BENTHIC AND SEDIMENTOLOGICAL STUDIES OF THE GEORGETOWN OCEAN DREDGED MATERIAL DISPOSAL SITE[1]

by

Robert F. Van Dolah
David M. Knott
Elizabeth L. Wenner
Thomas D. Mathews
Michael P. Katuna[2]

Marine Resources Research Institute

South Carolina Wildlife and Marine Resources Department

P.O. Box 12559

Charleston, South Carolina 29412

South Carolina Marine Resources Center

Technical Report Number 59

FEBRUARY, 1984

[1]This study was funded under contract (#DACW60-83-C-0005) for the U.S. Army Corps of Engineers, Charleston District.

[2]Department of Geology, College of Charleston, Charleston, SC 29424.

Table of Contents

List of Figures

List of Tables

List of Appendices

Acknowledgments

We wish to thank several people who assisted us in this study. Special thanks are due to Caroline O'Rourke and Marty Levisen who helped in all study phases. Their careful and diligent work in the field and laboratory greatly contributed to the timely completion of this study. Others who helped in the field and laboratory include the crew of the Lady Lisa, Pete Richards and Mike Schwartz, and MRRI staff members Jim Stribling, Penny Travis, Beth Roland, Tina Chance, Priscilla Hinde, and Kathy Austin. Nancy Beaumont typed all drafts of this report and Karen Swanson drafted all figures. Commonwealth Laboratory analyzed the contaminant samples for all parameters except trace metals. This report was reviewed by Victor Burrell, Rob Dunlap, Priscilla Hinde, Steve Morrison, Nick Roark and Jane Settle. Finally, we wish to thank Steve Morrison and John Carothers for their efforts in initiating this study, as well as for their part in the study design. We appreciate their encouragement and support of our work. This study was completed through funding under Contract #DACW60-83-C-0005 from the U.S. Army Corps of Engineers, Charleston District.

Introduction

The Georgetown Ocean Dredged Material Disposal Site (DMDS) has been selected by the Corps of Engineers for release of sediments dredged from the channels associated with Georgetown Harbor. This disposal area is similar in depth and bottom type to the larger Charleston Harbor Ocean Disposal Area located approximately 87 km to the southwest. Although the latter area was sampled in 1978 for a baseline benthic and sedimentological characteriation (South Carolina Wildlife and Marine Resources Department, 1979), no similar data base exists for the Georgetown DMDS. At the present time, the Georgetown DMDS is being used under iterim approval by the Environmental Protection Agency (EPA). Continued use of this site requires more baseline information for final EPA site approval as authorized by the Marine Protection Research and Sanctuaries Act (MPRSA). To obtain the necessary data, the Corps contracted with the South Carolina Wildlife and Marine Resources Department (SCWMRD) to conduct benthic and sedimentological studies in and near the Georgetown DMDS. Specific objectives of this study were to:

1) Provide a review of existing information on the physical, chemical and biological conditions in the vicinity of the Georgetown DMDS and provide a succinct description of biological, recreational, or other resources that might be affected by ocean disposal;

2) Describe the mineralogical, textural, and chemical characteristics of the bottom sediments in the Georgetown DMDS, in a control site, in three stations "down current" of the DMDS, and in the navigation channel;

3) Describe the sediment bedforms present in the Georgetown DMDS, in the control area and in the three "down current" stations with regard to their size, orientation, and composition.

4) Ascertain whether the sediment characteristics of the DMDS and the stations "down current" have been altered by current disposal practices;

5) Describe temperature-depth, salinity-depth, and dissolved oxygen-depth profiles in the water column at all stations, and determine concentrations of metals, pesticides, PCB's, high molecular weight hydrocarbons, and the turbidities at four stations (one DMDS station, one control station, one "down current" station, and one entrance channel station);

6) Characterize the species composition and density of benthic communities in the DMDS, in the control site, and in the "down current" stations;

7) Determine the degree of bioaccumulation of pollutants in selected sedentary benthic organisms collected from the DMDS, control site, and "down current" stations;

8) Assess the effects of the present dredged material disposal practices on bottom communities in the DMDS and the three "down current" stations.

Results presented in this report provide baseline data necessary for appraising the effects of deposition of dredged material in the Georgetown ocean disposal area. The study also supplements existing knowledge of the physical, chemical, and biological characteristics of the nearshore sand bottom habitat off South Carolina.

Review of Existing Information

The following survey of existing information is intended to provide a brief description of the environmental conditions and biological resources near the Georgetown DMDS. This information is compared with that described by the US EPA (1982) for similar disposal sites within the South Atlantic Bight.

ENVIRONMENTAL AND BIOLOGICAL CHARACTERISTICS

Hydrography and Currents

A summary of previous studies which provide hydrographic data in the vicinity of the Georgetown DMDS is presented in Figure 1. Although most of these studies sampled areas either inshore or offshore of the proposed DMDS, the data generally support conditions described by the US EPA (1982) for nearshore South Carolina waters.

Surface water temperatures in the nearshore areas around Winyah Bay are usually within the seasonal variation of 10-25°C noted in surveys near Savannah, Charleston, and Wilmington (US EPA, 1982), although temperatures have been noted which exceed those extremes. For example, Mathews and Pashuk (1977, 1982) noted surface temperatures from < 11-22°C in nearshore South

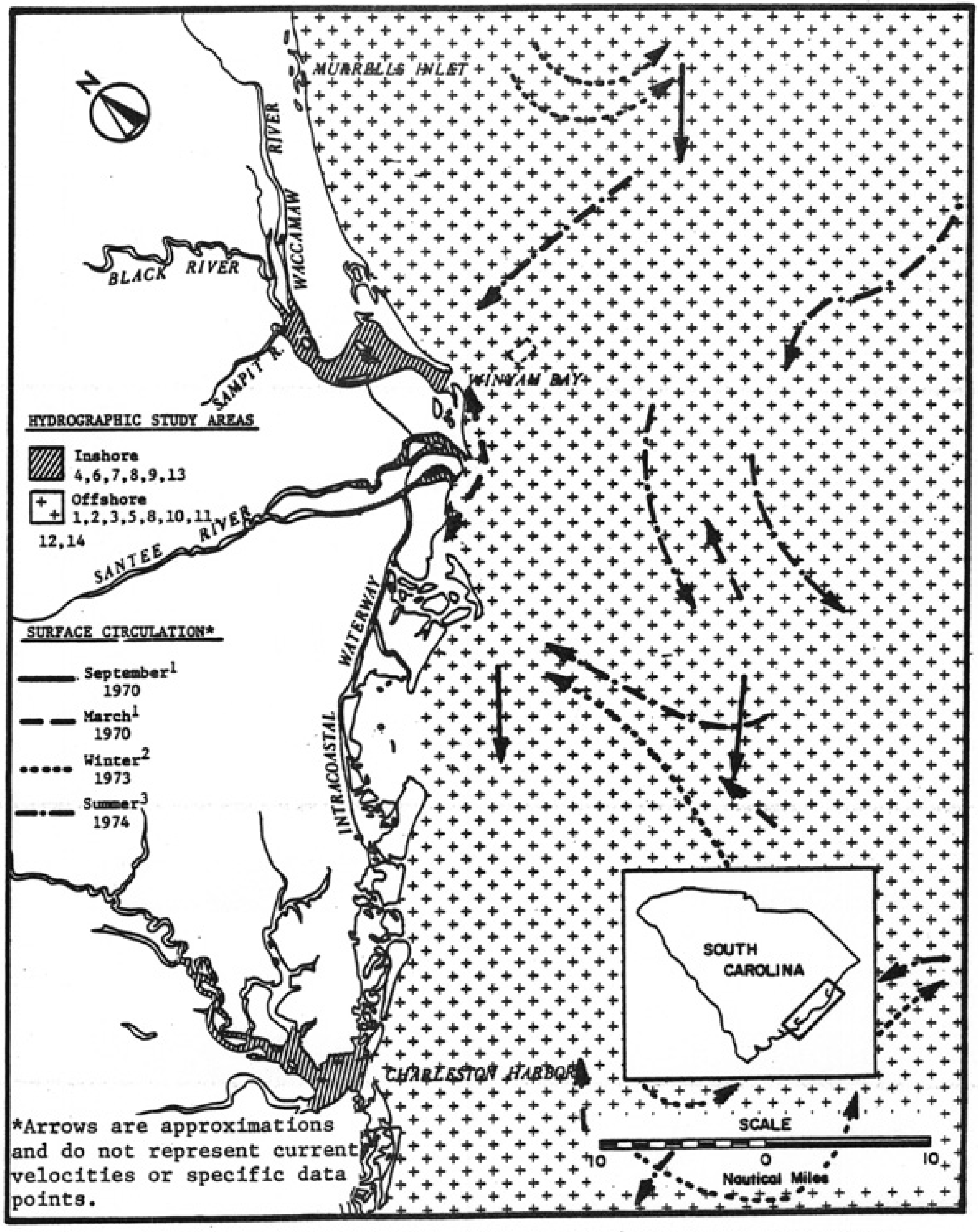

Figure 1. Location of hydrographic study areas and surface circulation patterns: [1]Bureau of Land Management (BLM), 1981; [2]Mathews and Pashuk, 1977; [3]Mathews and Pashuk, 1982; [4]Allen, et al., 1982; [5]Churgin and Halminski, 1974; [6]Hinde, et al., 1981; [7]Johnson, 1970; [8]Jones, Edmunds and Assoc., 1979a, 1979b, 1979c; [9]Mathews et al., 1981; [10]Minerals Management Service (MMS), 1982; [11]Science Applications Inc. (SAI), 1981a, 1981b; [12]SAI, 1983a, 1983b; [13]Shealy, 1974; [14]South Carolina Wildlife and Marine Resources Dept., 1979.

Carolina waters during four sampling periods of 1973 (Feb. - Nov.), but during 1974 (May - Nov.), temperatures varied from 18-27.5°C. Churgin and Halminski (1974) also presented water temperature data collected over a 50-year period from inshore and offshore waters of the region (32-34°N, 75-81°W) and noted surface temperatures of 10.9-29.3°C. Just inshore of the Georgetown DMDS, Allen et al. (1982) collected samples from Winyah Bay and observed surface temperatures ranging from 6.0-30.7°C at their station near the mouth of the Bay. Similarly, surface temperatures ranging from 11.0-29.8°C were noted in the mouth of the North Santee River (Mathews et al., 1981). Water temperatures in nearshore areas are primarily influenced by air temperature and river runoff.

The salinity and turbidity of water in the vicinity of the Georgetown DMDS is greatly influenced by waters from Winyah Bay and, to some extent, by waters from the Santee Rivers. Figure 2 clearly shows the influence of Winyah Bay waters with respect to turbidity and sediment loads. Obviously, waters from Winyah Bay are also influencing the salinity and temperature in the area of the DMDS. In the mouth of Winyah Bay, Allen et al. (1982) noted salinities ranging from 27.2-35.2 ‰ and never recorded secchi disc readings greater than 0.65 m. At a nearby location in the Bay, Mathews and Shealy (1982) observed extremely low salinities (< 2 ‰). Similarly, in the mouth of the North Santee, Mathews et al. (1981) noted salinities from 0.2-32.9 ‰ and secchi disc readings which never exceeded 0.8 m. Further offshore, Mathews and Pashuk (1977, 1982) observed surface salinities which ranged from 32.5-34 ‰ in 1973 and 34-35 ‰ in 1974. Finally, over the 50-year period evaluated by Churgin and Halminski (1974), surface salinities in nearshore and offshore waters ranged from 31.9-35.9 ‰.

Due to the shallow depths in the Georgetown DMDS and its proximity to Winyah Bay and the Santee Rivers, vertical stratification of salinities in the area is dependent on tidal stage, wind disturbance and the amount of fresh water runoff. After the scheduled rediversion of water flow from the Cooper River to the Santee Rivers, the hydrographic regime and vertical stratification in the area of the Georgetown DMDS may be considerably altered.

Current patterns in the vicinity of the Georgetown DMDS have not been well studied. Generally, longshore and nearshore currents run in a southerly direction along the South Carolina coast, although inshore currents become less well defined in the fall (Mathews and Pashuk, 1977). The strong tidal currents in Winyah Bay also have an influence on water flow in the area of the Georgetown DMDS. Generally, factors considered most important in influencing inner-shelf circulation patterns are wind and water density (Science Applications, Inc., 1983).

Wave energy is moderate along the South Carolina coast because waters are relatively shallow for a considerable distance offshore. Waves less than 4 ft. are observed 55% of the time and waves greater than 12 ft. are observed only 2% of the time (MMS, 1983).

Bottom Sediments

Sediments in the nearshore area around Winyah Bay have not been well studied, but shelf sediments in this region appear to be primarily represented by medium- to coarse-grained sands (Pilkey et al., 1979; MMS, 1983). A summary of sedimentological conditions on the shelf off South Carolina is provided in Figure 3. In the entrance channel of Winyah Bay, Hinde et al. (1981) obtained limited information on sediments at three stations just outside the jetties. Two of the stations sampled in that study (CW01 and CW02) were mostly medium to coarse sands (> 90%) and the third station (CW03) was mostly silty clays.

With respect to sediment transport, Mathews et al. (1980) indicated that the north jetty of the Winyah Bay entrance channel traps the southerly littoral drift of sediments, resulting in deposition at the southern end of North Island. They also indicated that the original Winyah Bay ebb-tidal delta has largely been destroyed since completion of the south jetty. Stapor (1978) noted that between 1925 and 1964 South Island experienced a net deposition rate of 70,000 m^3/yr. from onshore movement of sand under the influence of waves and tidal currents. If similar deposition patterns are occurring presently, it is possible that sediments disposed in the DMDS would move shoreward towards South Island. Additionally, some disposal sediments could also move back into the bay channels due to very strong tidal currents. Because of the shallow bottom depths in the Georgetown DMDS ($\approx$ 6-11 m) and the proximity of this area to the entrance channel, wave action and tidal currents should be the primary factors influencing sediment distribution. Detailed bathymetric surveys in the area show no clear evidence of sediment mounding as a result of past disposal activities (see Figure 4 for a plot of an April 1983 survey).

Chemistry and Pollutants

Dissolved oxygen in nearshore and offshore waters off South Carolina were recorded over a 50-year period by Churgin and Halminski (1974). Values ranged from 3.8-6.1 ml/l, with highest average concentrations observed during the winter and lowest average concentrations observed in the summer. Near Winyah Bay, the dissolved oxygen in surface coastal waters ranged from < 4.0 ml/l to 6.5 ml/l during 1973-1974 with similar seasonal trends in concentrations (Mathews and Pashuk, 1977, 1982).

Nutrient input to the Georgetown DMDS area may be strongly influenced by waters from Winyah Bay. Although no seasonal data could be found for waters at the Bay entrance, Allen et al. (1982) collected samples at two stations in Winyah Bay and noted a bimodal pattern of nitrate and nitrite concentrations. Highest values were observed in late fall, winter, and spring; lowest values were noted in summer. Allen et al. (1982) also measured phosphorous

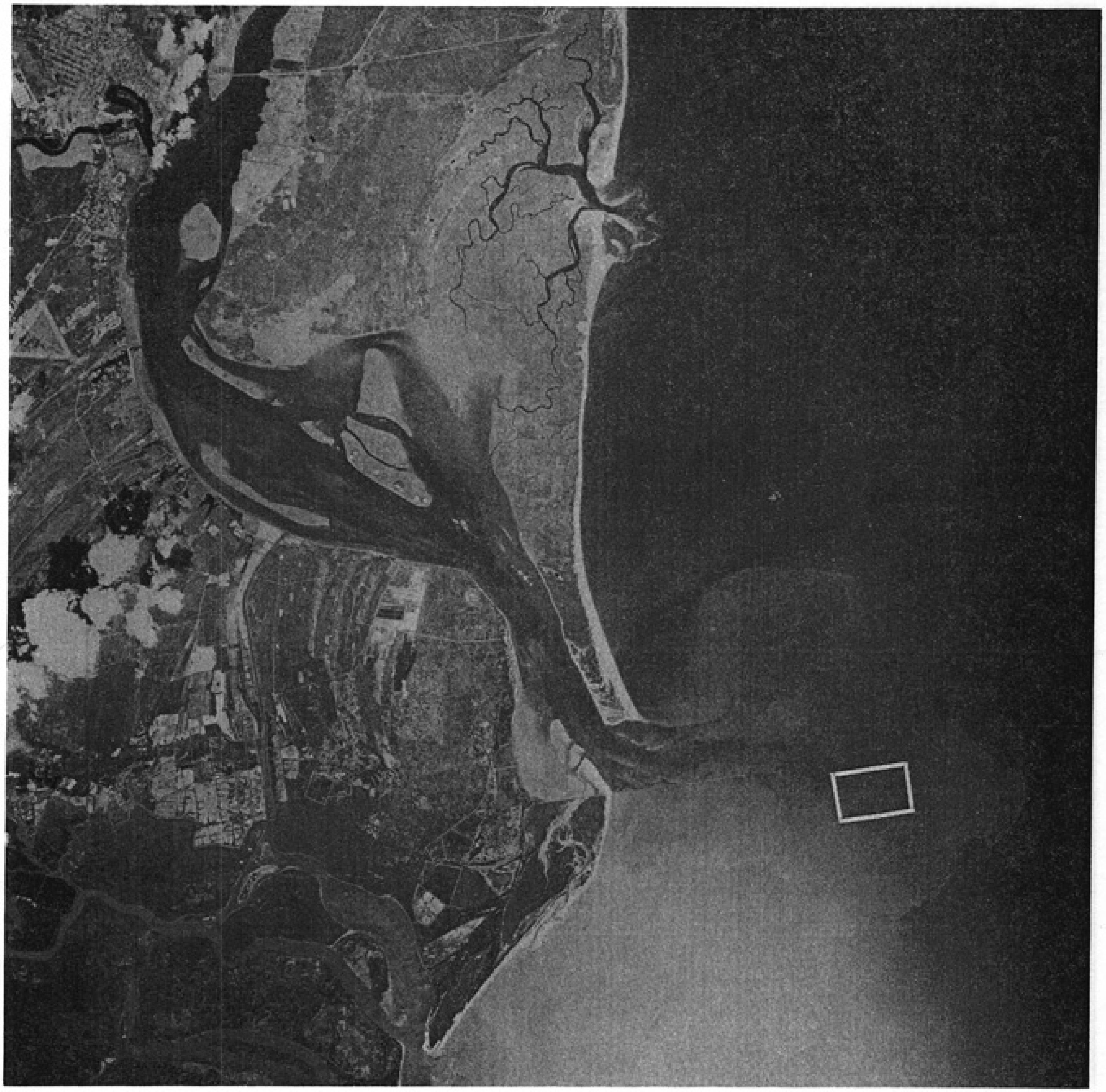

Figure 2. Landsat photograph of Winyah Bay and nearshore coastal waters. Note the large plume of turbid water which encompasses the DMDS area. Lighter area at bottom of photograph is reflection of the sun.

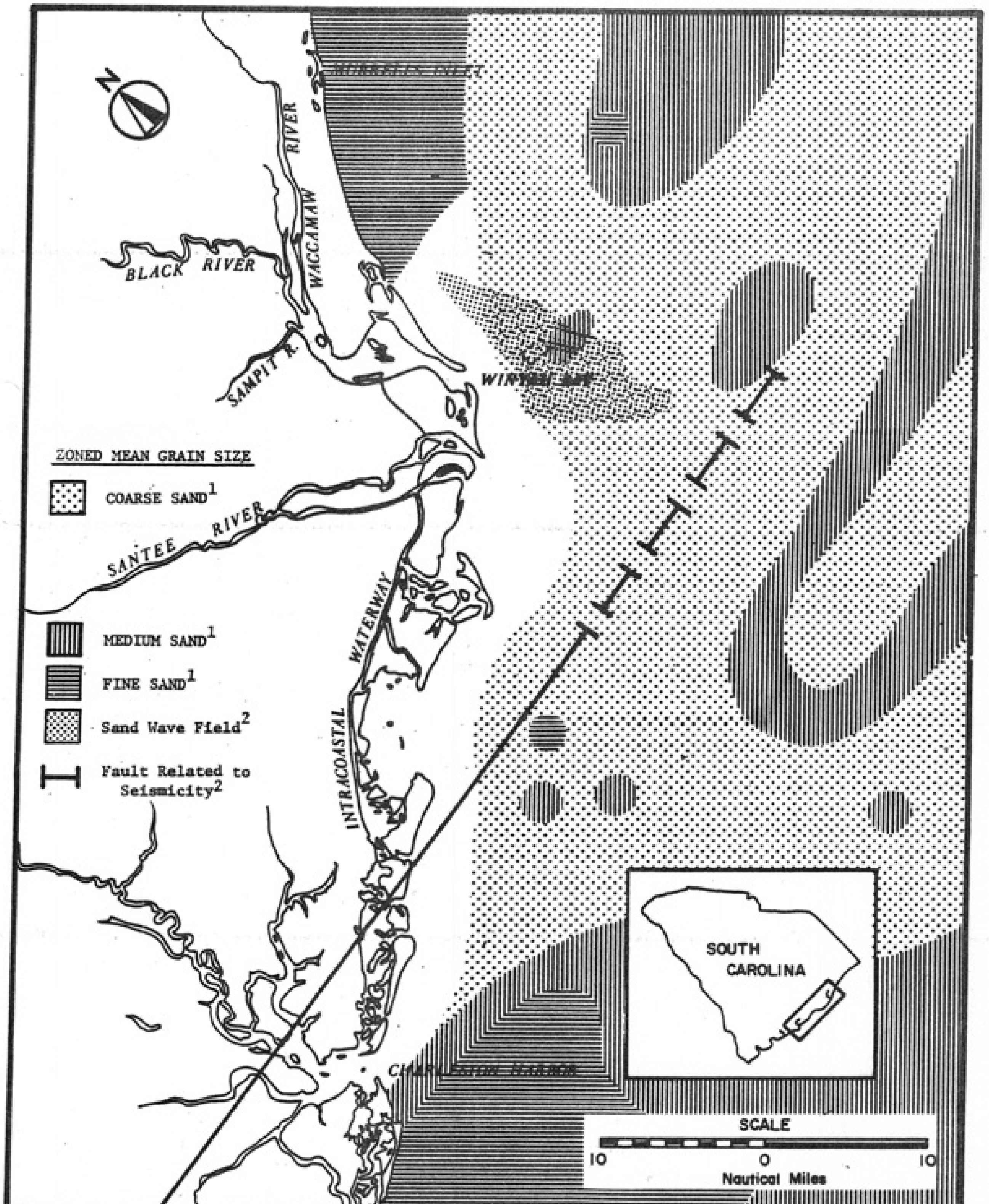

Figure 3. Areal distribution of mean grain size: [1]Pilkey et al., 1979; [2]MMS, 1983.

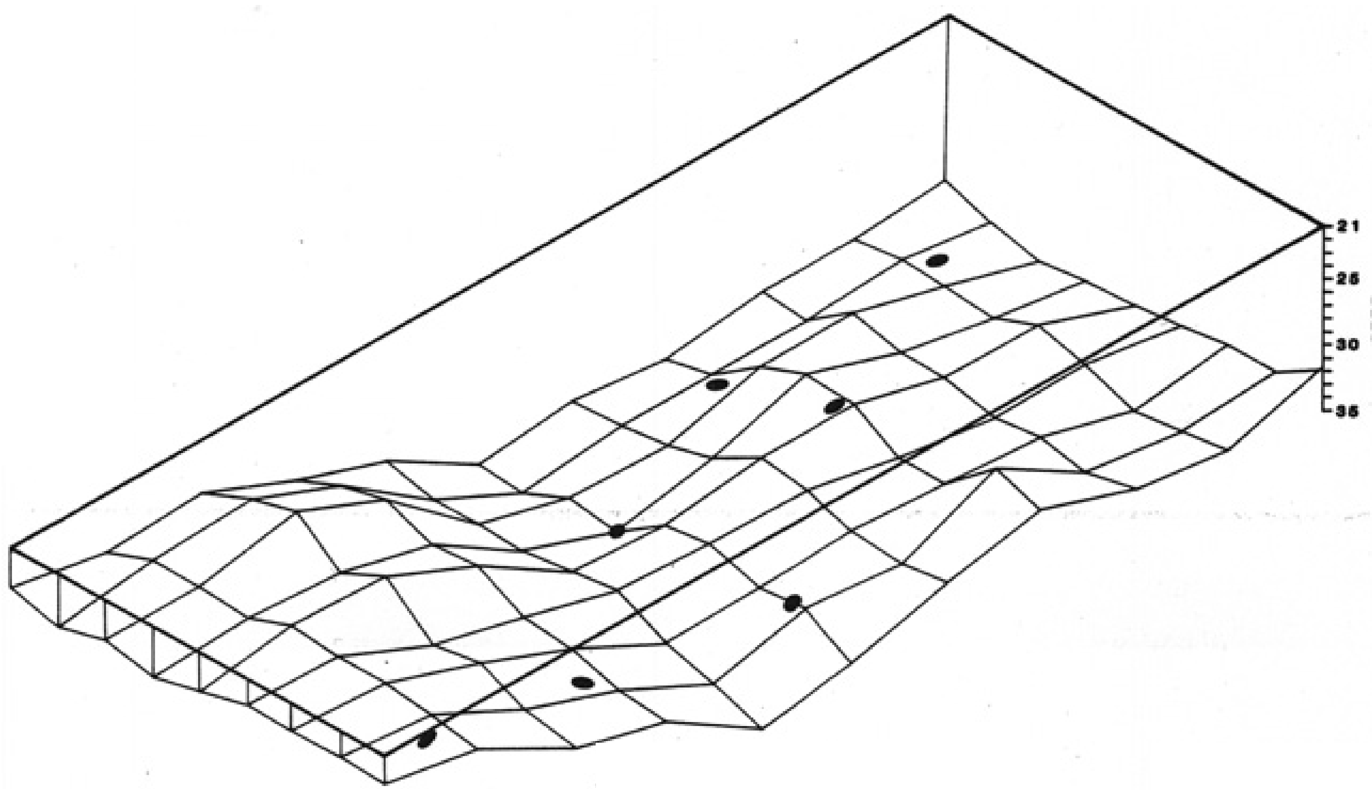

Figure 4. Three-dimensional plot of bottom survey data collected in the Georgetown DMDS by the U.S. Army Corps of Engineers, April 1983. Rectangular boundaries represent the DMDS boundaries and dots represent the stations sampled during winter and summer in the present study. The vertical scale is greatly exaggerated relative to the horizontal scale.

Click here to continue