

# EFFECTS OF CLIMATE CHANGE AND HABITAT FRAGMENTATION ON TROPHIC INTERACTIONS

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## Summary

Habitat fragmentation and climate change are two anthropogenic impacts considered to be the main threats to biodiversity globally. Fragmentation involves reduction of available habitat area and increased distances between remaining habitat patches, and makes it more difficult for species to colonize new areas and maintain viable populations. Rises in global average temperatures force species to adapt to new climatic conditions, for example through altered timing of biological events or by shifting their distributions into areas with suitable conditions. Evidence that fragmentation and climate change are affecting species directly is accumulating, but the indirect effects on interactions among species may also be severe, with implications for the structure and functioning of ecological communities. Disruption of feeding interactions (for example between predators and prey, herbivores and plants, and hosts and parasites) will lead to changes in the outcome of competitive interactions and altered probabilities of persistence for individual species. Both range shifts in response to climate change and habitat fragmentation will alter the composition and structure of ecological food webs, although predicting the dynamic consequences of such changes is problematic. Finally, a largely unexplored topic is the interacting consequences of these two anthropogenic drivers on trophic interactions.

## 1. Introduction

Two of the most important human influences on natural ecosystems are habitat fragmentation and climate change, posing a threat to many species and identified as

major sources of recent and future extinctions. Habitat fragmentation is typically defined as loss of habitat area, combined with loss of connectivity between habitat patches and increase in the proportion of the landscape comprised by habitat edges. Habitat fragmentation can occur naturally at a range of spatial scales, but human activity has caused widespread fragmentation of many habitats that naturally would have more continuous distributions. 'Climate change' is a broad description of a wide range of possible consequences considered to be caused by the rise of carbon dioxide in the earth's atmosphere, including direct effects on photosynthesis and primary production, increases in average global temperature and changing patterns of precipitation. These two anthropogenic impacts are currently considered to be the most significant threats to biodiversity globally, although there is some debate as to their relative importance. Habitat loss and fragmentation until recently were considered the single greatest cause of current and future species extinctions. However, a recent study predicts that 18-35% of extant species will go extinct from the effects of climate change alone in the next 50 years, with extinctions caused by habitat loss and fragmentation being relative insignificant.

In this chapter, we begin by discussing briefly the direct effects of habitat fragmentation and climate change on biodiversity. By direct effects, we mean responses of individual species to changes in their environment, without considering their interactions with other species, for example resource, consumer or mutualist species. Most investigations of the ecological consequences of habitat fragmentation and climate change have been investigated in this autoecological context. However, this topic has been discussed widely elsewhere, and in the remainder of the chapter we focus on how trophic (feeding) interactions among species, a critical component of ecosystem structure and organization, may be affected by these two major anthropogenic drivers of environmental change.

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### **Biographical Sketches**

**Maartje Klapwijk** is a doctoral student at the University of Oxford UK. During her MSc at Leiden University, The Netherlands, she developed an interest in how species interactions are affected by habitat fragmentation and other anthropogenic impacts. Her current research focuses on host – parasitoid interactions, climate change and habitat fragmentation. In particular, she is interested in how temporal and spatial variation affects the interaction between hosts and parasitoids, and how different species of parasitoids coexist on a shared host in a spatially divided habitat.

**Owen Lewis** is Royal Society Research Fellow in the Department of Zoology, University of Oxford, UK. As a community ecologist and conservation biologist he is interested in the processes that maintain structure and threaten biodiversity. His current research includes the impact of human disturbance on the diversity and functioning of tropical forest ecosystems; the structure and dynamics of food webs involving plants, insect herbivores and their parasitoids; the role of plant pathogens and insect herbivores in structuring and maintaining the high diversity of tropical plants; and the effects of climate change, habitat fragmentation and degradation on interspecific interactions.