Predictive Modeling of Archaeological Sites In Death Valley National Park

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Introduction

Archaeologists have long worked to develop predictive modeling as human habitation locations are patterned and often align with environmental constraints.

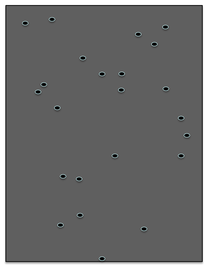

Figure 1. Random Site Sample

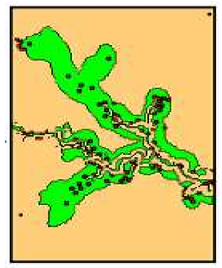

Figure 2. Sites with Environmental Data

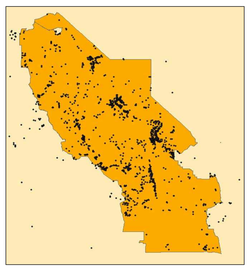

Figure 3. Cultural Resources in Death Valley

Existing research has been conducted through a partnership with the National Center for Preservation Technology and Training (NCPTT) and the National Park Service (NPS), who have developed methods to use a database with over 2,000 entries for various analyses. Statistics based on Maximum Entropy niche modeling determines the relative probability of the occurrence and spatial location of cultural resource sites in Death Valley National Park (DEVA).

Purpose

This research will facilitate future site identification, and assist NPS employees and researchers to manage potentially delicate areas with a high likelihood to contain cultural resources.

Hypothesis

If humans from any time period settle in patterns constrained, in part, by their environment, then it is possible to create a series of strong relational models influenced by statistical maximum entropy patterning to determine where unidentified habitation settlements are located.

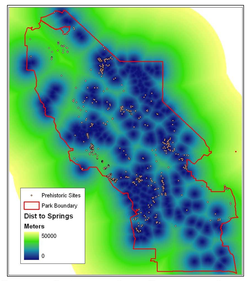

Figure 4. Prehistoric Sites, Distance to Springs

Data

1. Digital Elevation Models
2. Geomorphology
3. Environmental Data
4. Archaeological Site Files
5. Statistical Outputs

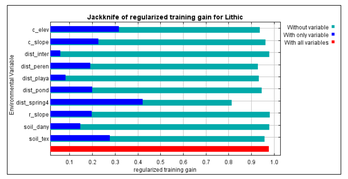

Figure 5. Jackknife test of regularized training gain

Results

The primary directive in working with the DEVA dataset was to identify areas within and between datasets that can be altered to minimally yet effectively restructure inputs. There are thirteen environmental inputs in an ASCII format; these data are layers on top of and integrated into the GIS data that are input into MaxEnt to output the statistical models about significance between the environments that are conducive to various cultural resources.

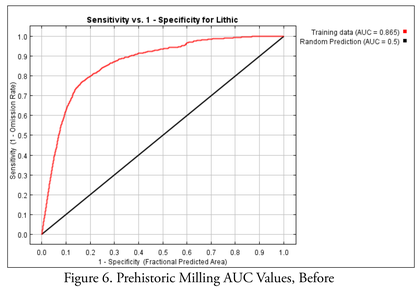

Figure 6. Prehistoric Milling AUC Values, Before

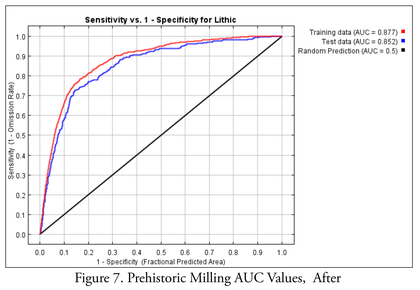

Figure 7. Prehistoric Milling AUC Values, After

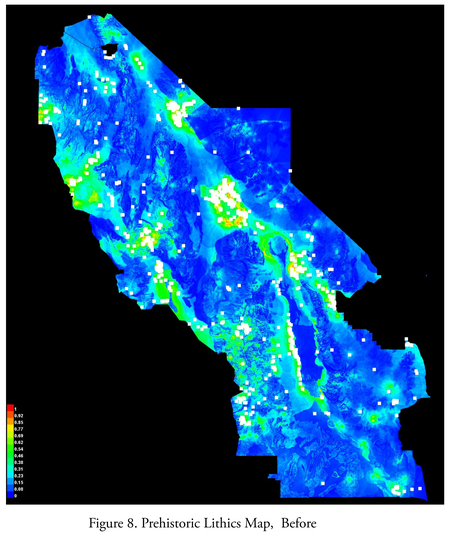

Figure 8. Prehistoric Lithics Map, Before

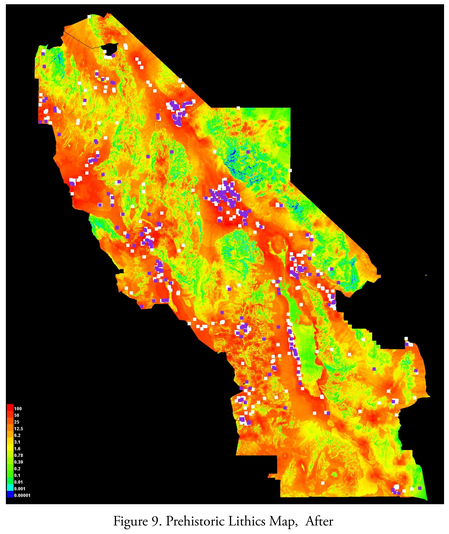

Figure 9. Prehistoric Lithics Map, After

Results, continued

While some environmental variables contribute significantly to the model, others contribute to less that 1% of the total predictive data output. The foundation of this experiment involved attempting increase the reliability of the models by deleting extraneous information that did not significantly contribute to the overall model.

Discussion

The models shown represent the graphical and statistical differences between experiment stages. Prehistoric Lithic models were statistically the weakest of all eight prehistoric site types run through the MaxEnt model. Significant methodological changes are twofold: (1) change the output method from logistic regression to cumulative, emphasizing the differences between high and low values without affecting the numerical attributes of the test; (2) dedicate 25% of the total sample to testing the predicted model. The statistical differences between the models are slight: the AUC measure before database work is 0.865 and after the adjustments is 0.877.

Future Research

Future research will include continued adjustments of the DEVA database and environmental datasets, and will use the size of the archaeological sites to run a Kvamme's Gain statistic to evaluate the overall predictive performance of the MaxEnt models.

Figure 10. Death Valley Survey