Education, Experience, and Integrity
Applied Ecology and Conservation

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The American Chestnut Foundation Narrative Report: FINAL

Modeling the historic range and habitat of American chestnut in Georgia circa 1804-1832, a guide for restoration efforts.

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Objectives

1) To generate a model of American Chestnut distribution in Georgia.

2) To assess the relative importance of soil and landform attributes in determining American Chestnut distribution in Georgia.

3) To create a map of habit suitability based on the predictions of the American Chestnut distribution model.

4) To disseminate the information discovered in this research to academics and the larger public, especially land managers and private land owners.

Methods

Prior to the grant period, Nathan Klaus with GA Department of Natural Resources Wildlife Conservation Section arranged with the state archives to have all available land lotter maps for GA digitized and georeferenced. Nathan then searched every map for all witness trees that were American Chestnut and created a geospatial data point for each location for a total of > 15,000 data points.

During the grant period, I downloaded gSSURGO soil data from the U.S.D.A. National Resources Conservation Service Website. I used ArcGIS Pro (ESRI) to manipulate several soil data tables from the gSSURGO database to extract and append to geospatial raster layers the following variables: percent clay, number of frost-free days, pH, drainage class, erosion class, texture, soil taxonomic groups, parent material kind and parent material origin. I also used an ESRI-provided digital elevation model to create raster layers for elevation, aspect, slope, and curvature. I clipped all environmental raster layers to the extent of the chestnut records (records were not available for all parts of the state), and I split all data into physiographic provinces for ease of data processing. I edited all layers to the same precise geographical reference system, cell size, and extent.

During the grant period I started but did not complete modeling and predictions for all five physiographic provinces within the study area. For each physiographic province I will use SDM package for R to check all variables for collinearity, eliminating variables until no collinearity remains. I will use the remaining variables to construct five competing species distribution models (each with different modelling approaches) for each province, then select the best performing model for each province using AUC scores. I will also use AUC scores to determine which variables had the most influence (i.e., were the most important in determining chestnut distribution) on the best model. I will use the best model to predict and create a raster layer of habitat suitability for chestnut for each province, then import the raster layers into ArcGIS Pro to produce a map of habitat suitability scores for the extent of the original witness tree data.

Actual results

Several aspects of this process proved more challenging than I had anticipated. The gSSURGO data was not intended to be used for this purpose and as such was difficult to manipulate. After much trial and error and advice from other GIS professionals, I was able to create usable raster layers from the data.

I originally intended to use MaxEnt software for modeling and prediction, however I learned during this process that the SDM package for R was available and allows the user to compare multiple modeling algorithms (including MaxEnt) and select the algorithm that works best for the data. Preparing data for use in the SDM package was time-consuming as a first-time user, however I was successful in completing it. There were predictor variable collinearity issues for some provinces and not others, so I removed problematic variables from the datasets until no collinearity issue remained.

Modeling using the SDM package is progressing nicely; I have produced models for two provinces to date with model performance in the moderate to excellent range. For the Piedmont province, the most influential variable was elevation followed, in order of importance by percent clay, slope, aspect, landform curvature, pH and number of frost-free days. For the Appalachian Plateau province, the most influential variable was also elevation (although it was not as important as it was in the Piedmont) followed by slope, landform curvature, aspect, percent clay, number of frost-free days, soil order, soil suborder, pH and soil great group. Currently I am working through some known issues with the predict function in the SDM for R package, as well as finishing the modeling process for the remaining three physiographic provinces.

I have yet to complete mapping or writing for publication and am applying for additional funding to finish the project. I expect to have the modeling, predictions and mapping finished around mid-year 2023 and aim to submit an article for *Chestnut: The Journal of The American Chestnut Foundation* by the end of 2023.

Published works and presentations

None to date.

Press coverage

None to date