

Appendix 5: Niche comparisons

Exploring the link of niche preference and richness

To link climatic niche preferences (mean annual temperature and annual precipitation) of species with richness patterns, we used density kernels in niche space (as shown in Fig. 4, main text; climate data were standardized for calculations). We used linear models of temperature and precipitations to estimate expected densities across geographic space, and we correlated these densities with (log-transformed) species richness patterns. Because climate – kernel density relationships are highly irregular, linear fits used for projection ($r^2 = 0.30$) are only rough approximations of expected densities of range midpoints (Fig. A5.1, left). Correlations of expected densities of range midpoints and species richness yielded $r^2 = 0.255$ (Fig. A5.1, right).

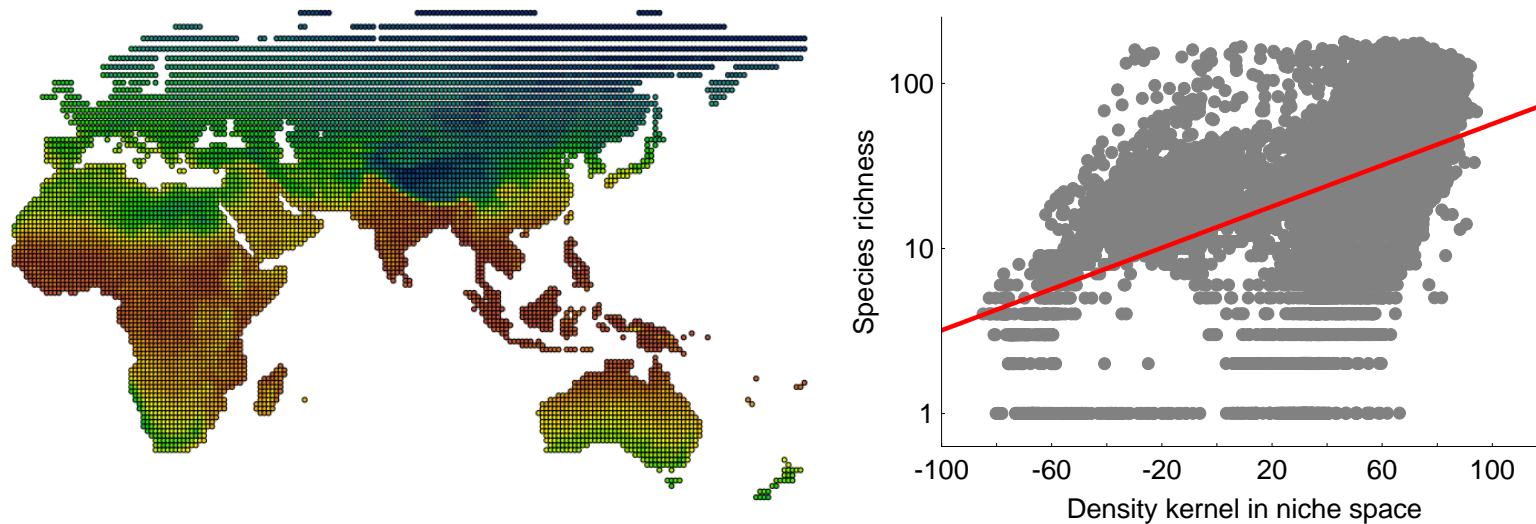


Fig. A5.1 Temperature & precipitation estimate of niche position density kernel (*left*), correlation with estimated species richness pattern (*right*).

We repeated these analyses for all tribes separately, finding consistent correlations (Macroglossini: $r^2 = 0.374$; Sphingini: $r^2 = 0.291$, Acherontiini: $r^2 = 0.385$; Ambulycini: $r^2 = 0.168$; Smerinthini: $r^2 = 0.247$) except in Dilophonitini ($r^2 = 0.060$) and Sphingulini ($r^2 = 0.064$), where relationships were generally weak.

Table A5.2 Pairwise results from a climatic niche overlap analysis based on density kernel in PCA space (Broennimann *et al.* 2011), using the niche dimensions *mean annual temperature* and *annual precipitation*. The D metric measures the niche overlap (i.e. D_{obs} ; 0 = no overlap, 1= complete overlap). We carried out two types of null models and tested for significance (* $p < 0.05$) in 100 runs. Niche equivalence (D_{equi}) determines whether the niches of two tribes in two geographical ranges are equivalent (i.e. significant rejection means the niches are more different than expected by chance). Niche similarity (D_{sim}) examines whether the environmental niche occupied in one range is more similar to the occupied niche in the other range than would be expected by chance (i.e. significant rejection means the niches are not similar).

D metric /Tribe	Acherontini			Ambulycini			Dilophonotini			Macroglosini			Smerinthini			Sphingini		
	D_{obs}	D_{equi}	D_{sim}	D_{obs}	D_{equi}	D_{sim}	D_{obs}	D_{equi}	D_{sim}	D_{obs}	D_{equi}	D_{sim}	D_{obs}	D_{equi}	D_{sim}	D_{obs}	D_{equi}	D_{sim}
Acherontini	-	-	-															
Ambulycini	0.748	0.961*	0.246*	-	-	-												
Dilophonotini	0.759	0.966*	0.280*	0.688	0.955*	0.263*	-	-	-									
Macroglosini	0.723	0.968*	0.038*	0.641	0.964*	0.186*	0.888	0.969*	0.392*	-	-	-						
Smerinthini	0.770	0.966*	0.056*	0.678	0.962*	0.211*	0.96	0.968	0.414*	0.887	0.969*	0.406*	-	-	-			
Sphingini	0.722	0.966*	0.273*	0.687	0.956*	0.265*	0.944	0.967*	0.404*	0.863	0.969*	0.424*	0.923	0.967*	0.374*	-	-	-
Sphingulini	0.728	0.960*	0.278*	0.758	0.951*	0.190*	0.727	0.962*	0.267*	0.69	0.964*	0.270*	0.718	0.960*	0.230*	0.713	0.961*	0.219*

Reference:

Broennimann, O., Fitzpatrick, M.C., Pearman, P.B., Petitpierre, B., Pellissier, L., Yoccoz, N.G., Thuiller, W., Fortin, M.-J., Randin, C., Zimmermann, N.E., Graham, C.H. & Guisan, A. (2011) Measuring ecological niche overlap from occurrence and spatial environmental data. *Global Ecology and Biogeography*, 21, 481–497.