Taxonomic aggregation and the detection of patterns in a tropical marine benthos data set

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Abstract: Soft-bottom benthic abundance data were aggregated from genera to phylum and the effect of such aggregation in the detection of a depth related pattern explored. It was found that at least for this data set, the aggregation has no effect, the pattern being clear across the taxonomic aggregations. If this is a general feature of tropical soft-bottom rapid assessments, for instance in the case of quick surveys or pollution events, would be possible.

Key words: Soft-bottom benthos, taxonomic aggregation, pattern detection, Colombian Caribbean.

Infaunal soft-bottom benthos has been long regarded as much suitable for the monitoring of pollution effects due mainly to its relative sessile habit (*e.g.* Warwick 1993). However, two major problems of practical order have precluded its routine use for that purpose: taxonomic uncertainty and sorting time as already noted by Warwick (1988a). The first problem is valid even for well known waters (*e.g.* Ellis 1988): no all research institutions have the taxonomic expertise readily at hand, not to speak of areas where systematic taxonomic surveys are scarce like most Caribbean regions.

In view of that situation a number of works have been done comparing the picture obtained at higher levels of taxonomic aggregation, notably Warwick (1988a and 1988b) and Ferraro and Cole (1990). In general, it has been found that taxonomic aggregation does not distort association patterns in the data, *i. e.*, the effect of pollution was detectable at higher than species taxonomic level.

Until now most work have been conducted in cold and temperate waters, with perhaps the only exception of Agard *et al.* (1993), and in the context of pollution. Therefore the present work wants to contribute with the analysis of a tropical data set where the pattern to be detected is a natural one.

The data come from an area where no localized pollution event was taking place at the moment of sampling. Since the objective is to explore the possible distortion in associative patterns with increasing taxonomic aggregation in the data, a subset of 10 stations out of 27 in the original work (Guzmán 1993) were selected such that they represent two well defined, distinct groups of stations as found in the classification and ordination of the original 27 stations. The environmental gradient found to better explain the classification and ordination of stations is depth (Guzmán 1993), so this is reflected in the 10 selected stations (see below).

The study area (Golfo de Salamanaca) is located between the 11°00'-11°20' N of latitude and the 74°10'-74°40' W of longitude (Fig. 1). This area is influenced seasonally by continental discharges from the Magdalena river and from the Ciénaga Grande de Santa Marta Lagoon. Historically three climatic periods have been distinguished for the area: the dry season from December to April, the rainy season from May to November, and the "Veranillo de San Juan", in July-August, an intermediate period

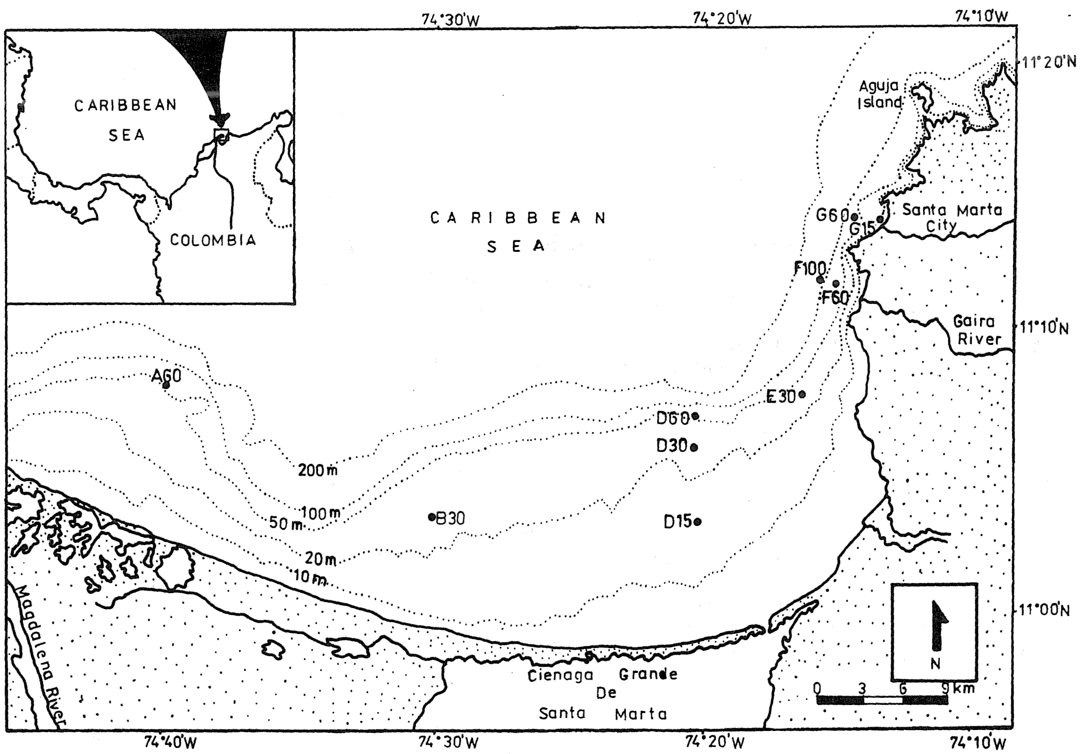

Fig. 1. Station locaties in the Golfo de Salamanca, colombian Caribbean. Stations labels correspond to transect (letter) and depth (number).

similar to the dry season (Salzwedel and Müller 1983). Sediments on the shelf are mainly fine litoclastic sands (Molina 1990).

Benthos samples were taken by a 0.05 m^2 van Veen grab during two cruises in October and November 1991. Three replicate grabs were taken by station. The samples were sieved through a 0.5 mm mesh screen and the material retained fixed in 10 % buffered formalin. Because of taxonomic difficulties only the taxocenosis polychaeta-crustacea-mollusca is considered. For these groups the specimens were identified to genera.

For the analysis the three replicated grabs for station were pooled. As mentioned in above, 10 station were selected which represents two well defined groups of stations from the original classification and ordination analysis of the 27 stations. These stations are labeled as follows: D15, D30, D60, G15 and B30, forming one group, and A60, E30, G60, F60 and F100, forming the second group. The letter represents the transect label and the number represents the station's depth. The second group of stations is in average twice as depth as the first group, so depth seems to be the environmental gradient behind the distribution patterns of the organisms.

A non-metric multidimensional scaling (NMDS) analysis was performed on the pooled data for station at each time higher taxonomic levels including genus, family, order and phylum. Analyses were performed for untransformed and 4th root-transformed data.

NMDS bidimentional plots for the 4 taxonomic aggregation steeps and raw and transformed data are shown in Figure 2. In all cases the identity of the two groups of stations is maintained. Changes occur at the relative position of stations inside the groups, which do not compromise the identity of the groups. Even at the phylum level this is so, which is the most remarkable considering that in this case only three taxa are involved (annelida, artrophoda and mollusca). Transformation of data has only at phylum level a noticeable effect in terms of dispersing the stations of

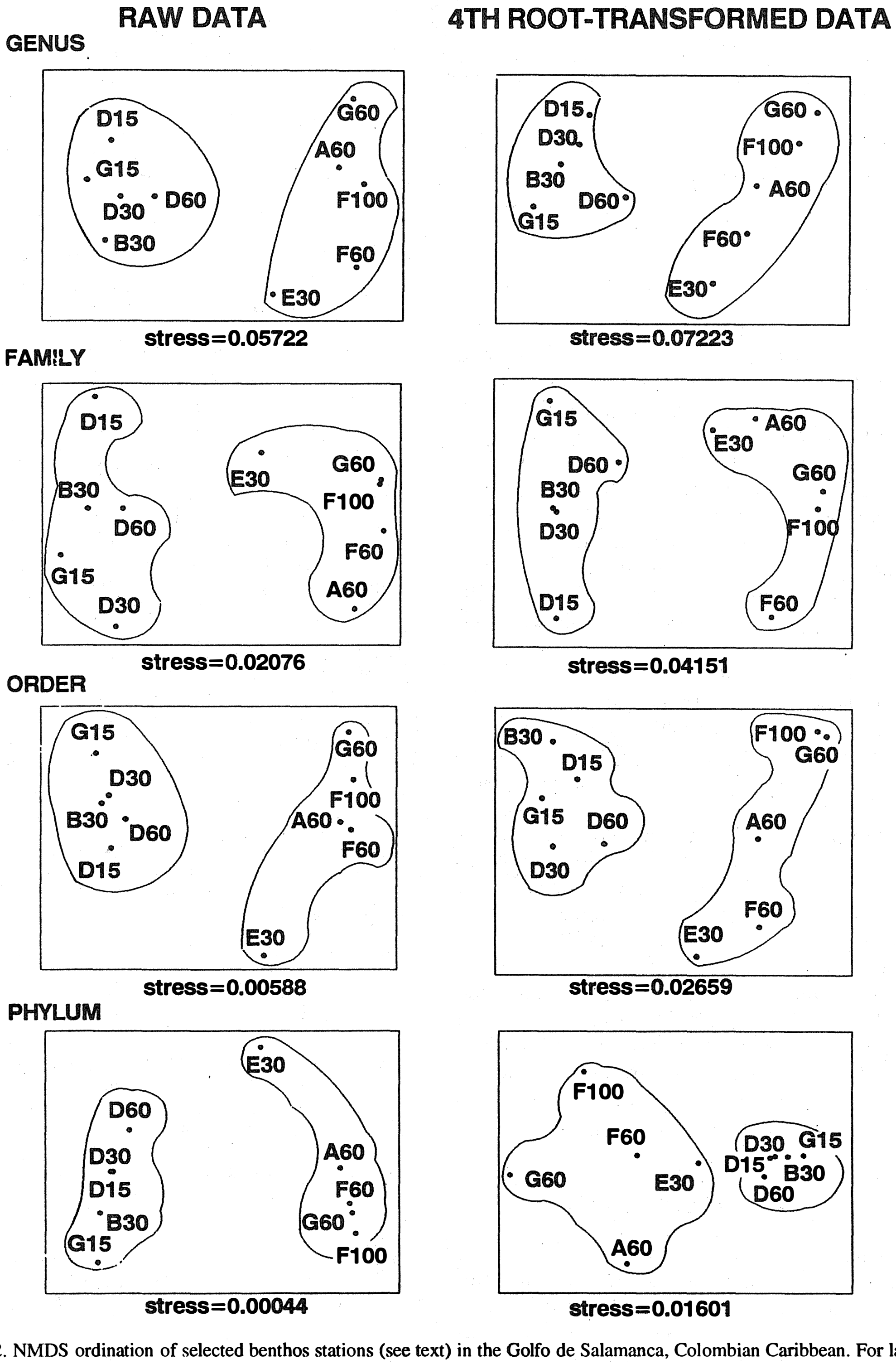

Fig. 2. NMDS ordination of selected benthos stations (see text) in the Golfo de Salamanca, Colombian Caribbean. For labels see Fig. 1. and text.

TABLE 1

Comparison of number of taxa by level of aggregation at different latitudes. Notice that in the case of this study the data used are restricted to the Phyla worked taxonomically (Annelida, Arthropoda and Mollusca) ignoring other Phyla present

Location	Species	Genus	Family	Order	Phylum	Source
Scotland	115	–	45	–	9	Warwick 1988a
Norway	109	–	52	–	8	Warwick 1988b
California	389	286	156	65	12	Ferraro and Cole 1990
G. Salamanca	–	171	76	27	3	This study

one group wider than in the untransformed case (Fig. 2), but even so, the groups are distinguishable as the stations of the other group are placed closer together.

Table 1 shows the number of taxa by taxonomic level used in the present work in comparison with figures obtained in other works. Regardless of differences in methodology, intensity of sampling, sample size, etc. a pattern of increasing taxonomic diversity with lower latitude can be seen. Thus, the approach of taxonomic aggregation seems to be robust, even for diverse systems.

As mentioned in the introduction, the ordination of stations is related to a depth gradient, not a pollution gradient. The fact that this natural gradient was detectable from genus to phylum in this data set suggests that the contention of Warwick (1988a, b) that taxonomic aggregation may minimize confounding effects of natural variables like water depth and sediment granulometry, may not be generalized (see also discussion in Ferraro and Cole 1990). This has two consequences: first, environmental variables should also be taken into account when working with aggregated taxa in the pollution context, and second, natural patterns in communities may also be accurately decribed at taxonomic levels other than species which would facilitate quick surveys.

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