Final Report

JOINT FIRE SCIENCE PROGRAM

TITLE OF PROJECT: Data Archival for Fire Studies in the Coastal Plain, Piedmont, and Southern Appalachian Mountains

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BACKGROUND

Datasets from on-going and previous fire studies in the Coastal Plain, Piedmont, and Southern Appalachian regions in the southeastern U.S. dating back over the past 50 years were compiled and publically made available to other interested persons. The projects included for this data archival have helped to advanced fire science and provided much needed information about fire effects on ecosystem components. The research from these projects has demonstrated how returning fire to once fire-adapted communities is an on-going process that needs to be repeated frequently. They also have given some insight into alternative treatments that may be used for fuel reduction, depending on land managers' objectives, and the ecological effects that may be associated with alternative treatment. The commonalities between these studies both in variables measured and site locations provide data that allow a more complete view of these ecosystems providing a unique opportunity for meta-analysis of multiple fires and other fuel reduction treatments at regional levels.

APPROACH

Datasets from 7 different studies were selected to provide information pertaining to fire and/or fuel treatment effects on vegetation, fuels, and soils: 1) prescribed burning for stand replacement in Table Mountain pine stands in the southern Appalachian Mountains; 2) consequences of fire and fuel reduction treatments in the Piedmont and Coastal Plain; 3) fuel classification by landscape position in the southern Appalachians; 4) fuel decomposition rates by landscape position in the Southern Appalachians; 5) prescribed burning and release of mercury; 6) long-term winter-burning effects on vegetation and soils in the Coastal Plain; and 7) season of burn and fire return interval effects on vegetation and soils in the Piedmont. Five of these studies can be considered as long-term projects with sampling occurring over 8-24 years (with one study encompassing 50+ years), whereas the other 2 studies were 2-5 year projects. Each dataset and its variables are found in Table 1.

DESCRIPTION OF DATASETS

Three of the above mentioned studies are currently being measured; therefore, a restriction on the data availability has been made until the data have been published or for a 2-year period, whichever comes first. Datasets have been (or will be) completed and submitted to the Forest Service Data Archive (http://www.fs.usda.gov/rds/archive). The name of each dataset and its variables are found in Appendix A. A detailed description of each dataset (and study's status) follows:

1. Prescribed burning for stand replacement of Table Mountain pine (*Pinus pungens* Lamb.) in the Southern Appalachian Mountains (1997-2009; inactive) – Seven locations within northeast Georgia and northwest South Carolina were burned to identify stand replacement dynamics for restoration of Table Mountain pine. Each study site included at least fifteen, permanently marked 200-m^2 plots, stratified by topographic position (north-facing slope, ridge top, or south-facing slope). Vegetation attributes for each forest stratum (overstory, midstory, and understory) were measured prior to and multiple times following each prescribed fire to examine mortality rates, success of pine regeneration, and changes in community structure and composition.

2. The consequences of fire and fire surrogate treatments: Piedmont and Coastal Plain Sites (2000-2008; inactive) – Study sites were established in Alabama, Florida, and South Carolina to investigate the long-term effects of fire or other fuel reduction treatments on fuels, forest structure, soil processes, and soil biology. Treatments included prescribed fire, mechanical fuel reduction, combination of fire and mechanical treatment, and control. Each treatment was replicated 3 times with each replicate containing ten rectangular 0.1-ha sample plots for vegetation and soils measurements; additionally, 72 to 120 transects (15-m long) were measured for estimating fuel loading. All data collection was performed prior to treatment, immediately following treatment, and 3 years following treatment. At least 1 mechanical and 2 burn treatments were implemented over the study period.

3. Fuel classification for the southern Appalachian Mountains using hyperspectral images and Landscape Ecosystem Classification (2002-2005; inactive) – Fuel loading by topographic position was estimated at 4 study sites within the southern Appalachian Mountains (northeastern Georgia, western North Carolina, northwestern South Carolina, and southeastern Tennessee). Each study site encompassed 26-km^2 of forested land containing up to 250 sample plots stratified by landscape position (SW lower slope, SW mid/upper slope, NE lower slope, NE mid/upper slope, or ridge top). Each sample plot was 200-m^2 and contained three, 15-m long transects for fuel sampling. Overstory and midstory vegetation were measured on the entire plot, whereas understory vegetation was recorded on half of the plot. Plots were also classified by disturbance type (fire, harvest, southern pine beetle, or wind damage) for comparison between disturbed vs. undisturbed.

4. Fuel decomposition and Landscape Ecosystem Classification in the southern Appalachians (2005-2007; inactive) – This project examined the input and decay rates of leaf litter and fine woody fuels across topographic gradients. Fifty sample locations (10 replicates for each landscape position) were located on middle or lower NE- or SW-facing slopes and ridge tops in northwestern Georgia. At each sample location, five litter traps ($1m^2$) were constructed and monitored every 3 months over 2 years. Samples from each trap were analyzed in the lab for wet/dry weight and C:N ratio.

5. Prescribed burning and the release of mercury (2005-present; active) – Estimation of local and region-wide emission of mercury in the South due to prescribed burning is on-going. Study sites in the Coastal Plain, Piedmont, and southern Appalachian Mountains were sampled prior to and immediately following burning to estimate the amount of mercury released into the atmosphere and leached into the soil. For each physiographic region, 2 sites were established with 10 sample locations per site. Samples were also collected to examine differences based on burn history. Forest floor and mineral soil samples were collected and stored according to protocols to limit mercury contamination and limit loss of gaseous mercury. A preliminary set of samples was analyzed in the laboratory to ensure correct procedures were followed and reliable data were acquired. These results were included in a final report to JFSP submitted by Tom Waldrop in 2009. Laboratory analysis is on-going for additional samples and is intended to be completed by the end of FY2013.

6. Osceola (1958-present; active) – Established in 1958 to examine the effects of burning frequency on fuel reduction. Burning treatments ever 1, 2, or 4 years have been applied since 1964. Within each block, 0.8-ha sample plots were randomly assigned to the different fire regimes. Vegetation structure and composition have measured over time demonstrating a shift from woody to herbaceous understory with increasing fire frequency. Overstory mortality has been observed over time. Soil biology is continuing to be measured to identify differences in soil species composition as related to fire return interval.

7. Season of burn and fire return interval on the Hitchiti Experimental Forest in the Georgia Piedmont (1987-present; active) – The study's overall objective is to quantify long-term responses to different seasons of burn (winter vs. summer) at various return intervals. Four replicates of twenty-four 1-ha plots were established to measure vegetation and soil response to 5 different burning treatments (winter or summer burning every 2 years, 3 years, or 6 years). Vegetation samples were collected during the first growing season following winter burns or late summer during the same year of summer burns. Forty soil samples per treatment plot were collected and analyzed for chemical and physical properties. Soils samples have also been collected for soil biology classification.

PROJECT DATA

Variables for fuels, vegetation, and soils have been submitted to the data repository. While the data were obtained from different studies, sample methodology was similar between studies and the data are reported in a consistent format across all studies. Fuel data are separated into forest floor, fine woody fuel, large woody debris, and total fuel loading (Mg/ha).

Vegetation data are reported for overstory basal area (m^2/ha) and mortality (%); stem density for all tree species in the overstory, midstory, or understory strata (#/ha); shrub cover as m^2/ha or percent cover (%) by species; and herbaceous vegetation as percent cover (%) by growth form.

Soil data include: nutrient analysis (Al, Ca, Fe, N, P, Mg, Na) (ppm); mercury concentration (µg/kg); nitrogen dynamics (total N (mg/kg); total inorganic N (mg/kg); net N mineralization (mg/kg/d) and net nitrification (mg/kg/d)); carbon dynamics (total C (mg/kg) and C:N ratio); and soil biology as indicated through DNA analysis or enzyme analysis (acid phosphatase, chitinase, and phenol oxidase (umol/h/g)).

Additional variables for some studies include landscape position and disturbance history as topography and history have significant impacts on fire behavior and vegetation composition.

Metadata accompany all datasets submitted in the data repository. The Biological Data Profile standard was used to ensure compliance with Federal Geographic Data Committee (FGDC) metadata standards. The metadata documentation tool Metavist was used for creating all metadata.

LONG-TERM DATA MANAGEMENT

Datasets, metadata, and references to scientific papers associated with the data are located in the U.S. Forest Service Data Archive (http://www.fs.usda.gov/rds/archive). All data are classified as “open access” except for current studies which have not been published as of August 31, 2013. These data are noted as active studies and have a 2-year time restriction placed on their data availability to allow for publication of new results. When research papers are completed before the end of the 2-year time period, notification will be sent to the archive and the time restriction will be removed.

Any changes made to the data will be recorded in a log, noting the reason for change, and updates will be made in the data repository with a notice for persons using the affected datasets.

Table 1. Data from southeastern United States (USA) fire studies included in the U.S. Forest Service data archive. (**Bold** data have not been published as of 31 August 2013 and will be archived by 2015.)

Study	Variables						
1) Table Mountain Pine Study	Overstory Basal Area (m^2/ha)	Stem Density (stems/ha)	Ericaceous Shrub Coverage (%)				
2) Fire and Fire Surrogate Study	Overstory Basal Area (m^2/ha)	Stem Density (stems/ha)	Understory Cover (%)	Soil Carbon and Nitrogen Dynamics	Soil Nutrients (Al, Ca, Fe, N, P, K, Mg, Na)	Soil Biology (enzyme activity)	Fuel Loading (Mg/ha)
3) Hyperspectral Study	Overstory Basal Area (m^2/ha)	Ericaceous Shrub Coverage (%)	Fuel Loading (Mg/ha)	Landscape Position	Disturbance Type		
4) Fuel Decomposition Study	Fuel Loading (Mg/ha)	Litter/Fine Fuel Accumulation (g/m^2)	Litter/Fine Fuel Decomposition (% mass remaining)	Carbon and Nitrogen Dynamics	Landscape Position		
5) Soil Mercury Study	**Mercury Concentration (µg/kg)**	**Forest Floor and Soil Mass (t/ha)**	**Organic Carbon Concentration (% by mass)**				
6) Osceola National Forest Long-Term, Winter Burn Study	Overstory Basal Area (m^2/ha)	Stem Density (stems/ha)	Mortality (%)	**Soil Biology (DNA analysis)**	Fuel Loading (Mg/ha)		
7) Hitchiti Experimental Forest Fire Return Interval and Season of Burn Study	Overstory Basal Area (m^2/ha)	Stem Density (stems/ha)	Understory Cover (%)	**Soil Carbon and Nitrogen**	**Soil Nutrients (Al, Ca, Fe, N, P, K, Mg, Na)**	**Soil Biology (DNA analysis)**	