Oecologia
DOI 10.1007/s00442-010-1832-9

COMMUNITY ECOLOGY - ORIGINAL PAPER

Do differences in understory light contribute to species distributions along a tropical rainfall gradient?

T. Brenes-Arguedas · A. B. Roddy · P. D. Coley · Thomas A. Kursar

Received: 3 July 2009 / Accepted: 20 October 2010

Abstract In tropical forests, regional differences in annual rainfall correlate with differences in plant species composition. Although water availability is clearly one factor determining species distribution, other environmental variables that covary with rainfall may contribute to distributions. One such variable is light availability in the understory, which decreases towards wetter forests due to differences in canopy density and phenology. We established common garden experiments in three sites along a rainfall gradient across the Isthmus of Panama in order to measure the differences in understory light availability, and to evaluate their influence on the performance of 24 shade-tolerant species with contrasting distributions. Within sites, the effect of understory light availability on species performance depended strongly on water availability. When water was not limiting, either naturally in the wetter site or through water supplementation in drier sites, seedling performance improved at higher light. In contrast, when water was limiting at the drier sites, seedling performance was reduced at higher light, presumably due to an increase in water stress that affected mostly wet-distribution species. Although wetter forest understories were on average darker, wet-distribution species were not more shade-tolerant than dry-distribution species. Instead, wet-distribution species had higher absolute growth rates and, when water was not limiting, were better able to take advantage of small increases in light than dry-distribution species. Our results suggest that in wet forests the ability to grow fast during temporary increases in light may be a key trait for successful recruitment. The slower growth rates of the dry-distribution species, possibly due to trade-offs associated with greater drought tolerance, may exclude these species from wetter forests.

Keywords Panama · Shade tolerance · Drought tolerance · Tropical dry forest · Tropical wet forest

Communicated by Andy Hector.

Electronic supplementary material The online version of this article (doi:10.1007/s00442-010-1832-9) contains supplementary material, which is available to authorized users.

T. Brenes-Arguedas · A. B. Roddy · P. D. Coley · T. A. Kursar
Smithsonian Tropical Research Institute,
P.O. Box 0843-03092, Balboa, Ancon, Republic of Panama

P. D. Coley · T. A. Kursar (✉)
Department of Biology, University of Utah,
Salt Lake City, UT 84112, USA
e-mail: kursar@biology.utah.edu

Present Address:
A. B. Roddy
Department of Integrative Biology,
University of California, Berkeley, CA 94720, USA

Introduction

Changes in species composition along environmental gradients increase species diversity at regional scales (Chave 2008). For that reason, a central question in plant ecology is how biotic and abiotic interactions determine why species grow where they do, and to what extent species' adaptations to environmental niches can limit their spatial distributions (Suding et al. 2003; Gaston 2009; Sexton et al. 2009). At the regional scale, an important correlate of species turnover is annual rainfall, which in tropical ecosystems can vary tenfold between wet and dry forests. Change in forest composition along rainfall gradients has been well documented in the literature (Clinebell et al.

Published online: 01 December 2010