Final report, Joint Fire Science Program 2004-2 Task 1 Locally important knowledge or data gaps

Project Title: The effect of spring prescribed fires on nitrogen dynamics within riparian and stream ecosystems.

Project ID: 04-2-1-97

Project Location: Boise National Forest: Canyon Cr Fire Lowman RD, South Fork fire Cascade RD and Danskin Cr; Emmett RD.

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1. MAIN FINDINGS TO DATE

- **The soil and water nitrogen effects of prescribed fires do not mimic the nitrogen dynamics of wildfires.**
- **There is some increase in soil N after a prescribed burn but the magnitude and duration of this pulse is very short-lived relative to wildfire.**
- **Intense spring wildfires are required to increase soil N concentrations to a magnitude similar to wildfire.**
- In stark contrast to wildfires, nitrate concentrations in streamwater were not increased after prescribed burning, indicating the post-fire N pulse is completely retained in the terrestrial ecosystem.
- **The main take home message for managers is that spring prescribed fires do not mimic wildfire when considering nitrogen cycling. Wildfires provide significant long-term (3yr at least) pulses of nitrogen to aquatic systems but prescribed fires do not. This is true even when the headwater riparian areas are burned in a spring prescribed burn.**
- **If nitrogen is a limiting nutrient, you may want to consider intense spring wildfires to allow some additional nutrient flow into the aquatic ecosystem.**

2. DETAILS BEHIND THE MAIN FINDINGS TO DATE

Nitrogen dynamics in riparian forests and adjacent aquatic ecosystems respond differently to wildfire relative to prescribed fire.

Spring prescribed burning is a common tool for fuel reduction. But how do spring prescribed burns affect watershed scale nitrogen (N) cycling? We simultaneously measured N concentrations in soil, understory plant foliage, stream water, and in-stream biota in headwater watersheds of replicated spring prescribed burns and one more severe spring test burn for two post-fire years. We also compared the results of this study to the results of the companion study on wildfires. We found that soil ammonium and nitrate concentrations were significantly increased in burned relative to unburned watersheds about one month and three to four months, respectively, after prescribed burning ($P < 0.05$). The magnitude of increase was lower than that observed at the same time but nine to twelve months after wildfire. Interestingly, the magnitude of the post-fire increase in soil ammonium and nitrate was similar between the severe spring test burn site and

wildfires ($P > 0.05$) indicating a correlation between burn severity and soil inorganic N concentrations post-fire. Plants resprouting after prescribed burns retained post-fire available soil N as indicated by higher foliar N concentrations in a similar way as observed after wildfires. In stark contrast to wildfires, nitrate concentrations in streamwater were not increased after prescribed burning, indicating complete retention in the terrestrial ecosystem component. Thus, prescribed burns did not provide the stream ecosystem with the important nutrient pulses it has evolved with. The localized and short term effects on terrestrial nitrogen dynamics after low severity spring prescribed burns indicate that managers should aim for higher burn severity in order to stimulate N cycling and to reduce fuel loads more significantly.

More details can be found in the submitted journal articles, or in the PhD theses by Aki Koyama or Kirsten Stephen both of which are on file at the University of Idaho Library and the Joint Fire Science data base.

DELIVERABLES

Proposed	***Accomplished/Status***
Annual progress reports	Annual progress reports completed
Series of 4 journal papers	1) Stephan, K and Kavanagh K. *Accepted*. Suitability of the diffusion method for low concentrations of ammonium and nitrate in KCL extracts for 15N analysis at natural abundance. Soil Science Society of America Journal. 2) Stephan, K., Kavanagh K.L and Koyama A. *To be submitted June 2008*. Impact of fire severity on watershed nitrogen cycling using ^{15}N natural abundance in terrestrial and aquatic ecosystem components. Submit to Biogeochemistry. 3) Koyama, A. Kavanagh, K. and Stephan K. *Submitted Dec 2007*. Fire effects on gross inorganic N fluxes in riparian soils in coniferous forests of central Idaho, USA. Wildfires vs. Prescribed fires. Submit to Soil Biology and Biochemistry. 4) Stephan, K., Koyama A. and Kavanagh K.L Effects of Spring Prescribed Burning on Watershed Nitrogen Dynamics of Central Idaho Headwater Areas. *Submit to Ecosystems June 2008.*

Proposed	***Accomplished/Status***
Lab web site with preliminary results linked to JFSP website.	Web site was created www and preliminary results were posted. http://www.cnr.uidaho.edu/jfsp/ We will link this site to JFSP and FRAMES.
Short course to resource professionals containing results of this research.	This research has been presented at 3 short courses. 1) Spring 2005. Advanced Regeneration and Fire Restoration. an extended Education shortcourse offered to 22 forest management professionals from the USFS, BIA and BLM. 2) Spring 2006. Presentation made to the USFS Fire Mangers Boise ID. 3) Spring 2007. Intermountain Forest Tree Nutrition Coop Annual Meeting. Title. Presentation of results to USFS, BLM, State Agency and private landowners of the region.

Results from this research incorporated in coursework at U of I.	This research has been presented in the U of I Fire Ecology course taught by Dr. Penny Morgan. The graduate students on this project served as guest lecturers for 2 years. Results of this research were used to develop an online lecture covering fire effects as part of the online FOR 401 series from the U of I. http://401series.net/. The success of this research contributed to the development of the first BS in Fire Ecology and Management in the Country. This major began at the University of Idaho in Fall 2007.

Proposed	***Accomplished/Status***
Presentations at JFSP PI meetings and national ESA.	Three posters from this research were presented at the 3rd International Fire Ecology and Management Congress, San Diego. 2006. There was no JFSP PI meeting in 2006. I did attend the 2005 JFSP 2005 meeting but was not assigned a presentation. Three posters form this research were presented at the Ecological Society of America meetings in Montreal, CA 2005 and Memphis TN 2006, and the 2007 American Geophysical Union Meeting in San Francisco.