Impact of Climate Change on Biodiversity in Taiwan

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We study the impact of climate change on biodiversity in Taiwan by compiling species distribution data of bird, amphibian and freshwater fish species within a 1 × 1 grid cells and applying species distribution modeling. We also examine 17 endemic avian species on the island of Taiwan. Species observations, compiled into GIS format, are compared to modeled distributions for short (2020), mid (2050) and long (2100) term trends. Future projections of climate data (monthly mean temperature and average monthly precipitation) from IPCC were used as potential climate change scenarios. We use 5 general circulation models (CCCMA, CCSR, EHAM4, GFDL, and HADCM3) for the IPCC A2 and B2 scenarios. Using species prediction models, including genetic algorithm for rule-set prediction, Maxent (maximum entropy), logistic regression, and discriminant function analysis, we first predict current species distribution and hotspot locations, and then predict potential shift in species distribution under climate change in 2020, 2050, and 2100. The potential impact of climate change on Formosan Yuhina (Yuhina brunneiceps), a Taiwan's endemic bird species and Fairy Pitta (Pitta nympha), a summer migratory species, were estimated. Both show decreasing trend of potential habitat area and the change will be much greater in the period from 2050 to 2100. The distributions of 15 out of 17 species are predicted to shift up in elevation with warming. As the lower distributional limits contract to higher elevation, the upper edge of their current distributions cannot shift up in elevation because they were already near or at the tops of the mountains. Consequently, their distributions are predicted to shrink over time. The median of each of these species' distributions is higher than the median of all available habitats on Taiwan. In addition, we find that a few common species are predicted to become rare species under climate change. Two of the 17 species examined are not near the tops of the mountains and are the only species that have median elevations of their distributions lower than the median of all available habitats on Taiwan. These 2 species are predicted to expand the upper-elevation distribution limit but not to contract the lower-elevational limit, which results in a widening of their distributions. The future hotspot locations for freshwater fishes and amphibians also show similar trend under climate change scenario. Overall, the results indicate that potential change in biodiversity in Taiwan is severe especially in the period between 2050 and 2100 if current climate change trend continues.

Keyword: climate change, species distribution, endemism, geographic patterns, hotspot