CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Yana D. Petri

Project Number

S1114

Project Title

Modeling CMIP5 Projected Climate Change Impacts on Global Chiropteran Species-Range Shifts under RCP Emission Scenarios

Abstract

Objectives/Goals

The IPCC estimates that a 2-3C mean temperature rise would critically endanger 25% of the species. While projecting habitat shifts of terrestrial mammals is vital for mitigation policies, studies addressing this topic are rare due to modeling complexity/uncertainty. If Chiroptera (bats) are used as bioindicators, calculations could be simplified and help identify potential zoonotic disease (e.g. Ebola) hotspots. The goal of the project was to model, using MaxEnt, the present (1950-2000) global Chiroptera distribution and compare the resultant occurrence probabilities to those generated under RCP2.6 (low emissions) and RCP8.5 (high emissions) future scenarios (2061-80). Greatest niche area reduction was expected to occur under RCP8.5.

Methods/Materials

Bat records were downloaded from GBIF and cleaned in MySQL and ArcMap10. Present (1950-2000) and future (2061-80, under RCP2.6 and RCP8.5) climate data for BIO1 (annual mean temp), BIO4 (temp seasonal), BIO6 (min temp of the coldest month), BIO15 (rainfall seasonal), and BIO17 (rainfall of driest quarter) was obtained as ESRI GRID files from WorldClim. Future data was created using an average of 3 CMIP5 models. Species records, environmental layers were imported to MaxEnt and global maps of probabilities of bat occurrences in the present and future were generated.

Results

In the present and future periods, probability of bat occurrence was low in the temperate and frigid zones (northern Canada, Alaska, Greenland, Russia) and high in the tropics. Niche isolines moved up under both scenarios, but the greatest northern shift occurred under RCP8.5, which exhibited the greatest decrease in bat habitat area. Bat distribution under RCP2.6 changed little compared to that of the present. Based on the regularized training gain statistic, BIO6 (min temp of the coldest month) had the highest % contribution to the model. Analysis of AUC/Omission statistics for the present and future indicated that models had a better than random performance.

Conclusions/Discussion

The hypothesis that the greatest bat habitat reduction would occur under high-emissions RCP8.5 scenario was supported, suggesting that this policy would induce similar global shifts in the niche of terrestrial mammals. Models were deemed statistically significant and potentially useful for ecologists, policy makers, and epidemiologists.

Summary Statement

The effects of climate mitigation policies RCP2.6 and 8.5 on 2061-80 global bat habitat were modeled with MaxEnt, bringing attention to the need in reducing GHG emissions in order to prevent the extinction of numerous terrestrial mammals.

Help Received

Teacher and mentor Renee Fallon provided advice and support. Modeling was conducted at home using open-source GBIF, WorldClim, and CMIP5 data.