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First Test of Habitat Suitability Models for the Davy Crockett National Forest

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We called.
You answered.

The response to our Passport in Time (PIT) solicitation for the test of new habitat suitability models (Figure 1) for the Davy Crockett National Forest (DCNF) was fantastic, and thanks to our many friends and colleagues in the Texas Archeological Society and the Council of Texas Archeologists for helping us to spread the word. Participation in the test was limited to 20 volunteers per week (40 over the course of the two-week test), and we were very grateful to receive such a large pool of applicants from across the

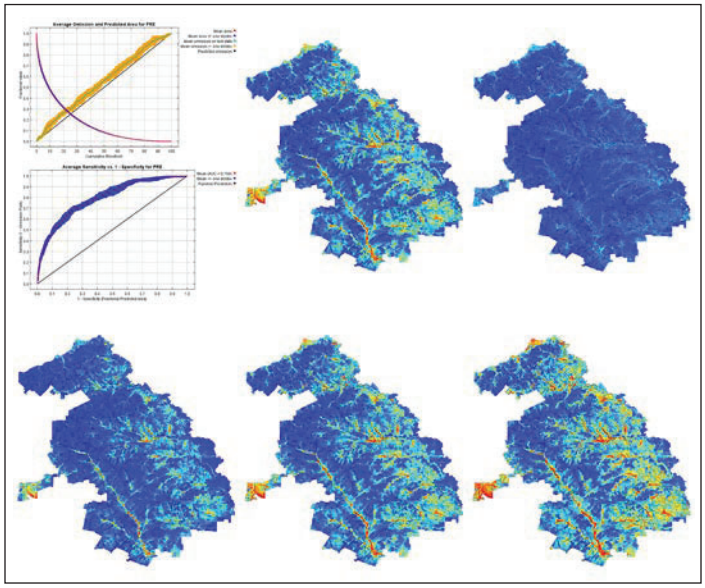

Figure 1

United States. Our volunteers ranged greatly in age and experience; from a young high school graduate taking a gap-year before beginning his studies at the University of Chicago to a retired professor from the University of Colorado at Boulder.

The PIT project leverages a recent documentation of archaeological collections from the National Forests and Grasslands in Texas (NFGT), enlisting those data to produce a suite of habitat suitability models for specific time periods based upon the presence of temporally-diagnostic artifacts (Figure 2). Using data layers associated with environmental variables, site locations, and others, the current suite of models (fourth iteration) provides a data-driven method that can be continually refined as we generate and test novel hypotheses on the forests. While a valuable addition to the management and protection of these important resources, the model is imperfect. Additional work is needed to test and refine the model through mitigating bias introduced through 30+ years of linear, block, and compartment-level surveys, achieved through shovel-testing a stratified random sample of up to 100 locations throughout the DCNF. With this test, that undertaking begins; however, to fully address survey bias, additional testing—beyond this initial effort—will be required.

The test for this suite of models was conducted as a double-blind survey since neither the United States Forest Service personnel (excepting Garcia) nor the participants were provided with any information regarding the model in advance of testing. Input from the model was shared with the crew the day after each location was tested (Figure 3). Enlistment of the double-blind survey method aids in reducing survey bias. Collection of data for this project begins with the stratified random sample. The sample consists of random locations throughout compartments of the DCNF. Those locations not visited in the first test of the model (February 18-March 3, 2018) will be surveyed following the PIT project. To test the stratified random sample, a three-by-three grid of nine shovel tests was excavated at each location. Those resources discovered during the survey were assigned a forest-specific number,

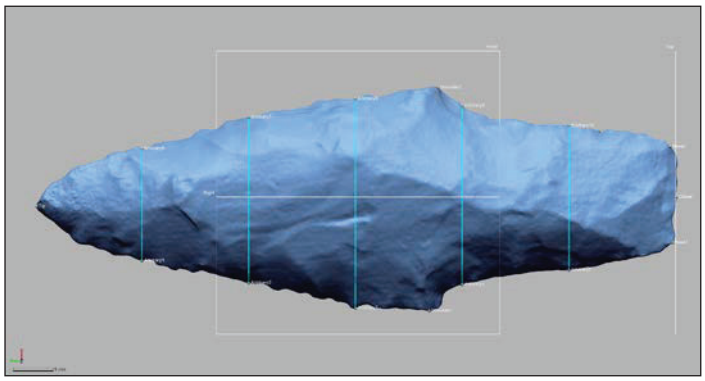

Figure 2

were documented, and the collections were subsequently transferred to the Center for Regional Heritage Research at Stephen F. Austin State University for analysis and processing.

Site Location Error

Site location error has been compounded by gradual improvements in the practice of documenting site locations; the addition and refinement of GPS locations in particular. Many previously recorded archaeological site locations on the DCNF are known to be problematic, warranting a site-relocation effort to reduce site location error, while simultaneously improving the decision-making capacity of Heritage personnel. Between the 2018 and 2019 tests of the habitat suitability models, the proposed site relocation project will focus upon refining geographic site locations on the DCNF, beginning with those digitized by georeferencing points from a paper map. While some site locations are known to occur within five meters of the current coordinates, others are known to deviate between 60 and 100 meters, introducing error, and causing challenges for both the models and for ongoing site management.

Figure 3

Data Challenges

Among those challenges associated with creating the models has been the identification of deficiencies in the data. One of those deficiencies occurred in the stream (or blue-line) shapefile associated with the local waterways and drainages, which was off by up to 30 meters in some locations. To address this deficiency, a new stream shapefile was created using a digital elevation model coupled with the Strahler method to order the resulting stream layer. Another challenge is that the available digital elevation models capture the canopy of the forest; meaning that a freshly cut pine stand appears much lower in elevation than an adjacent mature stand. In late 2016, the Federal Emergency Management Agency (FEMA) collected Light Detection and Ranging (LiDAR) data for the Neches River basin. The NFGT negotiated a higher resolution for the Angelina, Davy Crockett, Sam Houston, and parts of the Sabine National Forests that would be covered by the survey. Bare-earth LiDAR will be incorporated into the DCNF model as soon as it becomes available.

Production of the DCNF model follows a recent systematic study of predictive modeling literature that enlisted scientometrics to identify communities of practice in research articles that used archaeological applications of predictive modeling or predictive modeling techniques (Figure 4). A similar network was constructed more recently that is focused on applications of the three R packages used to generate the DCNF models (Maxent, ENMeval, and ENMTools), and is not limited to archaeology. Both networks inform the continued development of the DCNF models and have aided in the iterative refinement of models produced for this research program.

The current iteration of the DCNF models holds significant potential beyond the development of a heuristic habitat suitability model. Using diagnostic artifacts, the models can be further parsed to investigate novel research questions. Might Archaic-era hunter-gatherer populations, for instance, have prefered a different suite of geographic and landscape-based site selection criteria than the horticulturalists and agriculturalists associated with Woodland and Caddo populations? There are diagnostic artifacts assumed

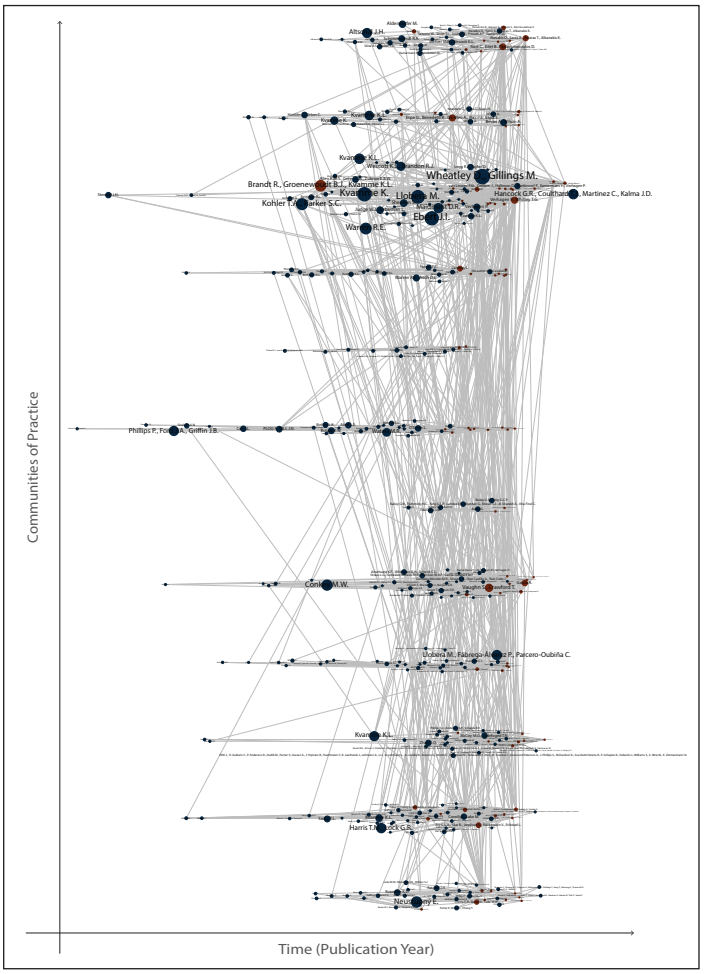

Figure 4

to transcend the hunter-gatherer-to-horticulturalist or agriculturalist transition (Kent and Gary dart points in particular) that are relatively abundant in the NFGT collections. In addition to the models, a geometric morphometric study is underway that asks whether the shape of Gary and Kent points differs at those sites where only lithics were recovered versus those where lithics and ceramics were recovered on the DCNF, and a hunter-gatherer-to-horticulturalist or agriculturalist model would afford more depth to that discussion. The development and first test for this suite of models represents the beginning of a long-term research program on NFGT lands in Texas. Much work lies ahead, and we are excited about the many possibilities.

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