

Box 9b

MEASUREMENTS OF GULF BEACH PROFILES
AT PADRE ISLAND NATIONAL SEASHORE, TEXAS

MAY 4, 1989

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ABSTRACT

Erosion and accretion are ongoing processes that continually modify coastlines along barrier islands. To assist in monitoring these processes, four shoreline profiles were measured along the Gulf coast of Padre Island National Seashore to compare with future measurements and to help determine rates and directions of sediment transport.

The beach gradient is steepest at a site of converging long-shore currents where the beach sand is coarsest. The backshore is wider to the south of that point, and the measured foreshore was wider to the north of that point.

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INTRODUCTION

Barrier islands along the Gulf coast are known to migrate as erosion and accretion affect their shorelines. This migration is attributed to many different causes, including: (1) global sea level changes, (2) change in volume of sediments supplied from rivers, such as resulting from the damming of rivers (for example the Rio Grande) and (3) local subsidence.

ENVIRONMENTAL SETTING

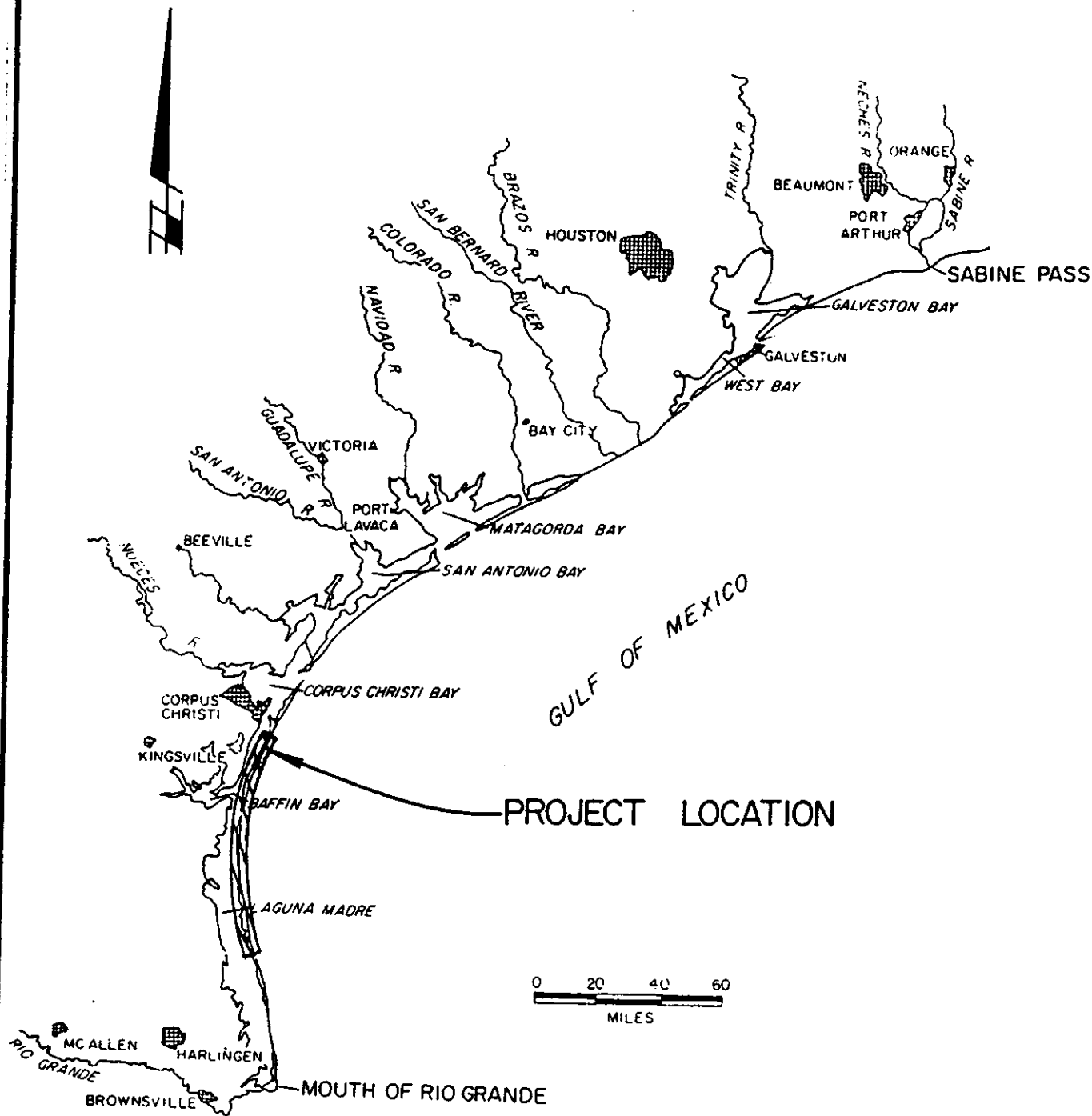
Padre Island, at 113 miles, is the longest barrier island in the United States. Lying along the southeast coastline of Texas bordering the Gulf of Mexico, it averages one to two miles wide. Laguna Madre is located west of Padre Island, and is a shallow body of water generally less than two feet deep. The only navigable water exchange through the island between Corpus Christi and Brownsville is at Mansfield Pass, located approximately 80 miles south of Corpus Christi Bay (Fig. 1).

The northern half of Padre Island lies in a subtropical climate zone, receiving approximately 29 inches of rain per year. The southern half of Padre Island lies in a semiarid climate zone, with approximately 26 inches of rain per year. The prevailing wind direction on Padre Island is predominately from the southeast from May to September, changing to north with the passage of frontal systems in the colder months (Weise and White, 1980).

Along coastlines, currents paralleling the beach typically develop in the direction of the alongshore component of an obliquely onshore wind. These are called longshore currents. The Texas coast is curved; the prevailing winds from the southeast strike Padre Island at a point approximately 27 degrees north in latitude. Because of the shoreline curvature north of this point, longshore currents to the north are deflected towards the southwest. The direction of curvature of the shore south of this point causes the currents to the south to be deflected to the north. At 27 degrees north latitude (a point about 30 miles south of Malaquite Beach on Padre Island National Seashore), the two longshore currents converge (ibid.).

OBJECTIVES

The objective of this project was to measure selected beach profiles along the Gulf shoreline of Padre Island National Seashore, in order to study the distribution of sediments along the beach. All profiles measured in this study will be monitored in the future; this will allow future comparisons.



LOCATION MAP

FIG. NO. 1

PROCEDURES

Topographic profiles were established at various sites along the shoreline. The profile locations were selected in a meeting with National Seashore personnel. These sites were chosen because of their locations relative to the known longshore current convergence zone. One profile was located at the convergence zone itself, at the 30-mile marker. Two other profiles were located to the south, at the 45 mile marker and at a point one mile north of Mansfield Pass jetties (at 59 miles south of Malaquite Beach). A fourth profile was located to the north, at the 15 mile marker (Fig. 2).

These profiles were measured relative to a benchmark set along each profile. Using a theodolite, a horizontal reference line along the cross section was established. The elevation of the theodolite above the benchmark was measured by sighting along a horizontal line to a graduated level rod on the benchmark. The elevation of the instrument was calculated by adding the reading on the level rod to the elevation of the benchmark. Then, points along the profile were measured at 25 foot intervals and at other areas of interest (dune troughs, crests, inflection points, etc.). Elevations of these points were measured by sighting through the instrument, reading the level rod and subtracting this value from the height of the instrument.

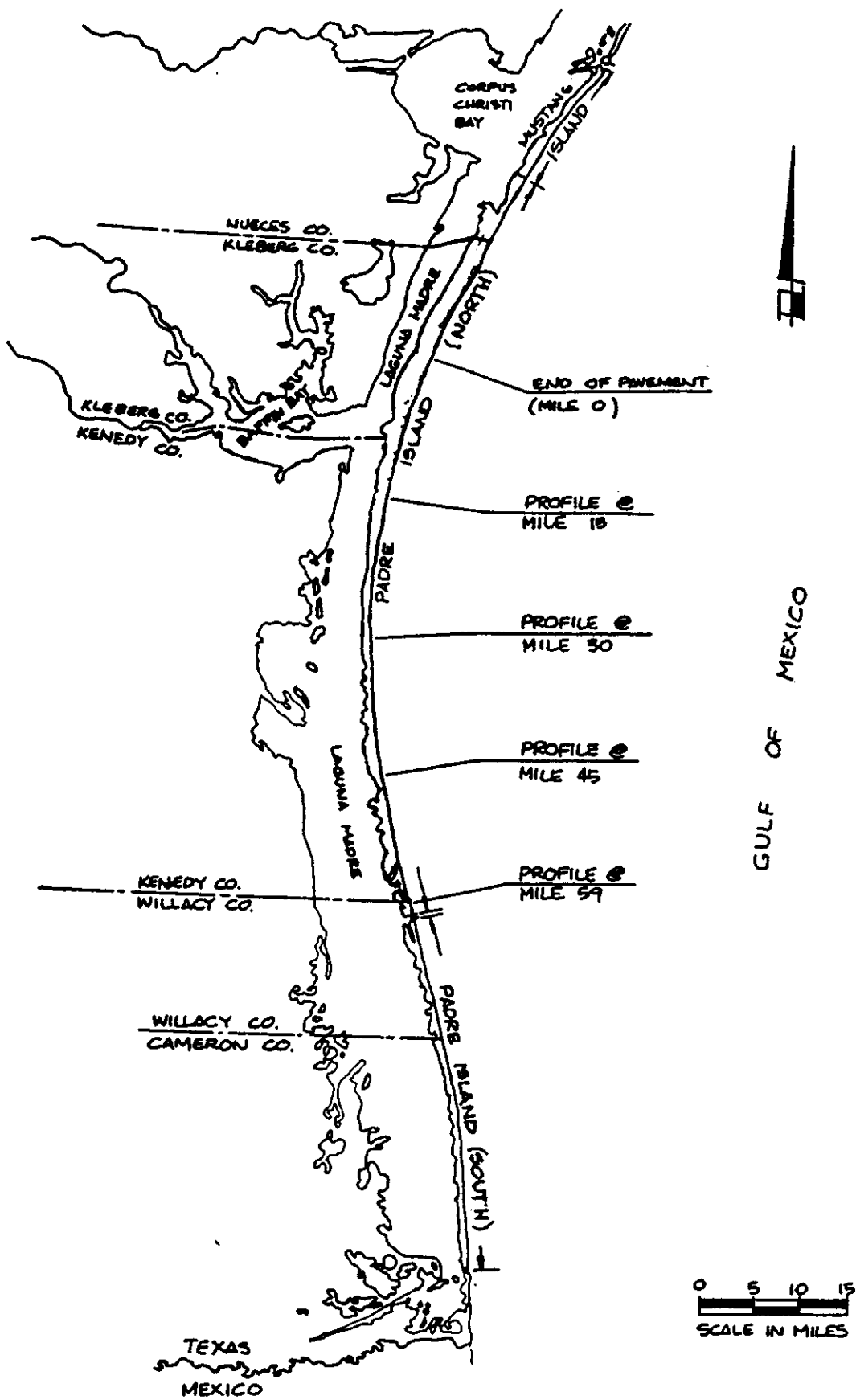
RESULTS AND DISCUSSION

The profiles measured are shown in figures 3, 4, 5, and 6, and the data measured are listed in Table 1. These profiles are drawn with a 10x vertical exaggeration. All but the Mile-59 profile were measured with the horizontal station 0+00 set at the mile marker pole. There is no mile marker at the Mile-59 profile, so the Mile-59 horizontal reference point is a hub and lath set in the dunes.

SECTION AT 15 MILE MARKER

Located 15 miles south of the entrance road at Malaquite beach, the horizontal reference point for this section is the 15 mile marker pole, with a 2"x 2" hub and a lath set in the dune as a backsite. A benchmark was established at an elevation 5.18 feet above the water level; the benchmark consists of 3 nails set in the 15 mile marker pole.

This profile has a relatively gentle slope compared to the other profiles. The foreshore had a 2.84% gradient, while the more landward backshore had a 0.92% gradient. The backshore was narrowest along this profile, being 150 feet from the fore-island



PROFILE LOCATIONS

FIG. NO. 2

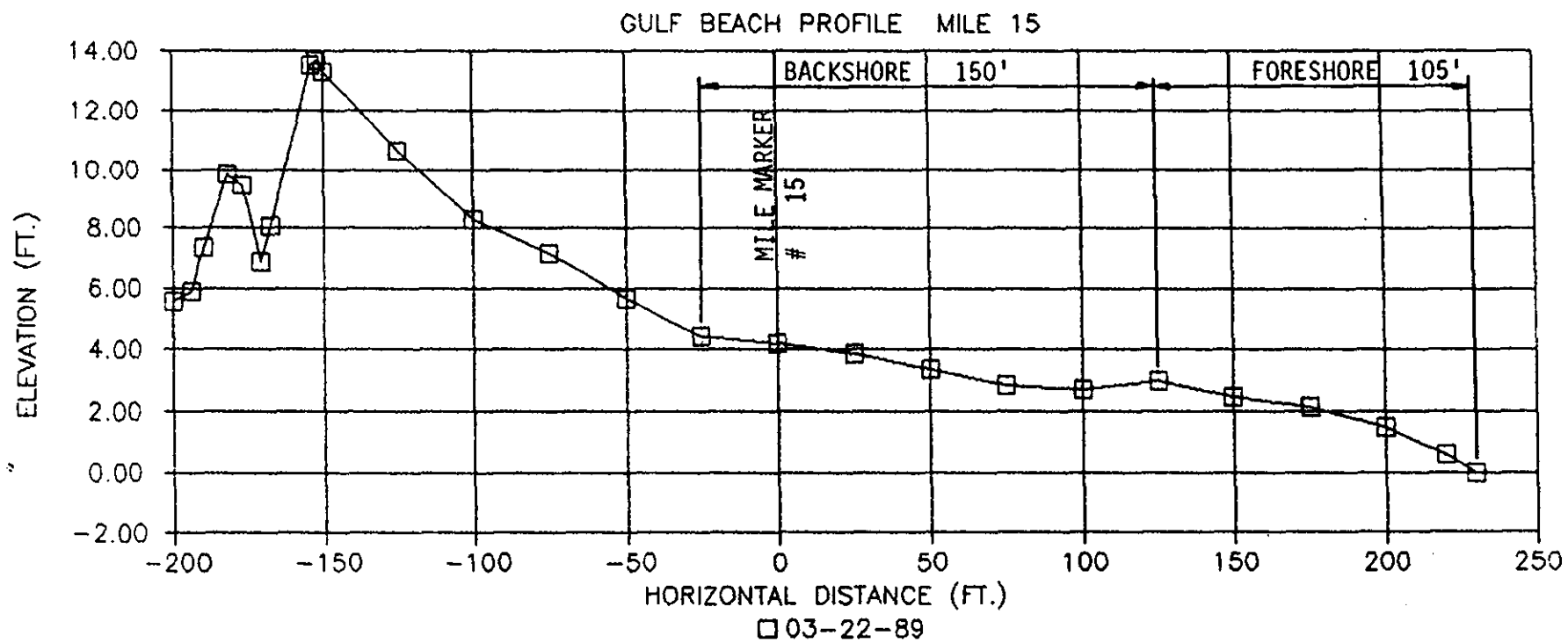


FIG. NO. 3

GULF BEACH PROFILE MILE 30

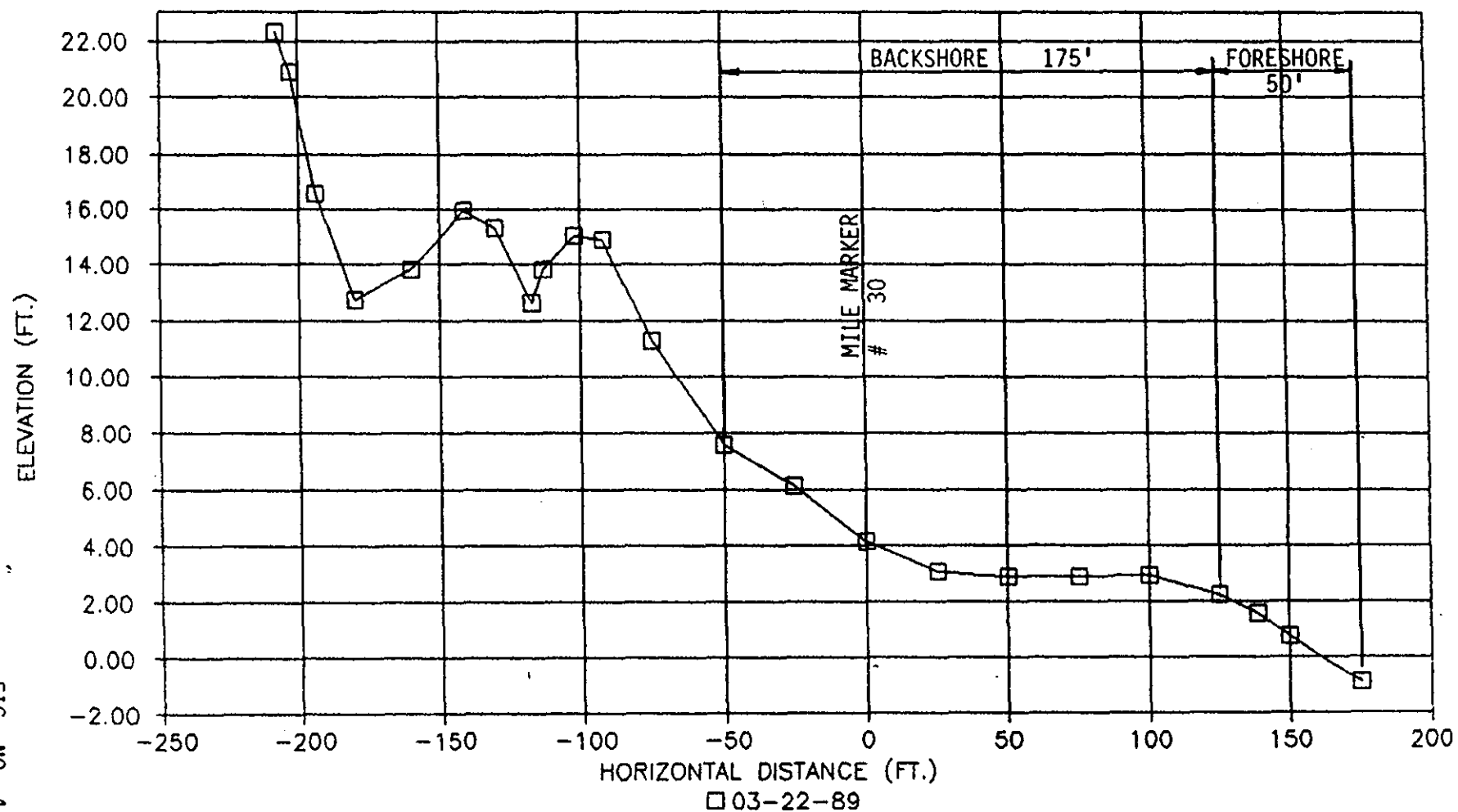


FIG. NO. 4

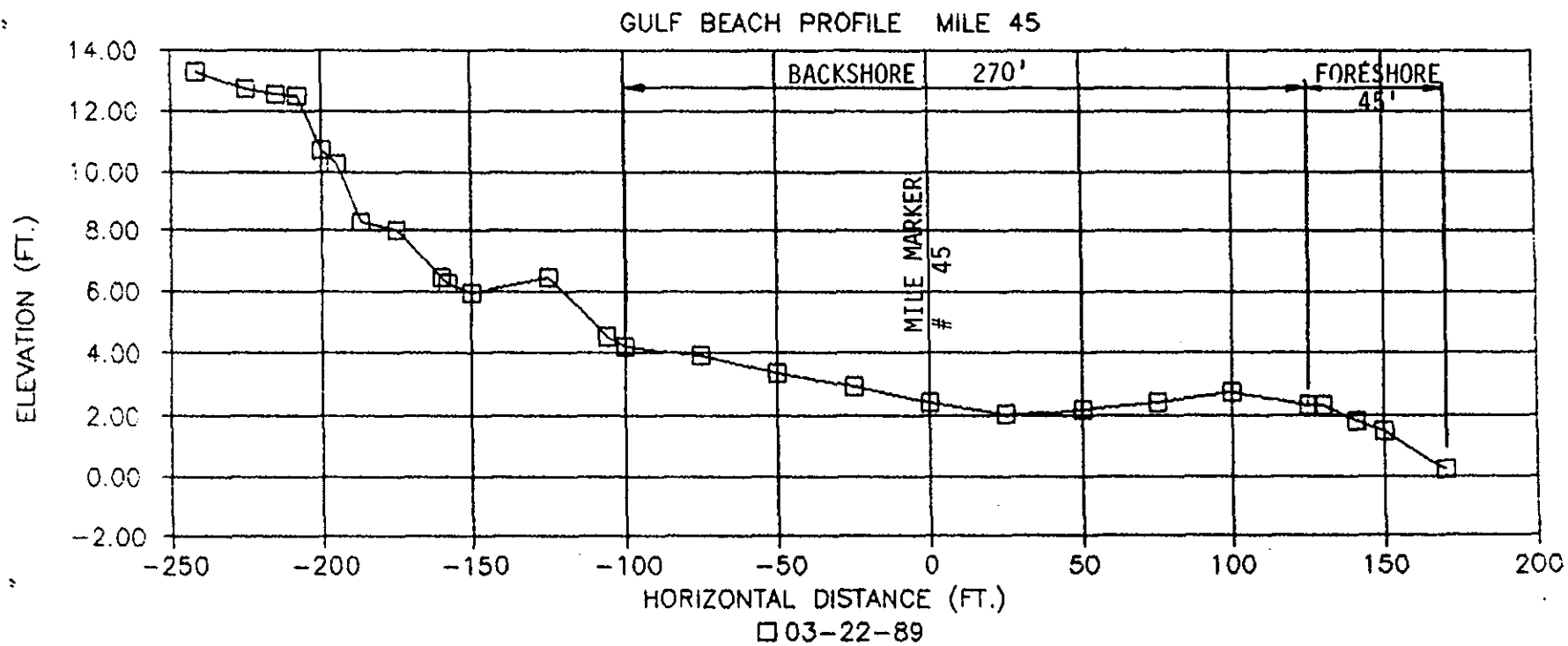


FIG. NO. 5

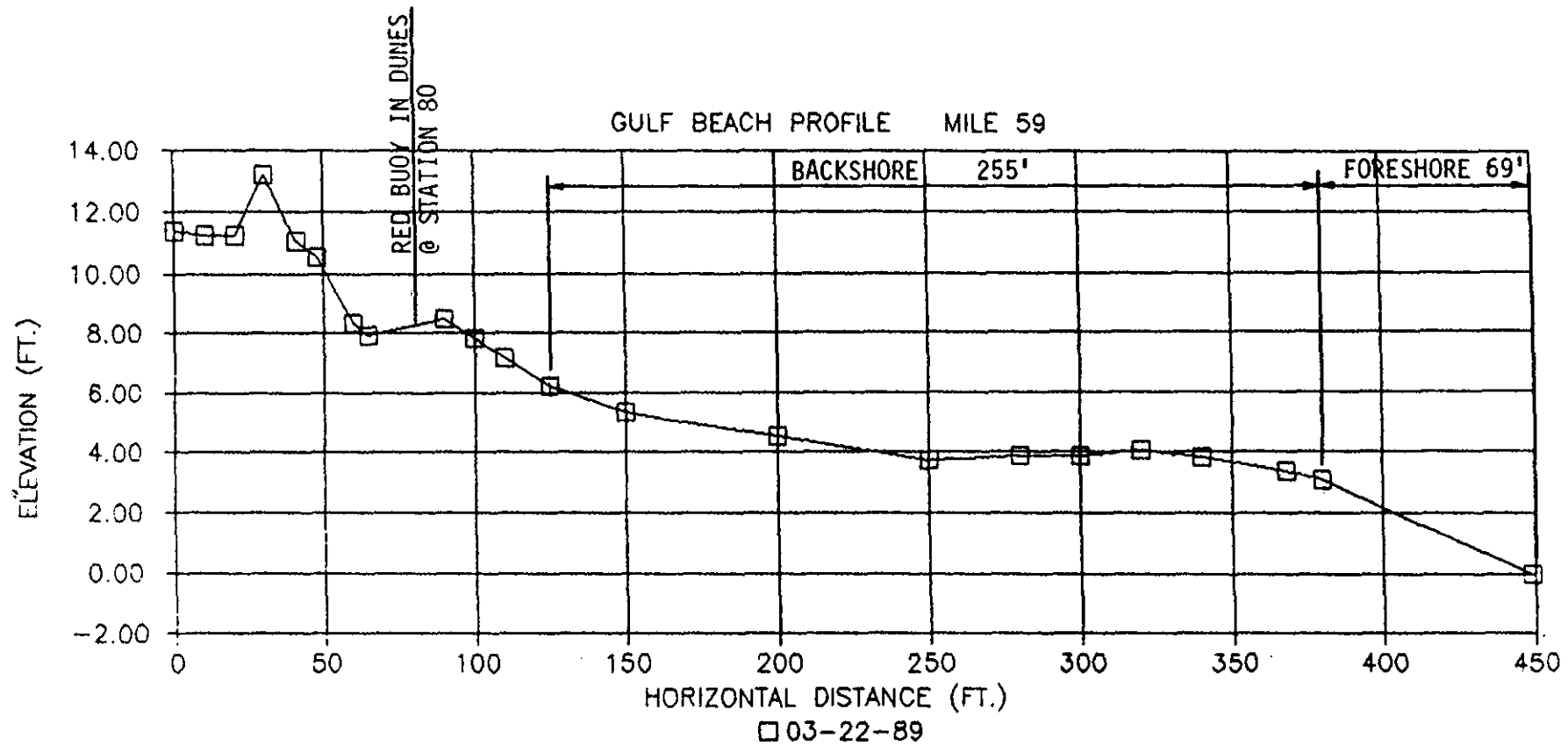


FIG. NO. 6

TABLE 1. Length of Shore Facies and Slopes

MILE NUMBER	LENGTH OF FORESHORE	% SLOPE	LENGTH OF BACKSHORE	% SLOPE	MAXIMUM ELEVATION
15	105	2.84	150	0.92	13.70
30	50	7.78	175	3.07	22.31
45	45	4.76	270	1.49	13.32
59	69	4.14	255	1.19	13.23

dune line to the beginning of the foreshore slope, and 105 feet of foreshore were measured.

Grain size was not measured in this project, but the sediments along this profile mainly consist of medium sized quartzose sand.

SECTION AT 30 MILE MARKER

This section is located 30 miles south of the entrance road at Malaquite beach. Its horizontal reference point is the 30 mile marker pole, with a 2"x 2" hub and a lath set in the dune as a backsite. A benchmark was established at an elevation 6.46 feet above the water level; it consisted of 3 nails set in the 30 mile marker pole.

This section has the steepest gradient of those measured. The foreshore had a 7.78% gradient, while the gentler backshore had a 3.07% gradient. The backshore was slightly wider (175 ft.) than the mile-15 section, and 50 feet of foreshore were measured.

Although grain size was not measured in this project, the sediments at the mile-30 marker consist largely of whole shells of *Arca* and other bivalves, broken shell fragments, and quartzose sand. They are coarsest in this region; in fact, this region of the beach is referred to as "Big Shell Beach" because of the high content of moderately large bivalve shells (Weise and White, 1980).

SECTION AT 45 MILE MARKER

This section is located 45 miles south of the entrance road at Malaquite beach. Its horizontal reference point is the 45 mile marker pole, with a 2"x 2" hub and a lath set in the dune as a backsite. A benchmark was established at an elevation 3.24 feet above water level; it consists of 3 nails set in the 45 mile marker pole.

This section has a steeper gradient than the 15-mile section, but gentler than at mile-30. The fore shore sloped seaward at a 4.76% gradient, while the gentler backshore sloped seaward at a 1.49% gradient. The backshore was widest along this section (270 ft.), and 45 ft. of foreshore were measured.

The sediments along this profile are mainly medium sized, slightly shelly quartzose sand.

SECTION AT MILE 59

This section is located 59 miles south of the entrance road at Malaquite beach and one mile north of the jetties at Mansfield Pass. This section's horizontal reference point is a 2"x 2" hub and a lath set in the dunes at station 0+00 (an elevation 11.62'

above the water). A second reference hub and lath were set as a backside behind the dunes at station -80.07 (elevation 6.88'). This section was located at a prominent (8' diameter) red buoy in the dunes which should be easy to relocate.

This section has a steeper gradient than at the 45-mile marker. The foreshore had a 4.14% gradient, while the backshore had a 1.19% gradient. The backshore was fairly wide (255 ft.), and 69 feet of foreshore were measured.

The sediments along this profile are mainly medium sized, slightly shelly quartzose sand.

CONCLUSIONS

The width of the beach on Padre Island National Seashore increases to the north and south of the convergence zone located approximately 30 miles south of the entrance road at Malaquite Beach.

The slope of the beach is steepest at the convergence zone, where sediments consist of coarse shells and quartzose sand. Beach sediments fine to the north and south, and consist mainly of medium to fine quartzose sand at Mile 15, Mile 45, and Mile 59.

Along many beaches, the grain size controls the gradient of the beach (Skinner and Porter, 1987). The coarse shelly sand at Mile-30 allows water breaking at the shoreface and washing up the foreshore to flow down between sand grains (because of the larger percentage of pore space), instead of back along the surface. Water infiltrating through the shelly sand back to the subtidal zone is not capable of erosion, so the surface sediments of the beach remain piled as a steep slope. The finer sand at Mile-15, Mile-45, and Mile-59, on the other hand, has less pore space. Waves breaking on the foreshore cannot percolate as easily into the sand, and instead wash back across the beach surface to the shoreface. As the water washes back across it erodes much of the sand, and as a result the beaches are flatter in these areas.

New profile locations will be added in the future to increase resolution of sediment transportation system. These profiles should be remeasured biannually to define typical winter and summer beach conditions, and to monitor long term sediment accretion or erosion at these sites.

LITERATURE CITED

Skinner B.J. and S.C. Porter (1987) Physical Geology, John Wiley and Sons, New York, 750 p.

Weise, B.R. and W.A. White (1980). Padre Island National Seashore. Bureau of Econ. Geol. Guidebook 17, 94 p. plus map.