MEMOIR 1: MIAMI GEOLOGICAL SOCIETY

A SYMPOSIUM OF RECENT SOUTH FLORIDA FORAMINIFERA

by

W. D. Bock
W. W. Hay
J. I. Jones
G. W. Lynts
S. L. Smith
R. C. Wright

Edited by James I. Jones and Wayne D. Bock

Additional copies of this memoir are available from the Miami Geological Society, 10 Rickenbacker Causeway, Miami, Florida 33149, at $7.00 each.

DISTRIBUTION OF RECENT FORAMINIFERA IN LOWER FLORIDA BAY

by

SHARON LYNNE SMITH

INTRODUCTION

This study was undertaken as part of a reconnaissance study of the present benthonic Foraminifera of Florida Bay and adjacent waters. Its primary purpose is to describe the fauna and its distribution and, secondarily, to consider ecologic factors as they may influence observed distribution patterns. The study area consisted of the western portion of Lower Florida Bay, a shallow carbonate shelf with waters depths ranging from less than one foot to as much as seventeen feet.

Twenty-six samples were collected in March 1963. Most were obtained by coring, but a few were taken by grab-samplers where the bottom sediment was too thin or too coarse to allow the recovery of sediment cores. At each station bottom temperature, water depth, and bottom community information were recorded and hydrographic samples were collected.

PREVIOUS WORK

Vaughan (1918) studied shallow water bottom samples from Murray Island, Australia, Florida, and the Bahamas. Cushman identified the foraminiferal species in the five samples from the Florida Keys and the Tortugas, finding Orbiculina adunca the most abundant species.

Cushman (1922) completed an ecological study of the shallow water Foraminifera of the Dry Tortugas including observations of living Foraminifera.

Norton (1930) made an ecologic study of samples from Australia and the Florida-Bahama region where he recognized ecologic zones based on temperature and depth. The families Peneroplidae and Miliolidae were most abundant in the shallowest and warmest waters, exhibiting decreasing abundance with increasing depth.

Thorp (1939) investigated calcareous marine deposits from the Florida-Bahama region. He found Foraminifera widely distributed, making up nine percent of the sediment. Archaias, Peneroplis, Quinqueloculina, Clavulina, and Valvulina were the most common genera.

Stubbs (1940) investigated the Foraminifera occurring in the Biscayne Bay area, finding the Miliolidae and Peneroplidae the predominant families and Archaias angulatus the most common species.

Bush (1949, 1958) first studied the distribution of Foraminifera in Biscayne Bay and in a later and more comprehensive study, examined the sediments and the ecological distribution of the Foraminifera. He divided the area into thirteen biotopes, dominated by porcelaneous species but also with significant numbers of agglutinated and perforate species.

Moore (1957), in an ecologic study of Foraminifera in the northern Florida Keys, established four faunal provinces: Florida Bay, back-reef, reef and fore-reef. The Peneroplidae, Milioidae and Nonionidae dominated the Florida Bay environment with the families Amphisteginidae Textulariidae, Lagenidae and Buliminidae absent. Ammonia beccarii and Cornuspiramia antillarum were restricted to the Florida Bay environment. He stated that only the Miliolidae were living in that environment and that the fauna was wave and current sorted.

Lynts (1961) made a study of the sediments and the benthonic Foraminifera in Upper Florida Bay. He found the fauna to be cosmopolitan and to lie within the porcelaneous zone. Ammonia beccarii and Elphidium galvestonense were inversely related, and the family Miliolidae, Quinqueloculina lamarckiana and Rosalina floridana directly related, to salinity. Living representatives of most of the families were identified in the area. He concluded that the lack of a high correlation between Foraminifera occurrence and sediment distribution indicated that the Foraminifera were not wave- or current-sorted. He further concluded that sediment size may influence the distribution of some species.

Bock (1961) investigated the benthonic Foraminifera of Southwestern Florida Bay and recognized current and wave sorting as the dominant factor affecting distribution. Archaias angulatus, Quinqueloculina bosciana, and Quinqueloculina poeyana were the most common species.

Scholz (1962) studied Foraminifera distribution in Hawk Channel, Florida finding Archaias angulatus and Quinqueloculina lamarckiana the most abundant species. She found significant associations of Quinqueloculina bosciana with Triloculina bermudezi and Triloculina circularis.

Distribution of Quinqueloculina bosciana seemed to be correlated with bottom sediment and depth of water.

Benda and Puri (1962) worked with the benthonic Foraminifera in the Cape Romano area of Florida and recognized four faunal assemblages: marsh river; lagoon; mangrove island; open gulf. Porcelaneous Foraminifera were most abundant in the open gulf environment with arenaceous forms most abundant in the others, with largest populations in the lagoons and greatest speciation in the open gulf environment. He considered grain size and organic carbon content of the sediment, salinity and temperature of the bottom water, and submarine topography important factors influencing foraminiferal distribution.

Wilcoxon (1964) in his study of the distribution of the Foraminifera of the Southern Atlantic Coast recognized four faunal depth zones: Beach Fauna, 0-1 meters; Inner Shelf Fauna, 1-15 meters; Middle Shelf Fauna, 15-61 meters; Open Shelf-Upper Continental Slope Fauna, 61-192 meters. Elphidium rugulosum and Ammonia tepida were most abundant in the Beach Fauna and were probably washed into the area. The Inner Shelf Fauna was characterized by species of Elphidium and Quinqueloculina. He concluded that sediment size was more important than sediment type in influencing foraminiferal distribution. Porcelaneous species were most abundant in near-shore shallow waters.

LOCATIONS OF STATIONS

Lower Florida Bay is located south of the Florida Peninsula between the mainland and the Florida Keys. The area studied lies between approximately $24^{o}58'$ and $25^{o}09'$ North Latitude and $80^{o}47'$ and $81^{o}08'$ West Longitude. The water depth varies from one foot to seventeen feet. Figure 1 shows the station locations while Table 1 gives the geographic position and water depth at each station.

METHOD OF STUDY

The top centimeter of each sediment core sample was separated, providing 4.8 cubic centimeters of sample from each station for analysis. Buffered formalin was added to each sample to preserve the protoplasm of the Foraminifera that were living at the time of collection. The samples were washed through number 20 and 200 sieves to a Foraminifera-size fraction. The coarse fraction was examined and any Foraminifera found therein were transfered to the Foraminifera size portion. Rose bengal (Walton, 1952) was then added to each sample.

The wet samples were washed through a microsplitter. One-half of the sample was then examined and the standing crop identified and counted. A one-sixteenth sample split was taken from the remaining half and distributed evenly in a gridded plastic counting tray. Three hundred Foraminifera were identified and counted. Representative specimens from each sample were wet-picked and retained. Population percentages (Bandy, 1954) and Foraminifera numbers were then calculated for the total population and the standing crop from each station.

FAUNAL ANALYSIS

Thirty-three families, sixty-one genera and one hundred fifty species were present in the total population. Thirty families, sixty-two genera and one hundred nineteen species were identified in the standing crop. The most abundant species found in the total population in order of abundance were:

Ammonia beccarii
Elphidium galvestonense
Nonion depressulum
Cribroelphidium poeyanum
Archaias angulatus
Quinqueloculina lamarckiana
Quinqueloculina seminulum
Quinqueloculina poeyana
Quinqueloculina laevigata
Miliolinella obliquonoda
Peneroplis proteus

Conorbina orbicularis
Triloculina bermudezi
Bolivina lowmani
Quinqueloculina bosciana
Bolivina striatula

The species most common in the standing crop in order of abundance were:

Ammonia beccarii
Quinqueloculina poeyana
Quinqueloculina laevigata
Quinqueloculina seminulum
Archaias angulatus
Nonion depressulum
Quinqueloculina lamarckiana
Triloculina trigonula
Triloculina bermudezi
Bolivina striatula
Nonion grateloupi
Elphidium galvestonense
Quinqueloculina bosciana
Bolivina lowmani

The Miliolidae generally constituted a larger percentage of the standing crop than of the total population,while the Rotaliidae formed a larger percentage of the total population than of the standing crop. These two families, with the families Elphidiidae, Nonionidae and Soritidae, formed the majority of the fauna in both the total population and the standing crop although their percentages from one to the other vary considerably (Figs. 2-5).

The area investigated may be conveniently divided into a north-south traverse consisting of stations one to fifteen and an east-west traverse consisting of stations seventeen to twenty-four and twenty-six. Stations sixteen and sixteen "a" are beach samples which do not relate to either traverse.

The Miliolidae and Soritidae tended to increase in abundance to the south toward more open-ocean conditions and away from the mainland. The Miliolidae increased in abundance to the east. The Rotaliidae and Elphidiidae decreased in abundance to the south and to the east (Figs. 2-5).

Each species, except for rare ones, was present in both the total population and the standing crop. Some species, however, such as Quinqueloculina poeyana, were more numerous in the standing crop than in the total population. This may indicate that their tests were perferentially removed or destroyed in the sediment, or that they had a longer reproductive cycle or fewer offsrping than other species (Fig. 6). Some other species, notably Ammonia beccarii (Fig. 7), were much more common in the total population than in the standing crop. This probably indicates that their tests are resistant to breakage and that they were washed in by currents. Seasonal population variability also undoubtedly is a factor in the observed distribution patterns (Phleger, 1960).

Except for the increase of Miliolidae and Soritidae and the decrease of Rotaliidae and Elphidiidae with increasing distance from shore, no definitive relationships were determined between the ecologic factors measured and the observed population distribution. It appears that the benthonic Foraminifera population in the lower Florida Bay reacts as a unit to the ecologic factors measured within the limits of accuracy under which they were measured. The area is environmentally rigorous, with major fluctuations in turbidity, salinity, temperature and water depth (Ginsburg, 1956). The species living in this environment appear to be generally tolerant to environmental fluctuation and do not react to small changes in the measured ecologic factors.

The number of living Foraminifera in a sample ranged from thirty to nine hundred, but this variation is not readily related to any of the factors measured, indicating that the productivity of any given area was related to an unmeasured variable, probably nutritional (Phleger, 1960).

The fauna approximates Phleger's (1960) porcelaneous zone and Wilcoxon's (1964) inner-shelf fauna.

CONCLUSIONS

1. The most abundant species was Ammonia beccarii.

2. The Rotaliidae, Miliolidae, Elphidiidae, Nonionidae and Soritidae were the most abundant families with Rotaliidae more important in the total population and Miliolidae more important in the standing crop.

3. Miliolidae and Soritidae increase as conditions approach those of the open-ocean. Rotaliidae and Elphidiidae decrease with increasing distance from shore.

4. Most species were found in both the total population and standing crop.

5. Species occurring more numerously in the standing crop than in the total population were assumed to indicate preferential test removal or destruction, or a longer reproductive cycle, or fewer offspring than other species.

6. Species significantly more common in the total population were interpreted as having resistant tests, having been washed in by currents, or indicating Foraminifera population season variations.

7. The foraminiferal fauna of Lower Florida Bay seems to be highly environmentally tolerant, and to react as a unit to the ecologic factors measured.

8. The productivity of an area did not demonstrate a close relationship to any measured environmental parameter. The principle determinant is assumed to be nutritional.

9. The Lower Florida Bay foraminiferal fauna corresponds to the porcelaneous zone and the inner shelf fauna as defined by Phleger and Williamson.