Formalizing

Renata Diaz

Definitions

S_j: Species richness in time period j.

$n_{s,j}$: Abundance of species s in time period j.

N_j: Total number of individuals observed in time period j. $\sum_{s=1}^{s=S} n_{s,j}$

μ_s: Mean mass for species s (grams).

σ_s: Standard deviation of mass for species s.

$SBSD_s(m)$: Species body-size distribution. Probability of observing an individual with mass m from species s. $Normal(\mu_s, \sigma_s)$.

$sbsd_{s,j}$: Sampled species body-size distribution. Vector of $n_{s,j}$ masses for individuals of species s observed in time period j, obtained by drawing $n_{s,j}$ values from $SBSD_s$.

isd_j: Sampled individual size distribution. Vector of N_j masses for all individuals, of all species, observed in time period j. Obtained by concatenating $sbsd_{s,j}$ for all s in time period j.

ied_j: Sampled individual energy use distribution. $pars(isd_j)$.

$ISD_j(m)$: Individual size distribution. Probability of observing an individual with mass m in time period j. Obtained by fitting a Gaussian mixture model to isd_j, extracting the density function, and rescaling so the total probability density sums to 1.

$risd_{N,ISD}$: Re-sampled individual size distribution. Vector of N individuals drawn from ISD.

$ried_{N,ISD}$: Re-sampled individual energy distribution. Obtained as for ied using $risd$.

B, rB: Total biomass ($\sum isd$) or re-sampled total biomass ($\sum risd$).

E, rE: Total energy use ($\sum ied$) or re-sampled total energy use ($\sum ried$).

$risd_{N_j,ISD_k}$: Re-sampled individual size distribution using N_j and ISD_k for time periods j and k.

$ried_{N_j,ISD_k}$, rB_{N_j,ISD_k}, rE_{N_j,ISD_k}: Obtained using N_j and ISD_k for time periods j and k, as for $risd_{N_j,ISD_k}$.

Comparing across time periods

Comparing N_j to N_k: Change in abundance from time j to k.

Comparing rB_{N_j,ISD_j} to rB_{N_k,ISD_k}: Change in biomass from time j to time k.

The crux of it:

Comparing rB_{N_j,ISD_j} to rB_{N_k,ISD_j}: Change in biomass from time j to time k *expected* if the size structure is held constant between the two time periods.