

**Predicting and measuring the impacts of climate change and
habitat loss on Southeast Asian and Australian birds**

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To my parents.

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Abstract

The evil quartet of habitat loss, overharvesting, introduced species, and extinction cascades threatens approximately 13% of the world's birds with extinction. Under a mid-range greenhouse gas emissions scenario, climate change and its synergistic interaction with the quartet may threaten an additional 20% of the global avifauna by 2100. Yet, studies of climate impacts on birds, particularly from the tropics, are so uncommon that it is difficult to assess extinction risk. Indeed, the International Union for the Conservation of Nature (IUCN) has no formal framework for evaluating extinction risk from climate change, largely because of the scarcity of measurements of climate-change impacts and uncertainty in model predictions.

In this thesis I measure and predict the effects of climate change on tropical birds, forecast climate-change impacts on a threatened Australian cockatoo, and analyse the U.S. national threatened species list's coverage of globally imperilled animals. The first chapter reviews studies on the effects of climate change on tropical birds and highlights urgent research avenues. Chapter two is the first field measurement of climate-change-induced range shifts in Southeast Asian birds. The third chapter combines abundance patterns along elevational gradients with climate and land-use change scenarios to forecast the additive effects of deforestation and climate change on endemic birds in Sulawesi. In chapter four I analyse autumn arrival dates in Singapore for the first study of climate change impacts on avian migration phenology in the tropics. The fifth chapter is a detailed case study where I link demographic and bioclimatic models to forecast extinction probability of an Australian cockatoo (*Calyptorhynchus lathami halmaturinus*) under climate-change, conservation-management, disease, and wildfire scenarios. Chapter six evaluates the coverage of IUCN-listed species by one of the world's leading national threatened species lists, the United States Endangered Species Act (ESA).

Main Findings: Chapter two showed that ranges of Southeast Asian birds appear to be moving upslope, with unknown consequences for bird communities. Model-based estimates in chapter three indicated that deforestation is likely to leave endemic species little scope for responding to climate change. Chapter four showed that arrival of long-distance waders and raptors is becoming delayed over time, which may impact other events in species' annual cycles. In chapter five I found that high emissions climate change or reduced brush-tail possum management is likely to threaten the cockatoo, and showed how coupling population and bioclimatic models serve to make predictions more realistic. Chapter six found that 40-95% of IUCN-listed animals found within the U.S. are not ESA-listed.

In conclusion, my results support previous predictions that many upland tropical species, which are currently considered secure, are likely at risk from climate change and its synergy with habitat loss. More measurements of climate-change-induced phenology and range changes are needed, especially from the tropics. Lastly, uncertainty in climate-biodiversity models can be minimised by using coupled demographic-bioclimate approaches.

Originality Statement

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution to J. Berton C. Harris and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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J. Berton C. Harris, 1 May 2012

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