3.4 Recommendations

1. Hierarchical clustering with group-average linking, based on sample similarities or dissimilarities such as Bray-Curtis, has proved a useful technique in a number of ecological studies of the past half-century. It is appropriate for delineating groups of sites with distinct community structure (this is not to imply that groups have no species in common, of course, but that different characteristic patterns of abundance are found consistently in different groups).

2. Clustering is less useful (and could sometimes be misleading) where there is a steady gradation in community structure across sites, perhaps in response to strong environmental forcing (e.g. large range of salinity, sediment grain size, depth of water column, etc). Ordination is preferable in these situations.

3. Even for samples which are strongly grouped, cluster analysis is often best used in conjunction with ordination. Superimposition of the clusters (at various levels of similarity) on an ordination plot will allow any relationship between the groups to be more informatively displayed, and it will be seen later (Chapter 5) that agreement between the two representations strengthens belief in the adequacy of both.

4. Historically, in order to define clusters, it was necessary to specify a threshold similarity level (or levels) at which to 'cut' the dendrogram (Fig. 3.3 shows a division for a threshold of 50%). This seems arbitrary, and usually is: it is unwise to take the *absolute* values of similarity too seriously since these vary with standardisation, transformation, taxonomic identification level, choice of coefficient etc. Most of the methods of this manual are a function only of the *relative* similarities among a set of samples. Nonetheless, it is still an intriguing question to ask how strong the evidence is for the community structure differing between several of the observed groups in a dendrogram. Note the difference between this *a posteriori* hypothesis and the equivalent *a priori* test from Fig. 3.1, namely examining the evidence for different communities at (pre-defined) sites A, B, C, etc. *A priori* groups need the ANOSIM test of Chapter 6; *a posteriori* ones can be tackled by the *similarity profile* test (SIMPROF) described below. This test also has an important role in identifying meaningful clusters of species (those which behave in a coherent fashion across samples, see Chapter 7) and in the context of two further (divisive) clustering techniques. The unconstrained form of the latter is described later in this chapter, and its constrained alternative (a *linkage tree*, 'explaining' a biotic clustering by its possible environmental drivers) is in Chapter 11.

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