more than 50 subplots to sample more units.


NC-140
Clear cut 1979
No scarification
Natural regeneration
NC-249
Clear cut 1980
Scarification
Natural regeneration
NC-1085
Partial cut 1996
Scarification
Planted
NC-760
Partial cut 1998
No scarification
Natural regeneration


Results Overview
Stem number/ha
450 stems/ac = 1112 stems/ha
willow
alder
black spruce
poplar
aspen
birch
white spruce
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Mean DBH
40.000
35.000
30.000
25.000
20.000
15.000
10.000
5.000
0.000
Biomass (kg)/ha
120000
100000
80000
60000
40000
20000
0
NC-120
NC-93
NC-190
NC-140-17
NC-249
NC-140-38
NC-395
NC-556
NC-305
NC-705
NC-740
NC-709
NC-842
NC-454
NC-733
NC-702
NC-747
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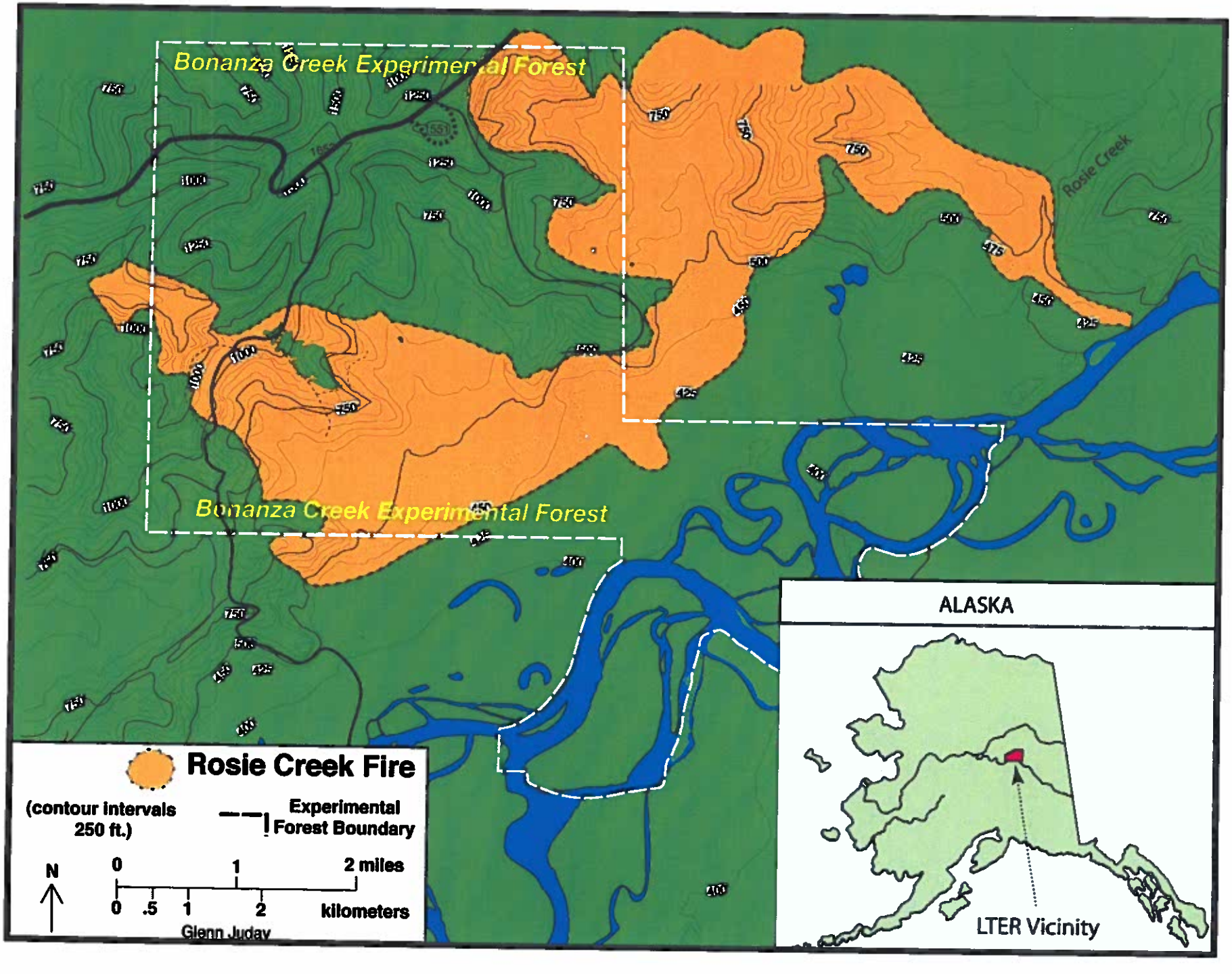
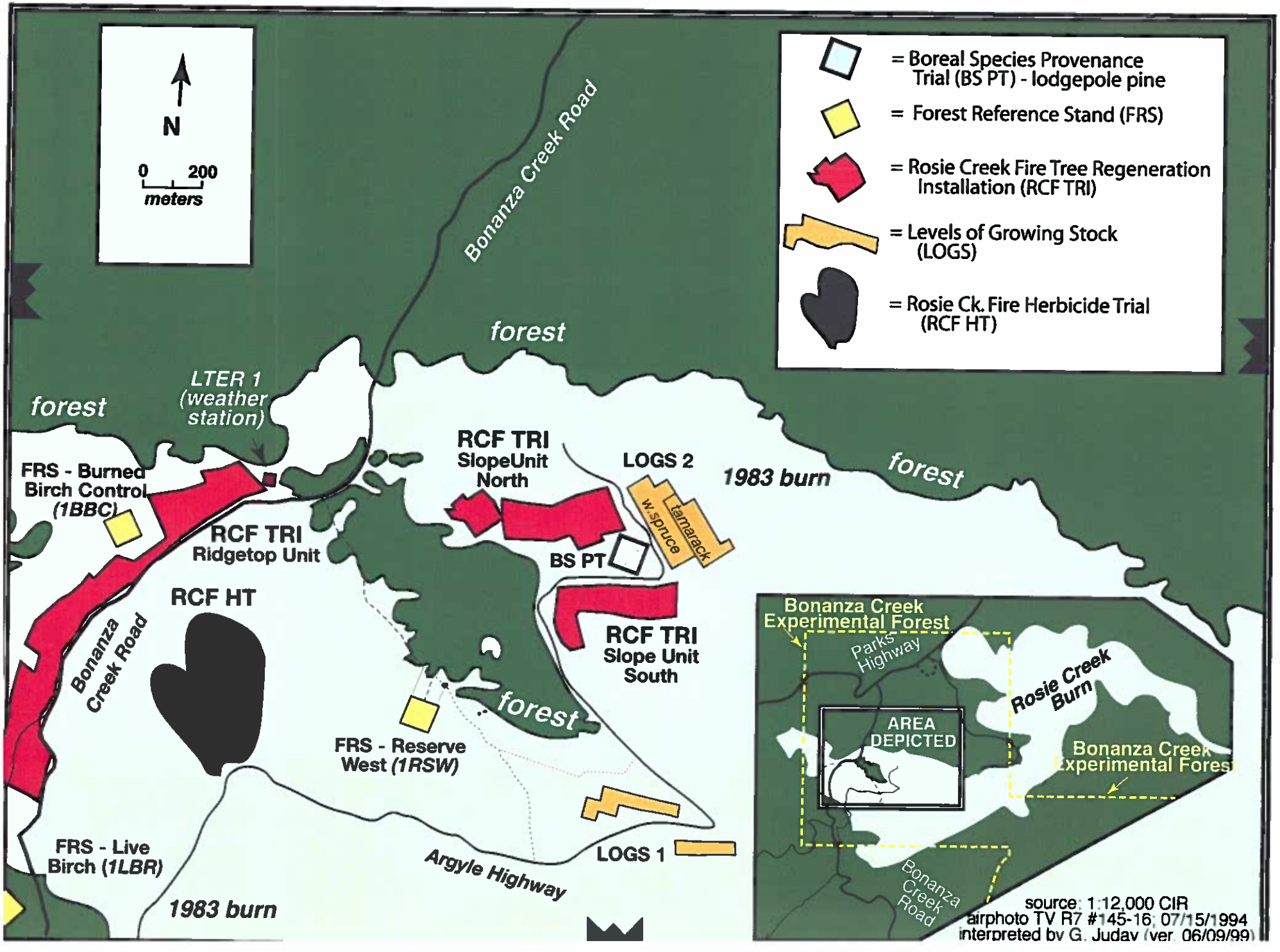
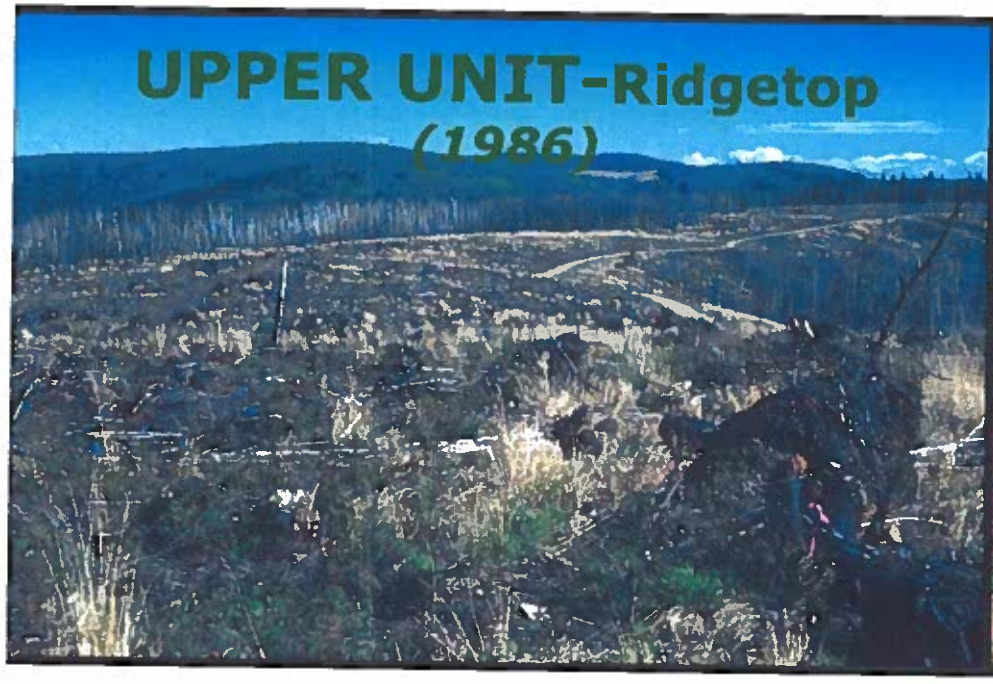
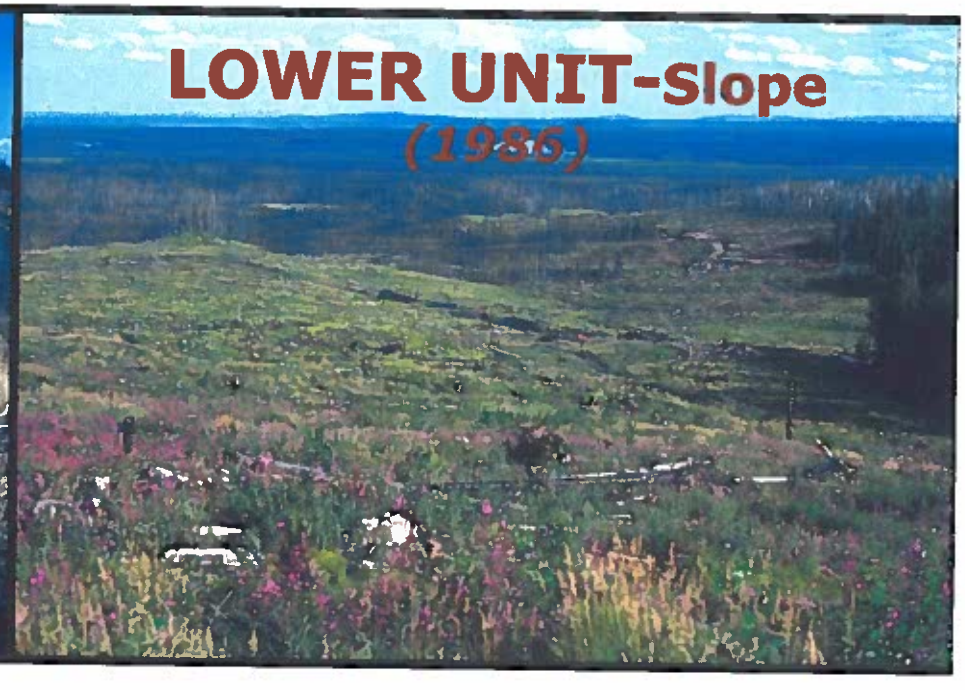
NC-1090
NC-1129
NC-1135
NC-1143
NC-1116


Bonanza Creek Experimental Forest
Bonanza Creek Experimental Forest
Rosie Creek
Rosie Creek Fire
(contour intervals 250 ft.)
Experimental Forest Boundary
N
0 1 2 miles
0 .5 1 2 kilometers
Glenn Juday
ALASKA
LTER Vicinity

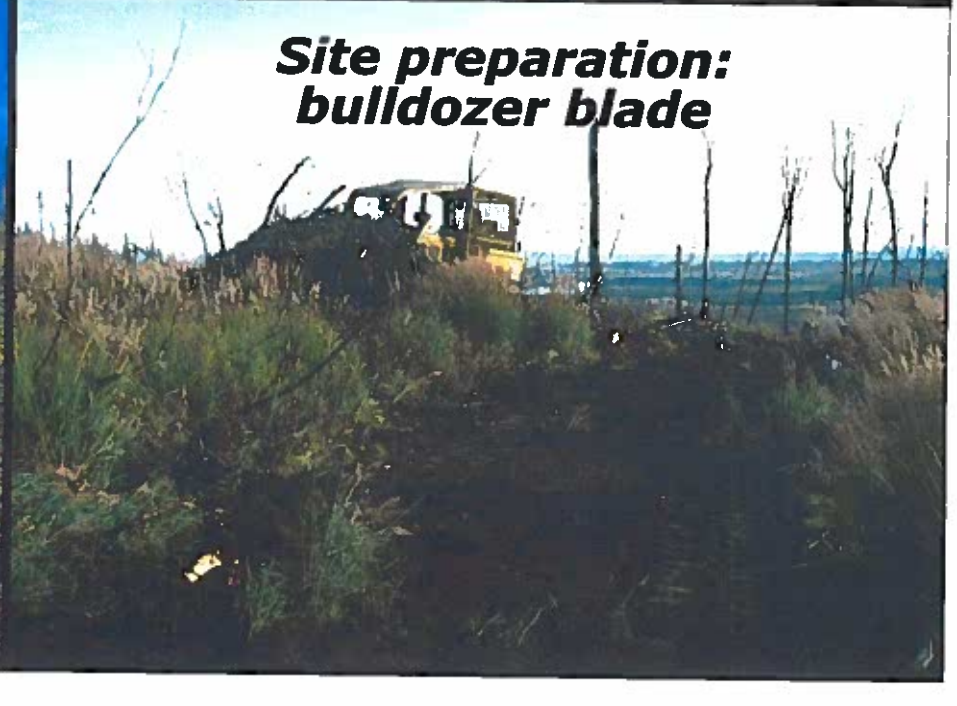
Location of some Legacy Adaptation Forest Management Research Installations in central Bonanza Creek Experimental Forest



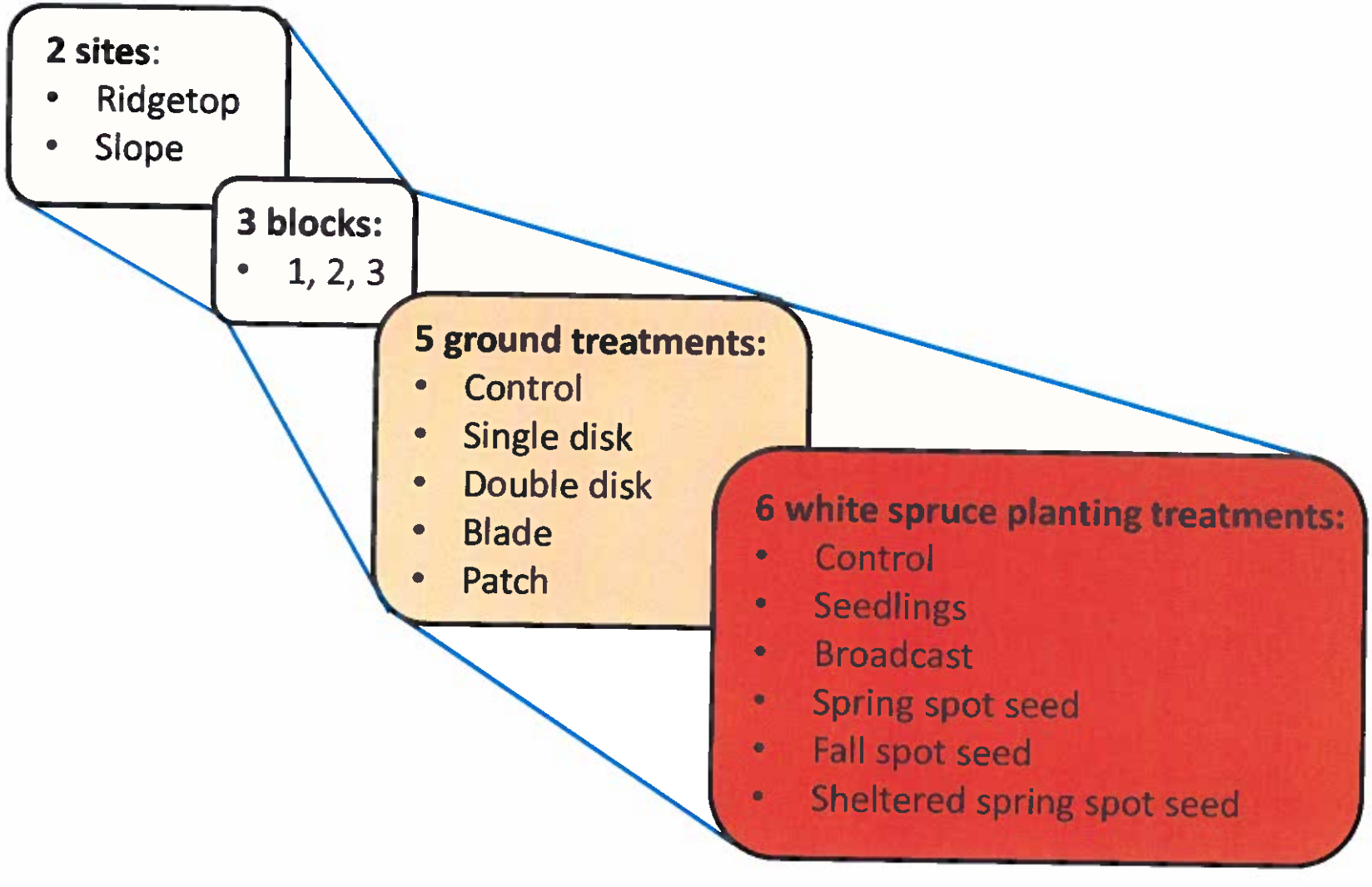

UPPER UNIT-Ridgetop
(1986)


LOWER UNIT-Slope
(1986)


Site preparation:
Disk trencher scarifier

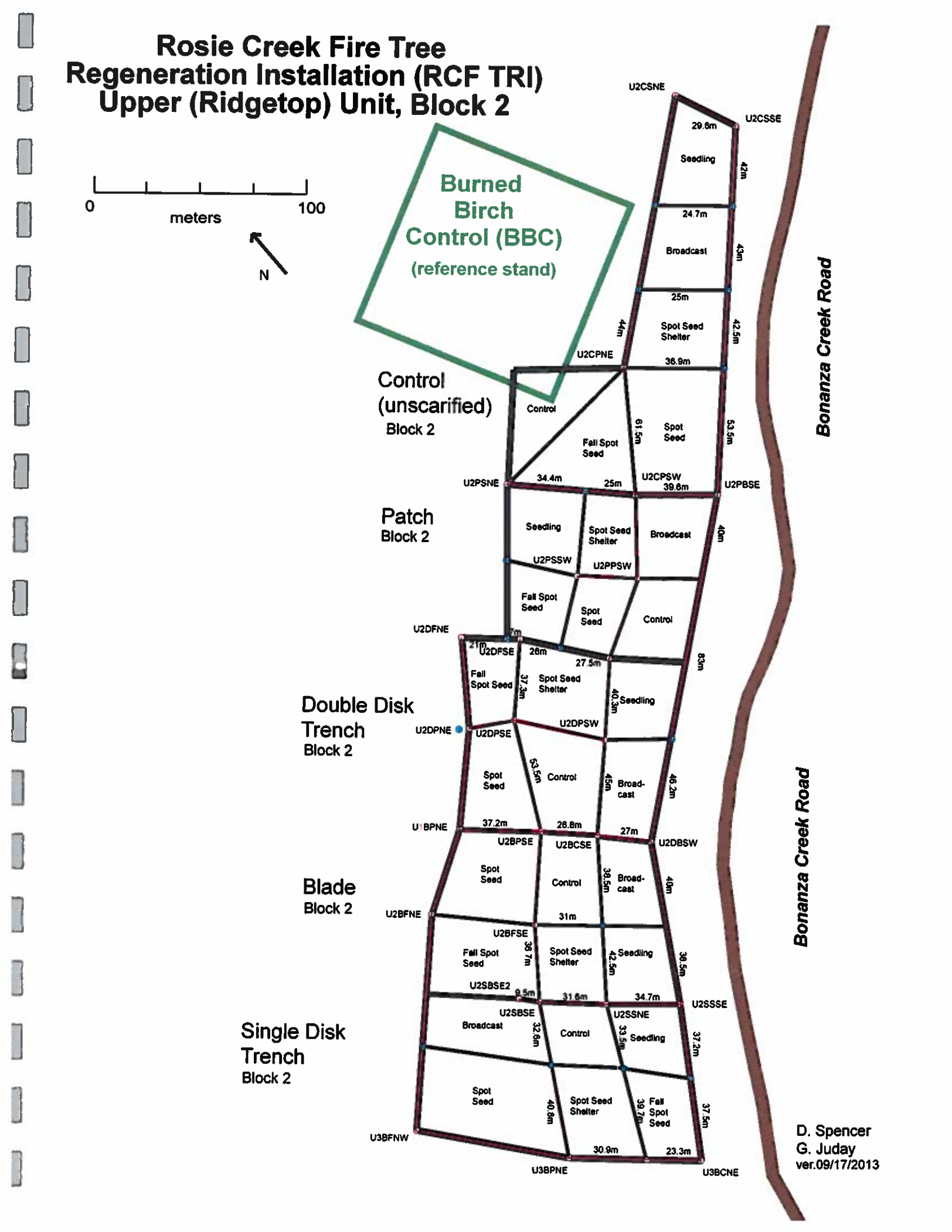

Site preparation:
bulldozer blade

Rosie Creek Fire Tree Regeneration Installation (RCF TRI)

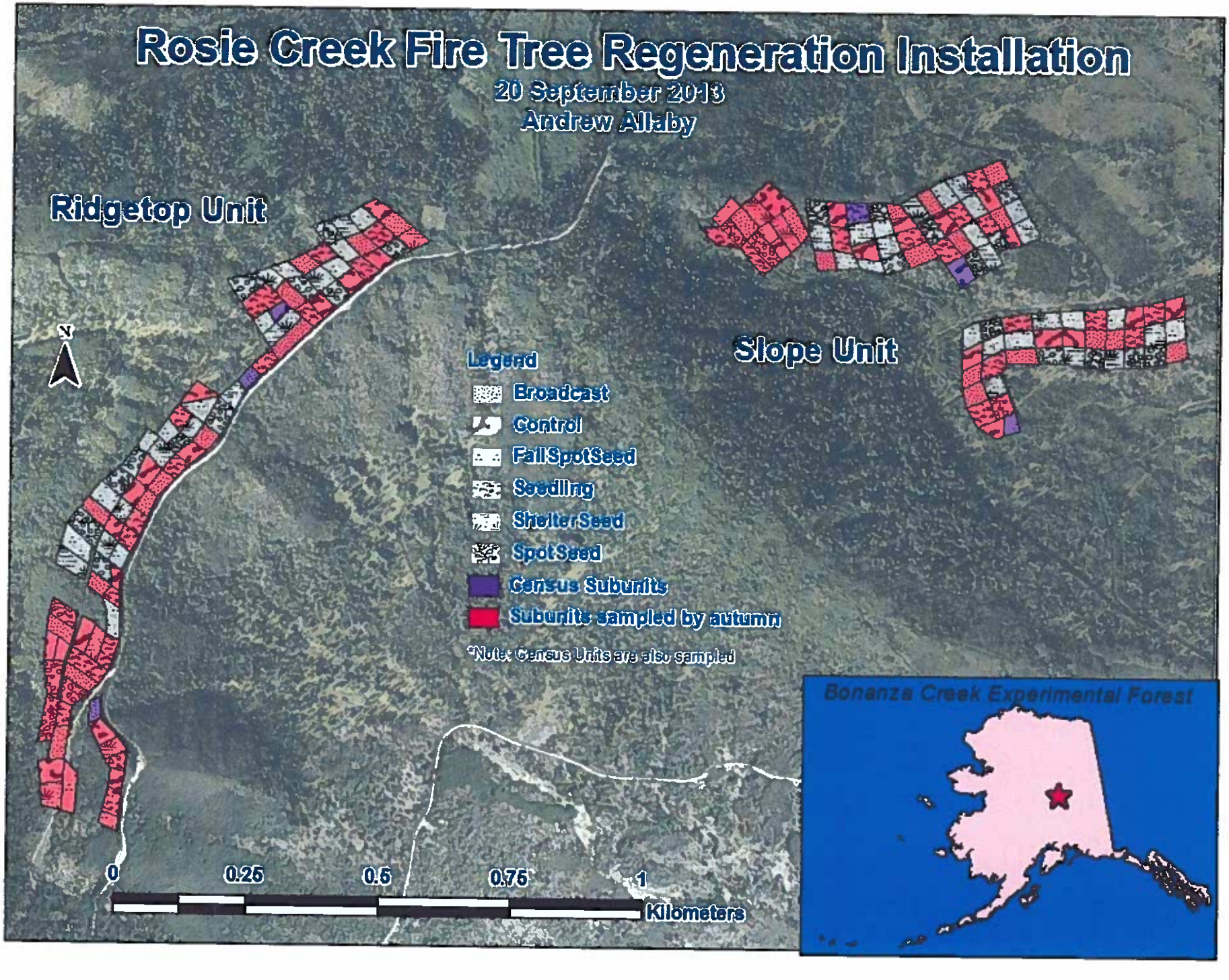


2 sites x 3 blocks x 5 ground x 6 planting = 180 subunits over 26.7 hectares (66 ac)

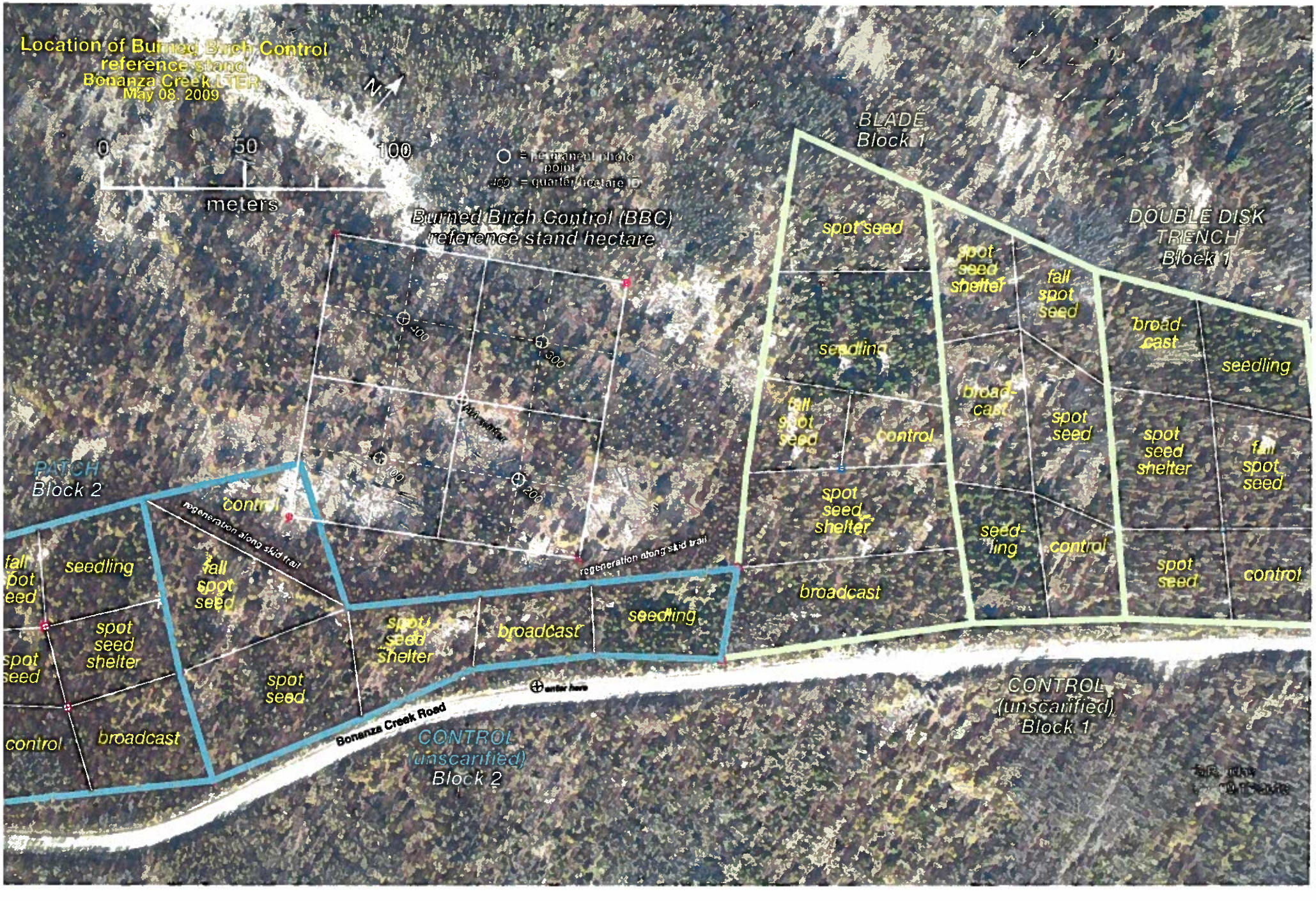
Rosie Creek Fire Tree Regeneration Installation (RCF TRI) Upper (Ridgetop) Unit, Block 2



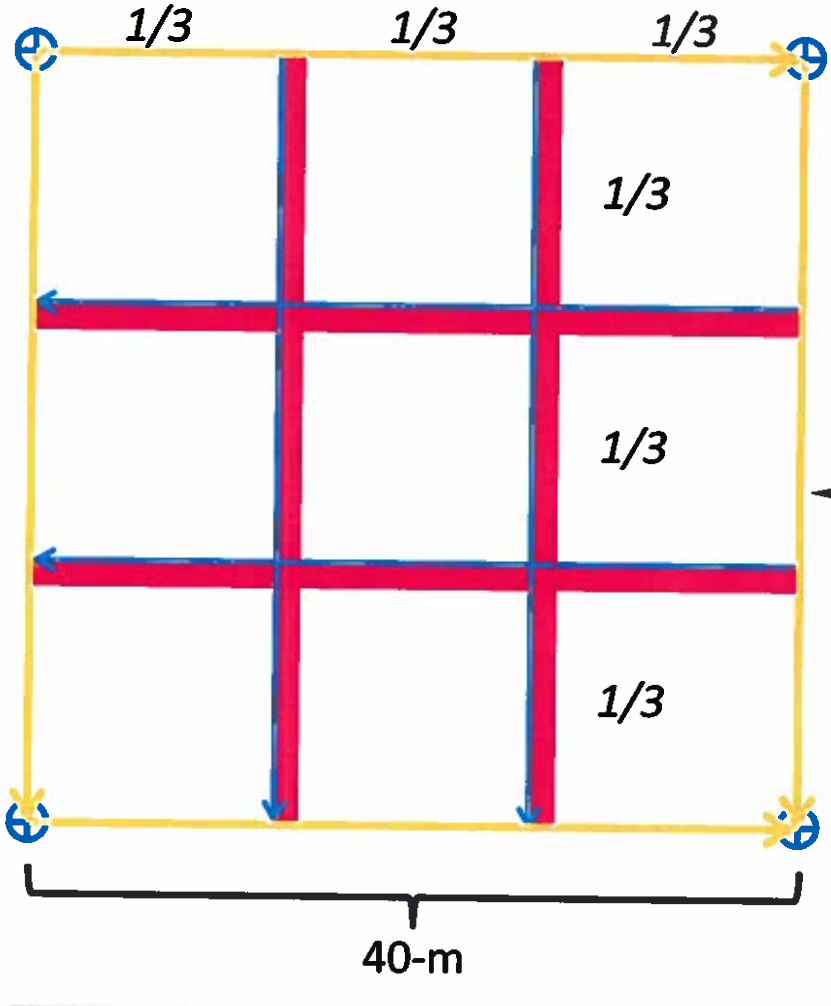
D. Spencer
G. Juday
ver.09/17/2013

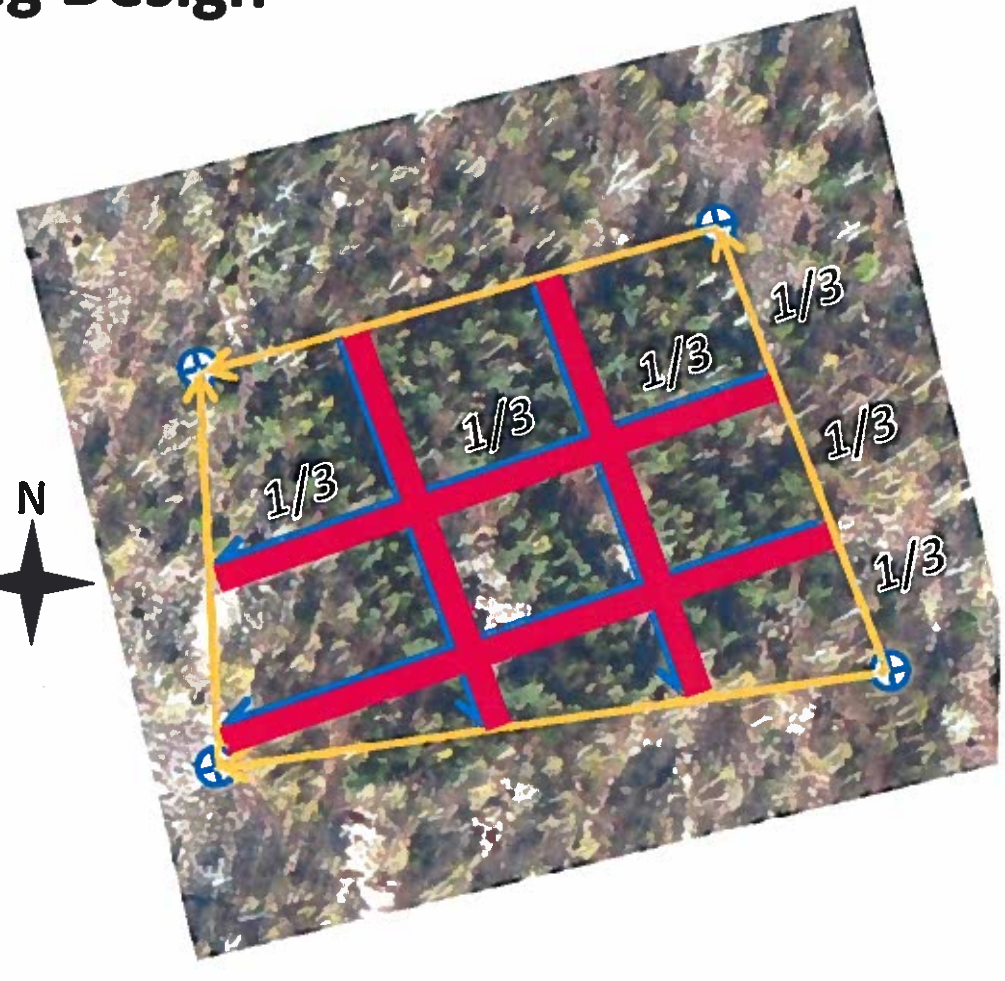

Rosie Creek Fire Tree Regeneration Installation
20 September 2013
Andrew Allaby
Ridgetop Unit
Slope Unit
N
Legend
Broadcast
Control
FallSpotSeed
Seedling
ShelterSeed
SpotSeed
Census Suburits
Suburits sampled by autumn
*Note: Census Units are also sampled
0
0.25
0.5
0.75
1
Kilometers
Bonanza Creek Experimental Forest

Location and layout of Rosie Creek Fire Tree Regeneration Installation (RCF TRI) (Blocks 1 and 2, Ridgetop Unit) and Burned Birch Control reference stand



Sampling Design





16,051 trees measured

17,432.5 meters^2 (4.3 acres)

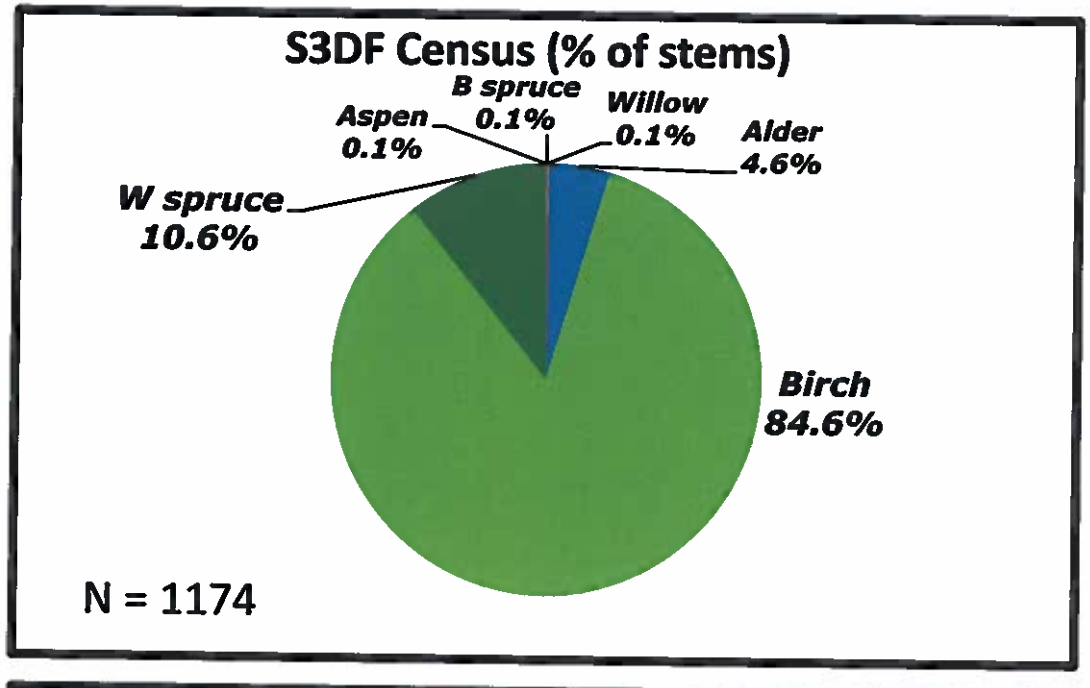
Corner Post

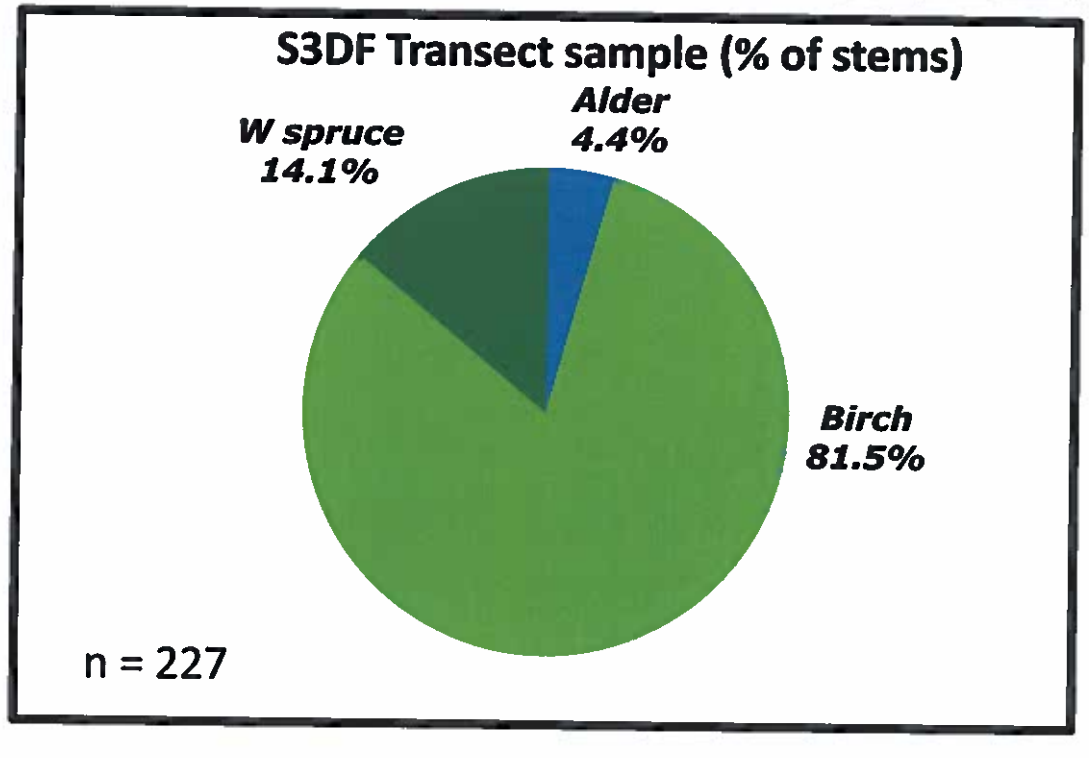
Boundary Line

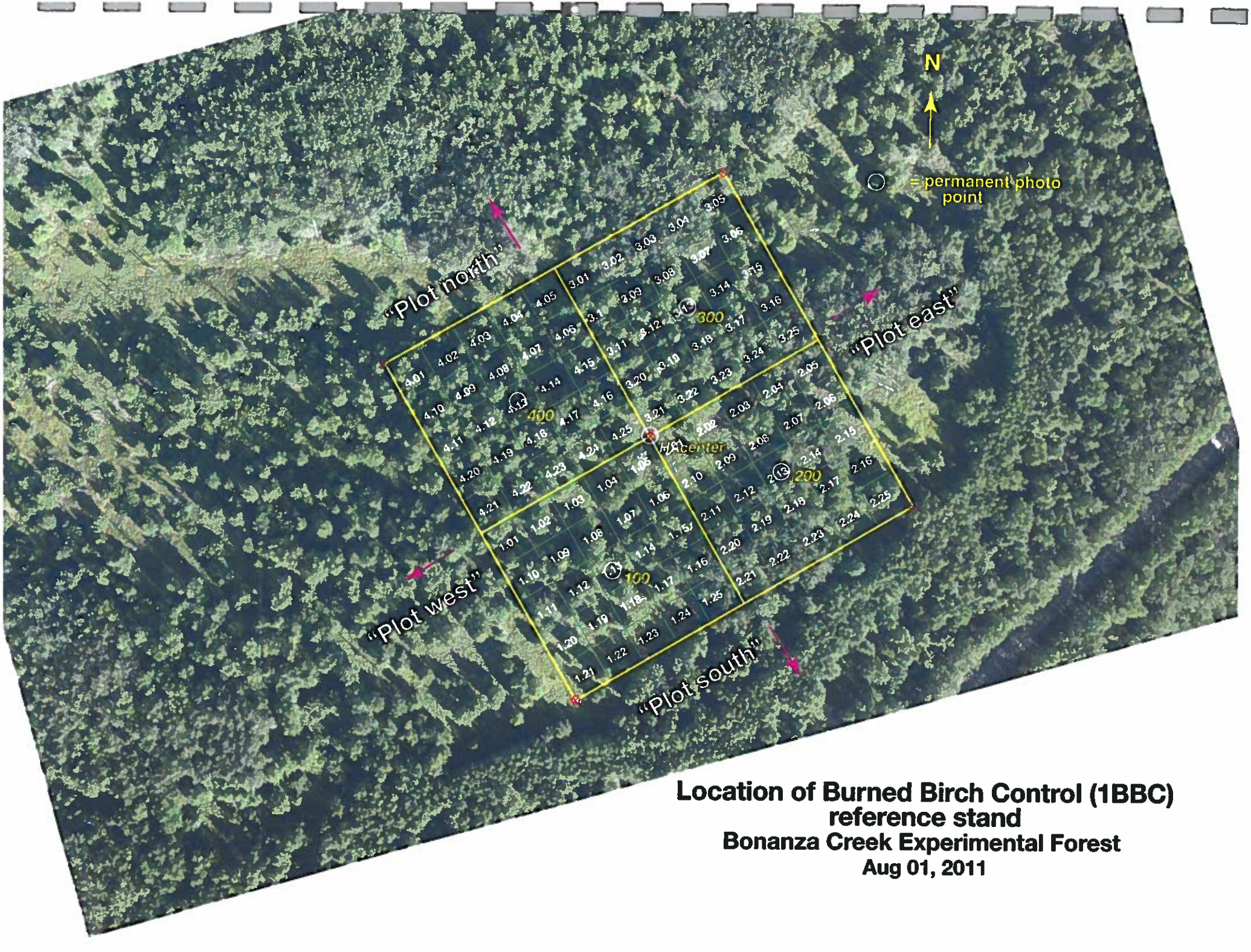
Transect Line

1-m Belt Transect

(not shown to scale)


S3DF Census (% of stems)
B spruce
0.1%
Willow
0.1%
Aspen
0.1%
Alder
4.6%
W spruce
10.6%
Birch
84.6%
N = 1174


S3DF Transect sample (% of stems)
Alder
4.4%
W spruce
14.1%
Birch
81.5%
n = 227



Location of Burned Birch Control (1BBC) reference stand
Bonanza Creek Experimental Forest
Aug 01, 2011

Boreal Alaska – Learning, Adaptation, Production (BAKLAP) Quarterly Report

2013 Quarter #3

(July 1, 2013 – September 30, 2013)

Authors of this Report:

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Boreal Alaska – Learning, Adaptation, Production (BAKLAP) Quarterly Report
2013 Quarter #3 (July 1, 2013 – September 30, 2013)

BAKLAP Background and Personnel

The BAKLAP project (Boreal Alaska – Learning, Adaptation, Production) is funded by an appropriation under the 2012 Alaska Capital Budget (HCS CSSB 160(FIN) am H).

> Mission Statement: The goals of BAK LAP are:
> 1) To upgrade Alaska forest research facilities and management practices to improve the value of Alaska's forests in meeting the rapidly expanding demand for wood biomass energy in a changing environment, and
> 2) To improve STEM teaching and learning outcomes by developing a model integrated K-12 curriculum based on hands-on experiences with the Alaskan boreal forest through inquiry science and art.

The BAKLAP project is being carried out under a Reimbursable Services Agreement (RSA) by the University of Alaska Fairbanks, School of Natural Resources and Agricultural Sciences (SNRAS) and the Alaska DNR, Division of Forestry. This is the **fifth** quarterly report of the project, covering the period July 1, 2013 through September 30, 2013.

Personnel status during Quarter #3, 2013:

Quarter #3 of 2013 was the fifth quarter for the operation of BAKLAP. The two co-Principal Investigators (Juday and Dawe) were in term-funded positions for the entire period, and Tom Grant began his 20% of FTE work in his new UAF transition position, as he began work in Colorado. This quarter was the main field season for the project, and a temporary surge of part time labor and volunteers or cooperators were involved in the project.

Zach Meyers. Instructional Designer. Temporary technical (Grade 77). He was supported by BAKLAP funding for full time (40 hrs./wk) from July though September, 2013.

David Spencer, Research Technician. Temporary technical (Grade 76). Left his position with UAF, and provided some short-term and informal transition assistance.

Miho Morimoto - Ph.D. Student. She was supported at the standard graduate assistant rate at half time or 20 hrs/ week from BAKLAP funding from July though September, 2013.

Andrew Allaby - M.S. Student. He was supported by BAKLAP funding (equivalent to) 20 hrs/ week, from July though September, 2013.

Ryan Jess - Research Technician. Temporary technical (Grade 77) – He worked 408.25 hrs. from BAKLAP funding. The remainder of his salary came from a BLM contract for White Mountains Fire and Caribou Habitat project.

Dashiell Feierabend - Research Technician. Temporary technical (Grade 74) Worked 65.25 hrs.

Glenn Juday – Professor of Forest Ecology (PI). His salary during the period came from the following sources:

- 7% State Appropriations - SNRAS research
- 17% State Appropriations - Teaching
- 29% BAKLAP Forest Research
- 29% BAKLAP Forest Education
- 18% Federal McIntire Stennis (land grant funds)

Jan Dawe (Co-PI) – Research Assistant Professor (term-funded faculty position). Her salary came 100% BAKLAP funding, and was 0.75FTE (75% full time).

Tom Grant – Research Assistant Professor Appointed (term-funded faculty position). He holds a position as Research Director of the Mountain Studies Institute in Silverton/Durango, and maintains an appointment with UAF in which he worked 1 day per week (20%) his current position title. During quarter #3 of 2013 his UAF work was supported by BAKLAP and the BLM White Mountains Fire and Caribou Habitat project.

Tricia Kent – Student Assistant C. Tricia worked 121.5 hrs. total

Margaret Klass – Temporary Technical (Artist in schools). (10% of full time) worked 20.75 hrs.

Diane Hunt - Student Assistant C. worked 391 hrs. total.

Structure of this Quarterly Report

This 2013 Quarter #3 report follows a three-fold division for reporting. For accounting purposes, and because of the differing indirect cost rates, three BAKLAP accounts are maintained at UAF:

Forest Research (FR)
Forest Education Outreach (FE)
K20 STEAM Education (K20 STEAM)

The BAK LAP project is being accomplished through the completion of 13 deliverable products organized into three tiers. The following table provides the names and acronyms for the deliverables used in this report.

Tier 1 Deliverables: Core Products for Management, Science, and Public Use

1.1 Title: Data Atlas of Forest Research Installations (DAFRI)
1.2 Title: Operational Regeneration Assessment (ORA)
1.3 Title: 1.3 Title: K-20 Curriculum Development: STEM to STEAM (STEAM)
1.4 Title: Forest Entrepreneur Camp (FORENCA)
1.5 Title: Scientific Publications on Forest Production and Climate (SCI PUB)

Tier 2 Deliverables: Synthesis and Application of Tier 1 Products

2.1 Title: Scientific Input for Optimum Management Practices: Biomass and Climate (OMP)
2.2 Title: K-12 Teacher Professional Development Courses (K-12PD)
2.3 Title: Curriculum for In-service Biomass Course for Professional Foresters (BICFOR)
2.4 Title: Citizen Science Field Training and Framework Development (CITFORSCI)

Tier 3 Deliverables: Support and Extension of Tier 1 and 2 Products

3.1 Title: Boreal Forest Management and Education - Internet Book/Portal (BFEM)
3.2 Title: BAK LAP Website (BAKLAP WEB)
3.3 Title: Forest Management Outcomes Report (FORMOR)
3.4 Title: Research and Installation Needs Assessment (RINA)

SECTION 1

Quarter #3, 2013 BAKLAP Activity: Forest Education

(Note: In the report that follows, each accomplishment is labeled "QR 3.13" for Quarterly Report 3 for 2013 with #1, #2, etc following.

Forest Education QR 3.13 Accomplishment #1 :
Deliverable 3.1 Boreal Forest Management and Education (BFEM)
Deliverable 3.2 BAKLAP Website (BAKLAP WEB)

During the 3rd quarter of 2013, 11 articles describing aspects of BAKLAP were posted to the School of Natural Resources and Agricultural Sciences (SNRAS) website (Table FE 1 below).

http://snras.blogspot.com/2013/07/interactive-mural-brings-boreal-forest.html

http://snras.blogspot.com/2013/07/steam-rolls-on-through-summer.html

http://snras.blogspot.com/2013/08/oregon-state-post-doctoral-scholar.html

http://snras.blogspot.com/2013/09/snras-offers-service-learning.html

http://snras.blogspot.com/2013/09/snras-launches-new-website.html

http://snras.blogspot.com/2013/09/alumni-profile-martin-wilmking.html

http://snras.blogspot.com/2013/09/noted-ethnoecologist-visits-snras-grad.html

http://snras.blogspot.com/2013/09/baklap-takes-legislators-on-tour-of.html

http://snras.blogspot.com/2013/10/26-years-of-monitoring-at-reserve-west.html

http://snras.blogspot.com/2013/10/peace-corps-fellow-works-with-onetree.html

http://snras.blogspot.com/2013/10/the-new-snrasafes-advisory-council-met.html

Related (SNRAS non-BAKLAP Biomass energy project)

http://snras.blogspot.com/2013/10/snras-researchers-find-potential-for.html

Table FE 1. *Article describing BAKLAP accomplishments posted to the UAF School of Natural Resources and Agricultural Sciences website – snras.blogspot.com – during the 3rd quarter of 2013.*

Forest Education QR 3.13 Accomplishment #2 : Alaska Interior Delegation Field Investigation and Report on Project BAKLAP

Deliverable 3.1 Boreal Forest Management and Education (BFEM)

Deliverable 3.4 Research and Installations Needs Assessment (RINA)

On September 20, 2013 the BAKLAP investigator team (Dr. Glenn Juday, Dr. Jan Dawe) conducted a 4 hour field investigation and report to the Alaska Interior Legislative delegation on project BAKLAP (see agenda – Table FE X). At the end of the 2012 legislative session that funded BAKLAP at 60% of the requested amount, which represents the current appropriation of $1.0 mill. The legislators involved directed the BAKLAP proposers to conduct the project for a year and then report back for an evaluation of the project and the proposal for its completion. BAKLAP became fully operational in fall of 2012, so fall 2013 represented the 1-year milestone for reporting and evaluation.

Information Packet for Field Investigation of Project BAKLAP (Boreal Alaska – Learning, Adaptation, and Production)

Figure FE 1. *Cover of trip guide produced for Alaska Interior Legislative Delegation Field Investigation and report, September 20, 2013.*

Three legislators, two state representatives and one senator attended in person. Seven legislative offices were represented, including 4 state representatives and 3 senators, and 2 other offices were briefed beforehand, including one of the principal sponsors of 2012, Rep. Wilson (Table FE 2). In total, 4 teachers from the Fairbanks North Star School District, 4 UAF Graduate Students, and 3 other professionals working on the project made presentations. In

addition, Chancellor Brian Rogers and Provost Susan Hendricks of UAF, and State Forester Chris Maisch attended the second half of the event. The BAKLAP Executive Team received valuable feedback and encouragement for the future of the project.

The field trip covered the early and emerging insights about the empirical record of boreal forest management since statehood, including successes, problems and challenges, and opportunities and needs. Providing these insights to state policy makers and leaders was especially valuable. The attendees were engaged and asked useful and often insightful questions. Some interest was expressed in convening oversight hearings during the regular legislative session on the Alaska boreal forest management situation.

Agenda for Legislative Field Investigation and Report
Boreal Alaska – Learning, Adaptation, and Production (Project BAKLAP), Sep. 20, 2013

1:00 PM. Vehicles arrive at Legislative Information Office (LIO)
5 min: Introduction, orientation, and purpose of field investigation and report (Glenn Juday)
Hand out information packets (maps and information about field installations)
Load vehicles and depart for Bonanza Creek Experimental Forest

1:20: PM. Vehicles depart LIO

1:20-1:45 PM. drive to George Parks Monument overlook on Parks Highway

1:45-2:05 PM. Briefing on Management challenges and opportunities for wood energy
Glenn Juday – Overview of state forest information needs
Miho Morimoto (Ph.D. student) – Operational Regeneration Assessment (ORA)

2:05-2:20 PM. Drive to Mile 2, Bonanza Creek Road

2:20-2:55 PM. Explain Rosie Creek Fire Tree Regeneration Installation (RCF TRI)
Glenn Juday – Reference Stand Network; History of the RCF TRI experiment
Andrew Allaby (M.S. student) – Current study/assessment of RCF TRI for biomass management
Short walk through RCF TRI experimental treatments

2:55-3:30 PM. Drive to UAF University Park Building on University Ave. (*Old* U Park School)

3:30-3:50 PM. BAKLAP Education activities report at University Park Building (outdoors)

- **Chris Maisch:** (State Forester) welcome back from state forest, relevance of BAKLAP to biomass management and future cooperation in research and education **(2-3 min)**
- **Brian Rogers:** (UAF Chancellor) welcome to UAF campus, partnerships in research and education **(2-3 min)**
- **Jan Dawe :** (Co-PI of BAK LAP project) Invitation to hands-on activities (**1 min**)
  Choice of 5-minute activities and pictures (**10 min total**)
  a) Diane Hunt – M.S. student: Tree Planting: Cold Hardiness/Dormancy Experiment
  b) Birch Pavelsky – Woodworker: Manufacturing Knitting Needles –Entrepreneurship

3:50-4:00 PM. Walk to University Park Building Room 158, refreshments (indoors)

4:00 PM. Resumption of report;
Steve Sparrow – Interim Dean, School of Natural Resources and Ag. Sciences and Director, Agriculture and Forestry Experiment Station: Integrated research, education and outreach

4:05-4:50 K-20 STEAM Education Reports: BAKLAP team and partners
***Jan Dawe** – Introduction to K-20 STEAM Education component

*__Chris Pasto__, Randy Smith Middle School Extended Learning Prog.: STEAM in the classroom
*__Karen Stomberg__ – FNSBSD Art Center Coordinator - The role of the Arts in STEM Education
*__Carri Forbes__ – Tanana Middle School science teacher, and Jan Dawe – Service Learning
*__Tricia Kent__ – M.S. student – Improving non-timber forest product manufacturing (birch sap)
*__Zachary Meyers__ – SNRAS Instructional Designer, __Klara Maisch__ – Artist: Watershed Charter School's Interactive Mural
*__Diane Hunt__ – M.S. student Perspectives on place-based learning
*__Margo Klass__ – Book Artist: Science-Art Exhibits

4:50-5:00 Glenn Juday – Discussion moderator

5:00-5:20 PM. Drive back to LIO

Attendance Field Investigation and Report, Sep 20, 2013

Rep. Scott Kawasaki – was present.
Rep. Doug Isaacson – was present.
Rep. David Guttenberg (not present, **Meredith Cameron** represented his office).
Rep. Steve Thompson (not present, Jan Dawe briefed his office beforehand).
Rep. Tammie Wilson (not present because of a scheduled trip to review education activities on Seward Peninsula, office was not represented, she was briefed by Jan Dawe before the field investigation).
Rep. Pete Higgins (not present, **Clifton Higgins** represented his office).
Sen. John Coghill – was present. **Rynnieva Moss** also attended.
Sen. Pete Kelly (not present, **Bruce Campbell** represented his office)
Sen. Click Bishop – attended indoor pre-trip briefing at LIO, had a previously scheduled meeting.

Table FE 2. *Agenda and attendance trip for Alaska Interior Legislative Delegation Field Investigation and report of BAKLAP, September 20, 2013.*

Figure FE 2. *From left, Meredith Cameron (Rep. David Guttenberg staffer), Sen. John Coghill, Rep. Scott Kawasaki, Glenn Juday and graduate student Andrew Allaby talk about BAKLAP research conducted by Allaby at the Rosie Creek Fire Tree Regeneration Installation on the Sep. 20 field investigation.*

Figure FE 3. *Jan Dawe explaining products made from birch by BAKLAP cooperators and in BAKLAP project classrooms during the Sep. 20 field investigation, University Park Building, UAF campus.*

Forest Education QR 3.13 Accomplishment #3 – Management lessons for biodiversity from climate change effects - the 35th Natural Areas Conference :

Deliverable 3.1 Scientific Input for Optimum Management Practices: Biomass and Climate (OMP)

Glenn Juday summarized the results of the large landscape level analysis of BAKLAP research for the 35th Natural Areas Conference sponsored by the Natural Areas Association, the largest organization of natural area managers and researchers in the U.S. and Canada. The abstract was accepted and published during the 3rd quarter of 2013, and the conference began on the last day of the quarter. Juday made the presentation on October 2 (Figure FE 4).

Climate Disruption Effects in Boreal Forest of Alaska: Lessons from Research Natural Areas and Bonanza Creek Long Term Ecological Research Site Glenn Patrick Juday[1], Thomas Grant[1], and Claire Alix[2].

[1]University of Alaska Fairbanks School of Natural Resources and Agricultural Sciences, gpjuday@alaska.edu; tagrant@alaska.edu, [2], University of Paris 1 Sorbonne, Claire.Alix@univ-paris1.fr.
Glenn Patrick Juday, 4837 Palo Verde Avenue, Fairbanks, AK 99709; 907-479-3765. gpjuday@alaska.edu

Climate sensitivities of white spruce, black spruce, aspen, and Alaska birch have been established in the Bonanza Creek Long Term Ecological Research site (BNZ LTER) and satellite Research Natural Areas in central Alaska. Performance of these species in Interior Alaska has been assessed through long term monitoring in hectare scale forest reference stands and tree ring analysis. All species register a negative sensitivity to summer temperature (decreased growth with warming), and are termed “negative responders.” The most recent 35 years have been the least favorable for growth of this population in the past 250 years at least. Recent warm anomalies, including 2013, have been extreme and stressed the trees directly and through facilitation of insect outbreaks, especially aspen leaf miner, spruce budworm, and engraver beetles, and eliminated older forests in large scale fires. Old growth dependent species are negatively affected include woodpeckers, arboreal lichens, and cavity nesting birds. However, tree growth and health in some environments in Alaska has improved with warming, and this population is termed “positive responders.” A transect down the major Alaska rivers (Yukon, Tanana, Kuskokwim) reveals the coherence of the distribution of positive versus negative responding white spruce populations. Negative responders occupy the interior region with hot dry summers, and positive responders occur in western Alaska closer to the Bering Sea coast. Natural forests to sustain older forest dependent organisms need to be allowed or encouraged to expand in western Alaska and secondarily at high elevations, even at the expense of decreasing tundra.

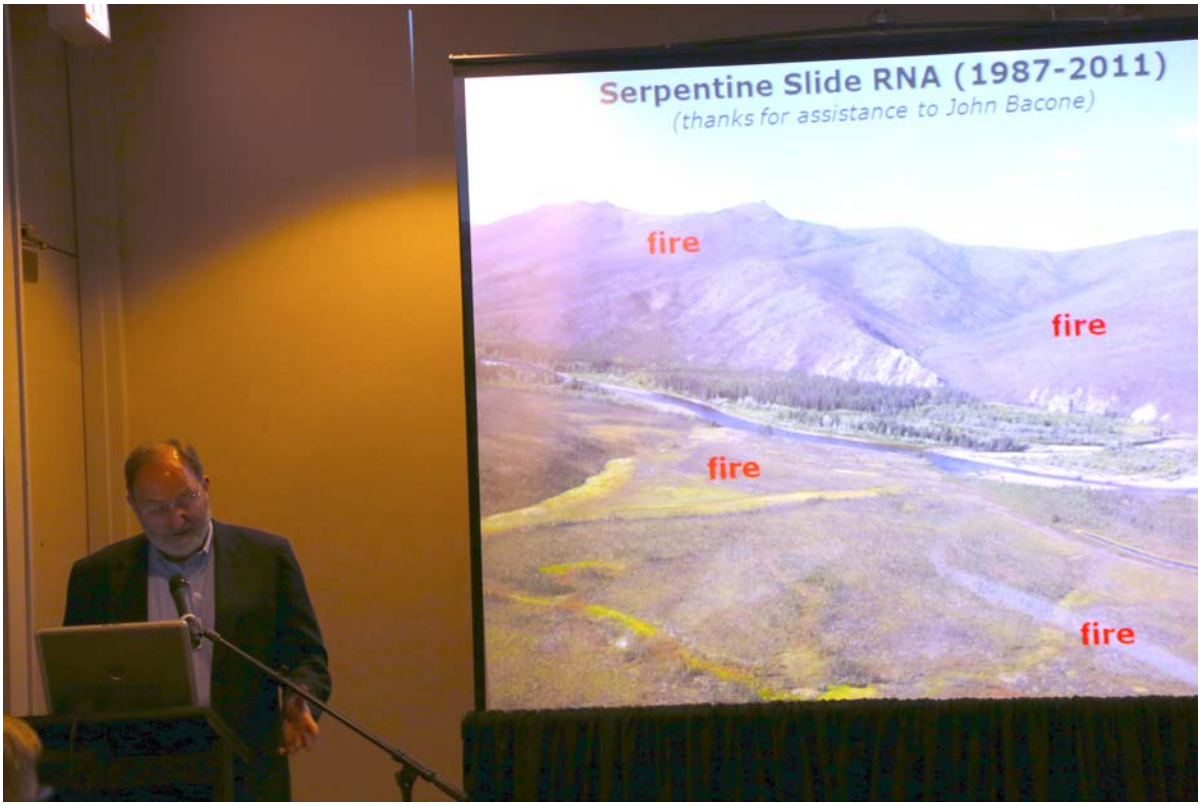


Figure FE 4. *Glenn Juday presenting "Climate Disruption Effects in Boreal Forest of Alaska: Lessons from Research Natural Areas and Bonanza Creek Long Term Ecological Research Site," at the 35th Natural Areas Conference, Chicago IL, October 02, 2013.*

Forest Education QR 3.13 Accomplishment #4 –Alaska Board of Forestry meeting, Soldotna, Alaska "Boreal Alaska: Learning, Adaptation, and Production (BAKLAP) – Midsummer 2013 UPDATE

Deliverable 3.1 Scientific Input for Optimum Management Practices: Biomass and Climate (OMP)

The Alaska Board of Forestry invited G. Juday to provide an update on progress in BAKLAP at the Board meeting August 12-13, 2013. Juday's presentation focused on the two main empirical research project being supported by BAKLAP - the Operational Regeneration Assessment (ORA), and the Rosie Creek Fire Tree Regeneration Installation (RCF TRI) (See sections, Forest Research Accomplishment #1 and Forest Research Accomplishment #2 that follow immediately in this quarterly report).

In discussion that followed the presentation the value of the forest regeneration research that was described was recognized. The possibility was raised of initiating a scientific and technical committee to review current reforestation standards under the Alaska Forest Practices Act. Juday expressed a willingness to have BAKLAP contribute to such a process if it is launched.

SECTION 2

Quarter #3, 2013 BAKLAP Activity: Forest Research

Forest Research QR 3.13 Accomplishment #1: Sampling and preliminary analysis for the Operational Regeneration Assessment (ORA)
Deliverable 1.1 Data Atlas of Forest Research Installations (DAFRI)
Deliverable 1.3 Operational Regeneration Assessment (ORA)

During Quarter #3 of 2013, a data collection protocol was developed and adopted for Operational Regeneration Assessment (ORA) (See: Forest Research QR 2.13 Accomplishment #2: Operational Regeneration Assessment). The protocol was developed by Miho Morimoto and her graduate advisory committee (G. Juday, Major Advisor) in consultation with Dr. Brian Young, Resource Forester, Alaska Division of Forestry.

In designing the ORA protocol, one goal was to make it as compatible as possible with the Alaska Division of Forestry's forest regeneration survey method, which is used to verify compliance with the standards of the Alaska Forest Practices Act. If the ORA sampling and Forest Practices act systems are comparable, it will be possible to greatly expand the data base for analyses of post-harvest tree regeneration and the success or issues associated with state forest regeneration management. The ORA study adopted a system of subplots of 1.69m radius.

A total of 27 forest harvest units were sampled during the entire field season (Table FR 1), with 699 subplots. Most of the sampled harvest units were west of Fairbanks (Figure FR 1). Three of the units selected for sampling were either not harvested or were burned by subsequent fires through the regenerated forest. In-kind assistance for the ORA sampling was extensive, including French forestry student interns, DoF trucks, ATV, and boat, and a UAF Experiment Farm vehicle. Sampling according to the full protocol was completed in late August. Data analysis has been performed as the data were collected.

The ORA project has put together the first comprehensive look through time of forest harvest levels and practices. In the 1970s to early 1980s, forest harvest activity in central Interior Alaska was very low (Figure FR 2). Regeneration activity has included both natural regeneration and planting of white spruce, with planting being most active from 1985 through 2001, 2004, and 2010 (Figure FR 2A). Less than half the area harvested is scarified, and in the last decade only one year (2010) was a significant amount of harvest area scarified (Figure FR 2B). A number of harvest systems have been used. Clearcutting was a significant amount of all harvest in the 1990s, but since then selection harvest systems have been more common (Figure 2C).

The 27 forest harvest units have been arranged in chronological order for a standard set of comparisons of changes in regeneration characteristics (tree stem density, dbh, biomass) with age (Figure FR 3 A, B, C,)

Table FR 1. *Operational Regeneration Assessment (ORA) sampling activity during Quarter #3, 2013.*

Location	Unit	# subplot	Year	Harvest	Scarification	Reforestation	Dates	Crews	Other assistance
Bonanza ck	NC-120	41	1975	partial	none	plant	8/14-15	Morimoto, Jess	DoF truck
Bonanza ck	NC-190	22	1977	clear	scarify	natural	6/19-23	Morimoto, Jess, Spencer	
Bonanza ck	NC-249	22	1980	clear	scarify	natural	6/23,7/9	Morimoto, Jess, Heuittmann, Lazlo	UAF farm vehicle
Bonanza ck	NC-556	20	1986	clear	none	natural	6/18, 8/29	Morimoto, Jess, Guisa	DoF boat
Bonanza ck	NC-842	7	1992	partial	none	natural	8/12	Morimoto, Jess	DoF truck, ATV
Cache Creek	NC-1129	22	1999	partial	none	plant	6/27-28	Morimoto, Juday, Guisa	DoF truck
Cache Creek	NC-454	44	1991	clear	scarify	plant	8/6, 13	Morimoto, Jess	DoF truck, ATV
Cache Creek	NC-927	43	1998	partial	none	plant	7/17,18,23	Morimoto, Jess, Meyers	UAF farm vehicle
Nenana	NC-747	31	1994	clear	none	plant	6/20-21	Morimoto, Guisa, Charly, Loic	DoF boat
Nenana Ridge	NC-1116	9	2003	partial	scarify	natural	7/29	Morimoto, Jess	UAF farm vehicle
Nenana Ridge	NC-733	45	1992	clear	scarify	plant	8/7-8, 15	Morimoto, Jess	DoF truck, ATV
Rosie Creek	NC-1135	49	2002	partial	none	plant	6/10-6/14	Morimoto, Jess, Spencer, Guisa	
Rosie Creek	NC-305	11	1987	partial	scarify	plant	7/8, 10	Morimoto, Jess	UAF farm vehicle
Rosie Creek	NC-279	21	1982	partial	scarify	plant			
Skinny	NC-1143	28	2004	partial	none	natural	8/5	Morimoto, Jess	DoF truck, ATV
Skinny	NC-93	36	1975	partial	none	natural	7/25, 28	Morimoto, Juday, Madan	UAF farm vehicle
Salcha	NC-1137	29	1997	clear	none	plant	7/31, 8/1	Morimoto, Jess	
Salcha	NC-395	21	1983	clear	none	natural	7/30	Morimoto, Jess	
Salcha	NC-740	8	1991	clear	none	plant	8/1	Morimoto, Jess	
Standard ck	NC-1085	47	1996	partial	scarify	plant	6/26, 7/15-16	Morimoto, Jess	DoF truck
Standard ck	NC-1090	7	1999	partial	none	natural	5/30, 7/16	Morimoto, Guisa, Spencer, Jess	UAF farm vehicle
Standard ck	NC-140-17	8	1979	clear	none	natural	5/27-28	Morimoto, Guisa	
Standard ck	NC-140-38	7	1982	clear	scarify	natural	5/29	Morimoto, Guisa, Spencer	
Standard ck	NC-702	9	1993	clear	none	plant	5/30, 7/16	Morimoto, Guisa, Spencer, Jess	UAF farm vehicle
Standard ck	NC-750	41	1995	clear	scarify	plant	6/24-25	Morimoto, Guisa, Jess	DoF truck
Two Rivers	NC-705	44	1989	clear	scarify	plant	7/1-3	Morimoto, Jess	
Two Rivers	NC-709	35	1991	clear	scarify	plant	8/21, 26-27	Morimoto, Jess, Young	DoF truck, ATV
Two Rivers	NC-760	13	1998	partial	none	natural	8/27	Morimoto, Jess	DoF truck, ATV
Two Rivers	NC-107	20	1973	partial	none	natural	7/5		
Two Rivers	NC-368	17	1983	clear	none	natural	7/5		

Red = units which were sampled in summer 2013, black = units which were visited but not sampled because they were not logged or burned after logging, year = year logged, note = resources provided

*Morimoto, Jess, Spencer, Juday and Meyers = UAF BAKLAP, Guisa, Charly and Loic = internship student at DoF, Young = DoF forester, Heuittmann = UAF faculty and committee member of Morimoto, Lazlo and Madan = internship student for Heuittmann

Figure FR 1. *Study Area. Fairbanks area of Tanana Valley State Forest.*

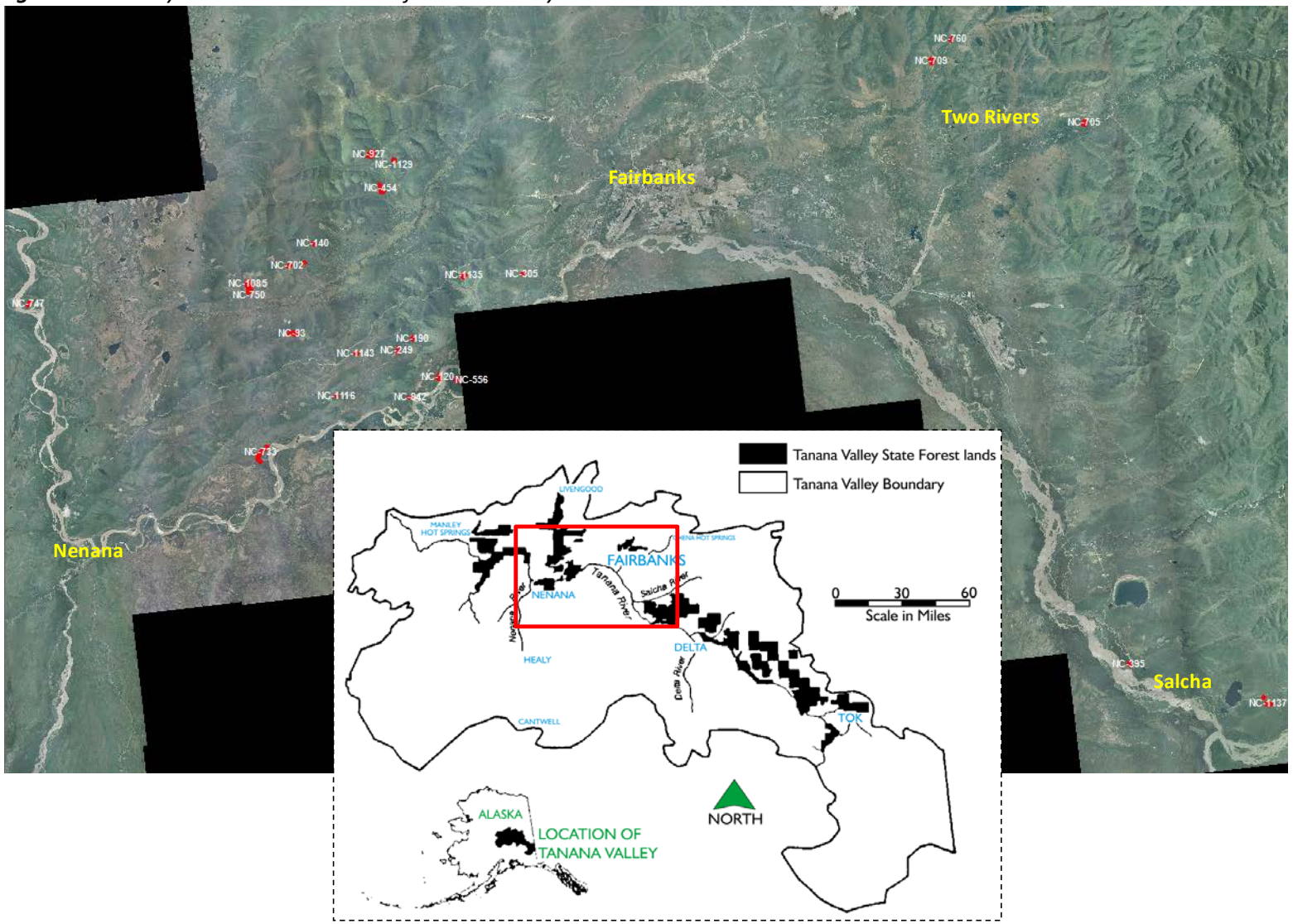


Figure FR 2. *Historical trends of harvest area (ha) by (a) harvest, (b) scarification, and (c) reforestation methods*

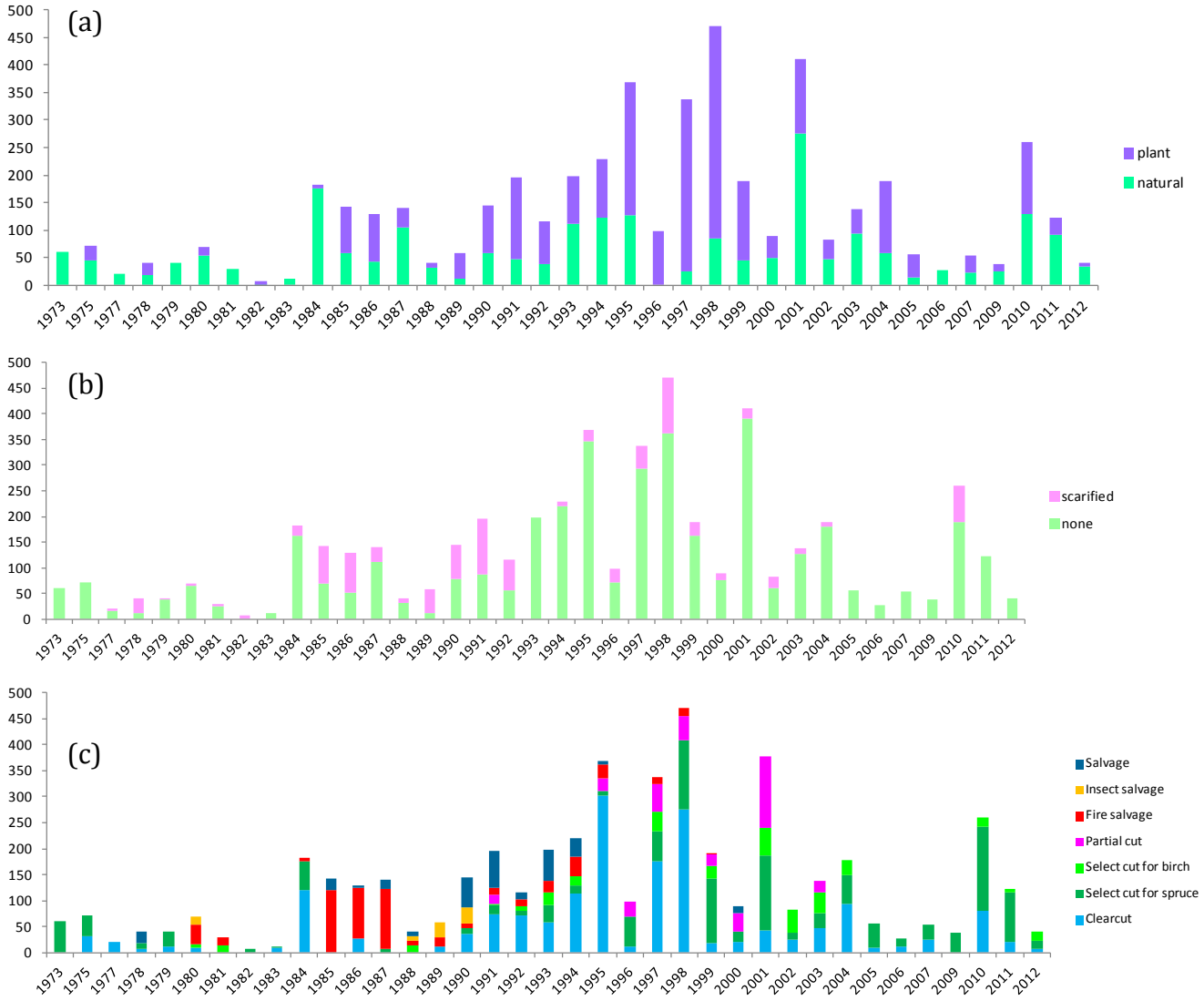
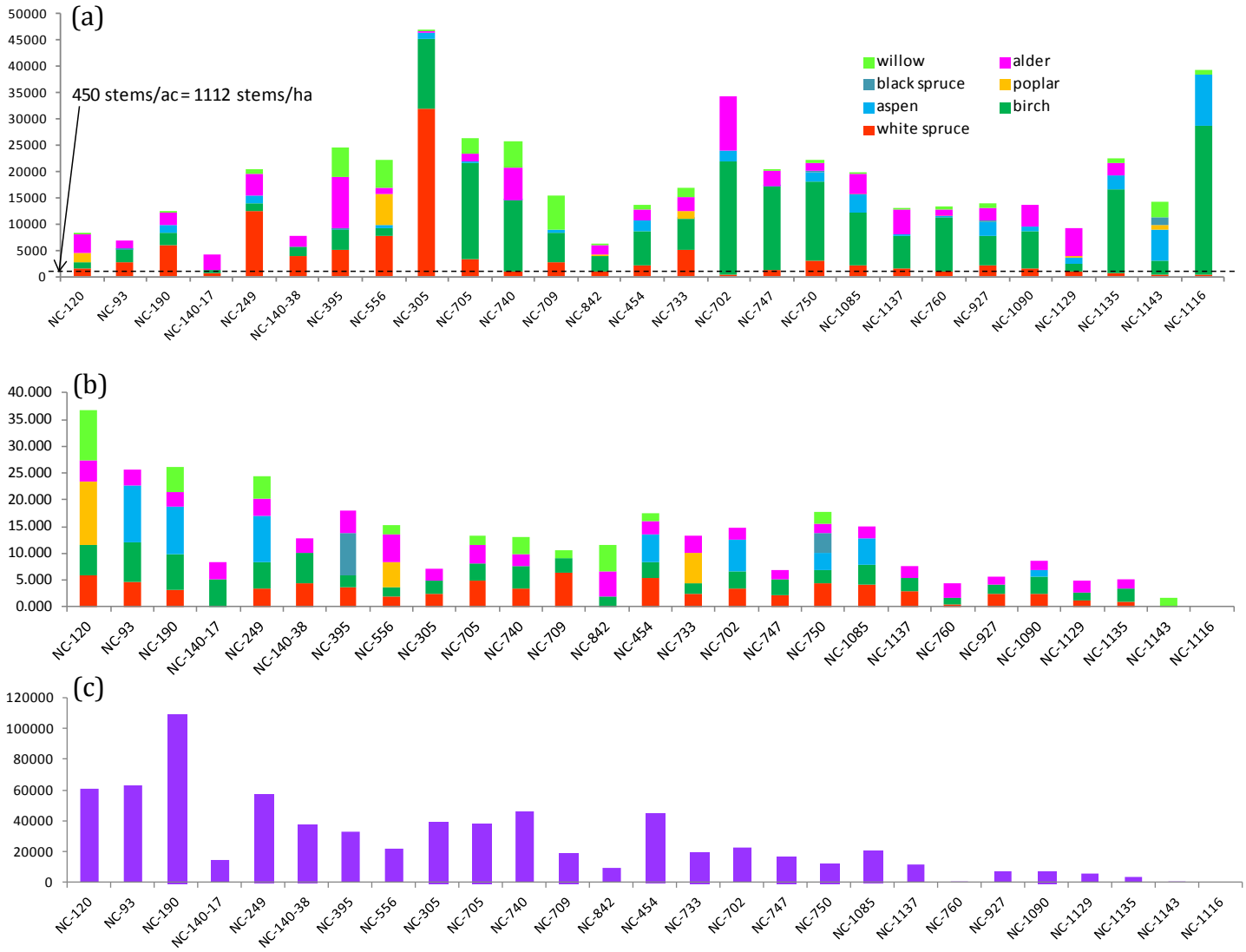


Figure FR 3. *(a) stem number per hectare by species (b) mean dbh by species and (c) biomass (kg) per hectare. The graph is in chronological order (older to younger).*



The Alaska Forest Practices Act standard for forest regeneration in Regions II and III (Interior or boreal forest) is 450 well-distributed, effective stems per acre within 7 years following harvest. This is equivalent to 1112 stems per hectare. Most of the forest harvest units sampled for ORA contained more than 1112 white spruce stems per hectare, and all the units had more than 1112 stems per hectare when all species were included down to the lower limit of 1.0 cm dbh (Figure FR 3A). The time since harvest (at the time of ORA sampling) was greater than 7 years for all harvest units.

In general, in the ORA chronology of harvest units (to date), younger units contain more birch stems and older units contain more white spruce stems (Figure FR 3A). As expected, average DBH and biomass become steadily larger as the units become older (Figure FR 3B, C), indicating that no regeneration gaps or failures in regeneration during specific time periods were incorporated into the ORA sample.

(a) White spruce stem density in number per hectare (vertical axis) versus management practice

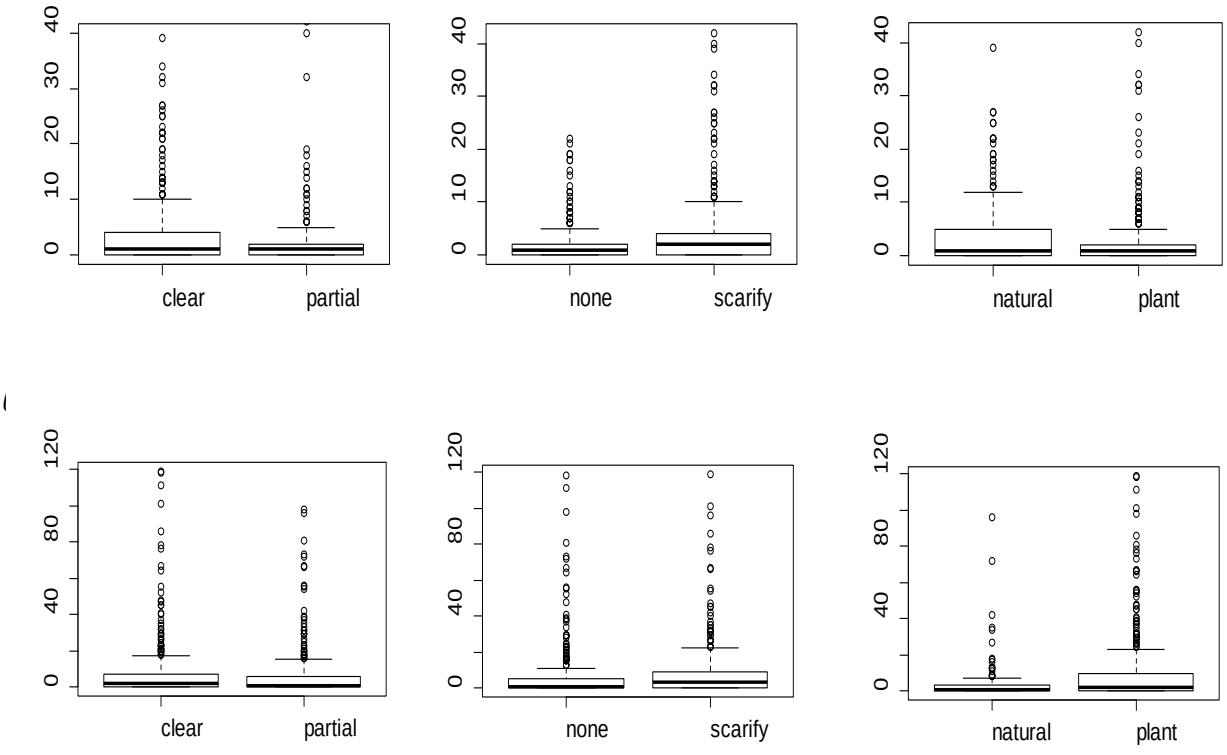


Figure FR 4. *Comparison of stem density of white spruce and Alaska birch by management practices of harvest type, scarification, and reforestation type.*

ORA data have been formatted and are presented here as a progress report, but a full analysis has not been conducted yet. The reader is specifically cautioned not to use these preliminary data as conclusions that have been appropriately tested and established.

Clearcutting appears to be associated with increased white spruce stem density (Figure FR 4A) but not birch density (Figure FR 4B). Scarification increased stem density of both white spruce and birch (Figure FR 4 A, B). White spruce was more abundant, as measured by stem density, in naturally regenerated units (Figure 4A) while birch was more abundant in planted units (Figure 4B).

White spruce appears to be larger in diameter in clearcuts compared to partially harvested units, on scarified sites versus sites with no scarification, and in planted units compared with naturally regenerated units (Figure FR 5 A). Again, tests for stastical significance of these differences are not complete. Birch appears to be larger in diameter only larger in natural regenerated units (Figure FR 5 B). In summary, clearcutting and scarification iis associated with an apparent increase in both stem number and mean DBH of white spruce, while planting of white spruce appears to be associated with a reduction in white spruce stem number and an increase in mean DBH. Harvest type and scarification did not appear to affect birch stem number and mean DBH. More birch appear to have regenerated in planted units but mean birch DBH appears to be larger in natural regenerated units. Statistical tests of the significance of these trends is not complete.

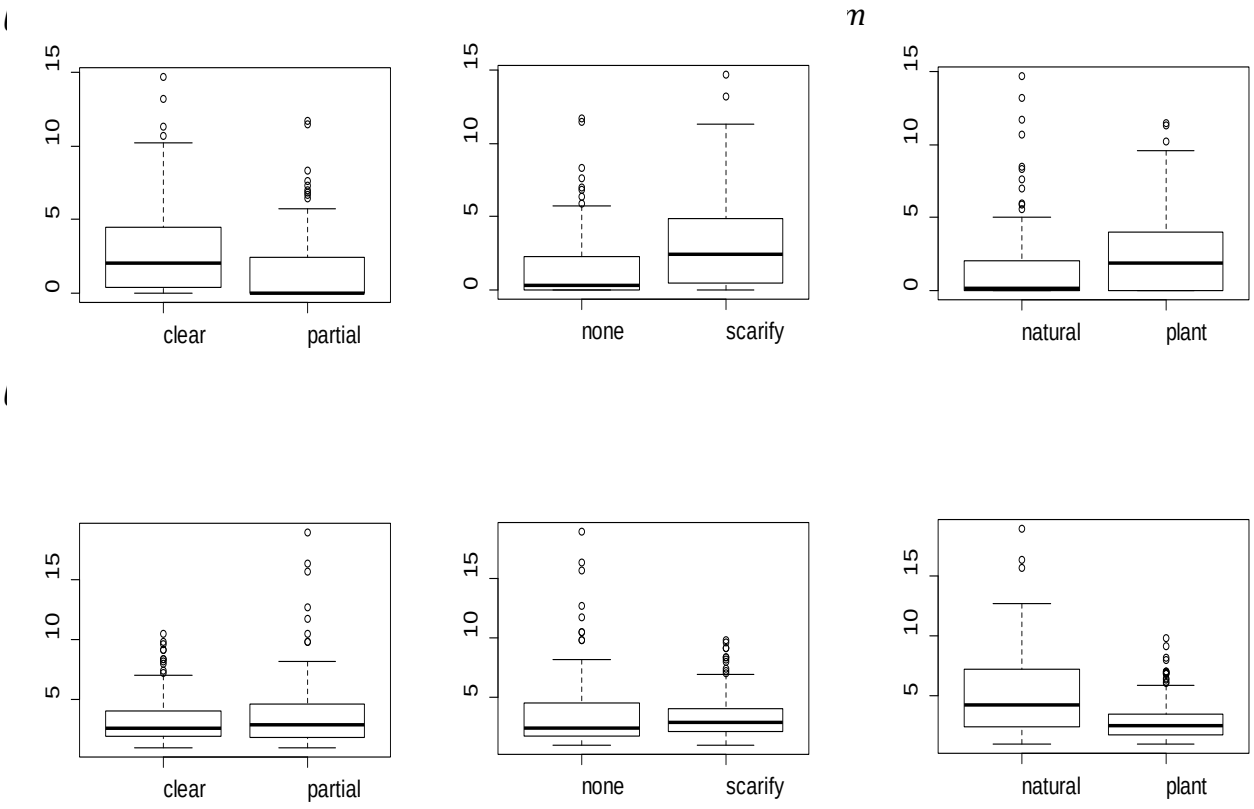


Figure FR 5. *Comparison of mean diameter of white spruce and Alaska birch by management practices of harvest type, scarification, and reforestation type.*

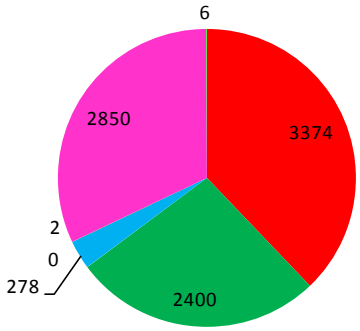
Figure FR 6. *Partial tree census in forest harvest unit NC-140-38 (outlined in red). Yellow shaded squares are 50m by 50 m census areas; standard sample plots are numbered red circles.*

In order to test the effectiveness of the ORA sampling system, which uses 1.69 m radius subplots spaced at 50 m intervals, a partial tree census was conducted on forest harvest unit NC-140-38 (Figure FR 6). The partial tree census covered alternate 0.25 ha (50m by 50m) blocks across the harvest unit.
In the in the .25 ha census blocks all stems taller than 1 m and smaller than 1 cm in DBH (size class 2) were counted, and all stems larger than 1 cm in DBH (size class 3) were measured. For all woody stems greater than 1 cm (size class 3), DBH was measured, and then height was measured on every 20th tree. The data were combined for the circular subplots and compared with the combined data of all 0.25 ha blocks (Figure FR 7).

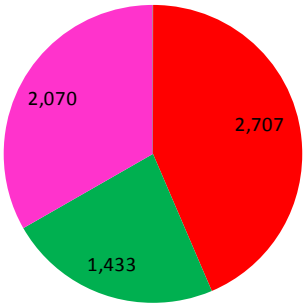
The proportion of stems (both size classes combined) by species are similar in the partial census blocks compared to the subplot estimate (Figure FR 7A, 7B). However, the actual stem density numbers appear to be underestimated in the subplot sample (Figure FR 7A, 7B) and particularly so for size class 2 stems (Figure FR 7C, 7D). The proportion of species in size class 3 appears to be similar in the partial census blocks compared to the subplot estimate (Figure FR 7E, 7F). The estimate of actual stem density of size class 3 white spruce is quite similar for the subplots estimate versus the partial census, but stem density appears to be underestimated by the subplots for alder and especially for birch (Figure FR 7E, 7F). Because biomass estimate are disproportionally influenced by larger stems, the subplot sampling system may generate useful estimates, although further analysis of the magnitude of sampling uncertainty is needed.

Figure FR 7. *Comparison of stem number per hectare between census and estimate from random sampling in NC-140-38*

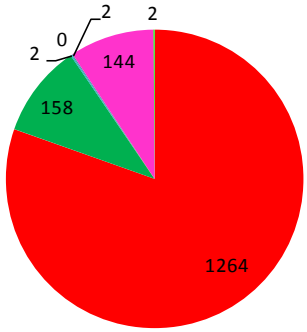
(a) Partial census stem density of size class 2 and 3



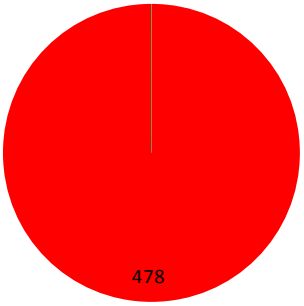
(b) Subplots stem density estimate of size class 2 and 3



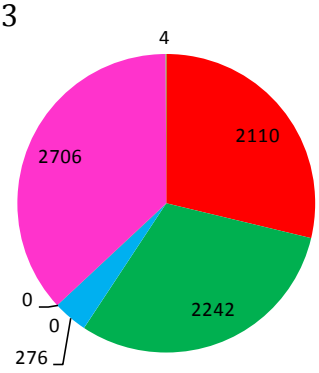
(c) Partial census stem density of size class 2



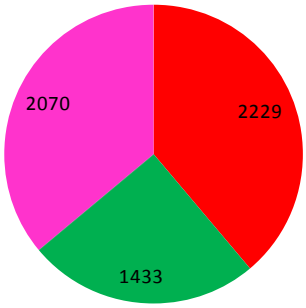
(d) Subplot stem density estimate of size class 2



(e) Partial census stem density of size class 3



(f) Subplot stem density estimate of size class 3



Stem number is underestimated from random sampling. Especially size class 2 is underestimated greater.

	DBH		Basal Area	
	Census	Subplot	Census	Subplot
White spruce	4.07	4.41	5.241	4.146
Birch	6.04	5.66	10.159	4.133
Aspen	9.07		1.983	
Poplar				
Black spruce				
Alder	3.19	2.81	0.476	1.639
Willow	1.95		0.001	
TOTAL			**17.860**	**9.918**

Table FR 2. *Comparison of DBH and basal area between partial census and subplots values at forest harvest unit NC-140-38 .*

Basal area at forest harvest unit NC-140-38 appears to be similar for white spruce in subplot sampling compared to the partial census, but underestimated for other species (Table FR 2). Further analysis will be performed to either better define the sampling uncertainty or improve the estimates generated from samples.

Forest Research QR 2.13 Accomplishment #2: Sampling and preliminary analysis of Rosie Creek Fire Tree Regeneration Installation (RCF TRI).

Deliverable 1.1 Data Atlas of Forest Research Installations (DAFRI)

Graduate student Andrew Allaby completed summer field measurements for his M.S. research, provisionally titled "A Boreal Silviculture Experiment and Implications for Wood Biomass." Sampling was in the 28-year old Rosie Creek Fire Tree Regeneration Installation (RCFTRI) located in Bonanza Creek Experimental Forest (Figure FR 8). Principal field effort during the 3rd Quarter was provided by technicians (and volunteers) listed in Table FR 3 (below).

Field Tech	Days in Field
Andrew Allaby	35
Kristy Johnsson	25
Kimberley Maher	7
Roy Flynn	6
Eva Allaby	2
Ryan Jess	2
Alex Allaby	1
Ari Pescovitz	1
Total Person-Days	**79**

Table FR 3: *Field technical assistance at the Rosie Creek Fire Tree Regeneration Installation (RCF TRI) over the 35 measurement days of field season 2013.*

Across the entire RCF TRI, 114 of the 180 experimental subunits were sampled During the 2013 field season. All of the subunits that received the three commonly used white spruce regeneration methods were sampled: 1) planted seedlings, 2) broadcast seeding, and 3) natural regeneration (control) (Figure FR 8). in addition to the 3 commonly used methods three other regeneration methods were used in the RCF TRI, including 4) spot seeding, 5) spot seeding with a plastic cone shelter, and 6) fall spot seeding. While the subunits with the 3 less commonly used regeneration methods were systematically avoided on much of the RCF TRI, on one of the replicate blocks, Ridgetop Site Block 3, every subunit was sampled (Figure FR 8).

In the 2013 field season, a total of 16,050 trees were sampled in 114 subunits for species and diameter at breast height (dbh). These results came from 456 one-meter wide transects totaling 17,415 m^2. An additional 5,022 trees were counted in 6 census subunits for species and dbh, and 257 trees were measured for height using a laser rangefinder. A census subunit was completed in each of the 6 blocks, including collection of height data on every 20th tree. In the census units 7,240 m^2 were surveyed; total area measured in both censuses and transects was 2.46 hectares (6.1 acres).

Over 2/3rds of the stems (> 1.0 cm) on the entire RCF TRI are birch, with about 17% white spruce, about 7% aspen (Figure FR 9). Compared to stem numbers, the proportion of the basal area among species on RCF TRI is slightly less birch, nearly triple the aspen (18%) aspen, and about the same of white spruce (Figure FR 10).

Most aspen at RCF TRI are in the 50 to 150 mm diameter range, with the largest over 250 mm (Figure 11). Alder stems occupy a narrow range of diameters, with a mean of 36 mm (Figure FR 11). Birch and white spruce have similar diameter distributions, with a strong negative exponential distribution and median values of just over 30 mm (Figures 13 and 14).

Allaby presented his research methods and objectives to representatives of the Interior Alaska legislative delegation during a field tour related to the BAK LAP capital appropriation on September 20 (See this report – item QR 3.13 FE #2).

Additional collection of height data and high-precision GPS georeferencing is ongoing, as well as initial statistical analyses.

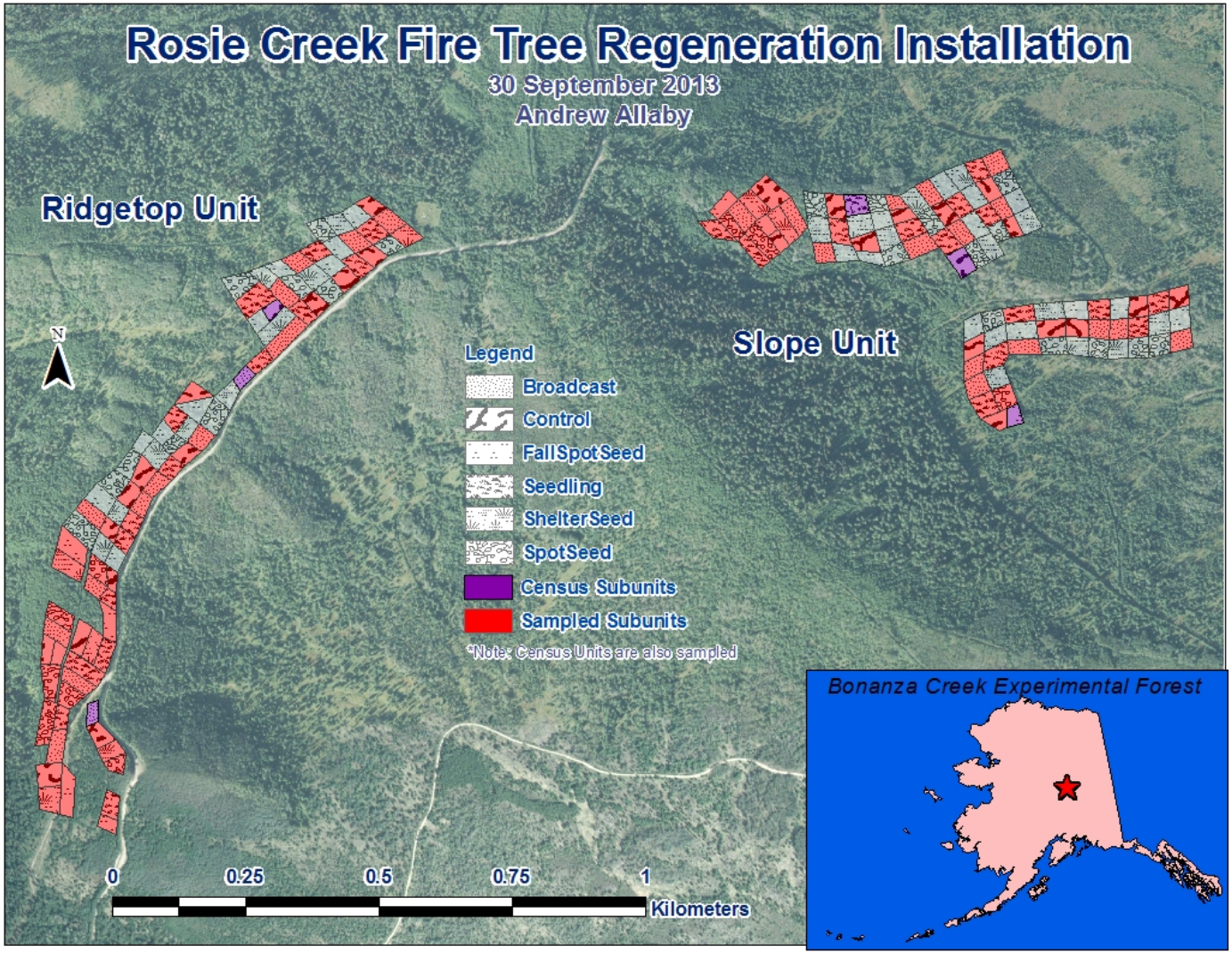


Figure FR 8: *Status of 2013 sampling in the Rosie Creek Fire Tree Regeneration Installation.*

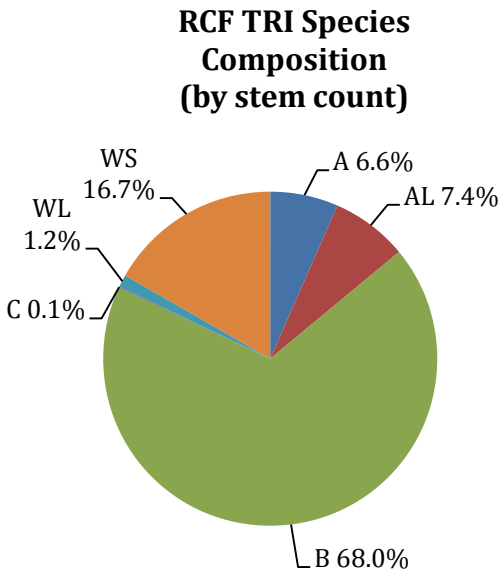


Figure FR 9: *Pie chart showing species composition for each tree species surveyed in the RCFTRI sample; data are for the entire site.*

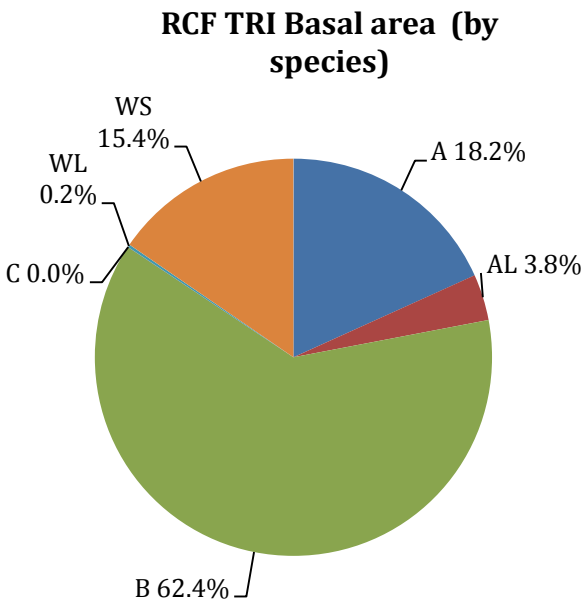
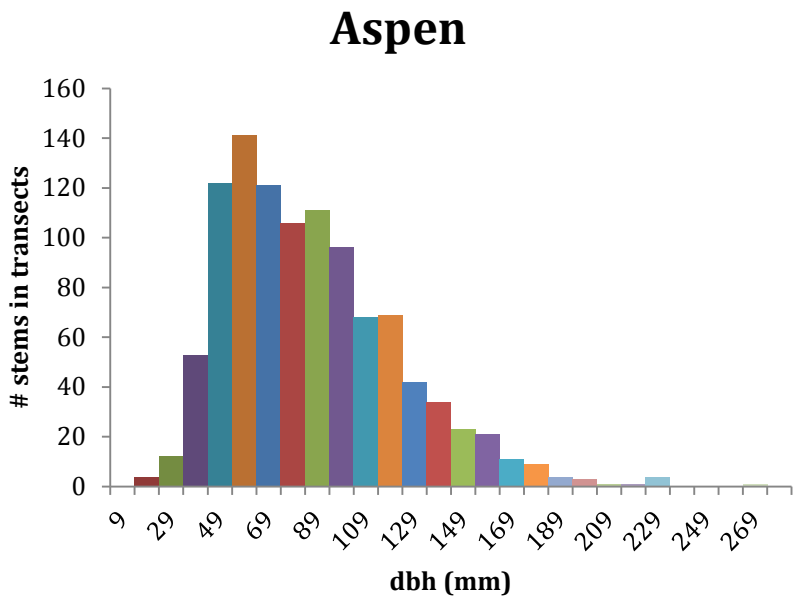


Figure FR 10: *Pie chart showing basal area*

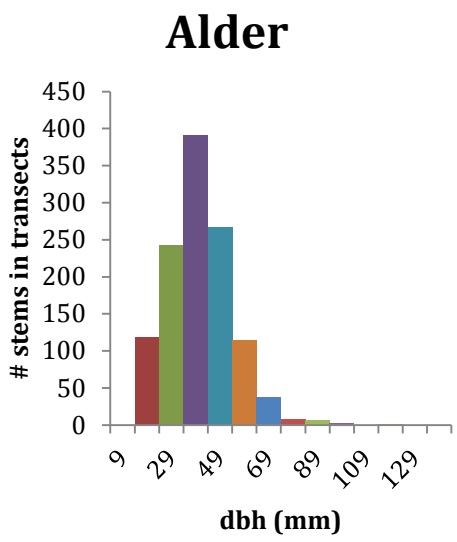
*π * (1/2 * dbh)^2 by species for the entire site, where dbh = diameter at breast height, 1.37m.*

Species Code	Species
A	Aspen (*Populus tremuloides*)
AL	Alder (*Alnus spp.*)
B	Birch (*Betula neoalaskana*)
C	Balsam Poplar (*Populus balsamea*)
WL	Willow (*Salix spp.*)
WS	White Spruce (*Picea glauca*)



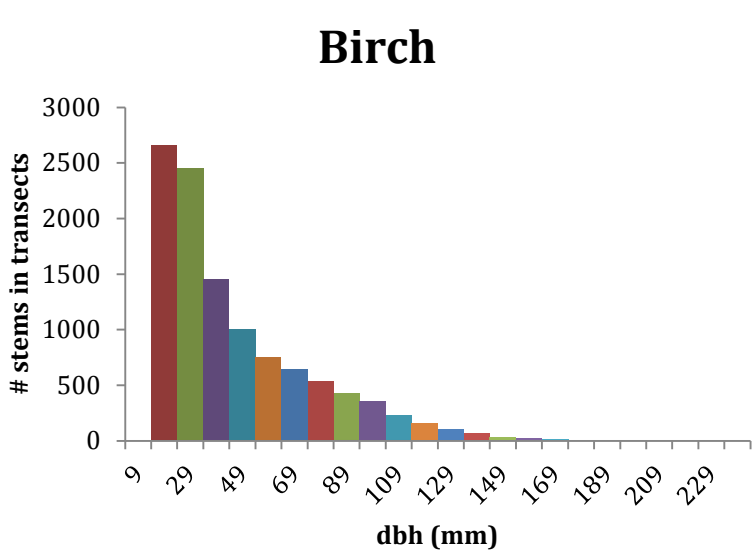
median	77
mean	82.43
stdev	35.94
min	12
max	267
count	1057

Figure FR 11: *Distribution and descriptive statistics of dbh (diameter at breast height, = 1.37m) for all aspen at RCF TRI.*



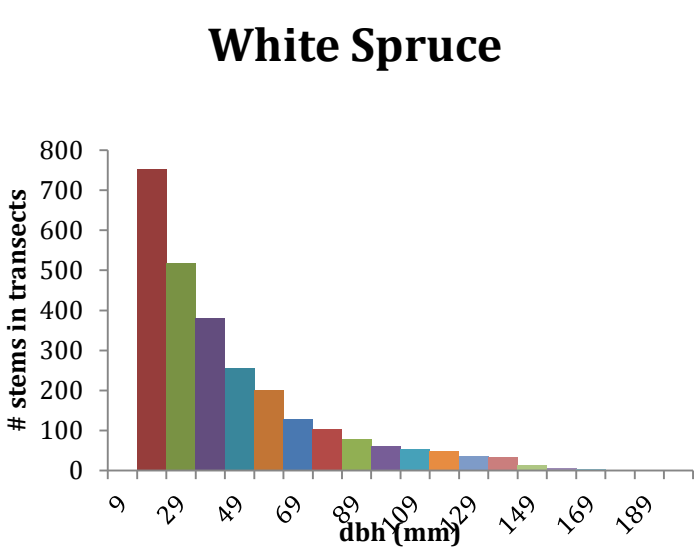
median	35
mean	36.10
stdev	13.22
min	10
max	110
count	1189

Figure FR 12: *Distribution and descriptive statistics of dbh (diameter at breast height, = 1.37m) for all sampled alder at RCF TRI.*



median	32
mean	42.19
stdev	29.94
min	10
max	220
count	10917

Figure FR 13: *Distribution and descriptive statistics of dbh (diameter at breast height, = 1.37m) for all sampled birch at RCF TRI.*



median	31
mean	41.50
stdev	31.17
min	10
max	185
count	2683

Figure FR 14: *Distribution and descriptive statistics of dbh (diameter at breast height, = 1.37m) for all sampled white spruce at RCF TRI.*

Boreal Alaska – Learning, Adaptation, Production (BAKLAP) Quarterly Report

2013 Quarter #3 - PART 2

(July 1, 2013 – September 30, 2013)

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Forest Research QR 3.13 Accomplishment #3: Forest Development and Succession Following Wildfire – the Reserve West Forest Reference Stand

Deliverable 1.1 Data Atlas of Forest Research Installations (DAFRI)

***Deliverable* 2.1 Title: Scientific Input for Optimum Management Practices: Biomass and Climate (OMP)**

***Deliverable* 2.4 Title: Citizen Science Field Training and Framework Development (CITFORSCI)**

***Deliverable* 3.3 Title: Forest Management Outcomes Report (FORMOR)**

During 2013 Quarter #3, progress was made in compiling data from the Bonanza Creek Experimental Forest Reference Stand Network. Reference stands are hectare-scale plots in which all trees were mapped and measured following the 1983 Rosie Creek Fire. Six reference hectares were established following the fire to represent the three main commercial forest types – aspen dominated, white spruce dominated, and Alaska birch dominated, on sites that were burned in the fire and matched stands that were not burned (Figure FR 15)

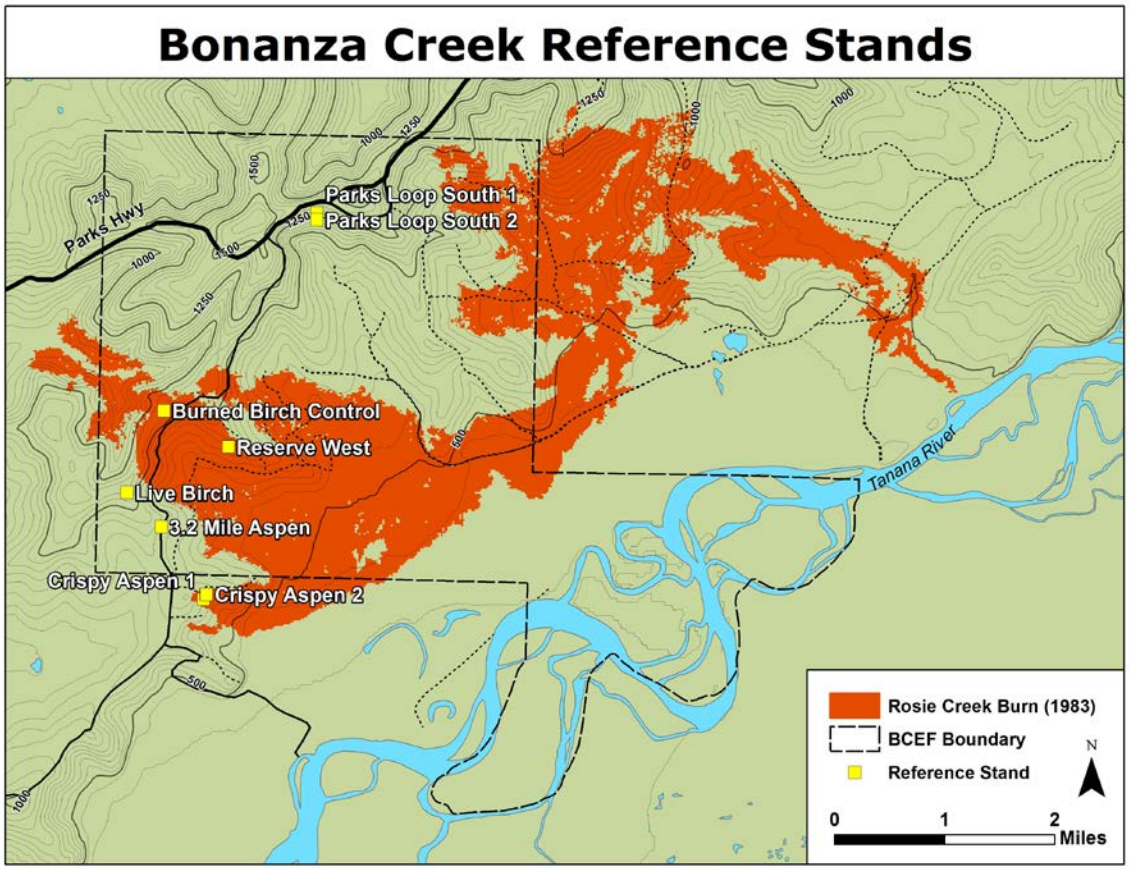

Figure FR 15: *Location and name of the 6 reference stand locations in Bonanza Creek Experimental Forest.*

The purpose, layout and history of the reference stands are described in a chapter in the second volume of Long-term Silvicultural and Ecological Studies (LTSR), Results for Science and Management, published by the Yale School of Forestry and Environmental Studies in 2013 (Figure FR 16). The first print run of the publication contained errors in the figures, and a second publishing will be issued.

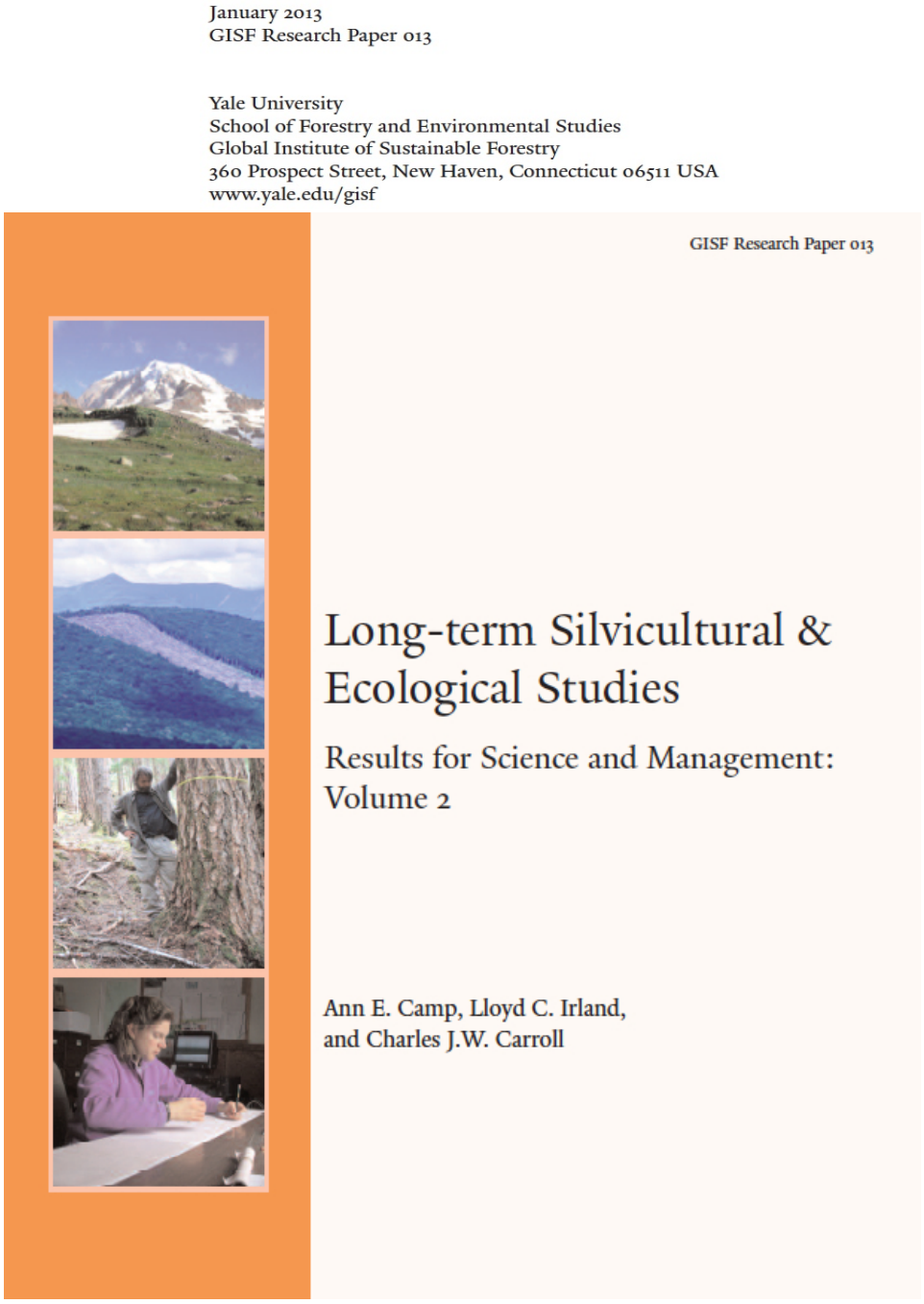

Figure FR 16: *Long-term studies publication containing two chapters with BAKLAP-related material.*

Volume 2 of LTSR also contains a chapter on the Rosie Creek Fire Tree Regeneration Installation (RCF TRI). The 2 chapters are:

Juday, Glenn P. 2013. Monitoring Hectare-Scale Forest Reference Stands At Bonanza Creek Experimental Forest LTER. Pp 31-48 In: Camp, A.E.; Irland, L.C.; Carroll, C.J.W. (eds.) Long-term Silvicultural & Ecological Studies: Results for Science and Management, Volume 2. Global Institute for Sustainable Forestry Research Paper 013, Yale University School of Forestry and Environmental Studies. 187 p.

Juday, Glenn P.; Densmore, Roseann V.; Zasada, John C. 2013. White Spruce Regeneration Silviculture Techniques 25 years after Wildfire: the Rosie Creek Fire Tree Regeneration Installation. Pp 49-65 In: Camp, A.E.; Irland, L.C.; Carroll, C.J.W. (eds.) Long-term Silvicultural & Ecological Studies: Results for Science and Management, Volume 2. Global Institute for Sustainable Forestry Research Paper 013, Yale University School of Forestry and Environmental Studies. 187 p.

This quarterly report will focus on the Reserve West reference hectare (formerly old growth white spruce stand, burned in 1983), located in the central portion of Bonanza Creek Experimental Forest (Figure FR 17).

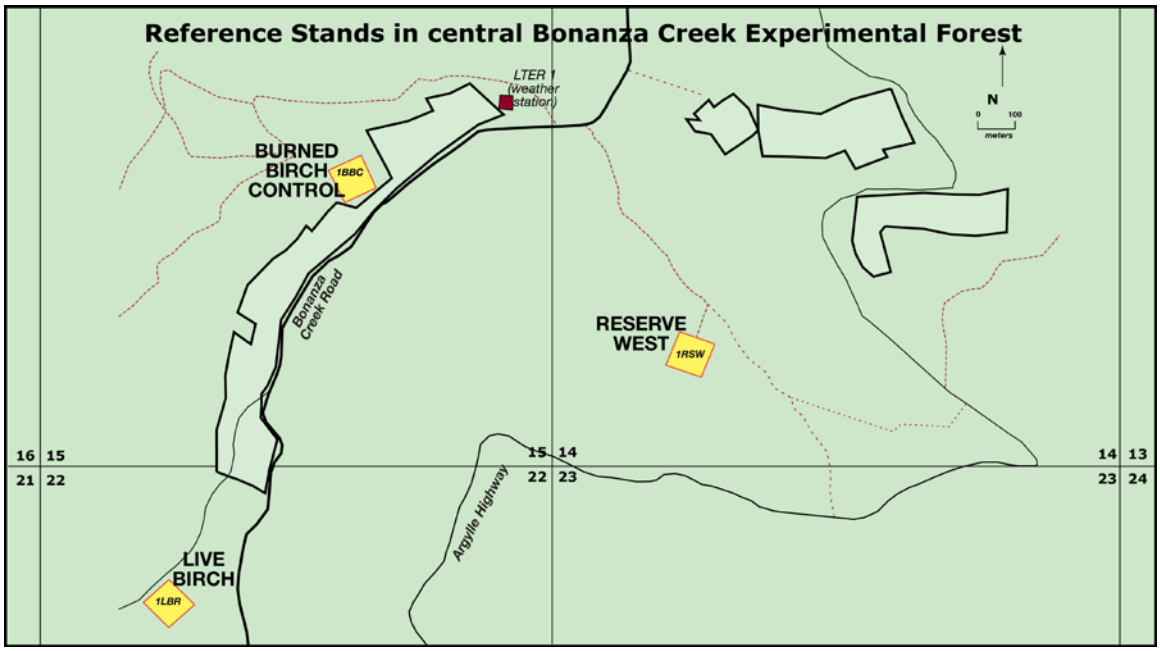

Figure FR 17: *Location of Reserve West Reference Hectare in Bonanza Creek Experimental Forest. .*

Reserve West is serving as a test case for the development of DAFRI data bases and data atlas entries. The location and layout of permanent photo monitoring stations is shown in Figure FR 18. These standard depictions of the location and layout are being replicated for the other 5 reference stands.

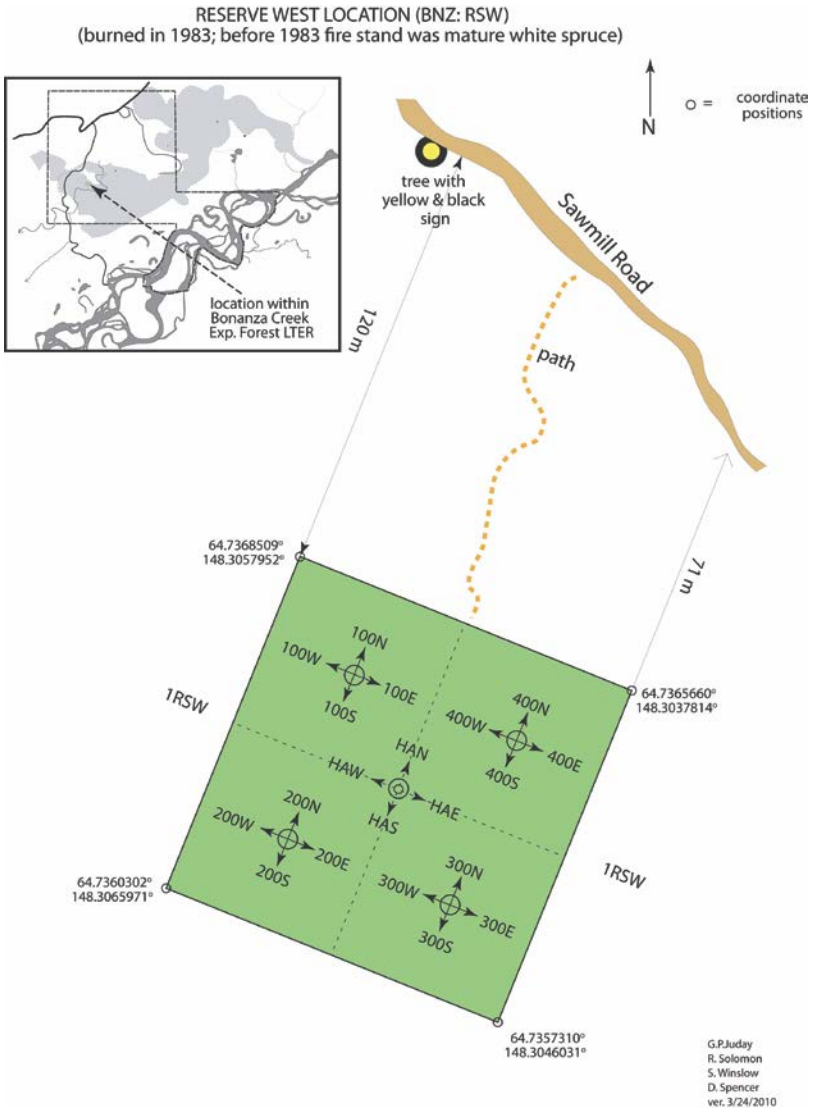

Figure FR 18*. Location of Reserve West Reference Stand and permanent photo monitoring stations.*

The growth, survival, and condition of all white spruce at Reserve West have been monitored annually since 1988. In 1989 reference hectare was divided up into 10m by 10m cells (Figure FR 19). Each 10m cell has a map of all live white spruce tree locations. It was found that in the field even with a complete list and the tagging of all tree locations (Figure FR 20), a location map was necessary in order to focus the search to relocate each tree.

After a few years of remeasurement of white spruce in the Reserve West Reference Stand, it was determined that more positional references were needed than provided by the positional posts in the 10m by 10m grid, so the hectare was gridded with posts places every 5m. This post gridding system allows a field reference measurement no farther than 2.5m for any feature in the plot.

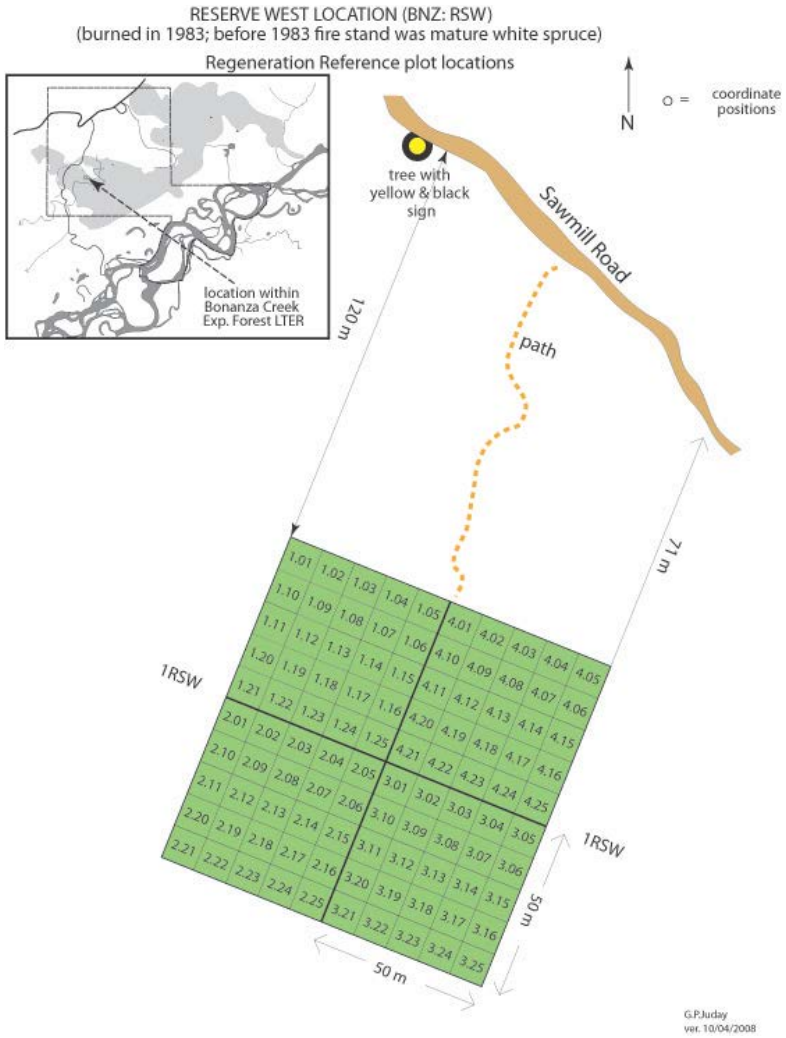

Figure FR 19*. Identification number of 10m by 10m gridded cells within Reserve West Reference Stand.*

Figure FR 20. *Pin flag and tag system for marking all 2,252 white spruce alive in the Reserve West Reference Hectare in 2013.*

Forest Research QR 2.13 Accomplishment #4:

Deliverable 1.3 Scientific Publications on Forest Production and Climate (SCIPUB)

Climatic variability continues to be a major challenge for the boreal forest of much of Alaska. Weather during 2013 was especially variable, with a record number of days with temperatures more than 2 standard deviations above or below normal by the end of the third quarter in

October (Figure FR 21). The near-record late spring and cold in April and early May was noted in a previous quarterly report. During the third quarter a record number of days with temperatures 80 degrees F or warmer was set at Fairbanks (Figure FR 22).

The late spring and snowmelt, together with moderate summer temperatures and well-timed rains in the 2012 growing season in central Alaska provided substantial relief from the cumulative heat and drought stress to trees that had reached severe levels over the past few decades. The trees entered 2013 growing season in a better condition than in many years. However the turn back to heat and drought was extreme. The mean temperature for the 5-month June through October time period at Fairbanks was a record high. Boreal trees on dry sites are now susceptible to decline from stress and are set to experience degraded performance in 2014.

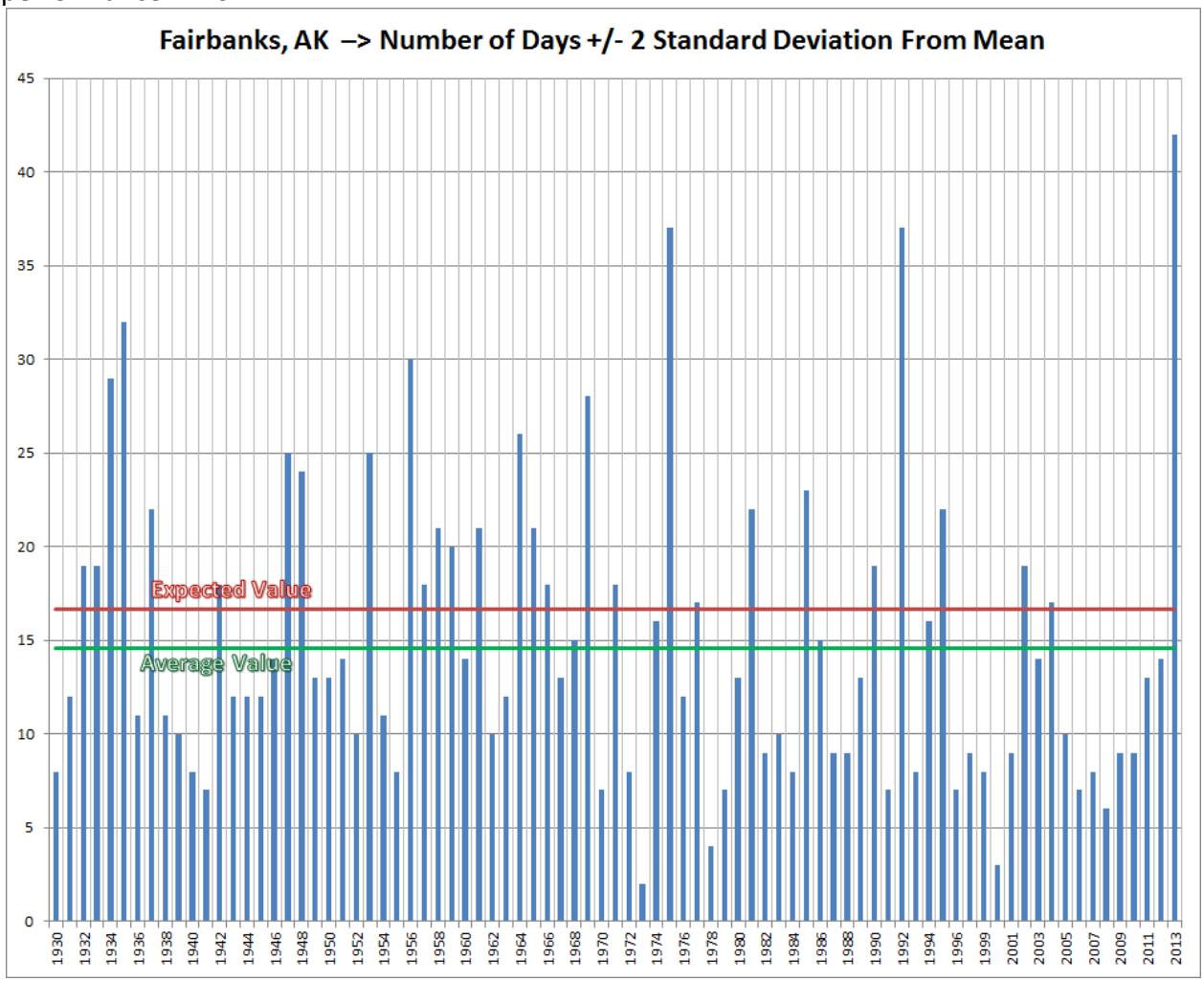

Figure FR 21. *Number of days with extreme departures from normal temperatures (above or below normal), by year, at Fairbanks Downtown (1930-1948) and Fairbanks International Airport (1949-2013) weather stations. Source: Fairbanks Office, National Weather Service, "Temperature Deviations From Normal" Sunday, October 20, 2013 (http://ak-wx.blogspot.com/). The year 2013 set the record only 3/4^{ths} of the way through the year.*

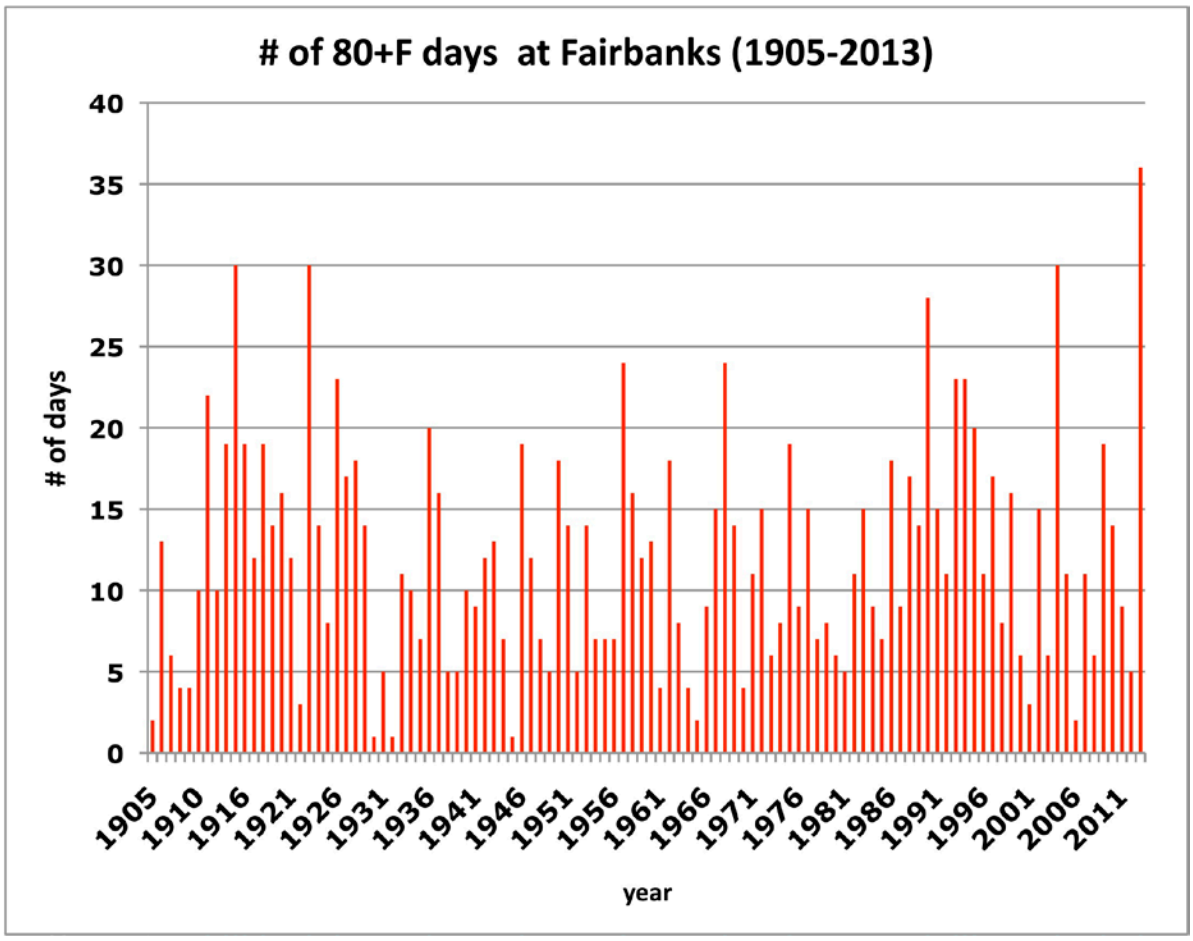

Figure FR 22. *Number of days with temperatures equal to or warmer than 80 degrees F at University Experiment Station (1905-1948) and Fairbanks International Airport (1949-2013).*

Forest Research QR 2.13 Accomplishment #5: Photo monitoring in Reference Stands

Deliverable 1.3 Scientific Publications on Forest Production and Climate (SCIPUB)

During the 2013 field season 2,756 monitoring photos were taken at fixed stations and views at the six reference stands (See: this report Figure FR 15), with an additional 174 general view photos (Table FR 4). The photos were taken on 18 unique days (Table FR 5) in three seasonal sets. The first set was taken after snowmelt but before leaf-out, the second during midsummer full leaf condition, and the third set after deciduous leaf fall but before snow accumulation.

Some fall photos were repeated because the deciduous leaves were retained to latest period in the fall in the last several decades at least, and it was assumed that fall photos with partial leaf retention would be preferable to photos with snow pack. In reality snow pack accumulation held off to a record-tying late date of October 31, so some fall photos were retaken with full leaf drop, but at the latest date in the 26 years of monitoring in the reference stand record.

A total of 30.9 GB of digital photos were added in 2013 to the collection (Table FR 4). Late in the quarter the BAKLAP team began a process of quality checking the entire collection of 15K photos, and standardizing the naming to make automated searches more feasible and specific.

BAKLAP Bonanza Creek Experimental Forest Photo monitoring; 2013 summary

Hectare	Year	Month	Day	# Photos	Data (MB)	# Photos	Data (MB)
132 A	2013	5	25	80	428.5		
132 A	2013	7	27	86	916.5		
132 A	2013	10	4	75	831.2		
132 A	2013	10	19	84	851.9		
Subtotal						325	3028.1
GenView 132A2013Sep16	2013	9	16	8	88.7		
Subtotal						8	88.7
2 PLS	2013	5	28	92	1061.5		
2 PLS	2013	7	26	78	800.8		
2 PLS	2013	9	25	86	852.8		
2 PLS	2013	10	16	70	736.2		
Subtotal						326	3451.3
1 PLS	2013	5	28	95	1071.1		
1 PLS	2013	7	26	83	828.5		
1 PLS	2013	9	25	93	928.7		
1 PLS	2013	10	16	77	800.0		
Subtotal						348	3628.3
1 LBR	2013	5	27	94	1325.0		
1 LBR	2013	7	27	94	1240.0		
1 LBR	2013	10	7	73	829.9		
1 LBR	2013	10	16	84	928.6		
Subtotal						345	4323.5
2 CRA	2013	5	22	112	1279.0		
2 CRA	2013	7	24	72	756.4		
2 CRA	2013	10	4	74	806.8		
2 CRA	2013	10	19	82	937.6		
Subtotal						340	3779.8
1 CRA	2013	5	22	98	1108.1		
1 CRA	2013	7	24	110	1010.0		
1 CRA	2013	10	4	71	841.4		
1 CRA	2013	10	17	82	726.1		
Subtotal						361	3685.6
1 BBC	2013	5	25	92	801.1		
1 BBC	2013	7	27	83	841.9		
1 BBC	2013	9	25	96	991.5		
1 BBC	2013	10	22	80	909.9		
Subtotal						351	3544.4
GenView 1BBC2013Sep16	2013	9	16	15	152.9		
GenView 1BBC2013Oct22	2013	10	22	12	130.5		
Subtotal						27	283.4
1 RSW	2013	5	23	93	1078.0		
1 RSW	2013	7	26	81	789.7		
1 RSW	2013	10	7	76	797.4		
1 RSW	2013	10	22	110	1186.7		
Subtotal						360	3851.8
GenView 1RSW2013Sep05	2013	9	5	33	278.6		
GenView 1RSW2013Sep16	2013	9	16	41	347.4		
GenView 1RSW2013Sep26	2013	9	26	36	301.0		
GenView 1RSW2013Oct22	2013	10	22	29	302.3		
Subtotal						139	1229.3
						# photos	**Data (MB)**
Monitoring subtotal						2756	29292.8
GenView subtotal						174	1601.4
TOTAL						2930	30894.2

Table FR 4. *Summary of field season 2013 reference stand monitoring photography.*

2013 month	2013 day	unique
5	22	1
5	23	1
5	25	1
5	27	1
5	28	1
7	24	1
7	26	1
7	27	1
9	5	1
9	16	1
9	25	1
9	26	1
10	4	1
10	7	1
10	16	1
10	17	1
10	19	1
10	22	1
sum		18

Table FR 5. *Dates of 2013 reference stand monitoring photography. Blue are spring season photo dates, green are summer dates, and red are fall dates.*

Forest Research QR 2.13 Accomplishment #6: Work log for Dashiell Feierabend

Note: covers the period 9/1 – 10/15

- Measuring spruce trees in Reserve West - 10.5 days
- Measuring DBH and height of hardwoods in Reserve West – 3 days
- Gathering missing data for Reserve West (including sample height protocol with laser) – 2 days
- Assisting with Bonanza Creek monitoring photos – 2 days
- Data management and map production in GIS
    - Importing Bonanza Creek photo monitoring plots
    - Importing Reserve West spruce and hardwood locations and associated attributes (Figure FR 22)
    - Digitizing Reserve West sampling grid
    - Displaying changes in spruce heights in Reserve West in 3D space from 1993-2013.
    - Comparing hardwood stem counts in Reserve West between 1997/1999 and 2013.
    - Displaying spatial extent of spruce trees taller than DBH height in Reserve West from 1988-2013.
    - Displaying spatial extent of hardwoods and spruce trees in Reserve West in 3D space in 1999.

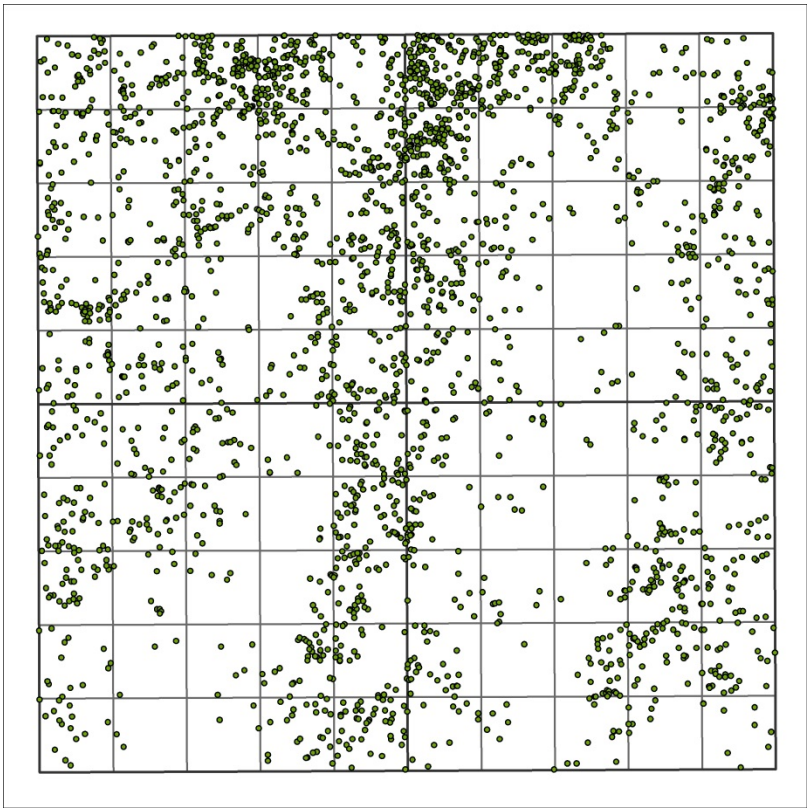

Figure FR 23. Reserve West spruce locations from new GIS file.

Forest Research QR 2.13 Accomplishment #7: Work log for Ryan Jess

(note: excludes BLM and work unrelated to BAKLAP)

July 1 – July 5

3 full days of Miho fieldwork in Two Rivers, forced to move due to Stuart Creek Fire
1 day Holiday
1 day West Ridge Phenology measurements, data entry, office work

July 8 – July 12

3 days (11-12hrs ea) Miho fieldwork in Rosie Creek and Bonanza Creek

July 15 – July 19

4 days Miho fieldwork in Cache Creek and Standard Creek
1 day West Ridge Phenology measurements and office work

July 22 – July 26

Vacation

July 29 – August 2

4 days (including one overnight) Miho fieldwork in Salcha, Nenana Ridge,

August 5 – August 9
4 days (including one overnight) Miho fieldwork off Parks Highway, Cache Creek, and Nenana Ridge

August 12 –August 16
4 days Miho fieldwork in Two Rivers, Cache Creek, Bonanza Creek, and Nenana Ridge

August 19 – August 23
3 office days preparing maps and data sheets for Reserve West measurements, testing out the laser accuracy, meetings with crew
1 day Miho fieldwork in Two Rivers with Brian Young

August 26 – August 30
3 days (including one overnight) Miho fieldwork in Two Rivers, and a boat trip to a remote plot across the river from Bonanza Creek
1 office day working on Reserve West preparation, datasheets, and maps

September 3 – September 6
2 days Andrew fieldwork in Bonanza Creek
2 days Reserve West prep/meetings/measurements

September 9 – September 13
4 days Reserve West measurements
1 day office work finishing up data sheets due to rain

September 16 – September 20
3 days Reserve West measurements
1 office day with meetings and preparation for Legislative Field Trip, gathered materials, etc.
1 day Legislative Field Trip, participated in each event, drove a shuttling vehicle

September 23 – September 27
1.5 days Reserve West, finishing the hectare
1 day Miho fieldwork in Standard Creek census plot
1 day Bonanza Creek Monitoring photos and photo naming
1 day gathering missing height/DBH information from Reserve West

September 30 – October 4
2 days measuring Reserve West Hardwoods
1 day Miho fieldwork in Standard Creek census plots
1 day redo height measurements with laser in Reserve West (laser height sample protocol)
1 day Bonanza Creek Monitoring photos and photo naming

Ryan Jess Totals:
28 days *(including many 10+ hour days)* working on Miho's fieldwork (including 3

overnights)

Sites include: Nenana Ridge, Bonanza Creek, Two Rivers, Salcha, Cache Creek, and Standard Creek

2 days West Ridge phenology measurements and data entry/management
2 days working on Andrew's fieldwork in Bonanza Creek
10.5 days measuring Reserve West
3 days measuring Reserve West Hardwoods (including hardwood heights with laser)
2 days gathering missing data (including sample height protocol with laser) in Reserve West
2 days of Bonanza Creek Monitoring Photos and naming
1.5 days of Legislative Fieldtrip preparation and participation
5 days office work, including data entry, datasheet creation, RSW maps, field preparations, etc.

Quarter 3, 2013 BAKLAP Report: K-20 STEAM Education Component

Summary and Highlights July-September 2013

*** Progress Made in Year 1 on Deliverables**

1) **Focus on Deliverable 1.3: K-20 Curriculum Development (STEM to STEAM)** Classroom activities:

   a) Germination and tree growth experiments and observations

      1. NEW "Does Family Matter?"

      2. NEW Cold Hardiness and Optimal Length of Dormancy

      3. NEW Growing Hybrid Birch

   b) "Tapping into Spring"

   c) Model Collaborative Instructional Design Projects

      1. NEW Watershed Charter School Interactive Mural

      2. NEW Effie Kokrine Early College Charter School

2) **Deliverable 1.4: Forest Entrepreneur Camp (FORENCA)**

3) **Deliverable 2.2: K-12 Teacher Professional Development Courses (K-12 PD)**

4) **Deliverable 2.4: Citizen Science Field Training and Framework Development (CITFORSCI)** (*Note: reserved for Q4 2013)*

*** Timeline and short reports: Travel, training, workshops, and special guests**

*** Legislative Field Investigation and Report**

* Progress Made in Year 1 on Deliverables

1) Focus on Deliverable 1.3: K-20 Curriculum Development (STEM to STEAM)

Evaluations and ongoing input from K-12 teachers and students, university service learners and BAKLAP personnel over the past year point in particular to three classroom activities as centerpieces of the project's K-12 approach. These include a) germination and tree growth experiments, b) Tapping into Spring, and 3) the project's commitment in all of its activities to customizing lesson plans and activities to suit grade-level curricula and teachers' special topic focus areas. K-12 teachers also commented how much they appreciate having scientists and graduate student service learners come into their classroom, and spoke about how inspiring these interactions are for their students *(see Sample "OneTree" Teacher Evaluation in Appendix).*

K-12 classroom-related efforts in Year 2 will focus on further developing these core activities, using our proven project-based, hands-on STEAM approach.

Currently, BAKLAP has grown to such an extent and so many people and institutions are involved that activities need to be scheduled continuously throughout a 12-month calendar. Summer remains a period of intense educational activity and projects. At the new higher tempo of work there is no longer a "shoulder season," and planning and preparation activities to have educational materials and people ready for classroom delivery has become a year-round imperative. However, current funding is only sufficient to accomplish this approach during 2013-2014, and continuation after that will only be possible with additional support.

Our goal is to maintain the high standard of content delivery and service while creating greater efficiencies and the ability to extend into more area classrooms. This quarterly report provides examples of classroom activities, Tapping into Spring, and model instructional design projects listed in Section 1, as examples of what we plan for Year 2.

a) **Germination and tree growth experiments and observations (conducted primarily during the first three quarters of the school year (September-early March)**

1. NEW "Does Family Matter?" After participating in BAKLAP Year 1 K-20 STEAM Education, Carri Forbes, a science teacher at Tanana Middle School, became interested in establishing a service-learning program at her school. She wrote a successful proposal to State Farm Foundation and secured training for herself and a mechanism to link her students to a nationwide program of school-based community service projects. The grant will pay bus fees for Ms. Forbes' five 7th grade classes to rotate travelling to the university 1-2x/month through the school year, as well as pay incidental expenses for experiments. Ms. Forbes and K-20

STEAM Education will work together throughout the school year on two observation-based science experiments.

Figure STEAM 1. *On left: Master of Education student, Diane Hunt, tends hundreds of newly germinated NR5 and NR14 seedlings, to be used in the university's replicate of Tanana Middle School's "Does Family Matter?" experiment. On right: a one-month-old NR5 seedling with first set true leaves (seed sown Sept. 14, photo taken Oct 14, 2013).*

The first, called "Does Family Matter?" will look at interactions between seedlings potted in different configurations. The objective is to learn whether growth response differs when sibling seedlings are grown together, as opposed to when unrelated seedlings are grown together. The experiment will be conducted at Tanana Middle School, with a smaller, parallel study done at the university. Both venues will use progeny from the same Nenana Ridge maternal trees (NR5 and NR14). The motivation to undertake this experiment comes from a new, exciting area of research about kin recognition in plants. Thanks to Ms. Forbes, Peter Shier's four 7th grade life science classes are considering joining the experiment at the beginning of 2014. (*To learn more, please refer to the NOVA and the World news brief "Plants With Family Values" in the Appendix* and *the entry Carri Forbes – Tanana Middle School science teacher: Tanana Middle School Service Learning Project in the Legislative Field Investigation and Report section of the report).*

2. NEW Cold Hardiness and Optimal Length of Dormancy Experiment: In addition to "Does Family Matter?" Ms. Forbes' students and university service learners will cooperate on a second experiment. This experiment, called "Cold Hardiness and Optimal Length of Dormancy" will be conducted in the IAB Greenhouse on the university campus. Continuity and oversight of data collection will be the provided by university personnel. Tanana Middle School