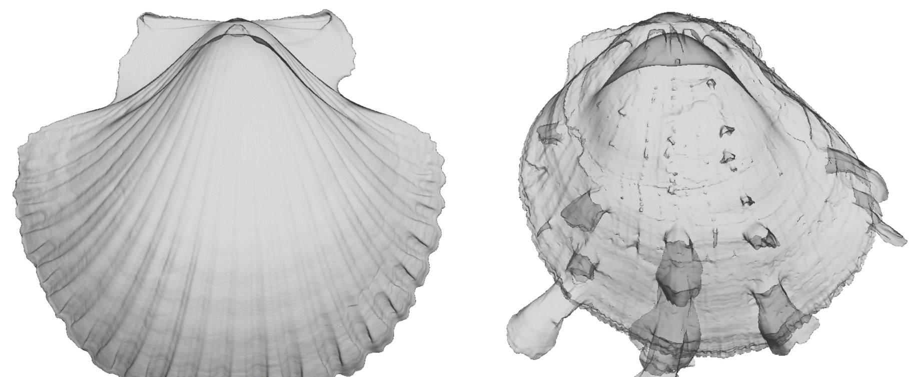
THE CLAMS BEFORE THE STORMS

The fate of bivalve diversity during times of crisis



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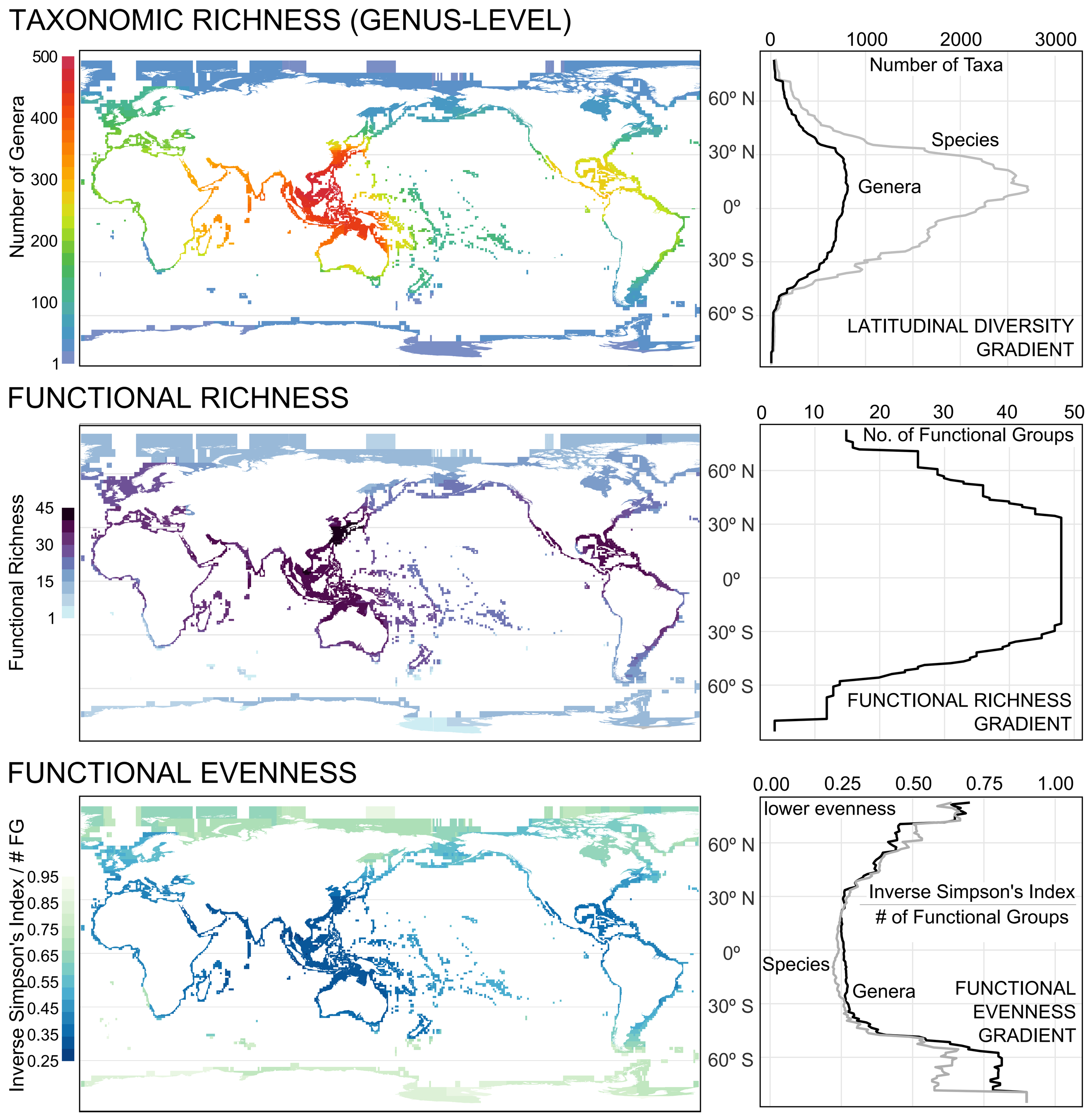
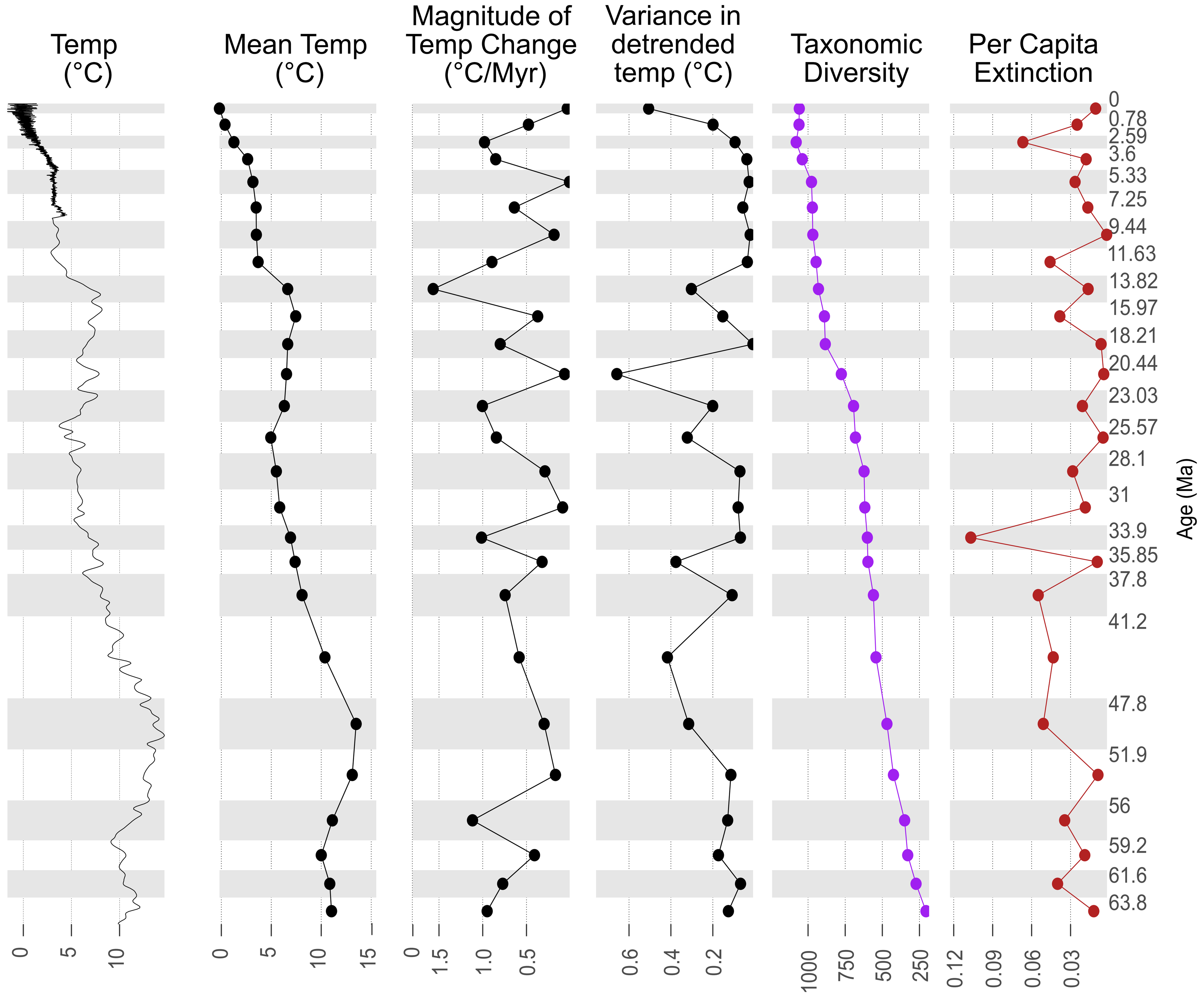
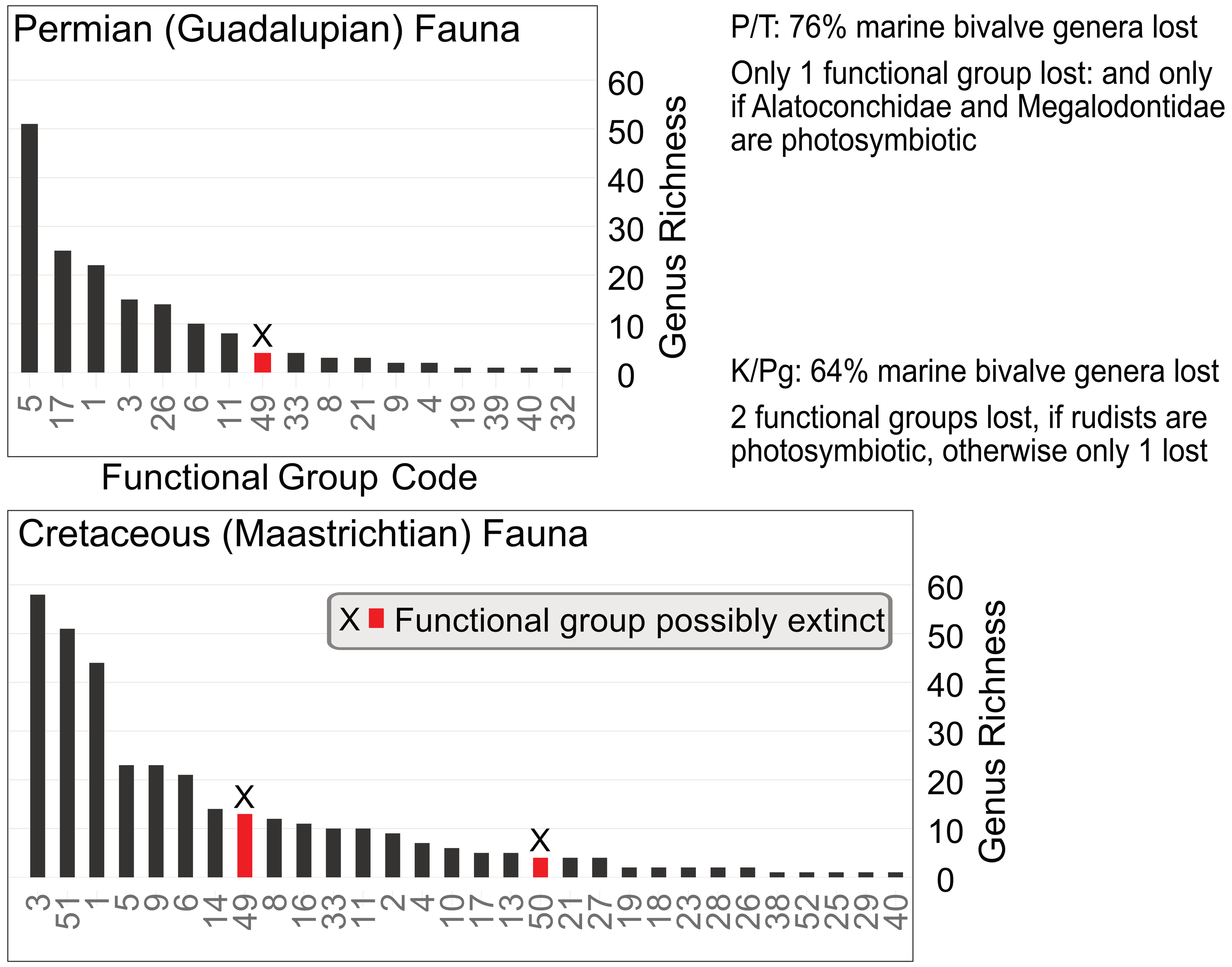
A: MODERN LATITUDINAL DIVERSITY GRADIENTS



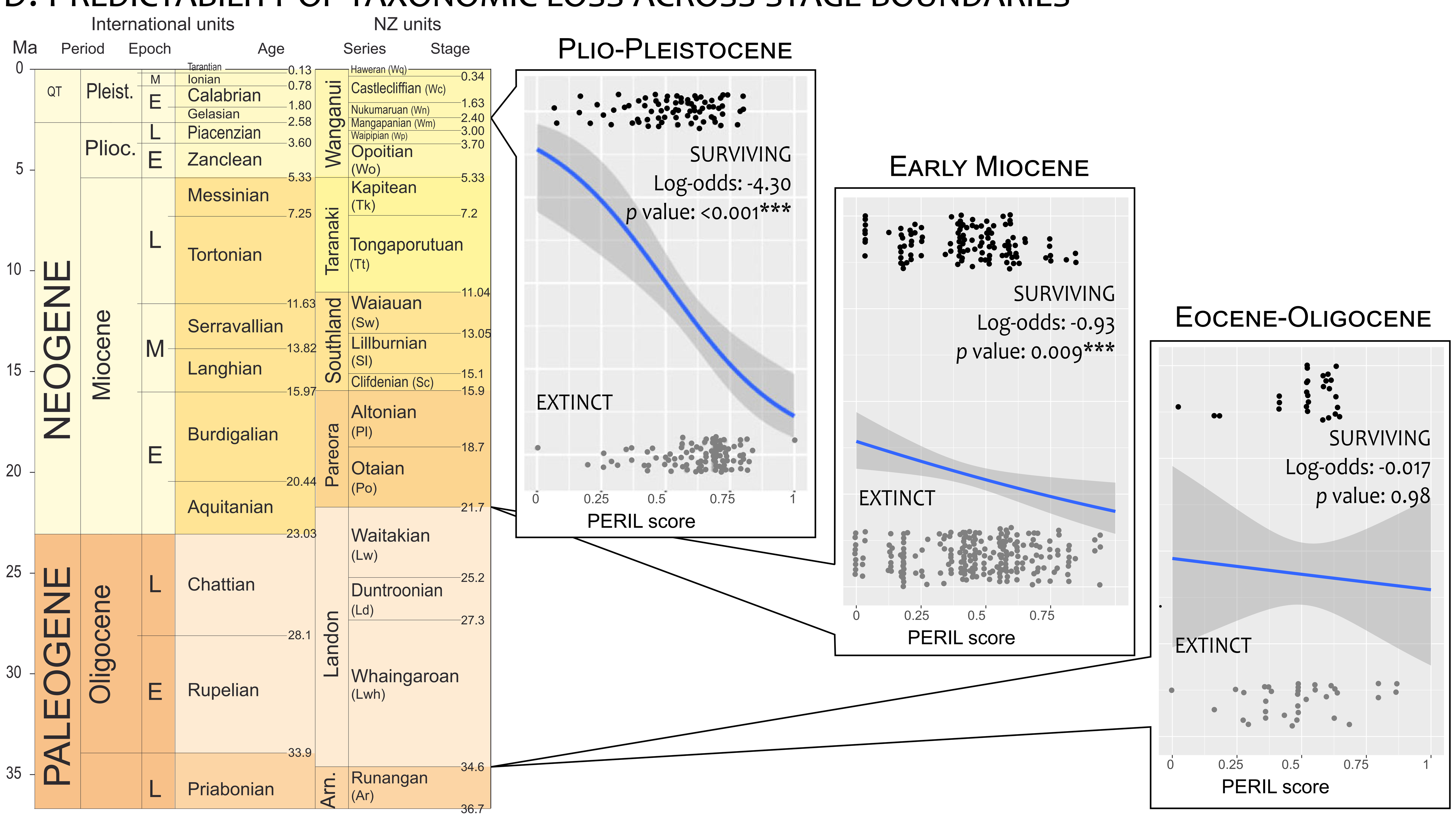
B: GLOBAL BIVALVE DIVERSITY VERSUS CLIMATE CHANGE



C: DECOUPLING OF TAXONOMIC AND FUNCTIONAL RICHNESS



D: PREDICTABILITY OF TAXONOMIC LOSS ACROSS STAGE BOUNDARIES



Bivalves have a long, rich fossil record, and are an ideal model system for the study of diversity patterns through time. Modern taxonomic diversity and functional richness covary with global temperature, seasonality, and primary productivity (Panel A: Edie et al 2018a), creating a latitudinal diversity gradient (LDG); Cenozoic temperatures do not directly covary with patterns of extinction, but instead extinction increases with rate of temperature change within the stage of extinction, and the absolute change in mean temperature from the preceding stage (Panel B; Edie et al 2018b).

After mass extinctions, taxonomic diversity (by definition) drops across the board, but few functional groups are lost (Panel C: Edie et al 2018a). Evidently, the modern LDG in functional richness is diversity-dependent, but the functional structure of the global fauna post-mass extinction is diversity-independent.

Extinction risk can be estimated using the PERIL metric (geographic range (GR) + thermal tolerance (TT) + extinction rate (ER) in family, scaled so that small GR, narrow TT and high ER = high PERIL (Collins et al. 2018)). ER and GR are known correlates of extinction: including TT improves model fit. Higher PERIL score as measured using data for a species in a given stage is associated with higher likelihood of that species going extinct in the next stage. Panel D shows three snapshots of extinction in bivalve faunas in the New Zealand Cenozoic. Survivorship analyses run on PERIL score for each species as it was in the stage of interest and compared to which species survive to the next stage using logistic regression show that the relationship between observed extinctions and the components of the metric appears weaker back through time - perhaps due to poorer sampling, or other environmental factors.

We know that changing climates can alter geographic ranges of species based on their thermal tolerances, affecting their susceptibility to further perturbations. Global analyses are susceptible to sampling deficiencies: local faunas are subject to different biases and so provide additional insights - more datasets need compilation. Functional diversity through intervals without a mass extinction event also needs investigation.