PALEOECOLOGICAL SIGNIFICANCE OF SIZE-FREQUENCY DISTRIBUTIONS OF SHELLS OF ARCOID BIVALVES FROM MODERN SEDIMENTS OF SAN SALVADOR ISLAND, BAHAMAS

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Detailed study of the taphonomic properties of bivalve death assemblages has the potential to improve the precision of paleoenvironmental interpretations. The object of this study is to show how this can be accomplished by quantifying the preservation states of arcoid shells in a variety of shallow water carbonate sediments from San Salvador, in the Bahamas.

The current phase of the study has focused on size-frequency distributions of assemblages of arcoid bivalve shells. Work begun in 1987 was concerned principally with distinguishing between pre-mortem and post-mortem encrustation and with identifying characteristic patterns of shell fragmentation associated with the activities of specific predators. That work has been critical to this part of the investigation, providing an independant data set against which hypotheses based on the observed size-frequency distributions can be tested. Together, these and additional taphonomic studies should yield paleoenvironmental interpretations that will improve the recognition of microfacies within the larger facies context of a carbonate shelf.

Field work for this project was conducted in June -July 1987, and June -July 1988. Bulk sediment samples were collected from open shelves, marine grass meadows dominated by Thalassia, patch reefs, subtidal rocky surfaces, a tidal creek/grass flat/delta complex, and the intertidal swash zone. Shells were separated from the sediments by sieving in the field, and arcoid bivalves were extracted in the laboratory from these samples. This study deals with the following arcoid species: Barbatia cancellaria, Barbatia domingensis, Barbatia candida, Arca imbricata, Arcopsis adamsi, Glycymeris pectinata, and Glycymeris undata.

Laboratory investigations have involved the systematic collection of data on shell size, encrustation, and fragmentation. For each sample, the presence or absence of each species and its abundance have been recorded, as well as the size-frequency distribution of the shells. An example of the application of this methodology is given here for two localities. One, known as Telephone Pole Reef, is on the protected western shore of the island. Here, the following environments are represented: rocky littoral and sublittoral surfaces, back reef sandy shelves, the patch reef, forereef sandy shelves, and the open shelf. Samples were obtained along a transect from the intertidal zone to the outer margin of the patch reef, 300 meters offshore. The other locality is at East Beach, on the exposed eastern shore of the island. Here, the samples were obtained from sediments adjacent to and between small patch reefs.

Glycymeris pectinata is present in all samples from Telephone Pole Reef, whereas Barbatia domingensis is absent from the sites closest to the shore. Numerical abundance data provide additional information. Glycymeris pectinata is abundant inshore, occurs only in modest numbers around the patch reef, but even more abundant in the open shelf sediments beyond the reef. When the size-frequency distributions are examined, those at the two inshore localities, TP1 and TP2, are clearly different from that at the offshore locality,TP8 (Figure 1). Two hypotheses are available to explain this difference. The onshore and offshore samples may be derived from one population, smaller shells having been preferentially transported offshore. Alternatively, Glycymeris pectinata may be living in both environments and achieving full adult size only inshore, due to a lower incidence of predation or disturbance. A considerable number of living specimens of Glycymeris pectinata were collected at the inshore localities, but none were found offshore. This suggests that the animals are living only inshore and that their dead shells are being transported offshore. However, in addition to their different size-frequency distributions, the onshore and offshore samples differ quite markedly in the extent of pigmentation, especially of the larger shells. The interior surfaces of many inshore shells are quite dark, while even the largest shells from TP8 are only lightly pigmented. Furthermore, the exterior surfaces of all the shells at TP1 and TP2 are coated with a thin layer of encrustation, while those from the offshore sample are bright and clean. Thus, it appears that the offshore sample does represent a different population of individuals that grew quickly to a modest size, despite the fact that no animals were found alive at the time of sampling.

At East Beach, Glycymeris pectinata was not collected at all. Here, Barbatia cancellaria is extremely abundant and its size-frequency distributions are strongly skewed towards the larger sizes in samples EB1 and EB3 (Figure 2).

Here, the paucity of small shells is clearly a result of selective transport and destruction the smaller shells by heavy seas. Taphonomic data confirm this inference. Large shells are encrusted on both their interior and exterior surfaces, or only on the outside. Encrustation on the inside of a shell is a function of a its residence time in the shell assemblage. Many of these shells retain a very fresh, shiny luster inside the shell, indicating a short residence time for a substantial portion of these assemblages. In contrast, relatively few of the small shells are heavily encrusted on either their interior or exterior surfaces. This implies both that they grow quite quickly to a modest size without acquiring much encrustation and that they have very short residence times in the shell assemblages.

On a broad scale, these examples reveal striking faunal and even greater taphonomic differences between localities on the exposed and the protected shores of San Salvador. This is not especially remarkable, given the difference in physical conditions. Much more promising are the subtler distinctions that can be drawn among samples from a complex mosaic of microfacies, on the basis of size-frequency, encrustation and fragmentation data.

Fig. 1: Selected Size-Frequency Distributions of G. pectinata at Telephone Pole Reef.

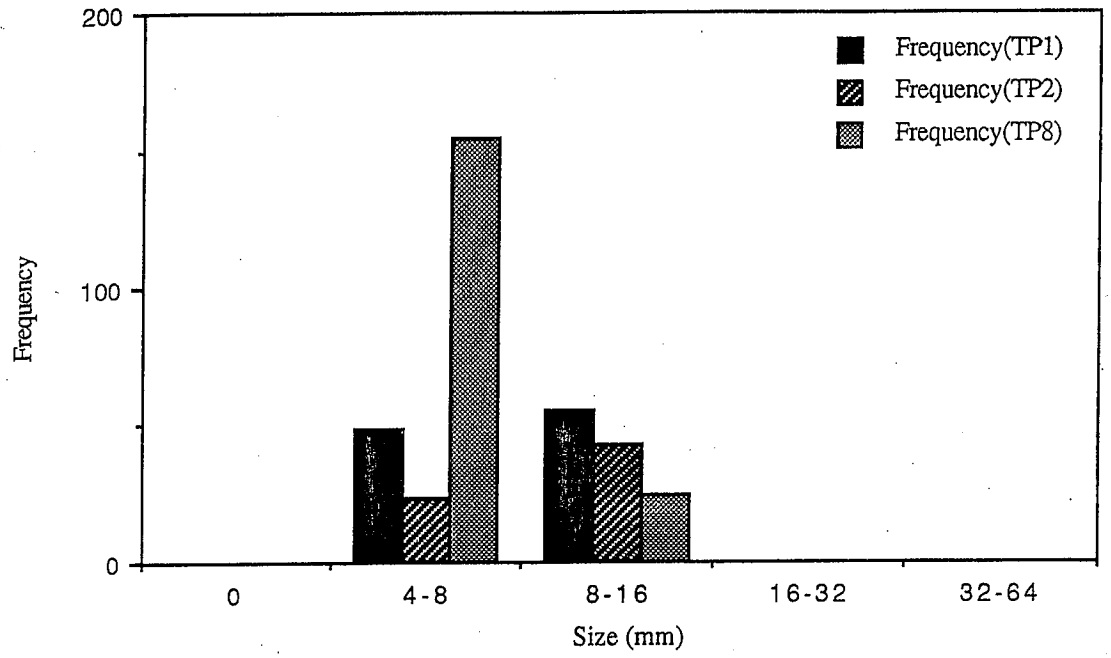

Fig. 2: Selected Size-Frequency Distributions for B. cancellaria at East Beach