UROP Proposal

Spring 2013

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Ongoing Dendroclimatology of Range Creek Canyon

Background

Range Creek is a small deeply incised canyon located in south central Utah. It is a remote canyon that has experienced minimal impact to its rich archaeological heritage by European-American settlers during the last two hundred years with the exceptions of a few homesteads and the Wilcox Ranch in the lower end of the canyon. The property was transferred to the University of Utah in 2009 by the Utah Division of Wildlife Resources and is now managed by the Natural History Museum of Utah. It is home to one of the University of Utah's Field Schools run by the Department of Anthropology. The canyon contains hundreds of important archaeological sites and thousands of artifacts from the Fremont culture that inhabited the area from around 800A.D. to 1350 A.D. Though work has been done on the archeological sites in the canyon, a better understanding of the paleoclimate and environment are needed to help understand why the Fremont culture disappeared so abruptly around 1160 A.D.

Dendrochronology has been shown to provide excellent data in the reconstructing of climatic conditions (Speer, 2010). Certain conifer trees species, including Douglas fir, have the characteristic of growing very symmetrically which enables researchers analyzing tree cores from these trees to cross date, or compare the ring widths from multiple trees to build a local history of tree growth rates through time that can be compared to climate records. Cross dating is the foundation of dendrochronology.

Objectives

I see a strong need for the use of multiple research approaches to understand the climate history of Range Creek Canyon and developing a solid dendrochronology for the area is the primary goal of my project. To this end, I hypothesize that Douglas fir will provide a sensitive

indicator of past changes in winter precipitation. Previous work has demonstrated that this tree species is most responsive to changes in winter moisture (Speer, 2010) and this project will explore the linkages between Douglas fir tree growth and regional weather station data to test this hypothesis. This project will also provide me with a hands-on research experience in the field of paleoclimate reconstructions. As I look forward to graduate school I hope to use this experience to build on my career goals in paleo research.

Preliminary Work

A small preliminary study on dendro samples (tree cores) from the species *Pseudotsuga menzesii* (Douglas-fir) from the area was completed as part of an internship with Dr. Mitchell Power during the 2011-2012 Academic year. The total sample size was very small, consisting of 10 tree cores. This small sample was taken to see if the Douglas fir trees were indeed responding to known climate data. With the limited known climate data, the samples in this preliminary study did suggest a response to climatic factors, such as a strong wet/dry season, but more data analysis is needed to address my hypothesis.

By using dendrochronology data to understand how the climate of Range Creek Canyon may have affected the flora of the region, I hope to shed more light on some of the potential challenges faced by the Fremont people living in the canyon. Additionally, as more archaeological wood samples are discovered in Range Creek, it may be possible to link my findings on the historical dendro-climate relationships to these much older wood fragments in hope of understanding why the Fremont culture disappeared may be answered.

Methods: Tree Cores

In order to develop better picture of past climate variability in Range Creek Canyon , I will be examining a larger sample of trees collected this summer from several areas climatically sensitive locations, such as sites located on steep rocky slopes and closer to the lower treeline (Speer, 2010). All tree cores will be collected using standard dendrochronological methods, including as the use of a non-destructive increment borer that extracts a 5mm core sample from a living tree. Field notes will document the diameter at breast height of each tree, GPS

coordinates will record the sample location, and all associated plant species will be identified. Additionally, information on slope angle, slope direction and elevation will help establish the site conditions for each sample. Tree rings will be counted and measured using Leica digital imagery software in the Garrett Herbarium at the Natural History Museum of Utah. All data will be recorded into an excel spreadsheet and pith dates (seedling establishment date) will be identified when the coring captures the center of the tree. Two cores will be collected and measure from each tree to provide a robust measure of ring widths for each location.

As I have discovered, the current dendro record of Range Creek is limited to a 170-200 year time span. I have expanded geographically and collected additional Douglas fir tree cores from a small stand located at Peruvian Ridge just above Alta Ski Resort. This will increase the chronology to at least 870 years. A record this long will bring me back to the late 12th century early 13th century, coinciding with the decline of the Fremont people in Utah.

Climate Data:

Climate data will be obtained from the Western Regional Climate Center which is administered by the National Oceanic and Atmospheric Administration (NOAA) with oversight from the National Climatic Data Center (NCDC). Since no data sets are available concerning the immediate area surrounding the site where samples were collected, the three closest data sets that were selected included Nutters Ranch, Sunnyside, and Sunnyside City Center. The historical climate data for these areas begin in 1900 to 1958. For Alta Ski Resort, I will be using the weather data collected from the Alta (COOP) weather station which shows a climate record from 1905 thru the present.

Analysis:

I will be using two new software packages in the analysis of the data. COFECHA is a quality control program used to check the cross-dating and overall quality of the chronology. ARSTAN is a program used to standardize raw tree-ring width data. The program produces chronologies from these measurement series by detrending and indexing or standardizing the series. Three

versions of the chronology are produced and contain a maximum common signal and a minimum amount of noise.

Expected Outcomes

I expect to find a strong relationship between the size and width of tree rings sampled and the climate record. A thorough cross dating of the samples would lead to improvements in the expected distribution and response mechanisms of Douglas-fir, allowing a more concrete interpretation to be made of the primary environmental factors concerning Douglas-fir growth. With improved cross dating between samples and more samples overall, sensitivity to climate factors would be more readily established. Additionally, inclusion of a climate model for the research area combined with in-situ measurements from the Range Creek weather station would improve the climate determinations using dendrochronology for this.

I expect the core processing to take 2 months and analysis of said data another 3months. This research is part of the ongoing paleoecological research being conducted by Dr. Power in the area.

By building a larger and stronger dendrochronology here in Utah we may be able to add to the existing dendrochronologic record, and eventually aid in bridging the floating dendrochronological records of Utah and the Southwestern United States.

References

Speer, James H. *Fundamentals of Tree-Ring Research*. Tucson: The University of Arizona Press, 2010. pp. 20-23.