

Interpreting Maxent's output

Clayton Visger

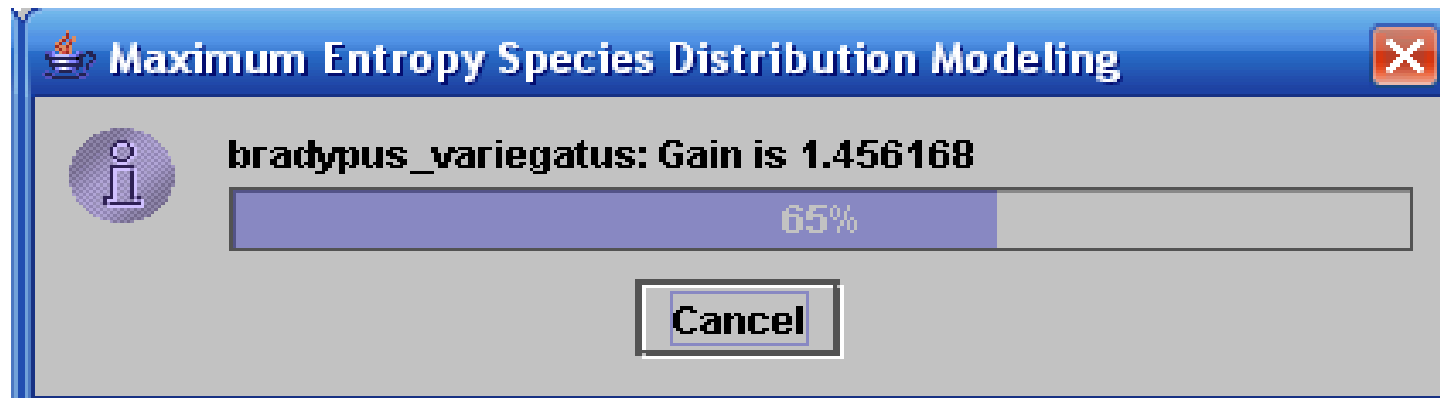
Florida Museum of Natural History

University of Florida



iDigBio is funded by a grant from the National Science Foundation's Advancing Digitization of Biodiversity Collections Program (Cooperative Agreement EF-1115210). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. All images used with permission or are free from copyright.

Maxent is finished: What now?

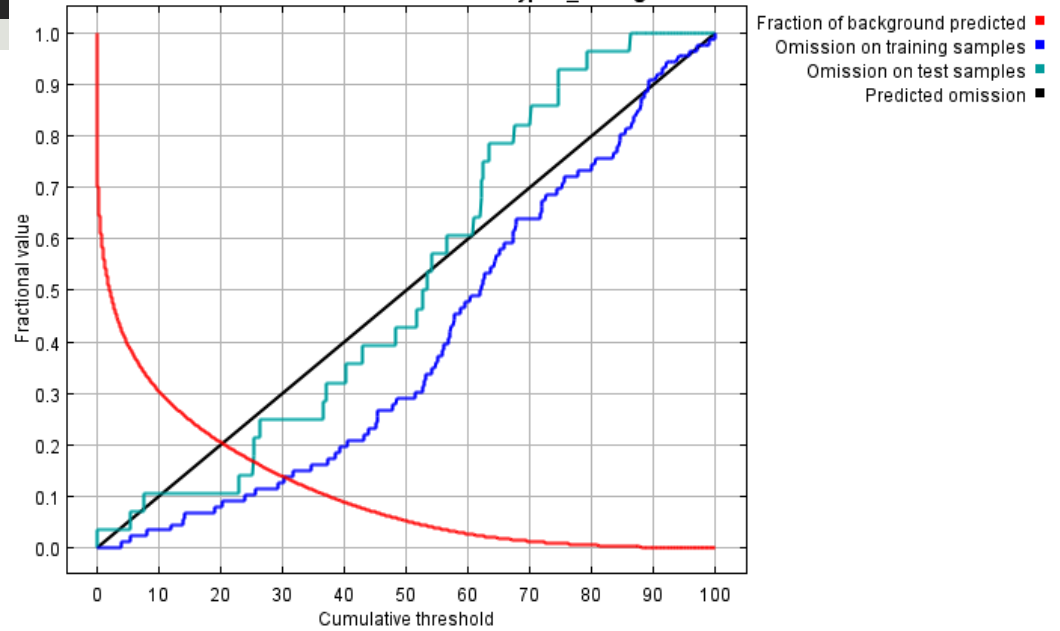


Maxent outputs a friendly .html with:

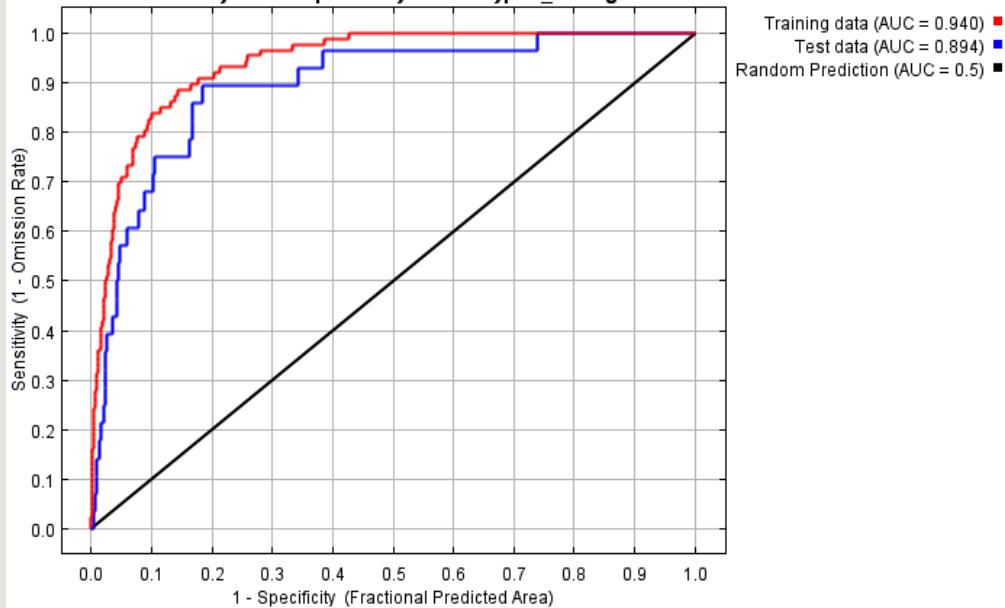
- Model statistics
 - Training vs Test data
 - AUC score
- Maps
 - Suitability scores
 - binary Thresholds
 - Projections
- Variable performance
 - Contribution to model
 - Response curves
- Settings used

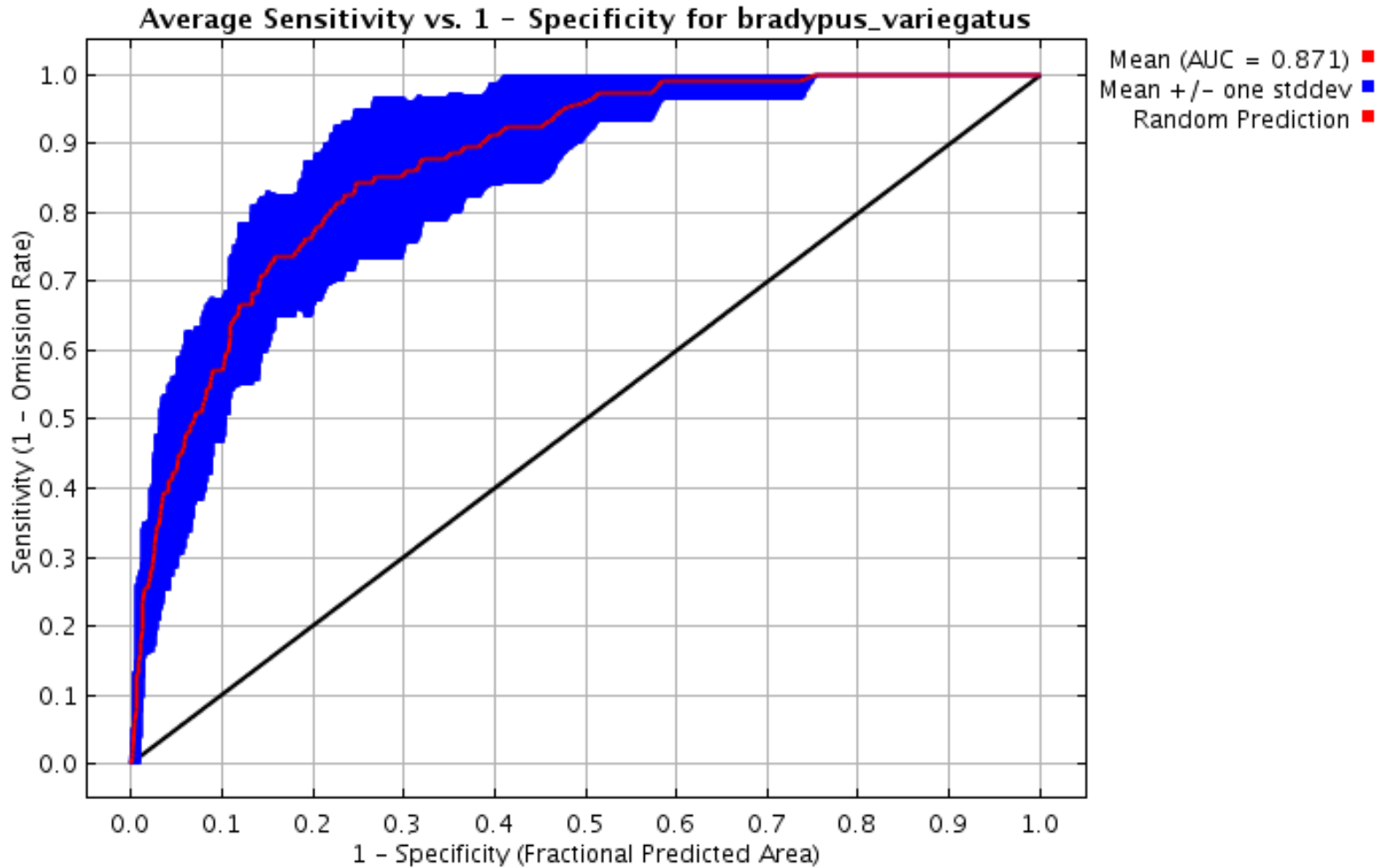
Model statistics

Omission and Predicted Area for *bradypus_variegatus*



Sensitivity vs. 1 - Specificity for *bradypus_variegatus*



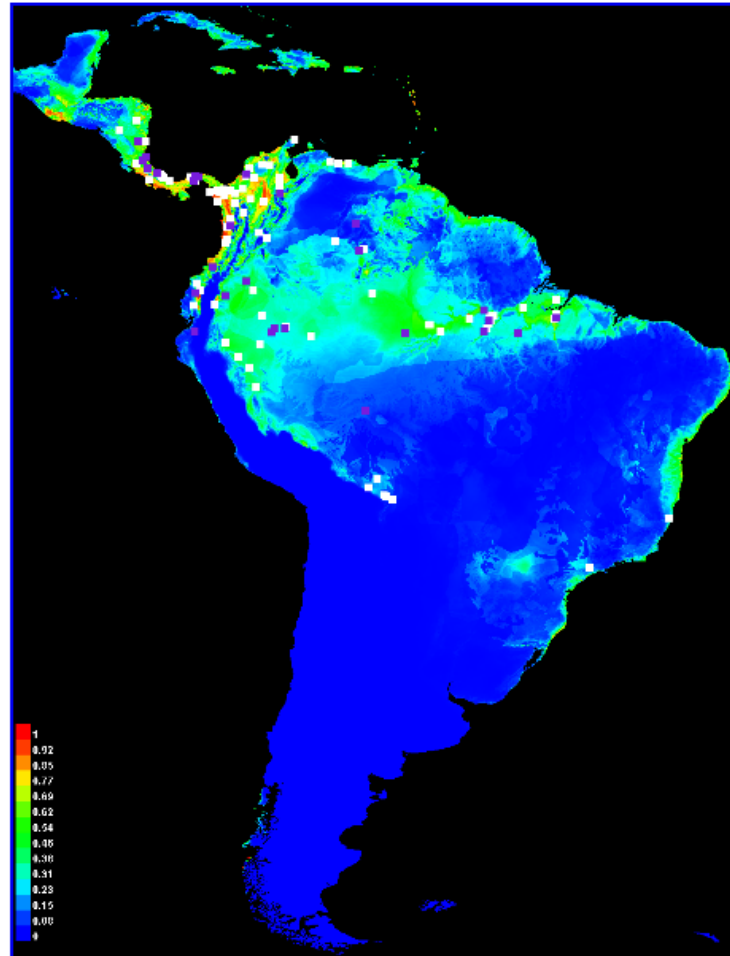


When replication
is used

Heatmap of suitability scores

Pictures of the model

This is a representation of the Maxent model for *bradypus_variegatus*. Warmer colors show areas with better predicted conditions. White dots show the presence locations used for training, while violet dots show test locations. Click on the image for a full-size version.



Variable (layers) contributions to the model

Analysis of variable contributions

The following table gives estimates of relative contributions of the environmental variables to the Maxent model. To determine the first estimate, in each iteration of the training algorithm, the increase in regularized gain is added to the contribution of the corresponding variable, or subtracted from it if the change to the absolute value of lambda is negative. For the second estimate, for each environmental variable in turn, the values of that variable on training presence and background data are randomly permuted. The model is reevaluated on the permuted data, and the resulting drop in training AUC is shown in the table, normalized to percentages. As with the variable jackknife, variable contributions should be interpreted with caution when the predictor variables are correlated.

Variable	Percent contribution	Permutation importance
pre6190_i10	31.1	5.4
pre6190_i7	23.6	1.3
tmn6190_ann	14.7	20.6
h_dem	10.3	13.2
ecoreg	6.6	3.7
tmx6190_ann	4.3	19.6
pre6190_i1	2.2	1.8
frs6190_ann	2.1	25.6
pre6190_i4	1.8	3
vap6190_ann	1.6	0.3
tmp6190_ann	1.1	0.7
dtr6190_ann	0.4	4.7
pre6190_ann	0.3	0.1
cld6190_ann	0	0

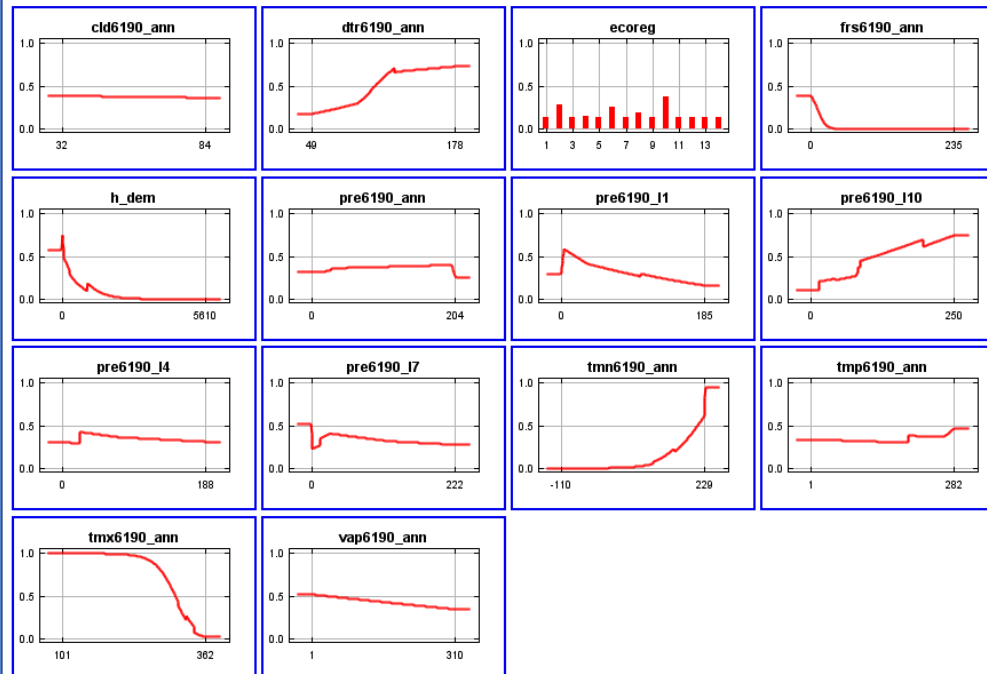
Find: Match case

Done

Impact of each variable on the suitability score

Response curves

These curves show how each environmental variable affects the Maxent prediction. The curves show how the logistic prediction changes as each environmental variable is varied, keeping all other environmental variables at their average sample value. Click on a response curve to see a larger version. Note that the curves can be hard to interpret if you have strongly correlated variables, as the model may depend on the correlations in ways that are not evident in the curves. In other words, the curves show the marginal effect of changing exactly one variable, whereas the model may take advantage of sets of variables changing together.



Maxent settings used

Raw data outputs and control parameters

The data used in the above analysis is contained in the next links. Please see the Help button for more information on these.

[The model applied to the training environmental layers](#)

[The coefficients of the model](#)

[The omission and predicted area for varying cumulative and raw thresholds](#)

[The prediction strength at the training and \(optionally\) test presence sites](#)

[Results for all species modeled in the same Maxent run, with summary statistics and \(optionally\) jackknife results](#)

Regularized training gain is 2.347, training AUC is 0.974, unregularized training gain is 2.717.

Unregularized test gain is 2.998.

Test AUC is 0.986, standard deviation is 0.004 (calculated as in DeLong, DeLong & Clarke-Pearson 1988, equation 2).

Algorithm converged after 520 iterations (4 seconds).

The follow settings were used during the run:

42 presence records used for training, 10 for testing.

10041 points used to determine the Maxent distribution (background points and presence points).

Environmental layers used (all continuous): alt bio1 bio10 bio11 bio12 bio13 bio14 bio15 bio16 bio17 bio18 bio19 bio2 bio3

Regularization values: linear/quadratic/product: 0.216, categorical: 0.250, threshold: 1.580, hinge: 0.500