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Regionally-defined niche-breadth of tropical African freshwater plant species predicts their global latitudinal range

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This study tested the hypothesis that the measured niche-breadth of river plant species (macrophytes) occurring within a closely-defined geographical area in southern tropical Africa (Zambia), may predict the larger-scale biogeographical range of these species.

Two measures of niche-breadth were calculated for 44 riverine macrophyte species commonly occurring in Zambia, using an approach based on PCA ordination with bio-physico-chemical ordination input variables: altitude, stream order, stream flow, pH, conductivity, soluble reactive phosphate concentration (SRP), benthic macroinvertebrate Average Score per Taxon (ASPT), and individual abundance of nine benthic macroinvertebrate families showing differing water quality tolerance, as indicated by their Sensitivity Weightings within the Zambian Invertebrate Scoring System (ZISS). Macrophyte large-scale latitudinal range was derived from world geopositional records held by online databases, supplemented by records held by the authors.

The two niche-breadth metrics divided the species into narrow-niche and intermediate/broad-niche categories, showing significant variation in altitude, stream flow, conductivity, SRP and ASPT, but not stream order or pH. There was no evidence to suggest that macrophyte alpha-diversity (as a measure of number of individual niches that may co-exist in a given habitat) showed any significant relationship with individual species niche-breadth. However, macrophyte alpha-diversity was significantly positively correlated with altitude, and significantly negatively related to conductivity, pH, ASPT, SRP, stream flow, and stream order. Narrow-niche macrophyte species included a higher proportion of Afrotropical endemics than did species with broader niche size. There were significant predictive relationships between macrophyte niche breadth and latitudinal range of the target species at global and Afrotropical scales, but not for the Neotropical range of species which occurred in both the Neotropics and Zambia. Rare, narrow-niche species distributional data may account for this.

The study found statistically-significant evidence that macrophyte species niche breadth, measured at sites within a limited latitudinal range of 9.83° in Zambian rivers, is a significant predictor of the latitudinal range size of these plants at global and Afrotropical bioregion scales; but not Neotropical range, for those species which co-occurred both in Zambia and the Neotropics.