Determining Percentage Carrying Capacity and Delayed Percentage-Dependency Lags in Palaeontological Time Series, Illustrated Using Benthonic Foraminifera in the Cipero Formation (*Catapsydrax Stainforthi* Zone, Lower Miocene) of Trinidad, Western Tropical Atlantic Ocean

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Abstract

The percent carrying capacity K_p is the percentage of a species an area can support while meeting very individual's needs. It is determined from a time series of percentage abundances for species i, where p_{it} is the abundance of that species at time t. The percentage point change in abundance Δp_i between samples is given by $\Delta p_i = p_{it+1} - p_{it}$, where p_{it+1} is the percentage abundance at time (t + 1). The rate of change for each percent r_t is given by $r_t = \Delta pi / p_{it}$.

Linear regression of r_t against p_{it} gives $r_t = r_m - s \bullet p_{it}$, where r_m is the rate of increase in r_t as p_{it} approaches zero, and the slope s shows the strength of intraspecific, interspecific and abiotic interactions for the species investigated. Setting $r_t = 0$, $p_{it} = K_p$ and $r_m - s \bullet K_p = 0$, which gives $K_p = r_m/s$. Nonlinear regression gives $r_t = r_m - s \bullet \ln(p_{it})$, from which $K_p = \exp(r_m / s)$. Delayed percentage-dependency lags (DPDLs) are determined by plotting phase portraits of r_t vs. p_{it} at lags (t + 2), (t + 3) . . . (t + x) and examining the regressions' goodness of fit.

Nonlinear regressions showed better goodness of fit than linear regressions for abundant species in the Lower Miocene Cipero Formation of Trinidad. Values of r_m and s show that *Gyroidinoides* cf. *soldanii* was the most opportunistic species of those examined and *Pullenia bulloides* the least. Species showed different DPDLs, *Stilostomella nuttalli gracillima* and *Cibicidoides mundulus* showing a best fit at (t + 1), *Pleurostomella cubensis* and *Globocassidulina subglobosa* at (t + 2), *Nuttallides umbonifera* at (t + 3), and *G.* cf. *soldanii*, *Oridorsalis umbonatus* and *P. bulloides* at (t + 4). The range of DPDLs argues against simple abiotic control by, say, glacial-interglacial cycles.