On Bird Functional Diversity: Species Richness and Functional Differentiation Show Contrasting Responses to Rainfall and Vegetation Structure in an Arid Landscape

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Abstract

Biodiversity affects ecosystem function through species' functional traits. Although it is possible to predict species richness (SR) patterns along environmental gradients, whether functional diversity (FD) changes in predictable ways is not known. In arid environments, SR typically increases with rainfall. Aridity may limit functional differentiation by allowing only certain traits, but could also be associated with diverse traits associated with various strategies for coping with spatial and temporal variation in resources. Rare species may have unique traits, making them particularly important to continued ecosystem function. We investigated SR, FD, and functional differentiation in bird assemblages along an aridity gradient, with attention to functional uniqueness of rare species. We surveyed bird communities in open savanna, bush-thickened, and riparian habitats at five sites of increasing aridity (~150-400 mm rainfall year−1) in wet and dry seasons for 3 years in Namibia. We calculated the standardized effect size of FD (sesFD) as a measure of functional differentiation and used mixed models to ascertain how SR, FD, and sesFD relate to rainfall, season, and habitat type. SR and FD increased with increasing rainfall. Conversely, sesFD declined with increasing rainfall and was lower in woody habitats, suggesting habitat filtering and greater niche overlap. Rare species were more functionally unique than common species, in all three habitats, so loss of rare species could degrade ecosystem function. Our results are consistent with a linear diversity-productivity relationship maintained by regular disturbance (drought) preventing strong competitors from excluding weaker competitors in higher productivity environments