Investigating Post Fire Archaeological Site Vulnerability: A Multi-Component Approach
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Introduction

Geographic Information Systems or GIS are now an integral part of archaeological workflow in both historic resource management (Dore & Wescott 2006) and private archaeology (Dore & Alblas 2006). GIS are currently used to manage large databases of archaeological site location information, create maps which predict site locations, as well as investigate patterns in human behavior (Hatzinikolaou et al. 2006). However, using GIS as an archaeological tool is not limited to these approaches (Dore & Harris 2006).

The impetus for this project is to assess the vulnerability of these sites in the Bureau of Land Management, Eagle Lake Field Office to looting after a devastating fire in August 2012. Goals for this project include investigating potential site locations in order to monitor site condition.

Methods

Archaeological Site Location Predictive Model:

A predictive model indicating probability of finding prehistoric archaeological sites within the Rush Fire burn area was created in order to identify areas of concern for site monitoring and assessment. This model predicts the location of sites based on distance to streams, known archaeological site locations, elevation, slope, and aspect (or “northness”). Distance to riparian areas and hiking time needed to travel through the area were also considered but significance tests proved them to be not significant variables.

Northness:

Northness, or the degree to which north or south slopes were favored for site location by prehistoric occupants of the area was calculated using the following equation:

Northness = cos (aspect in degrees) * P(1/180)

This equation calculates that walking time will be about 5km/hr through a given area.

Statistics:

A set of points were created to represent random sites or in this case “non-sites” were selected. All variables (Elevation, Slope, Northness, Distance to Streams, Distance to Riparian Areas, Hiking Time) were all tested to assess whether there was a significant difference for known sites versus random non-sites. All variables appeared significant to the 0.05 level except hiking time and distance to riparian areas, which were not statistically significant. Using a co-linear test all variables appear to be independent.

Logistic Regression:

Logistic regression is an equation that can be used to predict the probability of site presence or absence in an unsampled area. In this case, it’s based on the sample area of site and non-sites as well as environmental variables (Hatzinikolaou et al. 2006, Kvamme 2006). For this project known sites, non-sites, distance to streams, slope, elevation and northness were considered. The following equations were used in order to calculate:

Slope * distance to streams / (1 + exp (β0 + β1 (Elevation) + β2 (Slope) + β3 (Northness) + β4 (Distance to Streams) + β5 (Hiking Time))).

Burned Area Reflectance Classification (BARC) Map:

To understand which sites have been affected by the fire, a BARC map was acquired to assess burned severity at each of the archaeological sites. BARC maps are created through satellite-mad and multi-channel infrared reflectance values which indicates what the severity of the damage to vegetation has been. The map returns a range of values which can be used to assess the burn severity (USDA Forest Service).

Unburned / Very Low < .75
Unburned / Low > .50
Moderate = 100 – 187
High > 187

During the course of the year, 55 sites were visited for inspection and only 17 of these were active habitation areas which had burned primarily. This represents the intent of the BARC map to be a post-fire restoration planning tool and indicates that is unlikely to be investigated through on the ground field research.

Data & Results

The predictive model for archaeological sites within the Rush Fire burn area had interesting results (see map to left). In terms of northness, prehistoric archaeological sites seem to be located primarily on southern aspects, which was not expected. These tend to be hot in the summer and the area receives little cover. This may reinforce the theory that this area or parts of it is a likely winter habitation zone. Some parts of the area, particularly in the riparian areas, are known to have winter habitation sites in high densities. Prehistoric occupants in the area created winter dwellings using local brush and animal skins, warmth and sun exposure would likely be valued in these situations.

Lower slopes had a higher probability of archaeological sites at did lower elevations. These are not surprising results as most people would not want to live or camp on a steep slope or a mountain top with little cover. In general, areas that had high densities of known sites were fairly flat, near some kind of seasonal or permanent water source.

Conclusions

GIS is an immensely important and useful tool for archaeologists. These archaeologists monitoring thousands and sometimes as is the case at BLM ELFO, over a million acres of land find this tool to be a fundamental part of their work. GIS has a huge range of applications for archaeology. From simply recording an individual archaeological site, managing thousands of sites, creating predictive models, identifying trade routes and territories, etc., GIS is widely applicable.

In this project the breadth of work was focused on creating a predictive model for currently unknown archaeological site locations within the 2012 Rush Fire burn area. Using logistical regression, this created a map indicating the probability of finding sites within the burn area. This predictive model appears fairly accurate with only a few known sites falling within the predicted 0 to 20% predicted site probability area. Upon further investigation, these the integrity of the location method of these archaeological sites tended to be supported.

Within the areas appears to be the moderate to high burn areas there were no sites have been identified as significant by the Eagle Lake Field Office Archaeologist. Fieldwork in the past year has indicated that only 17 of these were burned severely so further fieldwork must be done in order to understand how many sites were truly affected by the fire.

Discussion

As with any study, this project faced a number of limitations. These included varying quality of data available. While it is known that there are some 500 sites or more just within the burn area, only 211 of these could be used for the purpose of this project. This had to do with incompatibility data for the known archaeological sites as well as poor site recording techniques. Other ways have to do with this way in which archaeological work is conducted in a management situation (Dore & Wescott 2006). Little information was available about each of the sites in the project area. While this project only created a predictive model for prehistoric sites, it did not take into account the type of site or interpretation of site use. This makes the model useful in the future creating predictive models based on habitation sites, hunting sites and other sites may prove more use and accurate. Finally, it is important to note that humans do not always act rationally and in a way that may be predicted, this will inevitably lead to site location which may never be modeled.

References


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