



Final Report

Proposal Title: Addition of 550 Fire History Datasets (FHX Files) to the IMPD (International Multi-Proxy Database)

JFSP Project ID: 13-4-01-8

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Abstract:

The International Multi-Proxy Database (IMPD) is a public database of fire history sites around the world and is managed by the National Climatic Data Center of NOAA. In the western US, fire history information provides a context for evaluating recent increases in extreme fire behavior over the past few decades. Networks of tree-ring fire history sites allow for analyzing historical fire-climate relationships from regional to continental scales, and thus, providing predictive tools for managers and policy-makers. The goal of this current project is to contribute 550 fire history datasets to the IMPD as part of an ongoing effort to synthesize and analyze fire history information for western North America. The Co-PI of this project, Erica Bigio, worked with Wendy Gross, the manager of the IMPD, to develop an efficient process for contributing fire history information to the IMPD. With this process, the IMPD will soon contain more than 800 sites for western North America. This rich dataset will be valuable for scientists and land managers, who wish to make observations and decisions using local to regional-scale fire history information.

Background and Purpose:

Large and severe forest fires throughout the western US are a very familiar topic to the Joint Fire Sciences Program. Over the past 30 years, there has been an increasing trend in large and severe forest fires in every region and forest type of the western US. These fires are related to a complex interaction of warming temperatures, severe regional droughts and human land-use practices, depending on the region and forest type of interest.

Fire history research provides a long-term context for understanding recent wildfires, and helps to identify the relative influence of management and climate change on current fire behavior. There are many methods for conducting fire history research, and tree-ring methods provide seasonal to annual records, covering the past 300 – 500 years. Fire-scarred trees preserve evidence of low-severity surface fires within the ring structure. When several trees are sampled from a landscape, they are combined to analyze historical patterns in surface fires. In many forest types, more extensive fires occurred during severe drought years, often associated with the El Niño-Southern Oscillation system. Large networks of fire-scarred trees have been used to identify regional and continental-scale climate influences on fire activity, by identifying patterns of synchronous fire activity across hundreds of sites.

What is the IMPD?

The IMPD (International Multi-Proxy Database) is a public database of fire history data, which includes both tree-ring and charcoal records. Data are contributed by researchers, who wish to make their data available to the public for analysis and review. Fire history data is organized into sites, and all sites are searchable by contributor name or location on the IMPD website. A tree-ring site includes between 1 – 50 trees, and the spatial area a site ranges from one to several thousand hectares, depending on the goals of the primary contributor.

The IMPD is one of many databases managed by the Paleoclimatology Branch of the National Climatic Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA). The NCDC is the world's largest climate data archive and is a member of the World Data System. The World Data System upholds a standard of data quality, public data access and long-term stability for its members. The NCDC is the primary resource for researchers, policy-makers and interested citizens to find proxy records and climate information.

What the FACS project did:

From 2009 – 2012, several PI's worked on a project titled: Fire and Climate Synthesis for the Western United States (FACS). This project was funded by the Joint Fire Sciences Program (09-2-01-10) and the US Forest Service Climate Change program. The PI's for the FACS project were: Tom Swetnam (University of Arizona), Don Falk (University of Arizona), Elaine Kennedy-Sutherland (Rocky Mountain Research Station, USFS), Peter Brown (Rocky Mountain Tree-Ring Research) and Tim Brown (Desert Research Institute). The Co-PI of this current data archive project, Erica Bigio, worked on the FACS project as a graduate research associate from 2009 -- 2011.

The goal of the FACS project was to compile as many fire history sites as possible from across western North America. The PI's contacted researchers across the country (and beyond) and asked each of them to share their data for the purpose of enhancing fire and climate analysis at the continental scale. In the end, the PI's compiled 550 datasets from 29 researchers from several universities and the federal agencies. In addition, datasets that were already in the IMPD were accessed and combined with the privately-contributed datasets.

The combined fire history datasets (both IMPD and FACS) reached 890 sites for western North America, representing the major forest types of western North America. This effort extended the ability to analyze fire-climate relationships at the continental scale to almost 1,000 years before present, though with the best sample depth in the past 500 years. This compilation is currently the largest and most complete, tree-ring based fire history collection in the world. The PI's are still conducting fire-climate analysis, and several publications are forthcoming.

The data compilation process took more than one year, and the majority of time was spent reviewing data quality and extracting site-specific attributes from literature and reports provided by each researcher. The Co-PI, Erica Bigio, managed the incoming data from the contributing researchers and reviewed data quality. In the process of reviewing data quality, the Co-PI fixed formatting problems in data files ('FHX files') and made sure that symbols used to represent fire events were used correctly. The Co-PI also determined the correct GPS coordinates for each site by looking at printed maps in publications in conjunction with Google Earth imagery.

Study description and location:

The JFSP Data Archive award (#13-4-01-8) provided support for the Co-PI, Erica Bigio, to contribute the 550 fire history sites compiled by the FACS project to the IMPD. The award helped to take advantage of the ongoing metadata and data quality review being conducted by the FACS project.

In order to contribute data to the IMPD, a researcher submits an FHX file and metadata for each fire history site. Minimum metadata required by the IMPD includes the following attributes: site name, collection date, contributor names, number of samples, species sampled, latitude/longitude coordinates, elevation and area sampled. An “FHX file” is a text file that represents each tree as a column with calendar dates for individual fire scars. Each of the 550 fire history sites compiled by the FACS project has an FHX files associated with it, along with several other metadata attributes organized in a database. Each FHX file should have a specific set of metadata attributes typed into rows at the top of each file. In the past, staff members at the IMPD found this information by reviewing the literature and metadata associated with each site. The CO-PI, Erica Bigio, already has already compiled most of the metadata required by the IMPD (site name, number of samples, area sampled, latitude/longitude and elevation) in a spreadsheet. However, many of the FHX files being contributed by the FACS project lack header information at the top of the files. The goal of this data archive project was to find an efficient way to transfer the metadata for each the site to the headers of the FHX files and the IMPD.

As part of the IMPD ingestion process, an additional information text file is created for each site, which contains the following metadata: sample storage location, funding agency dating method, literature citation (with abstract) and researcher comments. Again, in the past, this task had normally been completed by the IMPD staff members, yet the contribution of 550 files would have created an overwhelming amount work.

In order to complete this project, Erica Bigio traveled to Boulder, CO, to work directly with Wendy Gross, the current manager of the IMPD. Wendy and Erica worked together to develop an efficient procedure for contributing the set of 550 datasets to the IMPD. In this process, they developed a more streamlined and efficient process for all future tree-ring fire history site contributions to the IMPD. The study area for this project covers western North America.

Key Findings:

1) Improvement of data submission process

As Wendy and Erica worked together, they realized that a *major result* of this project was to develop an efficient procedure for incorporating new FHX files and metadata into the IMPD. An improved procedure would benefit the current project of contributing 550 fire history sites from the FACS project, as well as, all future submissions to the IMPD. The improved procedure aims to prevent time-consuming metadata extraction by the IMPD staff in the future.

Wendy and Erica developed an excel template that outlines all of the metadata requirements of the IMPD for new contributions of tree-ring fire history data. Some of these metadata attributes include: Site Name, Data Contributors, Publication Information (including abstract), GIS Latitude and Longitude, Mean Elevation, Country, State, Region, Area Sampled, Species Sampled, Funding agency with project number, and any relevant metadata provided by the researchers. Several of these metadata requirements are written into the top several lines of an FHX text file (called an FHX header). Wendy wrote a perl script (computer code) to transfer the metadata from the excel template to the headers of the FHX files. Because many of the files being lack FHX headers, and Erica filled the metadata into the fields of the excel template. Wendy then took the template for the sites being contributed by the FACS project and wrote FHX headers into each of the files. Wendy developed an automated procedure for creating an additional information text file, which uses the remaining metadata in the excel template. This additional information file contains the site name, funding agency, literature citation, researcher comments, among other attributes.

In summary, Wendy and Erica developed a template, where the required metadata for each fire history site is organized. The metadata in the template can then be used to create a complete FHX file and an additional information file for each site. Both of these files are then made available for download on the IMPD website. When an interested user (e.g., regional land manager, scientist, interested citizen) wants to obtain fire history information from the IMPD website, they search for sites through an interactive web browser with a searchable map and search engine. Some of the metadata from the excel template is also displayed on cover page for each fire history site. The cover page displays a map of the site, and summarizes the relevant metadata for the site. Once the users have navigated to the cover page, they may download the FHX files and additional information files from this page. The user can also look at plots of the fire history chronology displayed on the screen, which are also available to download as a JPEG/PDF.

2) Submission of 350 fire history sites

Erica contacted all of the researchers, who contributed more than 4 fire history sites to the FACS project. She asked each of them, whether they were interested in having their data submitted to the IMPD. Most of them responded favorably (n = 350 sites), although a few of them were not ready for their data to be made public. Erica is currently filling metadata into

the excel template for each researcher, where several sites of data can be conveniently viewed at once. After Erica has filled in the metadata fields, she sends the template to each researcher for review and confirmation. Once confirmation is received, Erica then submits the template with the FHX files to Wendy, who completes the remainder of the ingestion process to the IMPD. Wendy has ingested approximately 100 sites thus far into the IMPD. We will continue to transfer FHX files and metadata via the template method for the next few months.

Deliverables:

An excel template is now available for all researchers to contribute data to the IMPD. This is a much improved and streamlined procedure compared to the earlier procedure of submitting data to the IMPD. The excel template has been reviewed by two independent researchers in the fire history community (Emily Heyerdahl and Rosemary Sherriff). In the coming months, the IMPD will contain an additional 350 fire history sites for western North America, and a couple hundred more will become available in the next few years.

Management Implications:

Researchers, managers and interested citizens will now be able to utilize a fuller and more robust fire-scar network for western North America. With this network, researchers can analyze spatial and temporal patterns in historical fire events from regional to continental scales. They will be able to evaluate climatic drivers of fire activity at a range of spatial scales, which can help with making decisions about fire risk in the future, based on future climate scenarios. More importantly, fire managers and ecologists in local forest districts will now have more fire history information available to them for local-scale decisions and management.