

FROM MICROHABITAT TO METAPOPOPULATIONS:
A MODEL SYSTEM FOR CONSERVATION UNDER
CLIMATE CHANGE

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Abstract

Climate change is having important and widespread effects on global biodiversity. Species' geographic distributions are shifting as populations become extinct in the warmest parts of their range, and expand into cooler parts of their range that are becoming climatically suitable. Developing a holistic understanding of how climate affects ecological processes will improve our capacity to anticipate and ameliorate the impacts of climate change on biodiversity. In this thesis, I study the silver-spotted skipper butterfly *Hesperia comma* at its expanding upper latitude range margin in the UK to investigate the ecological effects of climate change. I examine how fine-scale variation in microclimate influences the spatiotemporal dynamics of range expansion and habitat use, and provide empirical tests of the extent to which different conservation actions can facilitate range shifts. I also develop a framework for analysing the predictive performance of species distribution forecasts under climate change. My principle findings are: (1) range expansions are vulnerable to setbacks, with patterns of local extinction related to spatial patterns of microclimate variation; (2) conservation actions at both local and landscape scales can enhance colonisation and population survival in range expansions; (3) current protected area networks combined with active conservation measures can offer effective means to facilitate range shifts; (4) fine-scale and short-term variation in climate interacts with microclimates generated by vegetation to drive changes in habitat use; and (5) current methods to assess range shift projections result in information loss, and predictions would be improved by the uptake of alternative performance metrics. These findings show how fine-scale variation in microclimate alters responses to climate change, but provide encouragement that existing conservation policy and practice, despite being originally designed to protect pre-existing populations, may transfer well to facilitate range shifts under global warming.

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