Modeling the Effects of Environmental Change on Crucial Wildlife Habitat

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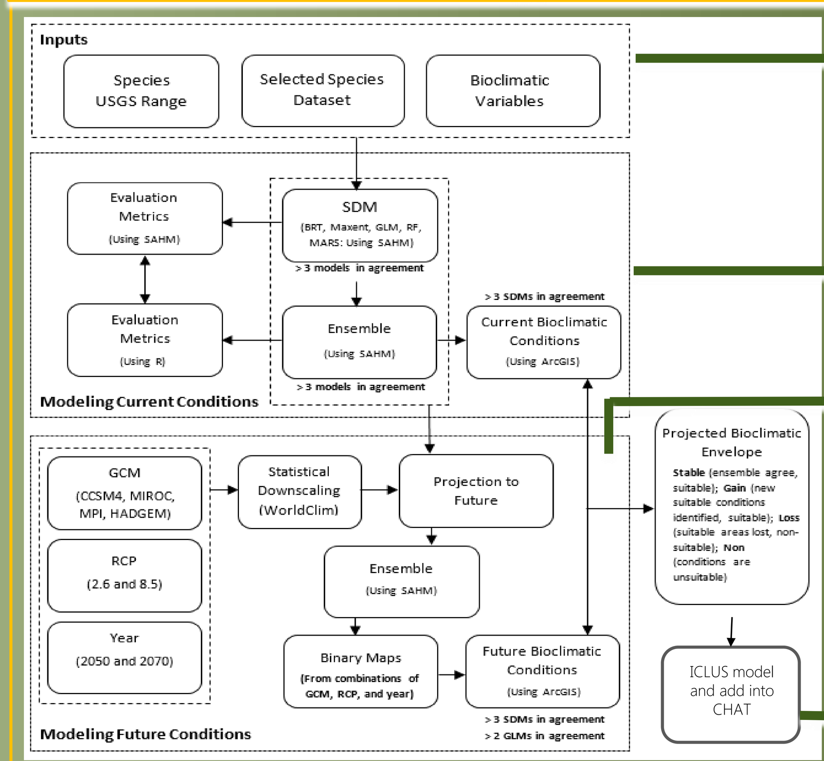
Project Overview

This project evaluated bioclimatic-envelope models (from 19 bioclimate variables) in order to project availability of suitable bioclimatic conditions for 20 terrestrial species, identified as species of concern (SOC) in the South Central United States. We used various climate projections derived from general circulation models (GCMs) and they were post-processed via application of a simple statistical downscaling method. We compared future projected climate envelope suitability results produced from combinations of four GCMs and two greenhouse gas concentration trajectories [Representative Concentration Pathways (RCPs) 2.6 and 8.5] for two future time periods (2050: average for 2041 to 2060 and 2070: average for 2061 to 2080).

Objectives and Hypothesis

Our objectives were to develop models of present day and future distributions of suitable environmental conditions for the 20 focal species and to compare how bioclimatic-envelope suitability is projected to change among different climatic scenarios. The focal species were identified a priori as having some vulnerability to climate change or dependence on the climatic variables likely to be affected by climate change. We hypothesized that the projection results would show most of the areas that currently possess suitable bioclimatic conditions for focal species would convert to unsuitable conditions in the future; and that a majority of the focal species would appear to be at high risk due to climate change.

Methodology



Datasets: species occurrence, species ranges, bioclimatic variables

Current Conditions: developed models, selected SDMs, generated current bioclimatic conditions

Future Conditions: selected GCMs and RCPs, and projected current to future conditions

Projected bioclimatic conditions, masked ICLUS models, incorporated into NM CHAT Tool

5 Species Distribution Models

Generalized Linear Model (GLM)
Random Forest (RF)
Boosted Regression Tree (BRT)
Maxent
Multivariate Adaptive Regression Splines (MARS)

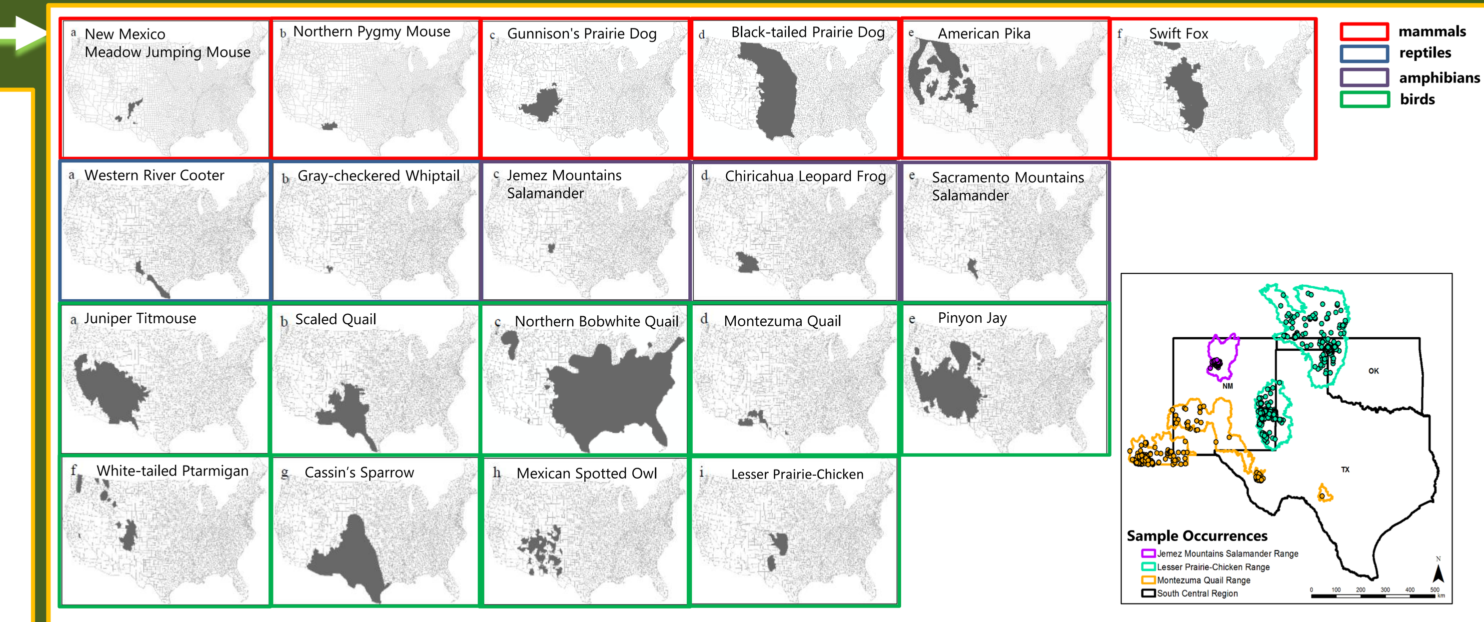
4 General Circulation Models

CCSM4
HadGEM2-ES
MIROC5
MPI-ESM-LR

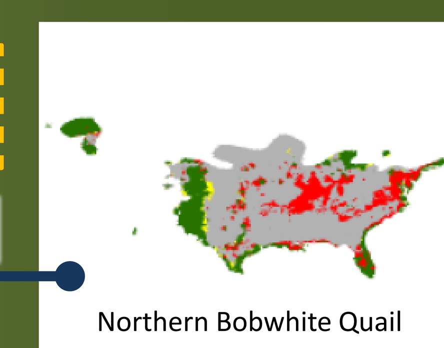
19 Bioclimatic Variables

Variable	Description
Bioclim 1	Annual Mean Temperature
Bioclim 2	Mean Diurnal Range
Bioclim 3	Isothermality
Bioclim 4	Temperature Seasonality
Bioclim 5	Maximum Temperature Warmest Month
Bioclim 6	Minimum Temperature Coldest Month
Bioclim 7	Temperature Annual Range
Bioclim 8	Mean Temperature of Wettest Quarter
Bioclim 9	Mean Temperature of Driest Quarter
Bioclim 10	Mean Temperature of Warmest Quarter
Bioclim 11	Mean Temperature of Coldest Quarter
Bioclim 12	Annual Precipitation
Bioclim 13	Precipitation of Wettest Month
Bioclim 14	Precipitation of Driest Month
Bioclim 15	Precipitation Seasonality
Bioclim 16	Precipitation of Wettest Quarter
Bioclim 17	Precipitation of Driest Quarter
Bioclim 18	Precipitation of Warmest Quarter
Bioclim 19	Precipitation of Coldest Quarter

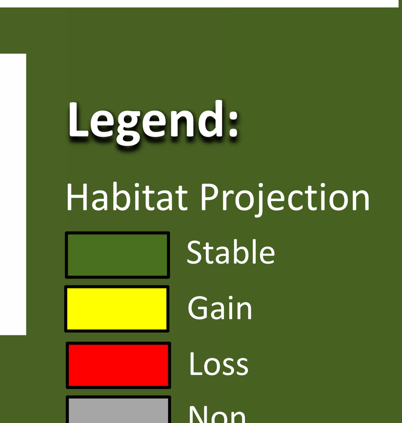
USGS GAP Species Range

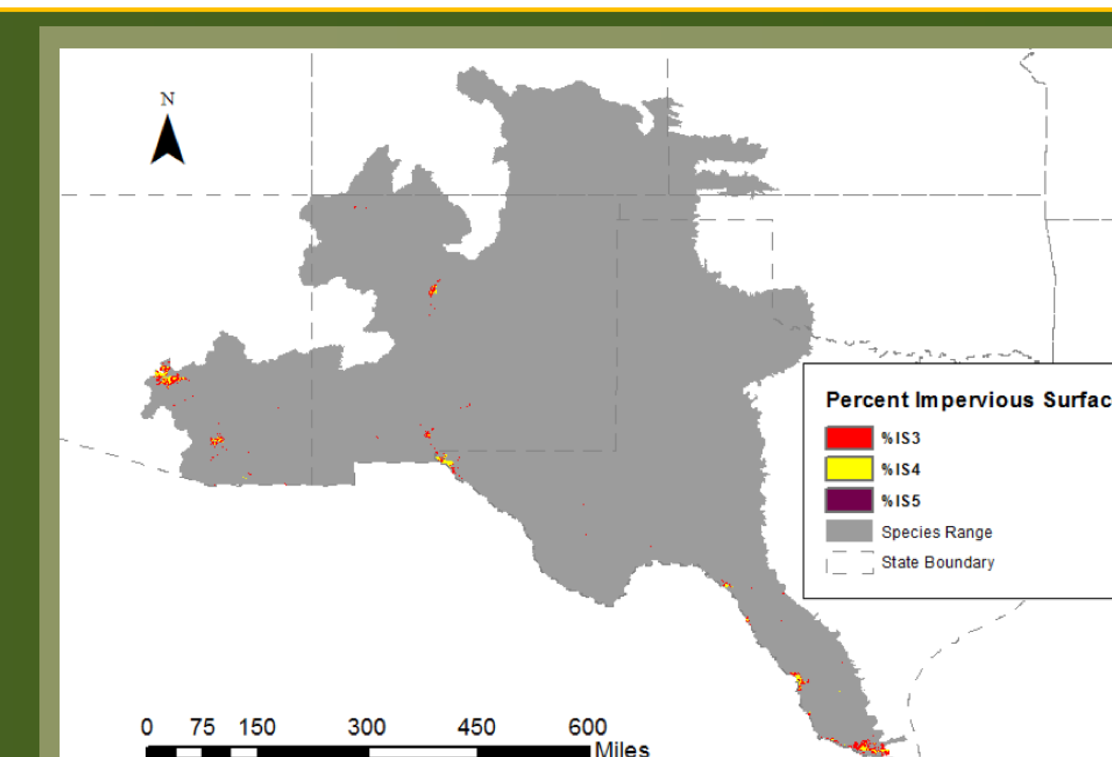


Projections to Year 2070 (RCP 8.5)

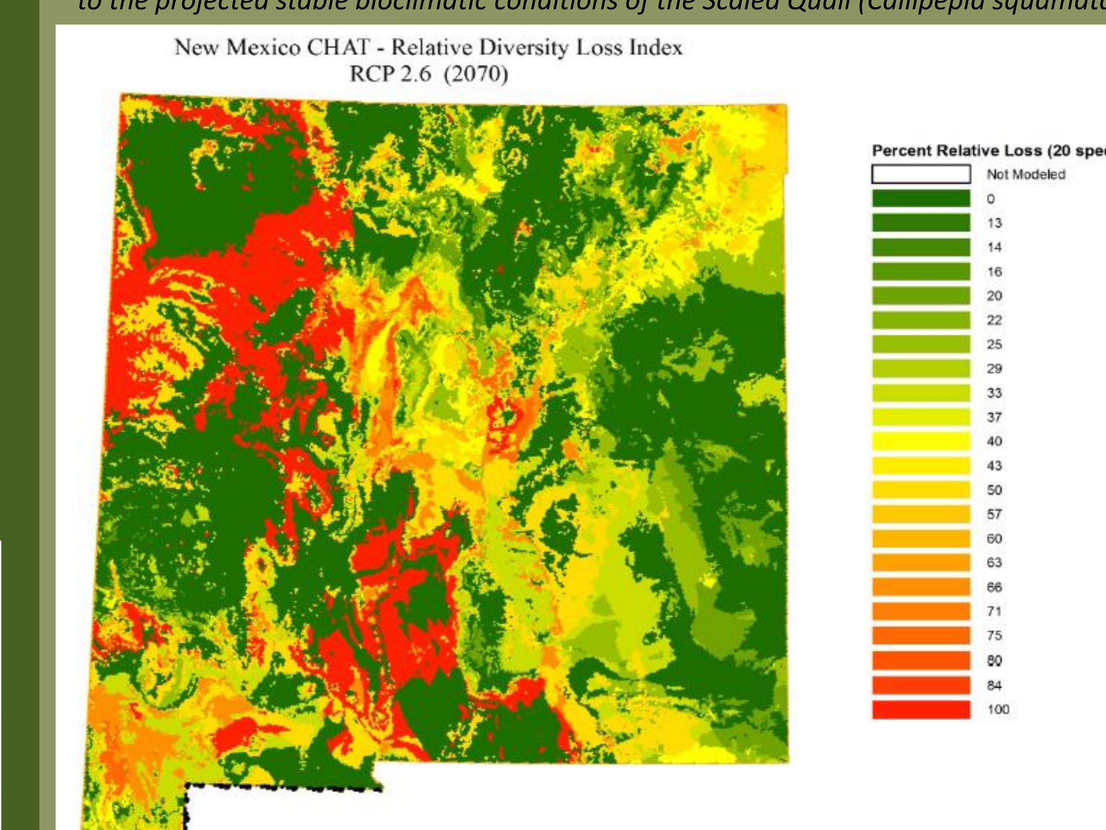








Sample: The projected impervious surface from ICLUS models RCP 8.5 has minimal effects to the projected stable bioclimatic conditions of the Scaled Quail (Callipepla squamata).



An example of the display of the Relative Diversity Loss Index (RDLI) in NM CHAT using the RCP 2.6 scenario in the year 2070.

Results and Conclusions

- Among the herpetofauna species, the Jemez Mountains Salamander is the only species that had <1% loss of area with currently suitable climatic conditions for all projected scenarios, making it the only species in this study that may not be at risk based on these climate variables since its current distribution would not be affected significantly.
- The White-tailed Ptarmigan would lose 62% of its suitable habitat by 2050 and 67% by 2070.
- The Lesser Prairie-Chicken would lose an average of 63% of bioclimatic-envelope suitability, and with minimal gains.
- The Cassin's Sparrow is the only bird species to have more than 50% gain in total area of suitable bioclimatic conditions for all future climatic scenarios.
- Loss > Gain in almost all scenarios for quails. Among all 9 birds, quails are the ones most affected by climate change.
- Three of the six mammals – Black-Tailed Prairie Dog, Swift Fox, and Gunnison's Prairie Dog – show more gain than loss of suitable bioclimatic conditions for all model scenarios.
- No species would lose its stable bioclimatic envelope due to the increasing impervious surface cover.

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