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Testing the accuracy of genus-level data to predict species diversity in Cenozoic marine diatoms

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SUPPLEMENTAL TABLE CAPTIONS

Table DR1 - Survey of publications listed by the Paleobiology Database (PBDB), covering all papers to which we had access published in the last ca 5 years, plus a small number randomly chosen from earlier years. For each paper, we indicate the fossil group(s) studied; whether species, genus or higher level taxa were analyzed; the reasons given by the authors (if any - only about half the papers did) as to why genus or higher taxon ranks were used; and if the study included primary biodiversity analyses of multiple samples. Various types of concerns expressed about the quality of available species data (identifications, completeness, and similar) are combined and recorded as 'data quality'. The only other explanation given was simply that the use of genera was 'standard practice' (alternately expressed as following previous studies), without further justification.

Table DR2 - Species: genus ratios for a selection of modern groups of organisms, chosen at random from available literature but covering all major clades other than prokaryotes.

Table DR3 - Pearson's r and Spearman's ρ correlation coefficients and probability values p for raw and linearly detrended Cenozoic time series of diatom species and genus diversity, oxygen and carbon deep-sea stable isotopes.

Table DR2

Group	Ngenera living	Nsp living	sp-g ratio	source
Mammals	1229	5488	4.5	IUCN redlist
Birds	2289	10719	4.7	IOC WORLD BIRD LIST (6.2) http://dx.doi.org/10.14344/IOC.ML.6.2
Reptiles	1131	9546	8.4	Pincheira-Donoso 2013 PLoSOne
Amphibians	504	6807	13.5	Pyron & Wiens, 2011 Molecular Phylogenetics and Evolution
Hemichordates	18	108	6.0	Cameron, 2008 A comprehensive list of extant Hemichordata with links to images
Ophiuroid echinoderms	334	2140	6.4	WoRMS. Includes a few subspecies.
Decapod crustaceans	2100	14756	7.0	DeGrave 2009 Raffles Bull. Zool. Genus estimate from total genera x % living vs only fossil families
Shallow water bivalves	769	5428	7.1	Krug et al., 2016 Proc. R. Soc. B
Chilopoda (centipedes)	429	3149	7.3	Bonato et al., 2006 <i>Chilobase: a web resource for Chilopoda taxonomy</i>
Polychaeta	1093	8350	7.6	https://www.environment.gov.au/system/files/pages/2ee3f4a1-f130-465b-9c7a-79373680a067/files/nlsaw-2nd-complete.pdf
Stylasteridae (Cnidaria: Hydrozoa)	26	247	9.5	Cairns, 2011 PloSOne
Acanthaceae (flowering plants)	225	2955	13.1	theplantlist.org (Kew, Mis.Bot.Gard etc collaboration)
Pteridophytes (ferns)	568	13000	22.9	theplantlist.org (Kew, Mis.Bot.Gard etc collaboration)
Agaricaceae (mushrooms)	85	1340	15.8	Kirk et al. 2008 Dictionary of the Fungi
Boletaceae (mushrooms)	35	787	22.5	Kirk et al. 2008 Dictionary of the Fungi
Diatoms	1000	12000	12.0	see '*' note below

* - Estimate is for all diatoms but fresh-water genera likely to have much higher sp:genus ratios due to endemism, vs pelagic marine. min estimate of sp-g ratio from described species only; Vanormelingen 2008 BiodivCons - 'lump' type morphospecies estimate, ca 10k described (Guiry 2012 JPhycol gives 8.3k in Algaebase; Mann&Vanormelingen 2013 JEukMicBio give 13k described, minimum of 30k species). Hires morphologic/molecular probably ca 100k species.

Cairns, S.D., 2011, Global Diversity of the Stylasteridae (Cnidaria: Hydrozoa: Athecatae): PLOS One, v. 6, p. 1-13

Cameron, C.B., 2008, A comprehensive list of extant Hemichordata with links to images: <https://www.webdepot.umontreal.ca/Usagers/cameroc/MonDepotPublic/Cameron/Species.html>

Krug, A.Z., Jablonski, D., Valentine, J.W., 2008, Species-genus ratios reflect a global history of diversification and range expansion in marine bivalves: Proc. R. Soc. B, v. 275, p. 1117-1123

Pincheira-Donoso, D., Bauer, A.M., Meiri, S., Uetz, P., 2013, Global Taxonomic Diversity of Living Reptiles: PLOS One, v. 8, p. 1-10

Pyron, R.A., Wiens, J.J., 2011, A large-scale phylogeny of Amphibia including over 2800 species, and a revised classification of extant frogs, salamanders, and caecilians: Molecular Phylogenetics and Evolution, v. 61, p. 543-583

Table DR3

	Species diversity		Genus diversity	
	Pearson's r	p-value	Pearson's r	p-value
$\delta^{18}\text{O}$ (Zachoset <i>al.</i> 2008)	0.928	<2E-16 ***	0.528	6.90E-05 ***
detrended	0.633	6.30E-07 ***	-0.101	0.479
$\delta^{13}\text{C}$ (Zachoset <i>al.</i> 2008)	-0.553	2.53E-05 ***	-0.243	0.085
detrended	-0.304	0.03 *	0.08	0.578
Genus diversity	0.599	8.65E-07 ***		
detrended	0.068	0.615		

*** $p < 0.001$ ** $0.001 < p < 0.01$ * $0.01 < p < 0.05$

	Species diversity		Genus diversity	
	Spearman's rho	p-value	Spearman's rho	p-value
$\delta^{18}\text{O}$ (Zachoset <i>al.</i> 2008)	0.914	<2E-16 ***	0.439	0.001 **
detrended	0.617	2.53E-06 ***	-0.043	0.762
$\delta^{13}\text{C}$ (Zachoset <i>al.</i> 2008)	-0.306	0.03 *	-0.066	0.6433
detrended	-0.278	0.048 *	0.103	0.4717
Genus diversity	0.539	5.84E-05 ***		
detrended	0.013	0.9272		

*** $p < 0.001$ ** $0.001 < p < 0.01$ * $0.01 < p < 0.05$