Tolerance curves are a description of fitness as a function of a continuous environmental axis.

We present a novel Bayesian inference method to model tolerance curves using a fixed set of biologically interpretable parameters. We applied the method to a hydrological tolerance experiment using fourteen taxa from the genus, *Lasthenia,* whose co-occurrences are predictably arranged along vernal pool inundation gradients*.* Using floral biomass as a measure of fitness, our modeling approach finds evidence for variation in taxonomic tolerance breadth, hydrological tolerance extremes, hydrological optima, and absolute cumulative fitness. After correcting for phylogenetic history, only parameters that influence taxa’s absolute floral biomass are correlated with their expected position along the vernal pool inundation gradient. The lack of correlation between inundation and hydrological optima highlights the need to further investigate both interspecific competitive exclusion and other environmental axes in driving *Lasthenia’s* spatial composition of vernal pools.