Factors Influencing the Numerical Accuracy of Benthonic Foraminifera Population Counts from Bottom Sediment Samples, Gulf of St. Lawrence:*

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Over the past two decades numerous ecological studies of shallow water benthonic Foraminifera have appeared in the literature. Most of these investigations have been carried out utilizing one of several types of mechanical sampler. Recent observations (employing underwater television motion picture cameras and SCUBA divers) suggest that the in situ configuration of most bottom surface sediment samples may be significantly changed by several factors. Some of these are as follows: (a) pressure wave generated by the sample that disturbs the sediment surface before the sampler contacts the bottom; (b) turbulence and mixing caused by activation (triggering) of the sampling device; and (c) partial loss of the sample together with sediment mixing, as the sampler is raised to the surface. In ecological studies of foraminifera, many of these variables may be eliminated when sampling is carried out by SCUBA divers.

There are many physical and biological factors operating in the marine environment that are responsible for widely differing numerical values as regards to both the number of living and the number of dead Foraminifera determined per square metre of sediment surface. Feeding habits and (or) locomotive modes of certain species of fish (e. g. flounders), as well as those of lobsters, sand dollars and snails, may give rise to barren sections of sediment surface that no longer reflect the average population density of benthonic Foraminifera inhabiting any given local area. In addition to biological factors, changes in hydrodynamic conditions may cause very rapid redistribution of both living and dead foraminiferal populations. This is especially true in those areas that are intermittantly exposed to wave-generated turbulence.

Preliminary results of temporal (seasonal) and lateral distribution studies of population of nearshore benthonic Foraminifera suggest that these physical and biological forces prevent the accurate determination of sedimentation rates calculated from living to total ratios of Foraminifera. This conclusion is based on data gathered from a series of laterally distributed subsamples (four samples equally spaced over a four-foot distance), obtained on a weekly basis at sampling stations in New London Bay, Prince Edward Island and in the Gulf of St. Lawrence adjacent to the northern coast of Prince Edward Island. Differences of up to 550 specimens were observed in the living Foraminiferal fauna between subsamples collected at a given station in the Gulf of St. Lawrence and at essentially the same time. Dead populations also showed similar lateral variations, although not of the same order of magnitude as those observed for the living specimens. Analysis of all currently available data suggest that benthonic Foraminifera populations are characterized by a patch-like or micro-environment distribution that cannot be adequately assessed from a single sample. Consequently the sedimentation rate, calculated from a single sample, would be essentially meaningless.

The micro-environmental distribution of benthonic Foraminifera is undoubtedly controlled by both biological and physical forces. In addition to the disturbing influence of larger invertebrates and fish, the mode of reproduction and the distribution of juvenile Foraminifera (Vilks 1967[1]) may also contribute to the patch-like population distributions observed by this investigator. Changes in hydrodynamic conditions are also effective in redistributing bottom sediments and Foraminifera. This variation has been observed in averaged, temporally distributed sample pairs. For example, when surface sediments are periodically subjected to wave-generated turbulence, a rippled surface is almost immediately developed. Observations of the number of Foraminifera obtained from ripple crest and trough samples show, generally, that higher populations of both living and dead specimens may be expected in ripple troughs than in the crests. Because there is about a 50 per cent chance that a sampling device may drop either on a crest or in a trough, an accurate quantitative sample of the foraminiferal population cannot be obtained from a single core or grab sample.

Recognition of the physical and biological variables suggest that future ecological studies of shallow water benthonic Foraminifera should be undertaken on a seasonal basis. Time must be allotted for re-sampling and subsampling of key environments in order to determine both the lateral and temporal limits of variation in the living and dead populations.

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[1] Unpublished Manuscript, BIO 67-1