

# Rapid Broad-Scale Ecosystem Changes and Their Consequences for Biodiversity

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## INTRODUCTION

Biodiversity contributes to and depends on ecosystem structure and associated function. Ecosystem structure, such as the amount and type of tree cover, influences fundamental abiotic variables such as near-ground incoming solar radiation (e.g., Royer et al. 2011; Villegas et al. 2017), which in turn affects species and associated biodiversity (e.g., Trotter et al. 2008). In many systems, foundational, dominant, or keystone species (or species groups) are important in determining biodiversity, often because of their role in determining ecosystem structure. At spatial scales ranging from ecosystems to regions and larger, structural characteristics of vegetation or other structurally dominant organisms such as corals can influence species diversity, whether focused on alpha diversity (mean species diversity at the habitat level), beta diversity (differentiation among habitats), or gamma diversity (total species diversity across a landscape; Whittaker 1960).

Climate change is already fundamentally altering ecosystems at broad scales, and these changes are projected to increase (IPCC 2014). Such ecosystem changes can occur rapidly in response to extreme events such as droughts, floods, and hurricanes (IPCC 2012). Consequently, rapid broad-scale changes in ecosystems are of increasing concern. Several rapid ecological changes have occurred at spatial scales that are sufficiently broad to represent biome changes (Gonzalez et al. 2010, Settele et al. 2014; Figure 7.1). Rapid broad-scale changes differ from other patterns of vegetation dynamics in that they result in a “crash” in one or more populations (Breshears et al. 2008) over large areas of the