8.2 Graphical/distributional plots

The purpose of graphical/distributional representations is to extract information on patterns of relative species abundances without reducing that information to a single summary statistic, such as a diversity index. This class of techniques can be thought of as intermediate between *univariate* summaries and full *multivariate* analyses. Unlike multivariate methods, these distributions may extract universal features of community structure which are not a function of the specific taxa present, and may therefore be related to levels of biological 'stress'.¶

1. *Rarefaction curves* Sanders (1968) were among the earliest to be used in marine studies. They are plots of the number of individuals on the *x*-axis against the number of species on the *y*-axis. The more diverse the community is, the steeper and more elevated is the rarefaction curve. The sample sizes (*N*) may differ widely between stations, but the relevant sections of the curves can still be compared.

2. Gray & Pearson (1982) recommend plotting the number of species in x2 *geometric abundance classes* (the SAD curves) as a means of detecting pollution effects. The plots are of the number of species represented by only 1 individual in the sample (class 1), 2–3 individuals (class 2), 4–7 (class 3), 8–15 (class 4) etc. In unpolluted situations there are many rare species and the curve is smooth with its mode well to the left. In polluted situations there are fewer rare species and more abundant species so that the higher geometric abundance classes are more strongly represented, and the curve may also become more irregular or 'jagged' (although this latter feature is more difficult to quantify). Gray and Pearson further suggest that it is the species in the intermediate abundance classes 3 to 5 that are the most sensitive to pollution-induced changes and might best illustrate the differences between polluted and unpolluted sites (e.g. this is a way of selecting 'indicator species' objectively).

3. *Ranked species abundance (dominance) curves* are based on the ranking of species (or higher taxa) in decreasing order of their importance in terms of abundance or biomass. The ranked abundances, expressed as a percentage of the total abundance of all species, are plotted against the relevant species rank. Log transformations of one or both axes have frequently been used to emphasise or downweight different sections of the curves. Logging the *x* (rank) axis enables the distribution of the commoner species to be better visualised.

4. *k-dominance curves* are *cumulative* ranked abundances plotted against species rank, or log species rank (Lambshead, Platt & Shaw (1983)). This has a smoothing effect on the curves. Ordering of curves on a plot will obviously be the reverse of rarefaction curves, with the most elevated curve having the *lowest* diversity. To compare *dominance* separately from the *number of species*, the *x*-axis (species rank) may be rescaled from 0–100 (relative species rank), to produce *Lorenz curves*.

¶ *Two plotting programs of this type are available in PRIMER: a) Geometric Class Plots, which produce a frequency distribution of geometric abundance classes, the so-called SAD curves (Fisher, Corbet & Williams (1943)), from which fitting log-series distributions gives rise to the α index output by the DIVERSE routine, and b) Dominance Plots, which generate ranked abundance (or biomass) curves, with options to choose from ordinary, cumulative or partial forms, and single or dual (Abundance-Biomass Comparison) curves, as seen below. DIVERSE also outputs rarefaction estimates: expected number of species, $ES(n)$, for one or more values of numbers of individuals, n (where n must be chosen <min(N) in the samples).*

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