 Utah Rock Art Research Association

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August 1, 2016

BLM Moab Field Office

Attention: Jared Lundell

82 Dogwood Ave.

Moab, UT 84532

Dear Jared:

Thank you for the opportunity to review and comment on Predictive Model of the Class I Cultural Resource Inventory (Class I) in development for the Moab Field Office (MFO).

The Utah Rock Art Research Association (URARA) is the largest organization dedicated to Utah rock art. Our mission is:

* To lead in the preservation and understanding of the value of rock art.
* To encourage the appreciation and enjoyment of rock art sites.
* To assist in the study, presentation, and publication of rock art research.

Our 300 members have professional, academic, and avocational interest in Utah rock art. Combined, our membership represents the largest body of knowledge regarding Utah rock art. We have worked with the Moab Field Office (MFO) as a consulting party and have an extensive history of collaborating with the BLM throughout Utah.

We appreciate the level of effort and attention to detail that has gone into the development of the predictive model for the MFO. However, we have concerns about the quality of the data used in the model, its planned use, and the involvement of consulting parties.

**Data Quality**

*Small Site Sample Size*

The MFO has an extensive number of cultural sites within its boundaries. The Class I indicates that there are 8,017[[1]](#footnote-1) archeological sites within the MFO boundaries. However, the Class I also indicates that only slightly over 10% of the MFO has been surveyed[[2]](#footnote-2) and that surveys comprising only 6%[[3]](#footnote-3) of the MFO acreage are used in the development of the predictive model.

While the number of archeological sites is impressive it represents only a small sampling of the actual MFO. Additionally, the bulk of the data is derived from surveys associated with Section 106 of the National Historic Preservation Act due to “surface disturbing activities.” These activities tend to revolve around roads, pipelines, electrical and other transmission lines, mineral leasing, fire mitigation, and construction. With the exception of fire mitigation, these activities generally occur in similar types of locations.

Because the models are built using known sites and inventory areas, they are biased by the areas that have received archaeological inventory. All areas have not been equally sampled by surveys, and the models produced are a reflection of the sites and environments that have been previously inventoried.[[4]](#footnote-4)

Thus the data set is both small and a non-representative sample of the MFO resources. We believe that statistical cultural site prediction requires a solid data set that this model lacks.

The model results demonstrate our concern. Tables 8-5 to 8-8 provide, what appears to be, compelling data for site prediction. However, aggregate data is not provided. This is rectified in the chart below.[[5]](#footnote-5)



The table above uses the preferred sample data for each of the eco-regions. We were unable to replicate the % Sites Predicted data in tables 8-5 to 8-8 so we substituted a calculation used in the Richfield Class I model for Total % Correct, despite the fact that it has apparently fallen out of favor in the last couple of months.[[6]](#footnote-6)

% Correct Site Cells max out at 55 .4% in the Forests eco-region, barely over a random toss of a coin. In the aggregate, the model accurately predicts site cells only 21.7% of the time due to its horrible results from the Deserts eco-region.

The Class I material describes two types of errors that should try to be avoided. Wasteful errors are False Positives (a cell that isn’t a site that the model predicts as a site) and gross errors which are False Negatives (a site that the model predicts as a non-site). The class I material goes on to state: “For management purposes however, gross errors (false negatives) are more costly than wasteful ones (false positives).”[[7]](#footnote-7) Note that these costly gross errors are predicted 22.1% of the time.

*Model Variables – All Cultural Sites*

The model is based on the world today using variables that are derived from current geographic information systems (GIS) data points. Prehistoric people did not live in today’s world and were not concerned about modern GIS data layers. We are concerned that the model does not consider temporal, climatic, geographical, and cultural variation. Climate varies over time, so proximity to water was not the same 1000 years ago as it is today as springs and lakes develop or dry up and rivers meander and change course. Metrics of site distance to current resources may not have been valid for people living long ago.

Assigning consistently weighted environmental variables to different cultural groups using the land at different times is not valid. Hunter gatherers moved through the MFO differently than the more sedentary Fremont. While we appreciate the predictive model’s split between high elevation and low elevation zones we believe that this could be taken to a much broader level. There are many types of “splits” that could have been done to make the model more accurate.

Just as proximity to water is important so is proximity to food sources, building materials, wood for heating and cooking. Many academic articles discuss an “economic” model for food procurement. Essentially, an economic model examines whether it costs more calories to produce the food than is gained from the consumption of the food. These models evaluate a broad set of flora, fauna, and environmental variables compared to travel and procurement costs. Likewise, at a URARA symposium Jerry Spangler discussed his findings at Nine Mile Canyon that winter habitation sites were found closer to firewood. If the BLM wants to build a strong predictive model the variables must consider the flora, fauna, and environment that are necessary for daily survival.

This predictive model uses broad simplification of temporal, climatic, geographical, and cultural variation in order to reduce complexity in computer processing. But reality *is* complex and requires high data levels to accurately model. This requires data, time, and resources which were not used in the creation of the model. In our opinion, the model design is insufficient to identify cultural site locations.

*Model Variables – Rock Art*

There is data relevant to rock art which is not part of the variables used in the model. For example:

* We know that rock art sites are much more common at canyon and drainage confluences.
* URARA members have noted that rock art is more prevalent on certain rock strata surfaces.[[8]](#footnote-8)
* Protected rock surfaces (overhangs, alcoves, small caves) are important for rock art either because they have protected the rock art or were deliberately chosen as site locations.
* Isolated boulders independent of slope (may be found on talus slopes or flat terrain)
* URARA members have also commented on aesthetics, acoustics, archeoastronomy, viewshed, prehistoric roads, horizontal rock surfaces, and a variety of other possible data points not included in the model for the location of rock art sites.
* Ethnographic research from modern Native American tribes indicates that the “mythological landscape” was important in terms of where sites were located. These landscapes are places where one or more cultures imbue the land with meaning. This meaning influences how a culture uses the land. Elements of the land, such as springs, mountain peaks, certain boulders and caves may be seen as sacred or inhabited by spirits. As such, they may be avoided, sites of prayers or be ceremonial sites. Some archeologists believe many rock art panels are associated with what we call “symbolic” or “mythical” landscapes. The rock art site participates in a cultural narrative rather being a located for geographic reasons such as distance to water, slope, elevation, etc. For example, certain Dinwoody petroglyphs in Wyoming are carved on a rock surface with special attention given to the way light and shadows cross the surface creating the impression of movement in the carving. Petroglyph owls seem to open and close their eyes as the shadows shift. Human figures appear to weep, light creates an impression of tears rolling down rock faces. Carved suns seem to radiate light. This is one of the many reasons why a statistical model designed to find repeating site locations based on topographic variables will not be successful predicting rock art sites which reflect or participate and a landscape shaped by an ancient cultural narrative.

We understand that many of the variables that we mentioned are not within currently available GIS datasets. Our comments are on data quality and how it is degraded by the reliance on easy to obtain statistical data. We are very uncomfortable with the following statement:

As is commonly understood, the environment has not remained constant throughout the span of human occupation, and the environmental variables used in this model do not necessarily reflect the environment at the time that Native American groups occupied the area. Topography, exposed bedrock, surface geomorphology, soils, climate, precipitation, flora, and fauna have all changed throughout the human occupation, as have cultures, land use strategies, mobility, and technology. However, the intent of this modeling is to provide the BLM with an additional planning tool that identifies high to low probability areas for exposures of cultural material as observable today. The intent is not to model prehistoric and historic behaviors or the placement of sites on some ancient landscape that is no longer directly observable. As a discovery based model, the intention is to use the decades of inventory data that have been collected from the modern ground surface to interpret the patterns in observable site presence and absence. With this focus, the changing environment through time is not applicable to the modeling effort. Rather, it is the current environmental parameters that allow for the discovery of archaeological sites that is pertinent – whether or not a site is discoverable during an inventory of the modern ground surface.[[9]](#footnote-9)

We doubt any prehistoric person made conscious decisions to make life easier for the BLM a thousand years in the future.

*Consulting Party Statistical Expertise*

Statistical predictive modeling is well outside the skill set of the URARA. While we can comment on macro issues apparent in the model we lack the expertise to comment on the quality of the model development, the mathematics, statistics, and computer modeling underlying its conclusions. We expect that most other consulting parties are in the same situation. Given the importance that the model will have in informing management decisions we believe it is imperative that the predictive model be reviewed by experts in the field who can provide a level of confidence as to the accuracy and use of this predictive model.

*Data Quality Conclusions*

Due to these concerns about the data quality of the model we believe it is imperative to:

* Test the model against real world data through extensive class II random sampling throughout the MFO to determine if there is a data bias based on Section 106 sources.
* Provide consulting parties the class II random sampling results for analysis and approval prior to use of the model for planning decisions.
* Assess the predictive model through a peer review process.

**Use of the Predictive Model**

We are concerned about how the BLM will use this predictive model for planning decisions within the MFO. We support the use of a predictive model which consulting parties concur has high predictive value for cultural resources.

*Sensitivity*

We are very concerned about how sensitivity was defined in the model. Because sensitivity was defined by considering only the eligible and not eligible sites it excludes 4072 sites or 21.5%[[10]](#footnote-10) of the population because they were undetermined or unknown. We are also concerned that some of the not eligible determinations may be based on antiquated views of archeology. For example, 114 of the 394 prehistoric rock art sites in the Benches and Canyons are deemed not eligible[[11]](#footnote-11) which would be an unusually high number under current standards. The Class I states: “However, it is suggested that all site types have likely been influenced by similar biases and that the “error rate” in NRHP interpretations should be fairly consistent across site types.”[[12]](#footnote-12) However, there is no data to support this “suggestion” and the high variability in the undetermined and unknown rates would tend to imply that this “suggestion” is spurious.

To accurately predict sensitivity it is necessary to make a national register eligibility determination for the undetermined and unknown sites and test the determination of not eligible sites focusing on sites with older documentation.

URARA and other groups with site information have provided the BLM with additional site data currently not in the BLM records. This site data may not meet SHPO standards for IMACS level documentation and are unlikely to have a national register eligibility determination. We recommend each of these sites be considered eligible when used in the predictive model until a qualified archeologist can make a determination.

*Predictive Model Updates*

The Class I recommends that the predictive model be updated as new data becomes available:

Perhaps more relevant, however, is an important characteristic of scientific models in general—scientific models are not static. Scientific models are useful precisely because empirically testable expectations can be drawn from them. When expectations of a model are subject to empirical evaluation, the results of that evaluation can, and very much should, be examined in light of the model. When expectations are met, the results further validate the model. When expectations are not met, the model should be revised as appropriate. This iterative process is central to the scientific method and the archaeological site location model developed and presented here is expected to undergo such evaluation and modification.[[13]](#footnote-13)

It is unclear to us how this will be done. In our discussions with BLM archeologists they have indicated they don’t have the skill set to update the predictive model. Will the BLM maintain a contract with a consulting agency to improve the model over time? If the model is to be used to make planning decisions into the future we believe the model must be updated and tested on an annual basis to be as useful as possible.

**Improvements in the Predictive Model**

We appreciate that the MFO is working to improve the predictive model over previous generations used in the Richfield and Fillmore Field Offices. We appreciate the use of data from the Monticello field office and of the addition of some of the new environmental variables. We believe that these efforts will improve the model.

**Additional Comments**

* We recognize the difficulty in providing maps of sufficient scale to be useable in a PDF document. However, the maps on pages 8-31 to 8-41, 8-47, and 8-51 are critical to the evaluation of the predictive model results. Their scale is so small that is virtually impossible for someone to evaluate whether the predictive model is accurately reflecting high, medium, and low probability areas.
* We noticed that several tables did not include totals. This practice is inconsistent with previous predictive models. The result is that it is more difficult to see overall results and requires additional time and effort for consulting parties to do our own mathematical overviews.
* It is difficult to follow the math in several of the tables. We encourage you to provide some aids as to how calculations are being performed.

Thank you for your consideration of these comments.

Troy Scotter

Conservation & Preservation Committee

Appendix 1: Tables 8-5 to 8-8 In An Understandable Format And Aggregate Data

Note that the data in the following tables is only for the preferred data sample and that we could not replicate % Sites Predicted values in the tables so we substituted a formula for Total % Correct used in previous Class I literature. We didn’t attempt to replicate acreage, gain, precision, or improvement over chance calculations.





1. Page 6-1 [↑](#footnote-ref-1)
2. Text page 4-11 and Table 4-1 on page 4-12. Either 297,592 acres (10.3%) or 303,417 acres (10.6%) have been surveyed. [↑](#footnote-ref-2)
3. Table 4-1. 171,865 acres of the 2,856,424 acres in the MFO boundaries. [↑](#footnote-ref-3)
4. P. 8-7 [↑](#footnote-ref-4)
5. See Appendix 1 for the derivation of the aggregate data [↑](#footnote-ref-5)
6. P. 8-21 [↑](#footnote-ref-6)
7. P. 8-20 [↑](#footnote-ref-7)
8. Jenkinson, Richard; Rock Art on an Ancient Migratory Route; Utah Rock Art Volume 30, 2010. [↑](#footnote-ref-8)
9. P. 8-12 [↑](#footnote-ref-9)
10. Table 8-9 (4,072/18,933=21.5%) [↑](#footnote-ref-10)
11. Table 8-9 [↑](#footnote-ref-11)
12. P. 8-43 [↑](#footnote-ref-12)
13. P. 8-3 [↑](#footnote-ref-13)