A comparison of traditional, cluster and Zürich-Montpellier analyses of infaunal pelecypod associations from two adjacent sediment beds*

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Abstract

A Zürich-Montpellier analysis provided more detailed information about pelecypod associations in two sediment beds than either a traditional subjective approach or a cluster analysis based on Jaccard’s coefficient. The Zürich-Montpellier test separated till and sand pelecypod associations, and indicated distinguishing species and atypical samples. Species distinguishing the till association were Cardita ventricosa, Yoldia myalis, Semele rubropicta, Venerupis kennerlyi, Clino-cardium nuttallii, Nuculana minuta and Macoma incongrua. Species distinguishing the sand were Macoma calcarea, Macoma brotula, Yoldia limatula and Macoma alaskana. Two samples contained species from both associations plus some species rare elsewhere. Combined R- and Q-type grouping procedures, of which the Zürich-Montpellier approach is an example, are useful in evaluating benthic faunal similarities, but the suitability of various forms of the procedure needs further study.

Introduction

Studies of marine sediment faunal associations have come to use quantitative measures of various types (FAGER, 1963; LIE and KELLEY, 1970). These contrast with the essentially subjective method of classifying “marine level bottom communities” detailed by THORSON (1957), as a development from interpreting faunal numbers and weight data first employed by PETERSON (1913).

This paper compares conclusions derived from a traditional Peterson-type subjective interpretation of faunal densities with conclusions derived from a selected similarity index grouped by a Q-type cluster procedure, and from a combined R- and Q-type grouping (SOKAL and SNEEATH, 1963). Sedentary infaunal pelecypods were chosen for the comparison, since these species can be collected quantitatively, and can be identified reliably in the area investigated.

The particular similarity index used was selected as one of the simplest from many available (SOKAL and SNEEATH, 1963). This was Jaccard’s coefficient, \( c = \frac{a + b - c}{a + b - c} \), where \( a \) is the number of species in sample A, \( b \) the number of species in sample B, and \( c \) the number of species in common between the two samples. A cluster analysis, grouping samples by species (Q-type) was performed on the data. The question whether an index based on presence-absence or abundance data is more appropriate to infaunal benthos as an association similarity measure is left in abeyance.

A Zürich-Montpellier analysis (KÜchler, 1967) was used for the combined R- and Q-type procedure, i.e. grouping species which co-occurred in samples, and grouping samples with co-occurring species, respectively. The analysis was by visual comparison of presence-absence data arranged in a series of increasingly more organised tables. The Zürich-Montpellier procedure may have been applied previously to sedimentary marine faunas, but we have been unable to find published references to it in this context. Certainly, the procedure has not been widely adopted by marine biologists, although similar computerised tests have been developed (FAGER and McGOWAN, 1963).

Computerisation of the Zürich-Montpellier procedure is now under way at the University of Victoria by ČEŠKA and ROEMER (personal communication), and this will increase the objectivity of the analysis. As with Jaccard’s coefficient, the Zürich-Montpellier procedure is used as a simple example of the general approach, i.e. combined R- and Q-type grouping, and the approach may be based either on presence-absence or abundance data (FAGER, 1963; LIE and KELLEY, 1970).

Materials and methods

Two adjacent distinctive faunas were sampled from a sandy shelf extending 1 mile north of Moresby Island (48°44’ N, 123°20’ W) close to southern Vancouver Island, Canada (Fig. 1). The shelf grades to the west into a coarser, poorly sorted deposit, apparently a glacial till (DUNNILL and ELLIS, 1969). Samples were taken in duplicate (B1 in quadruplicate) between May and August, 1967. A modified Foeister’s dredge (volume 52 l, width 52.5 cm) permitted the collection
of a uniform wedge-shaped sample with a maximum depth of 7.5 cm. Only full-volume samples were retained for quantitative analysis; the surface area sampled was calculated as 0.69 m².

Results

Species’ densities by sample (Table 2) show that 4 species, *Macoma incongrua*, *M. climata*, *M. calcarea* and *Yoldia limatula* together represent more than 50% of all pelecypods collected. Of these, *M. incongrua* was overwhelmingly more abundant on the till, whereas the other 3 species were more abundant on the sand. Some less abundant species follow the same distributional pattern, e.g., the till supports more *Clinocardium nuttalli*, *Semele rubropicta*, *Cardita ventricosa*, *Yoldia myalis*, *Venerupis kenneallyi*, and *Nuculana minuta*, whereas the sand supports more *Compsonyx subdiaphana*, *Yoldia ensiforma*, *Macoma alaskana*, *M. brota*, *M. lipara* and *Solen sicarius*. The mobile or attached epifaunal species *Chlamys hericius*, *C. hindsii* and *Modiolus modiolus* are disregarded for these analyses. By traditional subjective standards, the numerical differences between the sets of samples from till and sand can be taken to reflect the presence of two distinct faunal associations characterised by numerically dominating species, i.e., *M. incongrua*, *V. kenneallyi* and *Y. myalis* together represent more than 50% of infaunal pelecypods collected from the till, and *M. climata*, *M. calcarea* and *Y. limatula* more than 50% of pelecypods from the sand.

Values for Jaccard’s coefficient of community between samples are arranged in a matrix (Fig. 2), with highest values grouped as closely as possible. Shading is arranged in 4 class intervals selected for equal area in Fig. 2. Samples from the glacial till form a group to the upper left of the matrix, while samples from sand form another group to the lower right. The sand shows more shading than the till, indicating greater heterogeneity of the fauna.

The coefficients have been clustered by the Weighted Pair Group Method (Sokal and Sneath, 1963) and results presented as a dendrogram (Fig. 3). Till and sand associations cluster at 12%, indicating little similarity. Replicates cluster at values from 100%, down, but faunal differences such as those between D1a and b, and C4a and b, create clusters within till and sand groups, respectively, at low similarity levels. Within the sand cluster, there appear to be 3 subgroups. Duplicate samples at E1, D5 and C5 cluster, and all are located in the south-east corner of the sampling grid (Fig. 1). Duplicates at A1 and C2 cluster, and the only environmental connection seems to be proximity to the till. The remaining samples cluster in a way which defies explanation by visual scanning.

The Zürich-Montpellier method (Küchler, 1967) consists of visually grouping species and samples by means of increasingly more rigorously organised tables. Table 3 is the result of a partial analysis to the level of an “Orderly Extract Table” and is sufficient to distinguish 2 major groups. These are the till and sand associations already recognised.

Sediments were sub-sampled for mechanical analysis using a Bouyoucos (1951) hydrometric technique (Table 1), and the balance of the sample screened through a 2 mm mesh to retain the pelecypods.

![Map of the Moresby Island area showing position of collection stations](image)