Extrapolation of the Dunk and Hawley Red Tree Vole Habitat Suitability Model to the Species Range

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Overview

The U.S. Forest Service and Bureau of Land Management often have needs to quantify suitable habitat for the red tree vole throughout the species range. A habitat suitability model developed by Dunk and Hawley (2009) provides one approach for estimating habitat suitability. The primary purpose of the habitat model provided in Dunk and Hawley was to evaluate the relative strengths and predictive ability of environmental variables. Their analyses were based on the random-grid data collected on red tree voles and environmental variables within CVS/FIA plots. To allow the Dunk and Hawley model to be used throughout the red tree vole's range, we extrapolated the model using 2012 GNN vegetation data. This model thus provides a tool to estimate habitat suitability throughout the species range using recent vegetation data and data from the random-grid surveys. Although Dunk and Hawley's (2009) model performed very well with the random-grid data, we have not yet evaluated the extrapolated model with independent red tree vole presence/absence data.

Technical Details

To extrapolate the Dunk and Hawley model, we used GNN data modeled from 2012 satellite imagery data with 30 m resolution. GNN models the relationship between ground-based data from FIA/CVS plots and spatial predictor variables derived from Landsat satellite imagery, climate variables, topographic variables, and soil parent materials (Ohmann and Gregory 2002). We used Marine Geospatial Ecology Tools vers. 0.8a50 (MGET; http://mgel.env.duke.edu/mget; Roberts et al. 2010) which we ran as a tool in ARCGIS 10.0 to estimate probabilities of RTV occurrence for each 30 m pixel within the range of the RTV. We used MGET's "Model Data" function that uses Program R to estimate parameters for each model. To extrapolate the Dunk and Hawley model, we included the specific criteria they used in Program S-Plus (provided by J. Dunk, pers. commun.) to fit their Generalized Additive Model (GAM) with the MGET tool "FIT GAM" using the original data from the 365 RTV plots that Dunk and Hawley used to fit their model, and the option "GAM R Package". We then used the tool "PREDICT GAM FROM

RASTERS" applying the fit model to each pixel, creating a raster of predicted probabilities. Dunk (pers. commun.) provided criteria that allowed us to nearly replicate their model in MGET. Dunk and Hawley (2009) used a loess smoothing parameter for each parameter, and used a bivariate loess smoothing parameter for the northing and easting UTM coordinates. The exact specification for fitting the loess smoothing function that Dunk and Hawley used was not available in MGET but the predicted probabilities of RTV occurrence on the 365 plots used in Dunk and Hawley (2009) were nearly identical to that estimated with MGET (D. Rosenberg, unpubl. data). MGET vers. 0.8a50 did not include loess smoothing options or bivariate smoothing for GAM models. A patch was prepared by J. Roberts (Duke University, pers. communication.) that allowed us to estimate the GAM using these criteria. We used the following to fit the Dunk and Hawley model in MGET:

RTV ~ lo(UTME, UTMN) + lo(SLP) + lo(MAXDBH) +lo(BA4590) + lo(SDCONdbh), where SLP is the slope, MAXDBH is the maximum tree diameter, BA4590 is the basal area of trees with dbh of 45-90 cm, and SDCONdbh is the standard deviation of dbh of conifer trees for trees > 2.5 cm dbh.

The model was outputted as a raster file that can be used in ARCMAP.

References

Dunk, J. R., and J. J. Hawley. 2009. Red-tree vole habitat suitability modeling: implications for conservation and management. Forest Ecology and Management *258:*626-634.

Ohmann, J.L. and M.J. Gregory. 2002. Predictive mapping of forest composition and structure with direct gradient analysis and nearest-neighbor imputation in coastal Oregon, U.S.A. Canadian Journal of Forest Research. 32: 725–741.