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RESEARCH PAPER

Contrasting architecture of key African and Australian savanna tree taxa drives intercontinental structural divergence

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ABSTRACT

Aim We examined differences in the architecture of African and Australian savanna trees. We sought to attribute variation in tree architecture to current environments, wood density and phylogeny, and thereby elucidate the relative importance of biogeographic idiosyncrasies versus current factors in underpinning architectural differences.

Location Africa and Australia.

Methods We compiled canopy diameters and stem diameters from 4867 trees of 97 species and heights and stem diameters from 10,786 trees of 155 species from a range of African and Australian savanna ecosystems and climates. Using Bayesian methods we first estimated continental-scale savanna tree allometries, ignoring species differences. We then examined continental differences in species-specific allometries accounting for trait covariation using a phylogeny of our study species. Environmental variables and wood density data were included as covariates, allowing us to assess the potential underpinning of regional differences in tree allometry by differences in current environments and traits.

Results Substantial allometric differences exist between Australian and African savanna trees. Australian trees are on average 6 m taller at 20 cm diameter, with a 53% smaller canopy area than African trees. However, this extreme continental-scale variation is driven by the architecture of only a few taxa in this study – *Vachellia* and *Senegalia* versus *Eucalyptus* and *Corymbia* – rather than systematic differences between species, wood density and environment. These same genera often dominate the woody strata of South African and Australian savannas, respectively.

Main conclusions Stark differences in the architecture of African and Australian savanna tree taxa are not a product of environmental differences and are not consistent across species. Rather, the most likely explanation is the different evolutionary histories of African and Australian savannas, which share no woody species. We consider that these architectural differences are likely to impact regional patterns of woody biomass accumulation.

Keywords

Africa, allometry, Australia, Bayesian allometry, Bayesian phylogenetic regression, *Eucalyptus*, savanna, *Senegalia*, tree architecture, *Vachellia*.

INTRODUCTION

Tree architecture strongly influences the transport of water and nutrients within stems, acquisition of light by the canopy, competitive interactions among neighbouring plants and vulnerability and response to disturbance. (Niklas, 1992; Coomes & Grubb, 1998; Lawes *et al.*, 2011; Higgins *et al.*, 2012). Consequently, the examination of tree architecture within a

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