Annual Project Update Report

CESU Cooperative Agreement Number: H1200040001, CSU-RM31
Diane C. Abendroth and Dr. Mohammed A. Kalkhan
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1. Introduction:

This report serves as an update on the progress made toward completing the project funded under CESU Cooperative Agreement Number H1200040001. This update discusses progress made toward completion of graduate coursework, modifications to the research plan and expected outcomes, an outline of remaining work during 2006 and 2007, and a timeline for completion. The anticipated completion date is December 2007.

The Cooperative Ecosystem Studies Unit (CESU) agreement number H1200040001 funds a graduate research project entitled "Fire Severity and Fuels/Vegetation Map Updates in Burned Areas." This project includes Diane Abendroth's thesis work to fulfill the requirements of a Masters of Science degree in Forestry from Colorado State University. Diane Abendroth is also a Fire Effects Monitor working at Grand Teton National Park.

2. Coursework Progress :

The bulk of the coursework necessary for completing a M.S. degree in Forestry with a concentration in Fire Ecology was completed in 2005 and 2006. Courses were taken which will facilitate research planning, data analysis and interpretation, and an increased understanding of ecological principles and theories.

Completed Courses:

Fall 2005:

Course Name	Number	Credits	Grade
Experimental Design and Data Analysis for researchers I	ST 511	4	A
Seminar in Forestry	F 693	1	P
Ecology of Grasslands and Shrublands	RS 630	3	A
Thesis Research	F623	3	S

Spring 2006 :

Course Name	Number	Credits	Grade
Fire Ecology	F 624	3	A
Natural Resource Sampling	NR 421	3	A+
Experimental Design and Data Analysis for researchers II	ST 512	4	A
Silvicultural Practices	F525	4	A

Transfer Credits:

Course Name	Number	Credits	Grade
Techniques for Ecosystem Management - Colorado State Univ.	NR526	4	A
Topics in Forest Management - Utah State University	FRWS 6910	3	A
Special Studies in Forestry - Northern Arizona University	FOR 506	3	A

Fall 2006 Courses:

Course Number	Course Name	Credits	Grade
Concepts in GIS	NR 505	4	A
Spatial Statistical Modeling for Natural Resources	NR 512	3	A
Remote Sensing of Natural Resources	NR 323	3	A

Research Project:

Two alternatives were explored for design of the research project. The following two abstracts were provided to Dr. Kalkhan and the NPS Key Officials Lisa Elenz and Kelly McCloskey:

Abstract 1:

Fire Effects of Moderate Severity Burns in Intermountain Mixed Conifer Forests: Fuel Loading and Forest Structure Succession

Satellite imagery has been used to map and classify burn severity. The accuracy is highest with high severity. The effects of stand replacing fire and the successional trajectories following complete overstory mortality are well understood. This data has been helpful in managing rehabilitation and predicting primary succession. Less is understood about the effects of moderate burns, which generally make up 20-50% of large wildland fires in the intermountain West. The fire regimes of mixed conifer forests have been described as a "stand replacing regime," however significant portions of wildland fires are moderate and low severity.

Moderate severity burns are characterized by partial mortality of overstory trees, and incomplete combustion of fuels in the canopy and on the ground. The post-fire successional patterns are complicated by seed source, shading, and substrate factors.

Post-fire fuel loading changes over time are expected to depend on a variety of factors, including recruitment of downed woody debris, post fire plant succession, and unburned persistent fuels.

This study will use NBR burn severity mapping to locate moderately burned areas in GTNP and the BTNF over the past 30 years in mixed conifer. Adjacent control areas in unburned forests will be chosen by spectral reflectance analysis using pre-burn satellite images. The moderately burned locations will be paired with these unburned stands for sampling of post burn fuel loading

and forest structure. Comparisons will be made between burned and unburned areas by time since fire. This information will add to the understanding of how mixed conifer forests in the intermountain west respond to moderate severity fires over time. The findings will be used to predict post-burn changes in forest structure and fuel loading and update fuels maps for moderate burns post fire.

Abstract 2:

Predicting and Mapping Stand Replacement Fire in Western Wyoming Forests Using Satellite Imagery

This project will explore new methods for the use of Landsat data to map stand replacing fire effects in the forest types of western Wyoming. Burn severity has been measured and described in a variety of ways using remote sensing, but measures linked to ecological processes are lacking (Lentile et al 2006, Thode 2006, Key and Benson 2006, Ryan and Noste 1983). The Normalized Burn Ratio, a burn severity mapping method gaining widespread use, provides measures of the absolute spectral reflectance changes in post fire images. This has been used with success to classify burned areas into four or five categories ranging from "unburned" to "severely burned." Such classifications are not universal across ecosystems or vegetation types (Brewer et al 2005, Miller and Thode 2006), nor are they easily interpreted in terms of ecological structure or function (Lentile et al 2006).

In western forests, a basic, important, and tangible measure of burn severity is stand replacement fire (Ryan and Noste 1983, Turner et al 1994). Maps of the distribution of stand replacing fire effects have utility for both resource managers and ecologists. Because canopy vegetation is visible to overhead instruments, it is likely that the near and middle infrared portions of the electromagnetic spectrum are sufficiently sensitive to predict this mortality threshold (White et al 1996). I propose that a suitable model for detecting and differentiating stand replacing fire can be developed.

I have collected over 620 Composite Burn Index (CBI) ground truthing plots in 19 recent large fires in Grand Teton National Park, Yellowstone National Park, and the Bridger-Teton National Forest in western Wyoming since 2000. I will attempt several modeling approaches to identify thresholds in Landsat TM and ETM+ images that will make it possible to map stand replacing fire. I will test the inclusion of ancillary data such as pre-fire vegetation type, reflectance transformations, and topography. When the best-performing model is found, I will use it to map stand replacement for large fires in the study area from 1984-present using archived Landsat data. Accuracy assessment will be conducted on a sample of fires using scanned and geo-referenced post-burn true color aerial photographs. These maps of stand replacing fire will provide a framework for further investigations into the spatial patterns and processes of fire behavior, vegetative recovery and fuels recruitment that has occurred in the study area over 20 years.

3. Modificaitons to Research Outcomes:

Due to the selection of the second research alternative, the following adjustments should be made to the project deliverables in the agreement.

1. A model to predict ecologically meaningful severity distribution patterns using remote sensing. This will provide the groundwork for predicting fuels succession and ecological effects of large wildland fires in Northwest Wyoming landscapes (12/2007).

2. Acquisition, interpretation, and production of quantitative and qualitative spatial data, including a Burn Severity history Atlas for Grand Teton National Park and the Bridger-Teton National Forest for use in the Fire Management Analysis phase II process (7/2007).

4. A context for determining and evaluating fire regime condition class and current vegetation versus desired future conditions on a local, landscape, and regional scale (12/2007).

5. A case study demonstrating the use of burn severity spatial data in evaluating the effects of fire events on fire regime condition class at the project and watershed level (12/2007).

6. Graduate Research Assistantship appointment for the Park's Fire Effects Monitor (8/2005-12/2007).

7. Graduate Tuition and Fees, office facilities, computer and lab use and pre-approved travel for Principal Investigator and Park's Fire Effects Monitor 8/2005 – 12/2007

8. Conference presentations and journal article submitted for publication by graduate student, co-authored by Dr. Kalkhan and others as appropriate based on contribution, pre-approved by NPS representatives.

Remaining Work:

During the 2007 Spring semester, only thesis credits will be taken. Data analysis for the research project will continue in Spring and Summer 2007.

Spring 2007:

Course Number	Course Name	Credits	Grade
Thesis Research	F623	1	

Timeline 2006-2007:

X = Completed
x = Not yet completed

Task:	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Coursework	X	X	X	X	X											
Committee Meeting					X											
Data Gathering	X	X	X	X	X	x	x	x								
Data Analysis			X	X	X	x	x	x	x	x						

Write Thesis			X	X	X	x	x	x	x	x						
Submit thesis for review										x	x					
Revise thesis											x	x	x	x	x	
Defend thesis														x	x	x
Result sharing															x	x