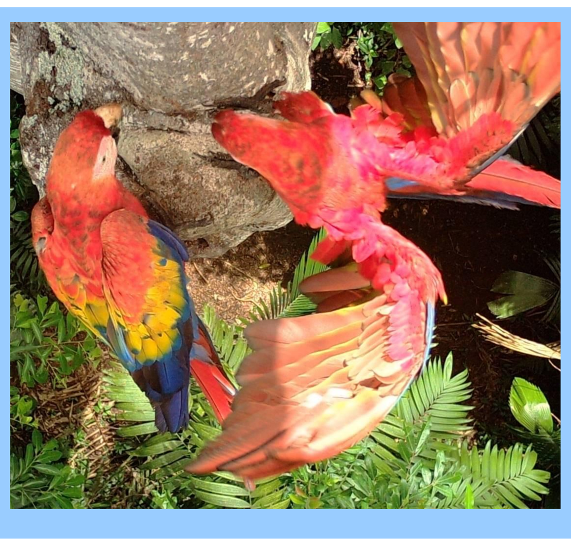
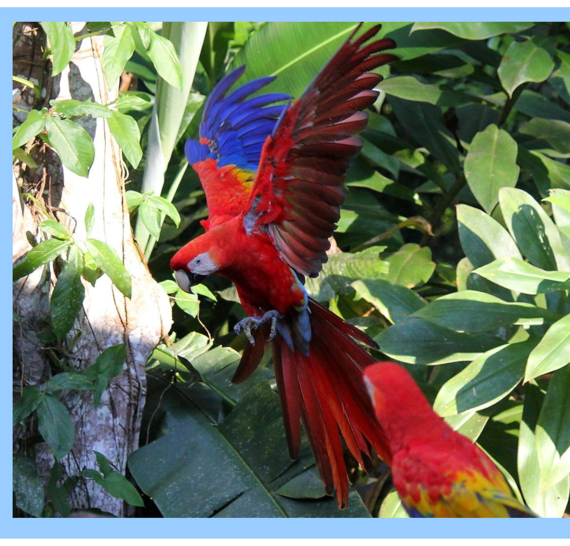


Predicting the spatial distribution of scarlet macaw (*Ara macao cyanoptera*) habitat under changing climate scenarios

Renata M. Diaz, Yichao Zeng, Boris M. Arevalo

Dept. of Wildlife Ecology and Conservation, University of Florida



INTRODUCTION

- Flagship species are key strategic tools for biodiversity conservation because they can ignite public interest and sympathy (Jepson and Barua 2015) - garnering support for conservation (Skibins et al. 2016), raising general biodiversity awareness, and securing conservation financing through philanthropy (Verissimo et al. 2011).
- The scarlet macaw *(Ara macao cyanoptera*) is a flagship species for biodiversity conservation in Belize. The northern subspecies, *A. macao cyanoptera,* is endangered throughout its range, due to habitat loss and degradation and the pet trade (Iñigo-Elías 1996, Britt et al. 2014, Tella and Hiraldo 2014).
- Understanding the spatial distribution of habitat for *A. macao cyanoptera* and how it may change under differing climate change scenarios will allow for better management and conservation of the species.
- Comparing predictions across scenarios will help modelers gauge the sensitivity of biodiversity predictions to climate model assumptions.

OBJECTIVES

- Model the distribution of potential habitat for *A. macao cyanoptera* in Belize.
- Explore changes in potential scarlet macaw habitat distribution across different climate change scenarios.
- Evaluate the sensitivity of model outputs to chosen climate scenarios.

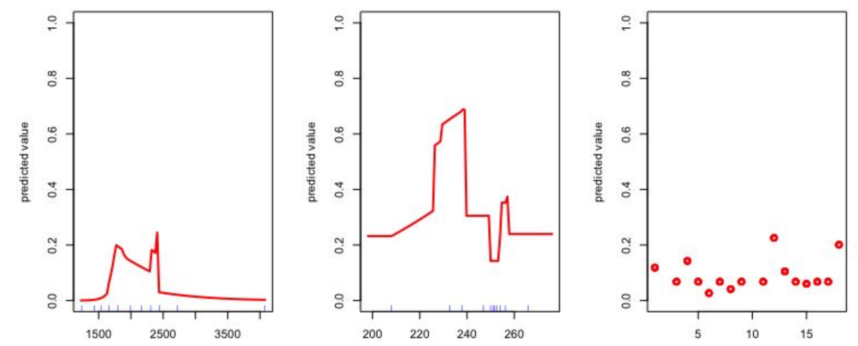
METHODS - Model Building

Data

- Scarlet macaw sighting point data (n = 266, presence-only) collected along roads, tracks, trails and rivers in the Maya Mountains Massif protected area, Belize.
- Environmental variables: mean annual temperature (WorldClim), mean annual precipitation (WorldClim), land-cover (Meerman & Clabaugh 2017), and elevation (ASTER DEM). Elevation was highly correlated with temperature (0.95) and removed.
- Subset sighting points into training (n = 100) and test (n = 166) datasets.

Models

- Fit MaxEnt species distribution models (`maxent`, Jurka and Tsuruoka 2013) on training data:
- Unconstrained feature selection (Merow et al, 2013).
- Beta = 0.01, 0.1, 0.5, 0.9, 1.
- Best-performing model selected using Boyce's criterion on models fit to test data.
- The best-performing model (corr. = 0.987) had beta = 1, but all models had high correlation coefficients and gave qualitatively similar results.



METHODS - Future Scenarios

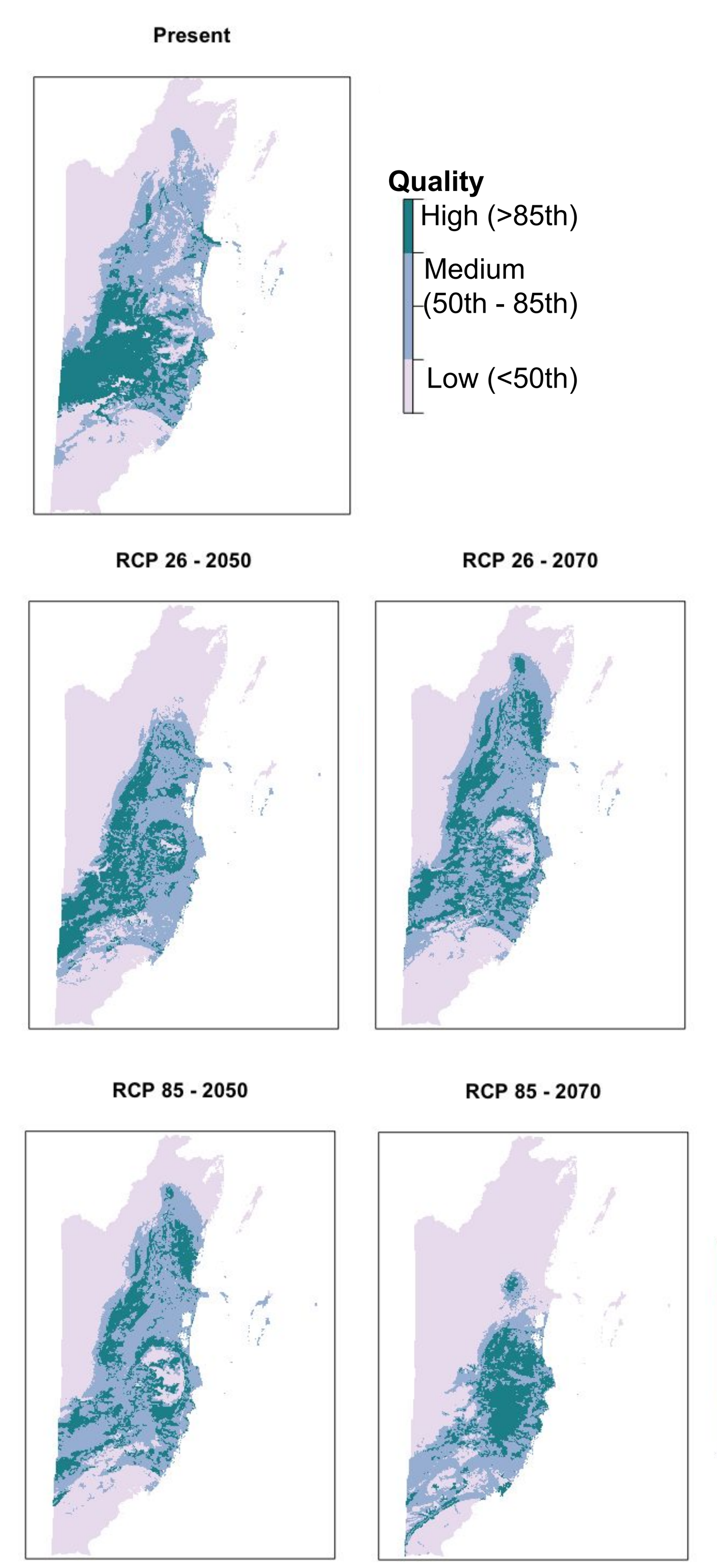
Data:

- Climate projections for 2050 and 2070 from BioClim, using the BCC-CSM1-1 model for two representative concentration pathways (RCP): RCP26 (least accumulation of CO2; least extreme) and RCP85 (most extreme).
- Extracted mean annual temperature and mean annual precipitation.
- Assumed no change in land cover.

Modeling:

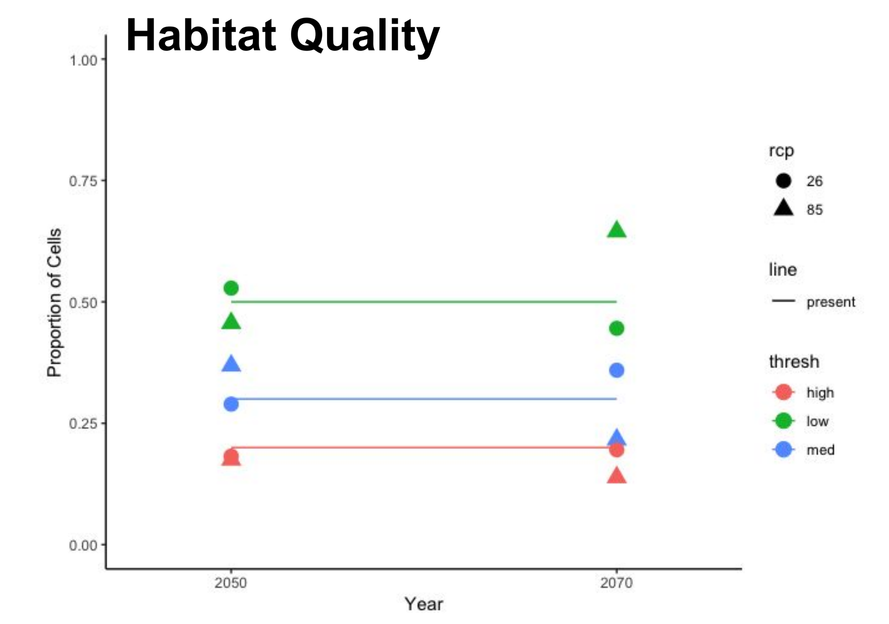
- Predicted occupancy probabilities for macaws according the selected model, using projected climate conditions as the environmental variables.
- To facilitate comparison across scenarios, we divided cells into low, medium, and high-probability based on how they compared to the present-day predictions. "High" values were above the 85th percentile of present-day values, medium, the 50th to the 85th percentile, and low, below the 50th percentile.
- We compared the proportion of cells falling into these categories according to different climate change scenarios.

RESULTS - Habitat Distribution



- Temperature contributed most to the model (60%), followed by precipitation (30%) and land-cover (10%).
- Potential scarlet macaw habitat suitability was highest in areas with annual precipitation of 1500-2500 mm, temperatures from 22-25 degrees C and in submontane broad-leaved moist forest, lowland broad-leaved moist forest, and riverine forest.
- At present, high-quality habitat is concentrated on the Maya Mountains Massif.
- Future climatic scenarios indicate a east-northeast shift in suitable habitat and becoming more fragmented especially under RCP85.

RESULTS - Habitat Amount



- The proportion of high-quality habitat decreases most dramatically under RCP 85. Moreover, under RCP 85, the proportion of *low* quality habitat increases much more than under RCP 26 by 2070.
- Under RCP 26, the proportion of high quality habitat remains similar to the present. Some habitat changes from low to medium quality by 2070.

CONCLUSIONS

- Temperature and precipitation were the most important variables in predicting scarlet macaw suitable habitat.
- The Maya Mountains Massif was identified as the best available scarlet macaw habitat, representing 20% of Belize.
- Both the spatial distribution and amount of high and medium-quality habitat are sensitive to RCP scenario, with the most drastic reduction in habitat availability under the RCP 85 scenario.
- Future efforts to model scarlet macaw habitat should consider a broader suite of environmental variables, and attempt to include projections for future land cover scenarios.

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