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Archival of eastern U.S. fire scar history data

Michael C. Stambaugh
University of Missouri

Joseph M. Marschall
University of Missouri

Richard P. Guyette
University of Missouri

Final Report

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Title: Archival of eastern U.S. fire scar history data

Report authors: Michael C. Stambaugh, Joseph M. Marschall, Richard P. Guyette

Principal Investigator: Michael C. Stambaugh, Assistant Research Professor, Department of Forestry, University of Missouri

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I. Abstract

Fire scar histories are a critical fire data source because they form a foundation for defining fire regimes. The objective of this project was to properly archive the data (fire scar event chronologies, tree-ring chronologies) and metadata of eastern U.S. fire scar study sites developed under project #06-3-1-16, "Developing and Using Fire Scar Histories in the Southern and Eastern United States", PI: Richard Guyette. Datasets to be archived included tree-ring chronologies (annual resolution), fire event chronologies (annual to seasonal resolution), and wood samples. Crossdated tree-ring measurements used to date fire scars have been submitted to the International Tree-Ring Databank. All fire history datasets, including metadata, have been submitted to NOAA's International Multiproxy Paleofire Databank. Metadata describing tree species, spatial attributes, and access were entered into Metavist. The management implications of these data pertain to applications to forest ecosystem conservation and restoration through the design of fire management programs. Additional work is needed to complete archival of over 50 additional datasets completed by the Missouri Tree-Ring Laboratory.

II. Background and purpose

Fire scar histories are a critical fire data source because they form a foundation for defining fire regimes. These fire regime descriptions are used to inform land-management objectives, calibrate fire models, and address long-term land-use and climate-change effects. Multi-century and high quality fire scar datasets are unique datasets and are particularly uncommon in the eastern U.S. Archiving these data in publicly accessible databanks ensures they will be accessible to future generations that will likely have new analytical methods and tools.

Through Joint Fire Science Program funding (Project #06-3-1-16, period: 2006-2010, PI: Richard Guyette) twelve new fire history records were developed throughout the eastern U.S. in regions where no fire scar history data previously existed (Table 1). Fire event chronologies that extend into pre-EuroAmerican time periods (300+ years before present) were developed at sites located in Alabama, Louisiana, Kentucky, Iowa, Wisconsin, and Michigan. The outcome of this work included a final report (Guyette et al. 2010), two published peer-reviewed journal articles (Stambaugh et al. 2011, Guyette et al. 2012), a thesis (Bale 2009), and several JFSP science notes. One additional scientific manuscript is in review (Guyette et al. in review) and three manuscripts are in preparation. These eastern U.S. fire event chronologies contributed important data toward developing a physical chemistry fire frequency model (Guyette et al. 2012). Although the project has concluded the physical specimens, data, and metadata had not been properly stored or permanently archived. The objective of this project was to properly archive the data (fire scar event chronologies, tree-ring chronologies) and metadata in a publicly accessible site.

III. Study description and location

Datasets to be archived included tree-ring chronologies (annual resolution), fire event chronologies (annual to seasonal resolution), and wood samples. Tree-ring chronologies are important because they are the foundation for fire scar dates. Fire scar history data to be archived represent fire event records from pre-EuroAmerican settlement time periods. Sites are located in six states (Table 1). In Alabama, two study sites are located on or adjacent to the Talladega National Forest in montane longleaf pine (Pinus palustris) stands and in areas with active red-cockaded woodpecker management (Bale 2009). In Louisiana, a site was established on the Kisatchie National Forest in region characterized as a longleaf pine – bluestem ecosystem (Stambaugh et al. 2011, listed above). In Kentucky, three sites were established: one on the eastern edge of the state on the Daniel Boone National Forest and two on the western edge of the state on the Land Between the Lakes National Recreation Area. Two of these sites consisted of shortleaf pine (Pinus echinata) and one of post oak (Quercus stellata). In Iowa, a historic cabin located along the Mississippi River was found to have fire scars located on multiple butt white oak (Quercus alba) logs. This cabin provided the first pre-settlement period information of fire frequency in Iowa. In Wisconsin, two sites were established using red pine (Pinus resinosa) on the Chequamegon-Nicolet National Forest (Guyette et al. in prep.). Lastly, fire scar data from the Upper Peninsula of Michigan were collected in red pine forests in mountain and Lake Superior shoreline forests (Muzika et al. in review). These data include the longest existing fire event and tree growth chronologies for red pine.

Table 1. Fire scar history sites whose wood and data will be archived during this project.

Site	LabCode	State	Species[a]	Location	Time period[b]	Years
Land Between the Lakes	LBL	KY	PO	36°46'N, 88°03'W	1688-2005	318
Pine Camp	PCP	KY	SP	36°38'N, 88°01'W	1790-2005	216
Hatton Ridge	HTN	KY	Pinus	37°54'N, 83°41'W	1742-2004	263
Kisatchie Hills	KIS	LA	LP	31°31'N, 93°05'W	1595-1906	312
Choccolocco Mountain	CHO	AL	LP	33°49'N, 85°42'W	1547-2006	460
Brymer Mountain	BRY	AL	LP	33°42'N, 85°34'W	1634-1928	295
Nye Homestead	NYE	IA	WO	41°27'N, 90°59'W	1700-1858	159
Grindle Lake	GRL	WS	RP	45°13'N, 88°21'W	1651-2005	355
Waubee Lake	WBE	WS	RP	45°21'N, 88°26'W	1638-1871	234
Burnt Mountain	BRT	MI	RP	46°50'N, 87°55'W	1536-1900	365
Pine Lake and River	PLK	MI	RP	46°52'N, 87°52'W	1480-2005	526
Rush Lake	RSH	MI	RP	46°53'N, 87°54'W	1439-1976	538

[a]PO = Post Oak (Quercus stellata), SP = Shortleaf Pine (Pinus echinata), Pinus = unkown Pinus spp., alba), RP = Red Pine (Pinus resinosa) LP = Longleaf Pine (Pinus palustris), WO = White Oak (Quercus alba); [b]Period of tree-ring record

IV. Key findings

All fire history datasets have been submitted to NOAA's International Multiproxy Paleofire Databank (http://www.ncdc.noaa.gov/paleo/impd/). Datasets may be found by searching by maps and various search engine fields including: report author names and countries. These datasets include standard FHX2 metadata fields: name of site, site code, collection date, collectors, crossdater name(s), number samples, species name, common name, habitat type, country, state, county, park/monument, national forest, ranger district, township, range, section, quarter section, UTM easting, UTM northing, latitude, longitude, topographic map, lowest elevation, highest elevation, slope, aspect, area sampled, substrate type, comments.

Crossdated tree-ring measurements of sites have been submitted to the International Tree-Ring Databank. Datasets may be found by searching by maps and various search engine fields including: report author names, location, and species. These datasets are in standard decadal format. Metadata fields include: name of site, investigators, genus/species, location, elevation country, state, and measurement type. Additional information was included describing the sample storage facility, publication citations, and collection purpose.

Metadata describing samples and study sites were entered into MetaVist v. 2.0 (Beta 1 (July 2009) for .Net Framework version 3.5). Metavist 2 is a tool for entry of FGDC or NBII metadata with XML output. Standard metadata groupings provided by MetaVist 2 are: Identification, Data Quality, Spatial Data Organization, Spatial Data Organization, Spatial Reference, Entity and Attribute, Distribution, and Metadata Reference. Not all fields within these groupings were relevant to our tree-ring and fire scar history data. One XML file was generated for each of the study sites.

V. Management implications

Fire history data have direct applications to forest ecosystem conservation and restoration through the design of fire management programs (Fulé et al. 1997, Cissel et al. 1999). Paired data of long-term fire history and vegetation such as presented here provide historic analogs of fire-vegetation conditions which allow anticipation of the potential implications of various fire management practices and their effects over long time periods. Fire management objectives that focus on restoration of historic disturbance regimes or vegetation communities may be well-suited for directly applying these results, however few long-term studies (e.g., 30+ yrs) exist to assess the likelihood of success. Further work is needed to understand the adjustments needed to achieve historic conditions through prescribed fire.
The archiving of long-term fire history data is relevant for future science efforts and management evaluations. Land managers often look to historic fire regime descriptions for guidance. Long records of fire events provide data needed to describe the range of variability in fire regime characteristics. Archived fire history data provide managers with target goals for promoting or restoring ecosystems. Land managers often need past data to justify a burning regime to the public. Fire history is just one of the data sources that future generations might use to restore wildlife habitat, fuel conditions, or ecosystem health.

VI. Relationship to other recent findings and ongoing work on this topic

During the last two centuries dramatic changes have occurred to ecosystems within the deciduous forest region of eastern North America (East) due to the severe alteration of fire regimes. Relatively few attempts have been made to quantify historic fire regimes in the East despite fire's assumed historic prevalence and attribution of present day forest issues to altered fire regimes (invasive species, insect outbreaks, forest decline, carbon sequestration, fire risk, mesophication, loss of biodiversity). Long, annual resolution fire records such as those based on tree-rings and fire scars are critical to quantifying fire regime characteristics, establishing fire-linkages to paleoenvironmental conditions, and understanding pre-EuroAmerican settlement ecosystem conditions. Compared to western North America, the East has far fewer of these datasets (approx. 1/20th) and, we surmise, less advanced fire science and scholarship.

VII. Future work needed

Over 50 additional fire history datasets from the eastern U.S. remain unarchived in publicly available databanks. Currently additional fire history reconstruction projects are underway that will produce approximately 5-10 new datasets in the next five years. Although new grant proposal efforts are beginning to include costs for archiving data, archival of past datasets remain incomplete. Future archive efforts are needed to ensure all of these datasets are properly organized and stored.

Interpretation of fire scar history records should consider the characteristics of the recorder tree species used and the conditions of fire events within the area and time period sampled. Based on current materials

and methods it is possible for fire histories to both overestimate or underestimate fire conditions such as rates and severities. Fire management objectives are necessary for determining whether or not to consider fire history data in fire planning. Swetnam et al. (1999) provides more detail as to the strengths and limitations of applying historical ecological information to present day land management. Data of mean fire intervals and ranges can be considered for designing prescribed burn programs and should be established according to the relations between fire and vegetation (Nowacki and Abrams 2008). It is possible that land management objectives of today are not aligned with those of historic times and that mimicking the historic fire regime could be ineffective or considered inappropriate.

Even if fire history data are used to design fire management programs and prescribed burns are implemented accordingly, desired historic vegetation conditions may be difficult to reproduce. For long unburned Eastern oak ecosystems potential problems include: moving vegetation communities away from alternative stable states (Nowacki and Abrams 2008), restoring vegetation on sites that have been degraded (e.g., overgrazed, land conversion, fire suppression; Nelson 2012), or the long time period and investment required to achieve desired vegetation conditions. Further, prescribed fire programs will likely be challenged to implement burns that mimic historic conditions due to concerns for safety, budget constraints, and available land area. Burning prescriptions may pass through phases which may have differing objectives and complexities depending on vegetation types (Bidwell et al. 2004). Scientific understanding of the historic conditions will lead to better being able to plan adaptive management strategies for sustaining oak woodlands with prescribed fire.

VIII. Deliverables Crosswalk Table

Proposed	**Delivered**	**Status**
1. Data archive; 12 fire scar histories from eastern U.S.	Twelve files with fire scar data were successfully submitted to NOAAs International Multiproxy Paleofire Databank	Data submissions for all 12 sites is completed. These data can be searched by location or investigator names. This website has a delayed posting of data. See recently submitted data page on IMPD website: (http://www.ncdc.noaa.gov/paleo/impd/). Data are also available by contacting investigators.
2. Data archive; crossdated tree-ring width chronologies of fire history sites	Twelve files consisting of crossdated tree-ring chronologies were successfully submitted to NOAAs International Tree-Ring Databank	Data submissions for all 12 sites is completed. These data can be searched by location or investigator names. This website has a delayed posting of data. See recently submitted data page on ITRDB website: (http://www.ncdc.noaa.gov/paleo/treering.html). Data are also available by contacting investigators.

3. Metadata; 12 fire scar histories from eastern U.S.	All metadata fields within the fire scar history files were successfully completed and submitted to NOAAs International Multiproxy Paleofire Databank	Meta data submissions for all 12 sites is completed. These data can be found in the header of FHX fire history files located on IMPD website: (http://www.ncdc.noaa.gov/paleo/impd/). Data are also available by contacting investigators.
4. Metadata; crossdated tree-ring width chronologies of fire history sites	Metadata fields provided during data submission to NOAAs ITRDB were completed upon data submission. Additionally, metadata were completed to FGDC / NBII format using the MetaVist 2 tool.	Entry of metadata was completed during submission to ITRDB. Additionally, metadata were entered for all 12 sites using the MetaVist Tool. Data are also available by contacting investigators.

IX. References of materials describing these data:

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Fulé, P.Z., W.W. Covington, M.M. Moore. 1997. Determining reference conditions for ecosystem management of southwestern ponderosa pine forests. Ecological Applications 7:895-908.

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