Marsh-estuarine benthic foraminiferal distributions and Holocene sea-level reconstructions along the South Carolina coastline.

by

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Submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy

at

Dalhousie University
Halifax, Nova Scotia
April, 1996

ISBN 0-612-15896-9

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ABSTRACT

The study of surface samples was used to characterize the marsh foraminiferal distributions for the first time in South Carolina in three marsh areas: Murrells Inlet, North Inlet and Santee Delta. Vertical zonations of foraminifera with respect to mean sea level are not as well defined as at more temperate localities to the north. The clearest marsh foraminiferal zonations were recognized at North Inlet which is also the least altered by human influence of the areas examined. Zonations in the other two areas were affected either by development (Murrells Inlet) or high river discharge (Santee Delta). Although some of the species are different from those in other marsh zonations from further north, comparable zonations do still exist but provide less absolute accuracy than found in, for example, Nova Scotian marshes. Marsh foraminifera are living infaunally in the shallow subsurface (to 20 cm) but appear to have little affect on the total assemblage (which is the ultimate fossil assemblage). Preservation of agglutinated foraminifera was generally poor in subsurface sediments, especially from Murrells Inlet, possibly as a result of bioturbation. Grab samples from the Intracoastal Waterway/Winyah Bay and nearshore localities show the effects of combined high organic matter loadings, pollution and high riverine discharge. Typical estuarine assemblages appear to be displaced offshore as a result of these effects. Using marsh foraminiferal assemblages in vibracores, a sea-level oscillation was identified in sediments from Murrells Inlet with a 2 m rise in sea-level between 5000 yBP and 4300 yBP followed by a 2 m fall between 4300 yBP and 3600 yBP which corresponds to the end of the mid Holocene warming. Limited data from North Inlet fit well on the Murrells Inlet sea-level curve although the highstand was not identified.

ACKNOWLEDGEMENTS

I would like to thank Dave Scott, Paul Gayes, Franco Medioli and Charlie Schafer for being members of my thesis committee. I would especially like to thank Dave for his support and encouragement and assistance in most aspects of the work (from sinking in the mud while collecting samples to reading this work many times). I would like to thank Paul for the opportunity to work on this project, his help with the field work, many discussions and assistance whenever problems arose. Thanks are also due to both Franco and Charlie for their many helpful suggestions and critical reviews of this work. I would also like to thank Paul and his wife Aggie, and Dave and his wife Kumiko Azetsu-Scott for their hospitality and the many wonderful meals while staying at their homes for extended periods while doing field work in South Carolina.

I would also like to thank others who assisted with the field work for this study. These people include Colton Bowles, Neal Gielstra, Kirk Koneski, Jim Matthews, Amy Nelson, Doug Nelson, Mike Pearson, Sally Pierce, Donna Radcliff and Todd Ward. Chloe Younger assisted with sample preparation and organic matter analyses which was greatly appreciated.

Thanks are also due to Susan Goldstein for the many discussions we had comparing her studies in Georgia to this in South Carolina and for her reviewing sections of this work. Don Colquhoun supplied useful information on his earlier work in South Carolina. Ted Cooney supplied some water flow data for the Santee River system.

I would also like to thank Ralph Stea, Francine McCarthy, Ana Putar and Wolfgang Kuhnt for the many useful discussions and support while working on this thesis. Finally, I am very grateful for the support of my parents, not only during the time I have been working on this thesis but through all the good and bad times.

I would also like to acknowledge the financial support from a Dalhousie University Fellowship while in the PhD program, and additional support for this project from South Carolina Cutting Edge Research Funds to Paul Gayes and from NSERC operating grants to Dave Scott and Franco Medioli.

CHAPTER I

INTRODUCTION

1.1 General Introduction

Recently, with the current concerns of, for example, global warming or for pollution monitoring, much attention has been focused on the coastal zone. Work in the coastal zone generally involves the study of beach, lagoon, estuarine and marsh systems. Unfortunately, it is often difficult to distinguish subsurface deposits of these various environments, especially between fresh and salt water marshes, based on sedimentology alone. Much of the paleoecological/sea-level work in South Carolina has been based on interpretation of undifferentiated peats (eg. Colquhoun and Brooks, 1986; Sexton, 1987) which often lead to ambiguous interpretations of the deposit. To properly interpret subsurface deposits from a given geographical locality, especially for marsh/estuarine systems, it is important to determine the characteristics of the present day environments from that area since conditions (both physical and biological), although they may be similar, vary with latitude (eg. Chapman, 1960; Goldstein, 1986; Murray, 1991). Benthic foraminifera and arcellaceans have been shown to be excellent indicators for characterizing various coastal environments, hence are useful in paleoenvironmental interpretations (see below) and are the proxies used in this study.

Benthic foraminifera are unicellular protists with a test that may be agglutinated, calcareous or porcelaneous (Loeblich and Tappan, 1964). Since the early work in Barnstable Harbor, Massachusetts by Phleger and Walton (1950), foraminiferal distributions in salt marshes have been documented in many localities throughout the world. Buzas (1969), in his study of Choptank River, Maryland for example, has shown that foraminiferal distributions are controlled by a number of interdependent variables. However, in marsh systems, the relative elevation in relation to sea level has been shown to be the primary controlling factor of the vertical zonation of foraminiferal assemblages across the marsh surface at Chezzetcook Inlet, Nova Scotia (Scott and Medioli, 1978; 1980a). This has been confirmed by other workers at localities in, for example, South America (Scott et al., 1990), British Columbia (Patterson, 1990), Oregon (Jennings and Nelson, 1992), Maine (Gehrels, 1994) and along the Pacific rim (Scott et al., in press). In a study of the Great Marshes, Massachusetts by de Rijk (1995), she concluded there was no relationship between foraminiferal assemblages and elevation above mean sea level. She concluded that changes in assemblages along the marsh were controlled by salinity variations. However, since the samples she examined were all from within the high marsh zone, it is questionable how significant her conclusions were.

For many years it has been known that benthic foraminiferal assemblages in a given area may be affected by a wide variety of physical, chemical and biological factors (eg. Phleger, 1951). From this, foraminiferal workers have used benthic foraminiferal assemblages as proxies in assessing environmental conditions in stressed or polluted areas. The importance of foraminifera for environmental applications was highlighted in a Theme Issue of Journal of Foraminiferal Research (July, 1995) on Environmental Applications of Foraminiferal Studies.

The purpose of this thesis was first to document the Recent benthic foraminiferal distributions (both living and total) in sediments from three marsh-estuarine-nearshore systems, from north to south - Murrells Inlet, North Inlet/Winyah Bay and Santee Delta since there was no previous quantitative distributional studies of benthic foraminifera in South Carolina (other than Collins et al., 1995, from this work) (Figure 1). This study also documents the occurrence of foraminifera living infaunally in sediments from a North Inlet marsh and evaluates their effect on the total (living + dead) assemblage. Based on these

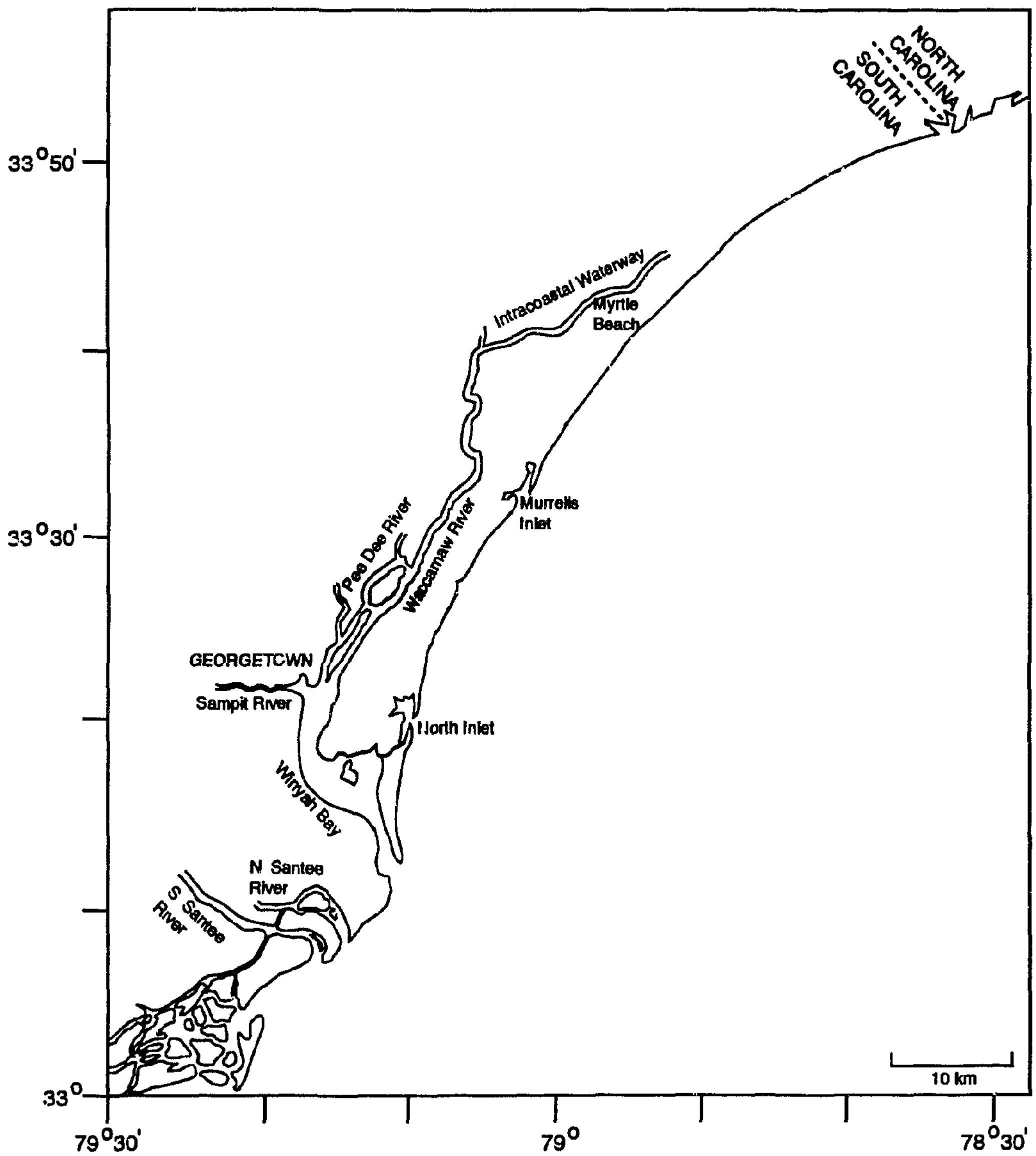


Figure 1. Map of study area showing the location of Murrells Inlet, North Inlet, Winyah Bay and Santee Delta region (North and South Santee River).

data the mid-Holocene to present sea-level history of this area was interpreted. A pollution study was also undertaken to determine if there was any relationship between the foraminiferal assemblages and organic matter loadings in sediments from Winyah Bay compared with those from Murrells Inlet and South Santee River.

1.2 Study Locations and Environmental Characteristics

Murrells Inlet is a small bar-built estuary located along the northern coast of South Carolina (Figure 1). Approximately 15.5 km^2 of marsh exist between the barrier beaches and the Pleistocene upland (Fulton et al., 1993). Tides are semi-diurnal with a mean tidal range of 1.4 m (Gayes et al., 1992). Salinity values are fairly constant throughout the inlet (generally greater than 30‰) since Murrells Inlet presently receives very limited freshwater input other than rainfall and runoff as no streams currently drain into it (Fulton et al., 1993). Jetties were constructed between 1977 and 1980 at the seaward mouth (both sides) of the inlet to stabilize the inlet for safe navigation (Douglas, 1987). The inlet exists within an embayment produced by the paleo-Pee Dee River valley (Gayes et al., 1992). Murrells Inlet is an impacted estuary, affected by urbanization in response to residential and tourist demands, but is not affected by industrial wastes (Fulton et al., 1993).

North Inlet (Figure 1) is considered to be a relatively pristine tidal estuary since it has minimal anthropogenic effects as a result of the Belle Baruch laboratory and reserve (Blood and Vernberg, 1992; Fulton et al., 1993). Approximately 20 km^2 of marsh are present around the North Inlet locality (Fulton et al., 1993). There is little freshwater input to the North Inlet system which has a mean tidal range of 1.4 m with semi-diurnal tides; salinities range between 30 and 34‰ in the outer part of the estuary (Blood and Vernberg, 1992). Although several creeks connect North Inlet to Winyah Bay, most of the water exchange between the two localities occurs through South Jones Creek (Schwing and Kjerfve, 1980).

Winyah Bay is one of the largest estuaries on the eastern coast of the United States (Figure 1). It is almost completely surrounded by marshes; 87% of these are affected by tidal influence and many of the marshes are dominated by either *Spartina alterniflora* or *S. cynosuroides* (Allen et al., 1982). Winyah Bay has an average depth of 4.2 m with a maintained navigable channel of 8.2 m water depth along the axis of the bay; mean tidal range is 1 m (Blood and Vernberg, 1992). Salinity range is extensive due to the large freshwater discharge primarily from the Pee Dee and Waccamaw Rivers (Schwing and Kjerfve, 1980). Allen et al. (1984) reported salinity values measured between Sept. 1981 and Sept. 1982 (33 measurements) where salinity ranged from 0 to 35.3‰ at various stations throughout the bay. Approximately 3 km upstream from the mouth of the Waccamaw River, salinity varied from 0 to 11.7‰ while at the mouth of the bay values ranged from 21.5 to 35.3‰. The bay is salt-wedge stratified for most of the year and differences of 10 to 15‰ between surface and bottom water samples were common (Allen et al., 1984). While collecting samples for this study, a plume of dark greyish water was noted flowing out of Winyah Bay (see Chapter 3 - Results, Winyah Bay). During periods of low freshwater flow to the bay, the salt wedge can be identified to approximately 35 km upstream from the mouth of the Waccamaw River while under average flow it reaches approximately 4 km upstream (Allen et al., 1984). The water quality in much of Winyah Bay is reduced due to the pulp and steel mills around Georgetown, ship traffic and domestic pollution (Schwing and Kjerfje, 1980). The Sampit River, discharging water to the bay near Georgetown, is the most heavily polluted river in the Winyah Bay system (Allen et al., 1982).

Santee Delta is the largest deltaic system on the east coast of the United States and the subaerial Santee River Delta covers an area approximately 100 km^2 (Sexton, 1987). Although this is a unique feature along the eastern United States coast, there is very little published environmental information on the delta system. With the completion of the Santee-Cooper dam in 1942, 95% of the freshwater flowing into the Santee River was diverted to the Cooper River (Stephens et al, 1975). The diversion caused: 1) the rivers to change from being salt-wedge stratified to a partially mixed type; 2) a decrease in downriver sediment supply, and 3) filling in of the rivers with sediment supplied from the ocean (Stephens et al., 1975). Salinity ranged from 35‰ at the mouth of the rivers to 0‰ just seaward of the Highway 17 bridge (Stephens et al., 1975). The tidal range averaged 1.4 m at the mouth of the North and South Santee Rivers (Stephens et al., 1976). The Santee Delta region is characterized by extensive swamps and marshes, few people live in this area and there is no industry on the rivers (Kjerfve and Greer, 1978). Due to problems in Charleston Harbor, as a result of the diversion of freshwater to the Cooper River, it was proposed to redivert up to 80% of the water flow back to Santee River by 1980 (Kjerfve and Greer, 1978). This diversion was completed in 1986 (C. Marsh, R. Devoy, pers. comm., 1995). As suggested by Kjerfve and Greer (1978), the diversion would cause the river to again become partially stratified and have less marine influence upstream.

1.3 Previous Work

Although distributional patterns of present day salt marsh foraminifera have been described from many east coast North American marshes, for example in Georgia (Goldstein and Frey, 1986), Virginia (Ellison and Nichols, 1976), Connecticut (Thomas and Varekamp, 1991), Massachusetts (Phleger and Walton, 1950; Parker and Athearn, 1959; Scott and Leckie, 1990; de Rijk, 1995), Maine (Gehrels, 1994) and Nova Scotia (Scott and Medioli, 1978; 1980a), no distributional studies, with the exception of data from this work on two North Inlet marsh transects (Collins et al, 1995), existed for South Carolina marsh systems.

The only published estuarine distributional study in South Carolina is that by Collins et al. (1995) for Winyah Bay from this work.

There has been some controversy among authors as to whether living or total benthic foraminiferal assemblages should be used in environmental analyses. Murray (1984) concluded that only the living foraminiferal assemblage should be used to interpret environmental conditions. Buzas (1968) felt that examination of the living assemblage at any one time did not represent the environmental conditions on the population over longer periods of time. Although some variation between living and dead assemblages have been noted, Scott and Medioli (1980b) have shown total (live + dead) populations to be good indicators of long term, rather than seasonal conditions and therefore serve as a better basis for paleoenvironmental studies. Murray (1991) listed ecological tolerances for many species identified in this study.

Few studies, especially concerning marsh foraminifera, have addressed the impact of both infaunal habitat and taphonomy when comparing surface and subsurface assemblages. The infaunal habitat of some foraminiferal species, and in some cases taphonomic processes, have been discussed primarily in deep sea marine environments (eg. Corliss, 1985; Loubere, 1989; Corliss and Emerson, 1990; Kuhnt et al., submitted) but there are a few studies from marshes. Matera and Lee (1972), in their study of marshes and adjacent sandflats near Southampton, Long Island, reported increased abundances of live *Trochammina inflata* specimens with depth. In studies of only living foraminifera from Hommocks salt marsh, New York, Steineck and Bergstein (1979) reported that *Ammobaculites exiguus* and *Ammonia beccarii* had a "living zone" extending 10 cm or more below the marsh surface. Goldstein (1988) identified living foraminifera to depths of 30 cm in sediments from a relict salt marsh along the eastern coast of St. Catherines Island, Georgia. Buzas et al. (1993) classified the infaunal character of 48 species in water depths ranging from less than one meter to 2975 m. Goldstein and Harben (1993), in their study of marshes on Sapelo Island, Georgia, identified living *Arenoparella mexicana* and *Haplophragmoides wilberti* to depths of 30 cm and also concluded there was selective preservation of agglutinated as well as calcareous foraminiferal tests in the subsurface marsh sediments. In marshes from the Fraser River Delta, British Columbia, Canada, Jonasson and Patterson (1992) also reported selective preservation of both agglutinated and calcareous foraminiferal tests with depth. This problem will also be addressed in this thesis.

Benthic foraminiferal assemblages have been used to determine the effects of pollution on the marine environment. Many of these studies focused on the environmental change caused by organic pollution from sewage outfalls (eg. Watkins, 1961; Schafer, 1970, 1973) or discharge from pulp and paper mills (eg. Schafer, 1973; Schafer and Cole, 1974; Nagy and Alve, 1987; Schafer et al., 1991). Often near the point source of sewage outfalls, an "abiotic zone" develops where there are no foraminifera while further from the source a "hypertrophic zone" develops where the are increased concentrations of some tolerant foraminiferal species relative to "normal" for the surrounding areas (Alve, 1995). From more diffuse sources, the pollution may be widely transported through river discharge and the effects on the foraminiferal populations are more difficult to assess. The zone of few or no foraminifera near the pollution source is probably due to low oxygen and pH values caused by higher organic matter loadings (Boltovskoy and Wright, 1976). Further from the pollution source (especially sewage) the extra organic material may act as food and supply nutrients for the foraminiferal population (Murray, 1991). This situation occurred around the Orange County, California sewage outfall site where concentrations of *Eggerella advena* were two to three times higher than the normal on the shelf off California (Watkins, 1961). A similar situation was reported by Schafer and Cole (1974). Schafer

(1970; 1973) reported that the *Elphidium incertum/clavatum* group (= *Elphidium excavatum* group, this study) dominated the living assemblages nearest to outfalls from a lead-zinc smelter, a fertilizer plant, a power plant, pulp and municipal wastes and a chlorine alkali plant. Schafer (1970) also identified a general increase in both the number of living and total foraminiferal specimens further from the pollution sources. Schafer et al. (1991) studied both the spatial and temporal changes in the benthic foraminiferal assemblages in the Saguenay Fiord, Quebec which, for most of the 20th century, had been contaminated primarily by organic matter discharges from several local pulp and paper mills. During times of intense pollution (1920-1970) foraminiferal results from core samples show these times are marked by barren intervals, absence of calcareous species or a reduction in the pollution-tolerant species *Spiroplectammina biformis.* These polluted sediments were capped by impervious marine clays during a 1971 landslide and with increased government regulations imposed on local industrial polluters, surficial grab samples collected in 1982 and 1988 show the recolonization of several calcareous and arenaceous foraminiferal species. In a study of Canso Strait, Nova Scotia, moderately polluted primarily by organic matter, Schafer et al. (1975) reported that sediments from the stressed environments near pollution sources were characterized by large numbers of *Eggerella advena* and *Elphidium incertum/clavatum* group (= *Elphidium excavatum* group, this study). Schafer (1982) also studied the recolonization of benthic foraminifera at an offshore dump site after cessation of dumping of dredge spoil with high concentrations of organic matter. By one month after the last dumping of spoil, benthic foraminifera had recolonized most of the site with *Eggerella advena* and *Ammotium cassis* being the pioneer species. Fewer studies have documented the effects of chemical pollution (eg. Schafer, 1970; Alve, 1991). A review on the effects of benthic foraminiferal response to various sources of estuarine pollution is presented by Alve (1995) while effects of anthropogenic changes to the marine environment are described by Culver and Buzas (1995).

Although there have been no previous distributional studies of Recent benthic foraminifera in South Carolina, other than Collins et al. (1995), a few foraminiferal samples were examined to prepare a preliminary sea level curve for Murrells Inlet (Gayes et al., 1992; Scott et al., 1995a). Colquhoun and Brooks (1986) and Colquhoun et al. (1995) have identified several Holocene sea-level fluctuations in their sea-level curve for South Carolina, based on archaeological data and undifferentiated peats. They identified a highstand at approximately 4000 yBP, which agrees well with that of this study. DePratter and Howard (1981) reported a highstand by 4500 yBP (uncorrected date) along the Georgia and South Carolina coasts based on archaeological sites and submerged tree stumps as sea-level points. This fluctuation has not been recorded along the east coast of North American except by Dionne (1988) in the St. Lawrence Valley. Data from Nova Scotia indicate an acceleration in sea-level rise between 5500 and 4500 yBP; no sea-level oscillation is identified but the rapid sea-level rise ends approximately at the time of the highstand in South Carolina (Scott et al., 1995a; Scott et al., 1995b). The highstand reported in South Carolina has not been identified in sea-level studies from adjacent areas, eg. North Carolina (Moslow and Heron, 1981), Virginia (van de Plassche, 1990), Delaware (Belknap and Kraft, 1977), Connecticut (van de Plassche, 1991)or Maine (Gehrels, 1994). No evidence for this highstand was found on Barbados (Fairbanks, 1989) although this curve had poor resolution in the last 6000 years.

CHAPTER II

FIELD AND LABORATORY METHODS

2.1 Field Methods

Sediment surface samples from the Murrells Inlet marsh system were collected in July 1990 (Transect 2) and in May 1991 (Transect 7 and Transect 8 - Figure 2). Samples from the North Inlet marsh transects were collected in July 1990 (Transect 1) and in March 1991 (Transect 6 - Figure 3). Short cores taken from the same marsh system, although not directly along Transect 6, were collected in April, 1991 (Figure 3). These were collected by gently pushing a core tube by hand into the sediment. Sediment surface samples from the Santee Delta marshes were collected in February 1991 (Transect 4 and Transect 5) and in May 1991 (Transect 10 - Figure 4). A 10 cm^3 sample from of the top centimeter of marsh sediment was collected at each surveyed (elevation and distance along transect measured with a theodolite and and stadia rod) station for foraminiferal analysis. In the absence of geodetic benchmarks, which in most cases were not accessible or had been disturbed, mean sea level was considered to be at the lowermost continuous occurrence of *Spartina alterniflora*; this was the datum elevations were measured from. The foraminiferal samples were stored in plastic bags or vials and treated immediately after returning from the field with buffered formalin to prevent the decay of any living foraminiferal protoplasm. A replicate sample was collected at most transect stations (none at Transect 1 or Transect 2) for organic matter analysis. These samples were frozen to prevent the decay of organics within the sediment.

A van veen grab sampler deployed from a boat was used to obtain sediment from the channels, bays and nearshore localities for this study. Samples from Murrells Inlet were collected in March 1991 (Stations 1 - 20) and from the nearshore off Murrells Inlet in May

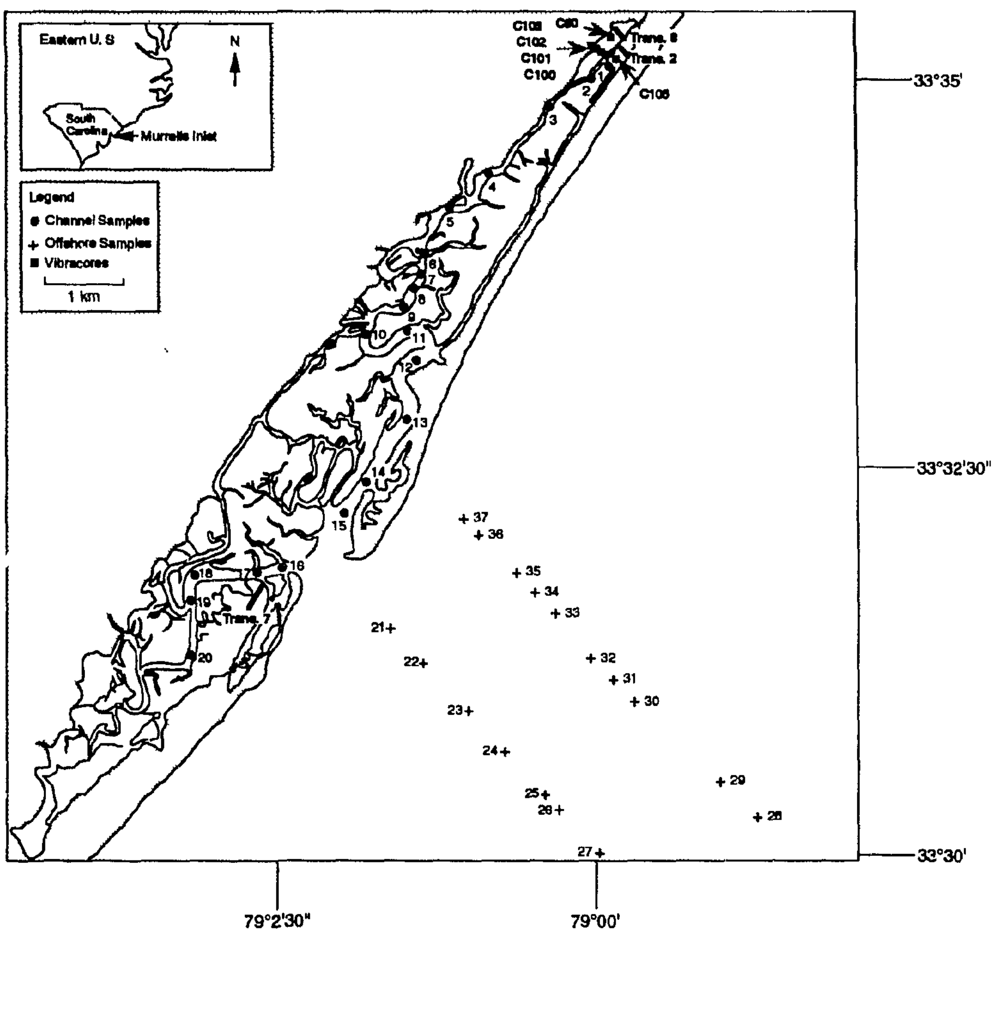


Figure 2. Detailed map of Murrells Inlet marsh system showing the location of Transects 2, 7 and 8; Channel samples; Offshore samples and Vibracores 90, 100, 101, 102, 103 and 106.

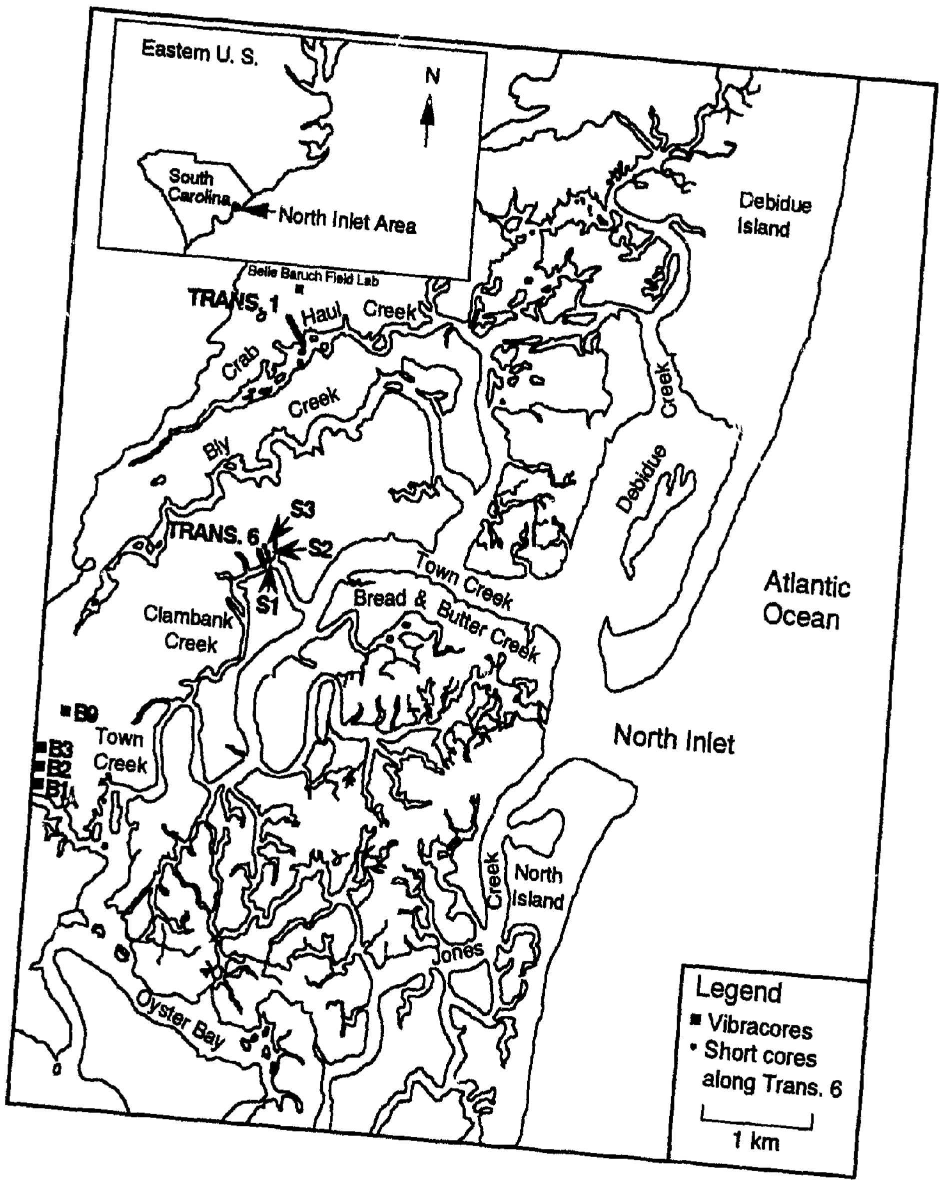


Figure 3. Detailed map of North Inlet marsh system showing the location of Transects 1 and 6; Short cores along Transect 6 and Vibracores B1, B2, B3 and B9.

Figure 4. Detailed map of Santee Delta region showing the location of North and South Santee Rivers, the location of River samples; Offshore samples and Vibracore 1, 3 and 7.

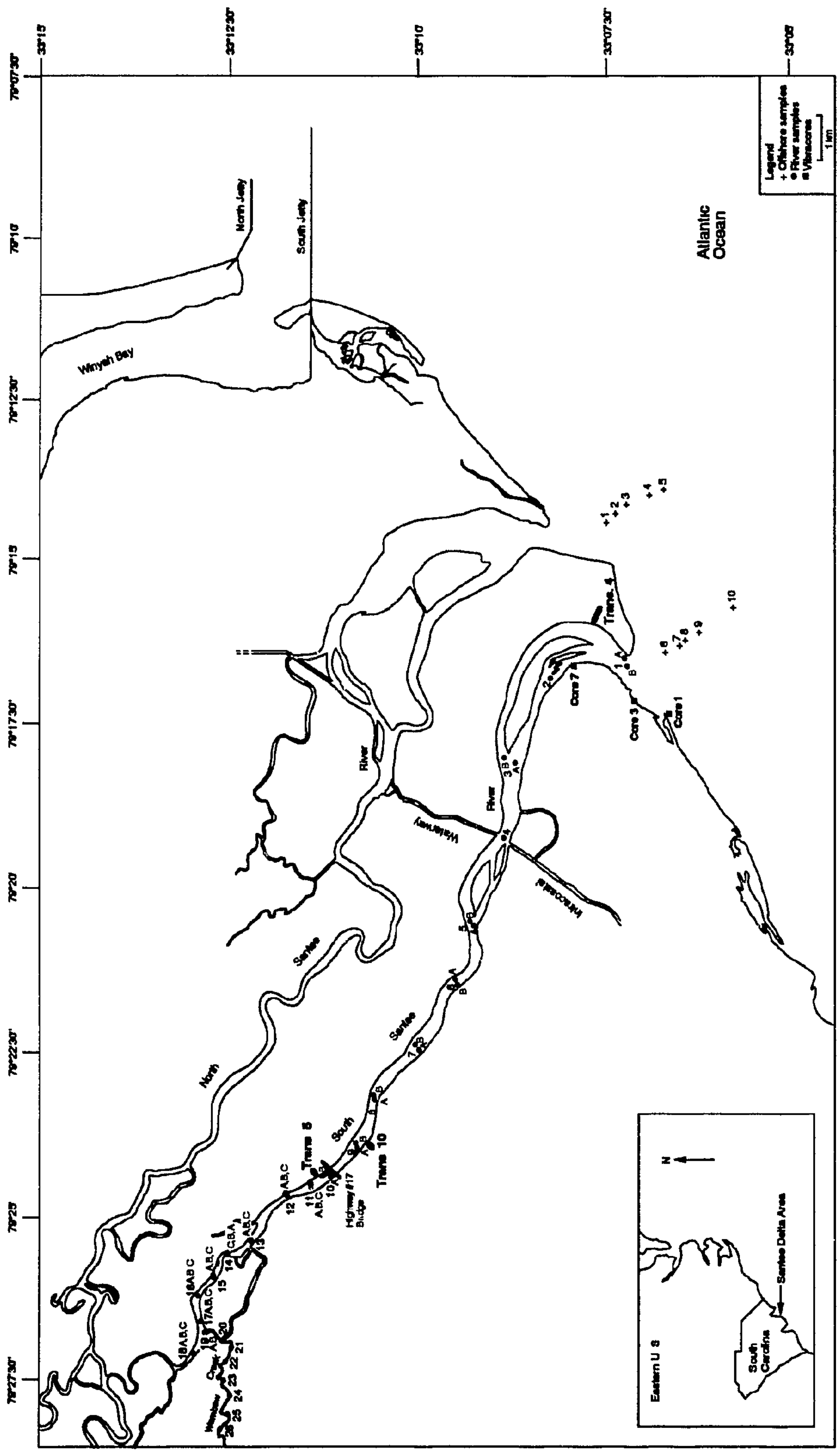

Atlantic Ocean
Winyah Bay
North Jetty
South Jetty
North Santee River
South Santee River
Waterway
Intracoastal
Legend
+ Offshore samples
● River samples
■ Vibracores
1 km
Eastern U S
South Carolina
Santee Delta Area
N
Highway #17 Bridge
Trans 4
Trans 8
Trans 10
Core 7
Core 3
Core 1

Figure 4

1991 (Stations 21 -37; Figure 2). Stations at South Santee River were sampled in February 1991 (Stations 1 - 10) and in October 1991 (Stations 11 - 26; Figure 4). Samples from the Intracoastal Waterway/Winyah Bay and nearshore localities were collected in May 1991 (Figure 5). Replicate 10 cm^3 subsamples of the top centimeter of sediment were removed for foraminiferal analysis and percentage organic matter determinations and the samples were treated as described above until they could be returned to the laboratory. Sample station positions were determined using Loran C at the Intracoastal Waterway/Winyah Bay and all nearshore localities and by visual determination with navigation charts at Murrells Inlet and South Santee River. Salinities were measured using an American Optical temperature-corrected salinity refractometer.

Vibracoring was the technique used to collect subsurface sediments. Vibracores were collected using a cement vibrator connected to a 9 m long, 7.62 cm diameter aluminum irrigation pipe. Sediment compaction during vibracoring was measured for each core taken. Compaction values during coring ranged from 0 to 135 cm. Compaction during deposition is more difficult to measure and remains a problem in accuracy of sea-level curves. Most compaction generally occurs in the younger salt marsh peats while there is little or no compaction due to coring in the sandy marsh, beach ridge or in the older desiccated freshwater peat deposits encountered in coring at the various localities. In the upper 1 m of Core 103, elevations of unit boundaries were also determined using non-compacted hand pushed core samples (same diameter as vibracores). When the core was retrieved it was capped and cut into 1.5 m sections, transported to the laboratory and split. Split cores were described, and foraminiferal and radiocarbon samples were taken within two weeks of collection. Vibracores were stored at 4° C to minimize diagenetic alteration of foraminiferal assemblages. Vibracores from Murrells Inlet marshes (Cores 100 - 106) were collected in February 1991 and Core 90 was collected in July 1990. Cores B1 - B3 and B9

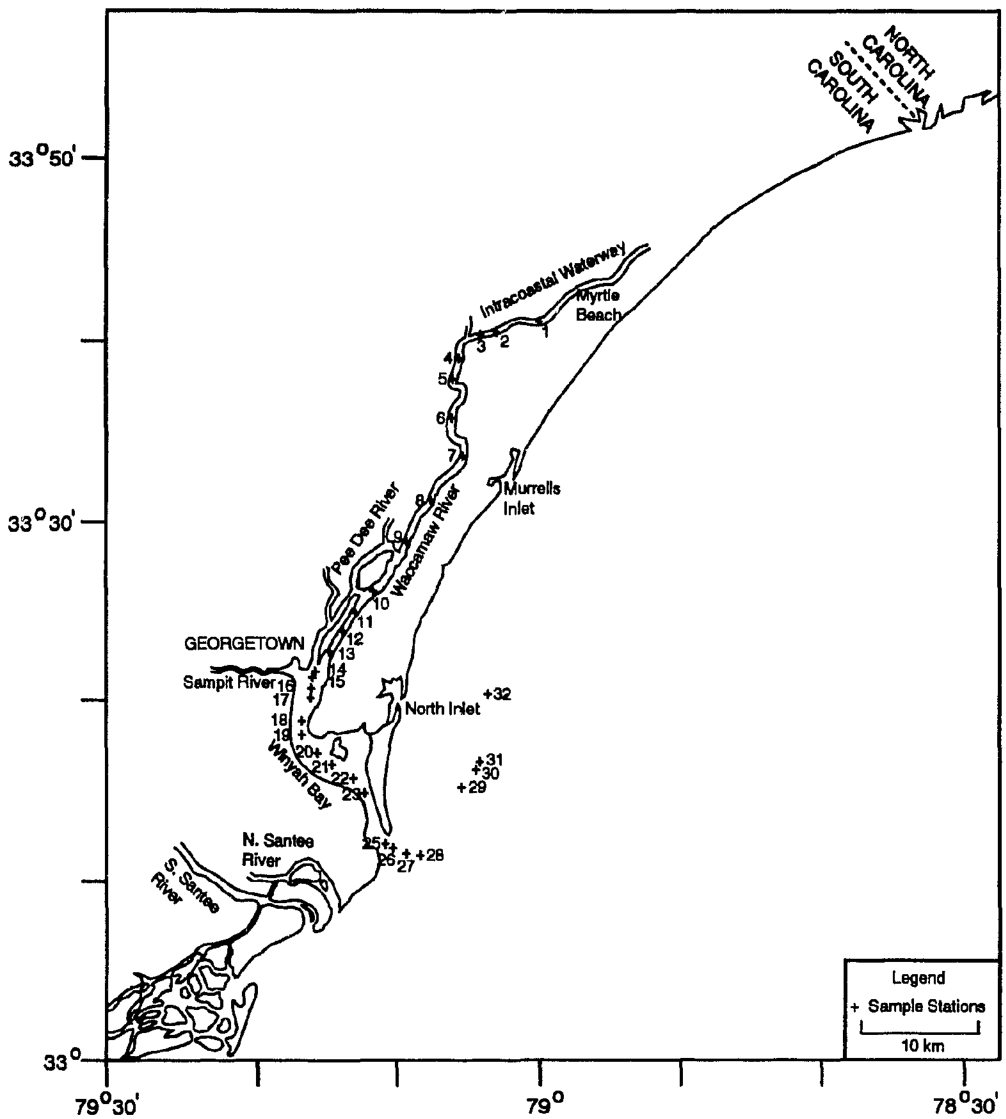


Figure 5. Map of study area showing the location of the Intracoastal Waterway/Winyah Bay and nearshore sample stations.

from North Inlet were collected in June 1991. Vibracores from Santee Delta (Cores 1, 3 and 7) were collected in August 1989.

2.2 Laboratory Methods

After collection, each foraminiferal subsample was preserved in buffered formalin. In the laboratory the samples were gently sieved through a 63 μm (#230 mesh) sieve; the residue was placed in a sample container with rose Bengal for about one hour, then washed again through a 63 μm sieve to remove any excess stain. Residues with little organic debris were dried in an oven at 40° C and the foraminifera were separated from the sand by flotation using carbon tetrachloride (specific gravity 1.58). Organic-rich residues were split using a wet splitter described by Scott and Hermelin (1993); the majority of samples were not decanted since McCarthy (1984) demonstrated that many arcellaceans may be lost in the decant (only a few from Core 106 were decanted) . This also appears to be the case for many small foraminifera (Collins and McCarthy, in progress). In all cases approximately 300 foraminifera or arcellaceans were counted and the quantitative data have been standardized to a volume of 10 cm^3.

Samples for organic matter analysis were dried in an oven at 50° C. After cooling the samples were pulverized using a ceramic mortar and pestle and the sediment was weighed. The samples were then roasted in a furnace at 500° C for 2.25 hours (Mook and Hoskin, 1982). Organic matter loss on ignition was determined after the sample had cooled to room temperature.

Foraminiferal assemblages were interpreted graphically since the small numbers of foraminifera present in most bay, channel and nearshore samples would render any statistical analyses meaningless. Trends within the marsh transects were quite obvious graphically; most physical and chemical parameters were not measured across the marsh surface since this was a one-time collection at each locality and Phleger and Bradshaw (1966) showed that these variables change dramatically throughout each tidal cycle.

Carbon -14 (^{14}C) dating of peat was done by Geochron Laboratories in Cambridge, Mass. using conventional techniques for larger peat samples. These include dispersing the entire sample in a large volume of water and the clays and organic matter were separated away from any sand and silt by decantation. The clay/organic fraction was then treated with hot dilute hydrochloric acid to remove any carbonates. The residue was then filtered, washed, dried and roasted in oxygen to recover carbon dioxide from the organic matter for the analysis. Radiocarbon ages, reported as radiocarbon years before present (BP), where present is 1950 AD, were converted from radiocarbon years to calendar years with the calibration CALIB 3.0.3 (Stuiver and Reimer, 1986; 1987) and are reported as cal yr BP. Parameters used in this conversion were those for atmospheric conditions at one sigma because the marsh plants, even though they are marine, draw their ^{14}C from the atmosphere (Stuiver et al., 1986, C. Hillaire-Marcel, pers. comm., 1995).

Scanning electron micrographs, which provide high surface detail but do not penetrate the surface of the shell, were taken using a Bausch and Lomb Nanolab 2000 scanning electron microscope located in the Biology Department at Dalhousie University, using black and white 35 mm film. Scanning light micrographs, which provide an image of some of the internal structures of hyaline foraminiferal species, were taken using a Dynaphot® scanning light microscope with Tech Pan black and white 35 mm film following the technique described in Gerakaris (1986) and Scott and Vilks (1991).

CHAPTER III

RESULTS

3.1 MARSH SURFICIAL TRANSECTS

3.1.1 Murrells Inlet

3.1.1.1 Transect 2

In the 26 samples examined from this transect, total abundances were generally quite high throughout (202 to 13,334 inds/10 cm^3) (Appendix Table 1; Figure 6). **Note**: In this and each subsequent data table arcellacean species are listed at the bottom of the table separated from the foraminiferal species by a double line. Numbers of living specimens were also quite high (52 to 3072 inds/10 cm^3) and the living distributions (Figure 7) were similar to those of the total distributions. In the higher elevations of this transect (higher than +40 cm) the assemblage was strongly dominated by the calcareous species *Ammonia beccarii*, *Elphidium excavatum* formae and *Helenina anderseni* while there was a consistent but low percentage of *Trochammina inflata* in these samples. In the low marsh (lower than +35 cm) the assemblages were dominated by the agglutinated species *Miliammina fusca* and *Ammotium salsum*; very rare calcareous specimens were present. Rare arcellacean specimens of the genus *Centropyxis* were identified in many samples throughout this transect. *Spartina alterniflora* dominated the floral assemblage from the edge of the small tidal channel (Station 24) to +53.8 cm (Station 16), above which there was a mixture of *Borrichia* spp., *Juncus* spp., *Salicornia* and *Spartina alterniflora*. *Distichlis* spp. and *Juncus* spp. dominated the floral assemblage from +72.8 cm (Station 7) to where the transect ended at the edge of a resident's backyard. There was very sparse vegetation at the end of the transect. Salinity ranged from 28‰ in the channel to 40‰ at Station 17, the last station where the sediment was wet enough to obtain a measurement.

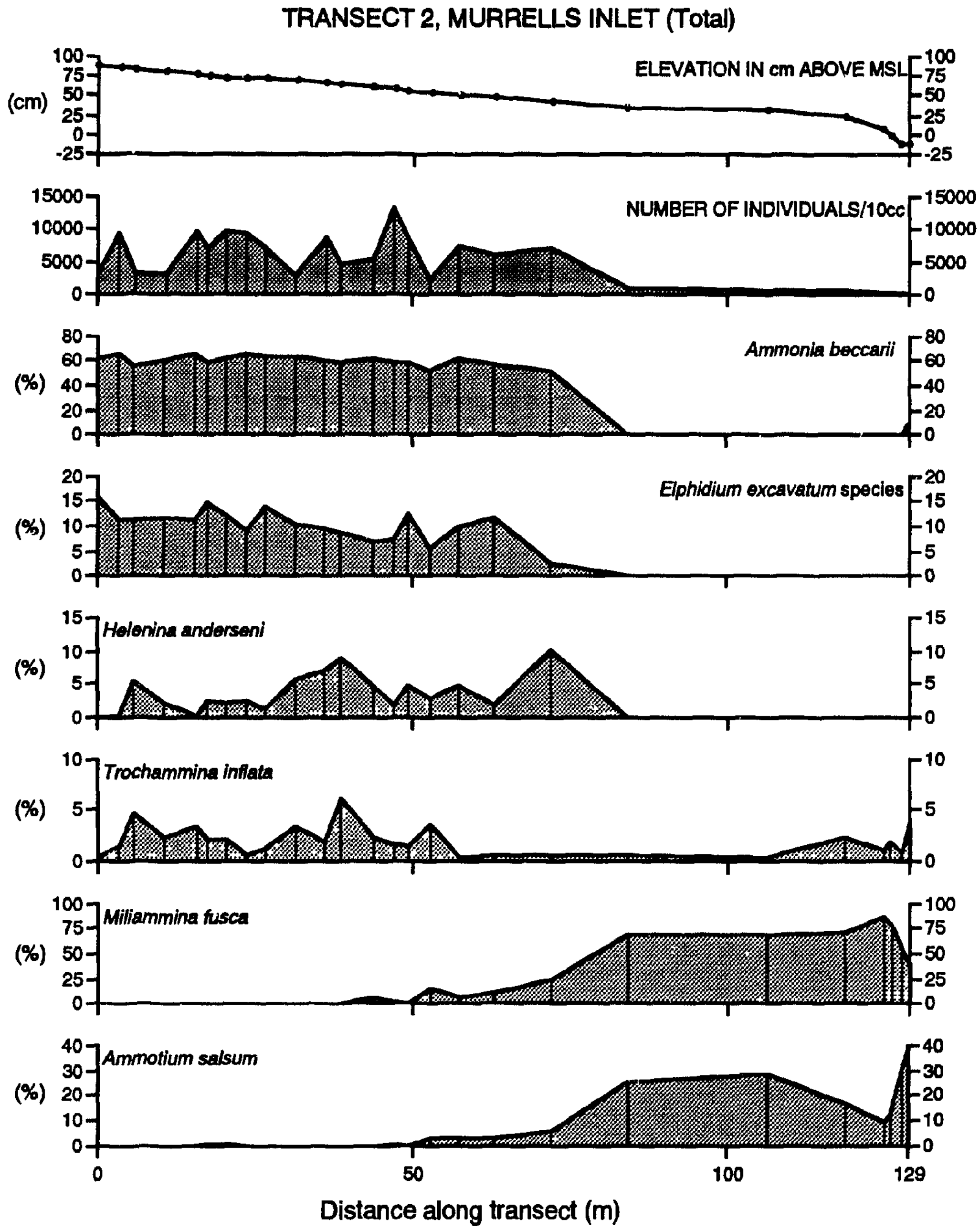


Figure 6. Profile of marsh elevation, number of individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Transect 2, Murrells Inlet.

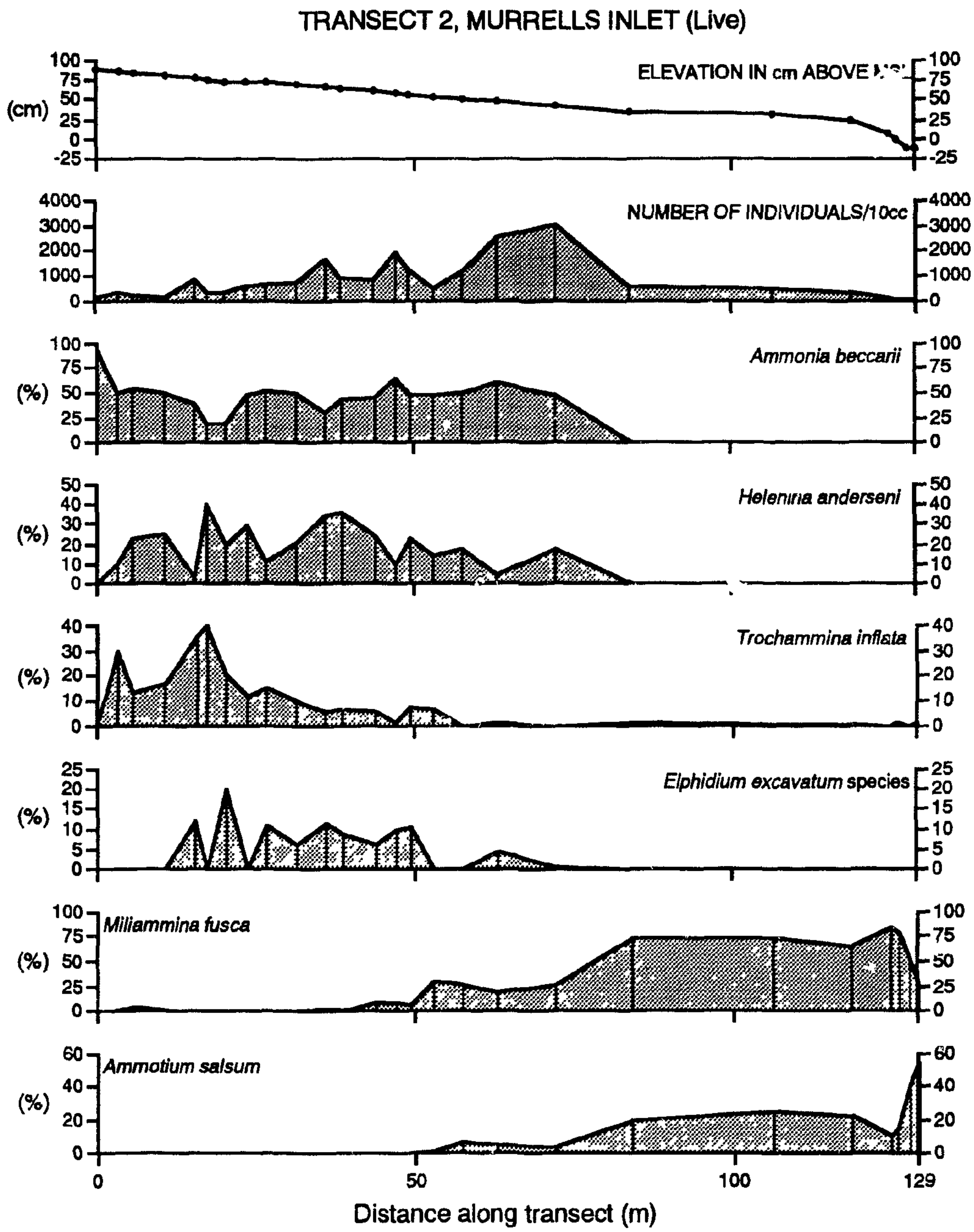


Figure 7. Profile of marsh elevation, number of individuals, and percent abundance of some foraminiferal species relative to the live foraminiferal and arcellacean assemblage in sediments from Transect 2, Murrells Inlet.

3.1.1.2 Transect 7

Of the 48 samples collected along this marsh transect, total abundances ranged from 4 to 1768 inds/10 cm^3 although total numbers were generally low at the majority of stations (Appendix Table 2; Figure 8). Abundances of living specimens were also low and ranged between 0 and 322 inds/10 cm^3; only four samples had >75 living inds/10 cm^3 (Figure 9). The foraminiferal assemblage was generally dominated by *Trochammina inflata, Trochammina macrescens* and *Siphotrochammina lobata* at elevations above 100 cm while below this height the assemblages were dominated by *Ammotium salsum* and *Miliammina fusca*. The exception to this was along the channel edge (seaward of the levee) where *Ammonia beccarii* and *Elphidium* spp. dominated the assemblage. Significant percentages of these species were also found in samples from the middle of the transect where the elevation decreased (the transect ran obliquely along a small tidal channel). *Trochammina ochracea* was also present in relatively high percentages at lower elevations, although it was identified throughout most of the transect. *Arenoparella mexicana* was present generally at stations with higher elevations. *Haplophragmoides wilberti* was only identified in samples near or greater than 150 cm at the landward end of the transect. Living percentages generally were similar to those of the total percentages. Organic matter percentages vary greatly across the transect with percentages ranging from 0.64% to 25.61%. Two peaks in organic matter were identified; the first in the depression just landward of the levee along the channel edge and the second at the termination of the transect at the forest edge. *Spartina alterniflora* dominated the floral assemblage from the waters edge at Station 1 to +97.3 cm (Station 10). There was then a mixed floral assemblage dominated by *Salicornia* spp. with some *Borrichia* spp., *Limonium* spp., *Spartina patens* with little *S. alterniflora*. This assemblage was replaced by one dominated by *Spartina alterniflora* when the marsh elevation dropped below approximately +100 cm

Figure 8. Profile of marsh elevation, number of individuals, organic matter, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Transect 7, Murrells Inlet.

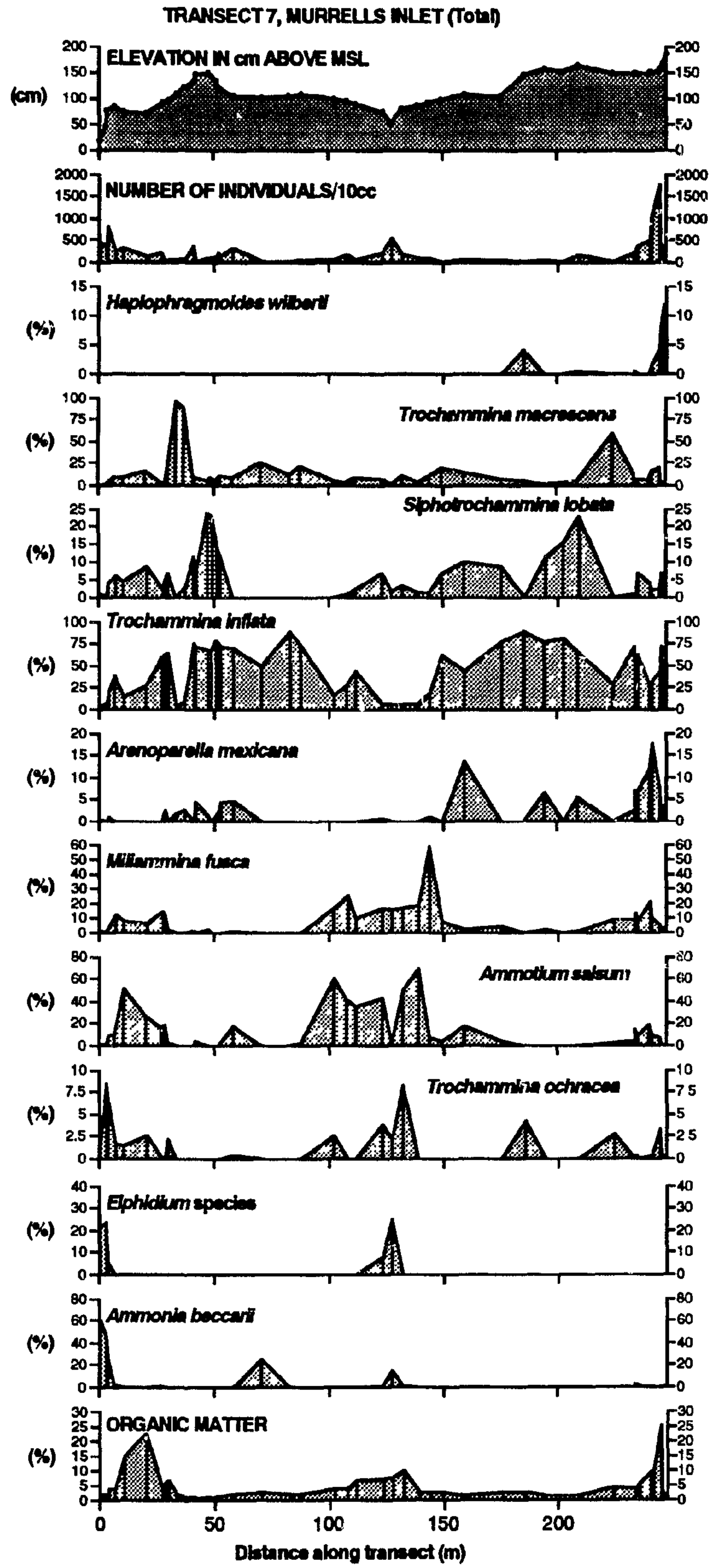
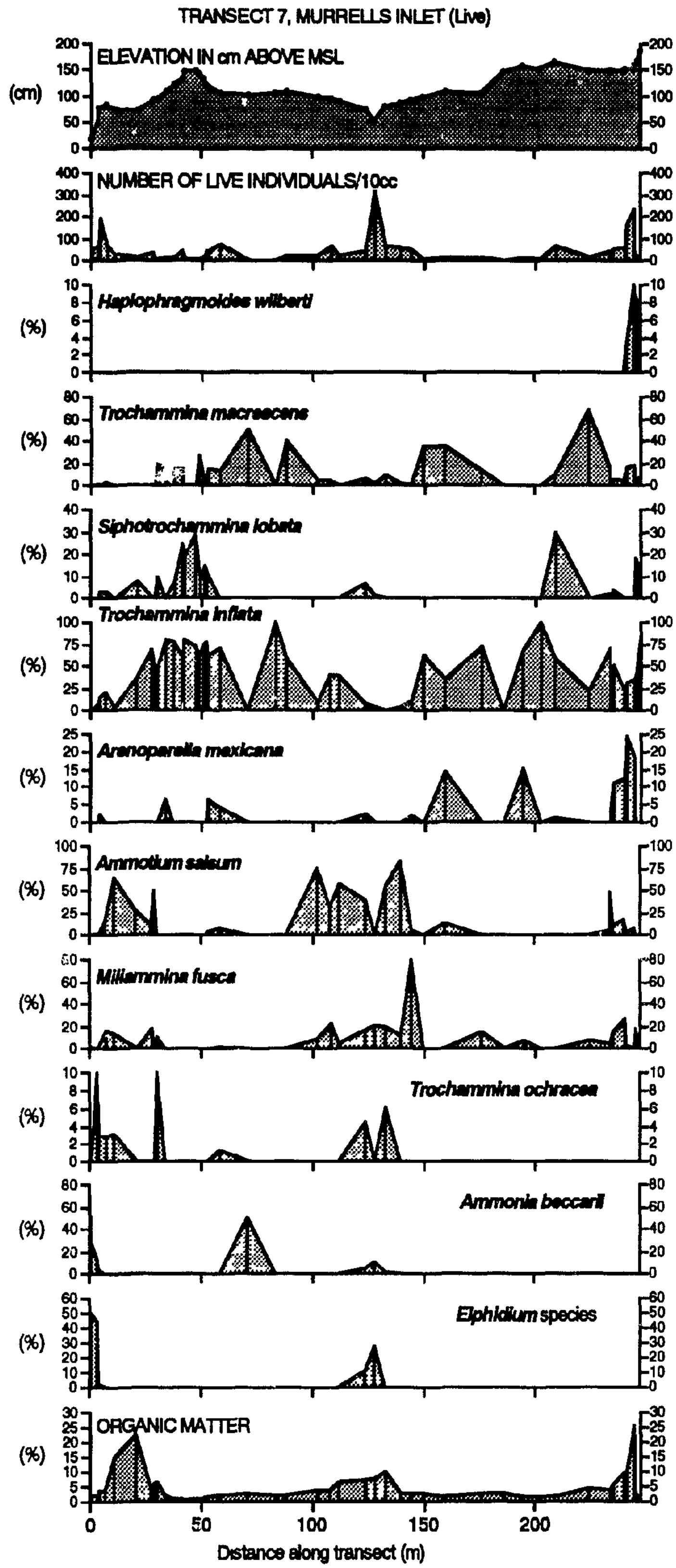

TRANSECT 7, MURRELLS INLET (Total)
ELEVATION IN cm ABOVE MSL
(cm)
NUMBER OF INDIVIDUALS/10cc
Haplophragmoides wilberti
Trochammina macrescens
Siphotrochammina lobata
Trochammina inflata
Arenoparella mexicana
Miliammina fusca
Ammotium salsum
Trochammina ochracea
Elphidium species
Ammonia beccarii
ORGANIC MATTER
(%)
0
50
100
150
200
Distance along transect (m)

Figure 8

Figure 9. Profile of marsh elevation, number of individuals, organic matter, and percent abundance of some foraminiferal species relative to the live foraminiferal and arcellacean assemblage in sediments from Transect 7, Murrells Inlet.



TRANSECT 7, MURRELLS INLET (Live)
ELEVATION IN cm ABOVE MSL
(cm)
NUMBER OF LIVE INDIVIDUALS/10cc
Haplophragmoides wilberti
Trochammina macrescens
Siphotrochammina lobata
Trochammina inflata
Arenoparrella mexicana
Ammotium salsum
Miliammina fusca
Trochammina ochracea
Ammonia beccarii
Elphidium species
ORGANIC MATTER
(%)
0
50
100
150
200
Distance along transect (m)

Figure 9

(Stations 25-30). Further along the transect the assemblage was again dominated by *Salicornia* spp. (with some *Distichlis* spp., *Limonium* spp. and little *Spartina alterniflora*) to approximately +150 cm (Station 41), above which *Juncus* spp. was almost the only plant present to the end of the transect at the edge of the forest. Salinity ranged from 26‰ in water from the channel at Station 1 to 32‰ in water from the channel close to Station 28. There was a small, very shallow marsh pond approximately 10 m from Station 34 where a salinity of 74‰ was measured.

3.1.1.3 Transect 8

In the 22 samples examined here, total abundances ranged between 174 and 3072 inds/10 cm^3 (Appendix Table 3; Figure 10). Living abundances were relatively high and ranged between 18 and 536 inds/10 cm^3 with all but four samples having greater than 100 live specimens (Figure 11). Living distributions were similar to those of the total distributions. *Miliammina fusca* and *Ammotium salsum* were the dominant species throughout most of the transect both in the living and total assemblage. Highest total abundances of *Arenoparella mexicana* were present in samples below +50 cm although the highest living percentages of this species were further along the transect between +73 cm and +87 cm. *Trochammina inflata* was also identified in all samples from this transect with the highest total percentage and most living specimens present in samples in elevations higher than +70 cm. *Ammoastuta inepta* and *Haplophragmoides* spp. were also present in most samples although the highest percentages and the only living specimens were identified in samples higher than +87 cm. Organic matter percentages were high throughout the transect and ranged from 3.67% at the channel edge to 26.95% at Station 18. The floral assemblage consisted exclusively *Spartina alterniflora* to Station 11; *Juncus* spp., with little *Spartina alterniflora* and *S. patens* strongly dominated the transect to Station

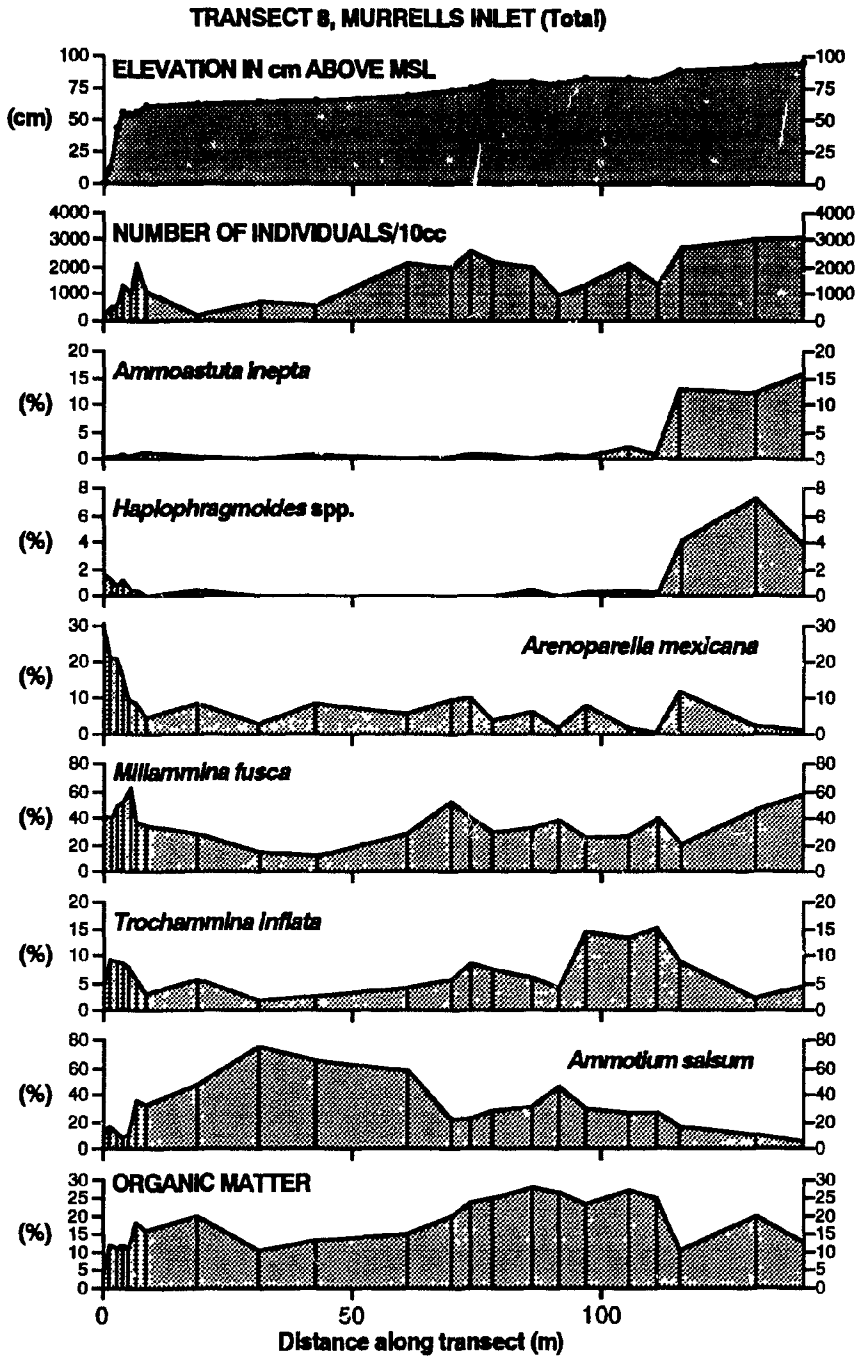


Figure 10. Profile of marsh elevation, number of individuals, organic matter, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Transect 8, Murrells Inlet.

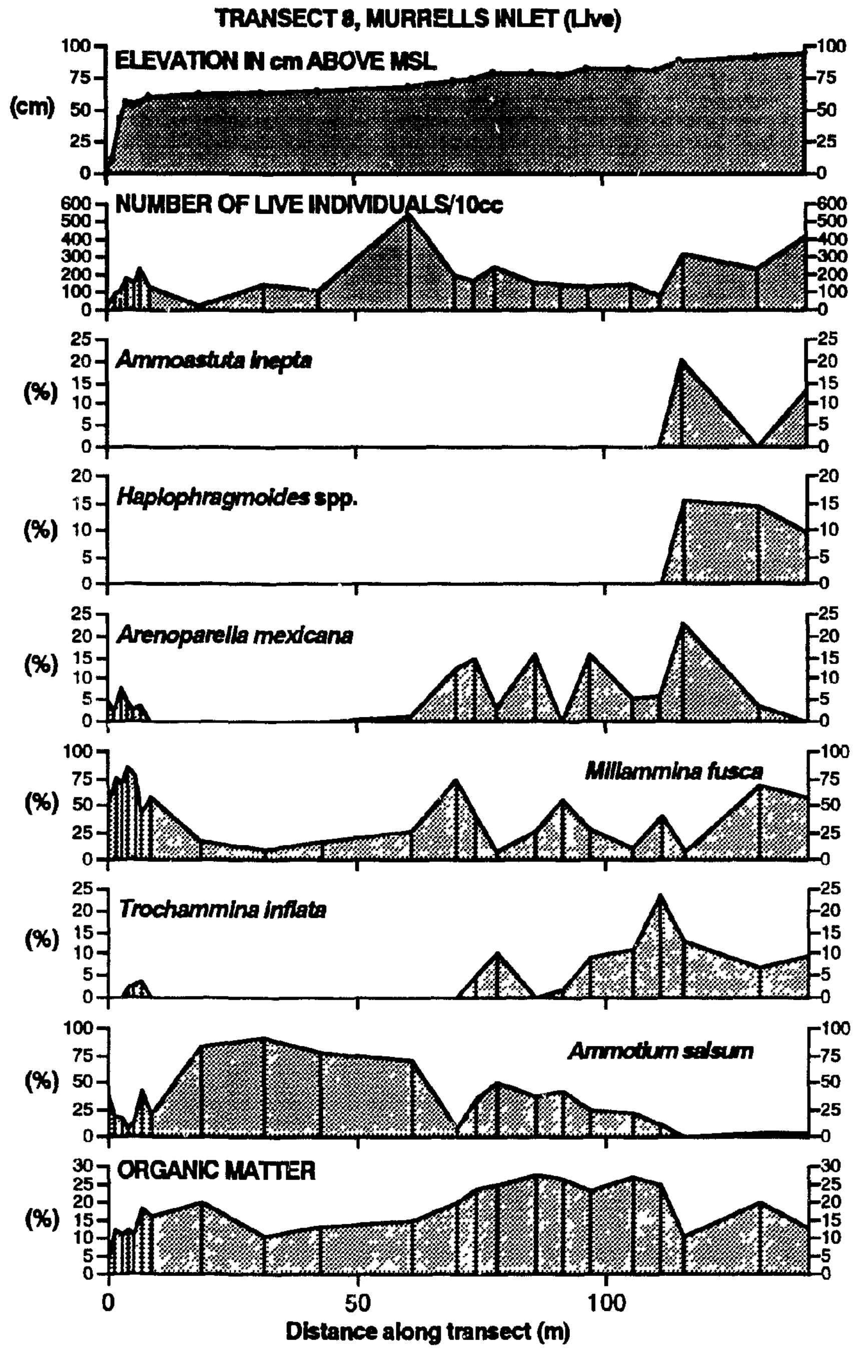


Figure 11. Profile of marsh elevation, number of individuals, organic matter, and percent abundance of some foraminiferal species relative to the live foraminiferal and arcellacean assemblage in sediments from Transect 8, Murrells Inlet.

20 where *Typha* spp. dominated to the end. The transect ended approximately 2 m from cedar trees and very close to a resident's backyard. Salinity varied greatly across this transect ranging from 19‰ in the channel at the beginning of the transect (35‰ at Station 8, 20‰ at Station 12) to 0‰ at Station 18. (**Note**: the elevation at Stations 21 and 22 were not measured because of the tall vegetation but these stations were somewhat higher than Station 20.

3.1.2 North Inlet

3.1.2.1 Transect 1

Of the 34 samples collected along this marsh transect, total abundances were generally high throughout (up to 5456 inds/ 10 cm^3) (Appendix Table 4; Figure 12). All samples contained living foraminifera (up to 1128 inds/10cm^3) (Figure 13) and for other than *Trochammina macrescens*, the distribution of living foraminifera generally mirror that of the total population. The foraminiferal fauna was dominated by agglutinated species but *Elphidium excavatum* was common in samples close to the channel. *Miliammina fusca* and *Ammotium salsum* were the dominant species in the lower elevations of the marsh (lower than +112 cm - Stations 20 to 34) with a significant percentage of *Trochammina macrescens* in the sample from the levee along the channel (Station 32). At higher elevations the assemblage was dominated by *Trochammina inflata, Haplophragmoides wilberti, Siphotrochammina lobata* and *Trochammina macrescens*. There are significant percentages of live *Trochammina macrescens* throughout most of the transect although live percentages are high only in samples from stations with elevations higher than +112 cm as well as in the levee sample. *Spartina alterniflora* was the only plant species present at stations below +77 cm (Stations 20 to 33) while between +77 cm and +105 cm the floral assemblage was strongly dominated by *Salicornia* spp with little *Spartina alterniflora*. Above

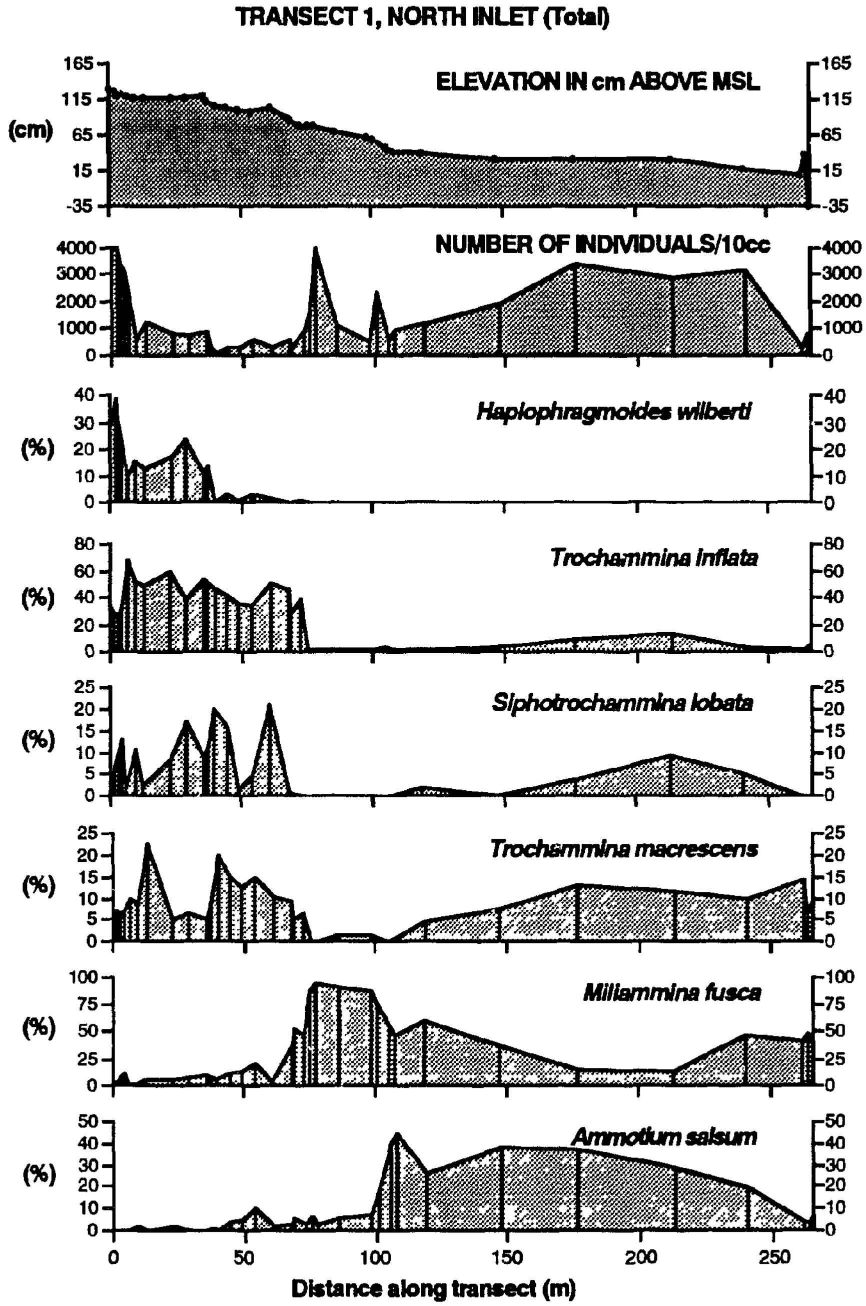


Figure 12. Profile of marsh elevation, number of individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Transect 1, North Inlet. Note the maximum Number of Individuals/10 cm^3 plotted is 4000 although there are higher values.

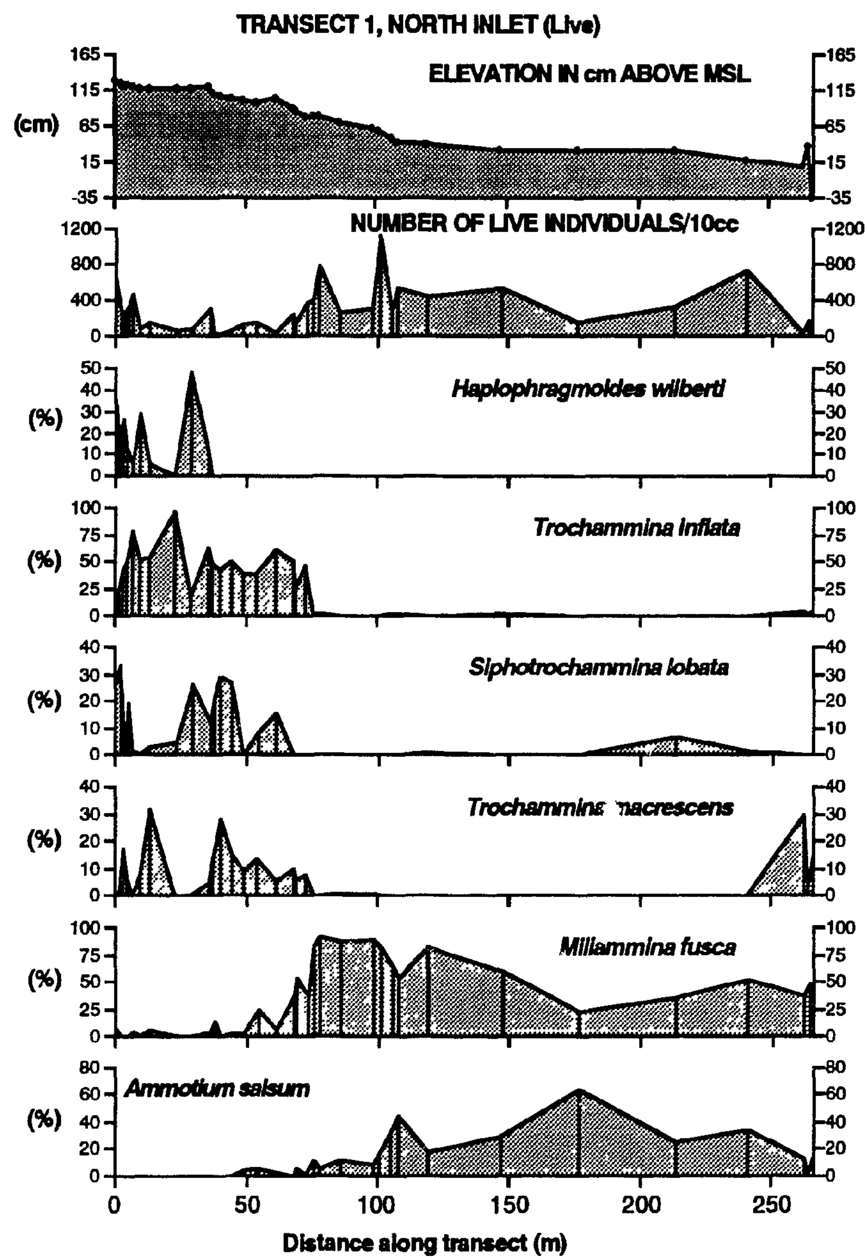


Figure 13. Profile of marsh elevation, number of individuals, and percent abundance of some foraminiferal species relative to the live foraminiferal and arcellacean assemblage in sediments from Transect 1, North Inlet.

this elevation, *Juncus* spp. with some *Distichlis* spp. and *Borrichia* spp. were the dominant plants. Sample 34 was taken 35 cm below the lowest occurrence of *Spartina alterniflora*. Salinity values ranged from 28‰ in the channel to 70‰ at Station 21.

3.1.2.2 Transect 6

In the 41 samples examined from this transect, total abundances ranged between 98 and 7224 inds/10 cm^3 (Appendix Table 5; Figure 14). Live abundances ranged between 2 and 2376 inds/10 cm^3 and the living distributions (Figure 15) were similar to the total distributions. At stations from the lower elevations of the marsh (lower than +70 cm) *Ammotium salsum* and *Miliammina fusca* were the dominant species in the assemblage with lesser percentages of *Trochammina inflata, T. macrescens* and *Siphotrochammina lobata*. *Miliammina fusca* reaches its peak between +60 cm and +70 cm where it strongly dominates the assemblage. Above this the assemblage was dominated by *Trochammina inflata* and *Haplophragmoides wilberti* with lower, but significant, percentages of *Trochammina macrescens* and *Siphotrochammina lobata*. *Siphotrochammina lobata* has a bimodal distribution in this transect; this species has significant percentages in the lower low marsh and in the high marsh but only rare specimens were identified between +40 cm and +80 cm. Calcareous foraminiferal specimens occurred rarely in few samples. The arcellacean species *Centropyxis aculeata* is present in many of the high marsh samples. Organic matter percentages are generally highest in the low marsh samples (up to 21.59%) and are significantly lower in the sandier samples from the high marsh. The floral assemblages were composed entirely of *Spartina alterniflora* to Station 12 (+60 cm) where it changes to one mixed [illegible]ally with *Puccinella* spp. to Station 17 (+70 cm). From there to the strand line (Station 24 - +111 cm) the floral assemblage was dominated by *Salicornia* spp. with some *Borrichia* spp. and rare *Spartina alterniflora*. Higher than +111 cm the floral assemblage was

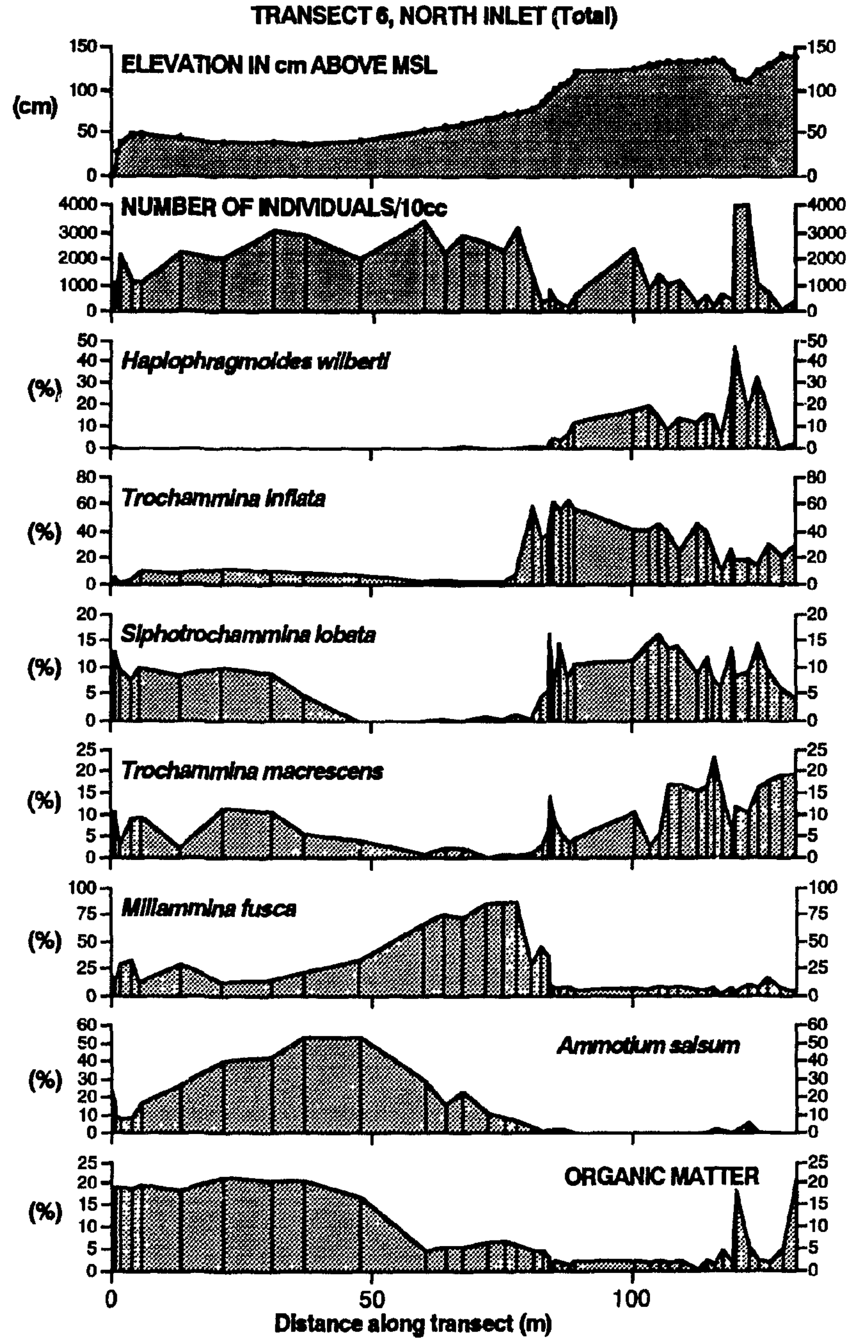


Figure 14. Profile of marsh elevation, number of individuals, organic matter, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Transect 6, North Inlet. Note the maximum Number of Individuals/10 cm^3 plotted is 4000 although there are higher values.

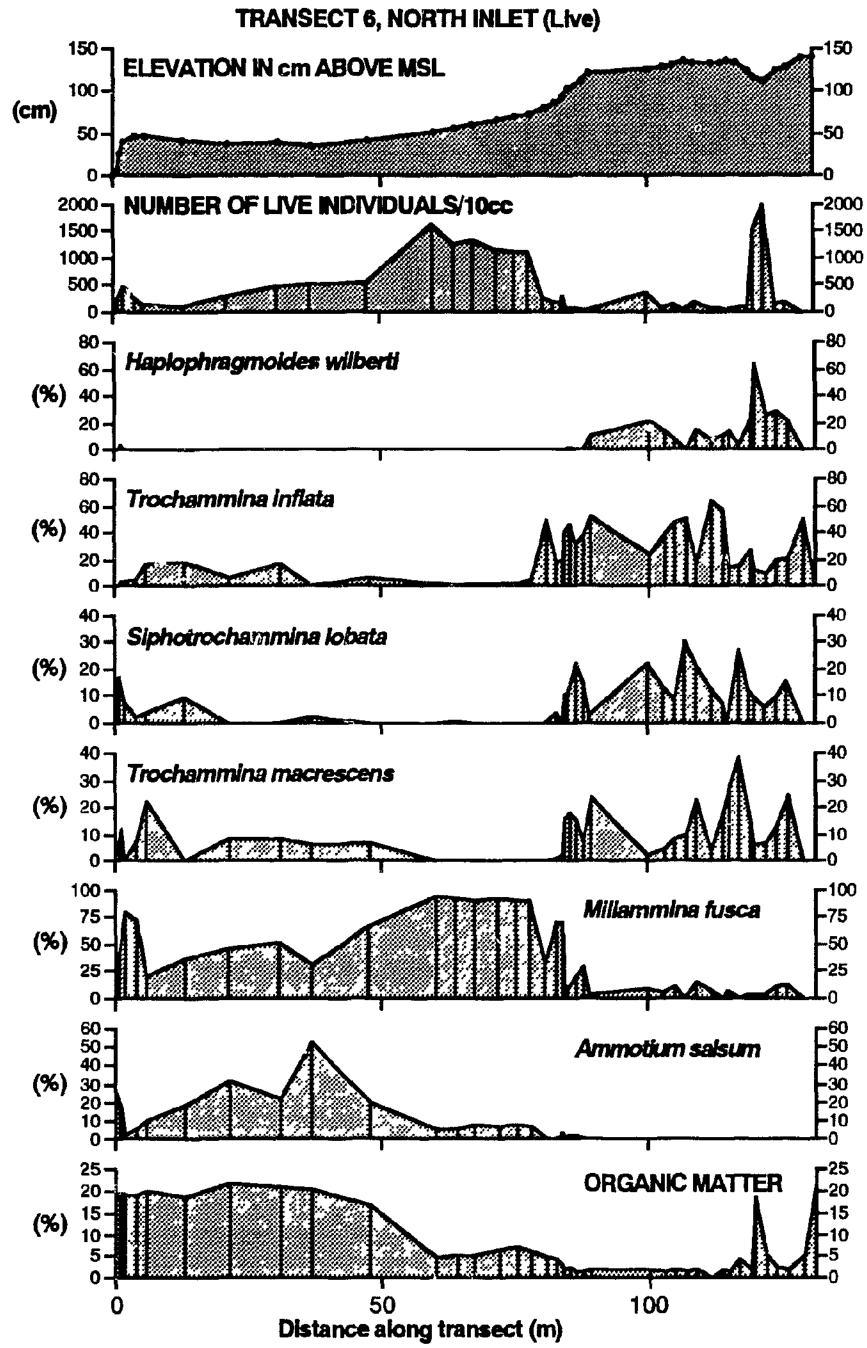


Figure 15. Profile of marsh elevation, number of individuals, organic matter, and percent abundance of some foraminiferal species relative to the live foraminiferal and arcellacean assemblage in sediments from Transect 6, North Inlet. Note the maximum Number of Individuals/10 cm^3 plotted is 2000 although there are higher values.

a mixture of *Juncus* spp., *Borrichia* spp. and *Distichlis* spp. Salinity varied little at the stations measured- from 22‰ at the edge of the channel to 24‰ at Station 13.

3.1.3 Santee Delta

3.1.3.1 Transect 4

Of the 24 samples collected along this transect, total numbers were somewhat low except at the landward end of the transect (11 - 544 inds/10cm3) (Appendix Table 6; Figure 16). Live numbers were also low (0 - 60 inds/10 cm^3) (Figure 17) with the highest occurrences from stations near the river. Living distributions are similar to those of the total distributions except in the highest marsh were calcareous foraminifera dominate but have few living representatives. Generally, narrow foraminiferal zones appear to be present along this transect. *Arenoparella mexicana* and *Trochammina inflata* were the only species to be consistently present, usually in high percentages, except at the end of the transect where they were replaced by *Ammonia beccarii* and *Elphidium* spp. as the dominant foraminifera. In the lowest marsh the assemblage was dominated by *Trochammina ochracea* with high percentages of *Miliammina fusca*. Further along, (Stations 4 - 6) higher percentages of *Ammotium salsum* and *Trochammina macrescens* were present with *Trochammina inflata* and *Arenoparella mexicana*. Between Stations 9 and 19 there were high percentages of *Haplophragmoides wilberti*, albeit in low numbers, combined with a peak of abundance of *Siphotrochammina lobata* at Station 17. Organic matter percentages ranged between 0.25% and 19.61% with the highest percentages in sediments from stations near the river. *Spartina alterniflora* dominated the floral assemblage from the rivers edge to Station 5 (+130 cm). From there to Station 14 the assemblage is dominated by *Salicornia* spp. but mixed with *Spartina alterniflora* and *Distichlis* spp. *Juncus* spp. with little *Distichlis* spp. and *Borrichia* spp. composed the assemblage to Station 20. Beyond this

Figure 16. Profile of marsh elevation, number of individuals, organic matter, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Transect 4, Santee Delta.

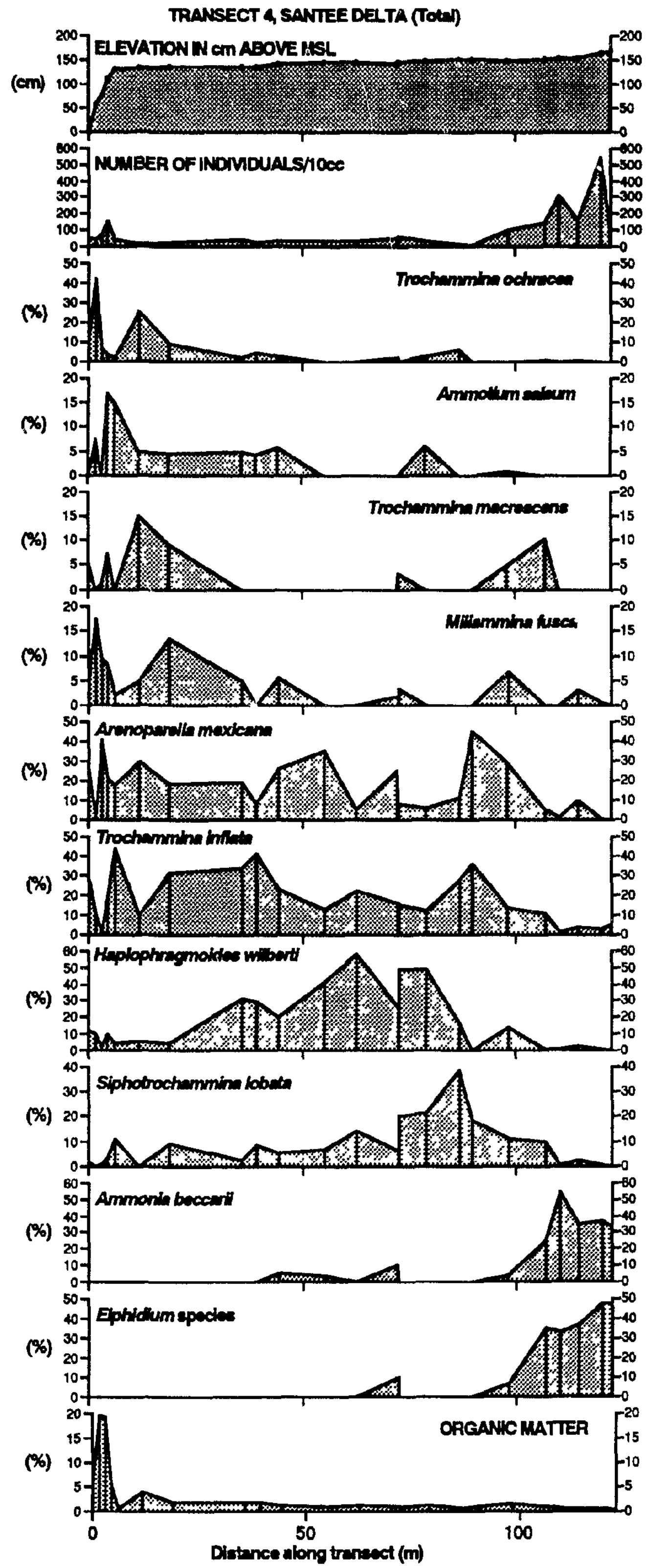

TRANSECT 4, SANTEE DELTA (Total)
ELEVATION IN cm ABOVE MSL
(cm)
NUMBER OF INDIVIDUALS/10cc
Trochammina ochracea
Ammotium salsum
Trochammina macrescens
Miliammina fusca
Arenoparella mexicana
Trochammina inflata
Haplophragmoides wilberti
Siphotrochammina lobata
Ammonia beccarii
Elphidium species
ORGANIC MATTER
(%)
Distance along transect (m)
0
50
100

Figure 16

Figure 17. Profile of marsh elevation, number of individuals, organic matter, and percent abundance of some foraminiferal species relative to the live foraminiferal and arcellacean assemblage in sediments from Transect 4, Santee Delta.

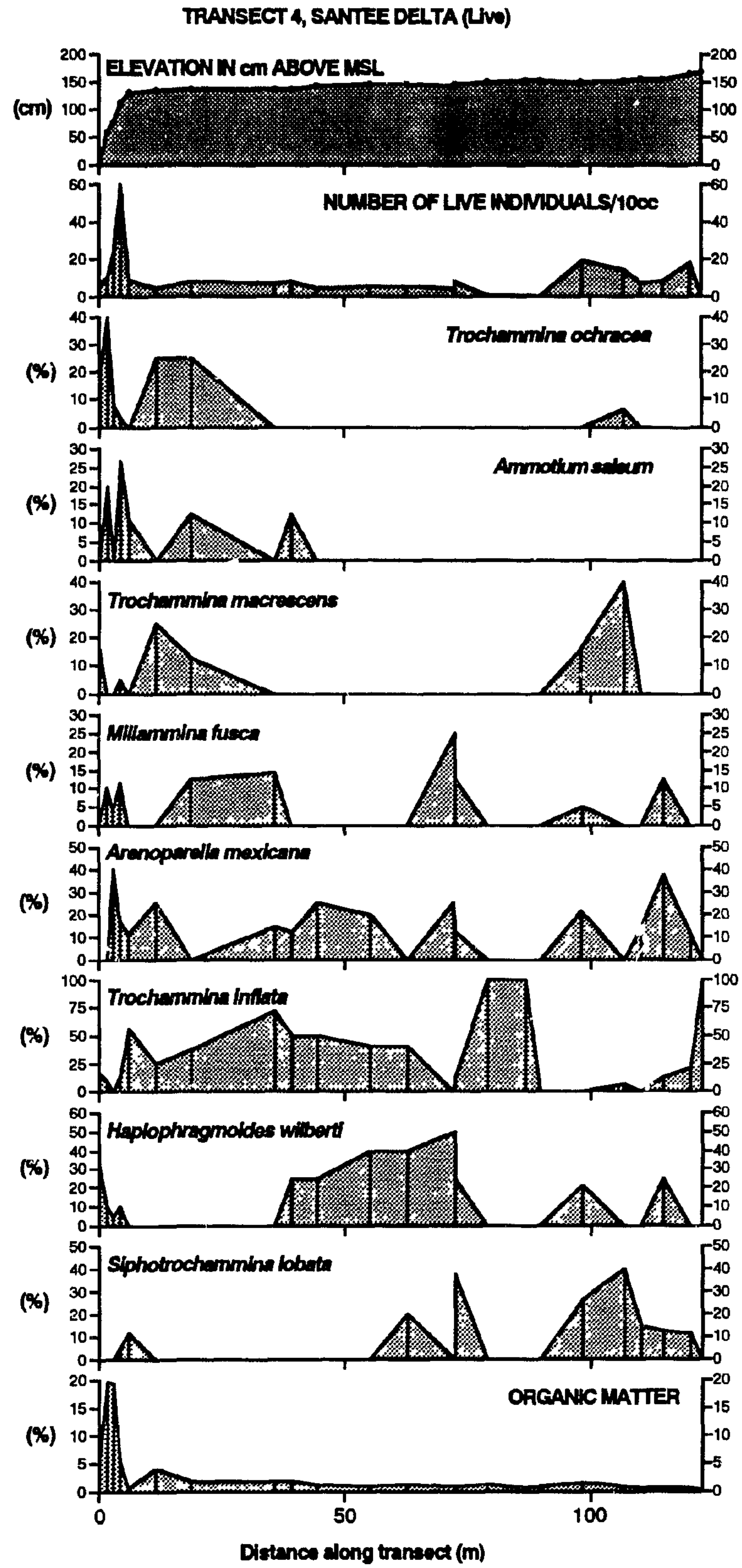

TRANSECT 4, SANTEE DELTA (Live)
ELEVATION IN cm ABOVE MSL
(cm)
NUMBER OF LIVE INDIVIDUALS/10cc
Trochammina ochracea
Ammotium salsum
Trochammina macrescens
Miliammina fusca
Arenoparella mexicana
Trochammina inflata
Haplophragmoides wilberti
Siphotrochammina lobata
ORGANIC MATTER
(%)
0
50
100
Distance along transect (m)

Figure 17

vegetation was extremely sparse, but there were a few *Salicornia* spp. patches. From Station 20 to the end of the transect, the substrate was composed completely of fine sand. Salinity values ranged from 6‰ near the river's edge to 25‰ at Station 13.

3.1.3.2 Transect 5

In the six samples examined from this short transect, total abundances ranged from 70 to 1176 inds/10 cm^3 (Appendix Table 7; Figure 18). Living abundances ranged from 6 to 328 inds/10 cm^3 and the living distributions were similar to the total distributions (Figure 19). Along the first two meters of this transect, the assemblage was dominated by *Trochammina ochracea*, Arcellaceans and *Haplophragmoides* spp. *Ammoastuta inepta* dominated the remaining samples with high percentages of *Arenoparella mexicana* and *Trochammina macrescens* in samples from some stations. *Ammoastuta inepta* dominated the living assemblage except at Station 2 where *Trochammina ochracea* was dominant. Organic matter percentages ranged from 17.81% to 22.44%. *Spartina cynosuroides* was the only plant species along this transect. Salinity or elevation measurements were not taken here due to the threat of alligators to my field assistants.

3.1.3.3 Transect 10

Of the 22 samples collected along this transect, total abundances were generally high and ranged between 14 and 5120 inds/10 cm3 (Appendix Table 10; Figure 20). Abundances of living specimens ranged between 0 and 496 inds/10 cm^3 (Figure 21) and the living distributions did not follow those of the total distributions. Few specimens were present in samples from the first two station but the assemblage was dominated by Arcellaceans. Arcellaceans, primarily *Centropyxis* spp., were present in all samples and usually formed at least 20% of the assemblage. *Arenoparella mexicana* was also present

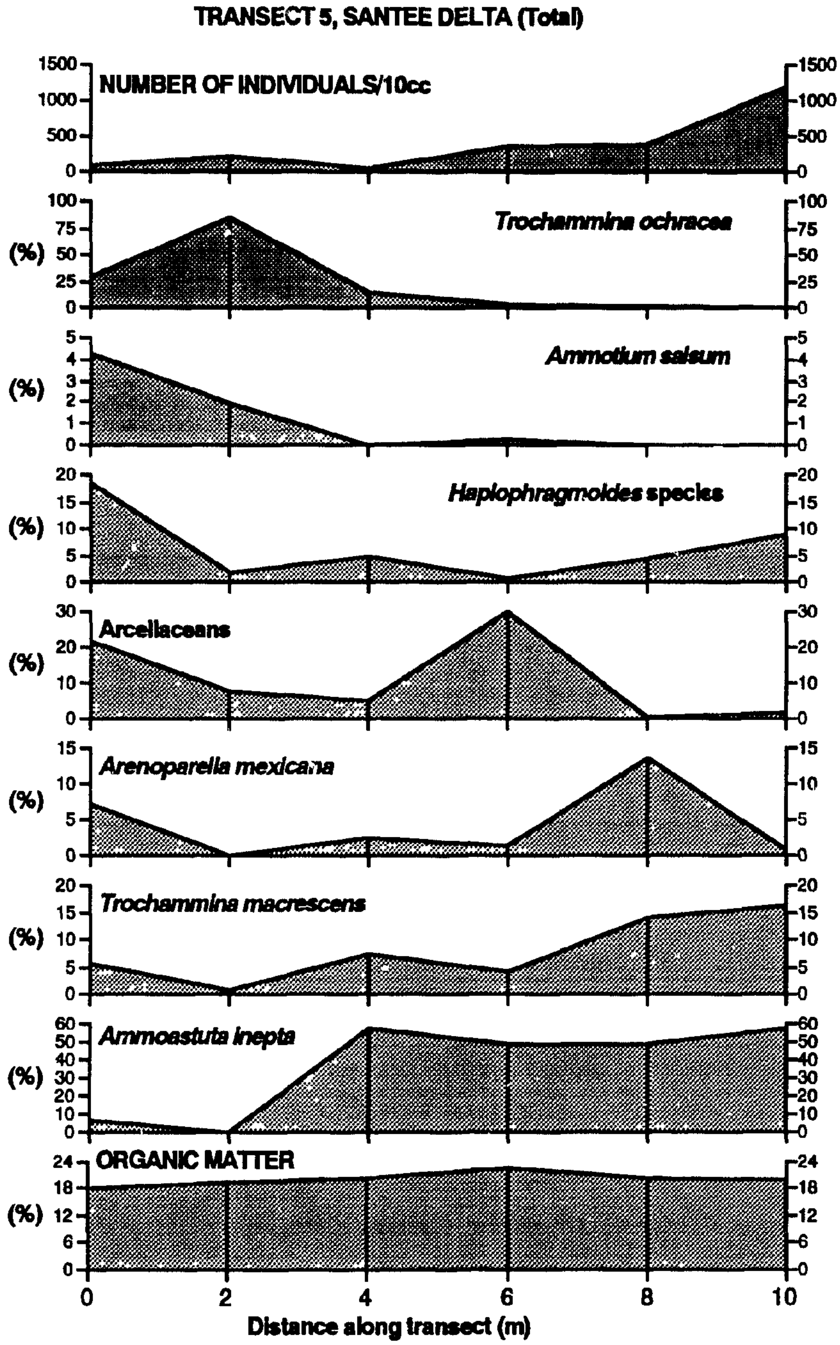


Figure 18. Profile of number of individuals, organic matter, and percent abundance of some foraminiferal species and arcellaceans relative to the total foraminiferal and arcellacean assemblage in sediments from Transect 5, Santee Delta.

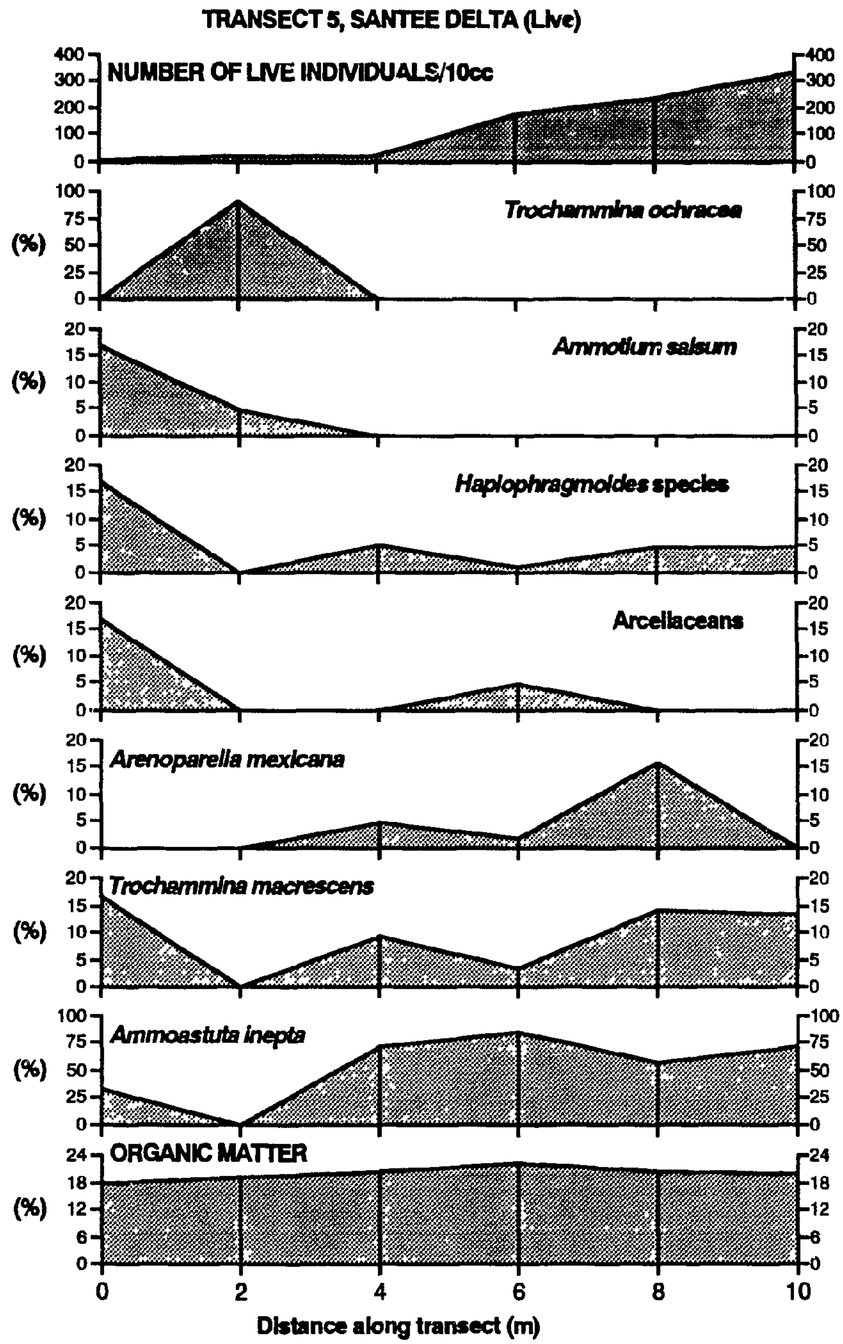


Figure 19. Profile of number of individuals, organic matter, and percent abundance of some foraminiferal species and arcellaceans relative to the live foraminiferal and arcellacean assemblage in sediments from Transect 5, Santee Delta.

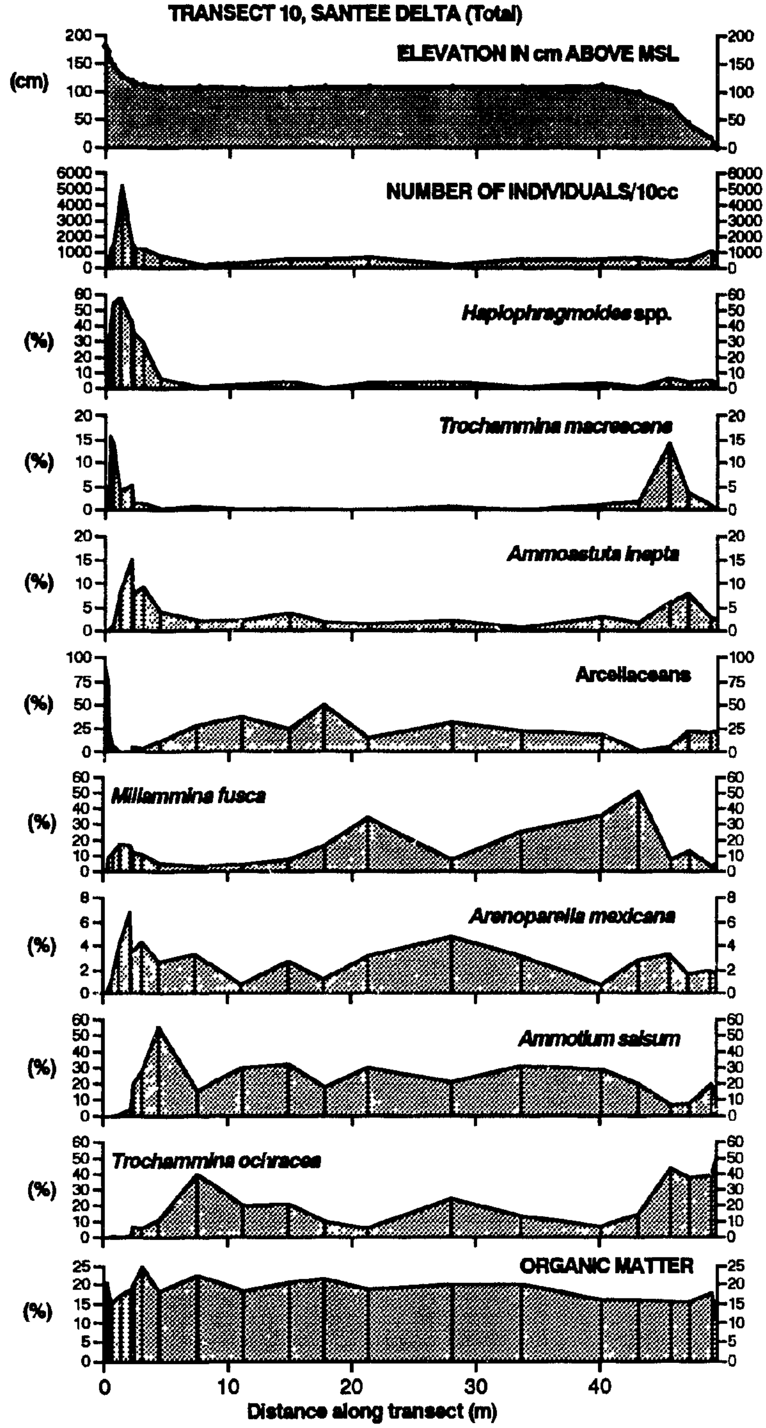


Figure 20. Profile of marsh elevation, number of individuals, organic matter, and percent abundance of some foraminiferal species and arcellaceans relative to the total foraminiferal and arcellacean assemblage in sediments from Transect 10, Santee Delta.

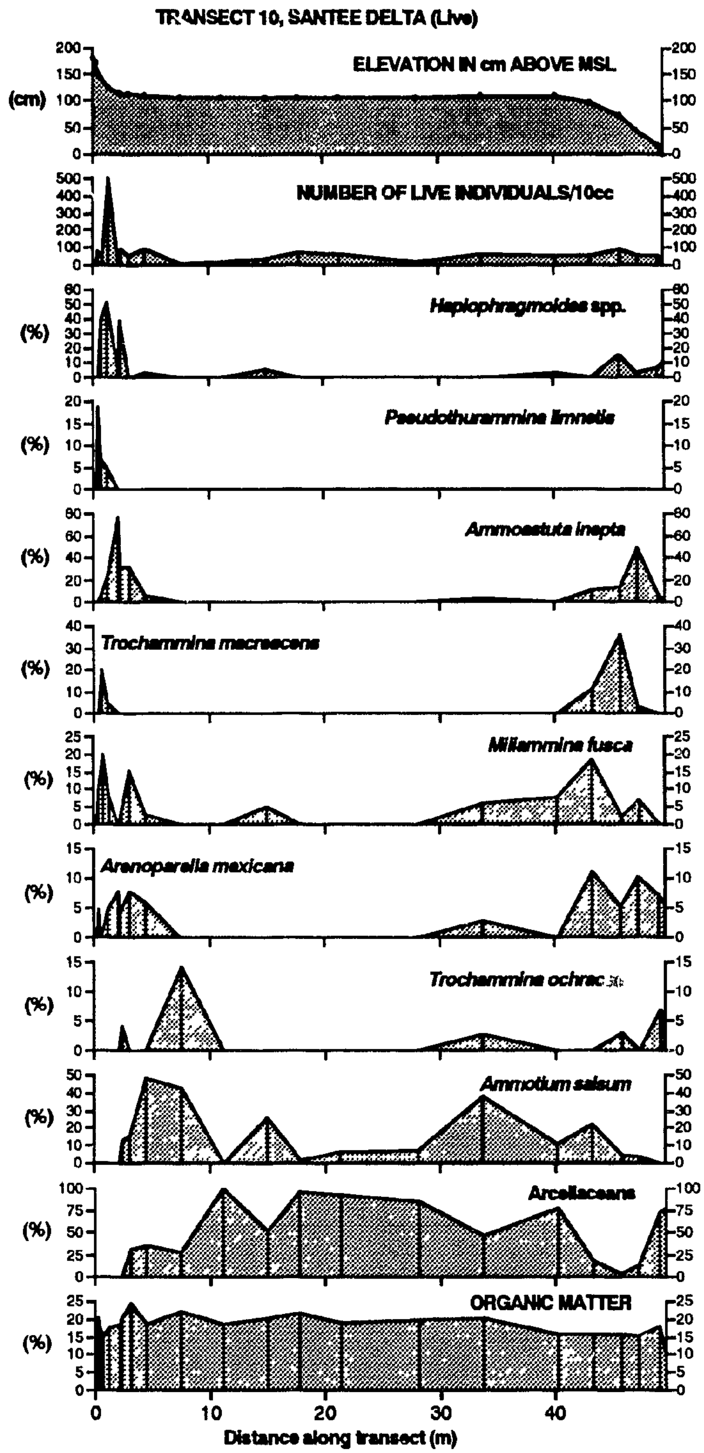


Figure 21. Profile of marsh elevation, number of individuals, organic matter, and percent abundance of some foraminiferal species and arcellaceans relative to the live foraminiferal and arcellacean assemblage in sediments from Transect 10, Santee Delta.

throughout the transect but at much lower percentages. *Haplophragmoides* spp. dominated the assemblages at the landward end of the transect with high percentages of *Trochammina macrescens* and *Ammoastuta inepta*. *Trochammina macrescens* had a bimodal distribution where high percentages were also in samples from stations close to the river. *Trochammina ochracea* dominated the samples from stations with elevations less than +100 cm with high percentages of *Ammotium salsum* and *Miliammina fusca*. *Miliammina fusca* and *Ammotium salsum* dominated the middle portion of the transect with high proportions of *Trochammina ochracea*. Many of the foraminiferal species (*Haplophragmoides* spp., *Ammoastuta inepta, Trochammina macrescens, Miliammina fusca, Arenoparella mexicana* and *Trochammina ochracea*) appeared to have somewhat bimodal living distributions with high percentages both at the beginning and the end of the transect. Arcellaceans strongly dominate the living assemblage in the middle of the transect with some *Ammotium salsum*. *Pseudothurammina limnetis*, which composed a small proportion of the total assemblage, had a high proportion of living individuals between Stations 3 and 5. Organic matter percentages ranged between 10.31% and 24.71%. Terrestrial plants were the only vegetation present at the first two stations. Beyond this, to Station 7, the floral assemblage was strongly dominated by *Spartina cynosuroides* with traces of *Scirpus* spp. Further along the transect, to Station 11, the floral assemblage was composed of an equal proportion of *Spartina cynosuroides* and *Scirpus* spp. Along the remainder of the transect, *Spartina alterniflora* was almost exclusively the only plant species present. Salinity was 0‰ at Stations 10 - 14, the only stations where it was measured.

3.2 BAY, CHANNEL, RIVER AND NEARSHORE SAMPLES

3.2.1 Murrells Inlet

3.2.1.1 Murrells Inlet (Channel)

Of the 20 samples collected from the inlet, total abundances varied greatly (from 14 to 3776 inds/10 cm^3) (Appendix Table 9; Figure 22). Total species diversity was also variable (6 to 29 species per sample). Most samples contained living foraminifera although their numbers were generally low (Appendix Table 9). *Ammonia beccarii* and *Elphidium excavatum* spp. were the dominant foraminifera both in the total and living distributions. *Haynesina depressula* was present at most stations although there were generally only living representatives in the upper part of the channel (Stations 1 to 13). *Trochammina ochracea* was present in samples from most stations with significant percentages (both in the total and living distributions) in some samples. Typical marsh foraminiferal species were present in many samples with few living representatives. Samples were collected from water depths ranging between 1.0 m and 4.0 m. Surface salinity values ranged between 26‰ and 28‰ throughout Murrells Inlet. Organic matter percentages were low (0.20% to 3.56%).

3.2.1.2 Murrells Inlet (Offshore)

In the 17 samples collected along two parallel transects just offshore of Murrells Inlet, total abundances were higher at Stations 28 - 37 (up to 836 inds/10cm^3) than in samples from Stations 21 - 27 (up to 128 inds/10cm^3) (Appendix Table 10; Figure 23). Species diversity and total living foraminifera were also generally higher in samples from Stations 28 -37. The dominant foraminiferal species were similar at equivalent depths for these two sample groups with the exception of *Trochammina ochracea*; higher percentages of this species were present in samples from Stations 21 - 27. *Ammonia beccarii* and *Elphidium excavatum* spp. were the dominant foraminifera. *Trochammina ochracea* and *Ammonia beccarii* generally dominated the living assemblage in samples from Stations 21 - 27; *Ammonia beccarii* dominated, with high percentages of *Elphidium*

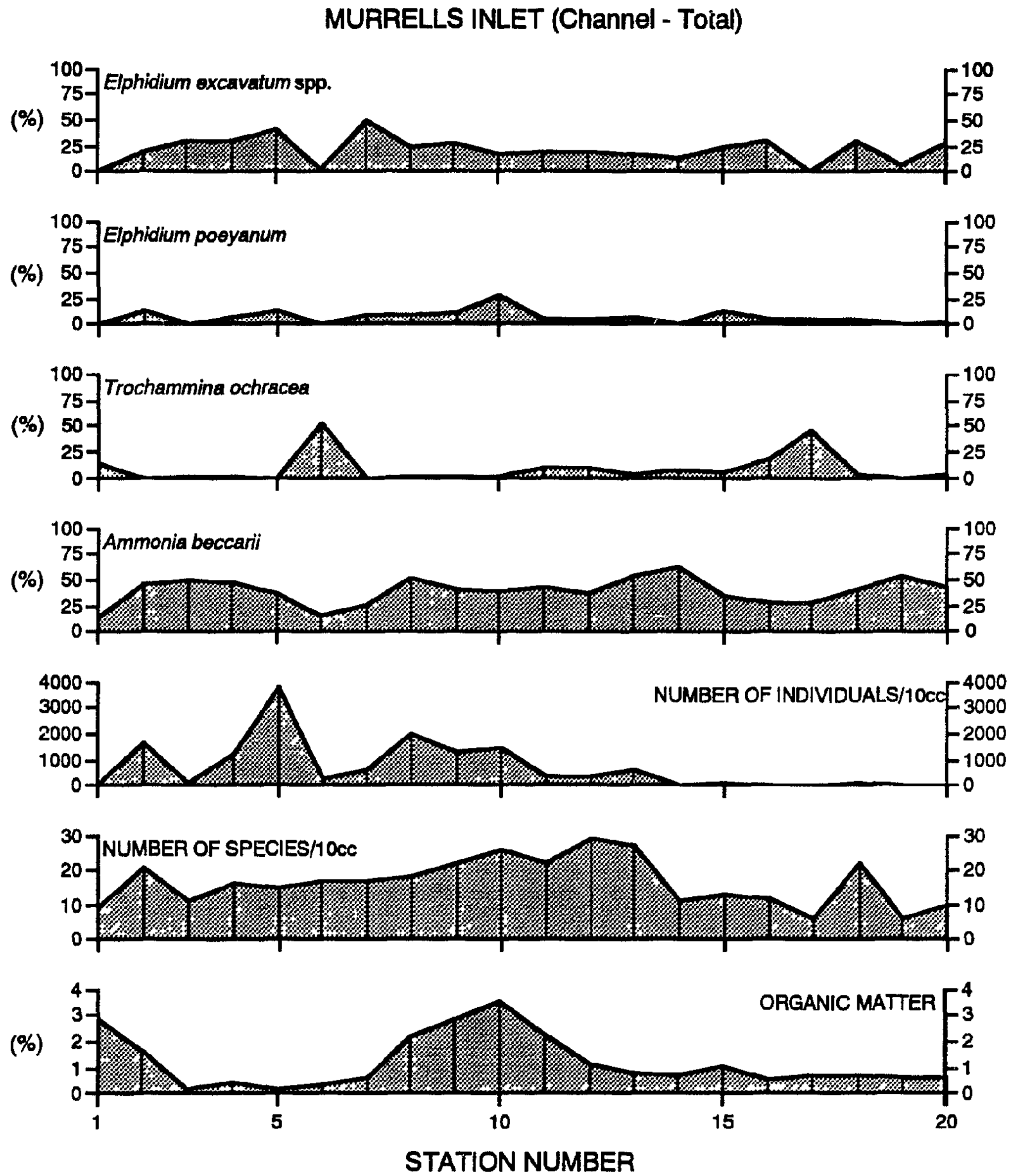


Figure 22. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Murrells Inlet (channel).

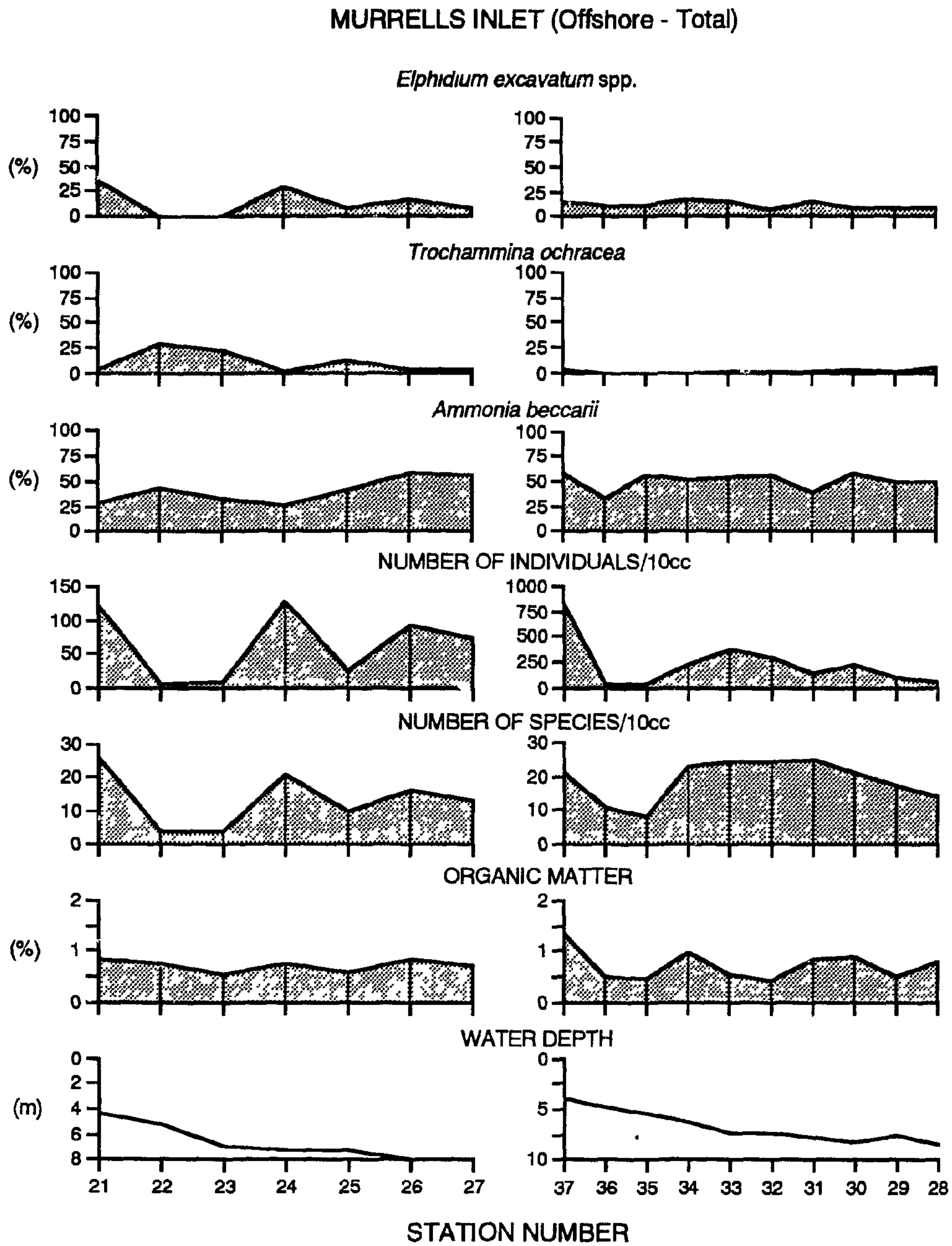


Figure 23. Profile of water depth, organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal assemblage in sediments from Murrells Inlet (offshore).

excavatum spp. and some *Gavelinopsis translucens*, the living assemblage in samples from Stations 28-37. Water depths ranged from 4.0 m to 8.5 m. Salinities were not measured at the stations. Organic matter percentages were low (less than 1.4%).

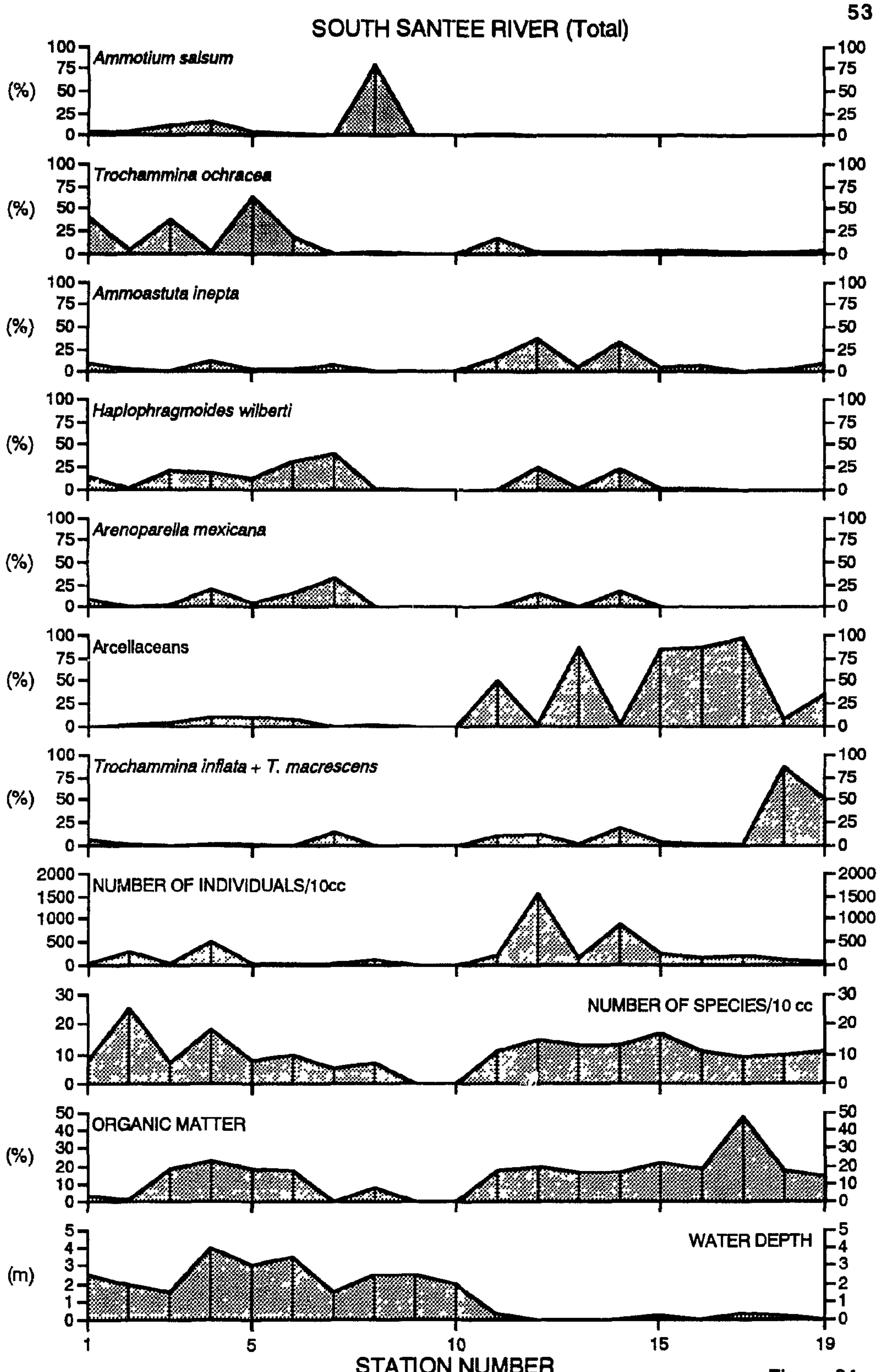
3.2.2 Santee Delta

3.2.2.1 South Santee River

Fifty one samples from 26 Stations (at different depths across the river) (Appendix Table 11) show variations in total abundance both across the river (i.e. at the same Station) and going up the river (i.e. different Stations). Figure 24 displays results for the shallowest sample at each Station (but not for Wambaw Creek - Stations 20 -26) along the river. The assemblage in Wambaw Creek was almost completely composed of arcellaceans, dominated by species of the genera *Centropyxis* and *Difflugia*. Total numbers ranged from 1 to 644 inds/10 cm^3 but were generally high (Appendix Table 11). There were few living arcellaceans in samples from these stations. Organic matter percentages ranged from 0.36% to 19.33%.

Generally, highest total abundances were observed in samples from the shallowest stations along the river, especially from stations where a sample was taken very close to, or at, the riverbank (Stations 11 - 19). Living abundances were low except at the very shallow sample sites. Organic matter percentages generally decreased with depth (at individual Stations), again highest at the very shallow sites close to the riverbank (Appendix Table 11). Figure 24 shows that this trend does not necessarily hold true when going downstream; high percentages of organic matter were present in many relatively deep samples (Stations 3 - 6). Changes in the faunal assemblage were also observed going downstream. Arcellaceans strongly dominated the total faunal assemblage in many shallow upstream samples (Stations 11 - 19) with high percentages of *Trochammina inflata* +

Figure 24. Profile of water depth, organic matter, number of species and individuals, and percent abundance of some foraminiferal species and arcellaceans relative to the total foraminiferal and arcellacean assemblage in sediments from the shallowest samples at each station from South Santee River. Station 1 is the most seaward.



SOUTH SANTEE RIVER (Total)
Ammotium salsum
Trochammina ochracea
Ammoastuta inepta
Haplophragmoides wilberti
Arenoparella mexicana
Arcellaceans
Trochammina inflata + T. macrescens
NUMBER OF INDIVIDUALS/10cc
NUMBER OF SPECIES/10 cc
ORGANIC MATTER
WATER DEPTH
(%)
(m)
STATION NUMBER

Figure 24

Trochammina macrescens, Ammoastuta inepta and *Haplophragmoides wilberti* in some samples. Few foraminifera or arcellaceans were identified in the deeper samples from these stations. Samples from Stations 9 and 10 were barren. Downstream (Stations 1 - 8), *Trochammina ochracea* dominated the total assemblage often with high percentages of *Haplophragmoides wilberti* and *Arenoparella mexicana*. The exception was the sample from Station 2 which had a higher species diversity and larger calcareous component in the assemblage. Generally fewer foraminifera or arcellaceans were identified in the deeper samples from these stations. Few living foraminifera or arcellaceans were present in any of the samples. A surface salinity of 5‰ was measured at Station 1, 1‰ at Station 2, and 0‰ at the remaining stations.

3.2.2.2 Santee Delta (Offshore)

Of the 10 samples examined here, total abundances varied greatly between those off North Santee River (Stations 1 -5) and South Santee River (Stations 6 - 10); abundances ranged from 41 to 8928 inds/10 cm3 off North Santee River and from 7 to 48 inds/10cm^3 off South Santee River (Appendix Table 12; Figure 25). Species diversity was also lower off South Santee River. The foraminiferal fauna was similar in these two transects; the assemblages from both short transects were dominated by *Ammonia beccarii, Elphidium* spp. and *Gavelinopsis translucens* with some *Trochammina ochracea* and *Quinqueloculina* spp. There were only rare living foraminiferal specimens in samples off South Santee River; *Elphidium* spp., *Gavelinopsis translucens* and *Trochammina ochracea* generally dominated the living assemblages in samples off North Santee River. Organic matter percentages ranged from 0.29% to 7.62% off North Santee River while values were less than 2% off South Santee River. Surface salinities varied greatly at these

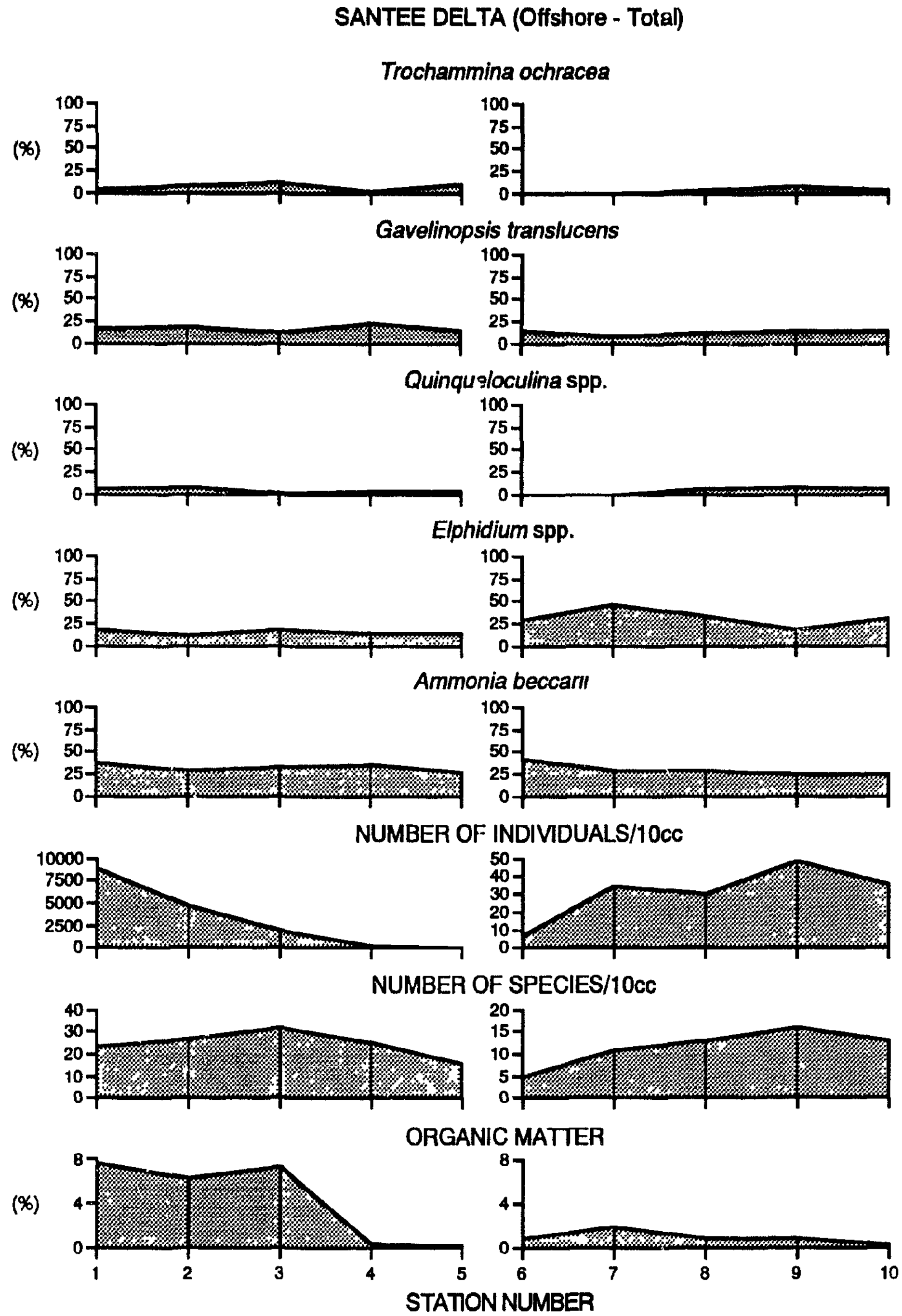


Figure 25. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Santee Delta (offshore).

Stations, from 6‰ to 25‰ off North Santee River and from 12‰ to 26‰ off South Santee River.

3.2.3 Intracoastal Waterway, Winyah Bay and Nearshore

3.2.3.1 Intracoastal Waterway

Of the 11 samples containing foraminifera or arcellaceans from the waterway, total abundances were generally low (1 - 123 inds/10 cm^3)(Appendix Table 13; Figure 26) Arcellaceans, mostly species from the genera *Centropyxis* and *Difflugia*, generally dominated the total assemblages but only rare specimens were present in the living assemblages. No living foraminifera were present. Organic matter percentages ranged between 0.19% and 14.79%.

3.2.3.2 Winyah Bay

In the 11 samples examined here, abundances ranged from 1 to 114 inds/10cm^3 (Appendix Table 13; Figure 26). No living specimens were observed in these samples. Arcellaceans were common in samples from the upper reaches of the bay and are absent in those from the lower reaches. The foraminiferal fauna from the upper part of the bay was dominated by agglutinated species, most commonly belonging to the genera *Trochammina, Ammotium* and *Ammobaculites*. Near the mouth of the bay the fauna consists of only calcareous foraminiferal species (mainly *Ammonia beccarii* and *Elphidium* spp.). Generally high organic matter percentages (up to 20.24%) are present in sediments from the upper reaches of the bay. Surface salinities ranged from 0‰ at Station 12 to 3‰ at Station 25.

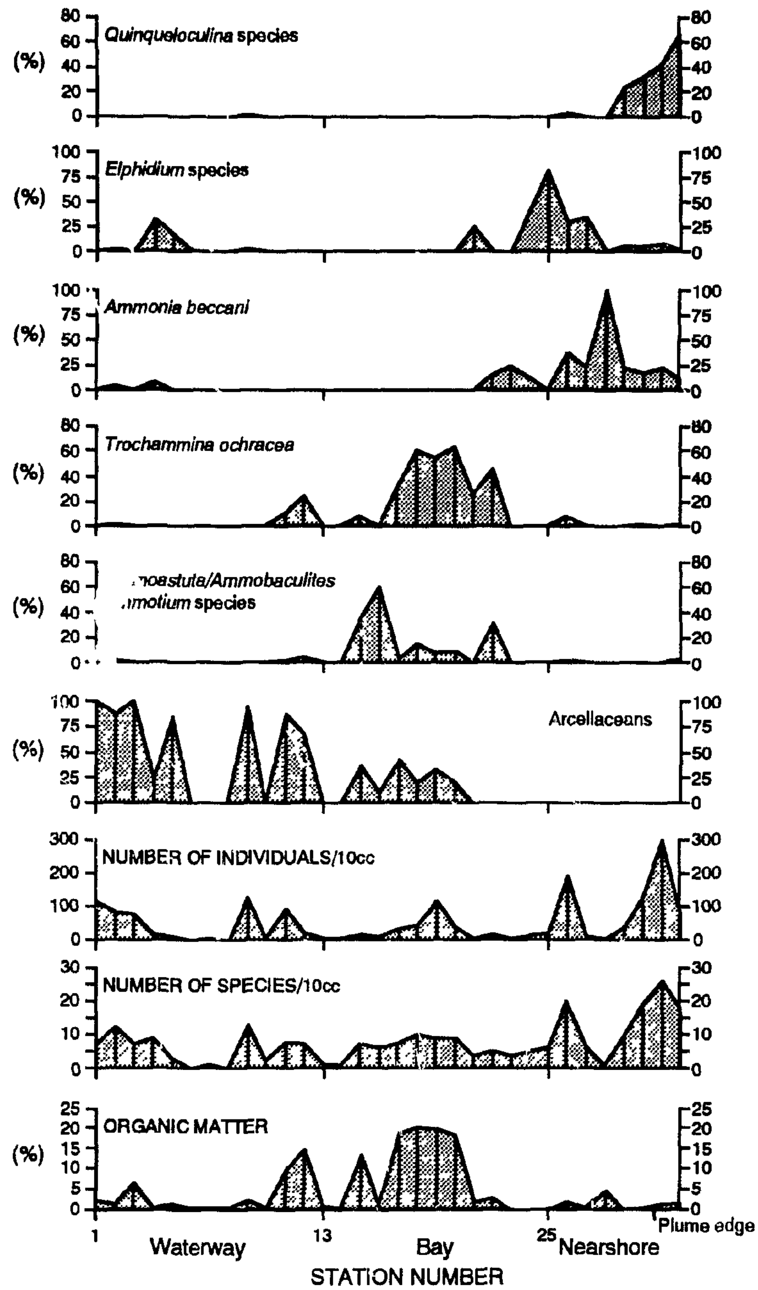


Figure 26. Profile of organic matter, number of species and individuals, and percent abundance of arcellaceans and some foraminiferal genera and species relative to the total foraminiferal and arcellacean assemblage in sediments from the Intracoastal Waterway, Winyah Bay and nearshore localities. Note the maximum Number of Individuals/10 cm^3 plotted is 300 although there are higher values.

3.2.3.3 Nearshore locality

Both the highest total abundance (1232 inds/10cm^3) and the highest species diversity (26 species) were observed in a sample from this area (Appendix Table 13; Figure 26). Generally high species diversity is observed in most of these samples. Few living foraminiferal specimens are present in samples furthest from the mouth of the bay. The foraminiferal fauna is dominated by calcareous species; species of the genus *Elphidium* and *Ammonia beccarii* dominate the total assemblage in samples close to the mouth of the bay while the percentage of species of the genus *Quinqueloculina* increase in more distal samples. Organic matter percentages ranged between 0.27 and 4.22%. Surface salinities at Stations 27 and 28 were 3‰ and 4‰ respectively while between Stations 29 and 32 salinities increased from 19‰ to 30‰.

3.3 CORE SAMPLES

3.3.1 Murrells Inlet

3.3.1.1 Vibracore 90

Of the 91 samples examined from this core, 36 were barren (Appendix Table .4). Total abundances and species diversity were generally low except in the intervals from 0 - 50 cm and between 152 and 168 cm. In these intervals, the number of Individuals/10 cm^3 reached to 1320 with up to 16 species present (Appendix Table 14; Figure 27). In the upper 50 cm of the core, the faunal assemblage was generally dominated by *Arenoparella mexicana*, with high percentages of *Trochammina inflata, Ammoastuta inepta* and *Haplophragmoides* spp. High percentages of *Miliammina fusca* were present in the top 10 cm of the core. No calcareous benthic foraminifera were present in the top 50 cm and only very rare specimens of the arcellacean *Centropyxis aculeata* were encountered. Between 50 and 152 cm of the core, rare specimens of both agglutinated and calcareous

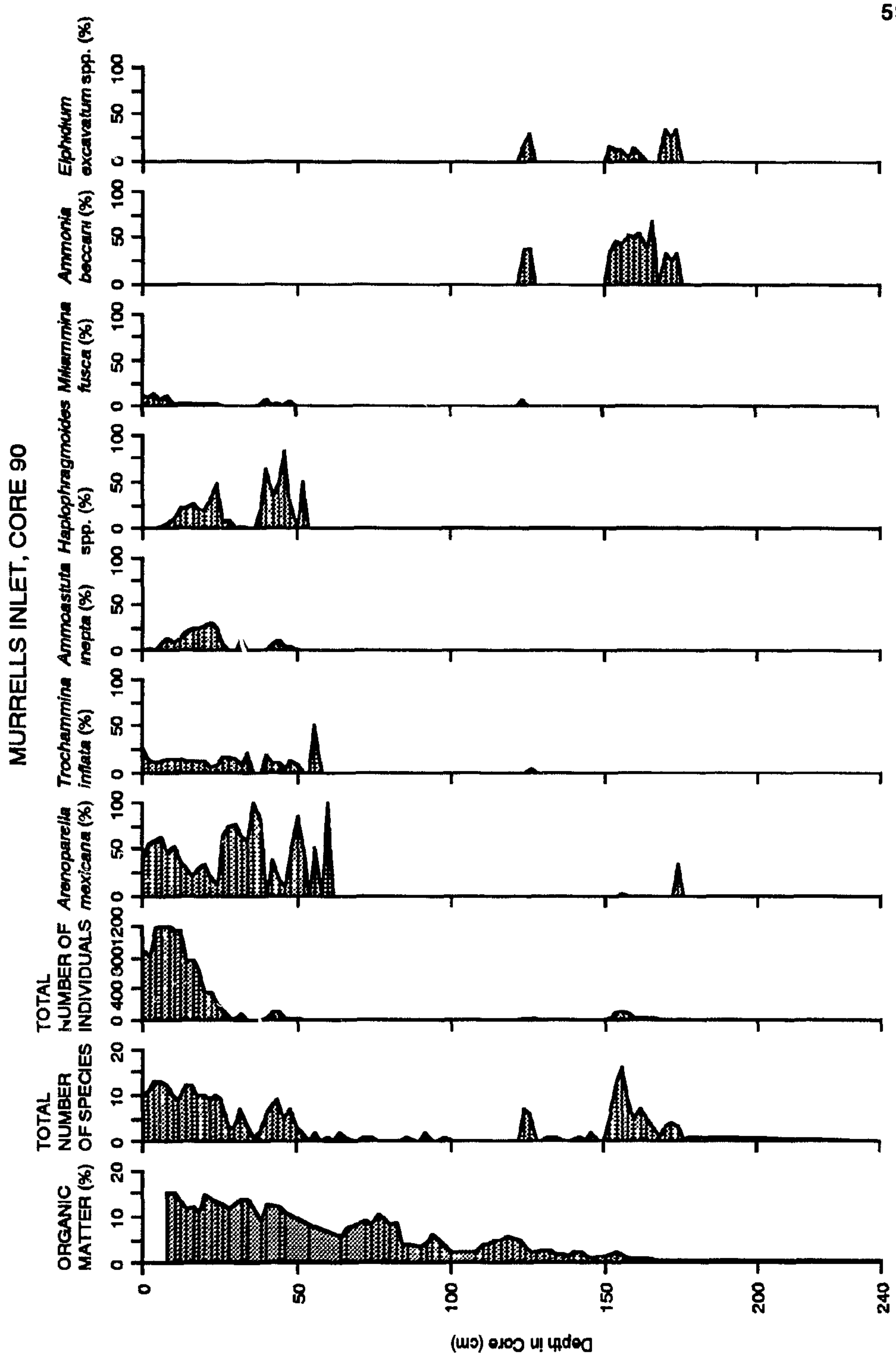


Figure 27. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Vibracore 90, Murrells Inlet.

foraminifera and *Centropyxis aculeata* were identified in a few samples. In the interval between 152 and 168 cm, the foraminiferal assemblage is essentially one composed of calcareous species and dominated by *Ammonia beccarii* and *Elphidium excavatum* spp. From 168 cm to the bottom of the core, rare specimens of generally calcareous benthic foraminifera were identified. Organic matter percentages ranged from 0.47% to 15.24% with the highest percentages near the top of the core; numerous organic matter values are missing throughout the core including those from the top 8 cm.

3.3.1.2 Vibracore 100

In the 22 samples examined from this core, only four had significant total numbers (Appendix Table 15). **Note:** In this and other vibracores from Murrells Inlet containing few foraminifera, no figures are presented. In those from intervals 16-18 cm, 21-23 cm, 30-32 cm and 70-72 cm, abundances ranged from 78 to 297 inds/10 cm^3 with between four and eight species present. Nine samples were barren while eight contained only one or two specimens each. In the top 30 cm of the core, the three samples from this interval were dominated by *Arenoparella mexicana*; the sample from 16-18 cm also had high percentages of *Miliammina fusca* and *Trochammina inflata*. The other sample with high total numbers, 70-72 cm, was also dominated by *Arenoparella mexicana*. The sample from 196-198 cm, which had only six foraminiferal specimens, contained only calcareous foraminifera (*Cibicides lobatulus*, *Elphidium excavatum* spp., *Helenina anderseni* and a planktonic). A radiocarbon age of 3435 ± 105 years before present (yBP) (Scott et al., 1995a) was obtained between 70-72 cm. Organic matter percentages were not measured from this core.

3.3.1.3 Vibracore 101

Of the 15 samples examined from this core, eight were barren (Appendix Table 16). The six samples from the top 70 cm of the core all contained foraminifera, with abundances ranging between 3 and 1328 inds/10 cm^3. Between three and nine species were present. The uppermost sample (8-10 cm) was dominated by *Miliammina fusca* with high percentages of *Trochammina inflata* and *Arenoparella mexicana*. The two samples from the interval between 16 and 30 cm were dominated by *Arenoparella mexicana*. In the interval between 40 and 52 cm, the two samples here were dominated by *Haplophragmoides* spp. with high percentages of *Arenoparella mexicana*. In the only other sample containing foraminifera (242-244 cm), a single specimen of *Cassidulina reniforme* was identified. This was also the only calcareous individual present in the core. Organic matter percentages were not measured.

3.3.1.4 Vibracore 102

Of the 16 samples examined here, only one below 77 cm contained rare foraminifera (273-275 cm) and there were eight barren samples (Appendix Table 17). The seven samples from the top 77 cm of this core all contained foraminifera, with abundances ranging between 2 and 529 inds/10 cm^3. One to 11 foraminiferal species were present. *Arenoparella mexicana* was the dominant species, with high percentages of *Trochammina inflata*. The only calcareous specimen (*Cibicides lobatulus*) was present in the sample from 273-275 cm. No organic matter percentages were obtained from these samples.

3.3.1.5 Push Core and Vibracore 103

Two data sets are presented in Appendix Table 18 from cores taken approximately 75 cm from each other. The push core was obtained by pushing a core tube by hand into the marsh peat; this sample was not affected by compaction. The second data set was from the vibracore. In the seven samples examined from the push core, total abundances ranged from 0 to 360 inds/10 cm^3 (Appendix Table 18). These samples were carefully decanted but the total numbers may be slightly low due to this processing technique. An assemblage dominated by *Haplophragmoides manilaensis, Trochammina inflata* and *Arenoparella mexicana* was identified in the top 48 cm. A unit containing very black peat and cyprus stumps (freshwater unit) was identified between 48 and 98 cm. Rare marsh foraminiferal specimens were present in the upper part of this unit. Another marsh faunal assemblage dominated by *Ammoastuta inepta* (in brown peat with marsh plant fragments) was identified in the unit between 99 cm and 110 cm. Below this, to the bottom of the core at 135 cm, there was again the very black peat. A single marsh foraminiferal specimen was identified in this unit. Radiocarbon ages were obtained from four intervals (42-47 cm - 405 ± 145 yBP; 70-75 cm - 2140 ± 230 yBP; 80-85 cm - 2510 ± 140 yBP; 100-105 cm - 3850 ± 145 yBP) (Gayes et al, 1992). Of the 20 samples examined from the vibracore, 12 were barren (Appendix Table 18). Of the remaining samples, abundances ranged from 1 to 691 inds/10cm3 and from 1 to 11 species (Appendix Table 18). Although *Arenoparella mexicana* strongly dominated the assemblage in the two samples from the top 14 cm, there were differences in the subordinate species. In the sample from 6-8 cm there were approximately equally high percentages of *Haplophragmoides wilberti, Miliammina fusca, Siphotrochammina lobata* and *Trochammina inflata*; 12-14 cm had high percentages of *Haplophragmoides wilberti* and *Trochammina macrescens*. The sample from 20-22 cm had *Arenoparella mexicana* and *Haplophragmoides manilaensis* as co-dominants with high percentages of *Tiphotrocha comprimata*. *Arenoparella mexicana* and *Ammoastuta inepta* dominated 35-37 cm while *Ammoastuta inepta*, with high percentages of *Haplophragmoides wilberti* and *Tiphotrocha comprimata*, dominated 45-47 cm. The faunal assemblage was strongly dominated by *Ammoastuta inepta*. A single specimen of *Ammonia beccarii* was identified at 310-312 cm. Organic matter percentages were not measured.

3.3.1.6 Vibracore 106

Of the 28 samples examined from this core, all but two contained foraminifera or arcellaceans (Appendix Table 19; Figure 28). In those with foraminifera or arcellaceans, abundances ranged from 1 to 2224 inds/10 cm3 (Appendix Table 19). In the upper 50 cm, the faunal assemblage was composed of typical marsh species, with the exception of the interval 15-17 cm. This sample, with few specimens and only calcareous foraminifera, contained coarse sand and may have been a storm deposit. *Miliammina fusca* strongly dominated the surface assemblage with high percentages of *Ammotium salsum* and *Arenoparella mexicana*. The sample from 8-10 cm was dominated by *Trochammina inflata* with high percentages of *Arenoparella mexicana* and *Miliammina fusca*. Between 23 and 47 cm, the assemblage was again strongly dominated by *Miliammina fusca* with percentages of *Arenoparella mexicana* toward the bottom of this interval. By 50-52 cm *Arenoparella mexicana* strongly dominated the assemblage. In the interval between 60 and 132 cm, the assemblage had an extremely high calcareous foraminiferal component dominated by *Ammonia beccarii, Elphidium* spp. and *Haynesina depressula*. Low percentages of *Arenoparella mexicana, Siphotrochammina lobata* and *Trochammina* spp. were present throughout. Total numbers of individuals drop significantly (compared to the unit dominated by calcareous foraminifera) from 140 cm to the bottom of the core. In the interval between 140 and 187 cm the assemblages were dominated by either *Arenoparella mexicana* or *Trochammina* spp. *Trochammina* spp. dominated from 190 to 202 cm. From 240 cm to the bottom of the core, a single specimen of *Centropyxis aculeata* was

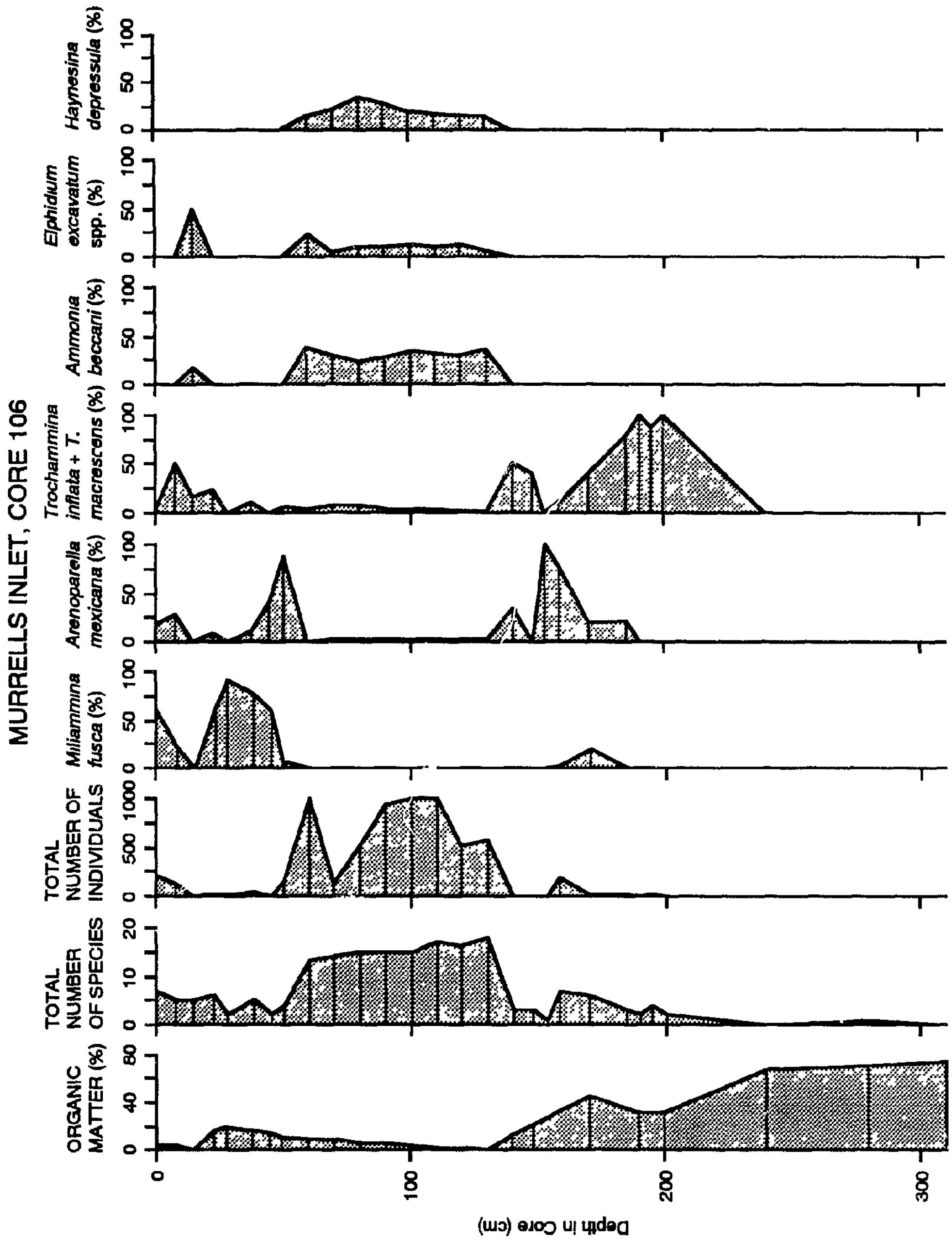


Figure 28. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Vibracore 106, Murrells Inlet.

encountered while the remainder of the samples were barren. Radiocarbon ages were obtained from three intervals (136-141 cm - 2475 ± 135 yBP; 163-166 cm - 3460 ± 155 yBP; 183-186 cm - 4090 ± 235 yBP) (Gayes et al, 1992). Organic matter percentages were measured at most intervals and values ranged between 0.22% and 74.20%. Highest values (greater than 20%) were obtained from samples below 140 cm and values exceeding 60% occurred below 210 cm.

3.3.2 North Inlet

3.3.2.1 Vibracore B1

Of the 30 samples examined from this core, all but four from the bottom 30 cm contained foraminifera or arcellaceans (Appendix Table 20; Figure 29). Abundances ranged from 14 to 15,072 inds/10 cm^3 although total numbers were generally high in most samples. In the upper 50 cm, the faunal assemblage was dominated by *Haplophragmoides wilberti*. There were also significant percentages of *Arenoparella mexicana*, generally increasing towards the bottom of the unit. Low percentages of other marsh foraminiferal species were also present although *Miliammina fusca* had higher percentages between 38 and 63 cm. By 63 cm, *Arenoparella mexicana* dominated and continued to do so to 110 cm. Percentages of *Haplophragmoides wilberti* continued to decrease throughout this interval. There was an increase in percentages of *Ammoastuta inepta* between 98 and 110 cm. From 119 to 157 cm, *Haplophragmoides wilberti* again strongly dominated the samples; there was a significant decrease in percentages of *Arenoparella mexicana*. There were generally high percentages of *Trochammina macrescens* throughout this interval, with decreasing percentages of *Tiphotrocha comprimata* with depth. Between 164 and 292 cm, *Arenoparella mexicana* generally dominated the assemblage although *Ammoastuta inepta* had high percentages, and dominated, at some levels. Percentages of *Haplophragmoides*

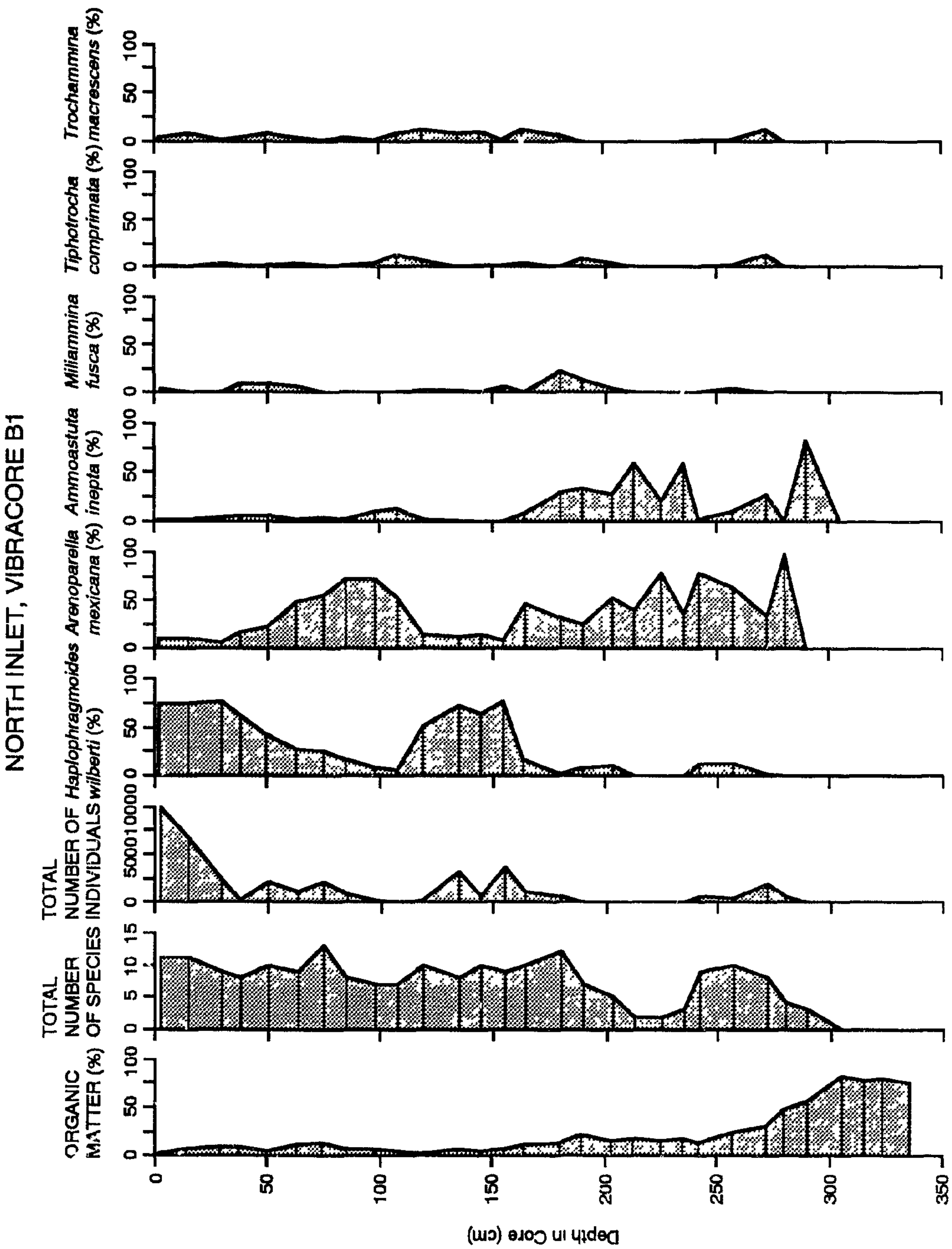


Figure 29. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Vibracore B1, North Inlet. Note the maximum Number of Individuals/10 cm^3 plotted is 10,000 although there are higher values.

wilberti were significantly lower than at the higher levels of the core. Highest percentages of *Miliammina fusca* were observed between 180 and 192 cm. Radiocarbon ages were obtained from three intervals (89-95 cm - 2075 ± 125 yBP; 245-251 cm - 4050 ± 145 yBP; 265-270 cm - 3835 ± 140 yBP). Organic matter percentages ranged from 2.15% at the top of the core to extremely high values (greater the 70%) near the bottom.

3.3.2.2 Vibracore B2

In the 30 samples examined from this core, abundances ranged from 0 to 5944 inds/10 cm^3 (Appendix Table 21; Figure 30). Ten samples were barren. In the uppermost sample from the core, the faunal assemblage was dominated by *Haplophragmoides wilberti* with significant percentages of *Arenoparella mexicana*. *Ammoastuta inepta* dominated the assemblage between 15 and 30 cm; there were decreasing percentages of *Arenoparella mexicana* and increasing values of *Haplophragmoides wilberti* down core in this interval. *Haplophragmoides wilberti* strongly dominated 35-37 cm while *Ammoastuta inepta* dominated 40-42 cm. The highest percentages of *Miliammina fusca* were also observed in this sample. From 47 to 70 cm, *Arenoparella mexicana* dominated with high percentages of *Haplophragmoides wilberti* and *Ammoastuta inepta*. *Haplophragmoides wilberti* dominated the assemblage between 80 and 122 cm with high percentages of *Arenoparella mexicana*. There were low, but somewhat consistent percentages of *Tiphotrocha comprimata*, *Trochammina inflata* and *T. macrescens* from the top of the core to 112 cm. Between 120 and 167 total numbers were quite low and *Arenoparella mexicana* was the dominant foraminifera. From 180 to 382 cm the interval was barren with them exception of a sample from 310-312 cm that contained three foraminifera. By 430 cm the assemblage was strongly dominated by *Elphidium* spp. Organic matter percentages ranged between 0.40 and 25.15%.

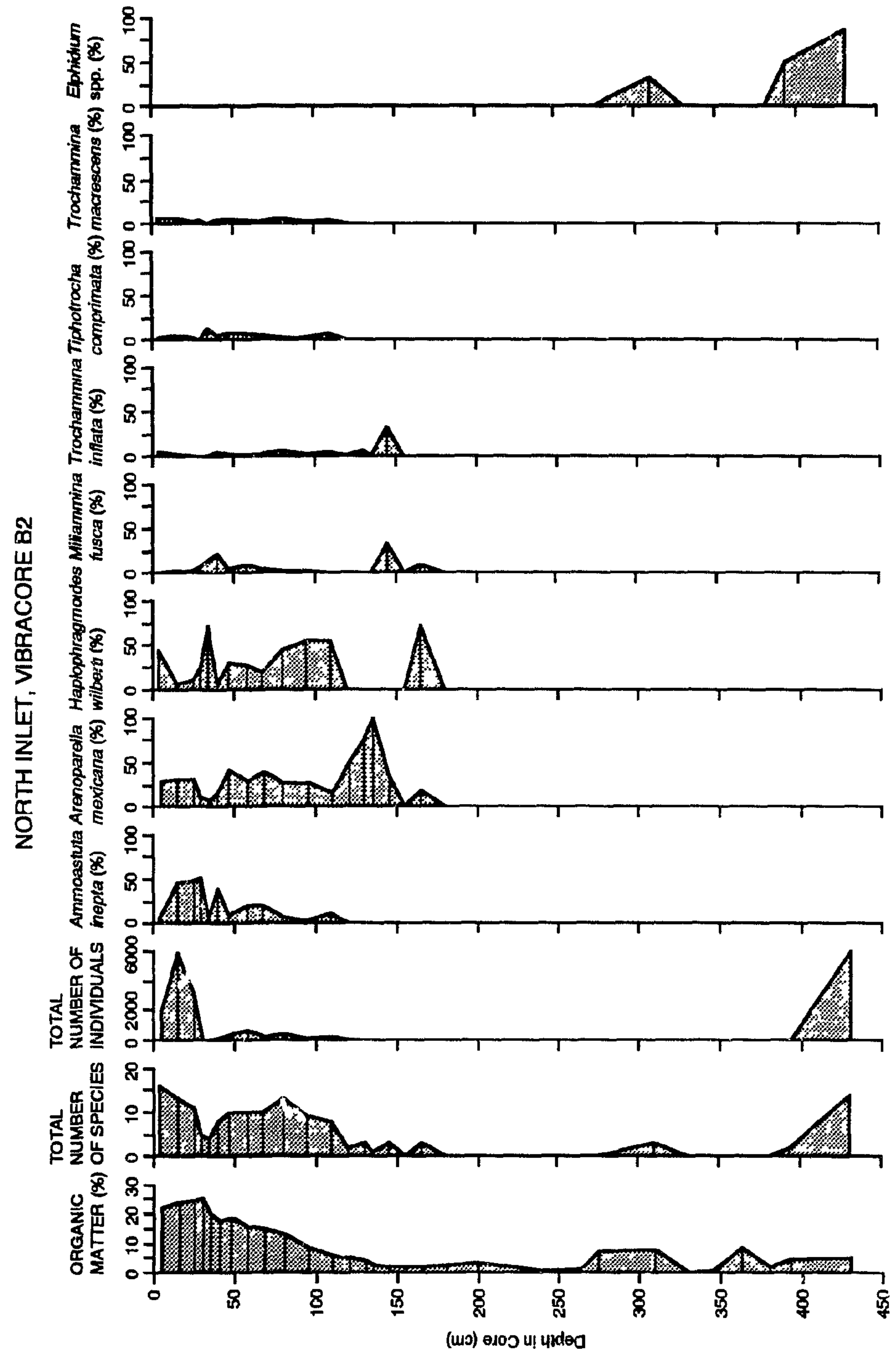


Figure 30. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Vibracore B2, North Inlet.

3.3.2.3 Vibracore B3

Of the 27 samples examined from this core, two broad assemblages were identified; the first. from the top to 152 cm was dominated by marsh foraminifera while from 200 to 672 cm a calcareous assemblage was present. Abundances ranged from 0 to 3104 inds/10 cm^3 in the samples dominated by marsh foraminifera while up to 33, 920 inds/10 cm^3 were identified in samples dominated by calcareous species (Appendix Table 22; Figure 31). Of those samples containing foraminifera in the top 97 cm of the core, the assemblage was strongly dominated by *Arenoparella mexicana*. High percentages of *Haplophragmoides wilberti* were present at some levels. There were lower, but significant percentages of *Ammoastuta inepta*, *Siphotrochammina lobata* and *Trochammina inflata* at different levels within this unit. Between 110 and 152 cm, *Haplophragmoides wilberti* dominated with high abundances of *Arenoparella mexicana*. The sample from 180-182 cm had a mixed agglutinated/calcareous foraminiferal assemblage. From 200 cm to the bottom of the core, *Elphidium excavatum* spp. dominated. There were high percentages of *Bolivina* spp. between 200 and 232 cm while present in most other samples. Highest abundances of *Quinqueloculina* spp. were identified in samples between 540 and 672 cm although they were present in low percentages at levels between 255 and 357 cm. Organic matter percentages ranged between 0.40 and 14.72%.

3.3.2.4 Vibracore B9

In the 43 samples examined from this core, an assemblage dominated by marsh foraminiferal species was identified between 0 and 197 cm while calcareous foraminifera dominated between 215 and 507 cm. Within the marsh foraminiferal assemblage zone, abundances ranged between 1 and 6728 inds/10 cm^3 and from 624 to 18,048 inds/10 cm^3 in the samples dominated by calcareous foraminifera (Appendix Table 23; Figure 32).

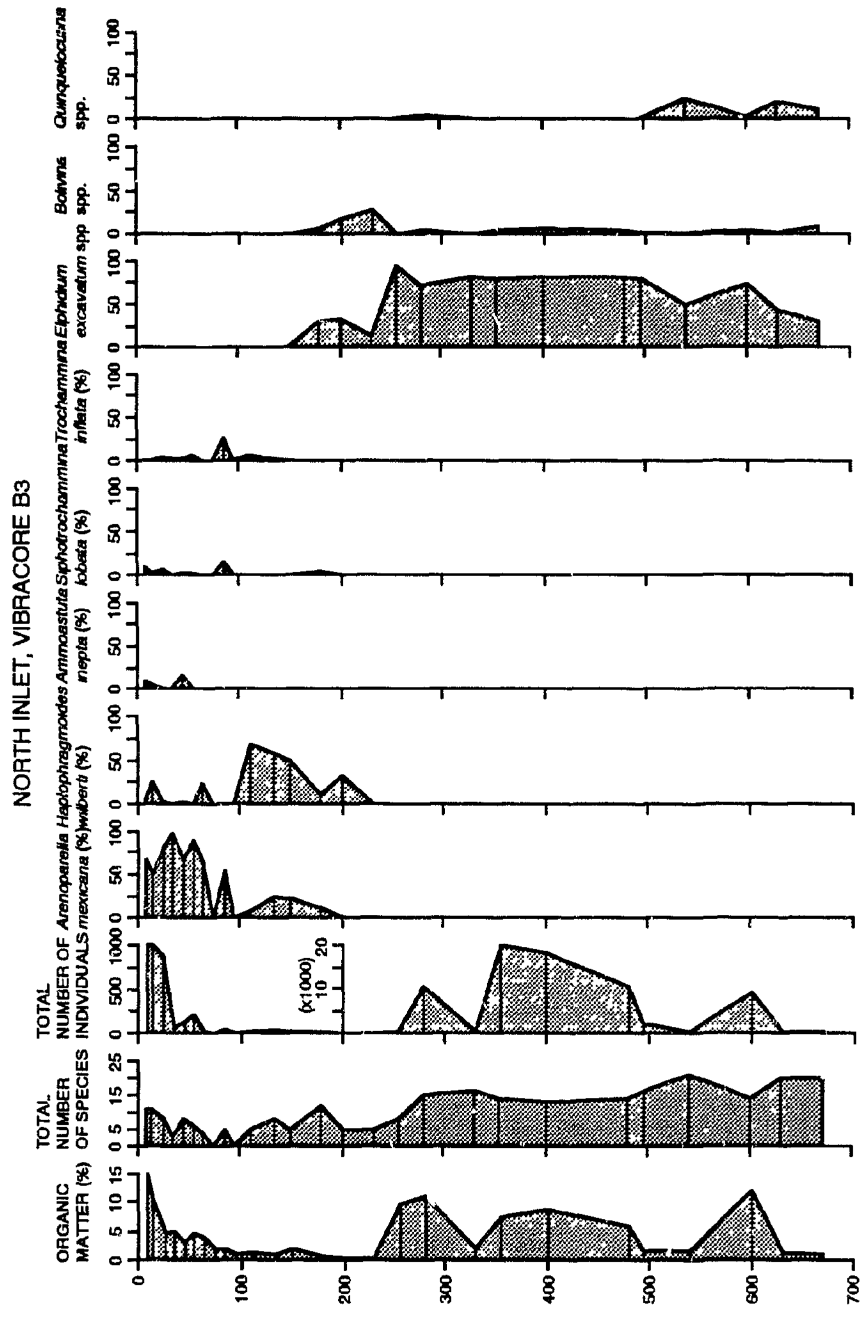


Figure 31. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal assemblage in sediments from Vibracore B3, North Inlet. Note the maximum Number of Individuals/10 cm^3 plotted is 1000 on the upper scale and 20,000 on the lower scale although there are higher values.

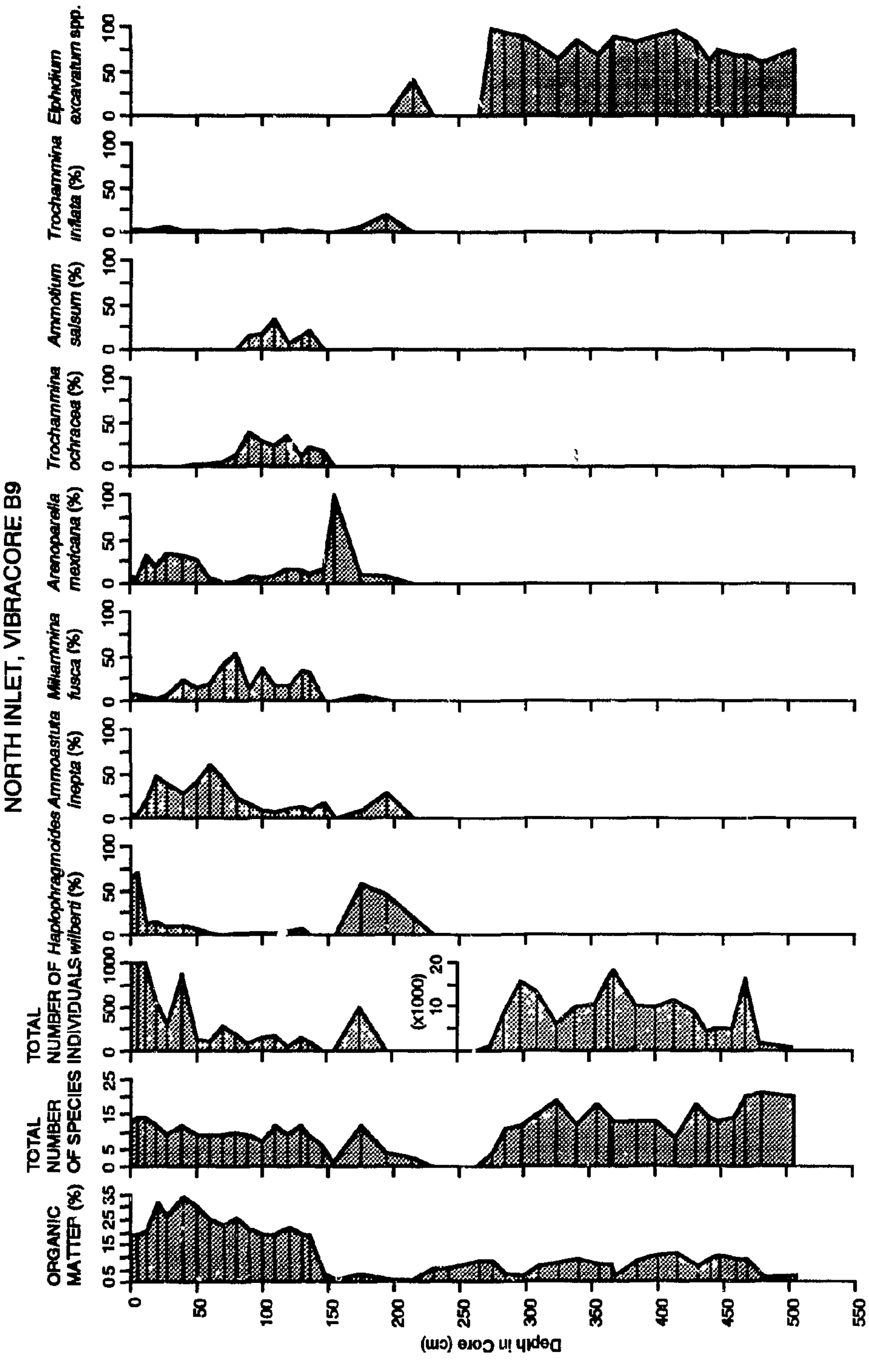


Figure 32. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Vibracore B9, North Inlet.

In the uppermost 10 cm of the core, *Haplophragmoides wilberti* strongly dominated the faunal assemblage. Between 12 and 52 cm the assemblage was generally dominated by *Ammoastuta inepta* or co-dominated with *Arenoparella mexicana*. Percentages of *Miliammina fusca* generally increased toward the bottom of the unit. From 60 to 82 cm, percentages of the *Ammoastuta inepta* decreased down core as percentages of *Miliammina fusca* increased. *Trochammina ochracea*, *Ammotium salsum* and *Miliammina fusca* generally co-dominated the interval between 90 and 122 cm. From 130 to 138 cm the assemblage was dominated by *Miliammina fusca*, with high percentages of *Ammoastuta inepta*, *Ammotium salsum*, *Arenoparella mexicana* and *Trochammina ochracea*. Few foraminiferal specimens were identified between 147 and 157 cm. *Haplophragmoides wilberti* strongly dominated the interval between 175 and 197 cm and this interval contained the highest percentage of *Trochammina inflata* in the core. *Elphidium excavatum* spp. strongly dominated samples between 275 and 507 cm. Radiocarbon ages were obtained from two intervals (142-147 cm - 2045 ± 175 yBP; 449-456 cm - >34,500 yBP). Organic matter percentages ranged from 0.91 to 33.67%.

3.3.2.5 Short Core 1 (Trans. 6)

Of the 30 samples examined continuously every centimeter down this core, total abundances ranged between 173 and 815 inds/10 cm^3 (Appendix Table 24; Figure 33). Total species diversity was quite consistent throughout. Generally the total assemblage was co-dominated by *Trochammina inflata* and *T. macrescens* throughout the core. *Miliammina fusca* dominated the surface with another, but lower percentage, peak between 4 and 6 cm. There were moderate percentages of *Trochammina ochracea* throughout the core, with a general increase in values below 8 cm. There were low percentages of *Siphotrochammina lobata* and *Ammotium salsum* throughout the core; there was generally

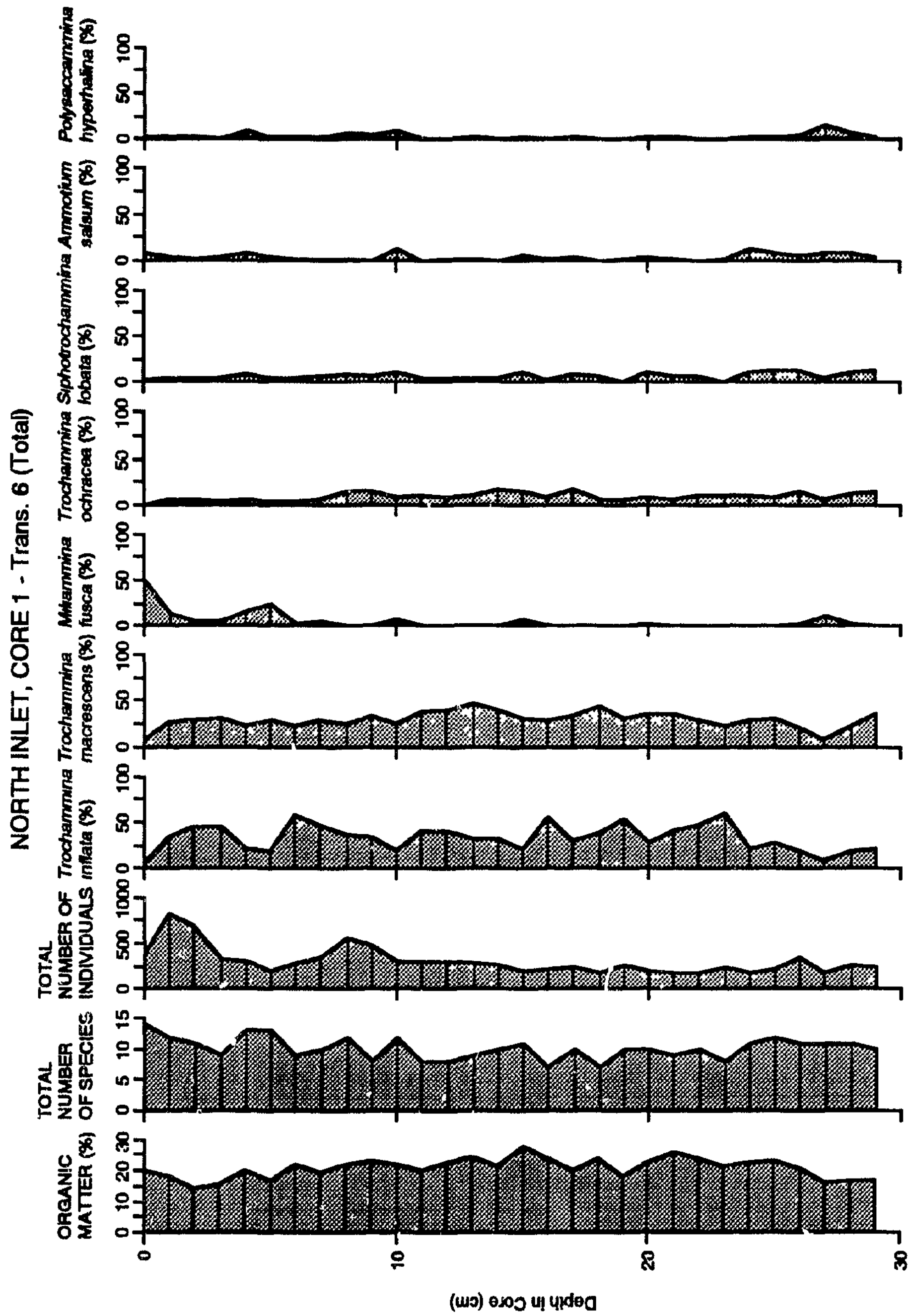


Figure 33. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal assemblage in sediments from Core 1 (Trans. 6), North Inlet.

a slight increase in percentages of *Ammotium salsum* below the 24 cm level. Low percentages of *Polysaccammina hyperhalina* were present throughout, with the highest values near the bottom. Living specimens were identified to the 15-16 cm level and abundances ranged from 1 to 152 inds/10 cm^3 (Appendix Table 24; Figure 34). Of the 12 species having living representatives, nine were present in the surface (0-1 cm) sample. Highest numbers (greater than 30) of living specimens were present in the top 6 cm. *Miliammina fusca* generally dominated the living assemblage throughout. There were moderate percentages of *Trochammina inflata* in the upper eight centimeters with highest values between 1 and 3 cm. Low numbers of living *Ammotium salsum* were present to 5 cm (highest at the surface), *Polysaccammina hyperhalina* to 8 cm and *Trochammina macrescens* to 12 cm. Organic matter percentages ranged from 14.09 to 27.68%. Tall *Spartina alterniflora* was the only plant species present at this core locality. A salinity value of 20‰ was obtained at this core site.

3.3.2.6 Short Core 2 (Trans. 6)

In the 30 samples examined from every centimeter down this core, total abundances ranged from 13 to 1256 inds/10 cm^3 (Appendix Table 25; Figure 35). Total numbers dropped significantly below 3 cm. *Ammotium salsum* generally dominated, although co-dominated the faunal assemblage with *Miliammina fusca*, in many samples from the upper 15 cm; there were also high percentages of *Miliammina fusca* at some levels below 15 cm. High percentages of *Trochammina inflata* and *T. macrescens* were also present at some levels between 0 and 15 cm. *Trochammina macrescens* dominated between 16 and 17 cm while *Trochammina inflata*, with high percentages of *Trochammina macrescens*, generally dominated between 19 and 24 cm. Below this, *Trochammina inflata* continued to have high percentages. The continuous down core occurrence of

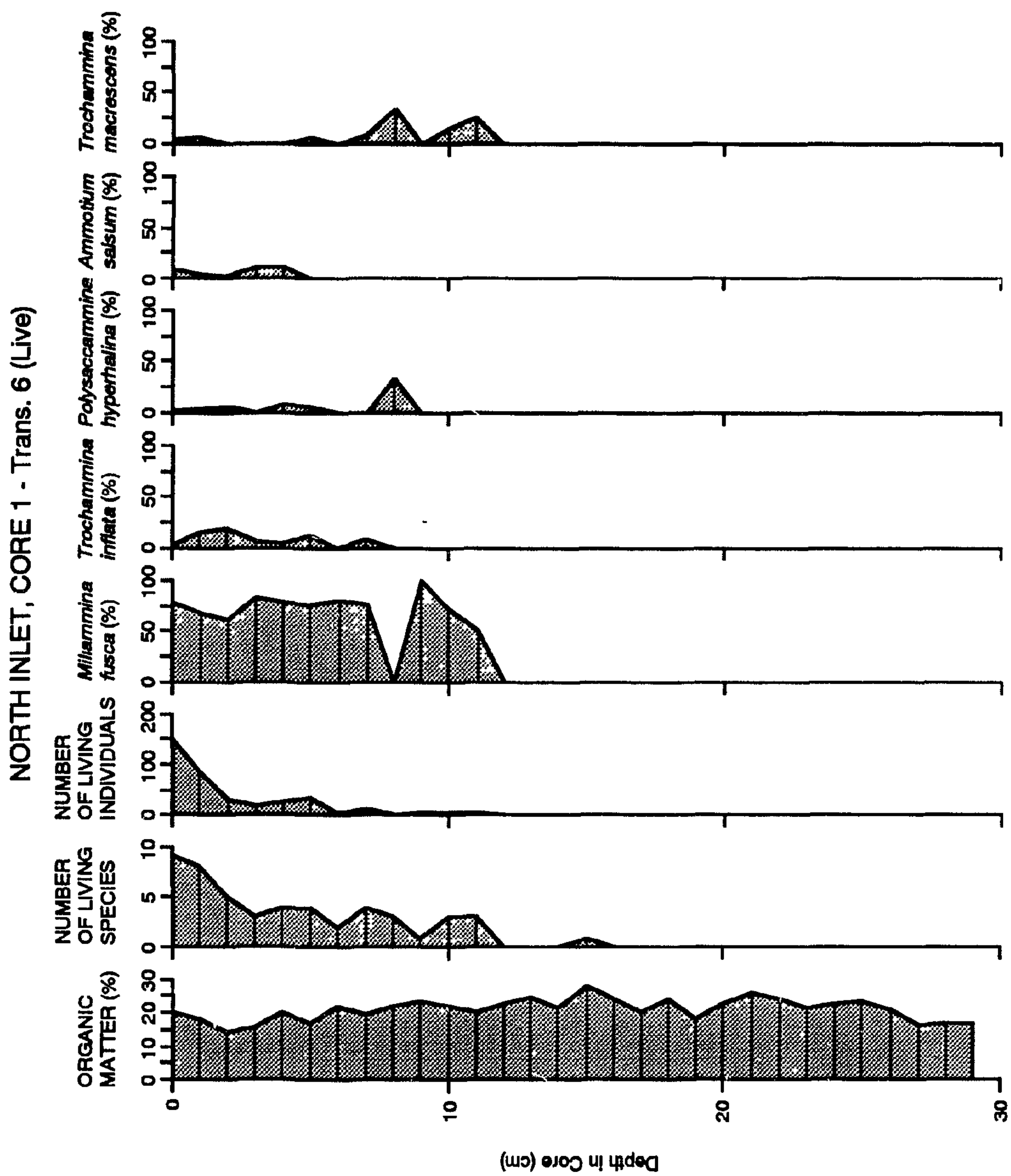


Figure 34. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the live foraminiferal assemblage in sediments from Core 1 (Trans. 6), North Inlet.

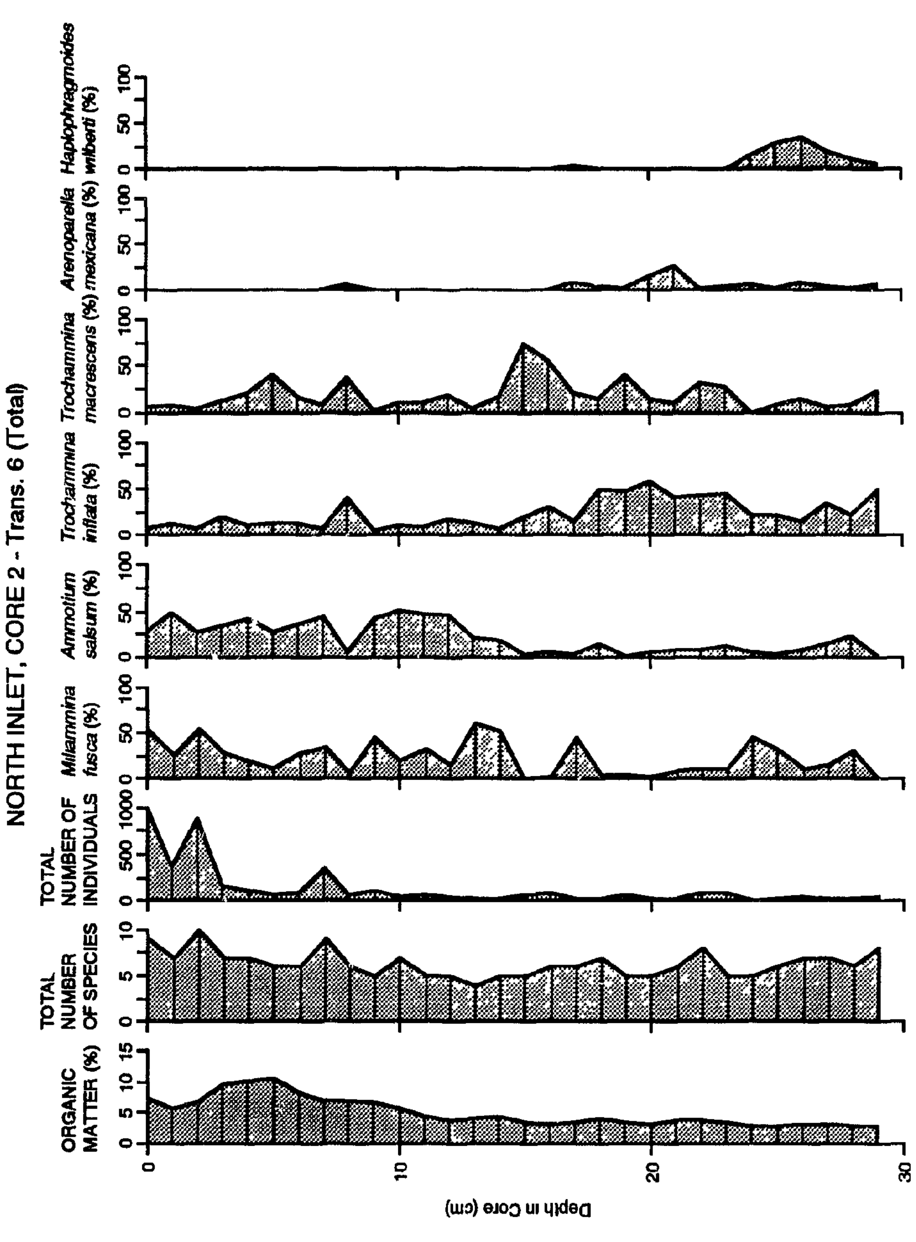


Figure 35. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Core 2 (Trans. 6), North Inlet.

Arenoparella mexicana began at 17 cm while percentages peaked between 20 and 22 cm. *Haplophragmoides wilberti* formed a significant component of the assemblage (up to 35.4%) between 24 and 30 cm and only a single specimen of this species was identified above this interval. Living foraminifera were identified in each sample between 0 and 13 cm, with the highest numbers in the top 3 cm, and abundances ranged from 1 to 632 inds/10 cm^3 (Appendix Table 25; Figure 36). Of the 7 species having living representatives, five were present in the surface (0-1 cm) sample. Five live specimens were also identified at the 16-17 cm level. The living faunal assemblage had low diversity (up to five species per sample). *Miliammina fusca* generally dominated (strongly at the surface) the living assemblage with high percentages of *Ammotium salsum.* Percentages of *Ammotium salsum* generally increased with depth, although there was a decrease in absolute numbers, from the surface to the 5-6 cm level. Between 1 and 5 cm there were consistent, but moderate, percentages, although a decrease absolute numbers, of *Trochammina inflata* and lower percentages of *Trochammina macrescens.* There were also rare specimens of these species at some levels below this interval. Organic matter percentages ranged from 2.90 to 10.50%. This core was taken near the transition from tall to short *Spartina alterniflora*..

3.3.2.7 Short Core 3 (Trans. 6)

Of the 29 samples examined continuously from every centimeter down this core, total abundances ranged between 284 and 1240 inds/10 cm^3 with the lowest total numbers at the top of the core (Appendix Table 26; Figure 37). *Trochammina inflata* strongly dominated the foraminiferal assemblage throughout this core (50 to 65%) with high percentages of *Trochammina macrescens* (generally 20 to 30%). There were low percentages, with little variation in values throughout the core, of *Arenoparella mexicana,*

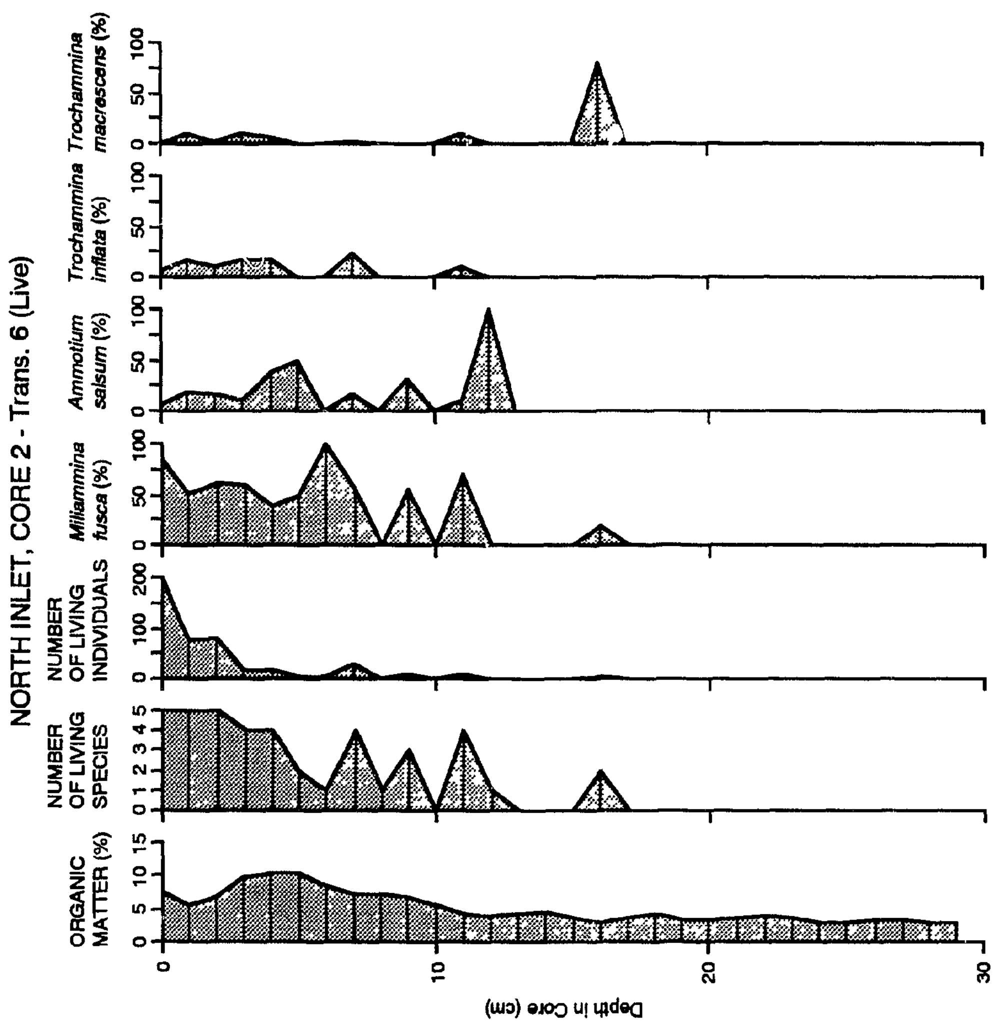


Figure 36. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the live foraminiferal and arcellacean assemblage in sediments from Core 2 (Trans. 6), North Inlet.

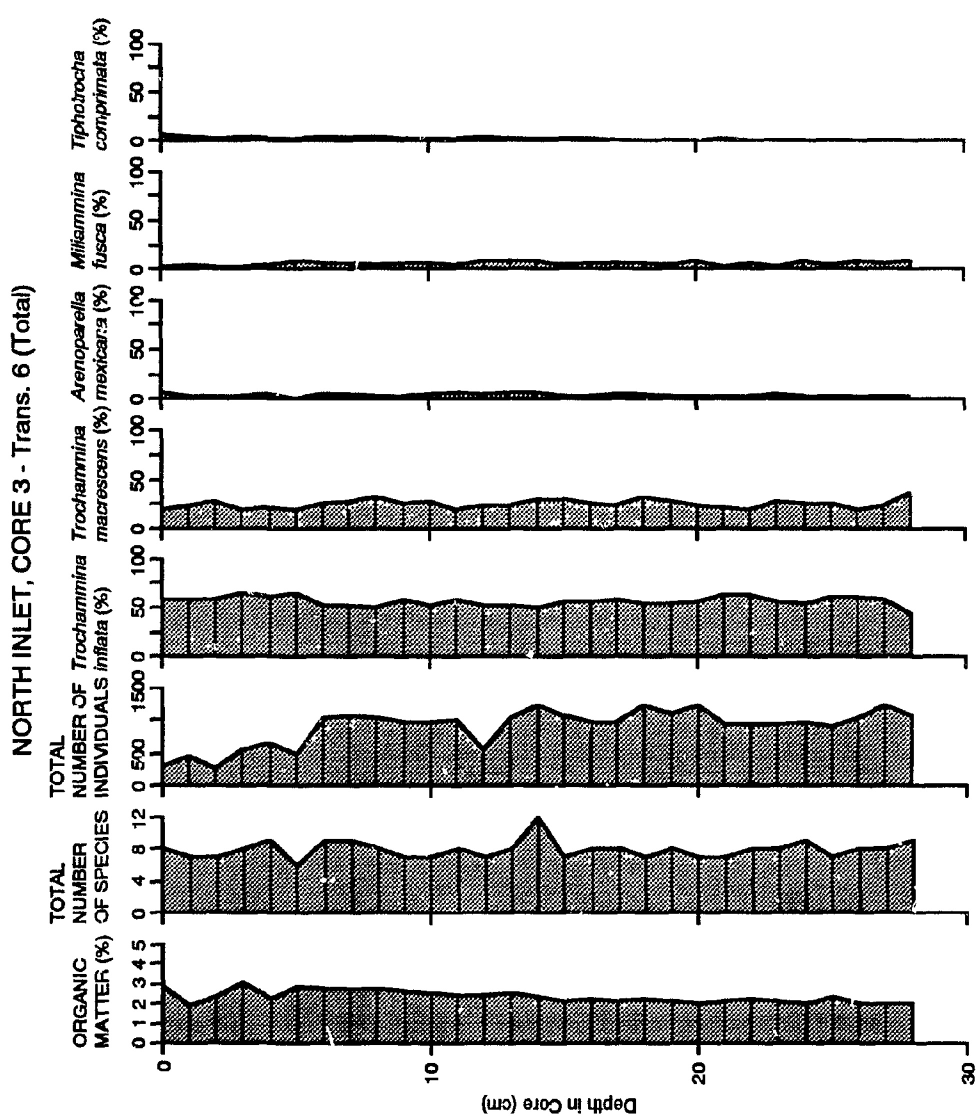


Figure 37. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal assemblage in sediments from Core 3 (Trans. 6), North Inlet.

Miliammina fusca, *Siphotrochammina lobata* and *Tiphotrocha comprimata*. Abundances of living specimens ranged between 4 and 152 inds/10 cm^3 with living specimens present to the 21 cm level (few specimens of *Miliammina fusca* and *Tiphotrocha comprimata*) (Appendix Table 26; Figure 38). Of the nine species having living representatives, six were present in the surface (0-1 cm) sample. High living abundances were generally present between 7 and 14 cm. *Trochammina inflata* generally dominated the living assemblage, with highest percentages generally in samples from the top 6 cm. *Trochammina macrescens* also had highest percentages near the top of the core; values greater than 10% also occurred between 7 and 12 cm. Percentages of living *Miliammina fusca* and *Arenoparella mexicana* both generally increased with depth. There were low percentages of *Miliammina fusca* near the surface, with peak values between 6 and 17 cm. For *Arenoparella mexicana*, other than sample 19-20 cm (100% live), percentages peaked between 10 and 17 cm. *Tiphotrocha comprimata* did not have a continuous living distribution down core; highest living percentages generally occurred lower in the core. Eight living specimens of *Siphotrochammina lobata* were identified between 7 and 8 cm. Organic matter percentages were consistently low throughout the core ranging from 1.86 to 3.13%. The floral assemblage at this core site was dominated by *Salicornia* sp. and *Borrichia* sp. with some *Spartina alterniflora*.

3.3.3 Santee Delta

3.3.3.1 Vibracore 1

Of the 26 samples examined from this core, all but three from the bottom 90 cm contained foraminifera or arcellaceans (Appendix Table 27: Figure 39). In those samples containing foraminifera or arcellaceans, abundances ranged from 1 to 14,592 inds/10 cm^3. Abundances were generally low in sediments from the upper meter of the core. Diversity

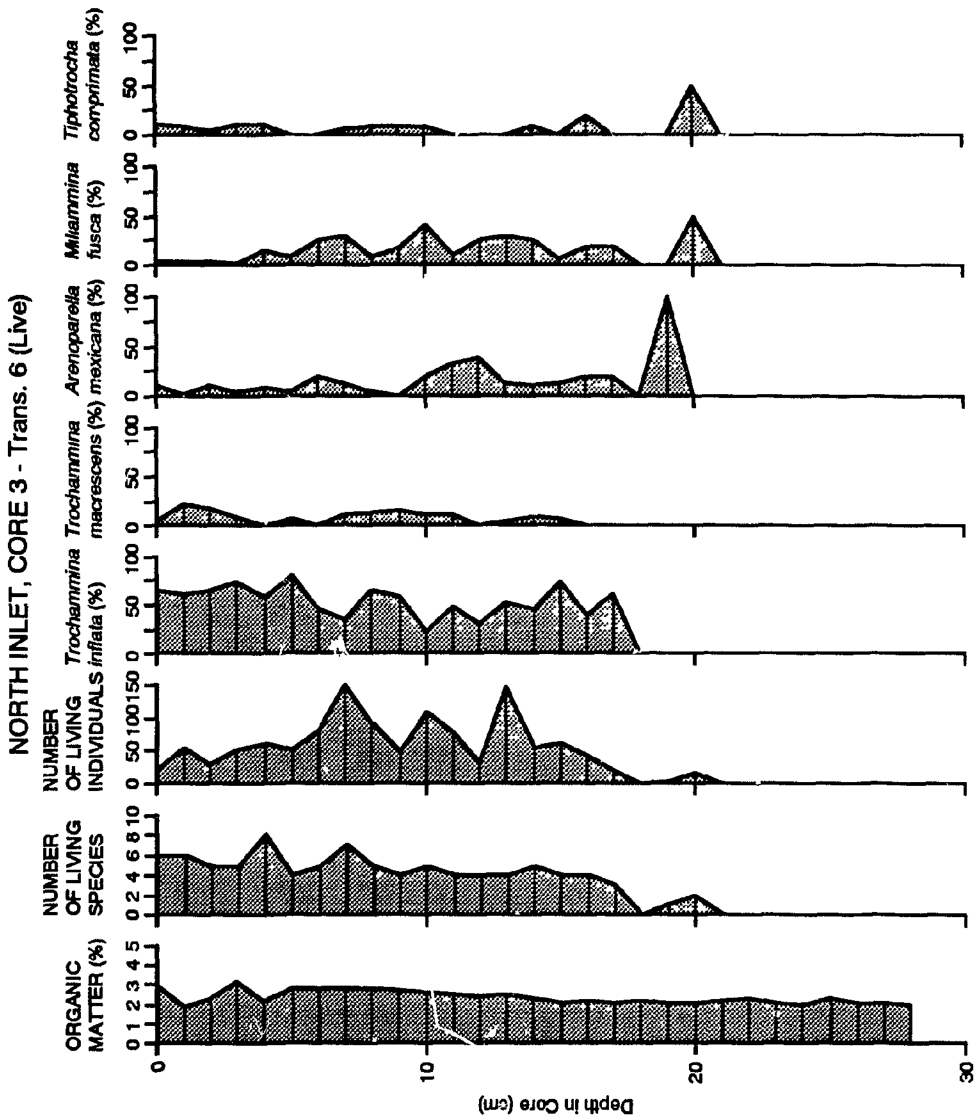


Figure 38. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the live foraminiferal assemblage in sediments from Core 3 (Trans. 6), North Inlet.

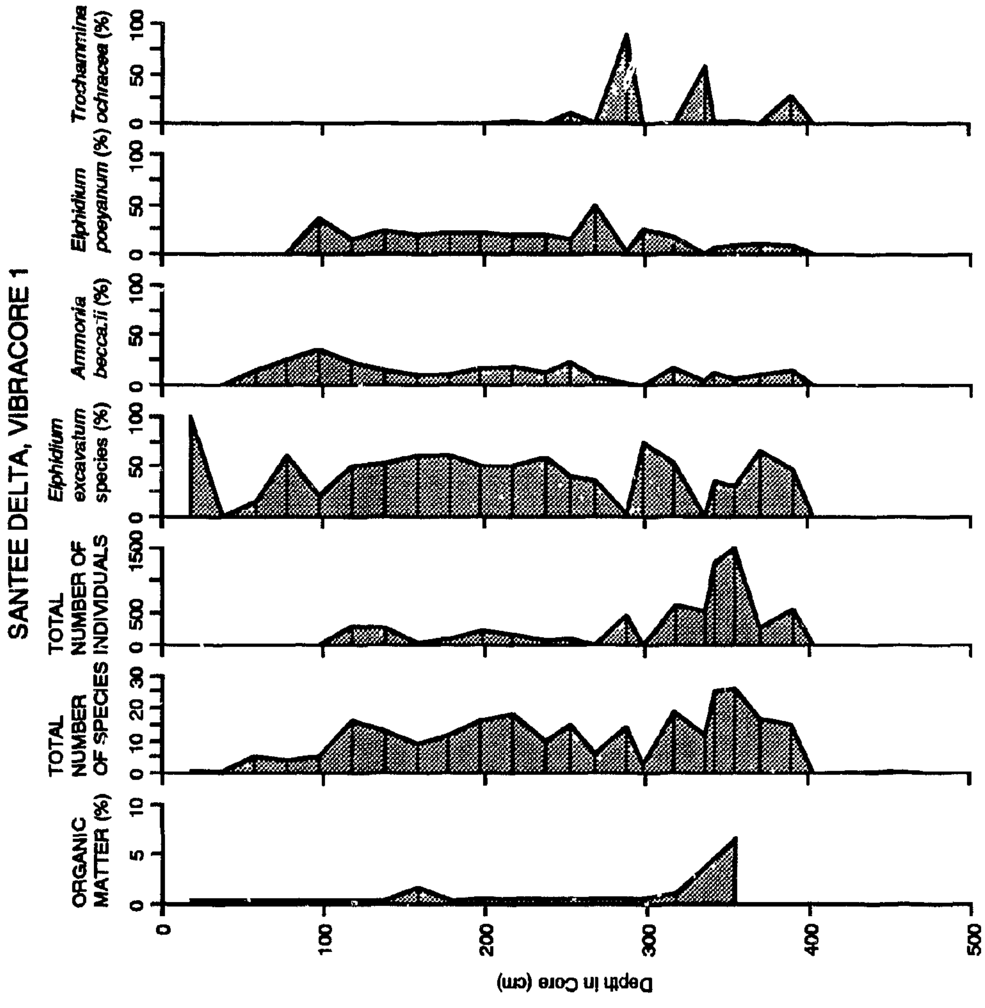


Figure 39. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Vibracore 1, Santee Delta. Note the maximum Number of Individuals/10 cm^3 plotted is 1500 although there are higher values.

was generally high although there were only rare specimens off many species. *Elphidium excavatum* spp. generally dominated the faunal assemblage throughout the core except at 288-290 cm and 336-338 cm where *Trochammina ochracea* strongly dominated. High percentages of *Trochammina ochracea* were also identified at 390-392 cm. *Ammonia beccarii* and *Elphidium poeyanum* also had high percentages at most levels and contributed significantly to the assemblage. A radiocarbon age was of 2045 ± 345 yBP was obtained from 288-290 cm. Organic matter percentages ranged from 0.32 to 6.49% although there were no measurements from many levels.

3.3.3.2 Vibracore 3

In the 46 samples examined from this core, abundances ranged from 1 to 27,264 inds/10 cm^3 in those samples containing foraminifera or arcellaceans (Appendix Table 28; Figure 40). Samples between 45 and 144 cm and between 490 and 570 cm generally had either low total numbers or were barren. Samples from the other levels generally had high species diversity. From 18 to 33 cm, the faunal assemblage was generally co-dominated by *Trochammina inflata* and *Arenoparella mexicana*. There were also low percentages of other marsh foraminiferal species in this interval. Between 45 and 90 cm the samples were barren. *Trochammina ochracea* strongly dominated the assemblage between 108 and 144 cm although there were low percentages of other marsh foraminiferal species. The interval between 160 and 490 cm generally contained the highest total numbers and highest species diversity in the core; the assemblage was dominated by *Elphidium excavatum* spp. with consistent, somewhat high, percentages of *Ammonia beccarii* and *Elphidium poèyanum*. From 493 to 551 cm (with the exception of 495-497 cm) few foraminifera were identified but the assemblage was dominated by *Arenoparella mexicana*. More numerous specimens were present at the 495-497 cm level and the assemblage was strongly

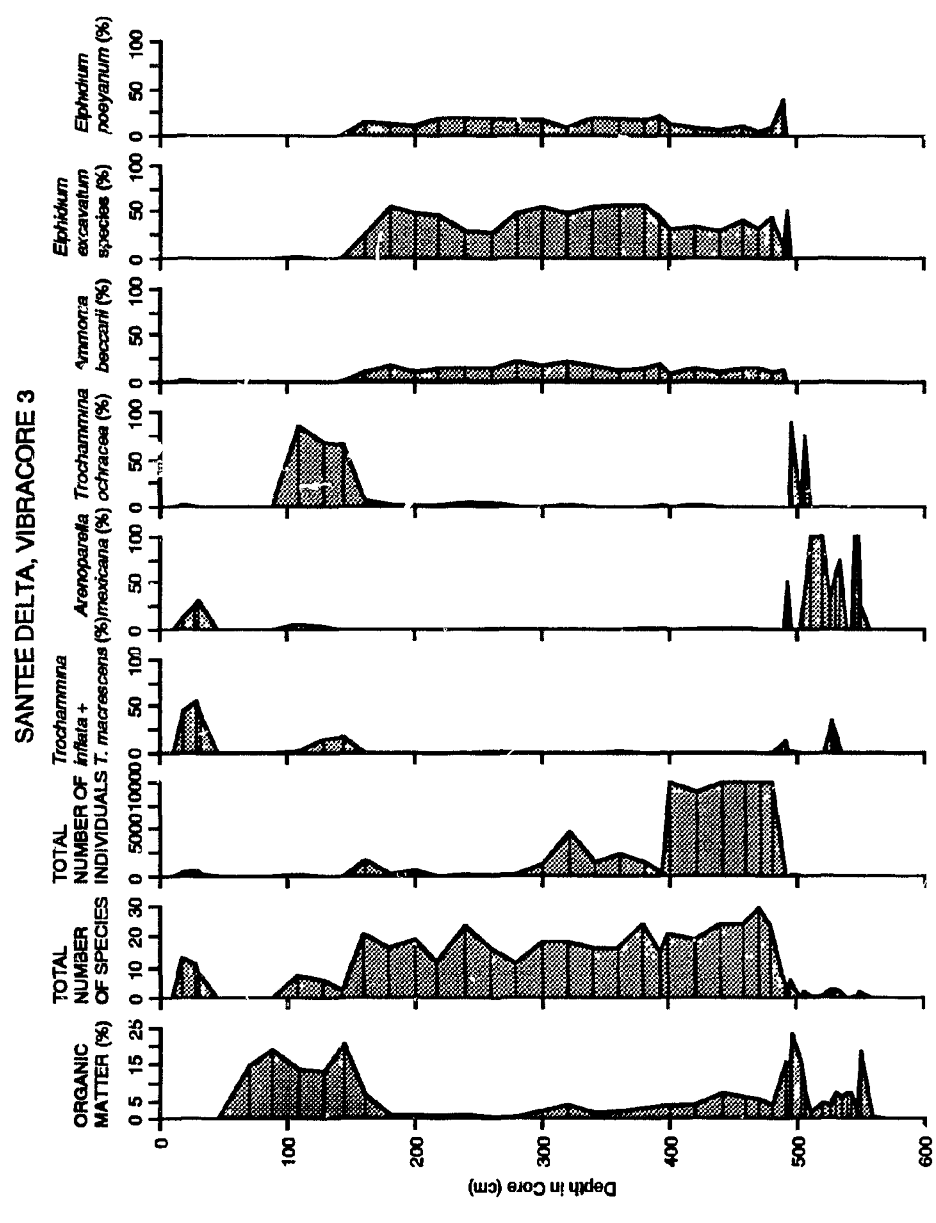


Figure 40. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Vibracore 3, Santee Delta. Note the maximum Number of Individuals/10 cm^3 plotted is 10,000 although there are higher values.

dominated by *Trochammina ochracea.* A radiocarbon age was of 2890 ± 230 yBP was obtained from 495-497 cm. Organic matter percentages ranged from 0.42 to 22.89% although there were no measurements from some levels.

3.3.3.3 Vibracore 7

Of the 33 samples examined from this core, all but two contained foraminifera or arcellaceans and abundances ranged from 20 to 31,488 inds/10 cm^3 (Appendix Table 29; Figure 41). From the top of the core to 80 cm (with the exception of 70-72 cm) the faunal assemblage was dominated by *Trochammina ochracea* with significant percentages of *Arenoparella mexicana* and *Trochammina inflata.* At the 70-72 cm level, *Elphidium excavatum* spp. dominated with high percentages of *Ammonia beccarii.* Between 90 and 140 cm the assemblage was generally dominated by *Elphidium excavatum* spp. with significant percentages of *Elphidium poeyanum* and *Gavelinopsis translucens.* There were also somewhat consistent, but lower percentages of *Ammonia beccarii* and *Trochammina ochracea.* From 148 to 270 cm, some levels were dominated by *Trochammina ochracea-Arenoparella mexicana* assemblage while others were dominated by the *Elphidium excavatum* spp.-*Ammonia beccarii/Elphidium poeyanum* assemblage. Between 281 and 337 cm, the assemblage was generally dominated by *Elphidium excavatum* spp. with significant percentages of *E. poeyanum, Gavelinopsis translucens* and *Ammonia beccarii.* A radiocarbon age was of 2680 ± 195 yBP was obtained from 268-270 cm. Organic matter percentages ranged from 1.31 to 29.24%.

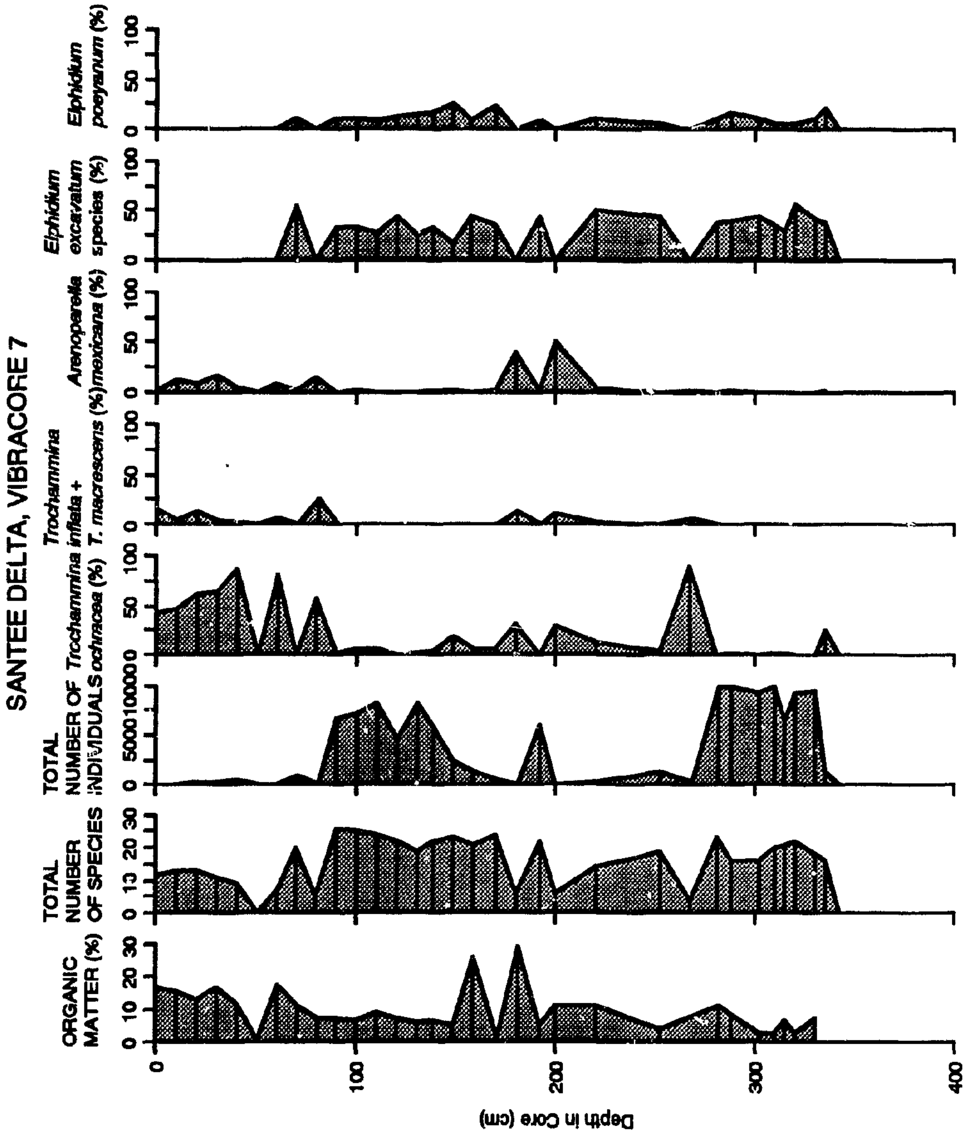


Figure 41. Profile of organic matter, number of species and individuals, and percent abundance of some foraminiferal species relative to the total foraminiferal and arcellacean assemblage in sediments from Vibracore 7, Santee Delta. Note the maximum Number of Individuals/10 cm^3 plotted is 10,000 although there are higher values.

CHAPTER IV

INTERPRETATIONS AND DISCUSSION

4.1 Vegetation and Relation to Mean Sea Level

Salt marsh plants, or halophytes, extend vertically from about mean sea level (MSL) to the upper limit of tides where they end at the point typical land vegetation begins to grow or else grade into freshwater swamps. A distinctive characteristic of most salt marshes throughout much of the world is the vertical zonation of many halophyte species (Chapman, 1960). Chapman (1960) characterized most marshes regionally throughout the world; those from South Carolina are considered to be in his "Eastern North American Group, Coastal Plain Type." He also stated that these marshes are similar to those further north (ie., Northeastern U.S.A. and Nova Scotia) with the addition of indigenous southern species which culminate in mangrove swamps at the southern tip of Florida and along part of the Gulf of Mexico coast. The typical vertical halophyte association in the Coastal Plain, described from North Carolina, is one in which *Spartina alterniflora* dominates the low marsh flora, followed by an association of *Spartina alterniflora, S. patens* and *Salicornia* spp. in the upper low marsh to middle marsh to *Distichlis* spp. and *Juncus* spp. in the high marsh (Wells, 1928). This is generally the vertical succession of halophytes observed in transects from both Murrells and North Inlets and from Transect 4, near the mouth of South Santee River, which has more tidal influence and hence higher salinities than observed in the transects further upstream. Throughout these marshes, Spartina *alterniflora* also fringes small tidal channels, situated at lower elevations. Figure 42 shows this generalized halophyte zonation. The floral zonation, especially in the high marsh, is generally not as well developed in South Carolina marshes compared to marshes further north (ie., Maine to Nova Scotia, see Scott and Medioli, 1980a; Gehrels, 1994). The vertical zonation of marsh

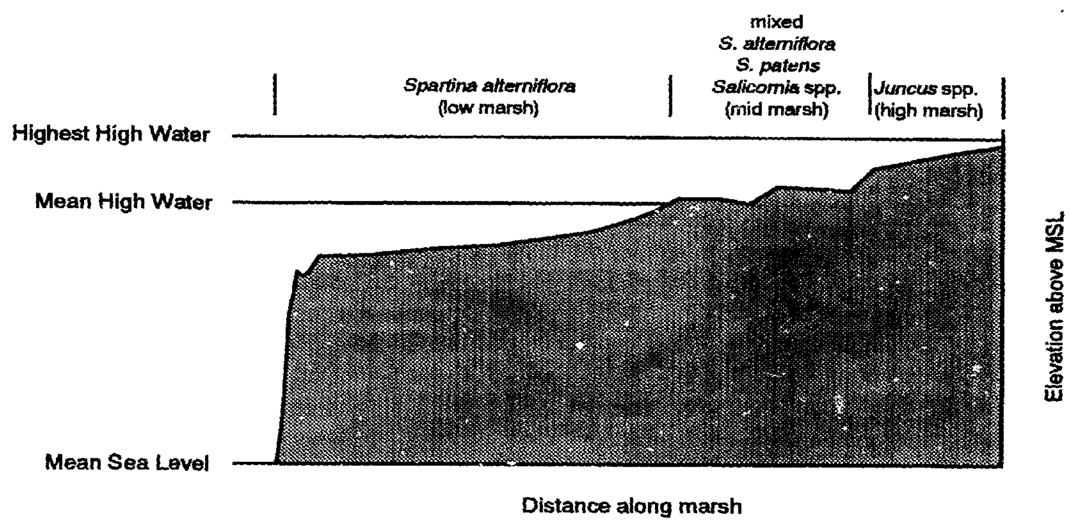


Figure 42. Generalized halophyte zonation in South Carolina marshes and their relation to mean sea level.

plants observed in the South Carolina marshes is similar to the associations reported by Goldstein and Frey (1986) and Goldstein and Harben (1993) for Georgia marshes.

There is also an apparent spatial change in marsh plant assemblages along estuaries, river banks or tributaries observed in coast to hinterland transects. This change is related to a general upstream decrease in salinity (less tidal influence) (Chapman, 1960). The typical association in this situation is one where *Spartina alterniflora* marshes grade laterally into marshes dominated by *Spartina cynosuroides* (generally a freshwater swamp species) and eventually to upland plants and trees (Chapman, 1960). This is the general plant zonation observed going upstream along the shores of South Santee River and along the shores of Winyah Bay. The transition between *Spartina alterniflora* and *S. cynosuroides* dominated marshes (along the riverbank) occurs between Transects 5 and 10 in the South Santee River system while *Spartina alterniflora* fringes much of the shoreline of Winyah Bay. In the very upper reaches of Winyah Bay, and along the Intracoastal Waterway, *Spartina cynosuroides* dominates because of the lowered salinities. Similar plant associations occur along the shoreline of Chesapeake Bay and estuaries draining into the Bay (Ellison and Nichols, 1976). In Nova Scotia a smaller variety of *Spartina cynosuroides* is virtually never in tidal areas regardless of salinity (Scott and Medioli, 1980a), showing some of the regional variation in plant species.

In this study, mean high water (MHW) is defined as the upper limit of the *Spartina alterniflora* zone. The area of the marsh surface above this horizon is considered to be high marsh, usually dominated by *Distichlis* spp. or *Juncus* spp.; the area below, which is either exclusively or strongly dominated by *Spartina alterniflora*, is considered the low marsh. A transition, or middle marsh with a mixed floral assemblage (but containing *Spartina alterniflora*) separate the two "end member" zones. Mean sea level is considered to be the lower limit of the growth of *Spartina alterniflora*, which is a reasonable assumption according to Chapman (1960). Highest high water is generally considered the point above which halophytes do not grow (Scott and Medioli, 1980a). This relationship has generally been shown to hold true in Nova Scotia (Scott and Medioli, 1980a) as well as in Maine (Gehrels, 1994) although in some transects from Chezzetcook Inlet, Nova Scotia, Scott and Medioli (1980a) reported that *Spartina alterniflora* can extend up to 30 cm below MSL.

The tidal range often becomes distorted as the tide propagates into shallow estuaries or into small tidal inlets inland along the U.S. East coast (Aubrey and Speer, 1985; Lincoln and Fitzgerald, 1988). Both of these studies reported a decrease in tidal amplitude with distance from the open ocean. A 50 to 60% decrease in tidal range over a distance of five to six kilometers was reported by Aubrey and Spears (1985) in a back barrier system in Massachusetts. Lincoln and Fitzgerald (1988) also reported a non-linear decrease in tidal amplitude with distance from some small Inlets in Maine; the reduction was attributed to the channel geometry and the broad, widespread character of the back barrier marshes. The spatial distribution of *Spartina alterniflora* was also observed in the marshes they investigated. The range in elevation of the upper limit of the *Spartina alterniflora* zone in transects from Murrells Inlet, although not quantified by relating the levels to benchmarks, may also be related to a spatial variation of mean high water levels. The upper limit of the floral zone dominated by *Spartina alterniflora* was approximately 100 cm above the lower limit of *Spartina alterniflora* (which was used as MSL in this study) at Transect 7 (near the open coast) while it was only 55 cm and 60 cm above MSL at Transects 2 and 8 respectively (near the head of the inlet). There are two causeways with bridges crossing the tidal channel between the mouth of Murrells Inlet and the head of the marsh system where Transects 2 and 8 were sampled; these may also be affecting the tidal flow since they cause a large decrease in the tidal prism (Scott et al., 1976).

In their study of Chezzetcook Inlet, Scott and Medioli (1980a) recognized that along the sides of some channels the slope was very steep due to the undercutting of the marsh peat by tidal currents. Along these channels there was usually a poorly developed low marsh with a narrow zone of *Spartina alterniflora*. In the transects at the head of Murrells Inlet, the slope was also somewhat steep close to the edge of the tidal channel (observed at low tide especially at Transect 8). A similar situation was observed at most transects, including Transect 7 at the mouth of the Inlet (ie. there were no gradational slopes to MSL or extensive mudflats). Although there is a well developed, extensive low marsh around the channel, both at Transects 2 and 8 near the head of Murrells Inlet, the lower limit of the *Spartina alterniflora* zone identified here may not be the true lower limit of this zone. Possibly some combination of changes in tidal amplitude from the mouth to the head of Murrells Inlet, the presence of causeways, or not establishing the true lower limit of the *Spartina alterniflora* zone (in relation to MSL by comparing this level to benchmarks) may account for the differences in the upper limit of the *Spartina alterniflora* zone between the head and mouth of Murrells Inlet.

4.2 Foraminifera From Surficial Marsh Transects and Comparison With Other Marshes

According to Scott and Medioli (1978; 1980a), there are discrete vertical ranges of certain species or assemblages of agglutinated salt marsh foraminifera which make them "the most accurate" sea-level indicators on temperate coastlines since these foraminiferal assemblages are generally preserved in subsurface sediments. The vertical zonation concept is based on the principal that there is a relationship between ecological parameters and species that controls their distribution (elevation). Some of these include salinity, temperature, substrate and length of tidal submergence. In their study of Chezzetcook Inlet, Nova Scotia, Scott and Medioli (1980a) identified an assemblage containing 100%

Trochammina macrescens that was restricted to a 6 cm vertical range along the uppermost edge of the marsh. Above this interval no foraminifera were present. Other foraminiferal assemblages were related to various elevation intervals across the marsh surface. Although the broad trends in foraminiferal distributions generally followed the halophyte zonation in Chezzetcook Inlet (ie. low to high marsh zones), these plant zones could be subdivided based on their associated agglutinated foraminiferal assemblages. Since the halophytes in Chezzetcook Inlet had larger vertical ranges than the agglutinated foraminiferal assemblages Scott and Medioli (1980a) concluded that they were less useful as accurate sea-level monitors than the foraminifera. Another problem with using salt-marsh plant remains as indicators of former marsh elevations is that identification of the plant remains from subsurface sediments to the species level can be extremely difficult. Conversely, in a preliminary quantitative study relating marsh foraminiferal distributions to elevation above mean sea level, in southern California, Scott (1976a) noted that the elevation ranges of some marsh species correlated exactly with the floral ranges. In marsh sediments from Sapelo Island, Georgia, Goldstein and Frey (1986) reported associations of marsh foraminiferal assemblages with specific marsh habitats but did not give vertical intervals for these associations. These examples show that there is a relationship between marsh foraminiferal assemblages and halophyte assemblages across the marsh surface which in turn can be generally related to sea-level or tidal variations.

4.2.1 Murrells Inlet

Although there are many similarities in species composition and spatial distribution of foraminifera within the transects from Murrells Inlet, there are also some striking differences (Figures 6-11). Transect 2 from the head of the Inlet has a distinctively high calcareous component (*Ammonia beccarii* and *Elphidium excavatum* spp.) in the high marsh, in both the living and total assemblages. Of all the marshes examined during this study, this is the only one where this situation occurs. Phleger (1965a) reported high percentages of calcareous foraminifera (*Ammonia beccarii- Elphidium* spp.) in sediments from a Mangrove marsh in Florida where the substrate was an organic calcareous quartz sand and silt. Phleger (1965b, 1965c) also identified living *Ammonia beccarii* and *Elphidium* spp. in coastal Texas marshes and lagoons. *Elphidium* spp. were generally restricted to the lower marsh while *Ammonia beccarii* was abundant throughout the marshes. These species were also common in the bays and lagoons surrounding the marshes and Phleger (1965b) suggested that they might have been introduced to the marsh during times of flooding from either the ocean or the lagoons. This may also be the case at Transect 2; the high marsh is not far from the ocean and is flooded periodically during storms or extreme tides. These species are present in nearshore environments seaward of the marsh (Figure 23). This possibility also seems to be supported by the presence of *Gavelinopsis translucens*, a marine foraminiferal species (Murray, 1991) which was observed in high marsh sediments from Transect 2. What is unusual is that *Ammonia beccarii* and *Elphidium* spp. have only occupied the sandier high marsh environment along this transect suggesting the possibility that tests deposited in the generally muddier, lower pH low marsh sediments may have dissolved. Given the high numbers of living specimens observed in high marsh sediments at the time of collection their presence should have also been observed in the low marsh if they were utilizing that habitat. In Chezzetcook Inlet, Scott and Medioli (1980b) identified living calcareous foraminiferal specimens in low marsh sediments with rare, badly etched, dead calcareous tests indicating the calcareous species dissolve quickly after death in the low pH marsh environments. Since Transect 2 was collected less than one year after Hurricane Hugo, this calcareous assemblage may be a result of flooding of the marsh with marine water during the hurricane, transporting these calcareous species to this locality and then conditions being favorable for their reproduction. Transect 8 on the opposite side of the channel was collected one year later. If calcareous foraminifera had been transported there by the hurricane, there was no record preserved in the surficial sediments.

Hurricane Hugo, with sustained winds of 248 km/hr, made landfall just north of Charleston, South Carolina on September 22, 1989 (Sexton and Hayes, 1991). This occurred about one hour before high tide and the storm surge ranged from between four and five meters above MHW in the Santee Delta region (Sexton and Hayes, 1991) and up to 3.6 m above mean low water along Myrtle Beach (Hall and Halsey, 1991). The head of Murrells Inlet (location of Transects 2 and 8) was probably flooded both by the surge directly from the ocean as well from increased water levels in the Inlet and tidal channels. Although there was little sediment deposited or major geomorphic changes as a result of the storm surge at inland localities along the coastline (Hall and Halsey, 1991; Gardner et al., 1992; Sexton, 1995), objects as large as refrigerators scattered across the marsh surface at Murrells Inlet (P. Gayes, pers. comm., 1990) were evidence of the high energy of this catastrophic event.

Parker and Athearn (1959) also reported calcareous species in marsh sediments from Massachusetts, although they were typically restricted to the low marsh. In Georgia, *Ammonia beccarii* is present throughout most marshes, from low to high marsh but with low numbers in high marsh sediments, while *Elphidium* spp. are restricted to the low marsh (S. Goldstein, pers. comm., 1995). There are low numbers of *Ammonia beccarii* and *Elphidium* spp. in some low marsh samples from Transect 7 but they do not extend into the high marsh zone.

Miliammina fusca and *Ammotium salsum* generally dominate the assemblages within the low marsh sediments from all Murrells Inlet transects. Subsidiary species in many samples include *Trochammina inflata* and *Arenoparella mexicana. Arenoparella mexicana* has also been identified in the low and high marsh zones in Georgia (Goldstein and Harben, 1993). Relatively high percentages of *Arenoparella mexicana* were present in samples near the channel end of Transect 8 although they were present generally throughout most of the transect. Calcareous species are present near the channel end of Transect 7. The dominant low marsh foraminiferal species from Murrells Inlet are similar to those from marshes to the north, ie. Maine (Gehrels, 1994) and Nova Scotia (Scott and Medioli, 1980a) although there are more subsidiary species in the Murrells Inlet samples. There is generally a lower calcareous component in these samples than in low marsh sediments to the south (Phleger, 1965b, 1965c; Goldstein and Harben, 1993).

To define an overall foraminiferal zonation, related to absolute elevation, of Murrells Inlet marsh system is somewhat problematic. With the difference in elevations between the boundaries of the high and low marshes from the head to the mouth of the Inlet, placing a number on this change for the whole system would be misleading in the absence of benchmarks. At Transect 7, closest to the ocean, and not affected by the possible tidal distortions previously discussed, more typical high and low marsh foraminiferal associations are observed. *Ammotium salsum* and *Miliammina fusca* generally dominate in low marsh assemblages to about +100 cm above the base of *Spartina alterniflora* (considered MSL). There are also significant percentages of *Ammonia beccarii* and *Elphidium* spp. near the channels. In the middle marsh (+100 to +150 cm) the foraminiferal assemblage is dominated generally by *Trochammina inflata* with high percentages of *Siphotrochammina lobata* and *Trochammina macrescens* in some samples. Between +110 cm and +121 cm, near the seaward end of the channel, there is an assemblage strongly dominated (but with relatively low numbers) by *Trochammina macrescens* although this assemblage is not repeated at equivalent elevations along the transect. This suggests there is some microhabitat favorable (and not necessarily elevation control) for this peak of *Trochammina macrescens* in this transect. In the high marsh of this transect (greater than +150 cm), the foraminiferal assemblage was again dominated by *Trochammina inflata* with some *Haplophragmoides wilberti;* this is the high marsh assemblage zone identified in sediments from North Inlet (see next section).

Scott and Medioli (1980a) used *Haplophragmoides bonplandi* (= *Haplophragmoides manilaensis*, this study) as a high marsh indicator species in Wallace Basin, Nova Scotia. Scott et al. (1990) used *Haplophragmoides* spp. (*Haplophragmoides manilaensis* + *Haplophragmoides wilberti*) and *Trochammina inflata* to characterize the environment above mangroves (high marsh) in Guaratuba, Brazil. They suggested that there may be an intergradation between these two species and included them as a group. There also appeared to be an intergradation in some specimens from South Carolina marshes although in most cases the typical end member species could be recognized. Generally, *Haplophragmoides wilberti* (and if intergradational, *Haplophragmoides manilaensis*) may also be considered a low salinity indicator since it was living (although in low percentages) along the riverbank in the upper reaches of Santee River (Appendix Table 11), presumably in a low salinity environment. In a study of the Great Marshes, Massachusetts, de Rijk (1995) presented data showing a positive correlation of *Haplophragmoides manilaensis* with elevation above mean high water and suggests that it may prefer more elevated areas. Nevertheless, she concludes that *Haplophragmoides manilaensis* is a low salinity indicator and that there is no relationship with elevation above mean sea level. A problem with this study is that de Rijk (1995) presented data only for those samples above mean high water. Since *Haplophragmoides manilaensis* occurs in the high marsh deposits at the Great Marshes it may (and since typical low marsh species are not present in her data set) be a high marsh, low salinity indicator. That interpretation of her work agrees well with that of this study and of other previous works.

The zonation observed in the marshes from Murrells Inlet is not as well refined as those from the northern marshes (ie. Scott and Medioli, 1978; 1980a; Gehrels, 1994). This may in part be due to the fact that there has been a lot of development around the head of Murrells Inlet and possibly this marsh system has not yet recovered from the possible alterations in the foraminiferal assemblages as a result of Hurricane Hugo. The interesting factor with Hurricane Hugo is that there is little or no sedimentological trace of this event on the modern marsh surface.

In all three transects from Murrells Inlet, foraminifera were living in the highest vertical samples of the transects, which, when sampled, had been thought to be at or above highest high water. This feature contrasts with the studies of Scott and Medioli (1980a) and Gehrels (1994) where environments above highest high water were barren of foraminifera. Transect 2 ended at the edge of a resident's backyard. At this site there were surprisingly high percentages of *Ammonia beccarii*, typically a low marsh to estuarine species (Murray, 1991), living in the highest marsh (that was dry and sandy) with sparse vegetation and bordering upland grass, ie., an environment in which salinity must be typically very low. Goldstein and Frey (1986) reported low total percentages of *Ammonia parkinsoniana* in moist high (*Juncus*) sediments from Sapelo Island, Georgia, but did not report on living percentages. Goldstein and Harben (1993) also reported low living and total percentages of *Ammonia beccarii* in moist high (*Distichlis*) marsh sediments which is perhaps not surprising since the *Distichlis* marsh is vertically lower than the *Juncus* marsh in Georgia (S. Goldstein, pers. comm., 1995). At the end of Transect 7, there were low numbers of living *Haplophragmoides wilberti*, *Siphotrochammina lobata* and *Trochammina inflata* living at the edge of the *Juncus* marsh. This transect ended at the edge of a forest, and although the numbers of both living and total foraminifera decrease, they were present above what is considered highest high water. Goldstein and Frey (1986) reported *Siphotrochammina lobata* from unvegetated tidal creeks but not in sediments from the high marsh, while Goldstein and Harben (1993) reported low percentages of both living *Haplophragmoides wilberti* and *Trochammina inflata* in high (*Distichlis*) marsh sediments in Georgia. In any case, although not measured, the salinity must be low for these nearby upland plants and trees to survive so these foraminiferal species can tolerate very low salinities. In more northern marshes, *Trochammina inflata* has been considered to thrive more in the upper low to middle marsh (ie. Scott and Medioli, 1980a). Transect 8 ended at the edge of the *Typha* spp. swamp, typically freshwater (Chapman, 1960), and very close to cypress trees and a resident's backyard. There were very high numbers of living foraminifera in these samples and the living assemblage was strongly dominated by *Miliammina fusca*. *Miliammina fusca* is generally considered to be an intertidal to low marsh species tolerating a salinity range of 0 to 35‰ (Murray, 1991) although usually found in localities at the lower end of this range. It generally lives in low marsh localities with salinities between 0 and 10‰ in Chezzetcook Inlet marshes, Nova Scotia (Scott and Medioli, 1980a) and in low marsh localities in Maine (Gehrels, 1994). It is interesting that *Miliammina fusca* is the dominant living taxon, with high total abundances in these high marsh sediments and the high abundances observed at the end of Transect 8 suggest that its presence is not exclusively controlled by either salinity or elevation. A similar situation was observed in a very brackish marsh in Japan (Scott et al., 1995c). *Ammoastuta inepta*, a typical low salinity foraminiferal species present in the high marsh along the James River Estuary, Virginia (Ellison and Nichols, 1976) is also present in high marsh sediments at the end of Transect 8 both in the living and total assemblage. *Haplophragmoides wilberti* is also present here, as expected, since this species is also a good high marsh indicator. There is a general inverse relationship between salinity and elevation in the salt marsh (especially if there is little marine influence other than tidal channels) and it appears that the relatively lower salinities at the end of Transect 8 may be affecting the assemblages present. The absence of large populations of arcellaceans suggest that freshwater input is relatively low (Medioli and Scott, 1983); rainfall is probably the only source of surface freshwater. In each of these cases the marsh foraminifera did extend slightly higher than what has been considered highest high water on the basis of floral zone boundaries. This suggests that salinity may be raised by capillary action creating a slightly brackish sediment/water interface suitable for foraminifera and that they may not necessarily require exposure to the effects of tides. If these typically low marsh foraminiferal species were passively transported to the high marsh (possibly during Hurricane Hugo), they have adapted well to conditions in this environment.

Phleger (1976) relates the number of foraminifera in a given locality to the organic production at that site. In areas with high organic production there is generally a high concentration of benthic foraminifera. Taken somewhat further, this relationship can be tied to the total organic matter concentration in sediments, since Phleger (1976) stated that marshes with sandy substrates generally have small standing crops of both marsh plants and foraminifera. Areas with high organic matter concentrations create an environment favorable for production of food for foraminifera (ie. bacteria or algae) (eg. Lee and Muller, 1973; Murray, 1991). Scott et al. (1991) noted limited marsh foraminiferal faunas in areas that had been affected by two hurricanes the year before collection; the hurricanes had swept the area clean of vegetation and the next year the plants (and organic matter) were just being reestablished and numbers of foraminifera were low compared to areas not affected by the hurricanes. Phleger (1976) also noted that in the highest marsh, although it may be organic-rich, there may be low densities of foraminifera since the area may only rarely be flooded by tides however in more northern marshes this does not appear to be true until you get above tidal influence (Scott and Medioli, 1980a; Gehrels, 1994). If there is a lot of freshwater influence, it would be expected that arcellaceans would colonize this environment.

Overall, percentages of organic matter were higher in Transect 8 and there were also higher total numbers of both total and living foraminifera in these sediments than those observed in Transect 7 material. Generally organic content will be higher as the marsh gets fresher (ie. higher plant productivity and diversity) so it is not surprising that total numbers of foraminifera would increase while diversity decreases. Some of the highest marsh foraminiferal densities measured (at least known to the author), both in living and total populations, are in a low salinity, highly organic marsh in eastern Hokkaido, Japan (Scott et al., 1995c). Numbers of both total and living foraminifera were also higher in sediments from Transect 2 (at the head of the Inlet) than Transect 8 and this suggests that the habitat for certain species of marsh foraminifera is more favorable at the head, rather than the mouth of the Inlet. The area around the head of the marsh is more sheltered than at the mouth and the freshwater entering the system is less diluted allowing more plant growth, more organic matter and more foraminifera.

4.2.2 North Inlet

Transects 1 and 6 showed very similar patterns in the benthic foraminiferal distributions (Figures 12-15). Well defined foraminiferal assemblage zones are identified from these transects based on the dominance of certain species. The elevations of the subdivisions of the marsh based on the plant zonations (ie., high, middle and low marsh) in relation to MSL corresponds well between the two transects, although they have not been tied to a benchmark but are based instead on the lowermost occurrence of *Spartina alterniflora* as being equal to MSL.

There are four distinct assemblages that are indicative of elevation changes within these transects. Below the MHW level (based on the dominance of *Spartina alterniflora*), the marsh fauna can be divided into two zones: the first (= Scott and Medioli, 1980a, Zone II B) ranges from MSL to +66 cm at Transect 1 (Figure 43) and from MSL to + 52 cm at Transect 6 (Figure 44). This assemblage contained varying percentages of *Ammotium salsum*, *Miliammina fusca*, *Trochammina inflata*, *T. macrescens* and *Siphotrochammina lobata*. There is also a zone strongly dominated by *Miliammina fusca* from + 66-77 cm at Transect 1 and from + 52-70 cm at Transect 6 (= Scott and Medioli, 1980a, Zone II A_1). Zone 3, corresponding to the middle marsh, is strongly dominated by *Trochammina inflata* with lesser percentages of *Trochammina macrescens* and *Siphotrochammina lobata*. This zone ranges from + 77 cm to + 105 cm at Transect 1 and from + 70 cm to + 111 cm at Transect 6. It corresponds roughly to Zone I B_2 of Scott and Medioli (1980a). The remaining zone, which marks the high marsh, is similar in faunal character to the middle marsh zone with the addition of significant percentages of *Haplophragmoides wilberti*. This zone corresponds approximately to Zone I B_1 of Scott and Medioli (1980a). Figure 45 shows the relationship of foraminiferal species along Transect 1, North Inlet with Scott and Medioli's (1980a) overall foraminiferal zonation from Chezzetcook Inlet (which is typical for marshes in most temperate areas).

Most of the foraminifera present in the low marsh Zone 1 are also present in Sample 34, Transect 1, that was taken 35 cm below the lowermost *Spartina alterniflora* (MSL in this study). This would make it virtually impossible to distinguish these shallow subtidal or mudflat deposits near the marsh based only on the benthic foraminifera. The total number of specimens per sample are generally higher in the marsh sediments although this may not always be the case. The high numbers in Sample 34 may be partially due to its proximity to

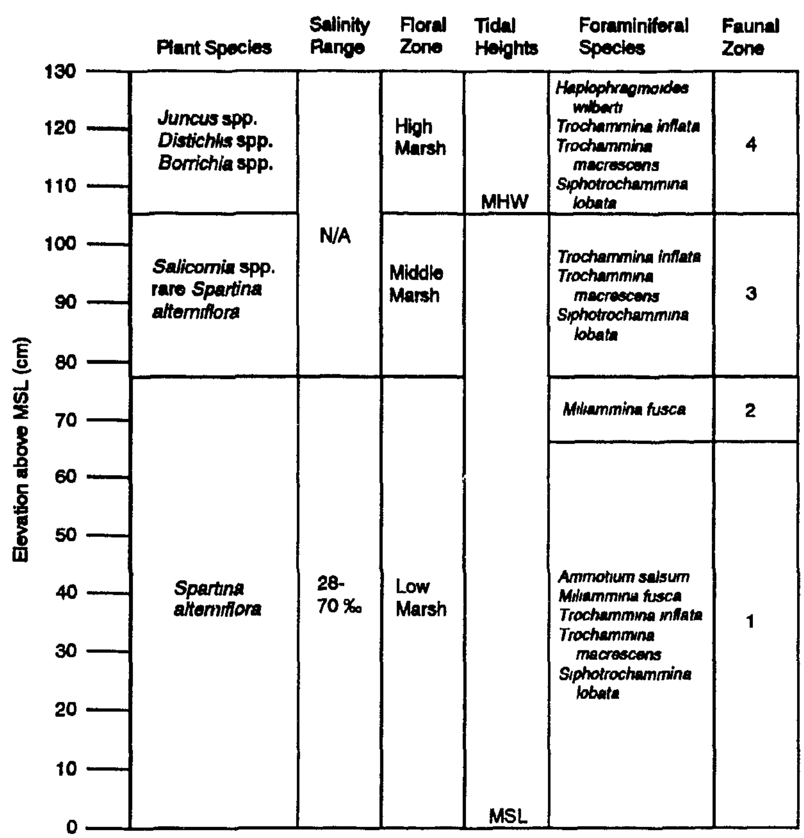


Figure 43. Summary of North Inlet, Transect 1; physical, vegetation and foraminiferal data. MSL = mean sea level, MHW = mean high water.

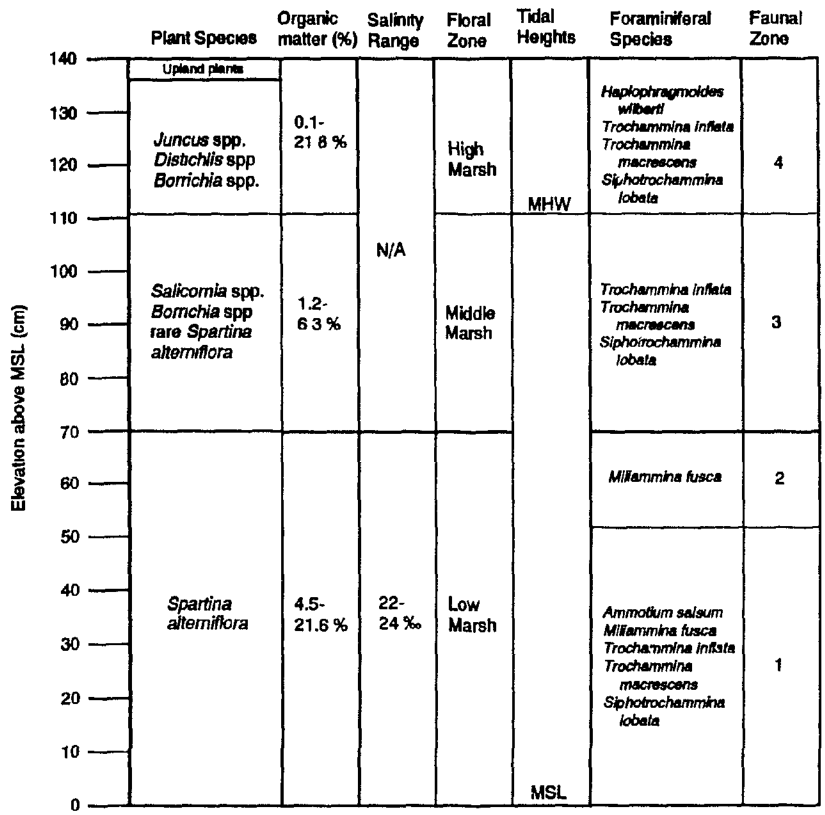


Figure 44. Summary of North Inlet, Transect 6; physical, vegetation and foraminiferal data. MSL = mean sea level, MHW = mean high water.

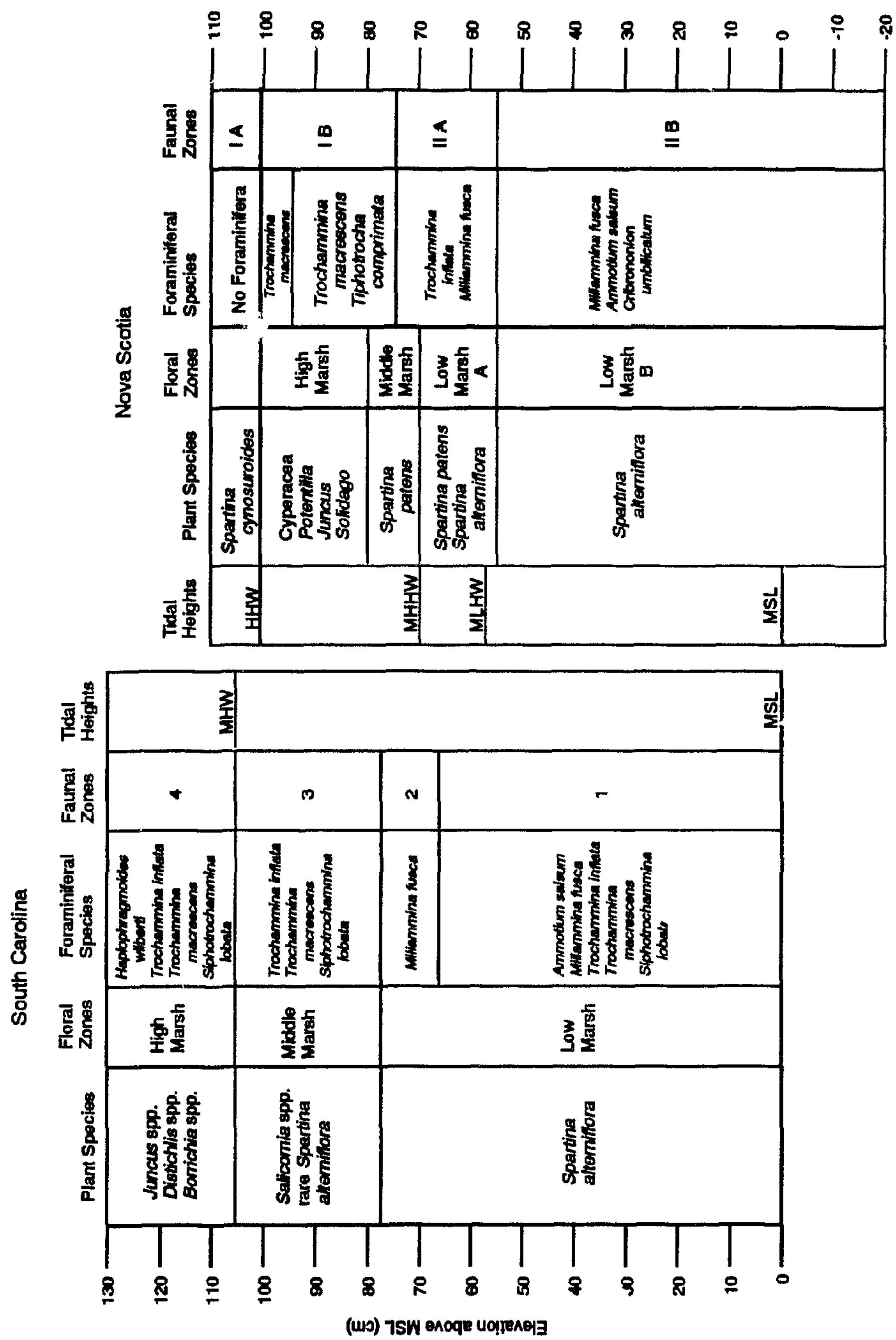


Figure 45. Comparison of North Inlet marsh data and Chezzetcook Inlet, Nova Scotia (Scott and Medioli, 1980a). MSL = mean sea level, MLHW = mean lowest high water, MHHW = mean highest high water, MHW = mean high water, HHW = highest high water.

the marsh edge where foraminifera may be transported into the channel through tidal action and/or slumping from marsh banks.

Scott and Medioli (1980a) and Gehrels (1994) both identified an assemblage containing only *Trochammina macrescens* in the highest high marshes from Nova Scotia and Maine respectively. This assemblage was also recognized in subsurface sediments and was considered to be a very accurate indicator of former sea-level position in their studies. The distribution of *Trochammina macrescens* along the two North Inlet transects show that there is no relationship of this taxon to elevation at these localities. In the total assemblage this species is present from the lowest to highest marsh, with lowest percentages in the upper low marsh (Zone 2). The living distribution is different from that of the total; highest living percentages are generally in the higher marsh although there are also living members in the low marsh. This suggests that the distribution is not totally related to salinity variations since this species is living both at higher and lower salinity areas. There appears to be a weak association of the *Trochammina macrescens* distribution with organic matter here; generally there are higher living percentages of living *Trochammina macrescens* at sample localities with low organic matter concentrations, especially in the high marsh. This could in part be due to low numbers generally and a more random distribution of the species here where it is not dominant. However, this species appears to favor high organic matter - the highest densities (both total and living) occurred in Japan in almost freshwater marshes. Also the highest living and total numbers of *Trochammina macrescens* in Chezzetcook Inlet occurred in the most brackish station which was high in organic matter (Scott and Medioli, 1980b). The distribution of *Siphotrochammina lobata* generally follows a similar pattern to *Trochammina macrescens. Trochammina inflata*, both in the living and total distributions, is more restricted to the high marsh. *Haplophragmoides manilaensis*, the low salinity indicator in the Great Marshes, Massachusetts (de Rijk, 1995), was observed in some high marsh sediments, but at much lower percentages than *Haplophragmoides wilberti.* Both of these species were restricted to the high marsh which again suggests there may be some salinity, as well as elevational control in their distribution.

4.2.3 Santee Delta

Three transects were obtained along Santee River (Figures 16-21) in what, from the vegetation zones, were considered to be affected by varying degrees of salinity. Near the mouth of the river Transect 4 displayed the typical floral associations (although the floral zones were somewhat narrow) from low to high marsh that were also observed at the higher salinity localities in Murrells and North Inlets. Upstream, at Transect 10, *Spartina alterniflora* was replaced by *S. cynosuroides* across the marsh. Along Transect 5 only *Spartina cynosuroides* was observed. It was expected that the transition from more marine to freshwater-influenced conditions, indicated by the floral assemblages, would be observed with respect to foraminifera in these transects but the relationship is not as simple as one in which foraminifera are replaced by arcellaceans.

Total numbers were very low throughout much of Transect 4 except from Station 20 to the end; the assemblage was strongly dominated by calcareous species (*Ammonia beccarii* and *Elphidium* spp.). Very rare living calcareous specimens were present perhaps a result of transport during washover from the nearby ocean. Few living marsh foraminifera were also present in these samples. The Holocene barrier sands (Sexton et al., 1992), on which the marsh has accreted, contain very little organic matter and the calcareous assemblage is a relict one. Although the low numbers of foraminiferal specimens present in this transect disallow any firm conclusions, some trends are worth mentioning.

Within the marsh itself there is a very narrow low marsh zone (5 m) along a steep topographic gradient. This zone contains the typical low marsh assemblage identified at both Murrells and North inlets (*Miliammina fusca* and *Ammotium salsum* with some *Trochammina inflata*) although here there are also significant percentages of *Trochammina ochracea* here. *Trochammina ochracea* is also common in Transects 5 and 10 further upstream. This species has a broad distribution that extends from the low marsh into South Santee River (see Appendix Table 11). Buzas (1965) identified *Trochammina squamata* (= *Trochammina ochracea*, this study) in many samples from Long Island Sound.

Excluding the sandy interval at the end of Transect 4, there is a 17 cm vertical change in elevation along the remainder of the transect (a distance of 101 m) and there are changes in the floral assemblage along the transect. Total numbers of foraminifera are low along the remainder of the transect except for Sample 19 which had more individuals (103 inds/10 cm^3). *Haplophragmoides wilberti* is again generally dominant at higher elevations, throughout much of the mid- to high marsh (based on the floral zonation), although the salinities measured in the middle marsh are high. These were "one time" salinity measurements and may not reflect either average or extreme values. *Arenoparella mexicana* and *Trochammina inflata* have high percentages through the transect but these species alone do not define any zonation. *Trochammina macrescens* showed a bimodal distribution and therefore cannot be used by itself to characterize a zone in relation to mean sea level as has been done in some northern areas (ie., Scott and Medioli, 1980a; Gehrels, 1994). There is a peak of *Siphotrochammina lobata* in the high marsh (based on halophyte associations) but, because of low total numbers, its use as a high marsh indicator is questionable. High percentages of this species were found in the high marsh both at Murrells and North Inlets, although not exclusively. A bimodal distribution of this species was observed at North Inlet. It is curious that there are living specimens of many of the marsh species in the high marsh and even in the sandy area at the end of the transect. The only typical low marsh species not found living there is *Ammotium salsum*.

In both Transects 5 and 10 a curious mixed foraminiferal and arcellacean species assemblage was identified. The surface samples in the: transects may be reflecting changes, presumably in salinity, caused by the rediversion of freshwater flow back to the Santee River in 1986. Since the accumulation rate of sediment on the recent marsh surface is not known, the numbers of years represented in the interval from 0-1 cm is cannot be estimated.

Medioli and Scott (1983), Collins et al. (1990) and Medioli et al. (1994) all suggested that the arcellacean species *Centropyxis aculeata*, although considered a freshwater species, could live and reproduce in slightly saline environments. Other arcellacean genera were considered to live exclusively in freshwater environments. In their study of foraminiferal and arcellaceans distributions in the lower Mississippi Delta, Scott et al. (1991) reported moderate percentages of living *Centropyxis* spp. in the brackish marshes (extremely rare living occurrences of *Difflugia* spp. were reported in a few samples from these transects) while even in their freshwater transects they observed low percentages of *Difflugia* spp. The low percentage of foraminiferal species in these freshwater marshes were attributed to episodic marine incursions, primarily from storms. In Santee Delta Transect 10, although *Centropyxis* spp. are the dominant living arcellaceans, there are consistent occurrences of live *Difflugia* spp. and *Cucurbitella tricuspis* in many samples in association with living foraminifera. This indicates that these arcellacean species also have a salinity tolerance (assuming that the foraminifera need some marine influence to live and reproduce).

It has been suggested that substrate composition may also control the arcellacean distribution at a given locality (Haman, 1990; Scott et al., 1991) and that in areas with little sand (ie. floating marshes or bogs) genera such as *Centropyxis* will dominate the assemblage while in more mineralic localities *Difflugia* spp. may dominate. Both genera have been recognized in samples from bogs in Nova Scotia (Medioli and Collins, unpublished data). Collins et al. (1990) suggested that climate and limnologic conditions also control the distributions of the taxa (eg. in a lake in Virginia with high concentrations of the algae *Spirogyra* spp., *Cucurbitella tricuspis* generally dominated although there were high percentages of both *Centropyxis* spp. and *Difflugia* spp.). There are high organic matter concentrations, as well as a high mineralic content in sediments from Transect 10, therefore substrate composition should not be a limiting factor for either *Centropyxis* spp. or *Difflugia* spp. In any case, this is the first known occurrence of *Difflugia* spp. and *Cucurbitella tricuspis* living throughout a marsh with living marsh foraminifera and is attributed to possible previously unreported salinity tolerances of these species.

Even with the mixed foraminiferal and arcellacean assemblage, some vertical zonation of the associated foraminiferal species is evident. It appears that this is the only transect where samples were obtained above highest high water. These samples (1 and 2) contained few, almost exclusively arcellacean specimens. Only terrestrial plants were present. In the floral zone that was strongly dominated by *Spartina cynosuroides*, (between +115 cm and +154 cm), highest total numbers of foraminiferal specimens were present and the assemblage was strongly dominated by *Haplophragmoides* spp. with lower percentages of *Ammoastuta inepta*, *Miliammina fusca* and *Trochammina macrescens*. This assemblage is similar to the high marsh assemblages identified at the other localities. High numbers of foraminifera in the *Spartina cynosuroides* zone contrasts markedly with results from Nova Scotia (Scott and Medioli, 1980a). No foraminifera were found in sediments from this plant zone in Nova Scotia; elevation measurements showed that this floral assemblage was growing above highest high water (Scott and Medioli, 1980a). This does not appear to be the case in South Carolina since foraminifera are living within the *Spartina cynosuroides* zone.

The remainder of the marsh has very little vertical change, approximately 7 cm (until it drops off near the channel). Generally, along this section of the marsh, the total assemblage is co-dominated by *Ammotium salsum*, *Miliammina fusca* and arcellaceans while the living assemblage is strongly dominated by arcellaceans. The exception is between Stations 7 and 11 where there were high total and living percentages of *Ammotium salsum*; there was a lateral floral change in this interval (an increase in *Scirpus* spp.) although this does not appear to be related to an elevation change. The difference between the species composition of living and total populations here may be indicative of changes in the hydrology of the river (the rediversion); the total population averages the accumulation of individuals over time (Scott and Medioli, 1980b) while the living population represents conditions at one time (Murray, 1984). Along this central, relatively flat portion of the transect the living microfossil assemblage suggests that conditions are quite fresh while the total assemblage suggests that conditions are more marine. Here the living population may be better reflecting the present conditions, with probable freshening since the rediversion of the flow back to Santee River, than the total although this is highly speculative without the benefit of core data from this locality. Salinities of 0‰ were obtained between Stations 10 and 14 although these were one time measurements only and probably do not reflect average salinity conditions.

Most marsh foraminifera are capable of withstanding a broad range of conditions since the marsh is an extremely harsh and variable environment (Phleger and Bradshaw, 1966; Murray, 1991). The foraminifera present in samples along Transect 10 may be particularly suited to withstanding extremely low salinities over a long period of time (Ellison and Nichols, 1976; Murray, 1991). It is interesting to note that *Trochammina inflata*, common to abundant in other transects including Transect 4 downstream, is rare or absent in most samples from this transect suggesting that it may need higher salinities to thrive. Murray (1991) lists its salinity range as highly variable.

No elevations were obtained, and the distances between samples along the short Transect 5 are approximate, but the faunal associations observed here are generally similar to those observed near the channel at Transect 10. Here living and total distributions are much more similar than in Transect 10; the main difference between these two transects is the higher percentage of living *Ammoastuta inepta* (although total numbers are low). In both transects, over comparable distances from the channel edge, organic matter percentages are similar; the only difference identified here is floral composition. *Spartina cynosuroides* dominates this interval in Transect 5 while *S. alterniflora* dominates Transect 10.

4.2.4 Comparisons Between Marsh Systems

Generally, a similar marsh foraminiferal assemblage zone (dominated by *Miliammina fusca* and *Ammotium salsum* usually with some *Trochammina inflata*) was recognized in sediments from the low marsh in all marine influenced-transects from Murrells Inlet, North Inlet and Santee Delta. High percentages of *Trochammina ochracea* were also present in low marsh sediments from Santee Delta, Transect 4. The best zonation of foraminiferal assemblages was recognized in sediments from North Inlet, where a subzone of the low marsh was recognized, and where low and high marsh assemblages were recognized at all localities. *Haplophragmoides wilberti* appeared to be a reliable high marsh indicator (above mean high water) in most transects; it was typically associated with low salinity plant assemblages. Santee Delta Transect 10 has a mixed foraminiferal and arcellacean faunal assemblage which may be reflecting the change in the hydrology of Santee River. Within this mixed assemblage, a distinctive high marsh foraminiferal assemblage could also be recognized. Although zonations can be recognized in these data, they are not as well-defined (and with different species contained in some zones) as in the marshes to the north (Nova Scotia, Maine and Massachusetts).

This suggests that although most of the marsh foraminiferal species are ubiquitous, there are regional differences in assemblage compositions that can possibly be related to climatic variations. Even within the same climatic region, marshes with broad variations in chemical or physical parameters (eg. salinity, organic matter composition, tidal exposure time, sediment type) will affect the foraminiferal assemblages across a marsh surface. The marsh foraminiferal assemblage zone is essentially a result of the tolerances of the various foraminiferal species to differing physical and chemical conditions that are usually different at different elevations. On a microscale this can be seen in Chezzetcook Inlet where *Haplophragmoides* spp. is a dominant component in upper estuarine high marsh assemblages but absent from high marsh assemblages in lower estuarine areas of the same inlet (Scott and Medioli, 1980a).

4.3 Estuarine Foraminiferal Assemblages and Relationship to Pollution

There are distinct differences in the estuarine fauna between the three localities studied. Murrells Inlet sediments contain a typical brackish water assemblage dominated by *Ammonia beccarii* and *Elphidium excavatum* spp. (Figure 22) identified in many estuaries along the western Atlantic seaboard (Murray, 1991). Although development has taken place around parts of the inlet, there is little evidence in the estuarine foraminiferal assemblages for anthropogenic changes. Species diversity decreases towards the mouth of the inlet (from Station 14) and this may in part be related to fewer marsh foraminifera (washed in from the fringing marshes) and higher energy conditions here. A similar situation, which was related to higher energy conditions, occurred near the head of

Chezzetcook Inlet; although conditions became more marine both species density and diversity decreased (Scott et al., 1980a). At Chezzetcook Inlet there was a decrease in numbers of more delicate species such as *Buliminella elegantissima* and an increase in more robust ones such as *Cibicides lobatulus* (Scott et al., 1980a); similar to what was observed in these samples. Organic matter percentages are low (less than 4%) throughout the inlet although they are lowest in these samples. The total numbers of foraminifera also decline at Station 14; from here the total numbers and species composition are similar to those in samples from the nearshore locality at Murrells Inlet (Figure 23). There are generally higher percentages of *Ammonia beccarii* in the nearshore samples which may be a result of higher salinities.

There are very few estuarine foraminifera in samples from South Santee River (Figure 24). Most of the foraminiferal assemblage consists of specimens washed in from the fringing marshes while arcellaceans are present in the upper reaches of the river and in Wambaw Creek. The absence of estuarine foraminifera and presence of thecamoebians near the river's mouth could be a result of the increase in freshwater flow resulting from the rediversion of flow back to the Santee River in 1986.

Two short transects were sampled off the mouths of the North and South Santee Rivers to test for differences in faunal characteristics (Figure 25). Total numbers were much higher off the mouth of North Santee River and these samples had a higher species diversity. The higher number of marsh foraminifera and some arcellaceans in these samples suggest that the discharge rate may be higher, and hence more sediment transport (including foraminiferal tests), from that branch compared to the South Santee River. This contention is supported by observations of higher organic matter percentages and abundance of marsh vegetation, and by depressed salinities that were measured close to the mouth of North Santee River.

Benthic foraminiferal and arcellacean distributions in the Intracoastal Waterway/Winyah Bay and associated nearshore localities suggested that the assemblages were reacting to a combined pollution/estuarine signal. The relatively low numbers of arcellaceans (both live and dead) in many of the Intracoastal Waterway samples suggested that this is not a hospitable environment for their colonization and reproduction. Schafer *et al.* (1991) suggested that high organic matter percentages may enhance the environment for arcellaceans; that does not appear to be the case in the Intracoastal Waterway. Surface salinities, where measured, were low in the bay (0 - 3‰) and increased to 30‰ at the nearshore localities. Again these were one time measurements and do not represent the salinity variation throughout the bay (see Introduction - Environmental Characteristics).

The presence of arcellaceans in the upper reaches of Winyah Bay confirms the high freshwater and probable sediment transport from the Waccamaw and Pee Dee Rivers. Species of typical marsh foraminifera genera such as *Trochammina, Ammoastuta, Ammobaculites* and *Ammotium* have also been washed into this area from surrounding marshes. The presence of only the transported dead foraminifera and arcellaceans, and the associated high organic matter loadings suggest that the typical estuarine fauna that should be present in this environment either (1) cannot colonize at this locality, or (2) their tests have been destroyed by post-mortem diagenesis. Ellison and Nichols (1976) identified an *Ammobaculites crassus* assemblage in very low salinity localities in the Chesapeake Bay region and *Elphidium clavatum* in higher salinity localities; neither assemblage was present in the upper reaches of Winyah Bay.

Towards the mouth of the bay, where sediments are characterized by lower organic matter percentages (less than 4%), an assemblage containing a high calcareous component is present. The visually recognized plume of water leaving Winyah Bay has apparently minimal effects on the benthic foraminiferal assemblages further seaward, where samples were taken that contain a generally higher species diversity and higher total numbers. This can be recognized clearly by the dominance of miliolid species at Station 30, a location where the organic matter percentage drops to almost zero (Figure 26). Although many of the pollution-tolerant species recognized by Schafer (1970, 1973), Nagy and Alve (1987), Alve (1991) and Schafer *et al.* (1991) are not present in the Winyah Bay samples (eg. *Eggerella advena, Elphidium excavatum* spp.), the spatial change from a predominantly agglutinated assemblage to one dominated by calcareous forms (distal to the pollution source or area) is observed. A similar situation may occur in the transition from an estuarine to marginal marine setting; a combination of these two factors are probably affecting the foraminiferal assemblages in the Winyah Bay region.

4.4 Comparisons of Infaunal Habitat and Taphonomic Implications of Foraminifera from North Inlet Short Cores and Vibracores

According to Loubere (1989) the downcore distribution of total assemblages of benthic foraminifera are controlled by three factors: 1) changing environmental conditions at the sediment surface which may result in changes in the composition of the living populations, 2) the different habitat depth of the populations, and 3) taphonomic processes and different fossilization potential of the tests. Loubere (1989) concluded that under conditions of constant habitat, or stable environment, epifaunal species would have constant abundances in the entire sediment column, while infaunal species will have abundances in the sediments that increase down to their maximum habitat depth and then remain constant below that depth. The three short cores discussed here came from different marsh settings within the same marsh; Short Core (SC) 1 was from the low marsh, SC 2 was from the upper low marsh while SC 3 was obtained from the middle or transition marsh and allows comparison between these settings. In many cases, the few numbers of living foraminifera of some species in these sediments do not allow for proper evaluation of the infaunal character of each species with living specimens in the subsurface.

The increase in the total number of foraminifera between 1 and 3 cm of SC 1 can not be attributed to an increase in infaunal specimens; there is a sharp decline in the total number of living specimens in this interval. The high percentages of living *Miliammina fusca* in sediments from the top 6 cm are contributing greatly to the total proportion of *Miliammina fusca* within this interval, although the peak in relative percentage between 4 and 6 cm appears to be caused more by a decrease in total numbers of all specimens rather than the increase in the numbers of living *Miliammina fusca*. The generally high living percentage of *Miliammina fusca* between 7 and 11 cm represents only a few specimens in an impoverished living assemblage. The slight peak in the relative abundance of live *Trochammina inflata* between 1 and 3 cm is not contributing much to the total assemblage, although a similar distribution pattern is seen in the total percentage, due to the low number of living *Trochammina inflata* specimens. The remaining species do not appear to be affected by living infaunal representatives.

Overall, the density of total foraminifera decreases somewhat downcore in SC 1. There are higher total numbers in the interval between 7 and 10 cm but this enrichment of total foraminifera in these shallow subsurface samples cannot be attributed to an increase in infaunal specimens. The overall decrease in total numbers downcore is either related to changes in environmental conditions at the time of deposition, resulting in a different faunal density than is observed now at the surface, or selective preservation of foraminiferal tests. Other than the distribution of *Miliammina fusca*, which generally has persistent occurrences but at much lower frequencies downcore than in the surface assemblage, there is little difference between the surface and subsurface distributions of the other foraminiferal species present. While this suggests some selective preservation of *Miliammina fusca* in this core, it does not occur at all core sites from North Inlet. Goldstein and Harben (1993) suggested *Miliammina fusca* was more prone to degradation than many other marsh species while Scott (1977) and Scott et al. (1995b) did not observe any diagenetic effects of this species in cores from Nova Scotia. Highest concentrations of organic matter of the three short cores were observed in sediments from SC 1 and possible high oxidation or bacterial action may be affecting the *Miliammina fusca* tests. The remnant organic linings, even in the surface sample, of some calcareous species also indicate lowered pH conditions has resulted in the destruction of the calcium carbonate.

Maximum densities of infaunal specimens are present in the upper 3 cm of SC 2 and this is the only interval where infaunal foraminifera have an effect on the total assemblage. The high densities of living *Miliammina fusca* in this uppermost interval are reflected in the total percentage for this species. The peaks in relative abundances of living species below this interval generally represents few specimens and these are not reflected in the total percentage. There is a dramatic decrease in total densities below 3 cm in SC 2. Although there are minor fluctuations in relative total abundances between 3 and 14 cm, the overall trends are fairly constant, so if the decrease in density is a result of taphonomic processes, all species are being affected equally. The depth range of infaunal species is very similar between SC 1 and SC 2.

There are differences in the foraminiferal composition between the bottom and the top of Core SC 2 but it is difficult to relate these to either infaunal or taphonomic causes. Other than the one sample containing rare specimens of *Arenoparella mexicana* at the 8-9 cm level, both *Arenoparella mexicana* and *Haplophragmoides wilberti* were restricted to the lower 12 cm of the core although there were no living representatives. The relatively high percentages of these two species represent only a few specimens. Goldstein and Harben (1993) recognized both as deep infaunal species (living to depths of 30 cm) in marsh deposits in Georgia. This assemblage represents either the possible infaunal nature of these species or changes in environmental conditions at the marsh surface during deposition.

Although there are moderate to high densities of infaunal specimens in SC 3, there appears to be no effect on the total assemblage distributions. There are variations in both densities and relative abundances of the dominant living species although the total relative abundances are almost constant throughout the core. This also indicates no taphonomic alterations of the assemblages and may be related to the consistently low organic matter percentages in the sediments from this core.

The infaunal assemblage has a deeper living zone in SC 3 than in the cores from the low marsh. Higher numbers of infaunal specimens are present below the 0-1 cm interval and may be a result of drier conditions at the surface of the marsh due to the higher elevation.

Comparisons of the infaunal distribution of SC 3 with that from a *Salicornia* marsh in Georgia (Goldstein and Harben, 1993) show some similarities although there are some surface vegetation differences (the North Inlet marsh also has some *Borrichia* spp. and little *Spartina alterniflora*) and the samples from Georgia were collected in July. In Georgia, highest percentages of *Arenoparella mexicana* were observed at 8-10 cm, very similar to those for this study although in South Carolina *Arenoparella mexicana* was not the dominant infaunal species. There were no infaunal *Miliammina fusca*, rare *Trochammina macrescens* and *Trochammina inflata* had low abundances between 3 and 15 cm in the Georgia marsh.

According to Buzas et al. (1993), foraminifera living within the top centimeter of sediment should be considered as shallow infaunal, due to the size of foraminifera in relation to one centimeter of sediment. Their description of an epifaunal species is one living generally on a hard substrate. Loosely following their classification (since no statistical analyses were performed on these data and very rare occurrences were not considered) the species discussed here can be classified as deep infaunal.

The data show that there was poor preservation of benthic foraminifera in sediments from many of the vibracores but especially from Murrells Inlet marsh. Some units without foraminifera have been interpreted as freshwater deposits (see following section, Figure 46), so there would not be any foraminifera in those anyway. Even within near surface marsh deposits, however, densities are much lower than observed at the surface of the marsh. Very few typical marsh or calcareous foraminiferal specimens were identified below approximately 50 cm in cores from this marsh system. The profile for Core 90 from Murrells Inlet, which was examined continuously to 180 cm, shows a dramatic decrease in densities at 28 cm and this does not appear to be related to variations in organic matter concentrations. Organic matter percentages did not have to be particularly high, even in shallow subsurface sediments, for there to be few foraminifera preserved. Calcareous foraminifera were preserved in the subsurface in an interval from Core 106, and although the lower part of this unit had very low organic matter percentages and this unit was sandy. The upper part of it had organic matter percentages with values similar to the overlying marsh deposit. These foraminifera did display some effects of dissolution but in most cases the specimens could be identified to the species level. This suggests that high organic matter concentrations alone are not creating the adverse conditions causing the destruction of foraminiferal tests, either agglutinated or calcareous.

The foraminiferal assemblages in North Inlet vibracore subsurface sediments also suggest some taphonomic alteration although not as severe as at Murrells Inlet. Densities do drop substantially below the uppermost core samples although high numbers of marsh foraminifera were present in many samples with high organic matter concentrations. The calcareous assemblage present in the Pleistocene sands at the bases of some of these cores was well preserved. The calcareous assemblages in sediments from the Santee Delta cores also generally contained abundant foraminifera and the specimens were usually well preserved indicating little alteration. The marsh sequences in the lower sections of cores from Santee Delta generally had few foraminifera although it is impossible to determine if this is a result of alteration of the deposited assemblage.

Further north, from marsh sequences in Maine (Gehrels, 1994) and Nova Scotia (eg. Scott et al., 1995b) there is little or no loss of foraminifera in the subsurface. Hence, it must be asked: what is different between these northern sites and South Carolina? First, organic matter contents are considerably higher in the northern sites with up to 50% organic content in some high marsh areas (Scott and Medioli, 1980a), whereas, the trend is for higher organic matter content in low marsh sediments in South Carolina. Second, temperature is higher in South Carolina which makes it easier to preserve $CaCO_3$. These two factors would seem to suggest less, not more, preservation in the north. A final factor, bioturbation (in this case, fiddler crabs) is much higher in South Carolina; bioturbation is minimal in the northern marshes. Bioturbation could have several effects on the subsurface foraminiferal assemblages: 1) it can physically break down specimens if the foraminifera are being eaten - this is not the case here since crabs don't eat foraminifera, although other detritus feeders may, 2) bioturbation does break down the layering of the sediments and introduces oxygen to the subsurface creating surface-like conditions inside some burrows, and 3) the oxygen introduced might facilitate oxidizing bacteria into the subsurface and these bacteria are known to destroy foraminiferal tests, especially agglutinated ones (Scott and Medioli, 1986). These processes may explain why subsurface assemblages are poor throughout the southeastern United States (Goldstein and Harben, 1993).

4.5 Marsh Evolution and Sea-Level Implications

Of the more than 50 vibracores collected from Murrells Inlet, only about 10 had good preservation of a detailed Holocene relative sea-level record. Of these, five along a transect (Cores 100, 101, 102, 103 and 106) were selected for detailed micropaleontological study while selected samples from some others were examined to prepare a sea-level curve for this marsh system. In most other cores the strata are reworked, largely as a result of migration of the tidal creeks. Figure 46 displays the lithostratigraphy and shows a record of the mid-Holocene sea-level reversal with salt marsh peat overlain by freshwater peat with salt marsh peat on top (Core 103). Table 1 lists a summary of the core intervals dated and the associated foraminiferal assemblages in these samples. Figure 47 shows the sea-level curve interpreted from the radiocarbon dates from the three marsh systems.

Unfortunately, the foraminiferal assemblages in the subsurface samples from the Murrells Inlet cores generally do not contain abundant foraminifera and this makes comparison with the surface transects more difficult. The foraminiferal species *Ammoastuta inepta*, *Haplophragmoides wilberti*, *Trochammina inflata* and *Arenoparella mexicana* generally had higher percentages in the middle to high marsh along the surface transects in this marsh system. Because of the comparative problems with subsurface assemblages, a relatively wide vertical accuracy of ±30 cm in relation to MHW is assigned to assemblages containing these species; in the subsurface intervals used for sea-level points typical low marsh indicators such as *Ammotium salsum* or *Miliammina fusca* were rare or absent. Freshwater peats were generally barren of microfossils but within these units there were often large cypress roots. It is probable that the subaerial exposure and transgressive erosion and oxidation destroyed the arcellaceans (since they are usually present in freshwater environments).

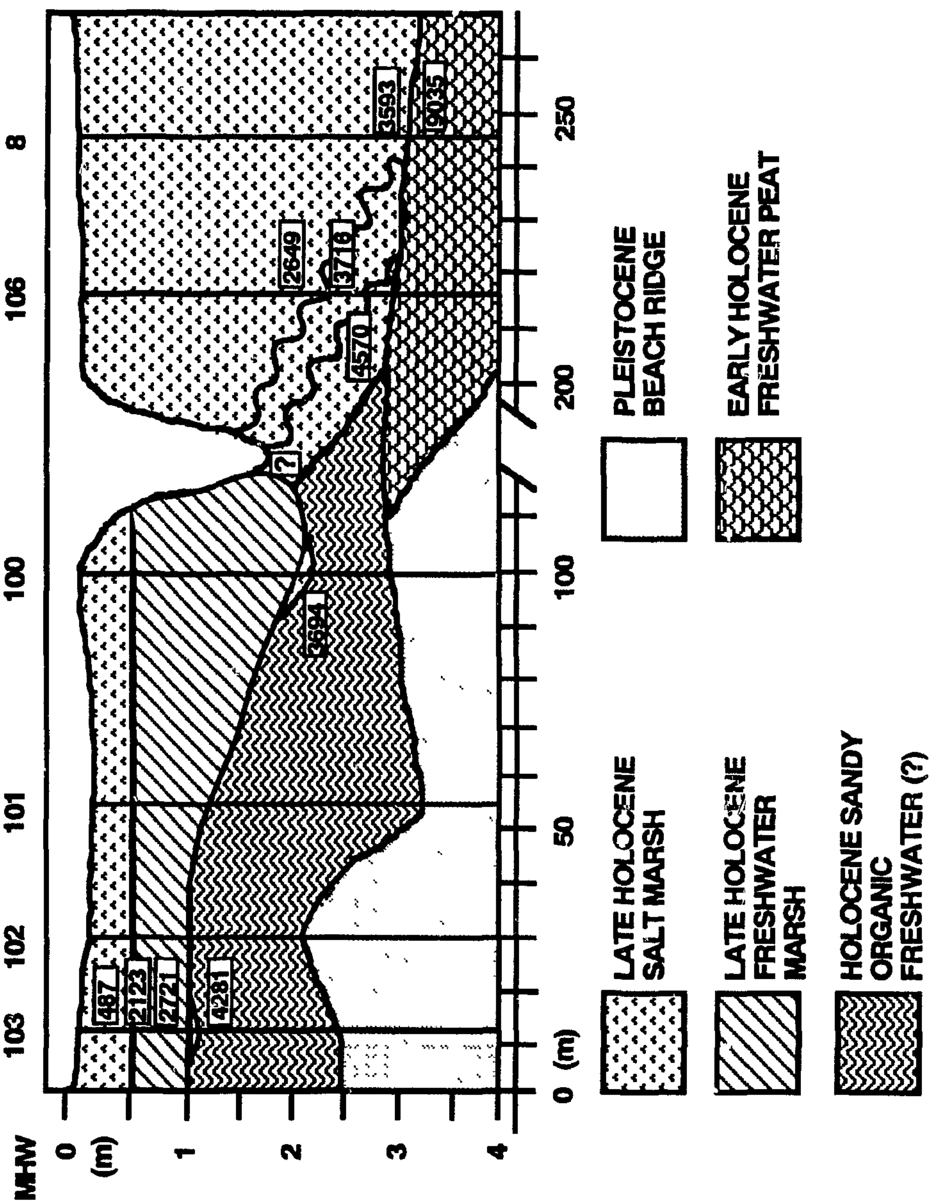


Figure 46. Lithostratigraphy interpreted from the transect of vibracores taken from Murrells Inlet. Numbers on top refer to vibracore and numbers in open boxes are ages in years before present (with sidereal corrections; Stuiver and Reimer, 1986; 1987).

#'s Corresponding to Fig.	Lab #	Material Dated and Foram Zone (if applicable)	Sample Depth Below Present MHW (cm)	Core/ Interval (cm)	C14 Age (yBP)	Sideral Age (yBP)
Murrells Inlet						
1	GX-16478	High marsh peat *Ammoastuta*	119 ± 30	103 100-105	3850 ± 145	4281 (4449 - 4089)
2	GX-16477	Wood - freshwater	98	103 80-85	2510 ± 140	2721 (2769 - 2369)
3	GX-16476	Peat - freshwater	88	103 70-75	2140 ± 230	2123 (2369 - 1860)
4	GX-16475	High marsh peat *Haplophragmoides/Trochammina*	60 ±30	103 42-47	405 ± 145	487 (550 - 310)
5	GX-16479	High marsh peat *Haplophragmoides/Trochammina*	98 ± 30	73 78-83	475 ±180	522 (660 - 320)
6	GX-16567	High marsh peat *Trochammina/Arenoparella*	263 ± 30	106 136-141	2475 ± 135	2649 (2759 - 2359)
7	GX-15987	High marsh peat *Haplophragmoides/Arenoparella*	312 ± 30	8 189-193	3340 ± 240	3593 (3889 - 3359)
8	GX-16569	High marsh peat *Trochammina*	310 ± 30	106 183-186	4090 ± 235	4570 (4879 - 4289)
9	GX-15989	High marsh peat *Trochammina/Haplophragmoides*	301 ± 30	73 265-270	4560 ±270	5239 (5599 - 4859)
10	GX-16568	High marsh peat *Arenoparella/Trochammina*	289 ± 30	106 158-161	3460 ± 155	3716 (3929 -3559)
11	GX-18812	High marsh peat *Arenoparella/Trochammina*	220 ± 30	100 70-72	3435 ± 105	3694 (3839 - 3579)
North Inlet						
12	GX-17302	High marsh peat *Arenoparella/Haplophragmoides*	104 ± 30	B1 89-95	2075 ± 125	2044 (2301 - 1897)
13	GX-17303	High marsh peat *Arenoparella/Ammoastuta*	248 ± 30	B1 245-251	4050 ± 145	4533 (4828 - 4409)
14	GX-17879	High marsh peat *Arenoparella/Ammoastuta*	160 ± 30	B9 142-147	2045 ± 175	2029 (2305 - 1820)
Santee Delta						
15	GX-15529	Low marsh peat *Trochammina ochracea*	421 ± 100	1 288-290	2040 ± 345	2009 (2369 - 1590)
16	GX-15531	Low marsh peat *Trochammina ochracea*	473 ±100	3 495-497	2890 ± 230	3011 (3369 - 2779)
17	GX-15533	Low marsh peat *Trochammina ochracea*	372 ± 100	7 268-270	2680 ± 195	2782 (3339 - 2339)

Table 1. Carbon^{14} dates and correction to sidereal dates (Stuiver and Reimer, 1986; 1987), laboratory numbers, material dated and foraminiferal zone, core interval and corrected depth in core (coring-compaction correction) for sea-level points plotted in Figure 47. MHW = mean high water. yBP = years before present. Dates from Murrells Inlet are from Scott at al., 1995a, those from Santee Delta are from Gayes et al., 1992.

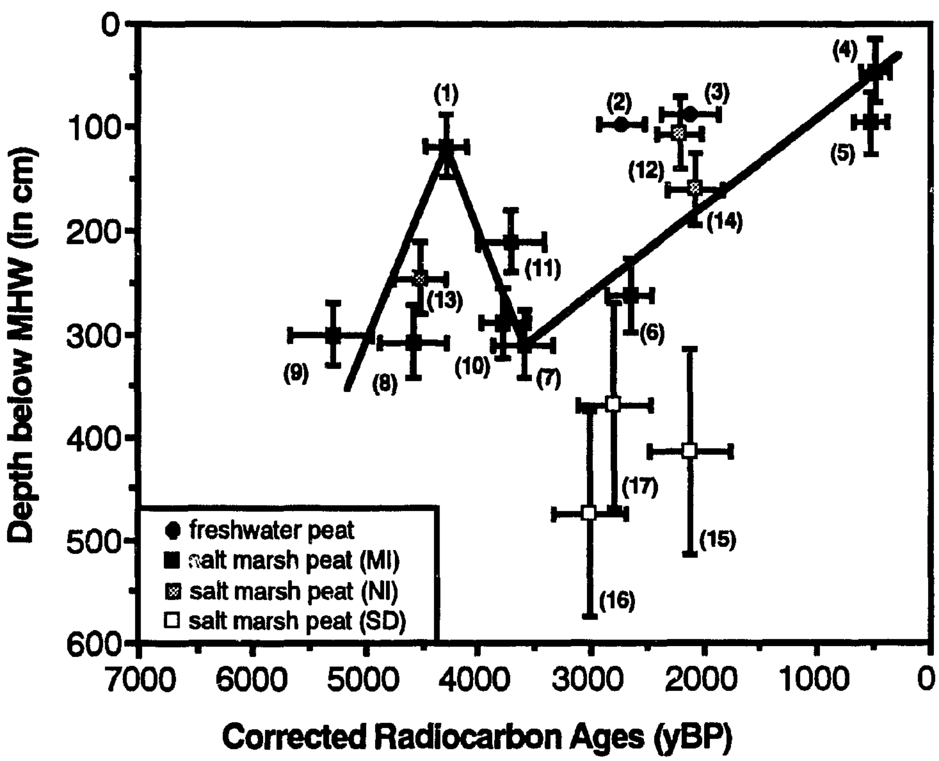


Figure 47. Sea-level curve interpreted from radiocarbon dates from Murrells Inlet cores with dates from North Inlet and Santee Delta plotted on the curve. Numbers on dates refer to Table 1. MI = Murrells Inlet, NI = North Inlet and SD = Santee Delta.

Another problem common with studies of marsh deposits is the autocompaction of the peat. It is probable that the most critical dates in this curve, the two lowstands, 4570 yBP (Core 106), 3593 yBP (Core 8- from Gayes et al., 1992) and the highstand, 4281 yBP (Core 103) are resting on non-compactable material. The salt marsh peats where the two lowstand dates were obtained were overlying extremely hard and weathered freshwater peat. A sandy unit was underlying the peat where the highstand date was obtained. However, compaction may have affected the samples from peat sequences not resting on a hard substrate and hence they may have formed at a higher level than they were identified in the core. In the case of dates 6 and 10 (Table 1), if they were higher they would fit on the curve slightly better (Figure 47).

The lithostratigraphy (in conjunction with the foraminiferal interpretations) also displays the complexity in the evolution of the marsh system at this locality. During the latest transgression salt marsh deposits were restricted to an area seaward of the present day channel until 500 years ago. From at least 2700 yBP (date 2, Table 1) to probably 500 yBP the landward side of the channel could have been cypress swamp although there is a large hiatus between the youngest cypress date (2123 yBP) and the first salt marsh date (487 yBP). During the regression (4281-3593 yBP) most of the salt marsh deposit was eroded away on the landward side of the present channel except one small pocket in Core 100. As sea level began to rise again at 3593 yBP (Core 8), salt marsh accretion was again generally restricted to the area seaward of the present channel, with either cypress swamp or other freshwater deposits on the landward side of the channel. At about 500 yBP there was an event that has been interpreted as a storm, recorded in other cores from Murrells Inlet (Gayes et al., 1992) that appears to have leveled the cypress, cut the channel and salt marsh accretion then started across its present extent (487 yBP, Core 103). This interpretation is supported by the foraminiferal assemblages in Core 90, collected further up the head of the marsh. In the upper section of the core marsh foraminifera disappear at 60 cm, and although this level is not dated, it is at approximately the same horizon that marsh foraminifera disappear in Cores 100-103 before going into freshwater sediments.

From the Murrells Inlet cores it appears that there is a highstand between 5000 and 3600 yBP which consists of a transgressive phase with a 2 m rise in sea-level between 5000 and 4300 yBP to 1.2 m below present mean sea level and a regressive phase with a 2 m fall from 4300 to 3600 yBP. The rates of both sea-level rise and fall during this period are high mid-Holocene rates (30 cm/100 yrs). The rate of rise since 3600 yBP is much slower (8 cm/100 yrs). A warming trend in the mid-Holocene followed by a cooling to the present is suggested in many climatic models (eg. Houghton et al., 1990); this was the explanation attributed to the oscillation in South Carolina by Gayes et al (1992) and by Scott et al. (1995a). A similar rise and fall in relative sea-level was doccumented in West Africa by Giresse (1989) and in Brazil (Dominquez et al., 1987). The limited data obtained from the North Inlet cores fit well on this curve and although the highstand was not identified, that was probably due to a lack of material collected and dated. The lowermost peat date fits well with the rise before the highstand while the other dates fit with the sea-level rise after the lowstand.

Figure 48 displays the lithostratigraphy interpreted from the cores from the short North Inlet transect. Here Core B1 obtained a freshwater peat unit (high organic matter) at approximately the same depth as that identified at Murrells Inlet. The remaining deposit records marsh accretion on Pleistocene sands or nearshore marine deposits.

The sea-level points from Santee Delta plot well below those from both Murrells and North Inlets (Figure 47). This may, in part, be explained by the foraminiferal assemblage in these peat samples which suggest they were deposited in a low marsh environment and the relative position in relation to mean high water is harder to determine.

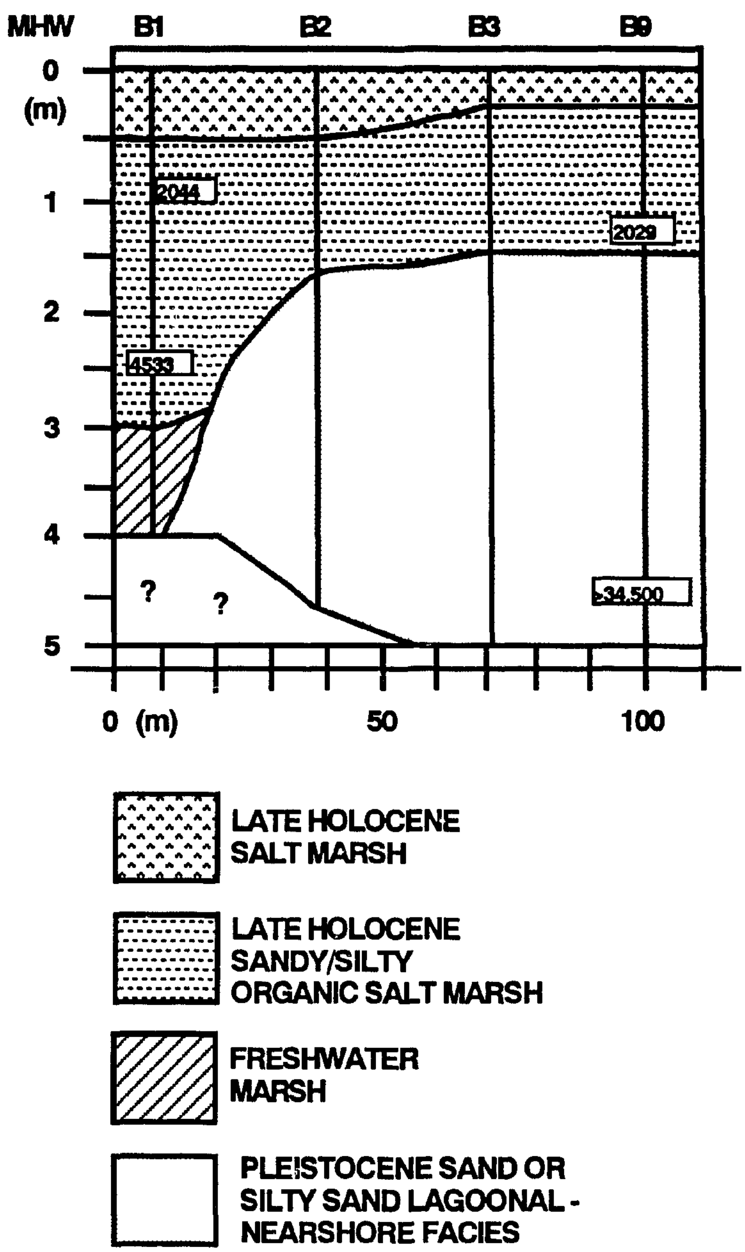


Figure 48. Lithostratigraphy interpreted from the transect of vibracores taken from North Inlet. Numbers on top refer to vibracore and numbers in open boxes are ages in years before present (with sidereal corrections; Stuiver and Reimer, 1986; 1987).

Santee Delta Core 1 was composed primarily of mud or shelly sandy mud with the exception of three thin somewhat peaty layers dominated by *Trochammina ochracea*. The upper 180 cm and lower 50 cm of Core 3 was somewhat peaty; the remainder of the core was mud or shelly mud. The top 90 cm of Core 7 is again peaty; the remainder of the core is either mud or shelly mud. The wide spacing of the cores do not allow for accurate correlations between them. The foraminiferal assemblages in peats dated from Santee Delta were dominated by *Trochammina ochracea* and indicate a low marsh environment with a vertical range of up to 1 m around mean sea level. This vertical difference in positions of sea-level points from Santee Delta may also be expected for a prograding delta where sediment loading and increased subsidence (ie. relative sea-level rise) can be significant (Gayes et al., 1992).

Stephens et al. (1976), in their study of North Santee River, suggested that there was a laterally continuous peat deposit at a depth of 5 to 6 m below mean sea level (MSL) at least at the delta front. An undifferentiated peat at this level was identified in a core from the island between North and South Santee Rivers and was dated at 4400 radiocarbon yBP (Aburawi, 1972). Eckard (1986) also identified what he called a freshwater peat horizon at this level seaward of the Intracoastal Waterway which dated between 6100 and 4400 radiocarbon yBP. Eckard (1987) identified a similar peat 2.5 km seaward of the active delta front between 6.5 and 7.5 m below MSL. If these peats are freshwater (there was no paleontological work done on them), the situation is similar to that at Murrells Inlet where the brackish marsh deposits are underlain by freshwater peats (which was not determined from the previous studies). These freshwater peats are at a lower elevation than those at Murrells Inlet, similar to the sea-level points obtained from the marsh, but this may be explained by high sediment loading and subsidence at the delta front.

De Pratter and Howard (1981) reported a fluctuation in sea level along the Georgia and South Carolina coasts where sea level reached 1.5 m below present MSL by 4500 yBP and had fallen to 3 to 4 m below present MSL by 3000 yBP (uncorrected dates). They used the position of shell middens and other archaeological sites as well as submerged tree stumps as sea-level points. Colquhoun and Brooks (1986) and Colquhoun et al. (1995) (Figure 49) proposed nine fluctuations in sea level (both rise and then fall) over the last 7000 years. Their former sea-level positions were based on both archaeological data and undifferentiated peats. Although they identify numerous fluctuations, they have a highstand at approximately 4000 yBP. This highstand is approximately 20 cm higher than that from the Murrells Inlet curve and essentially fits within the age range for the Murrells Inlet highstand.

The only other report of a sea-level oscillation north of South Carolina during mid-Holocene time is a report by Dionne (1988) from the North Shore of the St. Lawrence River estuary where he observed an oscillation in a deposit that is now raised above present sea level by isostatic rebound. New data from Chezzetcook Inlet and Baie Verte, Nova Scotia also show a sharp acceleration in sea-level rise in the mid-Holocene which ends at the time of the highstand in South Carolina (Scott et al., 1995b). No associated sea-level fall was identified after the acceleration in Nova Scotia.

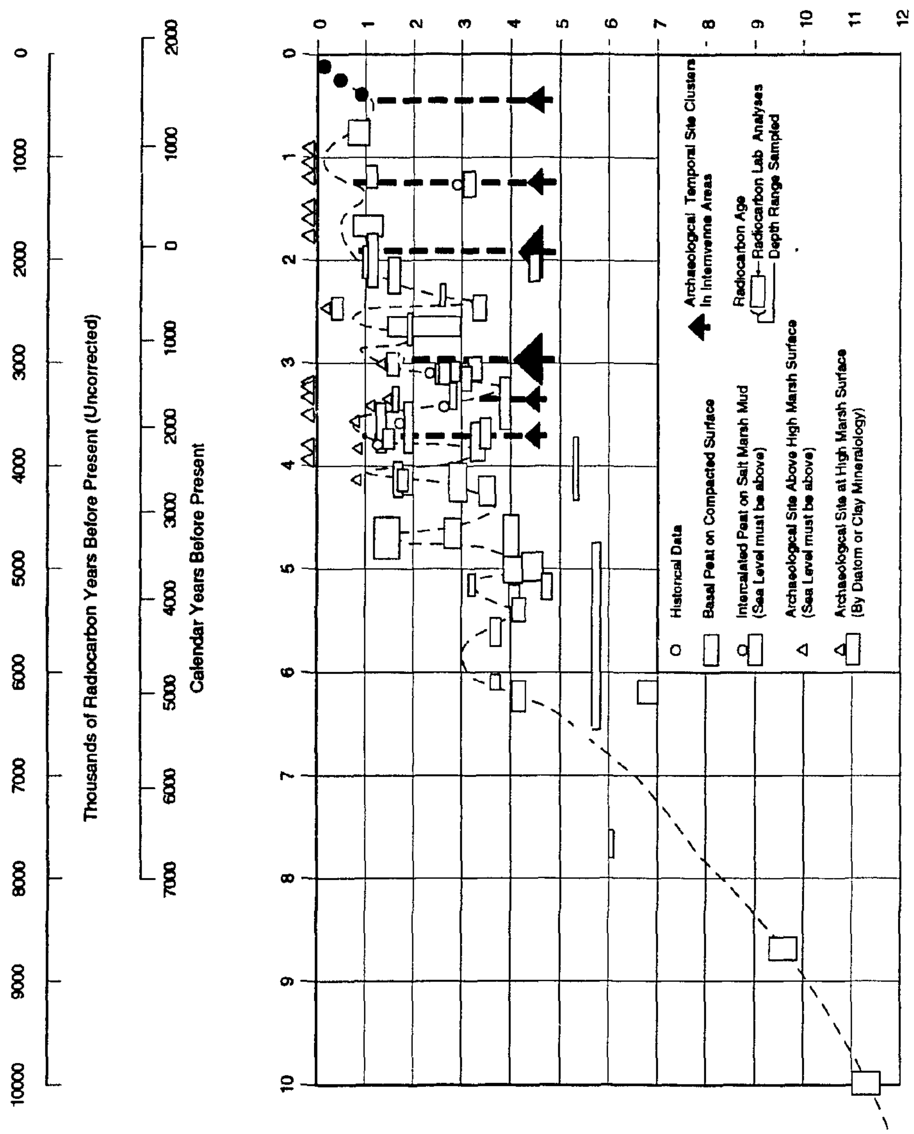


Figure 49. Holocene sea-level curve for South Carolina based on high marsh and estuarine associated archeological sea-level indicators (from Colquhoun et al., 1995).

CHAPTER V

CONCLUSIONS

1. Marsh Foraminiferal and Arcellacean Distributions

a. The vertical zonation of foraminifera in Murrells Inlet and Santee Delta marshes is not well defined although a low and high marsh foraminiferal assemblage zone can usually be recognized. This may in part be due to anthropogenic effects at Murrells Inlet and the low salinity environment at Santee Delta. The best vertical zonation of foraminiferal species is recognized in the normal salinity, undisturbed marshes at North Inlet.

b. The species composition of foraminifera in assemblage zones varies with geographic locality. The highest high marsh indicator in northern marshes, *Trochammina macrescens*, does not define any zone in South Carolina. Surficial information from the locality being studied must be assessed before interpreting subsurface material from that locality. An assemblage dominated by *Ammotium salsum* and *Miliammina fusca* generally dominates the low marsh assemblage at Murrells and North Inlets. These species, combined with high percentages of *Trochammina ochracea* dominate the low marsh at Santee Delta. *Haplophragmoides wilberti*, often in association with *Ammoastuta inepta*, *Trochammina inflata* or *Arenoparella mexicana* appear to be reliable high marsh indicators at these localities.

c. In Transect 2, Murrells Inlet, an assemblage dominated by *Ammonia beccarii* and *Elphidium* spp. was identified in high marsh sediments and may be a result of the storm surge from Hurricane Hugo.

d. Living foraminifera were identified in what have been considered freshwater plant associations (*Spartina cynosuroides*) indicating that the vertical range of foraminifera may extend above highest high water or that the freshwater plants can tolerate some tidal action.

e. *Cucurbitella tricuspis* and *Difflugia oblonga*, previously thought to be exclusively freshwater species, may tolerate slight salinities since they were found living with foraminifera in Santee Delta marshes. Their presence in this marsh system may be due to freshening of the marshes caused by the rediversion of water to the Santee River in 1986.

2. Estuarine Foraminiferal Assemblages

a. Typical estuarine foraminiferal assemblages were identified in Murrells Inlet. Although there is a lot of development around the inlet, the decrease in foraminiferal densities near the mouth of the inlet is probably due to higher energy here rather than anthropogenic changes.

b. In Santee River, the absence of an estuarine foraminiferal assemblage is a result of the high freshwater flow in the river.

c. Winyah Bay/Intracoastal Waterway sediments contain a mixed arcellacean and transported foraminiferal assemblage; its typical estuarine character is identified further seaward than expected. This is a result of combined the high organic matter loadings in sediments and high freshwater discharge.

3. Infaunal foraminifera and Taphonomy

a. Living marsh foraminifera were encountered to depths of 20 cm in sediments from short cores from North Inlet. Generally, highest densities of living foraminifera were encountered in the upper 5 cm of cores from the low marsh while in the core from the middle marsh living foraminifera densities were highest between 7 and 14 cm. Both total and living assemblages were studied and the living faunae at depth appear to have little influence in composition of the total faunae.

b. Preservation of agglutinated marsh foraminifera was poor in subsurface sediments, especially from Murrells Inlet marsh. Organic content of these sediments is not high but there is some bioturbation (fiddler crabs). This contrasts with marshes in more northern localities where subsurface foraminiferal assemblages are usually well preserved (ie. Massachusetts to Nova Scotia); the more temperate marshes generally have higher organic matter concentrations but lower bioturbation.

4. Sea-level History

A rapid sea-level oscillation was identified in Murrells Inlet deposits with a 2 m rise in sea level between 5000 and 4300 yBP and a 2 m fall between 4300 and 3600 yBP. The rate of sea-level rise and fall during the oscillation (30 cm/100 yrs each) is about three times the rate of sea-level rise from the lowstand (3600 yBP) to the present. Limited data from North Inlet fits well on this sea level curve although the highstand was not identified. Data from Santee Delta fall below the curve but this may be accounted for by increased subsidence due to sediment loading.

ABBREVIATED SYSTEMATIC TAXONOMY OF ARCELLACEANS AND BENTHIC FORAMINIFERA

Suprageneric classification of the foraminifera follow that of Loeblich and Tappan (1964, 1988); the suprageneric classification of Medioli and Scott (1983) and Medioli et al. (1987) was used for the arcellaceans. Generic names referred to in this section are organized within the classification system of Loeblich and Tappan (1964) except where otherwise noted. Species within genera are listed in alphabetical order. Each synonomy includes the original reference, those used in species identification as well as some generic changes for each species.

Order ARCELLINIDA Kent, 1880

Superfamily ARCELLACEA Ehrenberg, 1832

Family DIFFLUGIDAE Stein, 1859

Genus ***Difflugia*** LeClerc *in* Lamarck, 1816

Difflugia corona Wallich, 1864

Plate 1, figure 1

Difflugia proteiformis (sic) (Ehrenberg) subspecies *D. globularis* (Dujardin) var. *D. corona* (Wallich). WALLICH, 1864, p. 244, pl. 15, fig. 4b; pl. 16, figs. 19, 20.

Difflugia corona Wallich. ARCHER, 1866, p. 186. MEDIOLI and SCOTT, 1983, p. 22, pl. 1, figs. 6-14.

Difflugia oblonga Ehrenberg, 1832

Plate 1, figure 2

Difflugia oblonga EHRENBERG, 1832, p. 90. EHRENBERG, 1838, p. 131, pl. 9, fig. 2. MEDIOLI and SCOTT, 1983, p. 25, pl. 2, figs. 1-17, 24-26.

Difflugia capreolata Penard. Scott and others, 1980, p. 224, pl. 1, figs. 4-7.

Difflugia urceolata Carter, 1864

Plate 1, figure 3

Difflugia urceolata CARTER, 1864, p. 27, pl. 1, fig. 7. SCOTT and others, 1980, p. 224, pl. 1, figs. 10-12. MEDIOLI and SCOTT, 1983, p. 31, pl. 3, figs. 1-23; pl. 4, figs. 1-4.

Lagunculina vadescens CUSHMAN and BRÖNNIMANN, 1948a, p. 15, pl. 3, figs. 1, 2. PARKER, 1952a, p. 451, fig. 8.

Genus ***Pontigulasia*** Rhumbler, 1895

Pontigulasia compressa (Carter), 1864

Plate 1, figure 4

Difflugia compressa CARTER, 1864, p. 22, pl. 1, figs. 5, 6.

Pontigulasia compressa RHUMBLER, 1895, p. 105, pl. 4, figs. 13a, b.

Pontigulasia compressa (Carter). AVERINTSEV, 1906, p. 169. SCOTT and others, 1980, p. 224, pl. 1, figs. 10-12. MEDIOLI and SCOTT, 1983, p. 34, pl. 6, figs. 5-14.

Family HYALOSPHENIIDAE Schulze, 1877

Genus ***Cucurbitella*** Penard, 1902

Cucurbitella tricuspis (Carter), 1856

Plate 1, figure 5

Difflugia tricuspis CARTER, 1856, p. 221, pl. 7, fig. 80. MEDIOLI and SCOTT, 1983, p. 28, pl. 4, figs. 5-19. HAMAN, 1986, p. 47, pl. 1, figs. 1-14; pl. 2, figs. 1-12.

Cucurbitella mespiliformis PENARD, 1902, p. 311, text-figs. 1-9.

Cucurbitella tricuspis (Carter). MEDIOLI and others, 1987, p. 42, pl. 1, figs. 1-10; pl. 2, figs. 1-10; pl. 3, figs. 1-7; pl. 4, figs. 1-9.

Genus ***Heleopera*** Leidy, 1879

Heleopera sphagni (Leidy), 1874

Difflugia (*Nebela*) *sphagni* LEIDY, 1874, p. 15.

Nebela sphagni (Leidy). LEIDY, 1876, p. 118, text-figs. 16, 17.

Heleopera sphagni (Leidy). CASH and HOPKINSON, 1909, p. 143, pl. 30, figs. 4-9. MEDIOLI and SCOTT, 1983, p. 37, pl. 6, figs. 15-18.

Genus ***Lesquereusia*** Schlumberger, 1845

Lesquereusia spiralis (Ehrenberg), 1840a

Difflugia spiralis EHRENBERG, 1840a, p. 199.

Lesquereusia spiralis (Ehrenberg). PENARD, 1902, p. 36, text figs. 1-10. PATTERSON and others, 1985, p. 135, pl. 2, figs. 9, 10. SCOTT and others, 1991, p. 386, pl. 1, fig. 10.

Family CENTROPYXIDAE Jung, 1942

Genus ***Centropyxis*** Stein, 1859

Centropyxis aculeata (Ehrenberg), 1832 *ab* (Ehrenberg), 1830

Plate 1, figure 6

Arcella aculeata EHRENBERG, 1832 (*ab* Ehrenberg, 1830, p. 60, *nomen nudem*), p. 91.

Leptodermella salsa CUSHMAN and BRÖNNIMANN, 1948a, p. 15, pl. 3, figs. 3, 4.

Leptodermella variabilis PARKER, 1952a, p. 452, pl. 1, figs. 11, 12.

Centropyxis excentricus (Cushman and Brönnimann). SCOTT, 1976, p. 320, pl. 1, figs. 1, 2. SCOTT and others, 1980, p. 224, pl. 1, figs. 1-3.

Centropyxis aculeata (Ehrenberg). STEIN, 1859, p. 43. MEDIOLI and SCOTT, 1983, p. 39, pl. 7, figs. 10-19. SCOTT and others, 1991, p. 384, pl. 1, figs. 7-9.

Centropyxis constricta (Ehrenberg, 1843)

Plate 1, figure 7

Arcella constricta EHRENBERG, 1843, p. 410, pl. 4, fig. 35, pl. 5, fig. 1.

Difflugia constricta (Ehrenberg). LEIDY, 1879, p. 120, pl. 18, figs. 8-55.

Urnulina compressa CUSHMAN, 1930a, p. 15, pl. 1, fig. 2. PARKER, 1952a, p. 460, pl. 1, fig. 9. SCOTT and others, 1980, p. 224, pl. 1, figs. 13-15.

Centropyxis constricta (Ehrenberg). DEFLANDRE, 1929, p. 340, text-figs. 6-67. MEDIOLI and SCOTT, 1983, p. 41, pl. 7, figs. 1-9. SCOTT and others, 1991, p. 384, pl. 1, fig. 4.

Order FORAMINIFERIDA Eichwald, 1830

Suborder TEXTULARIINA Delage and Hérouard, 1896

Superfamily AMMODISCACEA Reuss, 1862

Family SACCAMMINIDAE Brady, 1884

Subfamily SACCAMMININAE Brady, 1884

Genus ***Polysaccammina*** Scott, 1976b

Remark: This genus was placed in this taxonomic position by Scott (1976b).

Polysaccammina hyperhalina Medioli, Scott and Petrucci, *In* Petrucci et al., 1983

Plate 1, figure 8

Polysaccammina hyperhalina MEDIOLI and others, *In* Petrucci et al., 1983, p. 72, pls. 1, 2. SCOTT and others, 1990, p. 731.

Polysaccammina ipohalina Scott, 1976b

Polysaccammina ipohalina SCOTT, 1976b, p. 316, pl. 2, figs. 1-4; text fig. 4. ZANINETTI and others, 1977, pl. 1, fig. 7. SCOTT and MEDIOLI, 1980a, p. 43, pl. 2, figs. 8-11. SCOTT and others, 1991, p. 386, pl. 2, fig. 3.

Genus ***Pseudothurammina*** Scott, Medioli and Williamson, *In* Scott et al., 1981

Remark: This genus was placed in this taxonomic position by Scott et al. (1981).

Pseudothurammina limnetis Scott, Medioli and Williamson, *In* Scott et al., 1981

Plate 1, figure 9

Astrammina sphaerica (Heron-Allen and Earland). ZANINETTI and others, 1977, pl. 1, fig. 9.

Thurammina (?) *limnetis* SCOTT and MEDIOLI, 1980a, p. 43, pl. 1, figs. 1-3.

Pseudothurammina limnetis SCOTT and others, *In* Scott et al., 1981, p. 126. SCOTT and others, 1991, p. 386, pl. 2, fig. 4.

Family AMMODISCIDAE Reuss, 1862

Subfamily AMMODISCINAE Reuss, 1862

Genus ***Ammodiscus*** Reuss, 1862

Ammodiscus catinus Höglund, 1947

Ammodiscus catinus HÖGLUND, 1947, p. 122. PARKER, 1952b, p. 398, pl. 2, figs. 3-4. GOLDSTEIN and FREY, 1986, pl. 3, fig. 4.

Genus ***Glomospira*** Rzehak, 1885

Glomospira gordialis (Jones and Parker), 1860

Trochammina squamata var. *gordialis* JONES and PARKER, 1860, p. 304.

Glomospira gordialis CUSHMAN and MCCULLOCH, 1939, p. 70, pl. 5, figs. 5, 6. SCOTT and others, 1991, p. 385.

Superfamily LITUOLACEA de Blainville, 1825

Family HORMOSINIDAE Haeckel, 1894

Subfamily HORMOSININAE Haeckel, 1894

Genus ***Reophax*** de Montfort, 1808

Reophax nana Rhumbler, 1911

Reophax nana RHUMBLER, 1911, p. 182, pl. 8, figs. 6-12. PARKER and others, 1953, p. 13, pl. 1, fig. 11. LANKFORD, 1959, p. 2099, pl. 1, fig. 2. SCOTT and MEDIOLI, 1980a, p. 43, pl. 2, fig. 6.

Genus ***Sulcophax*** Rhumbler *in* Wiesner, 1931

Sulcophax palustris Warren, 1957

Sulcophax palustris WARREN, 1957, p. 31, pl. 3, figs. 1-4.

Family RZEHAKINIDAE Cushman, 1933a

Genus ***Miliammina*** Heron-Allen and Earland, 1930a

Miliammina fusca (Brady), 1870

Plate 1, figure 10

Quinqueloculina fusca BRADY, 1870, p. 286, pl. 11, figs. 2, 3.

Miliammina fusca (Brady). PARKER and others, 1953, p. 10, pl. 1, figs. 40, 41. PARKER, 1952a, p. 452, pl. 2, fig. 6. PHLEGER, 1954, p. 642, pl. 2, figs. 22, 23. LANKFORD, 1959, p. 2098, pl. 1, fig. 18. SCOTT and MEDIOLI, 1980a, p. 40, pl.

2, figs. 1-3. GOLDSTEIN and FREY, 1986, pl. 4, fig. 23. BOLTOVSKOY, 1984, fig. 6. SCOTT and others, 1991, p. 386, pl. 1, fig. 14.

Family LITUOLIDAE de Blainville, 1825

Subfamily HAPLOPHRAGMOIDINAE Maync, 1952

Genus ***Haplophragmoides*** Cushman, 1910

Haplophragmoides manilaensis Andersen, 1953

Plate 1, figure 11

Haplophragmoides manilaensis ANDERSEN, 1953, p. 22, pl. 4, fig. 8. SAUNDERS, 1957, p. 2, pl. 1, figs. 1, 2. LANKFORD, 1959, p. 2098, pl. 1, fig. 3. SCOTT and others, 1991, p. 385, pl. 1, figs. 18, 19.

Haplophragmoides bonplandi TODD and BRÖNNIMANN, 1957, p. 23, pl. 2, fig. 2. SCOTT and MEDIOLI, 1980a, p. 40, pl. 2, figs. 4, 5.

Haplophragmoides wilberti Andersen, 1953

Plate 1, figure 12

Haplophragmoides wilberti ANDERSEN, 1953, p. 21, pl. 4, fig. 7. SAUNDERS, 1957, p. 3, pl. 2, fig. 1. ZANINETTI and others, 1977, pl. 1, fig. 12, 13. BOLTOVSKOY, 1984, fig. 7. GOLDSTEIN and FREY, 1986, pl. 3, fig. 11. SCOTT and others, 1991, p. 385, pl. 1, figs. 20, 21.

Subfamily LITUOLINAE de Blainville, 1825

Genus ***Ammoastuta*** Cushman and Brönnimann, 1948a

Ammoastuta inepta (Cushman and McCulloch), 1939

Plate 1, figure 13

Ammobaculites ineptus CUSHMAN and MCCULLOCH, 1939, p. 89, pl. 7, fig. 6.

Ammoastuta salsa CUSHMAN and BRÖNNIMANN, 1948a, p. 17, pl. 3, figs. 14-16. PARKER, 1952a, p. 443, pl. 2, figs, 1,2. ZANINETTI and others, 1977, pl. 2, figs. 1, 2, 6.

Ammoastuta inepta (Cushman and McCulloch). PARKER and others, 1953, p. 4, pl. 1, fig. 12. PHLEGER, 1954, p. 633, pl. 1, figs. 1-3. LANKFORD, 1959, p. 2097, pl. 1, fig. 4. SCOTT and others, 1991, p. 384, pl. 1, fig. 15.

Genus ***Ammobaculites*** Cushman, 1910

Ammobaculites dilatatus Cushman and Brönnimann, 1948b

Plate 1, figure 14

Ammobaculites dilatatus CUSHMAN and BRÖNNIMANN, 1948b, p. 39, pl. 7, figs. 10, 11. PARKER and others, 1953, p. 5, pl. 1, figs. 13-15. BOLTOVSKOY, 1984, figs. 11, 12. GOLDSTEIN and FREY, 1986, pl. 3, fig. 14.

Ammobaculites c. f. *foliaceus* (Brady). PARKER, 1952a, p. 444, pl. 1, figs. 20, 21.

Ammobaculites foliaceus (Brady). SCOTT and MEDIOLI, 1980a, p. 35, pl. 1, figs. 6-8.

Ammobaculites exiguus Cushman and Brönnimann, 1948b

Plate 1, figure 15

Ammobaculites exiguus CUSHMAN and BRÖNNIMANN, 1948b, p. 38, pl. 7, figs. 7, 8. SCOTT and others, 1991, p. 384.

Ammobaculites dilatatus CUSHMAN and BRÖNNIMANN. SCOTT and MEDIOLI, 1980a, p. 35, pl. 1, figs. 9, 10

Genus ***Ammotium*** Loeblich and Tappan, 1953

Ammotium multiloculatum Warren, 1957

Ammotium multiloculatum WARREN, 1957, p. 33, pl. 4, figs. 1, 2.

Ammotium salsum (Cushman and Brönnimann), 1948a

Plate 1, figure 16

Ammobaculites salsus CUSHMAN and BRÖNNIMANN, 1948a, p. 16, pl. 3, figs. 7-9. PARKER and others, 1953, p. 5, pl., figs. 17-25. PHLEGER, 1954, p. 635, pl. 1, figs. 7, 8.

Ammotium salsum (Cushman and Brönnimann) forma *exilie* Cushman and Brönnimann. POAG, 1978, p. 405, pl. 5, figs. 11-32, 34-39. POAG, 1981, p. 39, pl. 51, fig. 4; pl. 52, fig. 4.

Ammotium salsum (Cushman and Brönnimann) forma *typicum* POAG, 1978, p. 405, pl. 5, figs. 1-10, 33. POAG, 1981, p. 40, pl. 51, fig. 3; pl. 52, fig. 3.

Ammotium salsum (Cushman and Brönnimann). PARKER and ATHEARN, 1959, p. 340, pl. 50, figs. 6, 13. ZANINETTI and others, 1977, pl. 2, figs. 4, 5. SCOTT and MEDIOLI, 1980a, p. 35, pl. 1, figs. 11-13. GOLDSTEIN and FREY, 1986, pl. 3, fig. 13. SCOTT and others, 1991, p. 384, pl. 1, figs. 11-13.

Ammotium subdirectum Warren, 1957

Plate 1, figure 17

Ammotium subdirectum Warren, 1957, p. 33, pl. 4, figs. 6-8.

Family TEXTULARIIDAE Ehrenberg, 1838

Subfamily TEXTULARIINAE Ehrenberg, 1838

Genus ***Textularia*** Defrance *In* de Blainville, 1824

Textularia candeiana d'Orbigny, 1839a

Textularia candeiana d'ORBIGNY, 1839a, p. 143, pl. 1, figs. 19, 20. SCHNITKER, 1971, p. 212, pl. 1, fig. 10.

Family TROCHAMMINIDAE Schwager, 1877

Subfamily TROCHAMMININAE Schwager, 1877

Genus ***Trochammina*** Parker and Jones, 1859

Trochammina inflata (Montagu), 1808

Plate 2, figures 1-4

Nautilus inflatus MONTAGU, 1808, p. 81, pl. 18, fig. 3.

Rotalina inflata WILLIAMSON, 1858, p. 50, pl. 4, figs. 93, 94.

Trochammina inflata (Montagu). PARKER and JONES, 1859, p. 347. CARPENTER and others, 1862, p. 141, pl. 11, fig. 5. PARKER, 1952a, p. 459, pl. 3, fig. 1. PARKER and others, 1953, p. 15, pl. 3, figs. 7, 8. PHLEGER, 1954, p. 646, pl. 3, figs. 22, 23. LANKFORD, 1959, p. 2099, pl. 1, fig. 21. ZANINETTI and others, 1977, pl. 1, figs. 1, 2. SCOTT and MEDIOLI, 1980a, p. 44, pl. 3, figs. 12-14; pl. 4, figs. 1-3. BOLTOVSKOY, 1984, fig. 13. GOLDSTEIN and FREY, 1986, pl. 3, figs. 15-17. SCOTT and others, 1991, p. 388, pl. 2, figs. 7, 8.

Trochammina macrescens Brady, 1870

Plate 3, figure 3

Trochammina inflata (Montagu) var. *macrescens* BRADY, 1870, p. 290, pl. 11, fig. 5. SCOTT, 1976, p. 320, pl. 1, figs. 4-7.

Jadammina polystoma BARTENSTEIN and BRAND, 1938, p. 381, figs. 1, 2.

Trochammina macrescens Brady. PARKER, 1952a, p. 460, pl. 3, fig. 3. PARKER and others, 1953, p. 15, pl. 3, fig. 7, 8. PHLEGER, 1954, p. 646, pl. 3, fig. 24. SCOTT and MEDIOLI, 1980a, p. 44, pl. 3, figs. 1-12. SCOTT and others, 1991, p. 388, pl. 2, figs. 10, 11.

Trochammina ochracea (Williamson), 1858

Plate 1, figures 18, 19

Rotalina ochracea WILLIAMSON, 1858, p. 55, pl. 4, fig. 112, pl. 5, fig. 113.

Trochammina squamata PARKER and JONES, 1865, p. 407, pl. 15, figs. 30, 31. PARKER, 1952a, p. 460, pl. 3, fig. 4. PARKER, 1952b, p. 408, pl. 4, figs. 11-16. SCOTT and MEDIOLI, 1980a, p. 45, pl. 4, figs. 6, 7.

Trochammina squamata PARKER and JONES, and related species. PARKER, 1952a, p. 460, pl. 3, fig. 5.

Trochammina ochracea (Williamson). CUSHMAN, 1920, p. 75, pl. 15, fig. 3. SCOTT and MEDIOLI, 1980a, p. 45, pl. 4, figs. 4, 5. GOLDSTEIN and FREY, 1986, pl. 4, fig. 1.

Genus ***Arenoparella*** Andersen, 1951a

Arenoparella mexicana (Kornfeld), 1931

Plate 2, figures 5, 6

Trochammina inflata (Montagu) var. *mexicana* KORNFELD, 1931, p. 86, pl. 13, fig. 5.

Arenoparella mexicana (Kornfeld). ANDERSEN, 1951a, p. 31, fig. 1. ANDERSEN, 1951b, p. 96, pl. 11, fig. 4. PARKER and others, 1953, p. 6, pl. 2, figs. 33, 34. PHLEGER, 1954, p. 636, pl. 1, figs. 12-14. SAUNDERS, 1957, p. 12, pl. 4, fig. 5. ZANINETTI and others, 1977, pl. 2, figs. 3, 7. SCOTT and MEDIOLI, 1980a, p. 35, pl. 4, figs. 8-

11. GOLDSTEIN and FREY, 1986, pl. 4, figs. 19, 20. SCOTT and others, 1991, p. 384, pl. 1, figs. 16, 17.

Genus ***Siphotrochammina*** Saunders, 1957

Siphotrochammina lobata Saunders, 1957

Plate 2, figures 5-16; Plate 3, figures 1, 2

Siphotrochammina lobata SAUNDERS, 1957, p. 9, pl. 3, figs. 1, 2. GOLDSTEIN and FREY, 1986, pl. 4, figs. 21, 22.

Siphotrochammina elegans ZANINETTI and others, 1977, pl. 2, figs. 8, 10, 11.

Remarks: Although this species probably is an ecophenotype (as described by Mayr and others, 1953; Medioli and Scott, 1978; Miller and others, 1982) of *Trochammina inflata* it was counted separately in this work.

According to the original diagnosis by Saunders (1957) p. 9, "...*The last chamber has a ventral, siphon like lobe extending partially across the umbilicus. The aperture is situated at the umbilical end of this lobe and is directed forward. The aperture of the penultimate chamber opens into the ventral lobe of the last chamber...*" Saunders (1957) also recognized the similarity to *Trochammina* by stating on p. 9 "...*In Trochammina the aperture is an arched slit at the inner margin of the ventral side of the last chamber whereas in Siphotrochammina the aperture is a forward-directed, circular opening at the inner end of a siphon like lobe that extends from the last chamber into the umbilicus...*"

The S. E. M. photographs presented here show the variation in the position of the siphon-type aperture from the inner margin of the ventral side (Plate 2, figure 5), which is the location of the slit like aperture in *Trochammina*, to the umbilical region (Plate 2, figure 16) as described in the original diagnosis. This suggests that the variation could be ecophenotypic, i.e. caused by environmentally controlled non-genetic modifications of the phenotype (Mayr and others, 1953; Medioli and Scott, 1978; Miller and others, 1982). This problem needs to be more thoroughly investigated in localities that contain high percentages of both *Trochammina inflata* and *Siphotrochammina lobata*.

Genus ***Tiphotrocha*** Saunders, 1957

Tiphotrocha comprimata (Cushman and Brönnimann), 1948b

Plate 3, figures 7, 8

Trochammina comprimata CUSHMAN and BRÖNNIMANN, 1948b, p. 41, pl. 8, figs. 1-3. PARKER and others, 1953, p. 14, pl. 3, figs. 3, 4. PHLEGER, 1954, p. 646, pl. 3, figs. 20, 21.

Tiphotrocha comprimata (Cushman and Brönnimann). SAUNDERS, 1957, p. 11, pl. 4, figs. 1-4. ZANINETTI and others, 1977, pl. 1, figs. 4, 6. SCOTT and MEDIOLI, 1980a, p. 44, pl. 5, figs. 1-3. GOLDSTEIN and FREY, 1986, pl. 4, fig. 24. SCOTT and others, 1991, p. 388, pl. 2, figs. 5, 6.

Family ATAXOPHRAGMIIDAE Schwager, 1877

Subfamily VERNEUILININAE Cushman, 1911

Genus ***Gaudryina*** d'Orbigny, 1839a

Gaudryina exilis Cushman and Brönnimann, 1948b

Plate 3, figure 4

Gaudryina exilis CUSHMAN and BRÖNNIMANN, 1948b, p. 40, pl. 7, figs. 15, 16. ZANINETTI and others, 1977, pl. 1, fig. 3.

Subfamily GLOBOTEXTULARIINAE Cushman, 1927a

Genus ***Eggerella*** Cushman, 1933b

Eggerella advena (Cushman), 1922a

Verneuilina advena CUSHMAN, 1922a, p. 141.

Eggerella advena (Cushman). CUSHMAN, 1937, p. 51, pl. 5, figs. 12-15. PHLEGER and WALTON, 1950, p. 277, pl. 1, figs. 16-18. PARKER, 1952a, p. 447, pl. 2, fig. 3. SCOTT and MEDIOLI, 1980a, p. 40, pl. 2, fig. 7. SCOTT and others, 1991, p. 385, pl. 2, figs. 1, 2.

Suborder MILIOLINA Delage and Hèrouard, 1896

Superfamily MILIOLACEA Ehrenberg, 1839

Family FISCHERINIDAE Millett, 1898

Subfamily CYCLOGYRINAE Loeblich and Tappan, 1961

Genus ***Cyclogyra*** Wood, 1842

Cyclogyra involvens (Reuss), 1850

Operculina involvens REUSS, 1850, p. 370, pl. 46, fig. 30.

Cornuspira involvens (Reuss). REUSS, 1863, p. 39, pl. 1, fig. 2. CUSHMAN, 1929, p. 80, pl. 20, figs. 6, 8.

Cyclogyra involvens (Reuss). BOCK, 1971, p. 12, pl. 3, fig. 2.

Remark: The genus *Cornuspira* was placed in synonymy with the genus *Cyclogyra* by Loeblich and Tappan (1961).

Family NUBECULARIIDAE Jones, 1875

Subfamily OPHTHALMIDIINAE Wiesner, 1920

Genus ***Wiesnerella*** Cushman, 1933b

Wiesnerella auriculata (Egger), 1893

Plate 3, figure 9

Planispirina auriculata EGGER, 1893, p. 245, pl. 3, figs. 13-15.

Wiesnerella auriculata (Egger). SCHNITKER, 1971, p. 214, pl. 2, fig. 9.

Subfamily SPIROLOCULININAE Wiesner, 1920

Genus ***Spiroloculina*** d'Orbigny, 1826

Spiroloculina atlantica Cushman, 1947a

Spiroloculina atlantica CUSHMAN, 1947a, p. 88, pl. 19, figs. 3-5. SCHNITKER, 1971, p. 210, pl. 2, fig. 10.

Family MILIOLIDAE Ehrenberg, 1839

Subfamily QUINQUELOCULININAE Cushman, 1917

Genus ***Quinqueloculina*** d'Orbigny, 1826

Quinqueloculina compta Cushman, 1947a

Quinqueloculina compta CUSHMAN, 1947a, p. 87, pl. 19, fig. 2. BANDY, 1954, p. 138, pl. 28, fig. 2.

Quinqueloculina funafutiensis (Chapman), 1901

Miliolina funafutiensis CHAPMAN, 1901, p. 178, pl. 19, fig. 6.

Quinqueloculina funafutiensis (Chapman). CUSHMAN, 1922b, p. 67, pl. 13, fig. 3. CUSHMAN, 1929, p. 30, pl. 4, fig. 4.

Quinqueloculina lamarckiana d'Orbigny, 1839a

Plate 3, figure 10

Quinqueloculina lamarckiana d'Orbigny, 1839a, p. 189, pl. 11, figs. 14, 15. CUSHMAN, 1921, p. 65, pl. 15, figs. 13, 14. CUSHMAN, 1922b, p. 64. CUSHMAN, 1929, p.

26, pl. 2, fig. 6. BANDY, 1954, p. 138, pl. 28, fig. 3. BOCK, 1971, p. 19, pl. 6, figs. 7-9. TODD and LOW, 1971, p. 8, pl. 2, fig. 10.

Quinqueloculina polygona d'Orbigny, 1839a

Quinqueloculina polygona d'Orbigny, 1839a, p. 198, pl. 12, figs. 21-23. CUSHMAN, 1921, p. 66, pl. 16, figs. 3, 4. CUSHMAN, 1929, p. 28, pl. 3, fig. 5. BOCK, 1971, p. 20, pl. 7, figs. 1-3. TODD and LOW, 1971, p. 8, pl. 2, fig. 5.

Quinqueloculina seminulum (Linné), 1758

Serpula seminulum LINNÉ, 1758, p. 786.

Quinqueloculina seminulum (Linné). d'ORBIGNY, 1826, p. 301. CUSHMAN, 1929, p. 24, pl. 2, figs. 1, 2. PARKER, 1952a, p. 456, pl. 2, fig. 7. BOCK, 1971, p. 21, pl. 7, figs. 7-9. SCOTT and others, 1980, p. 231, pl. 3, figs. 3-5. SCOTT and others, 1991, p. 386, pl. 2, fig. 16.

Quinqueloculina seminulum (Linné), 1758 forma **_jugosa_** Cushman, 1944

Plate 3, figure 11

Quinqueloculina seminulum (Linné, 1758) var. *jugosa* Cushman, 1944, p. 13, pl. 2, fig. 15. PARKER, 1952a, p. 456, pl. 2, fig. 8.

Genus **_Triloculina_** Reuss, d'Orbigny, 1826

Triloculina oblonga (Montague), 1803

Plate 3, figure 12

Vermiculum oblongum MONTAGUE, 1803, p. 522, pl. 14, fig. 9.

Triloculina oblonga (Montague). d'ORBIGNY, 1826, p. 300, no. 16. BOCK, 1971, p. 27, pl. 11, figs. 2-4. GOLDSTEIN and FREY, 1986, pl. 4, fig. 25.

Suborder ROTALIINAE Delage and Hérouard, 1896

Superfamily NODOSARIACEA Ehrenberg, 1838

Family POLYMORPHINIDAE d'Orbigny, 1839a

Subfamily POLYMORPHININAE d'Orbigny, 1839a

Genus ***Guttulina*** d'Orbigny, 1839a

Guttulina lactea (Walker and Jacob), 1798

Serpula lactea WALKER and JACOB, 1798, p. 634, pl. 24, fig. 4.

Guttulina lactea (Walker and Jacob). SCHNITKER, 1971, p. 202, pl. 4, fig. 10.

Superfamily BULIMINACEA, Jones, 1875

Family TURRILINIDAE Cushman, 1927a

Subfamily TURRILININAE Cushman, 1927a

Genus ***Buliminella*** Cushman, 1911

Buliminella elegantissima (d'Orbigny), 1839b

Bulimina elegantissima d'ORBIGNY, 1839b, p. 51, pl. 7, figs. 13, 14.

Buliminella elegantissima (d'Orbigny). PARKER and others, 1953, p. 6, pl. 4, figs. 8, 9. PHLEGER, 1954, p. 637, pl. 1, figs. 24, 25. LANKFORD, 1959, p. 2097, pl. 2, fig. 16. BOCK, 1971, p. 44, pl. 16, fig. 9. SCOTT and others, 1980, p. 226, pl. 3, figs. 1, 2.

Family BOLIVINITIDAE Cushman, 1927a

Genus ***Bolivina*** d'Orbigny, 1839a

Bolivina lowmani Phleger and Parker, 1951

Plate 3, figure 13

Bolivina lowmani PHLEGER and PARKER, 1951, p. 13, pl. 6, figs. 20, 21. PARKER, 1954, p. 515, pl. 7, fig. 21. LANKFORD, 1959, p. 2097, pl. 3, fig. 4. BOCK, 1971, p. 46, pl. 16, fig. 14.

Brizalina lowmani (Phleger and Parker). SCOTT and others, 1991, p. 384, pl. 2, fig. 12.

Bolivina pseudoplicata Heron-Allen and Earland, 1930b

Bolivina pseudoplicta HERON-ALLEN and EARLAND, 1930b, p. 181, pl. 3, figs. 36-40. CUSHMAN and TODD, 1947, p. 66, pl. 16, fig. 2, 3. PARKER, 1952a, p. 444, pl. 4, fig. 11. SCHNITKER, 1971, p. 194, pl. 4, fig. 23. SCOTT and others, 1980, p. 226, pl. 4, fig. 3. SCOTT, 1987, p. 326.

Bolivina striatula Cushman, 1922b

Bolivina striatula CUSHMAN, 1922b, p. 27, pl. 3, fig. 10. PARKER and others, 1953, pl. 4, figs. 4, 5. BANDY, 1954, p. 135, pl. 31, fig. 9. LANKFORD, 1959, p. 2097, pl. 3, fig. 6.

Genus ***Rectobolivina*** Cushman, 1927a

Rectobolivina advena (Cushman), 1922b

Siphogenerina advena CUSHMAN, 1922b, p. 35, pl. 5, fig. 2.

Rectobolivina advena (Cushman). SCHNITKER, 1971, p. 208, pl. 4, fig. 26.

Family BULIMINIDAE Jones, 1875

Subfamily BULIMININAE Jones, 1875

Genus ***Bulimina*** d'Orbigny, 1826

Bulimina aculeata d'Orbigny, 1826

Bulimina aculeata d'ORBIGNY, 1826, p. 269. SCHNITKER, 1971, p. 194, pl. 5, fig. 4.

Genus ***Globobulimina*** Cushman, 1927a

Globobulimina auriculata (Bailey), 1851

Bulimina auriculata BAILEY, 1851, p. 12, figs. 25-27.

Globobulimina auriculata (Bailey). SCHNITKER, 1971, p. 202, pl. 5, fig. 6.

Family UVIGERINIDAE Haeckel, 1894

Genus ***Uvigerina*** d'Orbigny, 1826

Uvigerina auberiana d'Orbigny, 1839a

Uvigerina auberiana d'ORBIGNY, 1839a, p. 106, pl. 2, figs. 23, 24. SCHNITKER, 1971, p. 212, figs. 23, 24.

Genus ***Trifarina*** Cushman, 1923

Trifarina fluens (Todd), 1947

Anglogerina fluens TODD, *In* Cushman and Todd, 1947, p. 67, pl. 16, figs. 6, 7.

Trifarina fluens (Todd). SCOTT and others, 1980, p. 231, pl. 4, figs. 12, 13. SCOTT, 1987, p. 329.

Superfamily DISCORBACEA Ehrenberg, 1838

Family DISCORBIDAE Ehrenberg, 1838

Subfamily DISCORBINAE Ehrenberg, 1838

Genus ***Buccella*** Andersen, 1952

Buccella hannai (Phleger and Parker), 1951

Eponides hannai PHLEGER and PARKER, 1951, p. 21, pl. 10, figs. 10-14.

Buccella hannai (Phleger and Parker). SCHNITKER, 1971, p. 194, pl. 5, fig. 15.

Genus ***Eoeponidella*** Wickenden, 1949

Eoeponidella pulchella (Parker), 1952b

Prinaella (?) *pulchella* PARKER, 1952b, p. 420, pl. 6, figs. 18-20.

Genus ***Epistominella*** Husezima and Maruhasi, 1944

Epistominella takayanagii Iwasa, 1955

Epistominella takayanagii IWASA, 1955, p. 16, text fig. 4.

Genus ***Gavelinopsis*** Hofker, 1951

Gavelinopsis translucens (Phleger and Parker), 1951

Plate 3, figures 14, 15

"Rotalia" translucens PHLEGER and PARKER, 1951, p. 24, pl. 12, figs. 11, 12.

Gavelinopsis translucens (Phleger and Parker). SCOTT, 1987, p. 328, pl. 2, figs. 14, 15.

Genus ***Helenina*** Saunders, 1961

Helenina anderseni (Warren), 1957

Plate 3, figures 16, 17

Pseudoeponides anderseni WARREN, 1957, p. 39, pl. 4, figs. 12-15.

Helenina anderseni (Warren). SAUNDERS, 1961, p. 148. SCOTT and MEDIOLI, 1980a, p. 40, pl. 5, figs. 10, 11. SCOTT and others, 1991, p. 385, pl. 2, figs. 19, 20.

Genus ***Rosalina*** d'Orbigny, 1826

Rosalina columbiensis (Cushman), 1925

Discorbis columbiensis CUSHMAN, 1925, p. 43, pl. 6, fig. 13.

Rosalina columbiensis (Cushman). SCOTT and others, 1980, p. 231, pl. 4, figs. 6, 7.

Rosalina floridana (Cushman), 1922b

Discorbis floridana CUSHMAN, 1922b, p. 39, pl. 5, figs. 11, 12.

Rosalina floridana (Cushman). SCHNITKER, 1971, p. 210, pl. 5, fig. 19.

Superfamily SPIRILLINACEA Reuss, 1862

Family SPIRILLINIDAE Reuss, 1862

Subfamily PATELLININAE Rhumbler, 1906

Genus ***Patellina*** Williamson, 1858

Patellina corrugata Williamson, 1858

Patellina corrugata WILLIAMSON, 1858, p. 46, pl. 3, figs. 86-89. PHLEGER and PARKER, 1951, p. 23, pl. 12, fig. 4.

Superfamily ROTALIACEA Ehrenberg, 1839

Family ROTALIIDAE Ehrenberg, 1839

Subfamily ROTALIINAE Ehrenberg, 1839

Genus ***Ammonia*** Brünnich, 1772

Ammonia beccarii (Linné), 1758

Plate 3, figure 18

Nautilus beccarii LINNÉ, 1758, p. 710.

Ammonia beccarii (Linné). BRÜNNICH, 1772, p. 232. FRIZZELL and KEEN, 1949, p. 106. SCHNITKER, 1974, p. 216-223. SCOTT and MEDIOLI, 1980a, p. 35, pl. 5, figs. 8, 9.

"Rotalia" beccarii (Linné) var. *parkinsoniana* (d'Orbigny). PHLEGER and PARKER, 1951, p. 23, pl. 12, fig. 6. BOCK, 1971, p. 55, pl. 20, figs. 5, 6.

"Rotalia" beccarii (Linné) var. tepida CUSHMAN, 1926, p. 79, pl. 1. PHLEGER and PARKER, 1951, p. 23, pl. 12, fig. 7.

"Rotalia" beccarii (Linné) variants. PARKER, 1952a, p. 457, pl. 5, figs. 5, 7, 8. PARKER and others, 1953, p. 13, pl. 4, figs. 20-22, 25-30. PARKER, 1954, p. 531, pl. 10, figs. 1, 2, 5, 6. PHLEGER, 1954, p. 645, pl. 3, figs. 4-10. LANKFORD, 1959, p. 2099, pl. 3, figs. 10, 13.

Streblus beccarii (Linné) var. *sobrinus* (Shupack). BANDY, 1954, p. 138, pl. 30, fig. 7. BENDA and PURI, 1962, p. 355, pl. 1, figs. 12-14.

Streblus beccarii (Linné) var. *tepida* (Cushman). BENDA and PURI, 1962, p. 355, pl. 1, figs. 26, 27.

Streblus tepidus (Cushman). BANDY, 1956, p. 197, pl. 31, fig. 2.

Ammonia parkinsoniana (d'Orbigny) forma *tepida* Cushman. POAG, 1978, p. 397, pl. 1, figs. 1-4, 10-12, 17, 18. GOLDSTEIN and FREY, 1986, pl. 4, fig. 29.

Ammonia parkinsoniana (d'Orbigny) forma *typica* POAG, 1978, p. 397, pl. 1, figs. 5-9, 13-16, 19-21.

Remark: In this study, no attempt was made to distinguish the various forms of *Ammonia beccarii* since Schnitker (1974) demonstrated with culturing techniques that many of the described forms are ecophenotypic variations of *Ammonia beccarii.*

Family ELPHIDIIDAE Galloway, 1933

Subfamily ELPHIDIINAE Galloway, 1933

Genus ***Elphidium*** de Montfort, 1808

Elphidium excavatum (Terquem) forma **_clavatum_** Cushman, 1930b

Plate 4, figures 1, 2

Elphidium incertum (Williamson) var. *clavatum* CUSHMAN, 1930b, p. 20, pl. 7, fig. 10.

Elphidium incertum (Williamson) and variants. PARKER, 1952a, p. 448, pl. 3, fig. 16.

Elphidium excavatum (Terquem) forma *clavata* Cushman. MILLER and others, 1982, p. 124, pl. 1, figs. 5-8; pl. 2, figs. 3-8; pl. 3, figs. 3-8; pl. 4, figs. 1-6; pl. 5, figs. 4-8; pl. 6, figs. 1-5.

Elphidium excavatum (Terquem) forma **_excavatum_** (Terquem), 1876

Plate 4, figure 3

Polystomella excavata TERQUEM, 1876, p. 429, pl. 2, fig. 2.

Elphidium excavatum (Terquem). CUSHMAN, 1930b, p. 21, pl. 8, figs. 1-7. CUSHMAN, 1944, p. 26, pl. 2, fig. 40. BENDA and PURI, 1962, p. 325, pl. 1, fig. 16. HANSEN and LYKKE-ANDERSEN, 1976, p. 10, pl. 6, figs. 1-6.

Elphidium excavatum (Terquem) forma *excavata* (Terquem). MILLER and others, 1982, p. 128, pl. 1, figs. 9-12; pl. 2, figs. 1, 2; pl. 3, figs. 1, 2; pl. 4, figs. 13-16; pl. 5, figs. 15, 16; pl. 6, figs. 6-8, 14.

Elphidium excavatum (Terquem) forma **_gunteri_** Cole, 1931

Plate 4, figures 4, 5

Elphidium gunteri COLE, 1931, p. 34, pl. 4, figs. 9, 10. PARKER and others, 1953, p. 8, pl. 3, figs. 18, 19. PARKER, 1954, p. 508, pl. 6, fig. 16. PHLEGER, 1954, p. 639, pl. 2, figs. 3, 4. BANDY, 1956, p. 194, pl. 30, fig. 19. LEHMANN, 1957, p. 348, pl. 3, figs. 1-4. LANKFORD, 1959, p. 2098, pl. 2, fig. 7. BENDA and PURI, 1962, p. 335, pl. 1, fig. 11. SCOTT and others, 1991, p. 385, pl. 2, fig. 15.

Elphidium excavatum (Terquem) forma ***lidoensis*** Cushman, 1936

Plate 4, figures 6, 7

Elphidium lidoense CUSHMAN, 1936, p. 86, pl. 15, fig. 6.

Elphidium excavatum (Terquem) forma *lidoensis* Cushman. MILLER and others, 1982, p. 134, pl. 1, figs. 17-20; pl. 4, figs. 7-12; pl. 5, fig. 9; pl. 6, figs. 15, 16.

Elphidium excavatum (Terquem) forma ***selseyensis***

(Heron-Allen and Earland), 1911 emended (Brand), 1941

Plate 4, figures 8, 9

Designated by Brand, 1941, p. 66, as: *Polystominella striatopunctata* variety *selseyensis* Heron-Allen and Earland, 1909, p. 695, pl. 21, figs. 2a-2c.

Polystominella striatopunctata (Fichtel and Moll) variety HERON-ALLEN and EARLAND, 1909, p. 695, pl. 21, fig. 2a-2c.

Polystominella striatopunctata (Fichtel and Moll) variety selseyensis HERON-ALLEN and EARLAND, 1911, p. 448.

Elphidium incertum (Williamson) and variants. PARKER, 1952a, p. 448, pl. 3, figs. 14, 17; pl. 4, figs. 1, 2.

Elphidium excavatum (Terquem) forma *selseyensis* Heron-Allen and Earland. MILLER and others, 1982, p. 132, pl. 1, figs. 13-16; pl. 5, figs. 10-13; pl. 6, figs. 9-13.

Elphidium galvestonense Kornfeld, 1931

Plate 4, figure 10

Elphidium gunteri Cole var. *galvestonensis* KORNFELD, 1931, p. 87, pl. 15, fig. 1.

Elphidium galvestonense Kornfeld forma *typicum* POAG, 1978, p. 403, pl. 3, figs. 13-16, 22, 23. POAG, 1981, p. 60, pl. 35, fig. 3, pl. 36, fig. 3.

Elphidium galvestonense Kornfeld. PARKER and others, 1953, p. 7, pl. 3, figs. 15, 16. PHLEGER, 1954, p. 639, pl. 2, figs. 1, 2. LEHMANN, 1957, p. 348, pl. 2, figs. 37-40.

Elphidium poeyanum (d'Orbigny), 1839a

Plate 4, figures 11, 12

Polystomella poeyana d'Orbigny, 1839a, p. 55, pl. 6, figs. 25, 26.

Cribroelphidium kugleri CUSHMAN and BRÖNNIMANN, 1948a, p. 18, pl. 4, fig. 4.

Cribroelphidium poeyanum (d'Orbigny). BOCK, 1971, p. 57, pl. 21, figs. 1, 2.

Elphidium kugleri (Cushman and Brönnimann). HANSEN and LYKKE-ANDERSEN, 1976, p. 12, pl. 9, figs. 4-8.

Elphidium poeyanum (d'Orbigny). CUSHMAN, 1930b, p. 25, pl. 10, figs. 4, 5. PARKER and others, 1953, p. 9, pl. 3, fig. 26. BANDY, 1954, p. 136, pl. 30, fig. 6. PARKER, 1954, p. 509, pl. 6, fig. 17. PHLEGER, 1954, p. 639, pl. 2, figs. 8, 9. LEHMANN, 1957, p. 348, pl. 3, figs. 13, 14. LANKFORD, 1959, p. 2098, pl. 2, fig. 5. HANSEN and LYKKE-ANDERSEN, 1976, p. 13, pl. 9, figs. 9-12; pl. 10, figs. 1-5.

Elphidium subarcticum Cushman, 1944

Elphidium subarcticum CUSHMAN, 1944, p. 27, pl. 3, figs. 34, 35.

Cribrononion subarcticum (Cushman). SCOTT and others, 1980, p. 228, pl. 2, fig. 9.

Superfamily ORBITOIDACEA Schwager, 1876

Family EPONIDIDAE Hofker, 1951

Genus ***Eponides*** de Montfort, 1808

Eponides repandus (Fichtel and Moll), 179?

Nautilus repandus FICHTEL and MOLL, 1798, p. 35, pl. 3, figs. a-d.

Eponides repandus (Fichtel and Moll). BARKER, 1960, p. 214, pl. 104, fig. 18. BOCK, 1971, p. 58, pl. 21, figs. 6, 7.

Family CIBICIDIDAE Cushman, 1927a

Subfamily CIBICIDINAE Cushman, 1927a

Genus ***Cibicides*** de Montfort, 1808

Cibicides lobatulus (Walker and Jacob), 1798

Nautilus lobatulus WALKER and JACOB, 1798, p. 642, pl. 14, fig. 36.

Truncatulina lobatula (Walker and Jacob). d'Orbigny, 1839a, p. 134, pl. 2, figs. 22-24. BRADY, 1884, p. 660, pl. 92, fig. 10, pl. 93, fig. 1. CUSHMAN, 1918, p. 16, pl. 1, fig. 10, p. 60, pl. 17, figs. 1-3.

Cibicides lobatulus (Walker and Jacob). CUSHMAN, 1927b, p. 170, pl. 27, figs. 12, 13. CUSHMAN, 1935, p. 52, pl. 52, figs. 4-6. PARKER, 1952a, p. 446, pl. 5, fig. 11. SCOTT and others, 1980, p. 226, pl. 4, figs. 8, 9.

Superfamily CASSIDULINACEA d'Orbigny, 1839a

Family CASSIDULINIDAE d'Orbigny, 1839a

Genus ***Cassidulina*** d'Orbigny, 1826

Cassidulina laevigata d'Orbigny, 1826

Cassidulina laevigata d'ORBIGNY, 1826, p. 282, no. 1, pl. 15, figs. 4,5. SCHNITKER, 1971, p. 196, pl. 10, fig. 5.

Cassidulina reniforme Nørvang, 1945

Cassidulina crassa var. *reniforme* NØRVANG, 1945, p. 41, text figs. 6c-h.

Cassidulina reniforme (Nørvang). SCOTT, 1987, p. 327, pl. 2, figs. 11, 12.

Family NONIONIDAE Schultze, 1854

Subfamily NONIONINAE Schultze, 1854

Genus ***Haynesina*** Banner and Culver, 1978

Remark: This genus was placed in this taxonomic position since Banner and Culver (1978) designated *Nonionina germanica* Ehrenberg, 1840b as the type species for this genus.

Haynesina depressula (Walker and Jacob), 1798

Plate 4, figure 13

Nautilus depressulus WALKER and JACOB, 1798, p. 641, fig. 33.

Nonionina depressula (Walker and Jacob). HERON-ALLEN and EARLAND, 1916, p. 279, pl. 43, fig. 4.

Nonion depressulus (Walker and Jacob). MURRAY, 1965, p. 148, pl. 25, figs. 6, 7, pl. 26, figs. 7, 8. HAYNES, 1973, p. 209, pl. 22, figs. 8-11, pl. 29, fig. 9, text-fig. 44, no. 1-3.

Haynesina depressula (Walker and Jacob). BANNER and CULVER, 1978, p. 200, pl. 10, figs. 1-10.

Genus ***Nonionella*** Cushman, 1926

Nonionella auricula Heron-Allen and Earland, 1930b

Nonionella auricula HERON-ALLEN and EARLAND, 1930b, p. 192, pl. 5, figs. 68-70. CUSHMAN, 1947b, p. 13, pl. 2, fig. 14.

Family ANOMALINIDAE Cushman, 1927a

Subfamily ANOMALININAE Cushman, 1927a

Genus ***Hanzawaia*** Asano, 1944

Hanzawaia strattoni (Applin, Ellisor and Kniker), 1925

Truncatulina americana Cushman var. *strattoni* APPLIN and others, 1925, p. 99, pl. 3, fig. 3.

Cibicidina strattoni (Applin). PARKER and others, 1953, p. 7, pl. 4, figs. 38, 39.

PHLEGER, 1954, p. 638, pl. 1, figs. 26, 27.

Hanzawaia strattoni (Applin). BANDY, 1954, p. 136, pl. 31, fig. 4. LANKFORD, 1959,

p. 2098, pl. 3, fig. 16.

PLATE 1

Figure 1. *Difflugia corona* Ehrenberg.

Figure 2. *Difflugia oblonga* Ehrenberg.

Figure 3. *Difflugia urceolata* Carter.

Figure 4. *Pontigulasia compressa* (Carter).

Figure 5. *Cucurbitella tricuspis* (Carter).

Figure 6. *Centropyxis aculeata* (Ehrenberg).

Figure 7. *Centropyxis constricta* (Ehrenberg).

Figure 8. *Polysaccammina hyperhalina* Medioli, Scott and Petrucci.

Figure 9. *Pseudothurammina limnetis* Scott, Medioli and Williamson.

Figure 10. *Miliammina fusca* (Brady).

Figure 11. *Haplophragmoides manilaensis* Andersen.

Figure 12. *Haplophragmoides wilberti* Andersen.

Figure 13. *Ammoastuta inepta* (Cushman and Brönnimann).

Figure 14. *Ammobaculites dilatatus* Cushman and Brönnimann.

Figure 15. *Ammobaculites exiguus* Cushman and Brönnimann.

Figure 16. *Ammotium salsum* (Cushman and Brönnimann).

Figure 17. *Ammotium subdirectum* Warren.

Figure 18, 19. *Trochammina ochracea* (Williamson). 18. dorsal view, 19. ventral view.

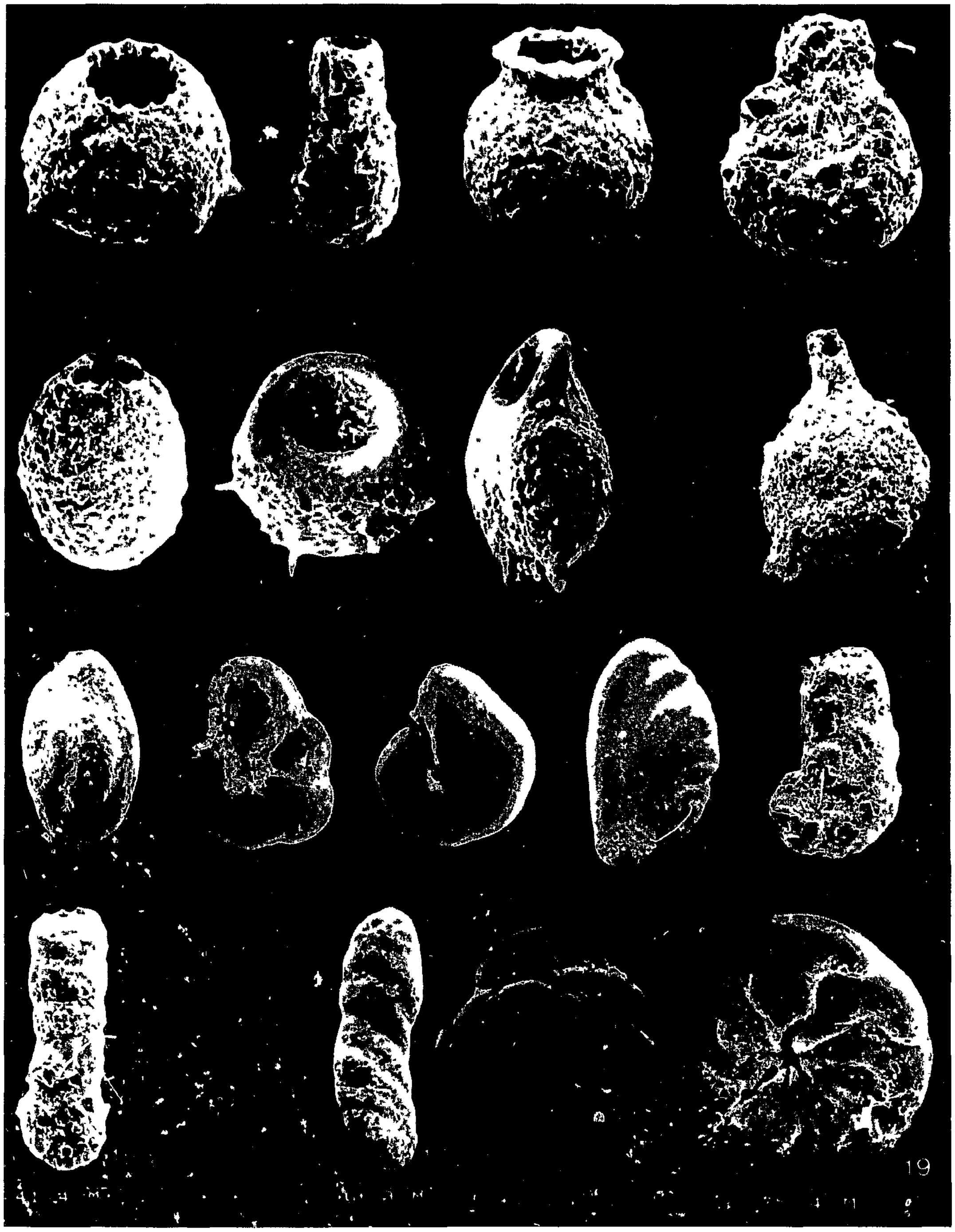


Plate 1

PLATE 2

Figure 1-4. *Trochammina inflata* (Montagu). 1. dorsal view, 2-4. ventral view.

Figure. 5-16. *Siphotrochammina lobata* Saunders. 5-16. ventral view.

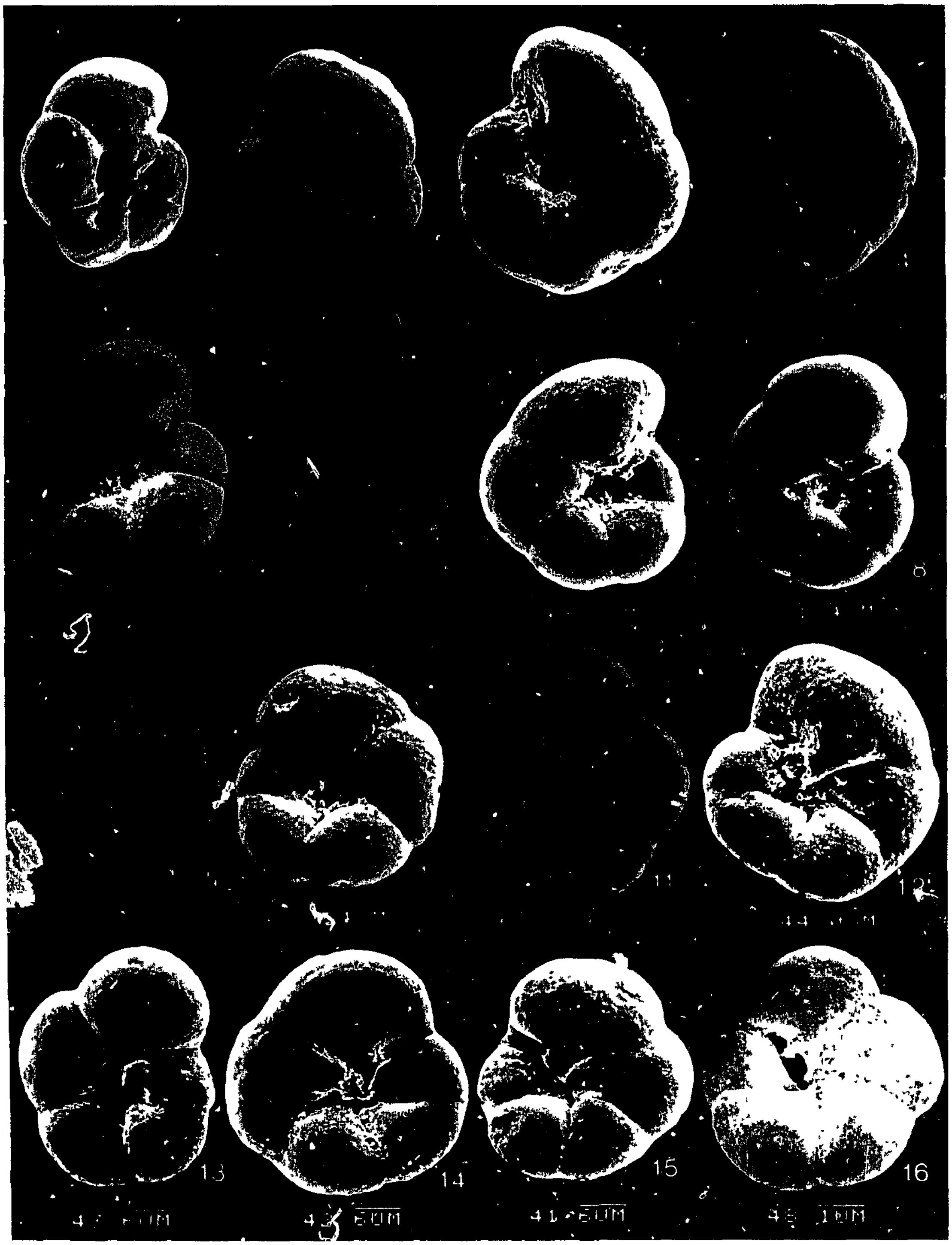


Plate 2

PLATE 3

Figure 1, 2. *Siphotrochammina lobata* Saunders. 1, 2. ventral view.

Figure 3. *Trochammina macrescens* Brady. 3. ventral view.

Figure 4. *Gaudryina exilis* Cushman and Brönnimann.

Figure 5, 6. *Arenoparella mexicana* (Kornfeld). 5. dorsal view, 6. ventral view.

Figure 7, 8. *Tiphotrocha comprimata* (Cushman and Brönnimann). 7. dorsal view, 8. ventral view.

Figure 9. *Wiesnerella auriculata* (Egger).

Figure 10. *Quinqueloculina lamarckiana* d'Orbigny.

Figure 11. *Quinqueloculina seminulum* (Linné) forma *jugosa* Cushman.

Figure 12. *Triloculina oblonga* (Montague).

Figure 13. *Bolivina lowmani* Phlegeer and Parker.

Figure 14, 15. *Gavelinopsis translucens* (Phlegeer and Parker). 14. dorsal view, 15. ventral view.

Figure 16, 17. *Helenina anderseni* (Warren). 16. dorsal view, 17. ventral view.

Figure 18. *Ammonia beccarii* (Linné).

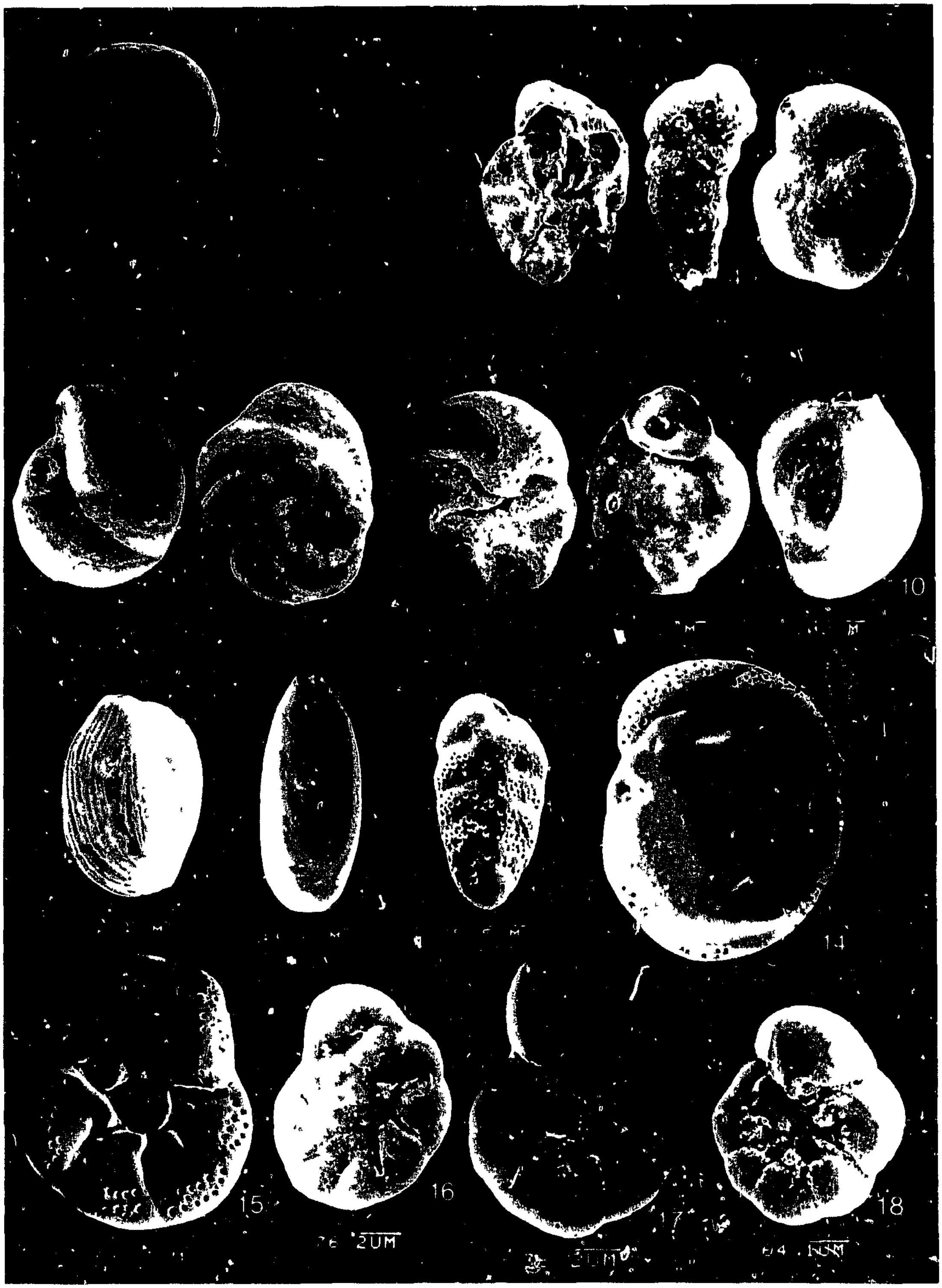


Plate 3

PLATE 4

Figure 1, 2. *Elphidium excavatum* (Terquem) forma *clavatum* Cushman. 2. Scanning Light Micrograph (SLM) x40

Figure 3. *Elphidium excavatum* (Terquem) forma *excavatum* (Terquem).

Figure 4, 5. *Elphidium excavatum* (Terquem) forma *gunteri* Cole. 4. SLM x40

Figure 6, 7. *Elphidium excavatum* (Terquem) forma *lidoensis* Cushman. 6. SLM x40

Figure 8, 9. *Elphidium excavatum* (Terquem) forma *selseyensis* (Heron-Allen and Earland, emmended Brand). 8. SLM x40

Figure 10. *Elphidium galvestonense* Kornfeld.

Figure 11, 12. *Elphidium poeyanum* (d'Orbigny). 12. SLM x40

Figure 13. *Haynesina depressula* (Walker and Jacob).

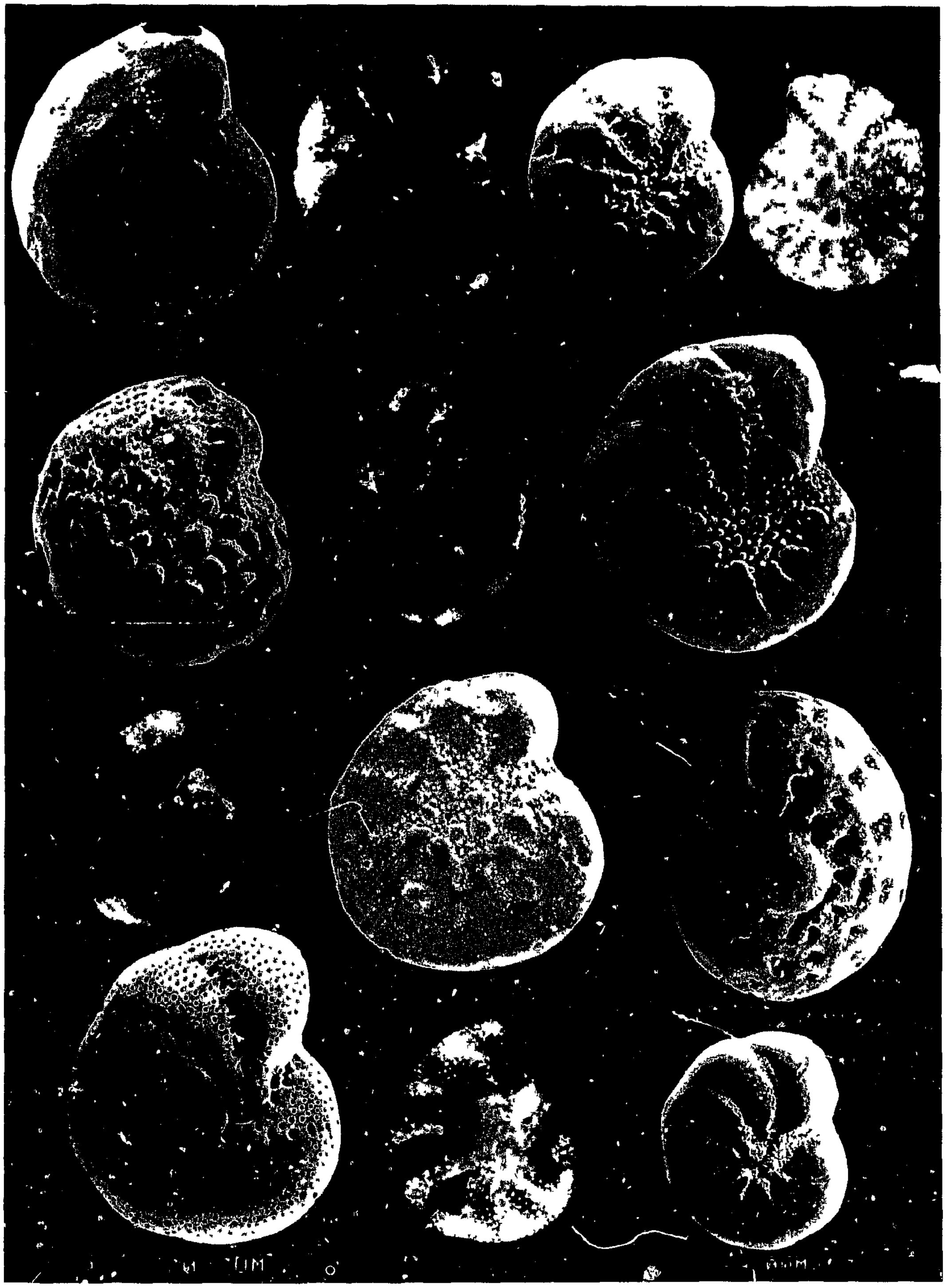


Plate 4

Appendix A. Data Tables

Appendix Table 1. Percent abundance of living (stained, L) and total (T) foraminifera and arceliaceans from Transect 2, Murrells Inlet

STATION NUMBER	1		2		3		4		5		6		7		8		9		10		11		12		13	
ELEVATION IN cm ABOVE MSL	86.8		85.0		82.3		80.4		75.5		74.6		72.8		71.6		70.9		69.1		67.9		65.1		62.1	
DISTANCE ALONG TRANSECT (m)	0		3.4		5.8		10.7		15.6		17.4		20.2		23.5		26.6		31.5		36.1		38.5		43.7	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO OF SPECIES	2	16	4	20	5	23	4	23	8	21	3	23	6	20	5	17	7	20	7	15	8	17	6	23	7	19
NO OF INDIVIDUALS/10cc	161	3232	320	9440	235	3243	128	3275	800	9568	320	7147	320	9632	544	9312	676	7063	715	2923	1664	8608	912	4624	800	5392
Ammobaculites dilatatus																										
A. exiguus																										
Ammonia beccarii	94.1	61.4	50.0	65.8	54.5	55.3	50.0	59.6	40.0	65.9	20.0	58.5	20.0	61.5	47.1	66.0	51.9	63.3	50.7	63.9	30.8	60.8	43.9	57.8	48.0	61.7
Ammotium multiloculatum																										
A. salsum												0.9		0.3												
A. subdirectum																										
Anomalina spp.				2.0		1.6		0.3				1.8		0.7		0.3		0.6		1.1		2.6		0.3		0.6
Arenoparella mexicana						1.3		0.3				0.3							7.5	2.2		0.4	1.8	1.0	6.0	1.5
Bolivina lowmani		3.3		3.1		2.3	8.3	2.6	8.0	3.7		2.1		4.7		2.7		3.9		0.4		3.7		0.7		1.8
B. pseudoplicata						0.3				0.7																
B. striatula												0.3														
Buccella hannai						0.7		1.0		0.3						0.7		0.3				0.7		1.0		0.3
Buliminella elegantissima	5.9	2.0	10.0	2.0	4.5	1.3		1.3		2.0		2.7		3.7	5.9	1.7		1.2		0.4		1.9		1.0		1.5
Cassidulina reniforme				0.7						0.3										0.4						0.3
Cibicides lobatulus		7.9		5.1		6.6		5.9		4.3		7.2		3.3		7.6	3.7	5.7	1.5	6.9	1.9	2.6		3.8		2.1
Cyclogyra involvens																										
Discorbis spp		1.3				1.6		4.6		1.7		0.3				0.3		0.3				0.7		1.0		0.6
Elphidium excavatum clavatum																				0.4						
E. excavatum excavatum		7.9		6.1		6.3		7.8	8.0	8.4		11.9	20.0	8.6		7.2	7.4	10.8	6.0	9.9	11.5	9.7	8.8	8.0	6.0	6.8
E. excavatum gunteri						0.3		0.3		0.7				0.3				0.3								
E. excavatum lidoensis		6.9		4.7		3.6		2.9	4.0	2.0		1.8		1.0		2.1		2.1						0.7		0.3
E. excavatum selseyensis		1.3		0.3		1.0		0.7		0.3		0.9		2.3			3.7	0.6								
E. galvestonense																				0.4						
E. poeyanum		1.0														0.3								1.0		
Epistominella takayanagii								0.3																		
Eponides repandus		0.3																								
Gaudryina exilis																										
Gavelinopsis translucens		2.6		3.7		1.6		2.6		2.7		0.3		3.3												
Globigerinelloides spp		1.3		0.3		0.3				0.7		0.9						0.6		0.4		0.4		0.4		
Guembelitria spp										0.3		0.6		0.7				0.3								1.2
Hanzawaia strattoni				0.3																						
Haplophragmoides manilaensis																								0.3		
H. wilberti										0.3																
Haynesina depressulum		0.7		0.7		3.6		1.3		1.0		2.4	10.0	2.3		5.5	7.4	5.4	3.0	4.4	9.6	4.8		3.1		6.5
Helenina andersoni			10.0	0.3	22.7	5.3	25.0	2.3	4.0	0.3	40.0	2.4	20.0	2.3	29.4	2.4	11.1	1.2	20.9	5.8	34.6	7.1	35.1	9.0	24.0	4.7
Heterohelix spp				0.3		0.3		0.3				0.6				0.3								0.3		
Lagena spp																		0.3								
Miliammina fusca					4.5	0.3						0.3				0.3				0.4	1.9	1.1		0.7	10.0	6.5
Nonionella atlantica														0.3												
Planktonics (Recent)						0.3																				
Polysaccammina hyperhalina																										
Quinqueloculina lamarckiana																										
Q. seminulum		1.0		0.3		0.7		2.3		0.7		0.3	10.0	0.3				0.3						0.3		
Rosalina floridana																										
Siphotrochammina lobata																									2.0	0.6
Trifarina fluens		0.7		0.7		0.7		0.3														0.4		0.3		0.3
Triloculina oblonga														0.3												
Trochammina inflata		0.3	30.0	1.4	13.8	4.8	16.7	2.3	36.0	3.3	40.0	2.1	20.0	2.0	11.8	0.7	14.8	1.2	10.4	3.3	5.8	1.9	7.0	6.2	6.0	2.4
T. macrescens																								0.3		
T. ochracea				1.7				0.3		0.3		1.2		1.7	5.9	0.7		1.2			3.8	1.1	3.5	2.1		0.3
Centropyxis aculeata				0.3				0.3				0.3		0.3		1.0		0.3				0.4		0.3		
C. constricta								0.3																		

Appendix Table 1 (continued).

STATION NUMBER	14		15		16		17		18		19		20		21		22		23		24		25		26	
ELEVATION IN cm ABOVE MSL	59.6		56.6		53.8		49.8		46.8		41.3		34.9		31.5		25.1		8.6		0		-11.3		-11.0	
DISTANCE ALONG TRANSECT (m)	47.1		49.2		52.9		57.5		63.0		72.2		84.1		106.4		116.7		124.8		126.0		127.8		129.0	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	7	23	6	19	5	17	4	16	10	21	6	10	6	8	6	8	6	5	5	10	5	10	4	10	8	12
NO. OF INDIVIDUALS/10cc	1920	13344	1248	8600	456	2280	1216	7424	2539	6144	3072	7253	623	1116	490	704	352	786	194	572	90	321	78	262	52	202
Ammobaculites dilatatus																				0.7						
A. exiguus										0.3					0.8	0.6						0.7		2.3		
Ammonia beccarii	65.0	59.2	48.7	59.3	47.4	52.3	49.1	61.8	61.3	56.9	48.6	52.1		0.4						0.3		0.4		0.8		5.4
Ammotium multiloculatum													1.9	1.1	0.4	0.9	0.6	0.8				1.4		1.5		0.5
A. salsum		0.7			1.8	3.2	7.0	2.9	5.0	3.1	4.9	5.6	19.8	25.4	24.9	28.7	22.7	16.5	10.3	8.7	15.2	12.5	41.0	31.3	53.8	36.8
A. subdirectum																								0.8		
Anomalina spp.		1.7		0.4		1.1		0.3		2.1																
Arenoparrella mexicana									0.8	0.3			2.5	2.2	0.4	0.9		0.3	2.1	1.0	2.5	3.2		0.8	1.9	2.0
Bolivina lowmani		4.3		2.2				2.0	0.8	0.3																
B. pseudoplicata																										
B. striatula																										
Buccella hannai		0.5																								
Buliminella elegantissima		1.2	2.6	1.5				1.1	0.8	1.4																
Cassidulina reniforme				0.4				0.3																		
Cibicides lobatulus		3.8		2.5		4.9		2.3		1.7																1.5
Cyclogyra involvens	1.7	0.2																								
Discorbis spp.		0.2		1.8		1.1				0.3																
Elphidium excavatum clavatum		1.0																								
E. excavatum excavatum	10.0	6.2	10.3	12.4		4.9		10.1	4.2	11.5	0.7	2.6														
E. excavatum gunteri						0.4																				
E. excavatum lidoensis		0.2				0.4																				
E. excavatum selseyensis																										
E. galvestonense				0.4		3.2		2.6		0.3		0.6														
E. poeyanum		0.2				0.4		0.3		1.0																
Epistominella takayanagii																										
Eponides repandus																										
Gaudryina exilis		0.2								0.3																
Gavelinopsis translucens		2.4																								
Globigerinelloides spp.		0.5				0.4		1.1		0.7																
Guembelitria spp.																										
Hanzawaia strattoni																										
Haplophragmoides manilaensis																										
H. wilberti																0.3										
Haynesina depressulum	3.3	8.4		8.4		5.8		1.1		4.9		3.2														
Helenina andersoni	10.0	1.9	23.1	4.7	14.0	2.8	17.5	4.6	4.2	1.7	17.4	10.3														
Heterohelix spp.						0.4		0.3		0.3																
Lagena spp.																										
Miliammina fusca	8.3	2.4	7.7	1.5	29.8	15.4	26.3	8.0	20.2	10.8	27.1	23.5	74.1	69.5	73.1	68.2	65.3	71.2	83.5	86.3	78.5	78.3	53.8	55.7	28.8	36.8
Nonionella atlantica		0.2																								
Planktonica (Recent)																										
Polysaccammina hyperhalina														0.4			10.2	7.2		0.3					1.9	1.0
Quinqueloculina lamarckiana				0.4																						
Q. seminulum				0.7																						
Rosalina floridana				0.4		0.4																				
Siphotrochammina lobata																			2.1	1.4		0.4			1.9	2.0
Trifarina fluens		0.5								0.3																
Triloculina oblonga																										
Trochammina inflata	1.7	1.7	7.7	1.5	7.0	3.5		0.3	1.7	0.7		0.6	1.3	0.7	0.4	0.3	0.8	2.3		1.0	1.3	1.8		0.8	1.9	4.0
T. macrescens				0.4					0.8	0.7						0.3				0.3		0.4	2.6	3.8	5.8	3.0
T. ochracea		2.4		0.7				0.6			1.4	1.2	0.6	0.4			0.8	1.0	2.1	0.7	2.5	1.1	2.6	2.3	3.8	1.5
Centropyxis aculeata				0.7				0.3				0.3						0.5								1.0
C. constricta																										

Appendix Table 2. Percent abundance of living (stained, L) and total (T) foraminifera and arcellaceans and percentage of organic matter from Transect 7, Murrells Inlet.

Appendix Table 2.

STATION NUMBER	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
ELEVATION IN cm ABOVE MSL	0		18.9		46.1		76.9		84.2		75.0		72.9		89.4		83.9		97.3		110.4		121.4		134.5		145.2		150.4		141.5	
DISTANCE ALONG TRANSECT (m)	0		0.6		3.1		4.0		7.0		11.0		20.7		27.5		28.7		30.2		33.6		37.2		41.2		42.1		47.3		48.8	
PERCENT ORGANIC MATTER	1.52		2.07		2.04		3.74		3.77		15.04		22.73		4.32		6.26		6.70		2.37		1.27		1.03		0.64		0.92		0.91	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	2	21	8	25	14	24	16	23	12	14	9	13	5	9	4	9	2	6	5	7	3	3	3	4	3	6	2	8	2	5	3	4
NO. OF INDIVIDUALS/10cc	8	688	50	427	70	383	192	792	68	254	31	331	14	117	34	205	6	44	10	45	15	64	13	40	41	365	5	24	7	75	11	87
Ammoastuta inepta																																
Ammobaculites dilatatus																																
A. exiguus											3.2	3.0	21.4	9.4	2.9	1.5				2.2												
Ammodiscus catinus																																
Ammonia beccarii	75.0	33.4	28.0	60.2	14.3	45.5	3.1	24.7		2.4						0.5																
Ammotium multiloculatum											3.2	2.4																				
A. salsum		1.2		0.7	1.4	1.3	3.1	7.8	14.7	10.6	64.5	50.8	28.8	26.5	11.8	16.8	50.0	18.2		2.2								4.2				
A. subdirectum								1.5		1.2																						
Arenoparella mexicana				0.2			2.1	1.0										2.3			6.7	1.6		2.5				4.2		1.3		
Bolivina lowmani		1.7		0.2	1.4	0.3																										
B. striatula						0.8																										
Buliminella elegantissima				0.7		0.5		0.3																								
Cibicides lobatulus		2.9		0.9		1.8		0.8				0.6				1.0																
Cyclogyra involvens			4.0	0.5			12.5	3.0																								
Eggerella advena											3.2	0.6																				
Elphidium excavatum clavatum		3.2	2.0	3.0		0.8		0.5																								
E. excavatum excavatum		2.9	2.0	0.5	5.7	4.1	1.0	0.3																								
E. excavatum gunteri		0.9			1.4	0.5																										
E. excavatum lidoensis		2.9	2.0	2.1	1.4	2.0																										
E. excavatum selseyensis		3.5		2.1																												
E. galvestonense		0.6																														
E. poeyanum	25.0	23.3	44.0	13.8	35.7	15.5	2.1	4.0																								
E. subarcticum						0.5																										
Eponides repandus																																
Gaudryina exilis		0.9		0.7	1.4	1.0	1.0	3.8	1.5	7.9	3.2	1.8	7.1	0.9		2.0										0.3						1.1
Gavelinopsis translucens		0.3		0.2																												
Glomospira gordialis									1.5	0.4																						
Hanzawaia strattoni		1.5		0.7																												
Haplophragmoides manilaensis																																
H. wilberti																																
Haynesina depressula		9.3	16.0	4.7	12.9	5.1	5.2	1.5	4.4	2.4																						
Helenina anderseni					4.3	0.8	15.6	4.5	20.6	5.5																						
Heterohelix sp.		0.6																														
Miliammina fusca			2.0	0.5		1.0	3.1	3.0	16.2	11.8	12.9	7.3		6.0	17.6	14.1		11.4	10.0	2.2						0.8				1.3		
Planktonics		0.9		1.4				1.0																								
Polysaccammina hyperhalina				1.2		1.0		2.3	4.4	2.4	3.2	5.4		2.6				2.3														
P. ipohalina																										0.5						
Pseudothurammina limnetis												0.3																4.2				
Quinqueloculina seminulum								0.5																								
Q. seminulum jugosa						0.3																										
Rosalina floridana				0.2			2.1	0.5																								
Siphotrochammina lobata		0.3		0.7		0.3	3.1	4.0	2.9	5.9		4.2	7.1	6.5		2.0		4.5	10.0	6.7			7.7	2.5	24.4	11.5	20.0	8.3	28.6	24.0	9.1	23.0
Tiphotrocha comprimata																																
Trifarina fluens		1.2		0.5		0.3																										
Triloculina oblonga					1.4	0.3	27.1	6.6	7.4	2.0																						
Trochammina inflata		2.0		2.3	7.1	8.9	14.6	18.9	20.6	38.2	3.2	13.9	35.7	26.5	87.6	58.5	50.0	61.4	50.0	64.4	80.0	3.1	76.9	7.5	[illegible]	75.9	80.0	70.8	71.4	86.0	63.6	67.8
T. macrescens					1.4	1.3	1.0	2.8	2.9	7.9		8.2		17.1		3.9			20.0	20.0	13.3	95.3	15.4	87.5	14.6	11.0		8.3		5.3	27.3	8.0
T. ochracea		6.7		1.6	10.0	8.4	3.1	6.6	2.9	1.6	3.2	1.5		2.6					10.0	2.2												
Wiesnerella auriculata				0.2																												
Centropyxis aculeata																																

Appendix Table 2 (continued).

STATION NUMBER	17		18		19		20		21		22		23		24		25		26		27		28		29		30		31		32	
ELEVATION IN cm ABOVE MSL	132.7		123.8		119.8		105.5		103.7		105.5		108.0		98.5		95.2		89.1		75.3		52.8		79.9		86.3		93.8		100.3	
DISTANCE ALONG TRANSECT (m)	50.9		51.9		52.8		58.3		70.8		82.7		87.8		102.2		108.0		111.9		123.5		127.5		132.1		139.1		144.0		149.5	
PERCENT ORGANIC MATTER	1.24		1.39		1.77		2.18		2.98		2.46		2.09		4.03		3.88		6.51		7.44		8.03		9.86		2.78		3.04		2.74	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	3	5	3	4	5	7	6	8	2	3	1	2	2	4	4	5	4	8	3	5	11	19	16	17	7	11	4	5	5	8	2	5
NO. OF INDIVIDUALS/10cc	20	141	46	211	45	142	72	321	2	4	3	8	22	61	21	38	65	163	21	43	45	207	322	536	65	170	59	85	49	104	11	29
Ammoastuta inepta																																
Ammobaculites dilatatus																														1.0		
A. exiguus																		1.2				1.0			3.1	3.5						
Ammodiscus catinus																														1.9		
Ammonia beccarii									50.0	25.0											4.4	1.4	10.9	13.6	1.5	0.6						
Ammotium multiloculatum																						0.5				1.2						
A. salsum					4.4	2.1	8.3	16.8						3.3	78.2	60.5	32.3	40.5	57.1	34.9	40.0	[illegible]	0.3	2.1	56.9	48.4	83.1	69.4	6.1	7.7		3.4
A. subdirectum																																
Arenoparella mexicana		1.4		2.4	6.7	4.2	4.2	4.7													2.2	0.5							2.0	1.0		
Bolivina lowmani																																
B. striatula																																
Buliminella elegantissima																																
Cibicides lobatulus						0.7																0.5		0.2								
Cyclogyra involvens																																
Eggerella advena																						0.5										
Elphidium excavatum clavatum																							0.9	0.6								
E. excavatum excavatum																							9.0	7.8								
E. excavatum gunteri																						0.5	6.2	4.1								
E. excavatum lidoensis																																
E. excavatum selseyensis																																
E. galvestonense																					6.7	5.8	0.6	0.7								
E. poeyanum																					4.4	1.9	11.5	11.6								
E. subarcticum																																
Eponides repandus																																
Gaudryina exilis																		0.6				1.4	0.3	0.4	3.1	1.2						
Gavelinopsis transiucens																																
Glomospira gordialis																																
Hanzawaia strattoni																																
Haplophragmoides manilaensis																																
H. wilberti																																
Haynesina depressula																							24.5	28.5								
Helenina andersoni																					2.2	0.5	5.0	3.2								
Heterohelix sp																																
Miliammina fusca							1.4	0.3							9.5	15.8	21.5	24.5	4.8	9.3	15.6	15.9	20.2	15.5	20.0	16.5	11.9	18.8	79.6	58.7		6.9
Planktonics																																
Polysaccammina hyperhalina																						1.4				0.6						
P. ipohalina																																
Pseudothurammina limnetis		0.7				0.7								1.6				2.5				0.5										
Quinqueloculina seminulum																																
Q. seminulum jugosa																																
Rosalina floridana																																
Siphotrochammina lobata	15.0	14.2	13.0	12.8	11.1	11.3												0.6		2.3	6.7	6.8	1.2	1.5		2.9		1.2		1.0		6.9
Tiphotrocha comprimata																																
Triterina fluens																																
Triloculina oblonga																							2.5	1.5								
Trochammina inflata	75.0	79.4	78.3	75.8	82.2	71.1	70.8	69.8		50.0	100	87.5	59.1	73.8	9.5	15.8	4.5	26.4	38.1	44.2	6.7	6.8	4.3	4.7		4.7	3.4	7.1	10.2	17.3	83.6	82.1
T. macrescens	10.0	4.3	8.7	9.0	15.6	9.9	13.9	8.1	50.0	25.0		12.5	40.9	21.3	4.8	5.3	4.6	3.7		9.3	6.7	7.7	2.2	2.1	9.2	11.2	1.7	3.5	2.0	11.5	38.4	20.7
T. ochracea							1.4	0.3								2.8					4.4	3.9	0.3	2.1	8.2	8.2						
Wiesnerella auriculata																																
Centropyxis aculeata																																

Appendix Table 2 (continued).

STATION NUMBER	33		34		35		36		37		38		39		40		41		42		43		44		45		46		47		48	
ELEVATION IN cm ABOVE MSL	110.4		107.4		144.6		159.5		151.3		165.0		148.5		149.5		149.8		148.5		149.8		151.0		153.7		158.2		168.7		188.1	
DISTANCE ALONG TRANSECT (m)	168.2		175.4		185.4		194.3		202.2		208.9		223.9		233.3		233.6		234.5		239.7		240.8		244.0		244.9		246.1		247.1	
PERCENT ORGANIC MATTER	1.68		3.01		2.88		1.88		1.41		1.91		4.18		4.13		3.97		5.77		9.62		10.07		25.61		2.64		1.11		1.84	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	4	8	3	5	0	4	4	6	1	3	4	7	3	5	5	7	8	12	7	10	9	16	8	13	7	12	7	15	4	11	2	9
NO. OF INDIVIDUALS/10cc	14	51	14	47	0	24	13	62	4	26	70	174	13	36	46	213	35	277	54	334	56	488	163	1067	240	1768	33	387	14	308	13	166
Ammoastuta inepta																								0.5		0.2						
Ammobaculites dilatatus																																
A. exiguus																0.5	2.9	0.7	1.9	0.6	3.6	1.8										
Ammodiscus catinus																																
Ammonia beccarii																		1.8		0.3		0.2						0.3		1.3		0.6
Ammotium multiloculatum																						0.2										
A. salsum	14.3	17.6		4.3										2.8	6.5	4.2	48.6	14.1	11.1	8.4	17.9	19.5	4.9	9.3	8.3	6.6		0.3				
A. subdirectum																						0.2										
Arenoparella mexicana	14.3	13.7					15.4	6.5			1.4	5.2				2.3	2.9	6.9	11.1	6.9	12.5	11.7	24.6	17.5	15.3	7.2		1.5		3.8		
Bolivina lowmani																																
B. striatula																																
Buliminella elegantissima																																
Cibicides lobatulus																																
Cyclogyra involvens																																
Eggerella advena																																
Elphidium excavatum clavatum																																
E. excavatum excavatum																																
E. excavatum gunteri																																
E. excavatum lidoensis																																
E. excavatum selseyensis																																
E. galvestonense																																
E. poeyanum																																
E. subarcticum																																
Eponides repandus																																
Gaudryina exilis							7.7	1.6				1.1					2.9	2.5		0.9	7.1	4.3	8.2	4.0	1.7	2.5	6.1	2.5		1.0		
Gavelinopsis translucens																																
Glomospira gordialis																						0.8										
Hanzawaia strattoni																																
Haplophragmoides manilaensis																								0.3								
H. wilberti						4.2						0.6						0.4					3.3	1.5	10.0	4.5	9.1	6.1	7.1	12.0		2.4
Haynesina depressula																																
Helenina andersoni																	8.6	1.1			1.8	0.2										
Heterohelix sp.																																
Miliammina fusca		2.0	14.3	4.3			7.7	1.6				0.6	7.7	8.3	4.3	8.0	8.6	13.0	14.8	6.9	26.8	21.1	3.3	9.8		4.8	18.2	1.8		2.3		2.4
Planktonics																																
Polysaccammina hyperhalina																				0.3		0.2		0.3				0.3				
P. ipohalina																												0.5		0.6		3.6
Pseudothurammina limnetis																												0.5		1.9		1.2
Quinqueloculina seminulum																																
Q. seminulum jugosa																																
Rosalina floridana																																
Siphotrochammina lobata		9.8		8.5				11.3		15.4	30.0	23.0			2.2	0.9		0.7	3.7	6.9		3.9		2.3		2.3	18.2	6.3	14.3	6.8	15.4	15.7
Tiphotrocha comprimata																					1.8	1.6	8.2	4.5	8.3	4.8	6.1	1.3				
Trifarina fluens																																
Triloculina oblonga																																
Trochammina inflata	35.7	43.1	71.4	76.6		87.5	68.2	77.4	100	80.8	80.0	64.9	23.1	27.8	69.6	71.8	22.9	51.6	51.9	62.0	23.2	28.1	31.1	33.3	35.0	43.9	39.4	71.0	71.4	67.9	84.6	63.9
T. macrescens	35.7	13.8	14.3	6.4		4.2		1.6		3.8	8.6	4.6	69.2	58.3	17.4	12.2	2.9	6.9	5.6	6.9	5.4	6.1	18.4	16.5	18.3	19.5	3.0	4.0	7.1	2.3		8.8
T. ochracea						4.2								2.8				0.4				0.2		0.3		3.2		0.5				
Wiesnerella auriculata																																
Centropyxis aculeata																										0.7		0.5		0.3		0.6

STATION NUMBER	1		2		3		4		5		6		7		8		9		10		11	
ELEVATION IN cm ABOVE MSL	0		12.5		44.4		56.7		55.2		56.7		61.3		61.9		63.7		64.7		68.9	
DISTANCE ALONG TRANSECT (m)	0		0.3		0.6		0.9		1.8		5.5		8.5		18.6		31.4		42.7		61.0	
PERCENT ORGANIC MATTER	3.67		12.19		11.06		12.21		11.17		18.08		16.34		19.82		10.43		13.18		14.74	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	4	13	4	16	5	12	4	18	5	13	6	13	7	15	2	12	2	8	3	12	4	10
NO. OF INDIVIDUALS/10cc	19	174	84	514	102	542	168	1328	148	1012	224	2112	132	1048	18	182	141	704	104	534	536	2080
Ammoastuta inepta				0.4		0.4		0.9		0.4		0.8		1.1		0.5				0.7		
Ammobaculites dilatatus		1.7		0.4				0.9		0.8			3.0	1.5		2.2		1.5		4.9		1.5
A. exiguus		0.6	2.4	1.9				0.3						0.4						0.4		
Ammodiscus catinus								0.3														
Ammotium multiloculatum	5.3	1.1		1.2				0.3			3.6	0.8	3.0	1.5		1.6		1.1	3.8	1.9		0.4
A. salsum	36.8	11.5	19.0	16.0	17.6	12.5	7.1	9.9	13.5	10.3	42.9	36.4	21.2	32.8	83.3	47.8	90.6	76.1	78.8	65.5	71.6	58.5
A. subdirectum								0.3						0.4		0.5						
Arenoparella mexicana	5.3	30.5	2.4	21.0	7.8	20.3	4.8	15.4	2.7	9.5	3.6	8.3		4.2		8.2		3.0		8.2	1.5	5.8
Eggerella advena																						
Gaudryina exilis		0.6		0.8				1.5		0.4		0.8		0.8								0.4
Glomospira gordialis														0.4								
Haplophragmoides manilaensis		0.6		0.8		0.4		0.3														
H. wilberti		1.1		0.4		0.4		0.9		0.4		0.4				0.5						
Miliammina fusca	52.6	41.4	76.2	39.3	70.6	48.7	85.7	52.1	76.4	62.1	42.9	37.1	57.6	33.6	16.7	27.5	9.4	15.5	17.3	12.4	25.4	27.7
Polysaccammina hyperhalina						0.7		0.6		0.8		0.8	3.0	1.1				0.4			1.5	0.8
Pseudothurammina limnetis				0.4																		
Siphotrochammina lobata		0.6		1.6	2.0	1.8		2.1		2.0		0.8		3.1						0.4		0.4
Tiphotrocha comprimata		2.3		2.7		2.2		1.2		1.2		1.1				1.1				0.7		
Trochammina inflata		4.6		9.3		8.9	2.4	8.7	2.7	7.9	3.6	5.7		3.1		5.5		1.9		2.6		4.2
T. macrescens		3.4		3.5	2.0	2.6		3.0	2.7	3.6	3.6	5.7	6.1	9.2		2.7				1.9		0.4
T. ochracea				0.4		1.1		1.2		0.8		1.5	6.1	6.9		2.2		0.4		0.4		
Centropyxis aculeata																						
Difflugia oblonga																						

Appendix Table 3. Percent abundance of living (stained, L) and total (T) foraminifera and arcellaceans and percentage of organic matter from Transect 8, Murrells Inlet.

STATION NUMBER	12		13		14		15		16		17		18		19		20		21		22	
ELEVATION IN cm ABOVE MSL	72.9		75.3		78.7		79.0		77.5		82.4		82.0		81.4		87.8		N/A		N/A	
DISTANCE ALONG TRANSECT (m)	69.9		73.8		78.1		85.0		91.5		97.0		105.5		111.3		115.9		130.9		140.9	
PERCENT ORGANIC MATTER	19.93		23.95		25.04		27.89		26.67		23.51		26.95		24.81		10.31		20.25		12.56	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	4	12	5	13	7	17	6	14	3	14	6	17	10	17	6	15	9	15	6	15	8	16
NO. OF INDIVIDUALS/10cc	192	1984	160	2584	240	2168	152	1992	139	893	128	1308	144	2080	68	1308	312	2696	224	2984	416	3072
Ammoastuta inepta		0.4		0.6		0.7				0.6		0.3		2.3		0.6	20.5	13.1		12.3	13.5	15.9
Ammobaculites dilatatus		0.4		0.9		0.4		0.8		1.2		1.8	5.6	2.3		1.5		0.9		1.3		0.3
A. exiguus						0.4							5.6	1.2								
Ammodiscus catinus																						
Ammotium multiloculatum		0.4				0.7																
A. salsum	8.3	22.2	35.0	22.9	50.0	28.4	36.8	31.3	42.3	46.0	25.0	30.3	22.2	27.7	11.8	26.3		16.3	3.6	10.2	3.8	6.8
A. subdirectum		4.4		10.2	13.3	9.6	5.3	11.6		0.6		3.1	16.7	10.0		3.1		2.4		0.3	1.9	0.3
Arenoparella mexicana	12.5	9.7	15.0	9.9	3.3	4.1	15.8	6.0		1.8	15.6	8.0	5.6	1.9	5.9	0.3	23.1	11.6	3.6	2.1		1.3
Eggerella advena													5.6	0.8								
Gaudryina exilis		2.4		3.7	13.3	5.2	10.5	4.4		0.9	9.4	1.8		1.9	5.9	0.6	2.6	1.2				
Glomospira gordialis				0.3			5.3	1.2		0.9	12.5	2.1			11.8	1.8	7.7	5.0		1.1		0.5
Haplophragmoides manilaensis												0.3		0.4						1.9	5.8	2.6
H. wilberti								0.4								0.3	15.4	4.2	14.3	5.4	3.8	1.3
Miliammina fusca	75.0	51.2	40.0	39.6	6.7	29.2	26.3	32.1	55.8	38.5	28.1	24.5	11.1	26.9	41.2	39.8	7.7	20.8	67.9	45.6	57.7	57.6
Polysaccammina hyperhalina		1.2		1.5	3.3	0.7		0.8		0.6		0.9		0.4								
Pseudothurammina limnetis						0.4		0.4				0.9	11.1	0.8		0.6		2.4		2.1		1.3
Siphotrochammina lobata				1.2		4.1		1.2		1.2		3.1		1.9		4.0		3.9		1.1		0.3
Tiphotrocha comprimata		1.2	5.0	0.6		0.7		0.4		1.8		3.4		1.2		2.8	2.6	3.0		4.8		2.1
Trochammina inflata		5.6	5.0	8.4	10.0	7.4		6.0	1.9	3.9	9.4	14.4	11.1	13.5	23.5	15.3	12.8	8.9	7.1	2.1	9.6	4.4
T. macrescens	4.2	0.8		0.3		7.0		3.2		1.8		3.7	5.6	6.2		2.4	7.7	6.2	3.6	5.1	3.8	3.1
T. ochracea						0.7				0.3		0.9		0.8		0.6						
Centropyxis aculeata						0.4						0.3						0.3		4.6		2.1
Difflugia oblonga																						0.3

Appendix Table 3 (continued).

STATION NUMBER	1		2		3		4		5		6		7		8		9		10		11		12	
ELEVATION IN cm ABOVE MSL	128.5		124.5		119.6		121.8		117.8		116.6		116.0		116.3		116.3		117.8		111.7		105.6	
DISTANCE ALONG TRANSECT (m)	0		1.8		3.1		4.6		6.4		9.5		13.1		23.2		29.0		35.7		37.2		39.7	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	5	9	5	10	5	9	8	9	7	10	5	11	5	8	2	13	4	8	7	10	5	10	3	5
NO. OF INDIVIDUALS/10cc	624	4640	288	4656	245	3307	331	3061	448	2352	68	585	136	1188	59	805	72	739	301	837	23	273	7	35
Ammobaculites dilatatus																								
A. exiguus		0.3										0.6				0.3								
Ammonia beccarii																								
Ammotium multiloculatum																								
A. salsum										0.3		1.5				1.7						0.7		
A. subdirectum																								
Arenoparella mexicana	7.7	7.2	5.6	3.4		1.6	3.2	1.4		0.3	2.6	1.5		0.7		1.0		2.5	3.5	4.5	4.3	4.8		8.6
Buliminella elegantissima																0.3								
Eggerella advena																								
Elphidium excavatum excavatum																0.3								
Epistominella takayanagii																								
Gaudryina exilis																0.3								
Haplophragmoides manilaensis				5.5		6.8	3.2	5.9	1.8	3.7								0.4		0.3		0.4		
H. wilberti	35.9	28.6	16.7	38.8	26.1	31.0	12.9	23.7	5.4	9.9	28.9	15.8	5.9	12.5		17.2	48.1	24.2	11.5	11.5		13.2		
Haynesina depressula																0.3								
Miliammina fusca	7.7	4.8		2.7		7.1		12.2	3.6	3.1		2.1	5.9	5.4		5.3		7.6	3.5	9.2	13.0	7.3		[illegible]
Planktonics																								
Polysaccammina hyperhalina												0.6												
P. ipohalina		1.4		1.0	4.3	0.6								0.3						3.2		1.8		
Pseudothurammina limnetis			22.2	3.1			3.2	3.1	7.1	2.4		0.3					7.4	3.2	2.7	2.2		0.7		
Siphotrochammina lobata	25.6		33.3	6.5		9.7	19.4	12.9	1.8	2.0		10.9	2.9	2.4	4.5	8.6	25.9	17.3	11.5	8.9	21.7	11.7	28.6	20.0
Tiphotrocha comprimata		1.4		3.8	8.7	10.3	3.2	2.8	1.8	0.3	7.9	5.5		7.4		0.3				1.6				
Trochammina inflata	23.1	34.1	22.2	28.2	43.5	26.5	48.4	31.0	78.5	68.0	52.6	52.0	52.9	48.8	95.5	59.3	18.5	38.3	62.8	53.2	47.8	50.9	42.9	45.7
T. macrescens		1.0		6.9	17.4	6.5	6.5	7.0		9.9	7.9	9.1	32.4	22.6		5.0		6.5	4.4	5.4	13.0	8.4	28.6	20.0
T. ochracea																								
Centropyxis aculeata																								

Appendix Table 4. Percent abundance of living (stained, L) and total (T) foraminifera and arcellaceans from Transect 1, North Inlet.

STATION NUMBER	13		16		14		15		17		18		19		20		21		22		23		24	
ELEVATION IN cm ABOVE MSL	101.3		99.2		98.3		101.6		87.9		86.1		78.8		77.2		76.9		70.2		61.1		57.1	
DISTANCE ALONG TRANSECT (m)	44.2		48.8		54.0		61.0		68.0		68.6		72.6		75.0		77.2		85.7		98.2		100.7	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	6	11	6	11	7	11	6	8	5	7	5	10	5	8	4	4	4	5	4	8	5	6	4	8
NO. OF INDIVIDUALS/10cc	53	243	118	294	152	558	38	238	234	522	135	293	376	840	392	1564	768	5456	257	1041	290	448	1128	2304
Ammobaculites dilatatus																								
A. exiguus	1.9	0.4	0.8	0.3		1.8						1.4										0.7		
Ammonia beccarii																		0.1						
Ammotium multiloculatum																								1.0
A. salsum		3.7	4.2	4.4	5.3	10.4	2.6	2.1		2.5	5.9	5.5	2.1	2.5	12.2	6.6	6.3	3.1	11.3	5.2	8.8	7.5	17.0	18.1
A. subdirectum																								
Arenoparella mexicana	3.8	5.3	44.9	19.7	9.2	7.9	10.5	8.8	4.1	2.5	8.1	5.1	5.7	3.2	2.0	4.1	2.1	1.2						
Buliminella elegantissima																								
Eggerella advena																								
Elphidium excavatum excavatum				1.4																0.1				
Epistominella takayanagii				4.4								0.3												
Gaudryina exilis		0.4																						
Haplophragmoides manilaensis						0.4																		
H. wilberti		3.3		0.7		2.9		1.3						1.0										
Haynesina depressula																								
Miliammina fusca	1.9	11.5	2.5	13.3	23.7	20.1	5.3	4.2	36.3	37.7	54.1	51.9	37.6	47.6	83.7	87.5	90.6	94.0	86.8	91.1	89.5	88.2	81.6	75.7
Planktonics				6.1																0.4				
Polysaccammina hyperhalina		1.2				2.2			10.7	0.6		1.4								0.1	0.6	0.4	0.7	1.4
P. ipohalina																								
Pseudothurammina limnetis					2.6	0.7						0.3		0.3										
Siphotrochammina lobata	26.4	16.0		1.7	7.9	4.7	15.8	21.0		0.9		0.7		0.3										0.3
Tiphotrocha comprimata		0.8						1.3																
Trochammina inflata	50.9	42.4	38.1	35.4	38.2	34.1	60.5	51.3	49.3	46.6	25.9	28.3	46.8	38.4	2.0	1.8	1.0	1.6	0.8	1.7	0.6	1.8	0.7	2.1
T. macrescens	15.1	14.8	9.3	12.6	13.2	15.1	5.3	10.1	9.6	9.2	5.9	5.1	7.3	6.7					1.2	1.3	0.6	1.4		1.0
T. ochracea																								0.3
Centropyxis aculeata																				0.1				

Appendix Table 4 (continued).

STATION NUMBER	25		26		27		28		29		30		31		33		32		34	
ELEVATION IN cm ABOVE MSL	47.7		41.9		38.2		30.0		30.6		29.4		16.9		9.2		34.6		-35.0	
DISTANCE ALONG TRANSECT (m)	105.2		107.7		118.6		147.3		176.6		213.2		240.6		262.0		264.1		266.0	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	3	6	5	9	3	7	5	7	3	9	6	8	6	10	7	11	12	16	9	12
NO. OF INDIVIDUALS/10cc	276	582	525	936	432	1136	512	1907	149	3371	331	2880	715	3179	30	282	172	747	67	440
Ammobaculites dilatatus		0.3																		
A. exiguus						3.5	3.8	3.7		8.9	22.6	12.6	3.0	5.0	3.3	2.5	1.7	1.2	1.5	1.1
Ammonia beccarii				0.6														0.4		
Ammotium multiloculatum				1.7																
A. salsum	33.3	39.5	44.7	44.4	17.6	26.1	30.0	38.3	64.3	37.0	25.8	[illegible]	34.3	19.1	13.3	3.9	2.9	3.9	14.9	7.7
A. subdirectum														0.7			0.6	0.1		
Arenoparella mexicana																	1.2	0.3	1.5	0.7
Buliminella elegantissima																				
Eggerella advena																	0.6	0.1		
Elphidium excavatum excavatum				0.3												10.6		7.2		2.0
Epistominella takayanagii																				
Gaudryina exilis								0.3		0.6	3.2	1.1	1.5	1.3		1.1	1.2	1.1	3.0	1.6
Haplophragmoides manilaensis																				
H. wilberti										0.3										
Haynesina depressula																				
Miliammina fusca	65.2	55.3	52.8	47.0	81.5	59.5	58.8	38.3	21.4	14.9	35.5	13.3	52.2	47.3	36.7	41.8	48.3	47.9	40.3	39.3
Planktonics				2.3												0.4		0.3		8.2
Polysaccammina hyperhalina		1.0	1.0	1.1		3.2	6.3	8.1	14.3	12.7	6.5	9.3	7.5	7.4	3.3	2.5	34.3	10.4	6.0	1.8
P. ipohalina																				
Pseudothurammina limnetis																				
Siphotrochammina lobata		0.3			0.9	1.8				3.8	6.5	9.3	1.5	5.0						
Tiphotrocha comprimata																0.7	1.2	2.3		0.2
Trochammina inflata	1.4	3.4	1.0	1.7		1.4	1.3	3.7		8.7		13.7		3.4	3.3	2.1	1.7	2.4	4.5	5.5
T. macrescens			0.5	0.9		4.6		7.7		13.0		11.9		9.7	30.0	14.5	2.9	6.6	14.9	9.8
T. ochracea														1.0	10.0	19.9	3.5	15.7	13.4	22.0
Centropyxis aculeata																		0.1		

Appendix Table 4 (continued).

STATION NUMBER	1		2		3		4		5		6		7		8		9		10		11		12		13	
ELEVATION IN cm ABOVE MSL	0		6.1		27 5		40.0		47 6		47 9		43.3		38 1		39 7		36.9		41 8		51 9		57 6	
DISTANCE ALONG TRANSECT (m)	0		0 6		0.9		1 8		4 0		5.8		13.1		21 4		30.8		36.9		47 6		60.*		64 0	
PERCENT ORGANIC MATTER	19 17		19 40		19 26		19 07		19 01		19 76		18 51		21 59		20.88		20.55		16.93		4 56		5.25	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO OF SPECIES	8	13	8	11	7	10	6	12	9	11	9	11	5	11	5	10	5	12	8	11	5	6	3	7	6	9
NO OF INDIVIDUALS/10cc	212	1064	104	1108	236	1052	472	2160	256	1156	124	1076	88	2216	280	1976	480	3040	512	2896	560	2000	1624	3400	1244	2220
Ammobaculites dilatatus												0 4						0 3								0 4
A. exiguus		0 4		0 4				1 1			3 2	1 5		1 4		1 2		1 8	1 6	1 7		0 8				0 2
Ammodiscus catinus																										
Ammonia beccarii		3.0				4 2																				
Ammotium multiloculatum	5 7	1 1		0 4							16.1	3.7		2 9				3 4		2 8				0 2		
A. salsum	26.4	23.3	19 2	15 9	16 9	9 9	1 7	7 0	4 7	8 0	9 7	16 4	18 2	26 4	31 4	39 3	21 7	41 3	53 1	52 5	20 0	52 9	4 9	28 2	5.5	15 5
A. subdirectum								0 4	1 6	0 3				0 4												
Arenoparrella mexicana			3.8	0 4														0 3								0 2
Eggerella advena								0 4		1 7						0 4			1 6	0 3						
Gaudryina exilis	3.8	3.0	11 5	3 6		0 4	6.8	2.6	1 6	2.4	6.5	1 5	18 2	5 8		1 2		1 1	3 1	0 6						
Glomospira gordialis																										
Haplophragmoides manilaensis																										
H. wilberti					3.4	0.8																				
Helenia andersoni		1 5																								
Miliammina fusca	50 9	19 9	15 4	16 6	44 1	12.2	79 7	28 9	71 9	32.5	19 4	11 9	36 4	28 9	45 7	13.0	51 7	14 7	31 3	21 0	65 7	32.4	93 6	65 6	92 3	75 3
Organic linings		2.6				1 5		1 9		3.1																
Polysaccammina hyperhalina	3 8	1 5	15 4	3 2			1 7	0 4	1 6	2 4	3 2	2 6		4 3	8 6	3 2	1 7	3 4	1 6	1 9	1 4	3 2		1 9	1 0	2 7
P. ipohalina																										
Pseudothurammina limnetis																										
Siphotrochammina lobata	3 8	7 9	15.4	10 1	16.9	12 9	6.8	9 6	1 6	7 6	3.2	9.7	9 1	8 3		9 7		8 7	1 6	4 7					0 3	0 2
Tiphotrocha comprimata																										
Trochammina inflata		3.8		4 3	3 4	4 9	3.4	1 1	4 7	3.5	16.1	9 3	18 2	8 3	5 7	11 3	16 7	9 2		7 7	5 7	6 8	1 5	2 6	0 6	3 4
T. macrescens	1 9	6.4	7 7	10 5	11 9	10 6		3.0	7 8	9 0	22 6	9 7		2 2	8 6	11 3	8 3	10 3	6 3	5 5	7 1	4 0		0 9	0.3	2 2
T. ochracea	3 8	25.6	11 5	34 7	3.4	42.6		43.7	4 7	29 4		33 5		11 2		9 3		5 5		1 4				0 5		
Centropyxis aculeata																										

Appendix Table 5. Percent abundance of living (stained, L) and total (T) foraminifera and arcellaceans and percentage of organic matter from Transect 6, North Inlet.

Appendix Table 5 (continued).

STATION NUMBER	14		15		16		17		18		19		20	
ELEVATION IN cm ABOVE MSL	60.1		65.6		70.2		73.5		78.7		86.0		91.2	
DISTANCE ALONG TRANSECT (m)	67.4		72.0		75.3		77.8		80.8		82.7		83.9	
PERCENT ORGANIC MATTER	5.18		6.36		6.97		6.03		4.64		4.26		2.99	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	3	7	5	6	6	10	3	6	5	10	6	9	8	11
NO. OF INDIVIDUALS/10cc	1328	2672	1128	2572	1096	2316	1088	3200	250	1354	180	391	168	442
Ammobaculites dilatatus			1.1	0.5		0.7								0.2
A. exiguus					0.7	0.3								
Ammodiscus catinus														
Ammonia beccarii														
Ammotium multiloculatum						0.2								
A. salsum	7.2	22.8	6.0	10.3	6.9	8.3	6.6	6.8		2.8		0.3	2.4	2.3
A. subdirectum														
Arenoparrella mexicana					0.4	0.2			15.2	6.3	4.4	4.3	2.4	5.9
Eggerella advena														
Gaudryina exilis								0.3		0.1			0.6	0.9
Glomospira gordialis														
Haplophragmoides manilaensis														
H. wilberti		0.3								0.4		0.5		
Helenina anderseni														
Miliammina fusca	90.4	70.8	91.1	84.3	90.5	86.7	90.0	85.8	33.6	28.4	68.9	45.3	69.0	37.3
Organic linings														
Polysaccammina hyperhalina		1.7	0.4	1.2	0.4	0.2								
P. ipohalina												0.3		0.2
Pseudothurammina limnetis									0.8	0.4			0.6	0.2
Siphotrochammina lobata				0.6		0.2		0.8		0.3	3.3	4.3		5.7
Tiphotrocha comprimata									0.8	0.4	4.4	6.4	3.0	3.2
Trochammina inflata	2.4	1.9	1.4	3.1	1.1	2.4	4.4	6.3	49.6	59.2	18.3	35.5	19.6	37.6
T. macrescens		2.2				0.9		0.3		1.2	0.6	3.1	2.4	6.6
T. ochracea		0.3												
Centropyxis aculeata														

STATION NUMBER	21		22		23		24		25		26		27	
ELEVATION IN cm ABOVE MSL	94.2		101.9		105.2		111.3		121.1		125.1		128.4	
DISTANCE ALONG TRANSECT (m)	84.2		85.1		86.3		87.8		89.1		100.1		100.1	
PERCENT ORGANIC MATTER	1.76		2.16		1.65		1.23		1.93		2.10		1.46	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	7	10	9	13	7	14	7	10	8	13	9	11	8	10
NO. OF INDIVIDUALS/10cc	286	843	56	442	45	266	27	229	38	633	368	2380	46	798
Ammobaculites dilatatus										0.3				
A. exiguus				0.2		1.1								
Ammodiscus catinus						0.4								
Ammonia beccarii														
Ammotium multiloculatum														
A. salsum	0.9	0.9	1.8	2.0	2.2	1.5		0.4						
A. subdirectum														
Arenoparrella mexicana	9.3	4.7		0.9	4.4	5.6	3.7	4.4	2.6	3.2	6.5	6.4	4.3	3.0
Eggerella advena														
Gaudryina exilis		0.9	1.8	1.4		0.4	3.7	0.9	2.6	0.2				
Glomospira gordialis		0.3									2.2	0.3		
Haplophragmoides manilaensis										0.2	4.3	1.0		0.8
H. wilberti		1.6	1.8	4.1		3.8		6.1	10.5	11.5	21.7	17.6	13.0	18.8
Helenina anderseni														
Miliammina fusca	13.0	10.8	8.9	6.8	20.0	7.1	29.6	9.2	2.6	4.6	8.7	5.4	4.3	5.5
Organic linings														
Polysaccammina hyperhalina						0.4								
P. ipohalina			1.8	1.8				2.6		4.1			4.3	6.3
Pseudothurammina limnetis				0.9		1.5				1.1	8.7	4.1	17.4	4.8
Siphotrochammina lobata	10.2	16.1	10.7	6.3	22.2	14.3	14.8	7.9	2.6	10.6	21.7	11.5	13.0	14.3
Tiphotrocha comprimata	10.2	4.1	8.9	4.8	4.4	1.9	3.7	1.3	2.6	2.4		0.3		3.0
Trochammina inflata	40.7	46.2	46.4	61.1	31.1	55.6	37.0	63.8	52.6	57.3	23.9	41.0	39.1	41.1
T. macrescens	15.7	14.2	17.9	9.0	15.6	5.6	7.4	3.5	23.7	4.4	2.2	10.5	4.3	2.5
T. ochracea				0.7		0.8				0.2				
Centropyxis aculeata												0.7		

STATION NUMBER	28		29		30		31		32		33		34		35		36		37		38		39		40		41	
ELEVATION IN cm ABOVE MSL	130 5		134 5		133 0		134 2		133.9		135 1		134 2		123.2		116.2		110.7		122 6		128 4		140.9		138 8	
DISTANCE ALONG TRANSECT (m)	105 0		106 8		108 9		112 3		114 1		115.4		116.9		119 0		119 6		122.1		123.9		126.0		128 5		131 2	
PERCENT ORGANIC MATTER	2.03		1 56		1 98		0.09		2 01		1 4[illegible]		4 34		1 80		18 47		5 19		2 34		[illegible] 91		4 96		21 73	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO OF SPECIES	7	11	4	8	6	8	6	10	6	10	8	14	5	11	8	11	7	12	7	14	7	11	9	13	2	7	1	9
NO OF INDIVIDUALS/10cc	144	1372	40	1020	188	1180	49	262	56	594	15	239	52	644	109	455	1496	5592	2376	7224	124	1036	154	713	2	98	3	341
Ammobaculites dilatatus		0 3																										
A exiguus																								0.1				
Ammodiscus catinus																								0 3				
Ammonia beccarii																												
Ammotium multiloculatum																												
A salsum												1 3		0 3				0 3		5.5								
A subdirectum																												
Arenoparella mexicana	13 9	3 8						0 4			6.7	0.4		0.6	3.7	6 2	4 3	7 6	47 5	22 1		3.9	1 9	1 5		1 0		0.6
Eggerella advena																												
Gaudryina exilis																				0 2								
Glomospira gordialis										0 3	6.7	0.4																
Haplophragmoides manilaensis			10 0	5 5	8 5	5 8		5 0	3.6	7 7	20 0	10.9		0.6	7 3	5 1		0.6		0.2	3.2	2.7	1 3	2 8				
H wilberti	8 3	14 3		7 8	14 9	13 6	6 2	11 8	10 7	15.5	13.3	14 2	3.8	5.3	22 0	27 3	64 7	47 2	25.9	17 6	29 0	33.2	20.8	17 5				1 8
Helenina andersoni																												
Miliammina fusca	11 1	7 9		5 9	14 9	8 5	6 1	4 2		5 7	6.7	6.3		1 6	2 8	6 8	2 7	3.1	3.7	10 9	9 7	7 3	12.3	15.6		6.1		3.8
Organic linings																												
Polysaccammina hyperhalina																		0 3		0.2								
P ipohalina		5 0										0.8				0 2						0 4		0 1				
Pseudothurammina limnetis	2 7	1 2				0 7				1 0	6.7	1 7		0.6				0 1	0 3	0.4			0 6	1 4				
Siphotrochammina lobata	8 3	16 0	30 0	13 7	21 3	13.9	12.2	8 8	7 1	11 8		7 9	26.9	6 2	11 9	13.4	9 1	8 4	5.7	9 1	9 7	14 3	15.6	9 4		6.1		3.8
Tiphotrocha comprimata		0 6		0 4			6 1	3.4		0 7		0.4			11 0	7 3	0.5	0.7		1 7	16.1	6.2	1 9	1 3	50.0	2.0		0 3
Trochammina inflata	47 2	45 2	50 0	38 8	17 0	24 1	63.3	45.8	57 1	38 1	13 3	24 3	15.4	9 9	26.6	26.6	12 3	18 6	9 8	18 8	19 4	14 3	20 9	30.2	50 0	21 4		28 4
T macrescens	8 3	5 2	10 0	16 9	23.4	16 9	4 1	15 6	17 9	16.5	26.7	23.4	38 5	14 9	14 7	6.4	6.4	11 9	7 1	10 7	12.9	16.2	24 7	18 1		19.4		19 1
T ochracea								1 9				0 4		0 3		,7				1 2		0 4						0 6
Centropyxis aculeata		0 6		11 0		16 6		3 1	3 6	1 7		7 5	15.4	59 6		0 2		1 1		1 1		1 2		1 7		43 9	100	41 6

Appendix Table 5 (continued).

STATION NUMBER	1		2		3		4		5		6		7		9		10		11		12		13	
ELEVATION IN cm ABOVE MSL	0		60.4		77.2		112.2		130.8		133.6		135.4		137.6		137.9		141.5		144.9		144.6	
DISTANCE ALONG TRANSECT (m)	0		0.3		0.9		1.5		4.9		11.6		18.6		35.7		39.0		44.2		55.2		62.5	
PERCENT ORGANIC MATTER	5.23		19.01		19.11		5.28		0.67		4.01		2.07		2.08		1.95		1.42		1.14		1.28	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	5	10	6	10	5	9	10	11	5	8	4	8	5	8	3	7	4	7	3	9	3	5	3	4
NO. OF INDIVIDUALS/10cc	6	58	10	40	25	73	60	153	9	46	4	20	8	22	7	41	8	24	4	35	5	31	5	36
Ammoastuta inepta		5.2			44.0	34.2		1.3																
Ammobaculites dilatatus	16.7	1.7																						
Ammonia beccarii																				5.7		3.2		
Ammotium salsum			20.0	7.5			28.7	17.0	11.1	15.2		5.0	12.5	4.5		4.9	12.5	4.2		5.7				
A. subdirectum																								
Arenoparella mexicana		25.9		2.5	40.0	41.1	16.7	21.6	11.1	17.4	25.0	30.0		18.2	14.3	19.5	12.5	8.3	25.0	25.7	20.0	35.5		5.6
Bolivina lowmani																								
Buliminella elegantissima																								
Cassidulina reniforme																								
Cibicides lobatulus																								
Cyclogyra involvens				2.5																				
Elphidium excavatum clavatum																								
E. excavatum excavatum																								
E. excavatum gunteri																								
E. excavatum lidoensis																								
E. excavatum selseyensis																								
E. poeyanum																								
E. subarcticum																								
Eponides repandus																								
Gaudryina exilis			10.0	2.5			3.3	5.2	11.1	4.3														
Gavelinopsis translucens																								
Hanzawaia strattoni																								
Haplophragmoides wilberti	33.3	12.1	10.0	10.0	4.0	2.7	10.0	9.8		4.3		5.0		4.5		31.7	25.0	29.2	25.0	20.0	40.0	41.9	40.0	58.3
Haynesina depressula																								
Helenina andersoni																								
Heterohelix sp.																								
Miliammina fusca		5.2	10.0	17.5	4.0	9.6	11.7	8.5		2.2		5.0	12.5	13.6	14.3	4.9				5.7				
Planktonics																								
Polysaccammina ipohalina																								
Pseudothurammina limnetis		1.7		2.5		1.4	3.3	2.0										4.2		5.7				
Quinqueloculina compta																								
Q. lamarckiana																								
Q. polygona																								
Q. seminulum																								
Q. seminulum jugosa																								
Rectobolivina advena																								
Rosalina floridana																								
Siphotrochammina lobata		1.7				1.4	5.0	3.3	11.1	10.9				9.1		2.4		8.3		5.7		6.5	20.0	13.9
Trifarina fluens																								
Trochammina inflata	16.7	29.3	10.0	10.0		1.4	15.0	20.9	55.6	43.5	25.0	10.0	37.5	31.8	71.4	34.1	50.0	41.7	50.0	22.9	40.0	12.9	40.0	22.2
T. macrescens	16.7	5.2				1.4	5.0	7.2			25.0	15.0	12.5	9.1										
T. ochracea	16.7	12.1	40.0	42.5	8.0	6.8	3.3	3.3		2.2	25.0	25.0	25.0	9.1		2.4		4.2		2.9				
Wiesnerella auriculata																								
Centropyxis aculeata												5.0												
Cucurbitella tricuspis				2.5																				

Appendix Table 6. Percent abundance of living (stained, L) and total (T) foraminifera and arcellaceans and percentage of organic matter from Transect 4, Santee Delta.

STATION NUMBER	14		15		16		17		18		19		20		21		22		23		24	
ELEVATION IN cm ABOVE MSL	142.7		146.1		147.6		151.3		153.1		148.2		150.7		156.2		155.2		163.5		166.6	
DISTANCE ALONG TRANSECT (m)	72.3		72.6		79.0		86.9		89.7		98.2		106.8		110.4		114.7		120.2		122.6	
PERCENT ORGANIC MATTER	1.05		1.06		1.36		0.78		1.09		1.50		1.08		0.72		0.70		0.83		0.25	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	3	10	5	6	1	7	1	5	0	3	6	15	5	17	3	21	5	19	9	26	1	13
NO. OF INDIVIDUALS/10cc	4	51	8	59	1	33	1	18	0	11	19	103	15	144	7	310	8	164	18	544	1	54
Ammoastuta inepta																						
Ammobaculites dilatatus																						
Ammonia beccarii		9.8										3.9		25.0	71.4	54.2		34.8	22.2	36.4		33.3
Ammotium salsum						6.1						1.0										
A. subdirectum						3.0																
Arenoparella mexicana	25.0	25.5	12.5	8.5		6.1		11.1		45.4	21.1	29.1		5.6	14.3	1.3	37.5	9.6	11.1	0.7		
Bolivina lowmani																0.6		1.2		0.4		
Buliminella elegantissima																0.3						
Cassidulina reniforme																0.3				0.7		
Cibicides lobatulus														0.7		1.6		0.6		1.8		5.6
Cyclogyra involvens																						
Elphidium excavatum clavatum												2.9		0.7		1.6		1.2		2.6		5.6
E. excavatum excavatum													6.7	0.7		0.3		0.6		1.5		3.7
E. excavatum gunteri														0.7		1.0				0.7		
E. excavatum lidoensis														5.6		1.0		1.8	11.1	2.6		5.6
E. excavatum selseyensis		9.8										1.9		13.2		8.7		8.5		7.4		9.3
E. poeyanum												1.9		13.9		20.6		25.0	11.1	32.0		16.7
E. subarcticum														0.7						0.4		5.6
Eponides repandus																						1.9
Gaudryina exilis												1.9										
Gavelinopsis translucens																1.6				0.7		3.7
Hanzawaia strattoni																1.0				0.7		
Haplophragmoides wilberti	50.0	25.5	25.0	49.2		48.5		16.7			21.1	13.6		0.7		0.6	25.0	3.0		0.4		
Haynesina depressula		2.0										1.9				0.6		1.2		1.1		1.9
Helenina andersoni											10.5	1.9										
Heterohelix sp.														0.7								
Miliammina fusca	25.0	2.0	12.5	3.4							5.3	6.8					12.5	3.0		0.7		
Planktonics																1.0		0.6				
Polysaccammina ipohalina												3.9										
Pseudothurammina limnetis		2.0																				
Quinqueloculina compta																				1.1		
Q. lamarckiana																		0.6		0.7		
Q. polygona																		0.6				
Q. seminulum																1.0		[illegible]		2.2		
Q. seminulum jugosa																0.6						
Rectobolivina advena																				0.4		
Rosalina floridana																			11.1	0.7		
Siphotrochammina lobata		5.9	37.5	20.3		21.2		38.9		18.2	26.3	10.7	40.0	9.7	14.3	0.3	12.5	2.4	11.1	0.7		
Trifarina fluens														0.7						0.4		
Trochammina inflata		15.7	12.5	15.3	100	12.1	100	27.8		36.4		13.6	6.7	10.4		1.6	12.5	3.7	22.2	2.6	100	5.6
T. macrescens				3.4							15.8	4.9	40.0	10.4								
T. ochracea		2.0				3.0		5.6					6.7	0.7				0.6				
Wiesnerella auriculata																				0.4		1.9
Centropyxis aculeata																						
Cucurbitella tricuspis																						

Appendix Table 6 (continued).

STATION NUMBER	1		2		3		4		5		6	
DISTANCE ALONG TRANSECT (m)	0		2		4		6		8		10	
PERCENT ORGANIC MATTER	17.81		19.25		20.35		22.44		20.26		19.84	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	5	10	3	9	5	7	9	13	9	12	7	11
NO. OF INDIVIDUALS/10cc	6	70	21	210	21	40	176	349	233	377	328	1176
Ammoastuta inepta	33.3	7.1			71.4	57.5	83.5	49.0	56.7	49.1	70.7	58.2
Ammobaculites dilatatus								0.3				
Ammotium salsum	16.7	4.3	4.8	1.9				0.3				
A. subdirectum							1.7	1.1				
Arenoparella mexicana		7.1			4.8	2.5	1.7	1.4	15.9	13.5		0.7
Haplophragmoides manilaensis									0.4	1.3	2.4	3.7
H. wilberti	16.7	18.6		1.9	4.8	5.0	0.6	0.9	3.4	3.2	2.4	5.1
Miliammina fusca		1.4	4.8	1.9	9.5	7.5	4.0	7.7	0.4	1.6	6.1	6.8
Pseudothurammina limnetis									6.0	11.4	1.2	2.4
Siphotrochammina lobata												0.3
Tiphotrocha comprimata				0.5					1 3	1.6		
Trochammina inflata		4.3		0.5			0.6	1.7	1.7	1.9	3.7	4.8
T. macrescens	16.7	5.7		1.0	9.5	7.5	3.4	4.0	14.2	14.3	13.4	16.3
T. ochracea		30.0	90.5	84.8		15.0		3.7		1.6		
Centropyxis aculeata	16.7	18.6		7.1		5.0	3.4	26.4		0.3		1.4
C. constricta							1.1	1.1				
Difflugia oblonga		2.9		0.5				2.3		0.3		
Heleopera sphagnii												0.3

Appendix Table 7. Percent abundance of living (stained, L) and total (T) foraminifera and arcellaceans and percentage of organic matter from Transect 5, Santee Delta.

STATION NUMBER	1		2		3		4		5		6		7		8		9		10		11	
ELEVATION IN cm ABOVE MSL	181.2		171.1		154.3		145.8		126.9		117.4		115.0		112.2		109.5		106.0		106.4	
DISTANCE ALONG TRANSECT (m)	0		0.2		0.4		0.7		1.3		2.2		2.4		3.1		4.5		7.5		11.2	
PERCENT ORGANIC MATTER	18.17		20.52		17.90		15.35		17.38		18.66		20.41		24.71		18.36		22.44		18.36	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	0	2	0	2	4	11	7	12	8	14	4	14	7	17	7	17	8	16	5	15	5	16
NO. OF INDIVIDUALS/10cc	0	14	0	4	84	1116	60	1384	496	5120	52	1528	92	1168	52	1216	93	707	7	125	14	251
Ammoastuta inepta						0.7	6.7	1.2	22.6	8.0	76.9	15.2	30.4	7.9	30.8	9.2	5.7	4.2		2.4		2.4
Ammobaculites dilatatus																		0.4				
A. exiguus																						0.4
Ammodiscus catinus																						0.4
Ammotium salsum										0.6		5.0	13.0	20.2	15.4	28.0	48.6	55.5	42.9	16.0		29.5
A. subdirectum												0.3		0.3				0.4				
Arenoparella mexicana					4.8	0.4		1.2	4.8	3.8	7.7	6.8	4.3	3.4	7.7	4.3	5.7	2.6		3.2		0.8
Eggerella advena																						
Gaudryina exilis														0.7						1.6		
Glomospira gordialis																						
Haplophragmoides manilaensis						10.0	6.7	9.2	8.1	3.6		1.6		1.4		1.0	2.9	0.4				
H. wilberti				25.0		30.8	33.3	45.4	43.5	54.4	7.7	40.1	39.1	34.6		28.0		6.4		1.6		2.4
Miliammina fusca					9.5	8.2	20.0	11.3	8.1	17.2		16.0	4.3	11.3	15.4	10.2	2.9	4.5		2.4		3.6
Polysaccammina hyperhalina												0.3				0.3						0.4
Pseudothurammina limnetis					19.0	2.9	6.7	1.7	4.8	1.9				0.7		1.0						
Siphotrochammina lobata						2.5		2.3		1.4		1.8		1.7		2.3		2.6				1.6
Tiphotrocha comprimata						1.4	6.7	2.9		2.5	7.7	3.4	4.3	3.4		0.7		0.8	14.3	0.8		0.4
Trochammina inflata		7.1				3.6		2.3	3.2	1.3		1.8		0.3		1.6				1.6		
T. macrescens						15.8	20.0	14.2	4.8	4.2		5.2		1.7		1.6		0.4		0.8		
T. ochracea								1.2		0.5		1.8	4.3	7.2		6.3		10.9	14.3	40.8		20.3
Centropyxis aculeata		92.9		75.0	66.7	23.7		7.2		0.3		0.8		3.1		3.0		3.8		19.2	7.1	11.6
C. constricta															15.4	1.3	25.7	4.2	14.3	0.8	50.0	5.2
Cucurbitella tricuspis														0.3	7.7	0.7	5.7	1.1	14.3	5.6	7.1	15.1
Difflugia oblonga														1.7	7.7	0.7	2.9	1.9		1.6	21.4	5.2
D. urceolata																					14.3	0.8
Lesquereusia spiralis																						

Appendix Table 8. Percent abundance of living (stained, L) and total (T) foraminifera and arcellaceans and percentage of organic matter from Transect 10, Santee Delta.

STATION NUMBER	12		13		14		15		16		17		18		19		20		21		22	
ELEVATION IN cm ABOVE MSL	106.4		108.0		108.0		108.3		109.5		110.7		99.1		74.1		45.4		18.3		0	
DISTANCE ALONG TRANSECT (m)	15.0		17.8		21.3		28.1		33.7		40.2		43.2		45.8		47.3		49.1		49.6	
PERCENT ORGANIC MATTER	20.46		21.57		18.81		19.91		20.32		15.92		15.96		15.57		15.31		17.86		10.31	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	6	17	6	15	5	16	5	13	8	13	6	16	8	13	10	13	10	14	8	18	6	17
NO. OF INDIVIDUALS/10cc	38	524	75	445	62	640	14	124	68	512	52	540	54	564	93	393	58	510	56	1060	36	616
Ammoastuta inepta		3.8		1.8		1.6		2.4	2.9	0.8		3.0	11.1	1.8	12.9	5.9	48.3	7.8	7.1	3.0		2.3
Ammobaculites dilatatus		0.8		1.2		1.6						0.4		1.4								
A. exiguus			1.8	0.3																1.1		
Ammodiscus catinus																0.5		0.4				0.3
Ammotium salsum	26.3	32.1	1.8	17 7	6.5	30.0	7.1	21.0	38.2	30.9	11.5	28.9	22.2	19.5	4.3	6.4	3.4	7.5		19.6		11.7
A. subdirectum												0.7										
Arenoparrella mexicana		2.7		1.2		3.1		4.8	2.9	3.1		0.7	11.1	2.8	5.4	3.3	10.3	1.6	7.1	1.9	5.6	1.6
Eggerella advena																						0.3
Gaudryina exilis		0.4		0.3		0.3				0.4										0.8		0.3
Glomospira gordialis																						
Haplophragmoides manilaensis																						
H. wilberti	5.3	4.2		0.3		3.1		4.0		1.6	3.8	3.0		1.4	15.1	6.6	3.4	4.3	7.1	6.0	11.1	3.6
Miliammina fusca	5.3	6.9		16.5		33.4		7.3	5.9	25.4	7.7	34.8	18.5	51.1	2.2	7.1	6.9	12.5		2.8		5.5
Polysaccammina hyperhalina		1.5				0.3	7.1	1.6				0.4								0.4		0.3
Pseudothurammina limnetis																0.3				0.4		
Siphotrochammina lobata										0.8		0.7		1.1			3.4	0.4				1.0
Tiphotrocha comprimata	10.5	2.3		0.9		1.3						0.7	7.4	2.5	16.1	5.6	6.9	0.8		3.8		0.6
Trochammina inflata		0.8				0.6		2.4		0.4		0.7								0.8		
T. macrescens		0.4						0.8				1.1	11.1	1.8	36.6	14.2	3.4	3.9		1.1		
T. ochracea		21.0		9.9		5.3		25.0	2.9	13.3		6.7		14.2	3.2	44.0		38.0	7.1	38.9	5.6	50.3
Centropyxis aculeata	5.3	8.8	10.7	21.9	6.5	5.0	14.3	15.3	35.3	19.1	30.8	12.6	14.8	1.8	2.2	4.8	6.9	15.7	42.9	16.2	33.3	15.3
C. constricta	47.4	5.3	76.8	17.1	80.6	9.4	50.0	6.5	5.9	0.8	30.8	3.7			2.2	0.8	6.9	3.5	14.3	1.9	38.9	3.6
Cucurbitella tricuspis		5.7		7.5		2.5		2.4		2.0				0.4				1.2	7.1	0.4		0.6
Difflugia oblonga		2.7	5.4	2.7	3.2	1.9	21.4	6.5	5.9	1.6	15.4	1.9	3.7	0.4		0.5		2.4		0.8	5.6	2.3
D. urceolata		0.8	3.6	0.9	3.2	0.6																
Lesquereusia spiralis																			7.1	0.4		0.3

Appendix Table 8 (continued).

Appendix Table 9. Percent abundance of living (stained, L) and total (T) foraminifera and arcellaceans and percentage of organic matter from Murrells Inlet (channel).

Appendix Table 9.

STATION NUMBER	1		2		3		4		5		6		7		8		9		10		11		12		[illegible]		14		15		16		17		18		19		20	
WATER DEPTH (m)	1.5		1.0		1.0		1.3		1.5		2.0		1.0		2.5		4.0		2.5		2.5		3.0		1.5		4.0		3.0		3.9		2.3		2.0		1.5		2.8	
PERCENT ORGANIC MATTER	2.87		1.81		0.20		0.43		0.20		N/A		0.88		2.18		N/A		3.58		2.24		1.14		0.80		0.88		1.04		0.59		0.89		0.71		0.65		0.88	
live/total	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	2	9	11	21	4	11	12	16	7	15	4	17	6	17	12	18	10	22	10	28	12	22	10	29	13	27	2	11	3	13	2	12	2	6	7	22	0	6	3	10
NO. OF INDIVIDUALS/10cc	2	14	130	1870	8	124	97	1221	258	3779	89	247	17	609	48	1988	[illegible]	1272	33	1488	39	355	39	389	[illegible]	580	3	40	11	78	2	51	4	17	11	121	0	15	3	34
Ammobaculites dilatatus				0.2																																				
A. exiguus				0.2																																				
Ammonia beccarii		14.3	28.5	46.4	37.5	30.8	35.1	48.4	45.8	37.0		18.2	23.5	23.9	52.1	52.7	60.4	41.2	33.3	38.0	20.0	43.9	21.1	38.0	24.2	33.2		62.5	63.6	35.5	50.0	27.5	25.0	29.4	27.3	40.5		53.3		44.1
Ammotium salsum			1.5	1.2				0.3		0.6										0.5																0.8				
Anomalina spp.																		0.8				0.8		0.8		0.2														
Arenoparrella mexicana		14.3																																						
Bolivina lowmani		7.1			12.5	0.8				0.3		4.9		0.3	12.5	2.7	4.2	0.8		0.8	5.7	2.5		1.5	3.0	2.5				3.8						1.7			33.3	2.9
B. pseudoplicata												1.6																												
B. striatula																				0.3																				
Buccella hannai																		1.4				0.3		0.3		0.2														
Buliminella elegantissima			3.8	1.4		0.8	8.3	2.6	4.2	0.6		0.4			4.2	1.7		0.8	3.0	0.3	2.9	1.1		0.5	3.0	1.5						3.9		5.9						
Cassidulina reniforme																				0.3																				
Cibicides lobatulus						0.8		0.3		2.3		4.0		3.8		1.7	2.1	8.2		3.5		2.5		3.9		0.8	33.3	2.5		7.8		3.9		5.9		2.5		6.7		8.8
Cyclogyra involvens												1.2			4.2	1.0					2.9	1.1		0.3																
Discorbis spp																				0.5		1.1				0.2														
Eggerella advena												0.4													1.5	0.2		2.5							9.1	0.8				
Elphidium excavatum clavatum				0.8		[illegible]	2.1	2.9		2.0		0.4		1.9		2.4	2.1	2.0	3.0	4.0		3.7		3.1		2.8		5.0		9.2		2.0				0.8				5.9
E. excavatum excavatum			7.7	2.3	[illegible]	[illegible]	13.4	5.8	12.5	8.8			5.9	2.2	4.2	3.2	4.2	2.5		1.3	5.7	4.2	5.3	3.6	12.1	3.8				1.3		2.0			18.2	5.8				5.9
E. excavatum gunteri			[illegible]	14.2		[illegible]	13.4	11.6	8.3	9.3				5.4	2.1	6.1	4.2	3.1	6.0	0.8		3.4		0.8		1.4				2.8		3.8				1.7				
E. excavatum lidoensis			1.5	2.1		4.9	2.1	3.7		11.0		1.2		12.1	2.1	4.8	4.2	6.5	24.2	2.0		2.8	7.9	5.1	18.2	3.1		7.5		2.8					9.1	6.3		6.7		17.6
E. excavatum selseyensis				1.0		6.8	3.1	6.3		9.6		0.8	29.4	29.4	4.2	7.8	10.4	15.3	12.1	8.1	2.9	6.5	7.9	8.2	1.5	8.1				9.2		21.6				14.0				
E. galvestonense			0.8	0.2										0.3																										
E. poeyanum			18.5	14.4			7.2	7.1	8.3	13.3		1.2	23.5	9.6		8.7		11.9	3.0	28.0		5.6	2.6	4.8	3.0	6.4			9.1	14.5		5.9		5.9		4.1				2.9
E. subarcticum				0.2				0.3																0.5																
Epistominella takayanagii																				0.5																				
Eponides repandus																					2.9	0.6		0.8	1.5	1.2		2.5				7.8		5.9				13.3		
Gaudryina exilis	50.0	7.1		0.8			1.0	0.5		0.3			5.9	0.3										0.3		0.2		2.3								0.8				
Gavelinopsis translucens											1.1	2.0			8.3	1.2		0.3			2.9	2.3	2.6	1.8	3.0	2.4		2.5				2.0			9.1	2.5		6.7		
Globigerinelloides spp																				0.3				0.3		0.2										0.8				
Guembelitria spp																										0.2														
Guttulina lactea																		0.3																						
Haplophragmoides wilberti																								3.9											9.1	0.8				
Haynesina depressulum			13.1	13.4	25.0	14.5	11.3	8.7	16.7	4.0		2.0	11.8	3.5		2.9	8.3	3.1		3.3	2.9	3.1	7.9	2.8	12.1	2.5				2.8						6.6			33.3	5.9
Helenina andersoni			0.8	0.2										0.3																										
Heterohelix spp																				0.3																				
Miliammina fusca	50.0	21.4	1.5	1.0														0.3					5.3	1.5		0.2										0.8				
Nodosaria spp.																				0.3																				
Planktonics (Recent)														0.3				0.3		0.3																				
Polysaccammina hyperhalina		7.1		0.4																																				
Quinqueloculina lamarckiana																																				0.2				
Q. seminulum		7.1					1.0	0.5	4.2	0.6				1.0		0.2		0.8	3.0	1.5		1.1		0.3		0.8		2.5		2.8						0.5				
Q. seminulum jugosa														4.2	2.1	0.2		0.6	3.0	0.5	2.9	0.8		1.8		2.4						2.0								
Rosalina floridana											14.6	7.3			2.1	1.2		1.4		0.5	2.9	2.5		0.5	9.1	3.8		2.5		1.3								13.3		
Siphotrochammina lobata								0.3				2.0											2.6	2.1																
Triloculina fluens										0.3				0.3						1.0				0.5												0.8				
Trochammina inflata				0.8							3.4	1.8						0.3		0.5				3.3		0.3										0.8				
T. macrescens		7.1																				0.3		2.1																2.9
T. ochracea		14.3		0.2		0.8	1.0	0.5			80.9	52.6			4.2	1.5	2.1	0.6	9.1	1.0	45.7	9.6	38.6	9.3	7.8	3.4	66.7	7.5	77.3	6.6	50.0	17.6	75.0	47.1	18.2	3.3			33.3	2.9
Wiesnerella auriculata																0.2										0.5														
Difflugia oblonga				0.2																																				

Appendix Table 10. Percent abundance of living (stained, L) and total (T) foraminifera and percentage of organic matter from Murrells Inlet (offshore).

Appendix Table 10.

STATION NUMBER	21		22		23		24		25		26		27		28		29	
WATER DEPTH (m)	4.3		5.2		7.0		7.3		7.3		7.9		7.9		8.5		7.6	
PERCENT ORGANIC MATTER	0.86		0.76		0.55		0.75		0.59		0.68		0.73		0.80		0.51	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	3	26	1	4	2	4	4	21	0	10	3	16	5	13	4	14	6	17
NO. OF INDIVIDUALS/10cc	10	120	2	7	3	9	9	128	0	25	9	93	17	73	14	63	17	111
Ammoastuta inepta																		
Ammobaculites exiguus																		
Ammonia beccarii	70.0	27.5		42.9	33.3	33.3	44.4	26.6		40.0	55.6	57.0	17.6	58.2	35.7	49.2	58.8	50.5
Ammotium salsum		0.8										1.1						
Anomalina spp.		0.8						1.8		8.0		1.1						
Bolivina lowmani								2.3		8.0		3.2	5.9	5.5			5.9	2.7
B. pseudoplicata																		
Buccella hannai								1.6										
Buliminella elegantissima		0.8												1.4				
Cassidulina laevigata		0.8										1.1						
C. reniforme																1.6		
Cibicides lobatulus		6.7				33.3	11.1	12.5		12.0		5.4		2.7		1.6	5.9	11.7
Cycloglyra involvens														1.4				
Discorbis spp		1.7						1.8				2.2				3.2		0.9
Elphidium excavatum clavatum		7.5						9.4				1.1		2.7		1.6		2.7
E. excavatum excavatum		6.7						3.9			11.1	7.5				1.6		1.6
E. excavatum gunteri	20.0	2.5						0.8								1.6		
E. excavatum lidoensis		9.2						7.6		4.0		4.3	5.9	2.7		1.6		2.7
E. excavatum selseyensis		10.0						8.8		4.0		3.2		2.7		3.2	5.9	1.8
E. galvestonense		0.8																
E. poeyanum		5.0						7.8		4.0		2.2		2.7				2.7
E. subarcticum				14.3														
Elphidium spp		0.8																
Eponides repandus		1.7																
Gaudryina exilis																		
Gavelinopsis translucens		0.8		14.3		11.1							52.9	13.7	28.6	9.5	17.6	11.7
Globigerinelloides spp		0.8										3.2						2.7
Guembelitria spp																		
Guttulina lactea																		
Haynesina depressulum		5.8					22.2	1.6		4.0		1.1				3.2		
Heterohelix spp																		
Lagena spp																		
Miliammina fusca								0.8										
Nonionella atlantica		1.7																
Planktonics (Recent)								1.8										
Quinqueloculina compta																		
Q. lamarckiana		0.6						2.3								7.9		0.9
Q. seminulum		0.8						1.8				2.2		2.7				2.7
Q. seminulum jugosa		0.8						3.9		4.0					7.1	7.9		1.8
Rosalina floridana														1.4				0.9
Siphotrochammina lobata		0.6																
Trifarina fluens								0.8										
Trochammina inflata		0.8																
T. ochracea	10.0	3.3	100	28.6	66.7	22.2	22.2	1.6		12.0	33.3	4.3	17.6	4.1	28.6	6.3	5.9	0.9
Wiesnerella auriculata																		0.9

STATION NUMBER	30		31		32		33		34		35		36		37	
WATER DEPTH (m)	8.2		7.9		7.3		7.3		8.4		5.5		4.9		4.0	
PERCENT ORGANIC MATTER	0.67		0.86		0.41		0.55		0.98		0.47		0.51		1.37	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	6	21	7	25	10	24	8	24	5	23	2	8	0	11	12	21
NO. OF INDIVIDUALS/10cc	19	222	12	155	39	295	29	384	24	224	3	35	0	41	116	838
Ammoastuta inepta								0.3								
Ammobaculites exiguus										0.4						
Ammonia beccarii	57.9	58.1	41.7	38.7	59.0	58.6	55.2	53.6	70.8	50.9	66.7	57.1		31.7	61.2	57.4
Ammotium salsum						0.3								2.4		
Anomalina spp.		2.7		2.6		1.7		1.3		1.3						0.6
Bolivina lowmani	5.3	3.2		0.6	2.6	2.4		0.5	12.5	2.7	33.3	2.9			0.9	0.4
B. pseudoplicata																0.2
Buccella hannai		0.5		0.6		0.3		0.5								
Buliminella elegantissima					2.6	1.0		0.3		0.9						0.2
Cassidulina laevigata		0.5		1.3		0.3										
C. reniforme						1.4		0.5								
Cibicides lobatulus		3.6	16.7	11.0	7.7	5.8	6.9	7.0	4.2	5.8		14.3		22.0	0.9	1.7
Cycloglyra involvens																
Discorbis spp		1.4		1.3												0.4
Elphidium excavatum clavatum		2.3	8.3	4.5	2.6	4.1	6.9	4.7		4.0						4.2
E. excavatum excavatum	5.3	3.6	8.3	5.6	2.6	2.7		6.0	8.3	4.9					3.4	2.5
E. excavatum gunteri				0.6		0.3										
E. excavatum lidoensis		2.3		1.3		0.7		2.9	4.2	4.5		8.6		2.4	2.6	6.7
E. excavatum selseyensis		1.8		3.9		0.3		1.6		3.6		2.9		9.8		1.3
E. galvestonense														2.4		
E. poeyanum	5.3	1.8	8.3	3.2	5.1	6.8	6.9	6.8		6.7		5.7		14.6		8.0
E. subarcticum																
Elphidium spp								0.3								
Eponides repandus		0.5														
Gaudryina exilis								0.3								
Gavelinopsis translucens	10.5	4.1	8.3	3.2	10.3	5.4	10.3	2.9		3.8		2.9		2.4	19.0	6.5
Globigerinelloides spp				0.6		0.7		0.5		0.9						
Guembelitria spp										0.4						
Guttulina lactea						0.3										
Haynesina depressulum		0.5		0.6		1.7	3.4	0.5		0.9					0.9	1.3
Heterohelix spp		0.5		0.6										7.3		0.2
Lagena spp										0.4						
Miliammina fusca																
Nonionella atlantica																
Planktonics (Recent)						0.3				0.4						
Quinqueloculina compta				0.6												
Q. lamarckiana		0.9		2.6				1.6		0.4					0.9	0.8
Q. seminulum		3.2	8.3	4.5		1.7	3.4	2.6		1.8		5.7		2.4	1.7	1.5
Q. seminulum jugosa		5.0		7.7		1.4		1.3		3.6						0.2
Rosalina floridana				0.6	2.6	1.7		1.6		0.9					0.9	1.9
Siphotrochammina lobata																
Trifarina fluens		0.9		1.9				1.0		0.4				2.4	0.9	1.1
Trochammina inflata																
T. ochracea	15.8	3.2		0.6	5.1	2.0	6.9	1.6							6.9	2.9
Wiesnerella auriculata				0.6						0.4						

Appendix Table 11. Percent abundance of living (stained, L) and total (T) foraminifera and arcellaceans and percentage of organic matter from South Santee River.

STATION NUMBER	1A		1B		2		3A		3B		4		5A		5B	
WATER DEPTH (m)	2.5		3.5		2.0		1.5		1.5		4.0		3.5		3.0	
PERCENT ORGANIC MATTER	3.62		0.67		1.67		0.41		18.83		22.38		3.47		18.19	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO OF SPECIES	0	8	0	5	1	25	0	1	0	7	11	18	1	11	2	8
NO OF INDIVIDUALS	0	20	0	14	3	271	0	1	0	34	69	518	1	133	2	43
Ammoastuta inepta		10.0				3.0					7.2	11.4		6.8	50.0	2.3
Ammobaculites dilatatus						3.3				14.7	10.1	4.8		31.6		
A. exiguus											4.3	2.3				
Ammotium salsum		5.0				4.1				11.8	34.8	18.4		42.1		4.7
Ammonia beccarii				35.7	100	45.0										
Arenoparella mexicana		10.0				0.7		100		2.9	14.5	18.9		4.5		4.7
Bolivina lowmani						0.4										
Buccella hannai						0.7										
Cibicides lobatulus						0.7										
Elphidium excavatum clavatum						0.7										
E. excavatum excavatum						7.7										
E. excavatum gunteri						1.1										
E. excavatum lidoensis				14.3		6.6										
E. excavatum selseyensis		10.0		21.4		7.7										
E. galvestonense						0.4										
E. poeyanum						7.0										
Eponides repandus				7.1												
Gaudryina exilis																
Haplophragmoides manilaensis												3.9		1.5		
H. wilberti		15.0				1.8				20.6	7.2	18.0	100	9.0		11.6
Haynesina depressulum						2.6										
Helenchelix spp						0.4										
Miliammina fusca						1.1				8.8	1.4	3.3				2.3
Planktonics (Recent)																
Pseudothurammina limnetis												1.2				
Reophax nana												0.2				
Siphotrochammina lobata		5.0										0.6				
Tiphotrocha comprimata						0.4					2.9	8.8		1.5		
Trilarina fluens						0.4										
Trochammina inflata		5.0				0.7					1.4	1.5				2.3
T. macrescens																
T. ochracea		40.0		21.4		2.6				38.2	1.4	1.4			50.0	62.8
Centropyxis aculeata												0.8		0.8		9.3
C. constricta						0.4						0.8		0.8		
Cucurbitella tricuspis																
Difflugia corona																
D. oblonga						0.4				2.9	14.5	7.9		0.8		
D. proteiformis																
D. urceolata												0.2		0.8		
Heleopera sphagni																
Lagenodifflugia vas																
Lesquereusia spiralis																
Pontigulasia compressa																

STATION NUMBER	6A		6B		7A		7B		8A		8B		9A		9B		10A		10B	
WATER DEPTH (m)	4.5		3.5		2.5		1.5		2.5		2.5		2.0		2.5		3.0		2.0	
PERCENT ORGANIC MATTER	0.53		16.98		7.07		0.27		8.07		4.88		0.24		0.23		0.25		0.36	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO OF SPECIES	0	1	0	10	1	8	1	5	1	7	4	11	0	0	0	0	0	0	0	0
NO OF INDIVIDUALS	0	2	0	26	2	61	2	15	1	131	18	85	0	0	0	0	0	0	0	0
Ammoastuta inepta				3.8		3.3		6.7		0.8	33.3	27.1								
Ammobaculites dilatatus						14.8				15.3		2.4								
A. exiguus																				
Ammotium salsum		100		3.8	100	63.9				79.4	22.2	23.5								
Ammonia beccarii																				
Arenoparella mexicana				15.4		9.8	100	33.3		1.5	38.9	18.8								
Bolivina lowmani																				
Buccella hannai																				
Cibicides lobatulus																				
Elphidium excavatum clavatum																				
E. excavatum excavatum																				
E. excavatum gunteri																				
E. excavatum lidoensis																				
E. excavatum selseyensis																				
E. galvestonense																				
E. poeyanum																				
Eponides repandus																				
Gaudryina exilis																				
Haplophragmoides manilaensis				3.8								1.2								
H. wilberti				30.8		3.3		40.0	100	0.8	5.6	18.5								
Haynesina depressulum																				
Helenchelix spp																				
Miliammina fusca				7.7		1.6		6.7				5.9								
Planktonics (Recent)																				
Pseudothurammina limnetis																				
Reophax nana																				
Siphotrochammina lobata				3.8		1.6						1.2								
Tiphotrocha comprimata				3.8								1.2								
Trilarina fluens																				
Trochammina inflata								13.3				1.2								
T. macrescens																				
T. ochracea				19.2		1.6				1.5										
Centropyxis aculeata																				
C. constricta																				
Cucurbitella tricuspis																				
Difflugia corona																				
D. oblonga				7.7						0.8		1.2								
D. proteiformis																				
D. urceolata																				
Heleopera sphagni																				
Lagenodifflugia vas																				
Lesquereusia spiralis																				
Pontigulasia compressa																				

Appendix Table 11.

STATION NUMBER	11A		11B		11C		12A		12B		12C		13A		13B		13C	
WATER DEPTH (m)	4 0		3.0		0.3		4 0		4 5		0		3 0		1 5		0	
PERCENT ORGANIC MATTER	0 28		12 18		17 56		0 30		7 18		20 03		0 26		12 43		16 72	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO OF SPECIES	0	2	1	7	3	11	0	3	0	5	8	15	0	0	5	14	2	13
NO OF INDIVIDUALS	0	2	2	71	7	188	0	3	0	8	84	1594	0	0	6	43	3	142
Ammoastuta inepta					71 4	14.9		33.3		33.3	77 4	35 9				4 7		4.9
Ammobaculites dilatatus																2.3		
A. exiguus																		
Ammotium salsum				25 4		3.2						0 3				4 7		
Ammonia beccarii																		
Arenoparella mexicana											8.3	16 2						1 4
Bolivina lowmani																		
Buccella hannai																		
Cibicides lobatulus		50																
Elphidium excavatum clavatum																		
E excavatum excavatum																		
E. excavatum gunteri																		
E excavatum lidoensis																		
E excavatum selseyensis																		
E. galvestonense																		
E poeyanum																		
Eponides repandus																		
Gaudryina exilis																2 3		
Haplophragmoides manilaensis								33.3			2 4	2 1						
H wilberti											6	23 9				16.3		0 7
Haynesina depressulum																		
Heterohelix spp																		
Miliammina fusca				2 8		5.3					2 4	4 8						0 7
Planktonics (Recent)		50																
Pseudothurammina limnetis												0 8						
Reophax nana																		
Siphotrochammina lobata																		
Tiphotrocha comprimata												1 8			16.7	2 3		
Trilarina fluens																		
Trochammina inflata				1 4		4.3		33.3			1 2	2 4				2 3		2 1
T macrescens						6 4					1 2	9				4 7		
T ochracea				31		16						0 4				18 6		2 1
Centropyxis aculeata				26 8	14 3	29.8				16 7	1 2	1 9				9 3		22 5
C constricta				5.6	14 3	12 6				16.7					16 7	11 6	66.7	40 1
Cucurbitella tricuspis						3 2						0 1						2 1
Difflugia corona																		
D oblonga			100	7		3 7				16.7		0 3			16.7	11 6		16.2
D proteiformis																	33 3	3 5
D urceolata										16.7					33 3	4 7		1 4
Heleopera sphagni																		
Lagenodifflugia vas																		
Lesquereusia spiralis						0.5									16.7	4 7		2 1
Pontigulasia compressa												0 1						

STATION NUMBER	14A		14B		14C		15A		15B		15C		16A		16B		16C	
WATER DEPTH (m)	1 5		1 0		0		2 0		1 0		0.2		3 0		1 5		0	
PERCENT ORGANIC MATTER	0 24		0.24		16.49		0 23		0 75		21 76		0.52		0.50		18.82	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO OF SPECIES	0	0	0	1	6	13	0	0	0	5	2	17	0	2	0	2	1	11
NO OF INDIVIDUALS	0	0	0	2	74	88[illegible]	0	0	0	7	2	260	0	2	0	2	1	167
Ammoastuta inepta					48.6	32.1				28 6		4 6		50				6 6
Ammobaculites dilatatus																		
A. exiguus																		
Ammotium salsum						0 1						0.8						
Ammonia beccarii																		
Arenoparella mexicana					23	18.6						0.4						
Bolivina lowmani																		
Buccella hannai																		
Cibicides lobatulus																		
Elphidium excavatum clavatum																		
E excavatum excavatum																		
E. excavatum gunteri																		
E excavatum lidoensis																		
E excavatum selseyensis																		
E. galvestonense																		
E poeyanum																		
Eponides repandus																		
Gaudryina exilis												0 4						
Haplophragmoides manilaensis						1 5				14 3								
H wilberti					2.7	22.4				28 6		1 9						0 6
Haynesina depressulum																		
Heterohelix spp																		
Miliammina fusca						2						1 5						0 6
Planktonics (Recent)				100										50				
Pseudothurammina limnetis					2 7	2.9												
Reophax nana																		
Siphotrochammina lobata																		
Tiphotrocha comprimata																		
Trilarina fluens																		
Trochammina inflata					5 4	4 4						1 5				50		0 6
T macrescens					17 6	14 3						1 9						
T ochracea						0 4				14 3		3 1				50		4.2
Centropyxis aculeata						1					50	45					100	50 9
C constricta												18.5						13.2
Cucurbitella tricuspis						0 2						2.3						2 4
Difflugia corona																		
D oblonga						0 1						12 7						15 6
D proteiformis												0.4						
D urceolata										14 3	50	3.1						3 6
Heleopera sphagni																		
Lagenodifflugia vas																		
Lesquereusia spiralis												0.8						1 8
Pontigulasia compressa												1 2						

Appendix Table 11 (continued).

Appendix Table 11 (continued).

STATION NUMBER	17A		17B		17C		18A		18B		18C		19A		19B		20		21		22		23		24		25		26	
WATER DEPTH (m)	2.0		1.0		0.3		4.0		1.5		0.2		3.0		0		2.5		3.5		4.0		5.0		7.0		6.0		4.5	
PERCENT ORGANIC MATTER	0.15		18.16		47.09		0.30		13.55		17.30		0.34		14.53		0.94		0.36		14.31		N/A		15.26		19.33		5.08	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	0	0	10	16	4	9	0	0	2	9	1	10	1	1	6	11	0	5	0	1	0	9	2	8	2	12	3	14	0	12
NO. OF INDIVIDUALS	0	0	29	356	7	223	0	0	2	150	5	114	1	2	8	93	0	51	0	1	0	236	2	40	2	460	5	644	0	92
Ammoastuta inepta				0.8								2.6			25	8.6														
Ammobaculites dilatatus																														
A. exiguus																														
Ammotium salsum				0.3						0.7		0.9												2.5						
Ammonia beccarii																														
Arenoparrella mexicana																														
Bolivina lowmani																														
Buccella hannai																														
Cibicides lobatulus																				100										
Elphidium excavatum clavatum																														
E. excavatum excavatum																														
E. excavatum gunteri																														
E. excavatum lidoensis																														
E. excavatum selseyensis																														
E. galvestonense																														
E. poeyanum																														
Eponides repandus																														
Gaudryina exilis																														
Haplophragmoides manilaensis																														
H. wilberti																		2												
Haynesina depressulum																														
Heterohelix spp																														
Miliammina fusca				0.3								0.9				1.1														
Planktonics (Recent)																														
Pseudothurammina limnetis																														
Reophax nana																														
Siphotrochammina lobata																														
Tiphotrocha comprimata																														
Trilarina fluens																														
Trochammina inflata			3.4	1.1		0.4				0.7		8.8			12.5	9.7												0.2		1.1
T. macrescens				0.3							100	78.9			25	41.9												0.2		
T. ochracea				0.8		0.9				24.7		0.9				4.3								25		0.7		0.2		10.9
Centropyxis aculeata			6.9	13.8	14.3	81.2				34.7		4.4	100	100	12.5	23.7		3.9				59.7		30		17.8	20	33.5		22.8
C. constricta			24.1	36.8	14.3	3.6			50	18.7		0.9			12.5	2.2						11.8		7.5	50	20.9		19.1		5.4
Cucurbitella tricuspis			10.3	2.5		3.1						0.9				1.1						1.7	50	2.5		4.6	20	2.3		6.5
Difflugia corona				0.3																		1.3				5.9		4.2		1.1
D. oblonga			6.9	20.5	57.1	8.3			50	18.7		0.9				5.4		82.4				20.2		25		30.7	60	28.7		29.3
D. proteiformis			10.3	3.7	14.3	0.4												9.8							50	10.9		6.1		6.5
D. urceolata			13.8	7.9		1.3				2												2.9		2.5		5.2		3		6.5
Heleopera sphagni			3.4	0.3																		0.8				0.9		0.3		
Lagenodifflugia vas																		2								1.1		0.8		3.3
Lesquereusia spiralis			17.2	7.3		2.7				1.3						1.1						0.4	50	5		1.1		0.8		4.3
Pontigulasia compressa			3.4	1.4						0.7					12.5	1.1						1.3				0.4		0.8		2.2

	off North Santee River										off South Santee River									
STATION NUMBER	1		2		3		4		5		6		7		8		9		10	
WATER DEPTH (m)	3.05		4.57		6.10		6.71		7.62		2.44		3.35		3.05		4.57		6.10	
PERCENT ORGANIC MATTER	7.62		6.14		7.19		0.41		0.29		0.83		1.86		0.87		0.89		0.39	
SALINITY (‰)	6		8		6		18		25		19		12		26		25		25	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	3	23	5	27	6	32	3	25	1	16	0	5	0	11	0	13	2	16	2	13
NO. OF INDIVIDUALS/10cc	160	8928	144	4816	52	1960	4	261	2	41	0	7	0	35	0	30	2	48	2	36
Ammoastuta inepta		0.4				0.2														
Ammobaculites exiguus						0.2		0.4								3.3				
Ammonia beccari		39.1		29.6	7.7	34.1		36.8		26.8		42.9		28.6		30.0		25.0		25.0
Ammotium salsum				0.3										2.9						
Anomalina spp						0.2		0.8												
Arenoparella mexicana				0.3		0.2		0.4												
Bolivina lowmani		4.3		3.7	15.4	4.7		3.4		2.4				2.9		3.3		2.1		
B. pseudoplicata				0.3		0.4		1.1												
Buliminella elegantissima		0.4		0.7		2.0		0.8										2.1		
Cassidulina reniforme				0.7		1.4				4.9										
Cibicides lobatulus		1.4		0.3		1.0	25.0	3.4		9.8				8.6		3.3		10.4		11.1
Cyclogyra involvens		0.4						0.4												
Discorbis spp.		0.4		6.3		3.5		1.1												
Eggerella advena				0.3																
Elphidium excavatum clavatum	40.0	1.1		1.0		1.8		0.8										2.1		
E. excavatum excavatum		2.9		4.0	15.4	4.3		4.6		2.4		14.3		8.6		10.0		2.1		11.1
E. excavatum gunteri		0.4				0.2														
E. excavatum lidoensis	40.0	5.4	22.2	1.3		3.5		1.9				14.3		5.7		3.3	50.0	4.2		5.6
E. excavatum selseyensis		1.8	22.2	1.3		2.7		2.3		4.9				8.6		10.0		2.1	50.0	11.1
E. poeyanum	20.0	6.5		5.3	15.4	4.9		3.1		4.9				20.0				6.3		2.8
Elphidium spp		0.4		0.3		0.8		0.8		2.4				2.9		10.0		2.1		
Eponides repandus						0.2						14.3								
Gaudryina exilis										2.4										
Gavelinopsis translucens		16.8	11.1	18.3	38.5	11.6	50.0	23.0		14.6		14.3		8.6		13.3		14.6	50.0	13.9
Globigerinelloides spp				0.3																2.8
Guttulina lactea		0.4																		
Haynesina depressulum		2.9		1.0		1.0		1.1		2.4						3.3				
Heterohelix spp				0.3																
Planktonics (Recent)		0.4				0.8		2.3						2.9				2.1		
Quinqueloculina lamarckiana		1.8		0.7		0.8		0.4		2.4						3.3				
Q. seminulum		4.3		7.3		1.6		2.7		2.4							50.0	8.3		5.6
Q. seminulum jugosa																3.3				
Reophax nana																				2.8
Rosalina floridana		2.2		1.3		3.1		5.0		4.9								5.3		2.8
Trifarina fluens						0.2		1.5												
Trochammina inflata				0.3		0.6				2.4										
T. macrescens						0.2														
T. ochracea		3.6	33.3	8.3	7.7	11.2	25.0	1.5	100	9.8						3.3		8.3		2.8
Wiesnerella auriculata		3.2	11.1	6.0		2.0		0.4										2.1		2.8
Difflugia oblonga				0.3		0.2														
Lesquereusia spiralis						0.2														

Appendix Table 12. Percent abundance of living (stained, L) and total (T) foraminifera and arcellaceans and percentage of organic matter from Santee Offshore.

Appendix Table 13. Percent abundance of living (stained, L) and total (T) foraminifera and arcellaceans and percentage of organic matter from Intracoastal Waterway, Winyah Bay and nearshore.

Appendix Table 13.

	Intracoastal Waterway																	Winyah Bay											Nearshore								
STATION NUMBER	1		2		3		4	5	6	7	8	9		10	11	12	13	14	15	16	17	18	19	20	21	22	23	25	26	27	28	29	30		31	32	
WATER DEPTH (m)	4.8		5.2		5.5		4.9	4.6	3.7	7.6	4.3	5.2		8.8	7.9	8.5	8.4	8.1	5.5	3.4	8.2	8.7	7.9	5.5	5.5	7.6	8.2	8.5	11.3	10.4	8.5	8.8	11.8		12.2	10.1	
PERCENT ORGANIC MATTER	2.04		1.36		6.26		0.19	1.18	0.24	0.19	0.27	1.97		0.25	9.36	14.79	0.7	0.23	13.03	0.87	18.67	20.24	19.75	18.1	1.84	2.71	N/A	N/A	1.47	0.27	4.22	N/A	0.46		1.05	1.02	
(live/total)	L	T	L	T	L	T	T	T	T	T	T	L	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	L	T	T	L	T
NO. OF SPECIES	1	7	1	12	1	7	9	3	0	1	0	2	13	2	8	7	1	1	7	6	7	10	9	9	4	5	4	8	20	6	1	10	5	19	26	2	18
NO. OF INDIVIDUALS/10cc	1	116	1	78	2	74	13	6		1		4	123	3	94	21	1	1	14	10	29	41	114	36	4	13	4	17	190	9	1	34	6	128	1232	6	75
Ammoastuta inepta																				10.0	3.4	7.3		2.8		7.7											2.7
Ammobaculites dilatatus																			14.3	30.0		2.4	7	2.8		23.1			1.1								
A. exiguus																																			0.3		
Ammonia beccarii				3.8			7.7																			15.4	25.0		38.4	22.2	100	23.5		17.5	23.1		12.0
Ammotium salsum				1.3											1.1	4.8			21.4	20.0		4.9		2.8													
Arenoparrella mexicana																													0.5								
Bolivina lowmani							7.7																				25.0		2.1					5.8	1.8		
B. pseudoplicata																																			0.8		
Buliminella elegantissima																													1.1								
Cassidulina reniforme																									25.0		25.0							1.8	0.3		
Cibicides lobatulus													0.8															5.9	1.8	11.1		5.9		3.2	2.6		
Cyclogyra involvens																							1.8	2.8													
Discorbis sp.																																		3.2	1.0		1.5
Elphidium excavatum clavatum																													2.8								
E. excavatum excavatum				2.6			7.7						0.8															5.9	0.5					1.6	1.6		
E. excavatum gunteri																																2.9					
E. excavatum lidoensis																												17.6	2.1						1.3		
E. excavatum selseyensis							7.7																					47.1	12.8	22.2				0.8	1		
E. poeyanum							15.4	16.7					0.8												25.0			11.8	11.8	11.1		2.9		3.2	3.2		2.7
E. subarcticum																													0.5								
Elphidium sp.																																		1.6	2.8		1.3
Gavelinopsis translucens				1.3			15.4			100				33.3			100								25.0				12.8	11.1		35.3	16.7	23	12.3		2.7
Gutulina lactea																																			0.3		
Hanzawaia strattoni																														22.2			16.7	4.0	1.6		2.7
Haplophragmoides manilaensis																								2.8													
H. wilberti																					3.4	2.4	1.8	2.8													
Haynesina depressulum																													0.5					0.8	1.3		
Miliammina fusca																4.8			14.3	10.0	20.7	2.4	1.8						0.5								
Nonionella auricula																																			0.3		
Planktonics													0.8	66.6				100																	0.3		2.7
Quinqueloculina compta																																					2.7
Q. funafutiensis																																	33.3	1.6	1.9	16.7	1.3
Q. lamarckiana																													1.1			8.8		17.5	19.6	83.3	49.3
Q. polygona																																		2.4			2.7
Q. seminulum													0.8																			2.9	16.7	8.3	13.6		1.3
Q. seminulum jugosa																													1.1			11.8			7.1		8
Reophax nana																																			0.3		2.7
Rosalina floridana							15.4																				25.0	11.8	1.8			2.9		0.8	1.0		1.3
Spiroloculina atlantica																																					1.3
Trilerina fluens																																			0.3		
Trochammina inflata																			7.1	20.0						7.7											
T. ochraceus				1.3											10.6	23.8			7.1		31.0	61.0	55.3	63.9	25.0	46.2			7.4				16.7	1.6	0.3		1.3
Wiesnerella auriculata				1.3																									0.5			2.9					
Centropyxis aculeata		35.3		8.4		39.2		16.7					12.2		57.4	33.3			28.6		13.8	7.3	22.8	13.9													
C. constricta		10.3		2.6		2.7							2.4		6.4	4.8						2.4	1.8														
Cucurbitella tricuspis		3.4				4.1	7.7						1.6									2.4	1.8														
Difflugia corona		0.9				2.7							0.8																								
D. oblonga	100	38.7		64.1		39.2	15.4	66.7				75.0	55.3		19.1	23.8			7.1	10.0	20.7	7.3	6.1	5.8													
D. urceolata		2.8		11.5		4.1							13																								
Heleopera sphagni															2.1																						
Lesquereusia spiralis		7.8		1.3	100	6.1							2.4		2.1	4.8					6.9																
Pontigulasia compressa			100	2.6								25.0	6.1		1.1																						

Appendix Table 14. Percent abundance of foraminifera and arcellaceans and percentage of organic matter from Vibracore 90, Murrells Inlet.

DEPTH IN CORE (cm)	0-2	2-4	4-6	6-8	8-10	10-12	12 14	14-16	16-18	18-20	20-22	22 24	24-26	26-28	28-30
PERCENT ORGANIC MATTER	N/A	N/A	N/A	N/A	15.24	15.24	13.18	11.62	12.18	11.00	14.52	13.96	13.05	12.35	11.57
NO OF SPECIES	10	11	13	13	12	10	9	12	12	10	10	9	10	9	3
NO OF INDIVIDUALS/10cc	880	805	1176	1320	1188	1140	1136	765	760	644	342	352	197	113	12
Ammoastuta inepta	0.6	3.0	1.4	6.4	14.1	8.8	14.1	20.6	24.2	23.4	27.2	31.3	24.4	6.2	
Ammobaculites exiguus		1.0													
Ammonia beccarii								0.3							
Ammotium salsum	9.7	7.0	6.8	1.2	2.4	0.4		0.3	0.3						
A. subdirectum			0.7		2.0			0.3							
Anomalina spp															
Arenoparrella mexicana	38.5	56.0	58.8	62.7	45.8	53.3	36.3	29.6	20.8	28.6	33.3	21.9	11.7	62.8	75.0
Cassidulina laevigata															
Cibicides lobatulus															
Elphidium excavatum excavatum															
E. excavatum gunteri															
E. excavatum lidoensis															
E. excavatum selseyensis															
E. crispum															
E. galvestonense															
E. poeyanum															
Eponides repandus															
Gaudryina exilis	1.5	0.7	0.7	0.3	0.7										
Guttulina lactea															
Haplophragmoides manilaensis		0.7		1.2	1.3	8.8	14.1	15.0	16.3	13.0	17.5	22.7	33.5	6.2	8.3
H. wilberti			0.7	1.5	3.0	2.5	7.0	7.7	10.5	7.5	2.0	9.7	14.7		
Haynesina depressulum															
Miliammina fusca	11.8	8.3	13.6	8.7	10.8	2.1	2.8	2.1	2.4	2.0	1.8	2.0	2.0	0.3	
Planktonics														0.9	
Polysaccammina hyperhalina	1.5		0.7												
P. ipohalina			0.3								0.6				
Pseudothurammina limnetis				0.3					0.5	0.2					
Quinqueloculina seminulum															
Siphotrochammina lobata	2.4	2.6	1.7	2.4	2.4	6.0	5.3	4.5	7.1	4.3	2.0	1.7	1.0	0.9	
Textularia candeiana															
Tiphotrocha comprimata	2.7	3.6	2.7	3.9	3.0	2.5	4.2	2.4	1.3	3.7	1.2	2.6	1.5	4.4	
Trochammina inflata	27.3	14.2	10.5	11.5	13.5	14.4	14.1	13.2	12.1	11.5	12.9	6.3	8.1	15.9	16.7
T. macrescens	3.9	3.0	1.4	1.5	1.0	1.4	2.1	3.8	4.2	5.7	1.5	2.0	2.0	1.8	
T. ochracea				0.3											
Centropyxis aculeata									0.3				1.0		

DEPTH IN CORE (cm)	30-32	32 34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50	50-52	52 54	54-56	56-58	58-60
PERCENT ORGANIC MATTER	N/A	13.61	13.86	N/A	9.30	12.40	N/A	12.18	10.90	N/A	N/A	N/A	8.35	N/A	N/A
NO OF SPECIES	3	7	3	1	2	6	8	9	5	7	3	2	0	2	0
NO OF INDIVIDUALS/10cc	13	78	5	1	5	16	86	107	21	25	13	2	0	2	0
Ammoastuta inepta		10.3					8.1	10.3	4.8	4.0					
Ammobaculites exiguus															
Ammonia beccarii															
Ammotium salsum															
A. subdirectum															
Anomalina spp															
Arenoparrella mexicana	76.9	64.1	80.0	100	80.0		37.2	15.9	9.5	44.0	84.6	50.0		50.0	
Cassidulina laevigata															
Cibicides lobatulus															
Elphidium excavatum excavatum															
E. excavatum gunteri															
E. excavatum lidoensis															
E. excavatum selseyensis															
E. crispum															
E. galvestonense															
E. poeyanum															
Eponides repandus															
Gaudryina exilis															
Guttulina lactea															
Haplophragmoides manilaensis		3.8			20.0	37.5	29.1	41.1	66.7	16.0		50.0			
H. wilberti						25.0	4.7	6.5	14.3	12.0					
Haynesina depressulum															
Miliammina fusca						6.3		1.9		4.0					
Planktonics	7.7														
Polysaccammina hyperhalina															
P. ipohalina															
Pseudothurammina limnetis						6.3	3.5	9.3							
Quinqueloculina seminulum															
Siphotrochammina lobata		6.4						0.9							
Textularia candeiana															
Tiphotrocha comprimata		5.1				6.3	5.8	4.7		8.0	7.7				
Trochammina inflata	15.4	9.0	20.0			18.8	10.5	9.3	4.8	12.0	7.7			50.0	
T. macrescens		1.3					1.2								
T. ochracea			20.0												
Centropyxis aculeata															

Appendix Table 14.

DEPTH IN CORE (cm)	60-62	62-64	64-66	66-68	68-70	70-72	72-74	74-76	76-78	78-80	80-82	82-84	84-86	86-88	88-90	90-92	92-94	94-96	96-98	98-100	100-102	102-104	104-106	106-108	108-110	110-112	112-114	114-116	116-118	118-120	120-122
PERCENT ORGANIC MATTER	N/A	N/A	5.86	7.27	N/A	N/A	9.18	8.35	10.31	9.66	8.18	8.69	3.95	4.18	N/A	3.42	4.22	5.90	4.98	N/A	2.20	N/A	N/A	N/A	2.25	3.80	3.95	4.63	4.90	5.52	5.30
NO. OF SPECIES	1	0	2	1	0	0	1	1	0	0	0	0	0	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0
NO. OF INDIVIDUALS/10cc	1	0	2	1	0	0	1	1	0	0	0	0	0	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Ammoastuta inepta																															
Ammobaculites exiguus																															
Ammonia beccarii																															
Ammotium salsum																															
A. subdirectum																															
Anomalina spp																															
Arenoparrella mexicana	100																														
Cassidulina laevigata																															
Cibicides lobatulus			50.0	100			100										50.0														
Elphidium excavatum excavatum																															
E. excavatum gunteri																															
E. excavatum lidoensis																															
E. excavatum selseyensis																															
E. crispum																															
E. galvestonense																															
E. poeyanum																															
Eponides repandus																															
Gaudryina exilis																															
Guttulina lactea																															
Haplophragmoides manilaensis																															
H. wilberti																															
Haynesina depressulum																															
Miliammina fusca																															
Planktonics																															
Polysaccammina hyperhalina																															
P. ipohalina																															
Pseudothurammina limnetis																															
Quinqueloculina seminulum																															
Siphotrochammina lobata																															
Textularia candeiana																															
Tiphotrocha comprimata																															
Trochammina inflata																															
T. macrescens																															
T. ochracea								100									50.0														
Centropyxis aculeata			50.0											100						100											

Appendix Table 14 (continued).

Appendix Table 14 (continued).

DEPTH IN CORE (cm)	122 124	124-126	126-128	128-130	130-132	132 134	134-136	136-138	138 140	140-142	142 144	144-146	146-148	148 150	150-152	152 154	154-156	156-158	158 160	160-162	162-164	164-166	166-168	168-170	170-172	172-174	174-176	176-178	178-180	240-242
PERCENT ORGANIC MATTER	4.86	3.59	2.34	2.45	2.51	2.61	1.97	1.75	1.47	2.30	2.36	1.26	1.19	1.20	1.23	1.86	2.08	1.44	1.19	1.15	0.91	0.83	0.64	0.60	0.55	0.72	0.74	0.54	0.54	0.47
NO OF SPECIES	0	7	6	0	0	1	1	0	0	0	1	0	2	0	0	5	13	16	9	5	7	5	3	1	3	4	3	0	1	0
NO OF INDIVIDUALS/10cc	0	16	24	0	0	1	1	0	0	0	1	0	2	0	0	19	97	92	65	20	27	18	16	2	3	4	3	0	1	0
Ammoastuta inepta																														
Ammobaculites exiguus																														
Ammonia beccarii		37.5	37.5													36.8	46.4	41.3	52.3	50.0	55.6	38.9	68.8		33.3	25.0	33.3			
Ammotium salsum																														
A subdirectum																														
Anomalina spp																10.5	5.2	1.1	3.1	5.0	3.7	5.6								
Arenoparella mexicana																		1.1									33.3			
Cassidulina laevigata																		1.1	1.5											
Cibicides lobatulus		25.0	20.8				100				100					31.6	20.6	27.2	29.2	25.0	18.5	44.4	25.0		33.3	50.0				
Elphidium excavatum excavatum																	1.0	1.1												
E. excavatum gunteri																	2.1	2.2												
E. excavatum lidoensis		12.5	25.0													15.8	6.2	4.3	1.5	15.0	7.4				33.3	25.0				
E. excavatum selseyensis		6.3	4.2														3.1	5.4	3.1								33.3			
E crispum																		1.1												
E. galvestonense																	1.0	2.2	3.1			5.6								
E poeyanum		6.3	8.3														8.2	6.5	4.6		7.4	5.6	6.3							
Eponides repandus																5.3	2.1	1.1	1.5	5.0	3.7			100						
Gaudryina exilis																														
Guttalina lactea																	1.0	1.1												
Haplophragmoides manilaensis																														
H wilberti																														
Haynesina depressulum		6.3															1.0	1.1			3.7									
Miliammina fusca		6.3																												
Planktonics													50.0																	
Polysaccammina hyperhalina																														
P ipohalina																														
Pseudothurammina limnetis																														
Quinqueloculina seminulum																	2.1	2.2												
Siphotrochammina lobata																													100	
Textularia candeiana						100							50.0																	
Tiphotrocha comprimata																														
Trochammina inflata			4.2																											
T macrescens																														
T ochracea																														
Centropyxis aculeata																														

DEPTH IN CORE (cm)	16-18	21-23	30-32	35-37	42-44	55-57	70-72	90-92	110-112	120-122	130-132	140-142	153-155	158-160	168-170	180-182	196-198	205-207	222-224	238-240	245-247	250-252
NO. OF SPECIES	8	7	4	1	1	0	7	0	1	1	0	1	0	1	0	0	6	0	1	0	0	1
NO. OF INDIVIDUALS/10cc	181	297	78	1	1	0	230	0	1	1	0	2	0	1	0	0	6	0	1	0	0	1
Ammoastuta inepta																						
Ammobaculites dilatatus	0.8																					
Ammonia beccarii																			100			
Ammotium salsum	4.7	0.5					2.2															
Arenoparrela mexicana	63.0	92.3	91.0	100	100		89.1															
Cibicides lobatulus												100					16.7					
Elphidium excavatum excavatum																	16.7					
E. excavatum gunteri																	16.7					
E. excavatum lidoensis																	16.7					
Haplophragmoides manilaensis									100													
Helenina anderseni																	16.7					
Miliammina fusca	3.4	1.4	1.3				1.3															
Nonionella auricula																						100
Planktonics																	16.7					
Siphotrochammina lobata		1.0					0.4															
Textularia candeiana										100				100								
Tiphotrocha comprimata	0.8	0.5	1.3				0.9															
Trochammina inflata	11.8	1.4	6.4				5.2															
T. macrescens	8.7	2.9					0.9															
T. ochracea	0.8																					

Appendix Table 15. Percent abundance of foraminifera from Vibracore 100, Murrells Inlet.

Appendix Table 16. Percent abundance of foraminifera from Vibracore 101, Murrells Inlet.

DEPTH IN CORE (cm)	8-10	16-18	28-30	40-42	50-52	70-72	90-92	107-109	140-142	171-173	190-192	215-217	242-244	270-272	290-292
NO. OF SPECIES	9	5	3	9	7	3	0	0	0	0	0	0	1	0	0
NO. OF INDIVIDUALS/10cc	139	1328	13	372	38	3	0	0	0	0	0	0	1	0	0
Ammoastuta inepta	0.7			0.3	2.6										
Ammobaculites exiguus	0.7														
Ammotium salsum	0.7		7.7												
Arenoparella mexicana	11.5	85.2	76.9	32.5	31.6	33.3									
Cassidulina reniforme													100		
Haplophragmoides manilaensis				12.4	10.5	33.3									
H. wilberti				41.4	34.2										
Miliammina fusca	43.2	2.4		0.3											
Siphotrochammina lobata	5.0	3.6		1.6		33.3									
Tiphotrocha comprimata	0.7			0.8	2.6										
Trochammina inflata	27.3	7.2	15.4	5.1	10.5										
T. macrescens	7.2	1.5		5.6	7.9										

Appendix Table 17. Percent abundance of foraminifera from Vibracore 102, Murrells Inlet.

DEPTH IN CORE (cm)	12-14	20-22	34-36	44-46	54-56	65-67	75-77	90-92	100-102	120-122	141-143	160-161	172-173	221-223	273-275	313-315
NO. OF SPECIES	7	8	5	11	9	4	1	0	0	0	0	0	0	0	2	0
NO. OF INDIVIDUALS/10cc	181	529	354	404	406	87	2	0	0	0	0	0	0	0	2	0
Ammoastuta inepta				0.3	0.4											
Ammotium salsum	0.7			0.3	0.7											
Arenoparella mexicana	65.5	42.0	61.5	68.7	53.2	75.9	100									
Cibicides lob[illegible]us															50.0	
Gaudryina exilis				0.3												
Haplophragmoides manilaensis				0.3												
H. wilberti		1.1		0.3	1.4											
Miliammina fusca	2.8	0.4		1.2	0.4											
Polysaccammina ipohalina		0.2														
Siphotrochammina lobata	0.7	1.3	2.1	1.9	3.9	1.1										
Textularia candeiana															50.0	
Tiphotrocha comprimata	2.8	1.1	1.1	0.3	0.7	1.1										
Trochammina inflata	23.4	44.2	17.3	20.4	35.9	21.8										
T. macrescens	4.1	9.6	18.0	5.9	3.5											

	Push Core								Vibracore																		
DEPTH IN CORE (cm)	42-44	52-54	78-80	88-90	91-93	100-102	112 114	131-133	6-8	12-14	20-22	35-37	45-47	60-62	78-80	102-104	120-122	135-137	160-162	200-202	250-252	283-285	300-302	310-312	320-322	325-327	340-342
NO OF SPECIES	9	5	2	0	0	3	0	1	11	7	8	8	8	0	2	0	0	0	0	0	0	0	0	1	0	0	0
NO OF INDIVIDUALS/10cc	360	5	2	0	0	18	0	1	691	35	60	62	105	0	2	0	0	0	0	0	0	0	0	1	0	0	0
Ammoastuta inepta	1 7	20 0				66 7			0.4		1 7	29 0	39 0														
Ammonia beccarii																								100			
Ammotium salsum	1 1								3.9																		
Arenoparella mexicana	25 3	20 0	50 0						46 7	40 0	35 0	33 9	4 8														
Gaudryina exilis									4 2																		
Haplophragmoides manilaensis	35 8	20 0				16 7					30 0	6 5	1 9														
H. wilberti	1 7								8.5	20 0	3.3	8 1	22 9		50 0												
Miliammina fusca	0.3								9 3	5.7		1 6	1 9														
Polysaccammina ipohalina									0 4																		
Siphotrochammina lobata									7 3	2.9	1 7																
Tiphotrocha comprimata	6.4	20 0				16 7			3.1	2.9	16 7	8 1	17 1		50 0												
Trochammina inflata	27 5	20 0	50 0						10 8	2.9	3.3	9 7	8.6														
T macrescens	0 3							100	5 4	25 7	8.3	3.2	3.8														

Appendix Table 18. Percent abundance of foraminifera from Push Core and Vibracore 103, Murrells Inlet.

DEPTH IN CORE (cm)	0-2	8-10	15-17	23-25	28-30	38-40	45-47	50-52	60-62	70-72	80-82	90-92	100-102	110-112
PERCENT ORGANIC MATTER	4.34	3.95	0.22	16.45	19.16	15.17	13.99	11.17	9.52	9.17	4.79	5.19	3.78	1.40
NO. OF SPECIES	7	5	5	6	2	5	2	4	13	14	15	15	15	17
NO. OF INDIVIDUALS/10cc	208	128	6	26	13	38	5	141	1445	136	504	940	2224	1531
Ammoastuta inepta	0.5													
Ammobaculites dilatatus	1.0													
A. exiguus		1.6												
Ammonia beccarii			16.7						36.7	30.1	23.0	28.5	34.5	32.8
Ammotium salsum	19.9			3.8	7.7	2.6		0.7	0.7	5.9				
Anomalina spp.												0.9	2.5	2.4
Arenoparella mexicana	16.0	26.6		7.7		10.5	40.0	86.5		1.5	2.8	1.3	1.6	1.7
Bolivina lowmani														0.7
Buliminella elegantissima														
Cassidulina laevigata											0.4			0.7
C. reniforme														
Cibicides lobatulus									2.2	2.9	2.0	2.1	8.6	12.5
Elphidium excavatum clavatum									1.1					
E. excavatum excavatum									15.1	2.2	9.1	8.1	10.8	4.2
E. excavatum gunteri									4.1	0.7				
E. excavatum lidoensis			16.7						1.5		1.2	1.3	2.2	3.5
E. excavatum selseyensis			33.3						0.7	0.7	0.4	0.9	0.4	2.4
E. galvestonense									4.4	3.7	0.4	0.9	0.4	1.0
E. poeyanum									11.1	16.4	12.3	21.7	11.9	13.6
Eponides repandus			16.7										0.7	0.7
Gavelinopsis translucens														
Guttulina lactea														
Haplophragmoides manilaensis										0.7				
H. wilberti											0.4			
Haynesina depressula									16.6	21.3	36.1	26.1	20.5	16.5
Helenina andersoni											1.2	1.3	1.6	1.0
Miliammina fusca	61.2	21.9		61.5	92.3	78.3	60.0	7.1						
Pseudothurammina limnetis				3.8										
Rosalina floridana														0.3
Siphotrochammina lobata										2.9	2.0	0.4		
Tiphotrocha comprimata														
Trifarina fluens													0.4	0.7
Trochammina inflata	1.0	35.9		15.4		7.9		5.7	3.3	8.1	8.3	3.8	3.2	3.1
T. macrescens		14.1	16.7	7.7		2.6			0.4	0.7		0.4	0.4	
T. ochracea	0.5										0.4	0.4		
Centropyxis aculeata														

DEPTH IN CORE (cm)	120-122	130-132	140-142	148-150	153-155	158-160	170-172	185-187	190-192	195-197	200-202	240-242	280-282	310-312
PERCENT ORGANIC MATTER	1.81	0.91	12.96	20.76	N/A	N/A	44.51	N/A	32.00	N/A	30.79	67.34	70.18	74.20
NO. OF SPECIES	16	18	3	3	1	7	6	3	2	4	2	0	1	0
NO. OF INDIVIDUALS/10cc	518	570	6	5	8	185	15	14	4	16	4	0	1	0
Ammoastuta inepta						2.7	13.3							
Ammobaculites dilatatus														
A. exiguus														
Ammonia beccarii	29.3	35.1												
Ammotium salsum														
Anomalina spp.	2.7	1.4												
Arenoparella mexicana	1.2	2.5	33.3		100	78.2	20.0	21.4						
Bolivina lowmani		1.1												
Buliminella elegantissima		0.4												
Cassidulina laevigata	0.4	0.4												
C. reniforme		0.4												
Cibicides lobatulus	26.6	10.5												
Elphidium excavatum clavatum	0.4													
E. excavatum excavatum	6.2	3.2												
E. excavatum gunteri														
E. excavatum lidoensis	3.9	2.8												
E. excavatum selseyensis	1.9	1.1												
E. galvestonense		1.6												
E. poeyanum	8.1	19.8												
Eponides repandus	0.4													
Gavelinopsis translucens		0.4												
Guttulina lactea	0.8	0.7												
Haplophragmoides manilaensis														
H. wilberti						0.5								
Haynesina depressula	15.8	16.1												
Helenina andersoni	0.6	1.4												
Miliammina fusca						2.7	20.0							
Pseudothurammina limnetis														
Rosalina floridana														
Siphotrochammina lobata	0.4			60.0			6.7							
Tiphotrocha comprimata						8.1				6.3				
Trifarina fluens														
Trochammina inflata	1.2	1.4	50.0	20.0		7.6	26.7	50.0	25.0	56.3	25.0			
T. macrescens				20.0		2.2	13.3	28.6	75.0	31.3	75.0			
T. ochracea			16.7							6.3				
Centropyxis aculeata													100	

Appendix Table 19. Percent abundance of foraminifera and arcellaceans and percentage of organic matter from Vibracore 106, Murrells Inlet.

DEPTH IN CORE (cm)	2-4	15-17	30-32	38-40	50-52	63-65	75-77	85-87
PERCENT ORGANIC MATTER	2.15	7.28	8.39	8.38	5.82	10.68	13.21	7.83
NO. OF SPECIES	11	11	9	8	10	9	13	8
NO. OF INDIVIDUALS/10cc	15,072	6728	2504	284	2192	1028	2256	1012
Ammoastuta inepta	1.6	1.0	4.8	5.3	6.2	1.9	2.8	1.6
Ammobaculites dilatatus	0.1							
Ammotium subdirectum								
Arenoparrella mexicana	9.8	11.3	6.4	16.5	23.0	49.4	55.7	72.3
Haplophragmoides manilaensis	1.0	0.6	1.3		0.7		0.4	
H. wilberti	74.6	75.6	77.3	61.6	42.0	28.4	28.2	17.8
Miliammina fusca	5.0	0.7	1.0	8.8	9.9	7.8	0.7	1.2
Polysaccammina hyperhalina							0.4	
P. ipohalina		0.7						
Pseudothurammina limnetis	0.1	0.1					1.4	
Siphotrochammina lobata	0.6	0.4	1.6	0.7	2.8	2.3	4.3	1.2
Tiphotrocha comprimata	1.8	0.8	5.1	2.1	3.6	4.7	3.5	2.8
Trochammina inflata	1.6	1.2	1.3	1.1	3.3	0.8	1.8	0.8
T. macrescens	3.8	7.6	1.3	3.9	7.7	3.9	1.4	2.4
T. ochracea						0.8	0.4	
Centropyxis aculeata					1.1			
Difflugia oblonga							1.1	

DEPTH IN CORE (cm)	98-100	108-110	119-121	135-137	145-147	155-157	164-166	180-182	190-192	203-205	213-215
PERCENT ORGANIC MATTER	6.60	4.55	3.50	6.24	3.91	6.82	11.36	13.58	21.21	16.38	18.00
NO. OF SPECIES	7	7	10	8	10	9	10	12	7	5	2
NO. OF INDIVIDUALS/10cc	365	151	171	3232	680	3720	1132	611	24	19	22
Ammoastuta inepta	9.9	11.9	1.8		0.4	0.6	7.4	28.6	33.3	26.3	59.1
Ammobaculites dilatatus											
Ammotium subdirectum								0.7			
Arenoparrella mexicana	72.3	53.6	14.0	12.9	14.9	8.2	47.3	32.2	25.0	32.6	40.9
Haplophragmoides manilaensis			4.1	2.0	5.1	0.4	7.4	0.7			
H. wilberti	8.8	7.3	51.5	72.5	63.9	77.6	17.0	2.6	8.3	10.5	
Miliammina fusca	1.6		3.5	2.2	0.8	7.7	0.7	22.0	12.5	5.3	
Polysaccammina hyperhalina											
P. ipohalina											
Pseudothurammina limnetis					0.4			4.3	4.2		
Siphotrochammina lobata		4.0	2.9	1.0	0.4	0.2	2.5	1.0			
Tiphotrocha comprimata	4.0	12.6	7.6	1.2	2.0	3.0	4.9	1.6	8.3	5.3	
Trochammina inflata	2.6	2.0	1.8	0.2	1.6	0.6	0.7	0.7			
T. macrescens	1.1	8.6	12.3	7.9	10.6	1.5	11.3	4.9			
T. ochracea			0.6				0.7	0.7	8.3		
Centropyxis aculeata											
Difflugia oblonga											

DEPTH IN CORE (cm)	225-227	235-237	242-244	257-259	272-274	280-282	290-292	305-307	315-317	323-325	335-337
PERCENT ORGANIC MATTER	16.56	17.92	13.69	24.87	31.17	46.83	58.01	61.12	76.61	79.11	75.06
NO. OF SPECIES	2	3	9	10	8	4	3	0	0	0	0
NO. OF INDIVIDUALS/10cc	14	22	639	548	2072	720	18	0	0	0	0
Ammoastuta inepta	21.4	59.1	1.7	10.6	28.2	0.4	83.3				
Ammobaculites dilatatus											
Ammotium subdirectum				0.7	0.8	0.4	5.6				
Arenoparrella mexicana	78.6	38.4	77.7	64.6	34.7	98.9					
Haplophragmoides manilaensis			0.6								
H. wilberti			13.9	13.5	3.1						
Miliammina fusca			0.9	5.1							
Polysaccammina hyperhalina											
P. ipohalina											
Pseudothurammina limnetis				0.4							
Siphotrochammina lobata			1.1	1.5	7.7						
Tiphotrocha comprimata			1.3	1.8	13.5	0.4					
Trochammina inflata			0.6	0.4	1.2						
T. macrescens			2.0	1.5	10.8						
T. ochracea		4.5					11.1				
Centropyxis aculeata											
Difflugia oblonga											

Appendix Table 20. Percent abundance of foraminifera and arcellaceans and percentage of organic matter from Vibracore B1, North Inlet.

DEPTH IN CORE (cm)	4-6	15-17	25-27	30-32	35-37	40-42	47-49	58-60	68-70	80-82	95-97	110-112	120-122	130-132	135-137	145-147	155-157	165-167	180-182	200-202	240-242	264-266	275-277	310-312	330-332	345-347	363-365	380-382	393-395	430-432
PERCENT ORGANIC MATTER	21 76	23 68	24 76	25 15	20.37	17 45	19.02	15 33	14 66	12 73	8.49	6.02	5.56	4.25	2.53	2.22	2.06	2.03	2.89	3.22	0.78	1 23	7 49	7 64	0.40	0.57	8.52	1.86	4.99	5.63
NO OF SPECIES	16	13	11	5	4	8	10	10	10	13	9	8	2	3	1	3	0	3	0	0	0	0	0	3	0	0	0	0	2	14
NO OF INDIVIDUALS/10cc	1928	5944	3040	27	14	55	333	666	187	366	52	180	6	16	10	3	0	11	0	0	0	0	0	3	0	0	0	0	2	6272
Ammoastuta inepta	5.8	44 6	47.6	51 9	7 1	40 0	8.4	19 5	20 9	6.0	3.8	10 6																		
Ammobaculites dilatatus	0.2																													
Ammonia beccarii																														1 8
Ammotium salsum	1 0	0.8	0.3							0 5																				
A. subdirectum			1 1																											
Arenoparrella mexicana	29 3	29 7	31 6	11 1	7 1	16 4	41 4	28 4	40 1	28 5	28 9	15 0	50 0	75 0	100	33 3		18 2												
Bolivina lowmani																														2.8
Buliminella elegantissima																														0.5
Cibicides lobatulus									0.5															33 3						
Cyclogyra involvens																														3.5
Elphidium excavatum clavatum																														0.8
E. excavatum excavatum																														0.8
E. excavatum lidoensis																								33 3					50 0	44 1
E. excavatum selseyensis																														30.9
E. poeyanum																														9 7
Gaudryina exilis	0 6									0.8																				
Gavelinopsis translucens																														1.8
Hanzawaia strattoni																														0.5
Haplophragmoides manilaensis	0.2	0.5	0.8				2 1	1 8	2.7	1 6	3.8	0.6																		
H. wilberti	43 2	5.7	8.9	25 9	71 4	5 5	25 8	26 3	18 7	44 5	55.8	55 0						72 7												
Haynesina depressula																														2.8
Miliammina fusca	0.8	3.6	3.4	7 4		21 8	3.9	9 3	5.3	3.3	1 9	1 7				33 3		9.1												
Oolina spp.																														0.5
Planktonics	0.4		0.3			1 8	0.3			0 3				18 8										33 3						
Polysaccammina ipohalina								0.3																						
Pseudothurammina limnetis	3.7	0.4																												
Rosalina floridana																														2.8
Siphotrochammina lobata	1 7	0.7					0.9	1 2	1 1	0 3	1 9		50 0																50 0	
Sulcophax palustris		0 1																												
Tiphotrocha comprimata	2.3	4 2	3.7		14 3	5.5	7.2	6.0	4 8	3.6	1 9	7 8																		
Trochammina inflata	3.9	2.8	0.8			5.5	2.4	2.7	3.2	6.6	1 9	5.0		6.3		33 3														
T. macrescens	8.4	6.7	1 6	3.7		3.6	4 5	4 5	2.7	5 5	1 9	4 4																		
T. ochracea		0.1								0 3																				
Centropyxis aculeata	0.2																													
Lesquereusia spiralis	0 2																													

Appendix Table 21. Percent abundance of foraminifera and arcellaceans and percentage of organic matter from Vibracore B2, North Inlet.

DEPTH IN CORE (cm)	8-10	14-16	25-27	35-37	45-47	55-57	65-67	75-77	85-87	95-97	110-112	133-135	150-152	180-182	200-202	230-232	255-257	280-282	330-332	355-357	400-402	[illegible]	495-497	540-542	600-602	630-632	670-672
PERCENT ORGANIC MATTER	14 72	10 75	4 62	4.81	2.83	4 49	3.95	1 89	2.13	1 03	1 42	1 06	1 96	0.69	0.40	0 46	9.65	11 02	2.08	7 58	8.87	5.96	1 69	1 63	12 07	1 26	1 06
NO OF SPECIES	11	11	8	3	8	6	4	0	5	0	5	8	5	12	5	5	8	15	16	14	13	14	16	21	14	20	20
NO OF INDIVIDUALS/10cc	3104	4066	883	72	126	215	17	0	45	0	16	39	14	19	6	7	382	10,464	231	33,920	18,240	10,752	2184	552	9472	176	230
Ammoastuta inepta	8.5	4.3			15 9																						
Ammonia beccarii															16 7		1 6		2.2	1 9	2.1	0.9	1 8	1 1	1 4	0 6	1 3
Ammotium salsum	1 0												14 3														
A. subdirectum		0.4																									
Arenoparella mexicana	66 5	50 7	79 5	95 8	65 9	89 3	64 7		53 3		6.3	23 1	21 4	10 5													
Bolivina lowmani														5.3	16 7	28 6	0 5	4 6	0.4	3.8	5.3	3.3	0.7	0.7	4.4	1 1	7 8
B. pseudoplicata																			0.4		0.4	0.3	0.7	0.4			0.4
Buliminella elegantissima																		0 3			0.4			0.4	0.7	2.8	11 7
Cassidulina reniforme																				0.4		0.3					
Cibicides lobatulus											6.3			5.3		14 3		0 3	0.9	0.4	1 8	1 2				0.6	
Cyclogyra involvens																		2.8		1 9		0 9			1 0		1 3
Discorbis spp																		0.6		0.4							
Elphidium crispum																							0.4				
E. excavatum clavatum																							1 1				
E. excavatum excavatum																			0.9		0.4		0.4	0.4			0.4
E. excavatum gunteri																			2.6		0.4	0 3	0.4	0.4			0.4
E. excavatum lidoensis														28 3	16 7		41 9	49 8	28.6	54 0	51 6	44 3	19 4	32 2	54.4	31 8	22 6
E. excavatum selseyensis														5.3	16.7	14 3	53 1	21 7	49 8	26 0	29 8	37 2	57 9	16 7	19 3	12.5	7 8
E. galvestonense																			0.4				0.4	2.2		1 1	
E. poeyanum														10 5		14 3	1 0	4 6	9.1	1 1	4 2	4 5	13 6	8.3	1 7	9 7	5.7
Epistominella takayanagii																								0.4			
Eponides repandus																	1 0		0.9				1 1	4 0		4 5	3.9
Gavelinopsis translucens														5.3				1 2	0 4	2.3	0.4	0.3		0.4	4 4	2.3	9 8
Hanzawaia strattoni																								1 4		2.8	
Haplophragmoides manilaensis	0 5	0.6		1 4																							
H. wilberti	4 4	25 8	1 5		2.4		23 5				68 8	59 0	50 0	10 5	33 3												
Haynesina depressula																		2.1	0.9	1 5	1 1	1 5	0.7	0.7	3.7	2.3	0.4
Lagena spp																	0 5										0.4
Miliammina fusca	1 5	6 5	1 5		6.3	0 5	5 9		2.2		12 5	2.6	7 1														
Nonionella auricula																		1 2					0.4		0.7	1 7	1 3
Oolina spp																									0 7		
Planktonics													7 1			28 6			0.9				0.4			0.6	
Polysaccammina ipohalina		1 4	3.9		0.8		5.9																				
Pseudothurammina limnetis	0.3											2.6		5.3													
Quinqueloculina funafutiensis																								0.7			
Q. p'ygona																		1 2		0 4				3.6	0.3	1 1	0 4
Q. seminulum																	0 3	3 1	0.4	1 1				6.5	3.4	10 8	6 5
Q. seminulum jugosa																								14 1		8.0	3 9
Rosalina floridana														5.3				6 4	1 3	4 9	2.5	4 2		2.9	4.1	3.4	12 2
Siphotrochammina lobata	8.5	3.5	7 3		2.4	2.3			15 6					5.3													
Textularia candeiana																								2.5		1 7	
Tiphotrocha comprimata	2.8	5.1	0.9		3.2	0 5			2.2			2.6															
Trifarina fluens																						0.9	0.7			0.6	
Trochammina inflata	1 5	0.4	3.9	2.8	3.2	7 0			28 7		6.3	2.6															
T. macrescens	4 4	1 4	1 5			0 5						5.2															
T. ochracea												2.6															1 7
Wiesnerella auriculata														5 3				0 6									

Appendix Table 22. Percent abundance of foraminifera and percentage of organic matter from Vibracore B3, North Inlet.

DEPTH IN CORE (cm)	0-2	6-8	12-14	20-22	28-30	40-42	50-52	60-62	70-72	80-82	90-92	100-102	110-112	120-122	130-132	136-138	147-149	155-157	175-177	195-197	215-217	230-232	242-244
PERCENT ORGANIC MATTER	19.19	18.98	20.61	31.33	28.47	33.67	30.00	24.90	22.45	25.45	21.07	18.62	19.10	21.87	18.57	19.21	2.98	1.27	3.19	0.98	0.81	5.41	5.64
NO. OF SPECIES	13	14	14	12	9	12	9	9	9	10	9	7	12	9	12	9	0	1	12	4	3	0	0
NO. OF INDIVIDUALS/10cc	6728	6448	1556	556	311	672	138	111	282	189	84	157	181	55	180	108	6	1	490	11	5	0	0
Ammoastuta inepta	4.4	3.2	20.1	46.8	37.6	28.9	40.4	60.4	44.3	24.3	14.3	7.6	6.6	10.9	12.5	9.3	16.7		7.8	27.3			
Ammobaculites dilatatus													5.5		2.5								
Ammonia beccarii																	16.7						
Ammotium salsum			0.5							0.5	14.3	17.8	33.1	5.5	15.6	20.4							
A. subdirectum	0.6	0.1	1.8	1.1	0.3				0.7														
Arenoparrella mexicana	9.2	6.7	31.9	18.0	33.8	31.2	27.2	6.3	1.8	2.6	8.3	5.7	8.3	18.4	15.0	10.2	16.7	100	10.2	9.1			
Bolivina lowmani																					40.0		
B. pseudoplicata																							
B. striatula																							
Buliminella elegantissima																							
Cassidulina reniforme																							
Cibicides lobatulus																							
Cyclogyra involvens																							
Discorbis spp																							
Eggerella advena				0.4																			
Elphidium crispum																							
E. excavatum clavatum																							
E. excavatum excavatum																							
E. excavatum gunteri																							
E. excavatum lidoensis																					40.0		
E. excavatum selseyensis																							
E. galvestonense																							
E. poeyanum																							
Epistominella takayanagii																							
Eponides repandus																							
Gavelinopsis translucens																							
Hanzawaia strattoni																							
Haplophragmoides manilaensis	0.1	0.8	1.8	2.2			2.2	1.8		0.5					0.6				0.2				
H. wilberti	61.6	70.2	12.3	15.8	9.0	10.4	7.4	2.7	0.7	1.6	2.4	2.5	2.2	3.6	6.3	0.9			57.6	45.5	20.0		
Haynesina depressula																							
Helenina andersoni																	16.7						
Lagena spp																							
Miliammina fusca	7.6	6.9	4.4	2.2	6.4	22.3	14.0	18.9	42.6	52.4	13.1	36.9	16.0	16.4	34.4	32.4			6.5				
Nonionella auricula																							
Oolina spp																							
Planktonics																							
Polysaccammina ipohalina	0.2	0.4	2.1			0.3													0.6				
Pseudothurammina limnetis	3.6	1.4	2.8			0.3													1.6				
Quinqueloculina compta																							
Q. funafutiensis																							
Q. polygona																							
Q. seminulum																							
Q. seminulum jugosa																							
Rosalina columbiensis																							
R. floridana																							
Siphotrochammina lobata	4.9	1.5	3.9	1.8	0.3	0.9							0.8						4.9				
Sulcophax palustris		0.2	0.8			0.3													0.2				
Textularia candeiana																							
Tiphotrocha comprimata	1.1	0.8	6.7	3.6	4.5	2.4	2.2	0.9	3.5	2.1			0.6	3.8	0.6				1.2				
Trilerina fluens																							
Trochammina inflata	2.3	4.1	2.8	4.3	5.5	2.4	2.9	2.7	0.7	1.1	2.4		1.1	3.6	0.6	0.9			8.1	18.2			
T. macrescens	4.4	3.8	8.5	3.2	2.6	1.8	2.2	3.6	1.4	1.6	4.8	0.6	0.6	5.5	1.3	2.8	16.7		3.1				
T. ochracea		0.1		0.7		0.6	1.5	2.7	4.3	13.2	39.3	28.7	23.6	34.5	10.0	21.3	16.7						
Wiesnerella auriculata																							
Centropyxis aculeata													1.7		0.6	1.9							
Difflugia oblonga	0.1										1.2												

Appendix Table 23. Percent abundance of foraminifera and arcellaceans and percentage of organic matter from Vibracore B9, North Inlet.

Appendix Table 23 (continued).

DEPTH IN CORE (cm)	265-267	275-277	285-287	296-300	310-312	325-327	340-342	355-357	365-367	368-370	385-387	400-402	415-417	430-432	440-442	447-449	459-461	468-470	480-482	505-507
PERCENT ORGANIC MATTER	8.20	8.78	3.42	2.67	6.09	7.43	9.00	6.78	7.06	2.59	8.81	10.86	11.74	5.90	9.53	10.48	8.84	9.00	2.03	2.28
NO. OF SPECIES	0	4	11	12	15	19	12	18	14	13	13	13	8	18	14	13	14	20	21	20
NO. OF INDIVIDUALS/10cc	0	1032	8480	15,712	13,184	5760	9536	10,336	18,840	18,048	10,176	9824	11,296	8800	4320	4896	4896	16,320	1484	624
Ammoastuta inepta																				
Ammobaculites dilatatus																				
Ammonia beccarii		1.2	1.1	0.6	1.2					0.7	0.3			0.4	2.6	3.9	5.6	2.0	1.3	1.6
Ammotium salsum																				
A. subdirectum																				
Arenoparrella mexicana																				
Bolivina lowmani			1.5	1.6	2.4	5.0	2.7	6.2	2.7	1.6	1.6	1.6	0.3	1.1	5.2	3.9	4.6	6.3	4.9	2.6
B. pseudoplicata			0.4		0.5	0.8		0.9	0.8					0.4					0.3	0.3
B. striatula						0.3									0.7					
Buliminella elegantissima					0.7	0.3			0.4	0.4		0.3		0.4	0.4	1.0	1.0	0.4	0.3	0.6
Cassidulina reniforme						0.8		0.8		0.4	0.6	0.3		0.4			0.3	0.8	0.3	
Cibicides lobatulus						0.3		0.3			0.3				0.4	0.3		1.2		0.3
Cyclogyra involvens					1.5	2.2	0.7	1.9			0.9	0.3		0.4	2.6	1.0	1.0	2.0		0.6
Discorbis spp															0.4					
Eggerella advena																				
Elphidium crispum																				
E. excavatum clavatum																				
E. excavatum excavatum				0.2				0.3	0.4											0.3
E. excavatum gunteri			0.4				0.3	0.6	0.6		0.3							0.4		
E. excavatum lidoensis		29.6	37.5	34.6	54.1	22.2	34.9	31.6	32.3	25.5	19.6	37.5	24.1	30.5	35.9	49.7	36.2	52.9	39.6	65.4
E. excavatum selseyensis		66.2	56.2	54.8	25.7	41.9	50.7	35.9	49.6	64.9	63.6	52.4	72.0	52.4	25.2	23.9	29.7	14.5	20.5	9.9
E. galvestonense										0.4									1.6	0.6
E. poeyanum		0.6	1.1	2.6	1.2	2.2	0.3	3.7	0.4	1.6	1.3	1.0	0.3	0.4	0.7	1.0	2.3	1.2	5.7	1.9
Epistominella takayanagii																				
Eponides repandus														0.4				0.4	1.3	1.6
Gavelinopsis translucens			0.4	1.0	1.7	2.5	1.0	1.9	1.5	0.7	1.9	1.6	1.4	1.5	5.9	3.9	2.3	1.2	3.0	6.1
Hanzawaia strattoni				0.2		0.3						0.3		0.4					1.1	0.3
Haplophragmoides manilaensis																				
H. wilberti																				
Haynesina depressula			0.4	1.0	1.2	2.5	1.3	0.9	0.4	0.7	0.6	1.0	0.6	2.2	2.2	2.3	2.9	2.0	1.3	0.3
Helenina andersoni																				
Lagena spp																				
Miliammina fusca																				
Nonionella auricula			0.4		0.2															
Oolina spp.					0.2	0.6		0.9				0.3		0.4				0.4		
Planktonics																0.3	0.3		1.1	
Polysaccammina ipohalina																				
Pseudothurammina limnetis																				
Quinqueloculina compta																				0.3
Q. funafutiensis																			0.3	
Q. polygona				0.4	0.2	2.2	0.3	0.3	1.9	0.4				1.5				0.6	1.1	0.3
Q. seminulum				2.2	3.4	5.6	3.4	4.3	2.7	2.1	2.2	1.0	0.3	4.7	6.3	5.6	3.9	5.9	7.0	2.6
Q. seminulum jugosa						1.4	0.7	0.6						1.1				1.2	4.9	1.0
Rosalina columbiensis																		0.6		
R. floridana			0.4	0.6	5.6	6.9	3.7	6.7	5.6	0.4	6.3	2.3	0.6	1.8	11.5	3.3	7.5	5.5	3.5	3.2
Siphotrochammina lobata																				
Sulcophax palustris																				
Textularia candeiana									0.4										0.8	
Tiphotrocha comprimata																				
Trifarina fluens																	0.3	0.4	0.3	
Trochammina inflata																				
T. macrescens																				
T. ochracea																				
Wiesnerella auriculata						0.3		0.3												
Centropyxis aculeata																				
Difflugia oblonga																				

DEPTH IN CORE (cm)	0-1		1-2		2-3		3-4		4-5		5-6		6-7		7-8		8-9		9-10		10-11		11-12		12-13		13-14		14-15	
PERCENT ORGANIC MATTER	19.75		17.96		14.09		15.66		19.86		17.04		22.25		19.40		22.01		23.50		21.94		19.99		22.47		24.30		21.03	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	9	14	8	12	5	11	3	9	4	13	4	13	2	9	4	10	3	12	1	8	3	12	3	8	0	8	0	9	0	10
NO. OF INDIVIDUALS/10cc	182	394	88	815	32	701	17	329	27	300	35	197	5	278	13	356	3	582	4	470	7	313	4	310	0	319	0	282	0	288
Ammobaculites dilatatus		1.0		0.9	9.4	1.3		0.3		0.7		3.6						0.2												
A. exiguus	0.7	0.5		0.5		1.1				0.3				0.4	7.7	0.3		0.9			14.3	0.6						0.4		
Ammonia beccarii		0.3																												
Ammotium multiloculatum	3.9	4.6	2.3	1.1		0.6				0.3		1.5				0.3		0.4				0.6								
A. salsum	7.9	8.6	4.5	5.2	3.1	2.4	11.8	4.9	11.1	9.3		4.6		2.2		2.2		2.5		0.6		12.5		1.0		1.6		2.1		1.1
A. subdirectum																						0.6								0.4
Arenoparrella mexicana		0.3										0.5														0.6				
Eggerella advena				0.2						0.3		1.0						0.2												0.4
Gaudryina exilis	1.3	1.3	1.1	0.4		0.4		0.3		3.0		1.5	20.0	0.7		0.8	33.3	2.0		0.4		3.5		1.0		0.9		0.4		1.1
Miliammina fusca	78.9	50.3	67.0	13.6	82.5	5.0	82.4	5.5	77.8	16.3	77.1	23.4	80.0	2.5	76.9	4.2		0.4	100	0.8	71.4	6.4	50.0	0.6				0.4		0.4
Organic linings		11.9								0.7		1.0										0.8								
Polysaccammina hyperhalina	0.7	2.5	3.4	3.4	6.3	3.0		1.5	7.4	8.7	5.7	3.6		2.5		2.2	33.3	7.3		5.5		9.9		1.9		1.6		2.1		1.1
Siphotrochammina lobata	1.3	4.1	1.1	5.6		4.6		5.5		8.7		6.1		5.4		7.3		8.5		7.9		10.9		5.2		6.0		4.3		5.2
Sulcophax palustris																														
Trochammina inflata	2.0	7.6	14.8	36.1	18.8	46.2	5.9	45.6	3.7	22.3	11.4	20.8		59.0	7.7	47.2		37.2		35.5		20.4		42.8		41.7		33.7		32.5
T. macrescens	3.3	6.9	5.7	26.3		29.7		31.9		23.3	5.7	26.4		23.4	7.7	28.9	33.3	25.4		33.8	14.3	24.9	25.0	37.7		38.9		48.1		40.7
T. ochracea		0.3		6.9		5.7		4.6		6.0		4.1		4.0		6.5		15.1		15.3		8.9	25.0	10.0		8.8		10.6		16.8

DEPTH IN CORE (cm)	15-16		16-17		17-18		18-19		19-20		20-21		21-22		22-23		23-24		24-25		25-26		26-27		27-28		28-29		29-30	
PERCENT ORGANIC MATTER	27.68		23.96		19.84		23.84		18.24		22.35		26.01		24.22		21.06		22.35		23.36		20.91		16.53		18.64		16.96	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	1	11	0	7	0	10	0	7	0	10	0	10	0	9	0	10	0	8	0	11	0	12	0	11	0	11	0	11	0	10
NO. OF INDIVIDUALS/10cc	1	204	0	230	0	235	0	175	0	265	0	195	0	180	0	173	0	254	0	183	0	230	0	362	0	179	0	271	0	250
Ammobaculites dilatatus		0.5																0.4		0.5		0.9		2.5		16.2		3.0		2.4
A. exiguus		1.0				0.4				0.4				0.5		0.6				0.5						1.1		0.7		1.2
Ammonia beccarii																														
Ammotium multiloculatum																														
A. salsum		5.9		1.7		4.3		1.1		1.9		4.6		3.[illegible]		1.2		1.6		13.7		8.3		5.8		7.6		9.2		4.8
A. subdirectum	100	1.0										0.5										0.4								
Arenoparrella mexicana								0.6								1.2				1.1				0.8				1.5		
Eggerella advena						0.4				0.8		1.5										0.4		0.6		1.1				
Gaudryina exilis		1.0		1.3		1.7		1.1		0.8		2.6		1.6		0.6		0.4		6.0		2.6		10.5		18.4		10.7		1.2
Miliammina fusca		6.8				0.9				0.8		2.1		1.1		0.6				1.1		1.3		3.9		12.3		2.8		2.0
Organic linings																														
Polysaccammina hyperhalina		2.9		0.9		2.1				1.9		2.6		2.8		1.2		1.2		3.8		2.2		5.8		15.6		7.4		2.8
Siphotrochammina lobata		12.3		3.5		8.9		6.9		1.9		12.3		8.4		6.9		2.0		10.8		13.9		14.1		4.5		11.1		13.6
Sulcophax palustris																						0.4								
Trochammina inflata		22.5		56.1		31.5		39.4		54.0		29.2		40.5		47.4		60.6		21.9		28.3		20.4		8.9		19.2		22.0
T. macrescens		30.4		26.3		32.8		43.4		31.3		36.4		34.7		30.1		23.2		29.5		31.7		20.4		7.8		21.8		34.8
T. ochracea		15.7		8.3		17.0		7.4		6.4		8.2		7.4		10.4		10.6		10.9		9.6		15.2		6.1		12.9		15.2

Appendix Table 24. Percent abundance of living (stained, L) and total (T) foraminifera and percentage of organic matter from Core 1 (Trans. 6), North Inlet.

DEPTH IN CORE (cm)	0-1		1-2		2-3		3-4		4-5		5-6		6-7		7-8		8-9		9-10		10-11		11-12		12-13		13-14		14-15	
PERCENT ORGANIC MATTER	7.41		5.61		8.85		9.86		10.29		10.50		8.45		7.10		7.08		6.78		5.88		4.33		3.97		4.18		4.45	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO OF SPECIES	5	9	5	7	5	10	4	7	4	7	2	6	1	6	4	9	1	6	3	5	0	7	4	5	1	5	0	4	0	5
NO OF INDIVIDUALS/10cc	832	1256	77	388	81	593	17	158	18	113	4	70	2	104	29	340	1	68	9	114	0	57	10	82	1	61	0	23	0	25
Ammobaculites dilatatus	0.6	1.6				0.2						4.3		1.0		0.3	100	1.5				3.5								
A. exiguus						0.7						1.4														1.6				
Ammotium multiloculatum		0.3		0.8												0.3														
A. salsum	7.6	27.4	19.5	48.4	17.3	27.1	11.8	34.8	38.9	42.5	50.0	28.6		36.5	17.2	44.7		5.9	33.3	43.9		52.3	10.0	47.6	100	47.5		21.7		20.0
Arenoparella mexicana																		7.4												
Eggerella advena	0.6	0.6				0.7		0.6		1.8						0.6														
Gaudryina exilis						0.2																								
Haplophragmoides wilberti																														
Miliammina fusca	84.2	54.8	51.9	28.5	61.7	55.2	58.8	29.1	38.9	20.4	50.0	11.4	100	26.8	55.2	35.6		7.4	55.6	46.5		21.1	70.0	32.9		14.8		60.9		52.0
Polysaccammina hyperhalina		1.0	1.3	1.9	7.4	4.1		1.9		1.8				2.9		2.6			11.1	2.6				1.2						4.0
Siphotrochammina lobata		0.6		0.8		0.3		1.9		0.9						0.3						1.8								
Tiphotrocha comprimata																														
Trochammina inflata	7.0	8.3	16.9	12.8	11.1	8.0	17.6	19.6	16.7	12.4		14.3		13.5	24.1	8.2		41.2		5.3		10.5	10.0	8.5		18.0		13.0		8.0
T. macrescens		5.4	10.4	8.7	2.5	3.5	11.8	12.0	5.6	20.4		40.0		17.3	3.4	7.4		36.8		1.8		8.8	10.0	9.8		18.0		4.3		16.0
T. ochracea																						1.8								
Centropyxis aculeata																														
Difflugia oblonga																														

DEPTH IN CORE (cm)	15-16		16-17		17-18		18-19		19-20		20-21		21-22		22-23		23-24		24-25		25-26		26-27		27-28		28-29		29-30	
PERCENT ORGANIC MATTER	3.51		3.12		3.52		4.11		3.48		3.27		3.77		3.92		3.56		3.00		2.91		3.30		3.20		2.89		2.80	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO OF SPECIES	0	5	2	6	0	6	0	7	0	5	0	5	0	6	0	8	0	5	0	5	0	6	0	7	0	7	0	6	0	8
NO OF INDIVIDUALS/10cc	0	82	5	93	0	20	0	20	0	70	0	27	0	22	0	88	0	95	0	13	0	27	0	43	0	39	0	26	0	49
Ammobaculites dilatatus																														
A. exiguus																1.1														
Ammotium multiloculatum																														
A. salsum		3.7		6.5		5.0		15.0		2.9		7.4		9.1		8.0		12.6		7.7		3.7		8.3		15.4		23.1		2.0
Arenoparella mexicana						10.0		5.0		2.9		14.8		27.3		2.3		4.2		7.7		3.7		10.4		5.1		3.8		8.2
Eggerella advena																														
Gaudryina exilis																														
Haplophragmoides wilberti						5.0														15.4		29.6		35.4		20.5		11.5		8.2
Miliammina fusca		1.2	20.0	2.2		45.0		5.0		5.7		3.7		8.1		12.5		11.6		46.2		33.3		12.5		15.4		30.8		
Polysaccammina hyperhalina																														
Siphotrochammina lobata		1.2						5.0						4.5		1.1								2.1						2.0
Tiphotrocha comprimata																										2.6				4.1
Trochammina inflata		19.5		31.2		15.0		50.0		48.8		58.3		40.9		43.2		45.3		23.1		22.2		16.7		35.9		23.1		51.0
T. macrescens		74.4	80.0	54.8		20.0		15.0		40.0		14.8		9.1		30.7		26.3				7.4		14.6		5.1		7.7		22.4
T. ochracea																1.1														2.0
Centropyxis aculeata				1.1																										
Difflugia oblonga				4.3				5.0																						

Appendix Table 25. Percent abundance of living (stained, L) and total (T) foraminifera and arcellaceans and percentage of organic matter from Core 2 (Trans. 6), North Inlet.

DEPTH IN CORE (cm)	0-1		1-2		2-3		3-4		4-5		5-6		6-7		7-8		8-9		9-10		10-11		11-12		12-13		13-14		14-15	
PERCENT ORGANIC MATTER	2.92		1.66		2.32		3.13		2.19		2.84		2.81		2.79		2.82		2.67		2.56		2.46		2.42		2.52		2.33	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	6	8	6	7	5	7	5	8	8	9	4	8	5	8	7	9	5	8	4	7	5	7	4	8	4	7	4	8	5	12
NO. OF INDIVIDUALS/10cc	20	307	54	448	28	284	50	568	61	657	52	500	80	1040	152	1088	92	1048	48	988	108	988	76	992	32	556	148	1024	55	1232
Ammobaculites dilatatus								0.7																						
Ammotium salsum	5.0	0.3								0.8				0.4		0.4												1.6		0.2
Arenoparella mexicana	10.0	6.8	1.9	3.6	10.7	2.1	4.0	2.8	8.2	5.3	3.8	0.8	20.0	4.6	13.2	4.9	4.3	3.1		3.7	18.5	5.7	31.6	8.1	37.5	5.0	13.5	6.3	10.9	6.6
Gaudryina exilis									1.6	0.2				0.4				0.4						0.4						0.1
Haplophragmoides manilaensis																														
H. wilberti		2.6	1.9	2.2		1.4		1.4	1.6	0.8			5.0	0.4	2.6	1.1		0.8				0.8			8.3	1.4		1.2		0.6
Miliammina fusca	5.0	3.3	3.7	4.7	3.6	2.8	2.0	3.7	14.8	5.6	7.7	8.8	25.0	7.7	28.9	7.9	8.7	5.7	16.7	6.6	40.7	7.3	10.5	4.8	25.0	9.4	28.7	10.2	25.5	8.8
Polysaccammina hyperhalina																														0.1
P. ipohalina																0.4														0.1
Pseudothurammina limnetis																				0.4										0.2
Reophax nana																								0.4						
Siphotrochammina lobata		3.6		2.7		4.6		2.1	3.3	3.0		3.8	5.0	5.0	5.3	2.6		3.1		0.8		0.8		4.4		2.9		3.5		0.6
Tiphotrocha comprimata	10.0	6.2	9.3	4.7	3.6	3.9	10.0	4.6	9.8	3.2		3.8		4.2	5.3	4.5	8.7	4.6	8.3	3.3	7.4	3.6		2.8		4.3		2.0	9.1	3.7
Trochammina inflata	65.0	58.6	61.1	58.7	64.3	58.1	74.0	64.6	58.0	60.1	80.8	64.8	45.0	51.9	34.2	51.3	65.2	50.0	58.3	58.3	22.2	53.0	47.4	59.3	31.3	52.5	51.4	52.3	45.5	49.4
T. macrescens	5.0	18.6	22.2	23.4	17.9	27.1	10.0	20.1	1.6	21.0	7.7	18.4		25.4	10.5	27.0	13.0	32.4	16.7	26.9	11.1	28.7	10.5	19.8		24.5	5.4	23.0	9.1	29.6

DEPTH IN CORE (cm)	15-16		16-17		17-18		18-19		19-20		20-21		21-22		22-23		23-24		24-25		25-26		26-27		27-28		28-29	
PERCENT ORGANIC MATTER	2.08		2.16		2.09		2.20		2.11		2.05		2.15		2.27		2.11		1.97		2.32		2.04		2.04		1.99	
(live/total)	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T
NO. OF SPECIES	4	7	4	8	3	8	0	7	1	8	2	7	0	7	0	8	0	8	0	9	0	7	0	8	0	8	0	9
NO. OF INDIVIDUALS/10cc	60	1068	40	960	20	960	0	1232	4	1104	16	1240	0	936	0	936	0	958	0	966	0	924	0	1044	0	1216	0	1068
Ammobaculites dilatatus																												
Ammotium salsum				0.8		0.4				0.7								0.4										
Arenoparella mexicana	13.3	2.6	20.0	3.3	20.0	5.0		4.5	100	2.9		3.5		3.4		2.1		4.6		2.1		2.6		3.1		2.6		2.3
Gaudryina exilis																0.4				0.8						0.3		0.1
Haplophragmoides manilaensis						0.4														0.4								0.4
H. wilberti		1.5		2.9				0.6		4.0		1.9		1.7		2.1		3.8		5.0		2.2		4.2		5.3		4.0
Miliammina fusca	6.7	6.0	20.0	6.3	20.0	6.7		6.2		5.8	50.0	6.7		3.8		7.7		3.8		9.8		4.3		9.2		6.3		8.9
Polysaccammina hyperhalina																												
P. ipohalina																												
Pseudothurammina limnetis																								0.4				
Reophax nana																												
Siphotrochammina lobata		1.9		2.1		3.3		1.6		3.6		2.9		3.4		2.6		3.8		2.1		3.5		2.3		2.6		2.1
Tiphotrocha comprimata		2.2	20.0	2.1		1.3		1.3		1.1	50.0	1.3		2.1		0.9		0.4		1.2		1.3		0.8		1.0		1.4
Trochammina inflata	73.3	56.8	40.0	55.8	60.0	58.8		54.5		54.7		57.4		62.8		63.7		56.1		53.7		61.0		61.3		58.6		43.6
T. macrescens	6.7	29.2		26.7		24.2		31.2		27.2		24.2		22.8		20.5		27.2		24.8		25.1		18.8		23.4		37.1

Appendix Table 26. Percent abundance of living (stained, L) and total (T) foraminifera and percentage of organic matter from Core 3 (Trans. 6), North Inlet.

DEPTH IN CORE (cm)	18-20	38-40	58-60	78-80	98-100	118-120	138-140	158-160	178-180	198-200	218-220	238-240	253-255	268-270	288-290	298-300	318-320	336-338	343-345	355-357	370-372	380-382	403-405	409-411	450-452	460-462
PERCENT ORGANIC MATTER	0.32	0.43	0.45	0.38	0.38	0.40	0.36	1.66	0.48	0.60	0.60	0.57	N/A	0.62	N/A	0.57	1.09	N/A	N/A	6.49	N/A	N/A	N/A	N/A	N/A	N/A
NO. OF SPECIES	1	1	5	4	5	16	13	9	12	16	18	10	15	6	14	3	19	12	25	28	17	15	0	0	1	0
NO. OF INDIVIDUALS/10cc	2	1	7	8	14	311	274	43	118	223	,58	89	98	14	466	12	620	522	1270	14,592	280	540	0	0	1	0
Ammoastuta inepta													2.1						0.2							
Ammonia beccarii			14.3	25.0	35.7	23.5	15.3	8.3	9.5	17.5	18.4	12.4	22.9	7.1	2.1		15.6	4.9	11.8	6.6	10.0	13.5				
Ammotium salsum													1.0													
Arenoparella mexicana											0.6		1.0		0.2		0.6		0.2	0.2						
Bolivina lowmani															0.2		0.3	3.1	10.7	6.8	2.1	0.6				
B. pseudoplicata										0.4								0.3	1.3	0.7						
Buliminella elegantissima																	0.2	0.3	4.7	0.4	1.4					
Cassidulina reniforme													1.0						0.5	1.8	0.4					
Cibicides lobatulus						1.0	1.5			0.9	0.6	3.4					0.3			1.3	0.4	0.6				
Cyclogyra involvens																				0.2						
Discorbis spp.																			1.7		1.1					
Elphidium excavatum clavatum																						2.8				
E. excavatum excavatum						3.9	0.7	2.3	1.7	1.3	0.6		7.3	7.1	0.4		0.5			0.9	1.4	3.7				
E. excavatum gunteri						1.3	1.8		2.6	0.4	0.6	1.1	1.0				0.5			0.9	2.5	0.6				
E. excavatum lidoensis			14.3	50.0	7.1	24.8	24.8	32.6	26.7	17.0	22.8	15.7	25.0	7.1	1.3	8.3	26.6		36.2	24.8	36.8	32.0				
E. excavatum selseyensis	100			12.5	14.3	21.9	25.2	25.6	30.2	32.3	25.9	42.7	6.3	21.4	0.2	66.7	25.5			3.7	24.3	7.6				
E. galvestonense			42.9	12.5	7.1	1.6	1.1	2.3	0.9	1.3		1.1														
E. poeyanum					35.7	15.8	23.4	18.6	21.6	21.5	19.6	19.1	14.6	50.0	1.7	25.0	17.1		6.5	7.7	8.6	8.3				
Elphidium spp.								2.3			0.6							18.7		2.9						
Epistominella takayanii																				0.7						
Eoeponidella pulchella																			0.2							
Eponides repandus										0.4																
Fissurina spp.																			0.2							
Gavelinopsis translucens						1.0				0.4	0.6						1.3	0.3		16.0						
Glabratella spp.																			0.2							
Guttulina lactea																			0.2		0.4					
Haplophragmoides wilberti															0.6				0.2							
Hanzawaia strattoni						1.0	1.1		0.9	1.6	0.6	1.1		7.1			0.5			0.4						
Haynesina depressulum			14.3								0.6	1.1					3.1			4.6		0.2				
Lagena spp.																			0.3							
Miliammina fusca											0.6															
Nonionella auricula																			0.2							
Patellina corrugata																			0.3							
Planktonics		100						2.3	0.9								0.3	1.2		0.7	1.1					
Quinqueloculina funafutiensis																				0.2						
Q. polygona						0.3	1.5		3.4	0.4	1.9						1.0			0.9						
Q. seminulum			14.3			2.9	2.2	4.7	0.9	3.1	2.5	2.2	4.2				3.7		11.7	4.2	3.2	0.6				
Q. seminulum jugosa						0.3	0.7		0.9	0.4	0.6						1.5			2.2						
Q. spp.																		2.1								
Reophax nana																			0.2							
Rosalina floridana						0.3	0.7						1.0		0.2		1.3	9.5		8.6		0.6				
R. spp.																			8.8		3.8					
Spiroloculina atlantica																			0.2							
Textularia candeiana																						0.4				
Tiphotrocha comprimata													1.0		1.9											
Trifarina fluens						0.3				0.4			1.0		0.4				0.2		0.4	0.4				
Trochammina inflata											0.6				0.6											
T. macrescens															0.9			1.2	0.3	0.2						
T. ochracea											1.9		10.4		89.1		0.2	57.4	3.5	2.4	1.1	28.3				
Uvigerina auberiana						0.3																				
Centropyxis aculeata																		0.9							100	

Appendix Table 27. Percent abundance of foraminifera and arcellaceans and percentage of organic matter from Vibracore 1, Santee Delta.

DEPTH IN CORE (cm)	10-12	18-20	28-30	31-33	45-47	70-72	88-90	108-110	128-130	143-144	160-162	180-182	200-202	218-220	240-242	260-262	280-282	300-302	320-322	340-342	360-362	380-382	393-394	400-402
PERCENT ORGANIC MATTER	N/A	N/A	N/A	N/A	0.40	14.49	18.55	13.69	12.77	20.41	6.39	1.29	N/A	1.35	1.07	0.91	0.68	N/A	3.93	1.80	2.40	N/A	N/A	4.06
NO. OF SPECIES	0	13	11	8	0	0	0	7	6	3	21	16	19	12	23	16	11	18	18	16	16	24	15	21
NO. OF INDIVIDUALS/10cc	0	361	565	145	0	0	0	111	26	6	1588	190	658	60	232	81	123	1148	4736	1476	2368	1414	339	10,560
Ammoastuta inepta												0.5			0.4									
Ammobaculites dilatatus		0.4																						
Ammonia beccarii		0.7									9.6	15.3	10.9	15.0	15.1	14.8	22.0	16.7	20.3	17.5	11.8	13.9	19.8	7.9
Ammotium salsum		0.7	0.4																					
Arenoparella mexicana		13.3	25.8	31.7				6.3	3.8		0.3		0.3		0.4	1.2		0.3	0.3			0.8	1.3	
Bolivina lowmani											10.1	0.5	3.0		3.4	3.7			2.4	0.3		0.3	0.4	3.9
B. pseudoplicata											0.8		0.3		0.9				0.3		0.3	0.3		1.5
B. striatula														3.3										
Buliminella elegantissima									3.8		0.5							0.7	0.3			0.3		0.3
Cassidulina reniforme											1.8		0.9		0.4			0.3	0.3	0.3		0.1	0.4	1.5
Cibicides lobatulus											2.0	2.1	2.7		0.4		7.3	1.4	1.4	1.1	0.3	1.0	0.4	2.1
Cyclogyra involvens																							0.4	
Discorbis spp											0.3													
Elphidium excavatum excavatum		0.4						1.8			0.5		0.3		0.9		0.8				0.7			0.3
E. excavatum gunteri											0.3						1.6	0.3						
E. excavatum lidoensis											18.9	26.3	30.1	16.7	19.0	18.5	15.4	22.6	30.1	31.2	25.3	33.7	20.7	17.3
E. excavatum selseyensis											6.5	28.4	18.8	30.0	9.9	9.9	30.9	31.7	17.9	23.8	31.8	23.9	24.1	13.9
E. galvestonense											0.3			3.3		1.2	0.8							
E. poeyanum											15.4	13.7	10.3	18.3	18.5	18.5	17.1	17.1	8.8	19.8	18.6	16.0	21.1	12.7
Elphidium spp											4.8	2.1	5.2		5.2	4.9		1.4	3.4		2.4	1.1	0.4	4.2
Epistominella takayanii											0.5													
Gaudryina exilis			0.7	2.1				0.9																
Gavelinopsis translucens											3.0	0.5	5.2	3.3	5.6	7.4			4.7	0.3	0.3	1.6		20.9
Guttulina lactea																				0.3				
Hanzawaia strattoni												2.6	2.7		0.4	2.5		2.8		1.1	1.0	0.4	0.4	
Haplophragmoides manilaensis		8.9	2.5	0.7																				
H. wilberti		3.7	2.3	3.4					7.7	16.7					0.4			0.3	0.3				0.4	
Haynesina depressulum								0.9			11.8	1.6	1.8	1.7	2.6	6.2		0.3	2.7	0.5	3.4	2.1	6.8	3.6
Lagena spp.																						0.1		
Miliammina fusca		11.4	0.5																					
Oolina spp.																			0.7			0.1		0.3
Planktonics											0.5	1.1	0.3	1.7	0.9		1.6	0.3	0.7	0.3	0.3	0.6		1.8
Polysaccammina ipohalina			8.8	15.9																				
Quinqueloculina funafutiensis															0.4									0.3
Q. polygona															0.4							0.3		
Q. seminulum		0.4										0.5		1.7	0.9	2.5		0.3		1.9	1.7	0.4		0.3
Q. seminulum jugosa													0.3							0.3	0.7	0.6		0.3
Rosalina floridana											4.8	1.6	3.0		7.8	2.5		2.1	3.0	0.8	0.7	1.6	0.4	6.1
Siphotrochammina lobata		14.0		5.5																				
Tiphotrocha comprimata			4.4					1.8																
Trifarina fluens												0.5	0.3	3.3			1.6	0.7		0.5		0.6		
Trochammina inflata		33.6	43.4	34.5				2.7	11.5	16.7						1.2					0.7	0.1		
T. macrescens		11.1	11.0	6.2					3.8							1.2						0.1		
T. ochracea		1.5	0.2					85.6	69.2	66.7	7.6	1.6	3.3	1.7	5.6	3.7	0.8	0.3	2.4				3.0	0.3
Wiesnerella auriculata															0.4									0.3
Centropyxis aculeata																								

Appendix Table 28. Percent abundance of foraminifera and arcellaceans and percentage of organic matter from Vibracore 3, Santee Delta.

Appendix Table 28 (continued).

Depth in core (cm)	420-422	440-442	458-460	470-472	480-482	490-492	493-495	495-497	502-504	505-506	510-512	520-521	526-528	530-531	534-536	538-540	542-544	546-547	548-549	550-551	558-560	568-570
PERCENT ORGANIC MATTER	4.03	7.04	6.19	5.42	3.29	15.77	14.74	22.89	15.86	7.41	1.69	4.24	4.03	6.97	6.05	7.11	7.19	2.75	N/A	18.32	0.74	0.42
NO. OF SPECIES	19	24	24	29	23	5	2	6	0	2	1	1	3	3	2	0	0	1	1	2	0	0
NO. OF INDIVIDUALS/10cc	9024	12,992	13,536	17,984	27,264	8	2	130	0	4	1	1	3	5	4	0	0	1	2	4	0	0
Ammoastuta inepta								1.5														
Ammobaculites dilatatus																						
Ammonia beccarii	14.9	11.1	14.4	15.1	9.2	12.5																
Ammotium salsum																						
Arenoparella mexicana		0.7	0.9		0.2		50.0			25.0	100	100	33.3	60.0	75.0			100	100	25.0		
Bolivina lowmani	5.3	5.2	4.5	4.3	2.1																	
B. pseudoplicata	0.4	0.5		0.4	0.9																	
B. striatula					0.2																	
Buliminella elegantissima	2.8	4.7	1.9	2.3	0.5																	
Cassidulina reniforme	1.1	1.0	0.7	1.8	0.5																	
Cibicides lobatulus		1.2	1.9	1.8	1.6																	
Cyclogyra involvens		1.0		0.4																		
Discorbis spp.				0.2																		
Elphidium excavatum excavatum			0.7	0.7	1.6		50.0															
E. excavatum gunteri	0.4		0.2	0.4	0.2																	
E. excavatum lidoensis	17.0	16.5	24.1	19.9	28.4	12.5																
E. excavatum selseyensis	17.0	12.6	15.1	11.4	14.3																	
E. galvestonense				0.2																		
E. poeyanum	8.7	6.2	9.9	3.6	9.2	37.5																
Elphidium spp.	3.2	3.4	3.1	5.2	3.3																	
Epistominella takayanii	0.7	0.2	0.2	0.4	0.2																	
Gaudryina exilis																						
Gavelinopsis translucens	13.5	16.0	10.9	15.3	16.2																	
Guttulina lactea																						
Hanzawaia strattoni		0.7	0.9	0.4																		
Haplophragmoides manilaensis																						
H. wilberti		0.2	0.2	0.2									33.3	20.0	25.0					75.0		
Haynesina depressulum	7.4	5.2	2.6	4.3	4.9	25.0																
Lagena spp.																						
Miliammina fusca																						
Oolina spp.				0.4																		
Planktonics	0.4	2.0	0.5	0.7	0.9			1.5														
Polysaccammina ipohalina																						
Quinqueloculina funafutiensis		0.5	0.7	0.2																		
Q. polygona	0.4	0.2		0.4																		
Q. seminulum	1.4	3.0	2.1	3.6	2.1																	
Q. seminulum jugosa		0.2	0.5	0.2	0.5																	
Rosalina floridana	3.2	7.1	2.8	5.5	2.3																	
Siphotrochammina lobata																						
Tiphotrocha comprimata								3.1														
Trifarina fluens	0.4		0.7		0.2																	
Trochammina inflata													33.3									
T. macrescens						12.5		1.5						20.0								
T. ochracea	1.8	0.5	0.2	0.9	0.2			89.2		75.0												
Wiesnerella auriculata				0.4																		
Centropyxis aculeata								3.1														

Appendix Table 29. Percent abundance of foraminifera and arcellaceans and percentage of organic matter from Vibracore 7, Santee Delta.

Appendix Table 29.

DEPTH IN CORE (cm)	0-2	10-12	20-22	30-32	40-42	50-52	60-62	70-72	80-82	90-92	100-102	110-112	120-122	130-132	138-140	148-150	158-160	170-172	180-182	192-194	200-202	220-222	252-254	268-270	281-283	288-290	302-304	310-312	315-317	320-322	330-332	335-337	342-344
PERCENT ORGANIC MATTER	16.63	15.45	13.09	17.06	11.80	1.00	17.73	11.33	7.42	7.02	6.77	8.99	7.33	5.93	6.54	5.23	25.69	1.31	29.24	5.56	11.12	11.42	3.95	N/A	10.88	8.53	2.46	2.73	6.88	2.98	6.95	N/A	N/A
NO. OF SPECIES	12	13	13	11	9	0	7	20	5	26	25	24	22	19	22	23	21	24	6	22	6	14	19	4	23	16	16	20	21	22	18	16	0
NO. OF INDIVIDUALS/10cc	109	130	218	255	564	0	102	906	28	6763	7219	8288	4496	8160	5645	2336	1344	543	22	6112	20	276	1288	212	31,488	18,368	9152	14,234	6464	9312	9440	1318	0
Ammoastuta inepta	2.8	8.5	2.3	6.3	2.1		2.9		3.6							1.4		0.2			5.0												
Ammonia beccarii								20.5		4.7	5.3	4.6	5.3	4.7	6.9	4.6	5.7	9.0		12.6		12.7	10.2		8.7	9.1	15.4	7.9	8.6	14.1	12.5	9.6	
Ammotium salsum	4.6	0.8	0.5																														
Arenoparrella mexicana	1.8	11.5	8.7	16.1	3.9		7.8	0.7	14.3	0.3	0.7		0.4		1.1	1.0	0.3	2.0	40.9	0.8	50.0	2.9	0.3	1.9	0.5	0.7	0.3			0.3		1.7	
Bolivina lowmani								0.7		8.2	5.7	6.2	4.6	6.3	4.4	4.1	4.5	3.3		2.1			5.3		4.1	2.4	3.1	2.5	6.6	2.7	2.7	0.2	
B. pseudoplicata										0.9	0.4	1.5	0.4		0.7		0.9			0.3					1.4			0.4	1.3				
B. striatula																									0.3								
Bulimina aculeata										0.3																						0.2	
Buliminella elegantissima										1.9	1.4	0.8	0.7		0.7					0.3			0.6		2.2	2.8	0.3	2.5	3.0	0.7	1.0		
Cassidulina laevigata																	0.6																
C. reniforme										0.6	0.7	2.3	0.4	0.8	1.8	0.7	0.3	0.9		0.3			0.6		1.6		1.0	1.4	1.3	1.0	1.0		
Cibicides lobatulus										0.6	1.8	0.4	0.4	3.9	0.7	1.0				1.8			0.9		0.3		2.1	4.3	1.7	2.1	0.7	0.3	
Cyclogyra involvens												0.4			0.4					0.3													
Discorbis spp								0.4																									
Elphidium excavatum clavatum								3.2		1.6	1.1	0.4		0.4									0.3							0.3			
E. excavatum excavatum								9.2		0.3	1.8	1.2	1.4	1.2	0.4	1.0		1.8		0.5		1.1	0.6		0.3	1.0	0.3			0.7		3.2	
E. excavatum gunteri								1.1		0.3	0.7	0.4	1.8		0.4		0.3	0.2		0.3			0.6		0.3				0.7			0.3	
E. excavatum lidoensis								24.0		27.1	23.4	14.3	39.1	16.0	28.8	13.7	35.7	28.9		31.7		32.2	28.3		24.1	32.1	34.3	25.5	22.8	26.8	27.1	27.2	
E. excavatum selseyensis								17.7		4.4	6.4	11.2	2.8	6.3	3.6	1.4	8.0	4.1		12.8		16.7	14.9		12.7	7.7	10.1	9.4	6.3	29.9	14.9	6.8	
E. galvestonense											0.4	0.8				1.0		0.2															
E. poeyanum								10.2		11.0	11.3	8.5	12.1	15.3	16.8	24.7	7.4	24.1		8.4		10.5	5.6		9.8	17.1	10.1	6.8	6.3	8.2	9.5	21.7	
E. subarcticum								0.4																									
Elphidium spp								1.8		5.7	2.1	8.1		2.4	1.5	2.7	4.8	6.8		3.9			1.9		2.4	3.1	3.5	7.6	4.6	1.4	4.4		
Epistominella takayanagii																												0.4					
Gaudryina exilis	1.8	2.3	1.4	0.4	0.7									0.4																			
Gavelinopsis translucens								0.4		20.8	16.0	17.0	13.2	22.0	10.6	8.2	11.9	0.4		7.3			17.1		19.2	14.6	11.2	21.2	20.1	6.5	14.2		
Globobulimina auriculata																0.3																	
Guttulina lactea										0.3																							
Hanzawaia strattoni															1.1		0.6											0.4		0.7	0.7		
Haplophragmoides manilaensis	1.8																			0.3													
H. wilberti	7.3	10.8	3.7	2.7	1.4								0.4	0.4		0.3	0.3	1.1	9.1			1.4							0.3				
Haynesina depressulum								6.7		2.2	5.3	4.2	5.7	4.7	1.6	4.5	5.7	8.1		9.9		5.1	2.8		3.0	3.8	2.1	2.5	4.3	1.7	1.7		
Helenia andersoni										0.3								0.6															
Lagena spp.																0.3																	
Miliammina fusca	19.3	1.5	0.9	1.2				0.4														1.1											
Nonionella auricula																	0.3			0.3													
Oolina spp.												0.4				0.3		0.2											0.7	0.3	0.3		
Planktonics										0.6	0.4		0.4		1.1	1.4		0.2	4.5	0.5					1.1				1.0	1.0		0.3	
Polysaccammina hyperhalina			0.5																														
Quinqueloculina funafutiensis										0.3	0.4	0.4					0.3														0.3		
Q. polygona											0.4	0.8			0.4											0.3				0.7	0.3		
Q. seminulum										0.3	1.8	3.1	1.4	2.4	1.8		0.6	0.2					0.3		1.4	0.3	1.7	0.7	0.3	0.7	1.0	0.6	
Q. seminulum jugosa										0.6	0.7	0.4													0.8		1.0	0.4	0.3	0.3			
Rosalina floridana								0.4		4.4	4.3	5.0	6.6	7.1	9.9	7.2	5.4	1.8		3.9		1.1	5.3		4.1	3.1	3.1	3.6	6.6	1.4	6.8	0.2	
Siphotrochammina lobata	1.8	6.9	6.9	1.6	0.7		1.0	0.7		0.3				0.4		0.3		0.7				0.4			0.3								
Tiphotrocha comprimata		1.5	0.5	1.2			1.0														5.0			1.9								0.6	
Trifarina fluens													0.7							0.5					0.5			0.4		0.3			
Trochammina inflata	12.8	4.6	11.0	3.9	1.4		1.0	0.4	21.4		0.4		0.4			0.7	0.3	0.2	9.1		5.0	1.1	0.3										
T. macrescens	1.8	0.8	1.4	1.2	0.7		4.9	0.4	3.6				0.7					0.4	4.5		5.0	1.1		5.7								0.6	
T. ochracea	43.1	46.9	61.9	65.1	86.7		81.4	1.1	57.1	1.6	7.4	7.7	1.1	3.1	5.1	18.8	6.3	6.6	31.8	1.3	30.0	12.7	4.0	90.6	1.1	1.4		1.8	2.3		0.7	28.7	
Uvigerina auberiana														0.4																			
Wiesnerella auriculata																										0.3		0.4	1.0				
Centropyxis aculeata		3.1	0.5	0.4	0.4																												
Difflugia oblonga	0.9	0.8																															

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