FINAL REPORT

To
The U.S. Army Corps of Engineers
Galveston District
And
The Port of Houston Authority

SITE SELECTION FOR BENEFICIAL USE OF DREDGE MATERIAL THROUGH MARSH CREATION IN GALVESTON BAY

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Introduction

Purpose.

This investigation addresses the potential of marsh creation in Galveston Bay to provide benificial use in conjunction with widening and deepening of the Houston-Galveston Navigation Channel. Interagency planners are considering using dredge material from the project for beneficial uses including creation of marshes, bird islands, boater islands and for shoreline stabilization. The purpose of this study was to develop information for the Beneficial Uses Group to evaluate where in Galveston Bay significant biological gain may be achieved from marsh creation in open water habitat.

Background

Tidal wetlands are highly productive ecological systems that interface between land and sea. In particular, wetlands function as areas of nutrient cycling, carbon flux, sediment binding and habitat for many distinctive types of plants and animals. Among important attributes of tidal wetlands is their value as nurseries for estuarine-dependent fisheries. Up to 96 percent of the landings of commercial fisheries and 70 percent of recreational fisheries are estuarine-dependent in the U.S. Gulf of Mexico. In Galveston Bay, fishery species include brown shrimp, white shrimp, pink shrimp, blue crab, stone crab, red drum, spotted sea trout, southern flounder, Atlantic croaker and Gulf menhaden. Other species associated with tidal wetlands are important as elements in food chains. Some of these are grass shrimps, xanthid crabs, cyprinodontid fishes, gobiid fishes, annelid worms, amphipods and mysids. The wetlands used by these animals in Galveston Bay are mainly brackish and saline marshes.

Recent investigations show that utilization of brackish and salt marshes by fishery species influences their productivity. Previously, it was thought that fishery species used unvegetated creeks, but did not move directly onto marsh surfaces to any large extent (Weinstein 1979). Evidence of direct utilization came from experiments by Bell and Coull (1978) showing that marsh infauna as prey were impacted by invading aquatic predators. At about the same time, Turner (1977) found a positive relationship between offshore yields of brown shrimp fisheries and the amount of marsh area inshore. Then in the early 1980's, Zimmerman et al. (1984) and McIvor and Odum (1986) first quantified numbers of predators on marsh surfaces using drop trap and flume net sampling methods. At that time, the degree of external exploitation of marsh surfaces became known. These and other studies revealed that estuarine nekton, including many transient juveniles of fishery species, invaded tidal marsh surfaces

in large numbers (Zimmerman and Minello 1984; Rozas and Odum 1987; McIvor and Odum 1988; Hettler 1989; Mense and Wenner 1989). In Galveston Bay, densities of these secondary consumers were significantly higher in marshes than in adjacent open water habitat without vegetation (Zimmerman and Minello, 1984). Moreover, densities of consumers in salt marshes were found to be as high as densities of similar species found in seagrass habitats (Thomas et al 1990; Zimmerman et al 1990).

Manipulative experiments have since demonstrated that utilization of marsh habitat improves both the growth and survival of at least penaeid shrimp and blue crab juveniles (Thomas 1989; Minello and Zimmerman 1991). Shrimp grew faster in marsh habitat than on bare substrate during caging experiments (Zimmerman and Minello 1984b) and at the same time, predators of shrimp and blue crab are less effective in marshes thus increasing survival (Minello and Zimmerman 1983, Thomas 1990). This indicates that accessibility to marshes and the quality of food and cover in marshes can modify the productivity of fishery species.

Among the most abundant prey on marsh surfaces for shrimp, crab or fish predators are small infaunal and epifaunal worms and amphipods (Thomas 1976; Kneib 1982; Rader 1984). These animals are usually primary consumers and, as such, serve as links in food chains transforming energy of primary production to higher trophic levels. Mechanisms which control availability and abundance of prey may greatly determine the extent of coupling between marsh and open water communities.

Thus, secondary production may be higher in estuarine-dependent fisheries with more access to marsh surfaces where cover and prey are effectively utilized (Boesch and Turner 1984; Zimmerman and Minello 1984a; Minello and Zimmerman in press). Evidence of this relationship is seen in the correlation between the productivity of shrimp fisheries and annual fluctuations in sea level which influence frequency and duration of flooding in marshes (Childers et al 1990; Morris et al 1990). In Galveston Bay, estuarine recruitment events for shrimp postlarvae (Baxter and Renfro 1967). and blue crab megalopae (Thomas et. al 1990) coincide with periods of seasonal high water. Moreover, greater utilization of marsh surfaces is reported for juveniles of fishery species during periods of seasonally high water (Zimmerman and Minello 1984).

It follows that the loss of tidal wetlands affects production of wetland supported fauna including many important fisheries. Marsh habitat loss and the decline of seagrasses have been documented for Galveston Bay (White et al. 1985; Sheridan et al. 1988; Pulich and White 1991). For example, it is estimated that since the 1950's the estuary has lost about 21 % of its tidal marshes (White et al. 1993). These loss rates

continue at present and can accelerate with future sea level rise. As effects of wetland loss accumulate, it is inevitable that wetland supported secondary production will deteriorate. Among the few options available to offset the effects of wetland loss is creation of new wetlands.

Our study explores potential gains and losses of marsh creation in various parts of Galveston Bay. In conducting the study, we have compared animal numbers and biomass per unit area between salt marsh (Spartina alterniflora) and open water bay bottom habitats. Because these habitats are so physically different, it was necessary to use different sampling techniques. Intercalibration of these techniques was performed by measuring catch efficiencies (of gear types) relative to each other. Marsh and open water data for each target species, once adjusted for sampling efficiency, were directly comparable. This is the first time, in our awareness, that faunal densities have been quantitatively compared between marsh and the open bay.

Methods

Approach

Our approach was to measure densities and biomass of aquatic and sediment living animals (particularly fishery species) at open water habitats and in nearby marshes and compare utilization among sites scattered throughout Galveston Bay. Habitat utilization was based on field measurements of:

a) species composition,
b) density of animals, and
c) biomass of animals.

Differences in utilization between marsh and open water habitats among various sites were analyzed with analyses of variances (ANOVAs). The difference, between marsh and open water or between the sites, indicated potential for gain or loss from marsh creation. We assumed that under favorable circumstances and given enough time marshes created at disposal sites would function like existing marshes in the area.

Study Design

We employed a stratified design using sites, cells, zones and sides of the bay to compare fauna between habitats and among areas of the bay. This hierarchical design scales up in areawise coverage to accomodate analyses based on particular areas of the bay.

Sites. The smallest areal units were *sites*. Each site was comprised of an open water area (as a prospective disposal area) together with its nearest natural marsh. Marsh and open water were habitat types. *Sixteen sites* were scattered throughout Galveston Bay, Trinity Bay and the Houston Ship Channel. Correspondingly, there were 16 marshes and 16 open water site subunits. Site locations were predetermined by selection of possible disposal areas (Fig. 1) by the BUG. The geographical coordinates of open water and marsh locations for each site are in Table 1.

Sides. The largest areal subunits analyzed were the *two sides* of the bay system. These two subunits were comprised of eight sites positioned on either side of the Galveston Bay Ship Channel. All of the Houston Ship Channel (beyond the bay proper) was included as part of the western side and all of Trinity Bay was included on the eastern side. This division splits the bay into environmentally characteristic east and west halves.

Zones. The system was further divided for analysis into *four zones*, the lower, middle, upper Galveston Bay zones and a Houston Ship Channel and Trinity Bay zone. These zones reflected the salinity gradient and distance from the Gulf of Mexico.

Cells. Using sides and zones together, we created *eight cells* for analysis as smaller areal units. Each cell incorporated two sites.

Table 1. The locations of sixteen open water sites identified for potential marsh creation together the nearest existing marshes.

	OPEN WATER SITE		MARSH HABITAT	
SITE	Longitude	Latitude	Longitude	Latitude
Redfish (D2)	94°55'10"W	29°27'10"N	94°55'09"W	29°26'50"N
Moses Lake (M2b)	94°54'25"W	29°26'45"N	94°55'10"w	29°26'09"N
Bolivar Penisula (M1)	94°44'00"W	29°25'21"N	94°41'10"W	29°28'00"N
Bird Island (M5)	94°49'00"W	29°28'00"N	94°50'01"W	29°26'20"N
Houston Point (S9)	94°53'37"W	29°39'15"N	94°55'42"W	29°39'33"N
Atkinson Island (M11)	94°56'56"W	29°38'23"N	94°58'00"W	29°41'00"N
Smith Point (M7)	94°51'03"W	29°35'07"N	94°45'09"W	29°33'15"N
Double Bayou (M9)	94°42'34"W	29°39'09"N	94°41'52"W	29°40'06"N
Ash Point (M10)	94°50'00"W	29°41'00"N	94°41'49"W	29°40'39"N
Brownwood (M13)	95°03'10"W	29°45'20"N	95°03'43"W	29°46'13"N
Tabb's Bay (M12)	94°58'37"W	29°41'51"N	94°58'48"W	29°41'35"N
LaPorte (S8)	95°00'03"W	29°39'30"N	94°59'00"W	29°35'45"N
Seabrook (M8)	94°59'00"W	29°34'31"N	95°00'17"W	29°34'40"N
Texas City Dike (M2a)	94°53'00"W	29°21'07"N	94°53'41"W	29°21'07"N
Pelican Spit (B1)	94°50'00"W	29°21'00"N	94°49'34"W	29°20'53"N
Ving-et-un Islands(B3)	94°46'00"W	29°33'00"N	94°46'45"W	29°33'29"N

Time of Sampling.

The field work was conducted in the early fall of 1991 between mid-September and the first week of October. The survey assumed no significant site by season interaction in differences between marsh and open water among sites. The results from a previous study (Zimmerman et al. 1990), indicated that differences in animal abundance between marsh and open water do not vary significantly among locations with season. Past work also indicated that the early fall is a good time for maximizing the number of species present and for optimizing measurement of marsh utilization because of seasonally high water. Fall tides are typically the highest seasonal tides of the year (Turner 1991) which helps moderate the salinity gradient and to assure marsh inundation. These justifications rationalize conducting a one-time survey in the fall before the cool season emigration begins.

Sampling Procedures

Four sample replicates were acquired for each gear type in each marsh, in each proposed open water disposal area, and in each shallow water gear intercalibration area, at each site (Table 2). Several sampling gears were necessary because of differences in water depth, habitat type and the animals targeted. The drop sampler was effective in marsh vegetation and at water depths of 1 meter or less. The 1-m trawl could sample at all water depths, and the 3-m otter trawl in water depths of 1 m or more, but neither in vegetation. The catch efficiency of trawls also varied dependent on bottom type, water clarity, time-of-day, wave action, current movements and animal behaviors (burrowing, escape responses etc.). Hence it was necessary to intercalibrate the gear types, each time they were employed. We did this by using the drop sampler, beam trawl and otter trawl (4 replicates of each) simultaneously in shallow water (~ 1 m deep) during sampling at each site. Table 3 demonstrates differences in gear type catch efficiency from previous work and that intercalibration was necessary in order to standardize catch-per-unit-area.

Table 2. Sampling employed by gear type and habitat at each site. Four sample replicates are designated by each X.

Method	Marsh Habitat	Open Water Site	Intercalibration Area
Drop Sampler	X		X
1 m Beam Trawl		X	X
3.5 m Otter Trawl		X	X
10 cm Benthic Corer	X	X	

Table 3. Percent (%) catch efficiency of gear for measuring Penaeus aztecus densities (mean ± 1SD shrimp/m^2) in Galveston Bay.

Habitat Type	Drop Sampler	1-m Beam	Otter Trawl
Spartina marsh habitat	94% (8.9±3.7)	23% (2.2±2.2)	not operable
Nonvegetated open-water habitat	98% (0.30±0.30)	82% (0.25±0.46)	17% (0.05±0.04)

(from Zimmerman et al. 1984).

Target Species and Size Ranges

Our targets were species of abundant fishes and crustaceans of sizes between 10mm and 100 mm in length. Individuals of these sizes are numerous and many are the juveniles of commercially important species. These relatively small sizes are more effectively sampled than larger more widely dispersed individuals. Fishes and crustaceans targeted by our trawls and drop samples were:

brown shrimp	spotted seatrout
white shrimp	Atlantic croaker
blue crab	red drum
grass shrimp	bay anchovy
mysids	gobiids

The principal macroinvertebrate targets from sediment cores were:

annelid worms
peracarid crustaceans
mollusks

Field Procedures

Sampling of fish, shrimp and crab populations followed procedures of Zimmerman, Minello and Zamora (1984) and Zimmerman, Minello and Martinez (1985). Sampling of infaunal worms, peracarideans and mollusks followed Zimmerman, Minello, Castiglione and Smith (1990).

Laboratory Procedures

Fishes and crustaceans were sorted from drop samples and trawl samples, identified to species wherever possible, measured for length and counted. Subsamples of each species were weighed wet and dry (70 degrees C for 72 hr.) to establish length-weight curves for computing biomass. Infauna were separated into groups of annelids, peracarids, mollusks and others, then were counted, dried at 70 degrees C and weighed. All data were entered and stored in computer files.

Assumptions, Transformations, Analyses

The assumption of normality in the density data was not considered to be of major importance and was not tested. Our experience with many previous data sets indicates that animal densities are seldom normally distributed. We were most concerned about homogeneity of cell variances. We constructed plots of the variance and standard deviation in relation to the mean for grouped variables and abundant species. All of these plots showed positive relationships. In general, the standard deviation (SD) to mean plot was more linear, suggesting the need for a logarithmic transformation. This transformation should also help normalize the data.

After a log+1 transformation we ran F-Max tests comparing the maximum cell (32 habitat by site cells) variance to the minimum cell variance for the above variables. All variables appeared to have heterogeneous variances according to this test.

We also ran Levine's Test (on log+1 data) for homogeneity of variances by calculating the absolute values of the deviations from the 32 cell means and using these variables to test whether all 32 cells were equal in an ANOVA. All variables failed, usually with $P < 0.001$. We then ran REGWQ (a multiple range test) to identify outlier cells that appeared to be responsible for this heterogeneity. In general, only a few cells of the 32 were outliers. In order to examine whether these outlier cells had a major effect on the basic ANOVA, we calculated ANOVAs using log+1 transformed densities comparing all 32 cells and then recalculated these ANOVAs with the outliers identified in Levine's test omitted. A comparison of these analyses indicated that the Residual or Error MS was similar or higher

when all cells were included; thus tests of hypotheses in the full analyses (32 cell means) were conservative, having less chance of a Type I error.

We then compared results from the parametric tests (ANOVAs on log+1 densities) with results from Kruskal-Wallis Nonparametric tests on ranks. These analysis were run for each habitat separately, and the null hypothesis tested was whether all 16 sites were equal. Twenty four such comparisons were made (two habitats for 12 species groups or individual species), and probability values from the parametric and nonparametric tests were similar. At an alpha level of 0.05 conclusions from only one comparison out of the 24 would have been altered. The exception was a comparison of Anchoa mitchilli in marsh habitats, and probability values from the two analyses were actually quite similar (parametric P= 0.041, nonparametric P= 0.053).

As a result of our investigation into homogeneity in variance for the ANOVAs, we concluded that observed heterogeneity in cell variances was caused by only a few outlier cells. The inclusion of these cells in the analyses did not appear to affect test results. Nonparametric results for the basic analyses were similar to the parametric results, and this was strong supporting evidence that results from parametric tests were valid. We chose to proceed with the analyses using parametric methods (e.g. ANOVAs with a GLM contrasting procedure), because of the flexibility and increased analytical capability available in these methods.

Site Descriptions

The largest deepest natural marshes are in East Bay and eastern Trinity Bay. By comparison, marshes are nearly absent from western Trinity Bay and the La Porte-Seabrook area, existing only as fringing stands in a few shoreline reaches. The Texas City area has isolated marshes at Dickinson Bayou, Moses Lake and Swan Lake. The marshes at Atkinson Island and Pelican Island Spit are developed on dredge material (e.g. artificially created)..

D-2 *(Redfish Reef) 9/17/91-* The open water site was on the west side of Redfish Island (Long: 94°55'10"W; Lat: 29°27'10"N). Beam and otter trawl samples were taken between the two shell reefs that form the islands in water approximately 3.5 m deep. Bottom substrate was muddy clay. The corresponding marsh site was at the west end of Dickinson Bay (Long: 94°55'09"W; Lat: 29°26'50"N). where the channel of Dickinson Bayou opens into the bay. The calibration location was along the small dredge islands bordering the channel toward Dickinson Bay.

M-2b *(Moses Lake) 9/17/91-* The open water site was east of the Texas City Dike and just north of the pier at the bend (Long: 94°54'25'W; Lat: 29°26'45"N). Beam and otter trawl samples were taken around the datasonde. The beam trawls and otter trawls taken were in water 2 m deep. Bottom substrate was sandy. The corresponding marsh site was in Dollar Bay where it meets with Moses Lake (Long: 94°55'10"W; Lat: 29°26'09"N).. Substrates within the bay were muddy. The calibration location was in Moses Lake about 50 m from the marsh edge.

M-5 *(South Bird Island) 9/18/91-* The open water site was east of channel marker 41 (Long: 94°49'00"W; Lat: 29°28'00"N). Beam and otter trawl samples were taken around the datasonde in water approximately 3.0 to 3.5 m deep. Bottom substrate was sandy mud. The corresponding marsh site was east, and located on the natural marsh bordering the diked dredge fill area (Long: 94°50'01'W; Lat: 29°26'20"N).. Seiver's cut is the channel entering the Intercoastal Waterway closest to the marsh area and was approximately 1.5 km to the southwest. The calibration location was along the marsh about 30 m from the edge.

M-1 *(Bolivar Peninsula) 9/18/91-* The location of the open water site was along the dredge material island just north of Bolivar peninsula (Long: 94°44'00"W; Lat: 29°25'21"N). Beam and otter trawl samples were taken between in water approximately 1.5 m deep. Bottom substrate was hard sand. The corresponding marsh site was in the large natural marsh east of Seiver's Cut (Long: 94°41'10'W; Lat: 29°28'00"N).. The calibration location was on the nonvegetated bottom within 10 m of the marsh edge. Substrate in the marsh and calibration areas was silty mud.

S-9 *(Houston Point) 9/17/91-* The location of the open water site was on the west side of Redfish Island (Long: 94°53'37"W; Lat: 29°39'15"N). Beam and otter trawl samples were taken between the two shell reefs that form the islands in water approximately 3.5 m deep. Bottom substrate was muddy clay. The corresponding marsh site was at the west end of Dickinson Bay (Long: 94°55'42"W; Lat: 29°39'33"N), where the channel of Dickinson Bayou opens into the bay. The calibration location was along the small dredge material islands bordering the channel toward Dickinson Bay.

M-11 *(Atkinson Island) 9/24/91-* The location of the open water site was on the east side of Atkinson Island (Long: 94°56'56"W; Lat: 29°38'23"N). Beam and otter trawl samples were taken at the south end of the island in water approximately 2 m deep. Bottom substrate was hard sand. The corresponding marsh site was at the north end of Atkinson Island (Long: 94°58'00"W; Lat: 29°41'00"N) on the east side. The calibration location was in shallow water about 50 m from the marsh edge. The bottom was sandy mud.

M-10 *(Ash Point) 9/30/91-* The open water site was on the west side of Trinity Bay (Long: 94°50'00"W; Lat: 29°41'00"N). Beam and otter trawl samples were taken in open water approximately 3.5 m deep. Bottom substrate was muddy sand. The corresponding marsh site was due east on the opposite shore of Trinity Bay (Long: 94°41'49"W; Lat: 29°40'39"N); there were not stands of marsh large enough to sample on the west shore. The calibration location was along the marsh about 50 m from shore in 1 m water. The bottom was muddy sand.

M-9 *(Double Bayou) 9/17/91-* The open water site was on the southeast side of Trinity Bay (Long: 94°42'34"W; Lat: 29°39'09"N). Beam and otter trawl samples were taken bayward of the island at the mouth of Double Bayou in 2 m of water. The bottom was sandy mud. The corresponding marsh site was along the shore to the north of Double Bayou about 1.5 km (Long: 94°41'52"W; Lat: 29°40'06"N). The calibration location was offshore from the marsh about 100 m in 1 m of water. The bottom was sandy mud with Rangia shell.

M-7 *(Smith Point) 9/26/91-* The open water site was on the west side of Redfish Island (Long: 94°51'03"W; Lat: 29°35'07"N). Beam and otter trawl samples were taken in water approximately 3.5 m deep. Bottom substrate was muddy sand. The corresponding marsh site was at Houston Point south of Double Bayou (Long: 94°45'09"W; Lat: 29°33'15"N). The calibration location was along the marsh edge about 50 m from shore in 1 m of water. The bottom was sandy mud.

M-8 *(Seabrook) 9/17/91-* The open water site was off the shoreline north of Seabrook about 2 km (Long: 94°59'00"W; Lat: 29°34'31"N). Beam and otter trawl samples were taken in water approximately 2.5 m deep. Bottom substrate was mud, clay, and oyster shell. The corresponding marsh site was along the shoreline (Long: 94°00'17"W; Lat: 29°34'40"N). The calibration location was about 50 m from the marsh edge. The bottom was sand and clay.

S-8 *(LaPorte) 9/17/91-* The open water site was off the LaPorte shoreline about 0.5 km (Long: 94°00'03"W; Lat: 29°39'30"N). Beam and otter trawl samples were taken in water approximately 2.5 m deep. Bottom substrate was mud and clay. The corresponding marsh site was along the shoreline northeast of Seabrook (Long: 94°59'00"W; Lat: 29°35'45"N); there was not enough marsh along the LaPorte shoreline to sample. The calibration location was about 50 m from the marsh edge. The bottom was hard sand and clay

M-2a *(Texas City Dike) 9/17/91-* The open water site was 0.5 km to the east of the Texas City Dike (Long: 94°53'00"W; Lat: 29°21'07"N). Beam and otter trawl samples were taken in water approximately 1.5 m deep. Bottom substrate was sandy mud. The corresponding marsh site was at Swan Lake (Long: 94°53'41"W; Lat: 29°21'07"N). The calibration location was along the edge of the marsh about 50 m from shore. The bottom was soft mud.

B-1 *(Pelican Island Spit)9/17/91-* The open water site was about 0.5 km to the west of Pelican Island Spit (Long: 94°50'00"W; Lat: 29°21'00"N). Beam and otter trawl samples were taken in water approximately 2 m deep. Bottom substrate was sandy mud. The corresponding marsh site was on Pelican Island Spit (Long: 94°49'34"W; Lat: 29°20'53"N). The calibration location was across the Intercoastal Waterway from Little Pelican about 30 m from shore.

M-12 *(Tabb's Bay) 9/17/91-* The location of the open water site was on the east side of Hog Island (Long: 94°58'37"W; Lat: 29°41'51"N). Beam and otter trawl samples were taken in water approximately 1 m deep. Bottom substrate was silty mud. The corresponding marsh site was in a cove on the east side of Hog Island (Long: 94°58'48"W; Lat: 29°41'35"N). The calibration location was about 30 m from shore. The substrate was soft silty mud.

M-13 *(Brownwood) 9/17/91-* The location of the open water site was in Crystal Bay west of Wooster about 50 m from shore (Long: 95°03'10"W; Lat: 29°45'20"N). Beam and otter trawl samples were taken in water approximately 1 m deep. Bottom substrate was soft mud.. The corresponding marsh site was at in Burnett Bay east of San Jacinto State Park (Long: 94°03'43"W; Lat: 29°46'13"N). The calibration location was about 5 m from the marsh edge in about 1 m of water..

B-3 *(Vingt et un) 10/8/91-* The open water site was just north of the remaining islands and shoals of the Vingt et un island group (Long: 94°46'00"W; Lat: 29°33'00"N). Beam and otter trawl samples were taken around the location of the datasonde in depth of 1.5 to 2.0 m. Bottom substrate was muddy clay and shell. The corresponding marsh site was at Smith Point (Long: 94°46'45"W; Lat: 29°33'29"N). The calibration location was along the marsh edge about 20 m from shore.

RESULTS

Site by Site Comparisons

The locations of sites can be found in Figure 1 and Table 1. Mean abundance and biomass of animals in each habitat at each site are in Appendix Tables 1, 2, 3 and 4.. Sites are arranged in these tables so that habitat means at sites can be cross-referenced with the cell and zone means provided in the Figures. The target animal groups and species were **All Fishes, All Crustaceans, Bait Fishes, Commercial Fishes, Sciaenidae, Cyprinodontidae, Gobiidae, Penaeidae, Palemonetidae, Mysidae**, and abundant species ***Anchoa mitchilli*** *(Bay anchovy),* ***Micropogonias undulatus*** *(Atlantic Croaker),* ***Cynoscion nebulosus*** *(spotted seatrout),* ***Gobiosoma bosci*** *(naked goby),* ***Symphurus plagiusa*** *(blackcheek tonguefish),* ***Penaeus aztecus*** *(brown shrimp),* ***Penaeus setiferus*** *(white shrimp),* ***Callinectes sapidus*** *(blue crab) and* ***Palaemonetes pugio*** *(grass shrimp).*

Cell by Cell Comparisons

Cellwise comparisons are depicted in Figures 2, 3 and 4 and in Appendix Figures 1 through 21. Accordingly, abundance and biomass means of each animal group or species listed above are depicted in marsh and open water habitats in each cell of the bay. Results of tests for differences (ANOVA with a planned GLM contrast procedure; $P<0.05$) comparing marsh and open water means are indicated above the bar graphs. A horizontal line above the bars signifies no significant difference and the lack of a line indicates that means are significantly different. Also, marsh habitat means were analyzed for differences among cells and open water habitat means were analyzed for differences among cells(ANOVA with planned contrasts; $P<0.05$), but those results are not indicated on the graphs.

Zone by Zone Comparisons

Results of zonewise comparisons are shown in Figures 5, 6 and 7 and in Appendix Figures 22 through 42. Differences between marsh and open water habitat means were tested within each zone (each comprised of 4 sites) and the results are shown with a horizontal line above graph bars indicating no significant difference and the lack of a line signifing that the means are significantly different.. Differences between zones within marsh and within open water were also tested (results are not shown). As before, analyses were based on ANOVA with planned contrasts at the 0.05 alpha level.

East vs. West Side Comparisons

Comparisons of the two sides of the system are shown in Figures 8, 9 and 10 and in Appendix Figures 43 through 63. Differences between marsh and open water means were analyzed (results shown) as well as differences between sides by habitat (not shown) as before (ANOVA planned contrasts; $P>0.05$). Each side was comprised of 8 sites.

Fishes

Habitat means of all fish species combined are shown in Figure 2 (cell densities and biomass), Figure 5 (zone densities and biomass) and Figure 8 (side densities and biomass). Fish were further analyzed in categorizes as bait fishes (Appendix Figs 1, 22 and 43) and commercial fishes (Appendix Figs. 2, 23 and 44). Dominant fish families analyzed were sciaenidae (Appendix Figs. 3, 24 and 45), cyprinodontidae (Appendix Figs. 4, 25 and 46) and gobiidae (Appendix Figs. 5, 26 and 47).

Crustaceans

The habitat means of all decapod and peracarid crustacean species combined are shown in Figure 3 (cell densities and biomass), Figure 6 (zone densities and biomass) and Figure 9 (side densities and biomass). Dominant families of crustacea analyzed were penaeidae (Appendix Figs. 6, 27 and 48), palaemonidae (Appendix Figs. 7, 28 and 49) and mysidae (Appendix Figs. 8, 29 and 50).

Infauna

The habitat means of all infaunal species combined are in Figure 4 (cell densities and biomass), Figure 7 (zone densities and biomass) and Figure 10 (side densities and biomass). Infauna were further subdivided into categories as annelids (Appendix Figs. 18, 39 and 60), peracarids (Appendix Figs. 19, 40 and 61), molluscs (Appendix Figs. 20, 41 and 62) and others (Appendix Figs. 21, 42 and 63).

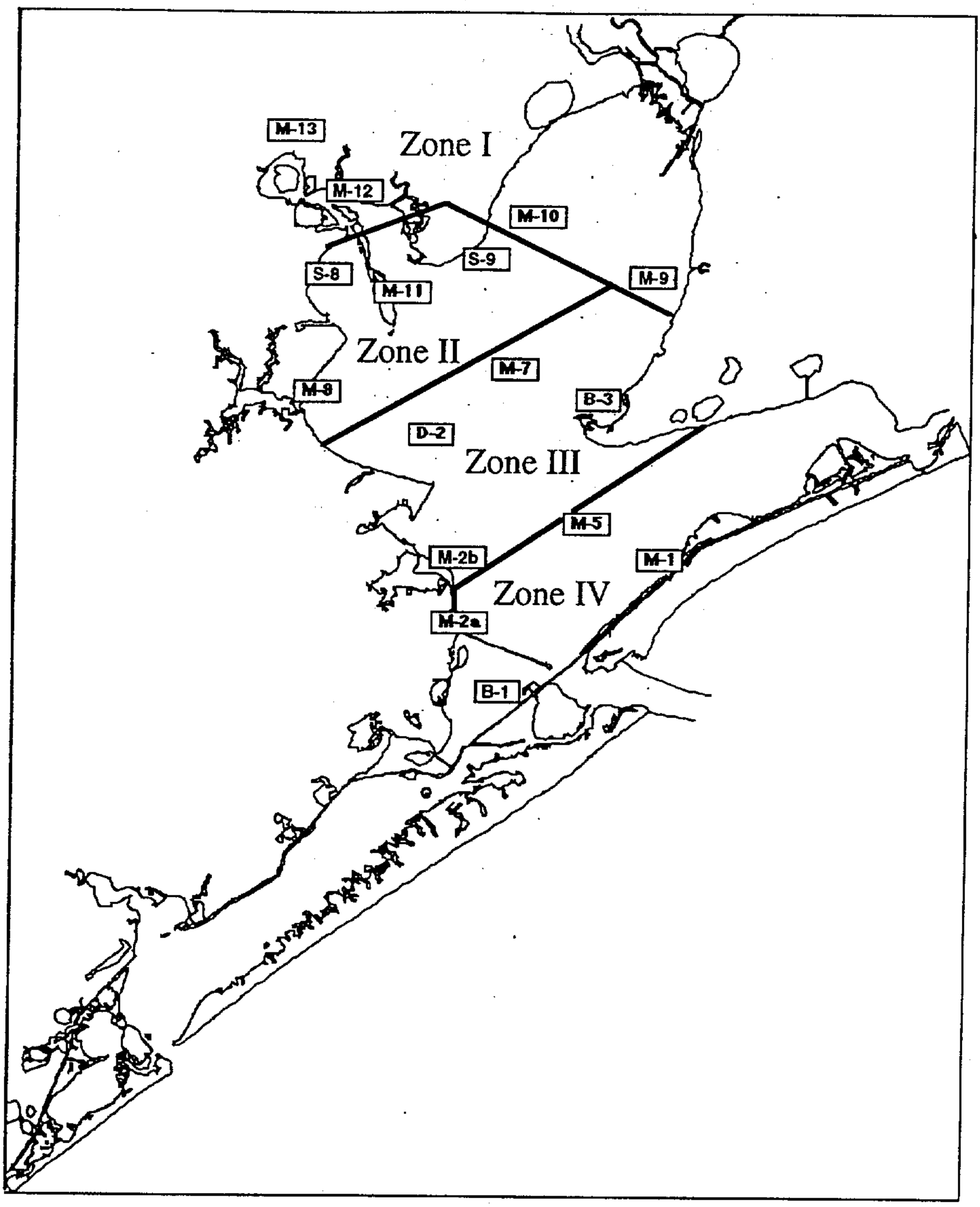


Figure 1. Open water sites proposed for marsh creation and other beneficial uses of dredge material from the Houston-Galveston Ship Channel Project. Study Zones I through IV are depicted.

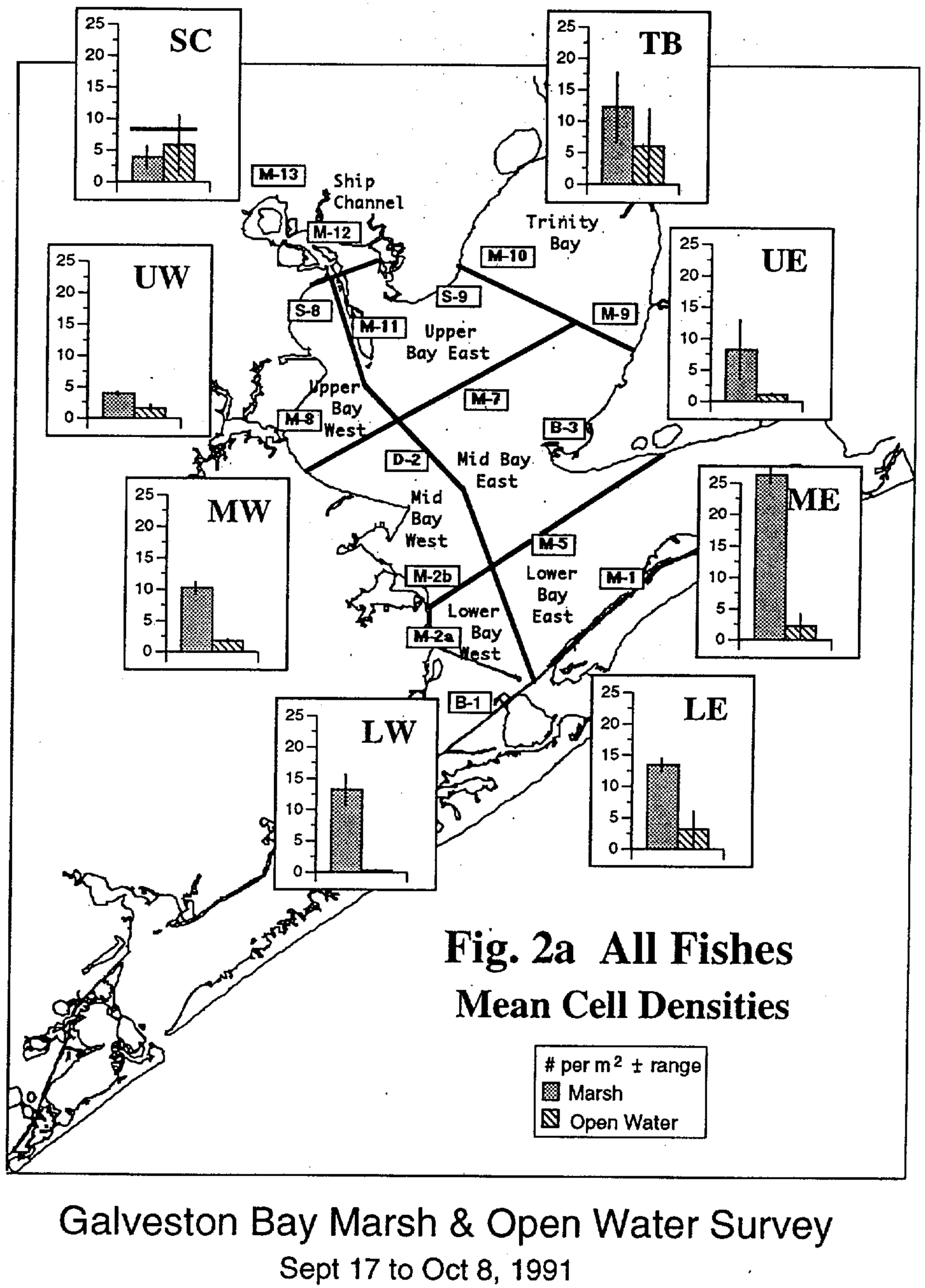


Fig. 2a All Fishes Mean Cell Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

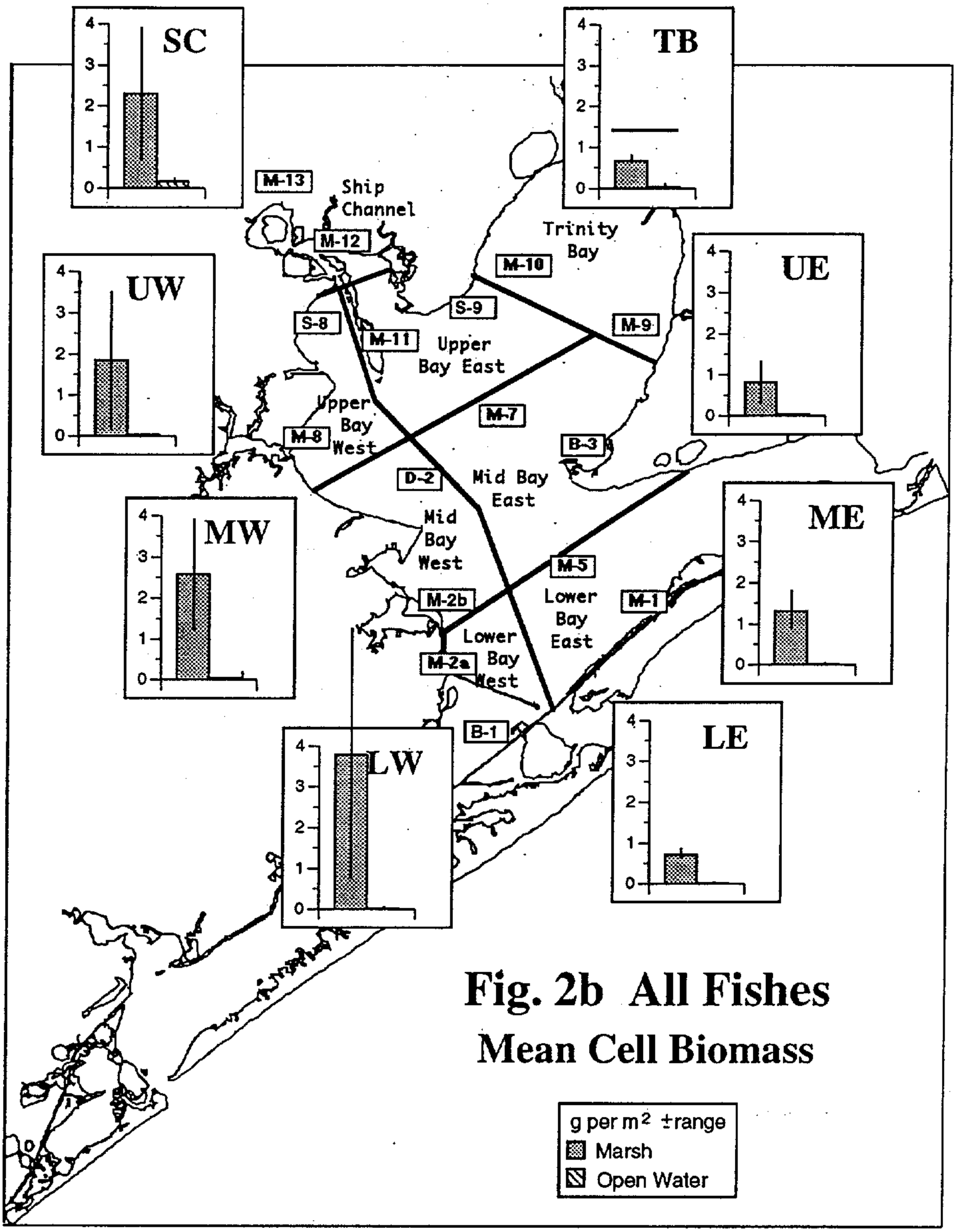


Fig. 2b All Fishes

Mean Cell Biomass

g per m^2 ±range
Marsh
Open Water

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

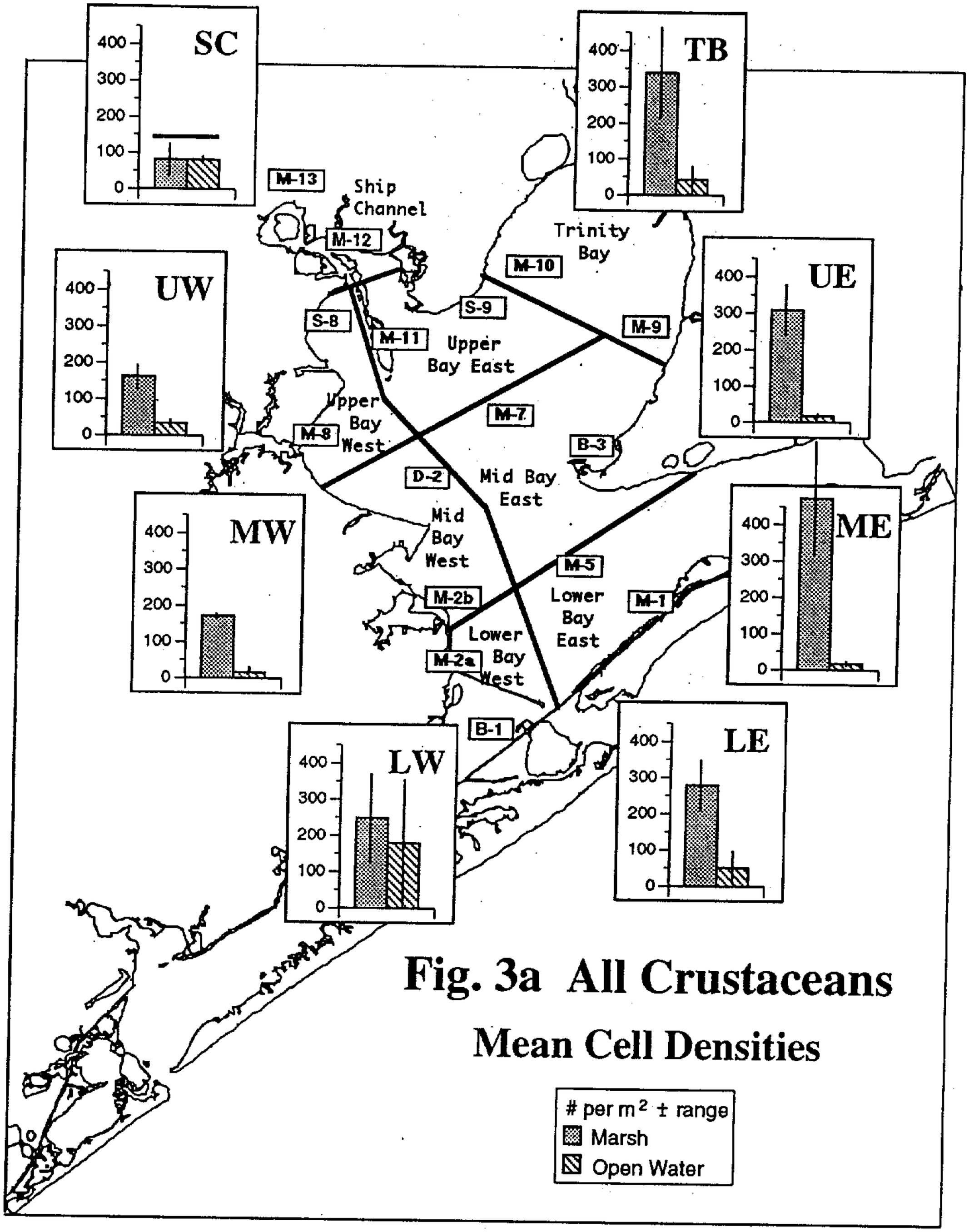


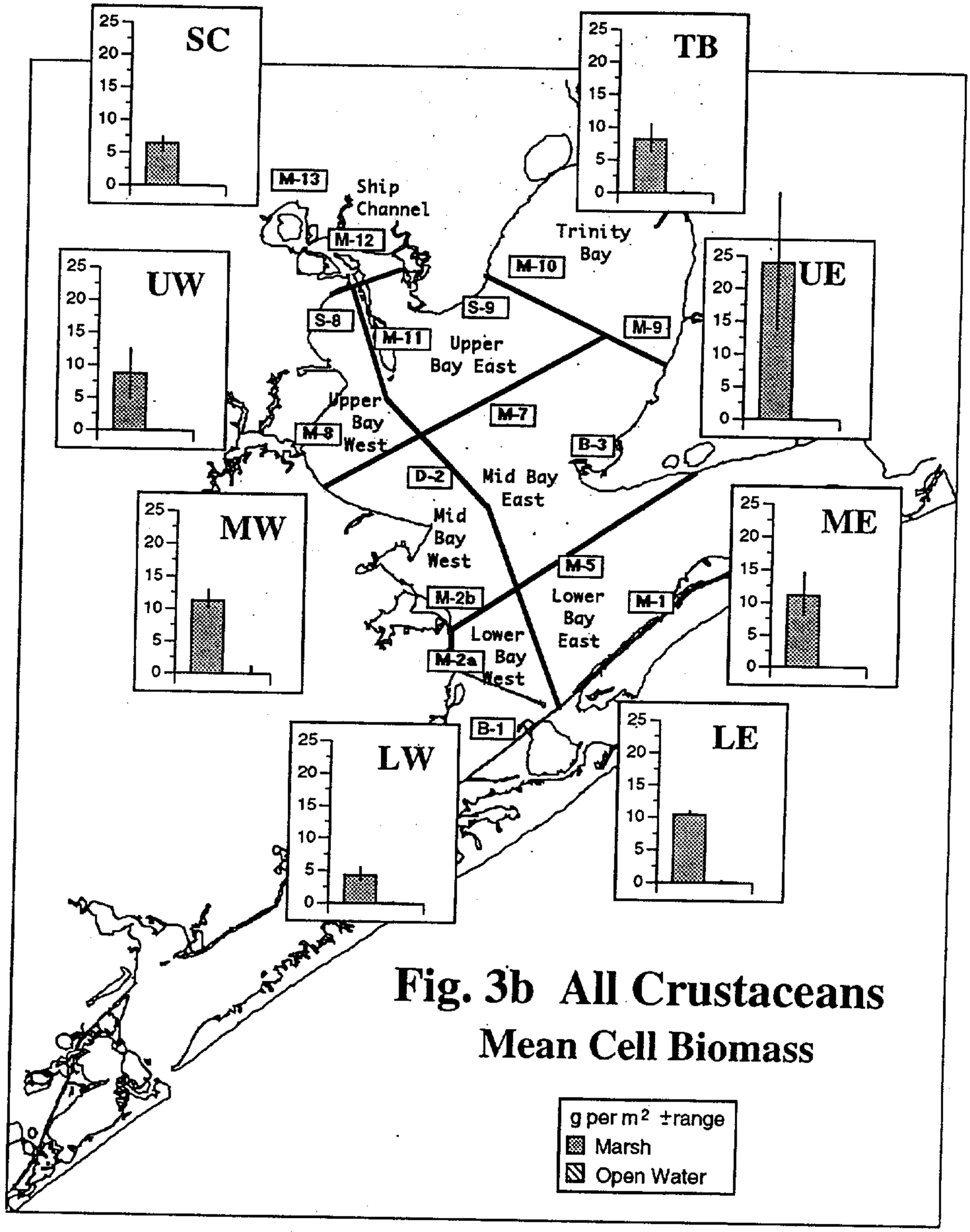
Fig. 3a All Crustaceans

Mean Cell Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

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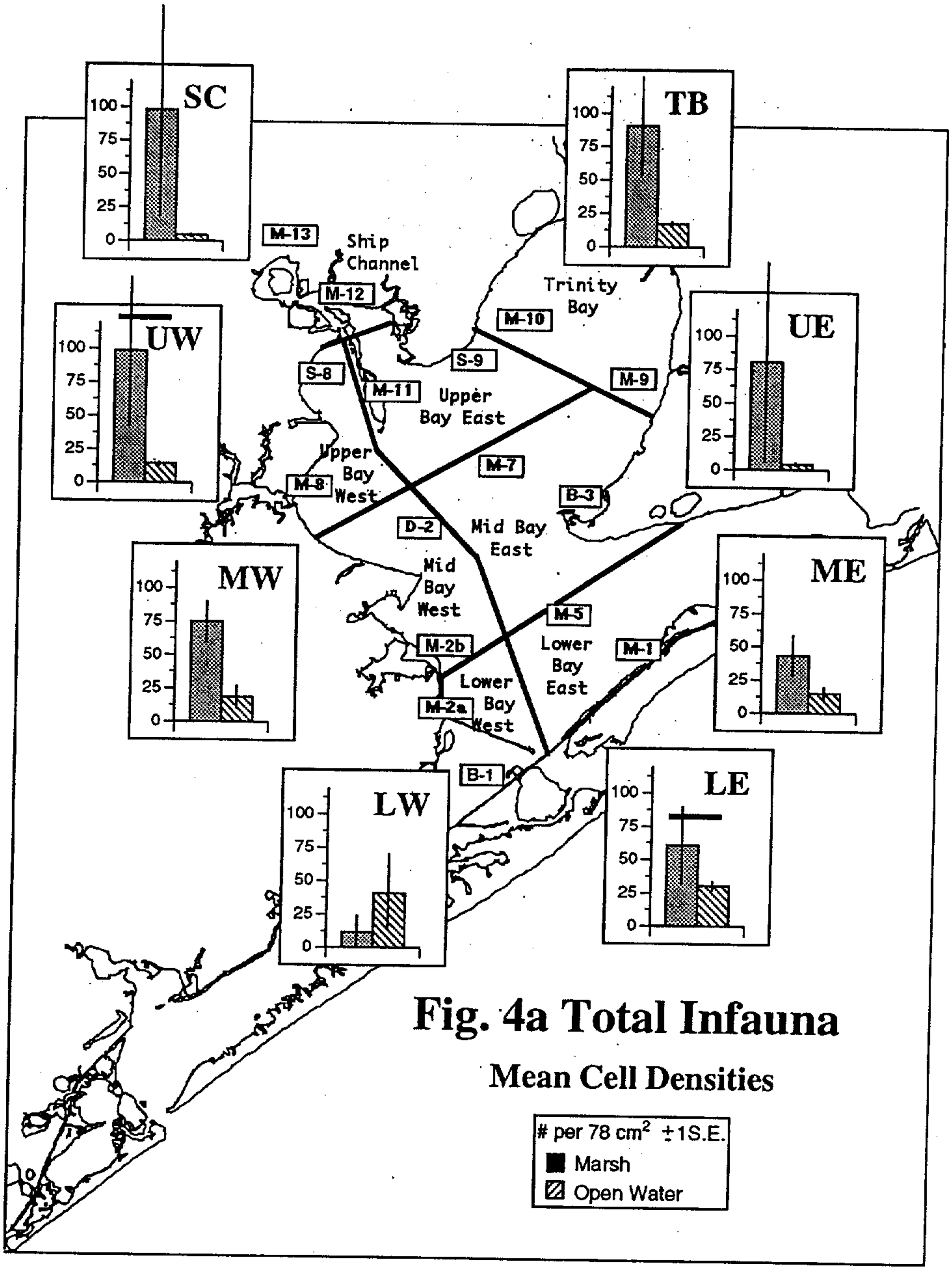


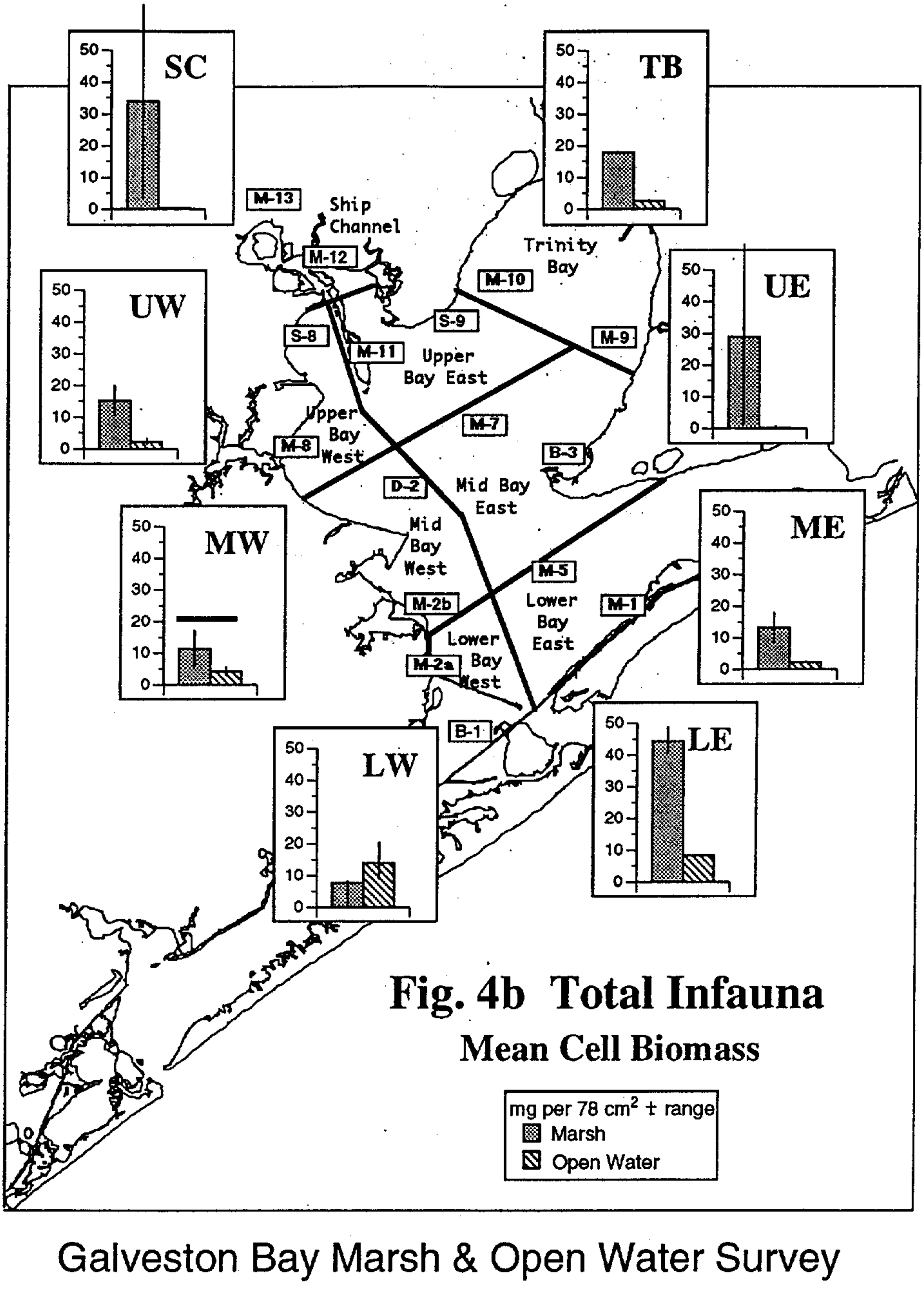
Fig. 4a Total Infauna

Mean Cell Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

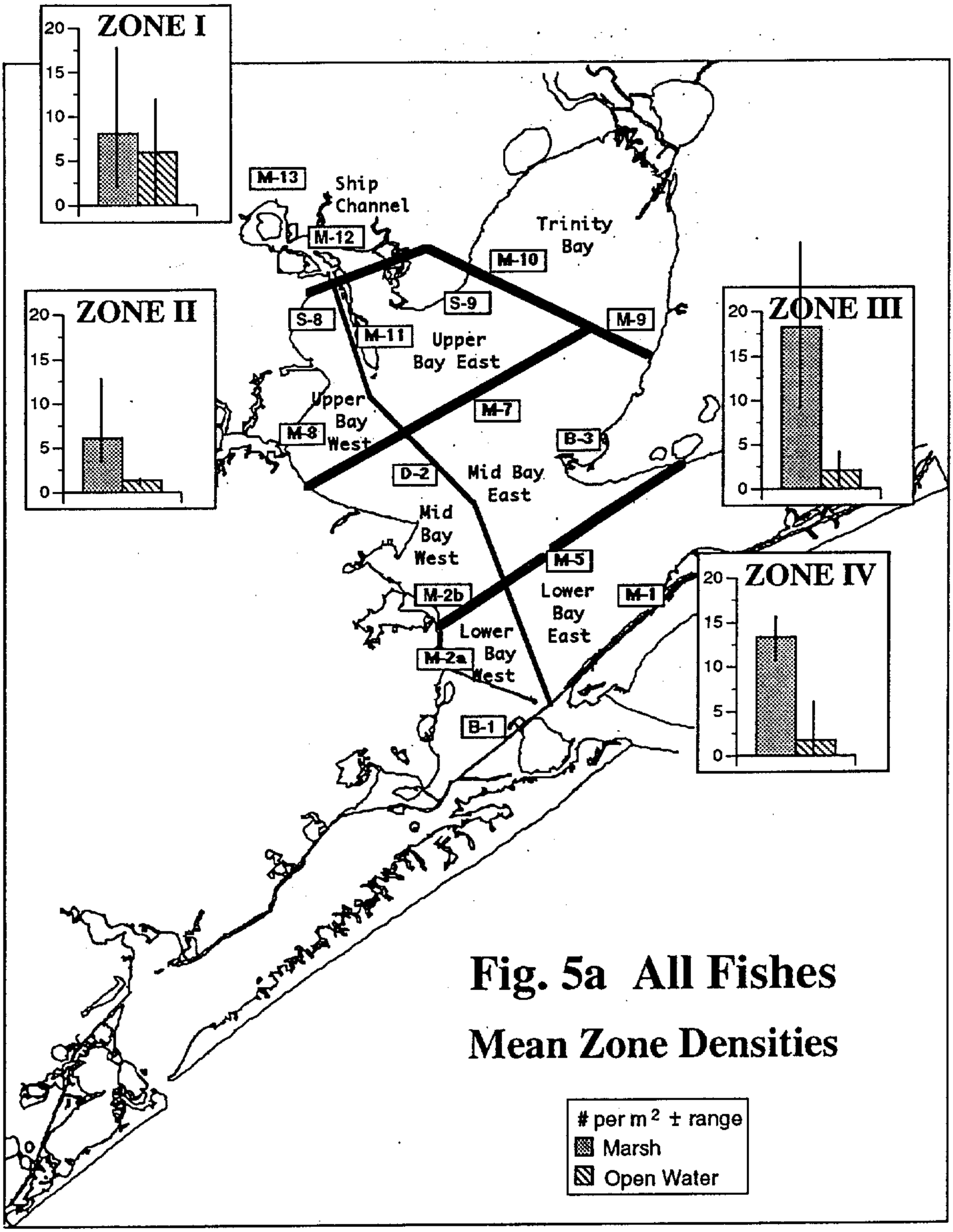


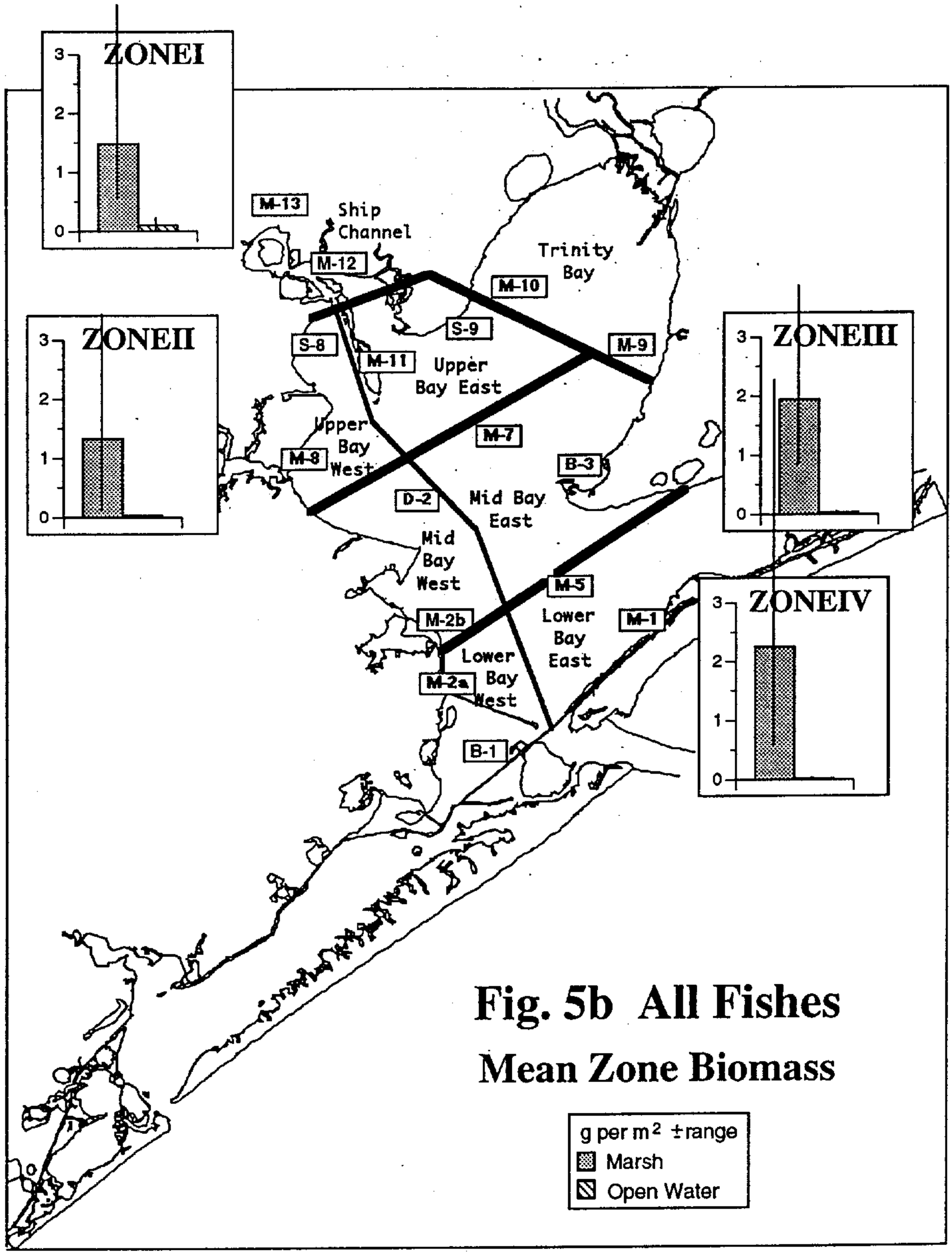
Fig. 5a All Fishes

Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)

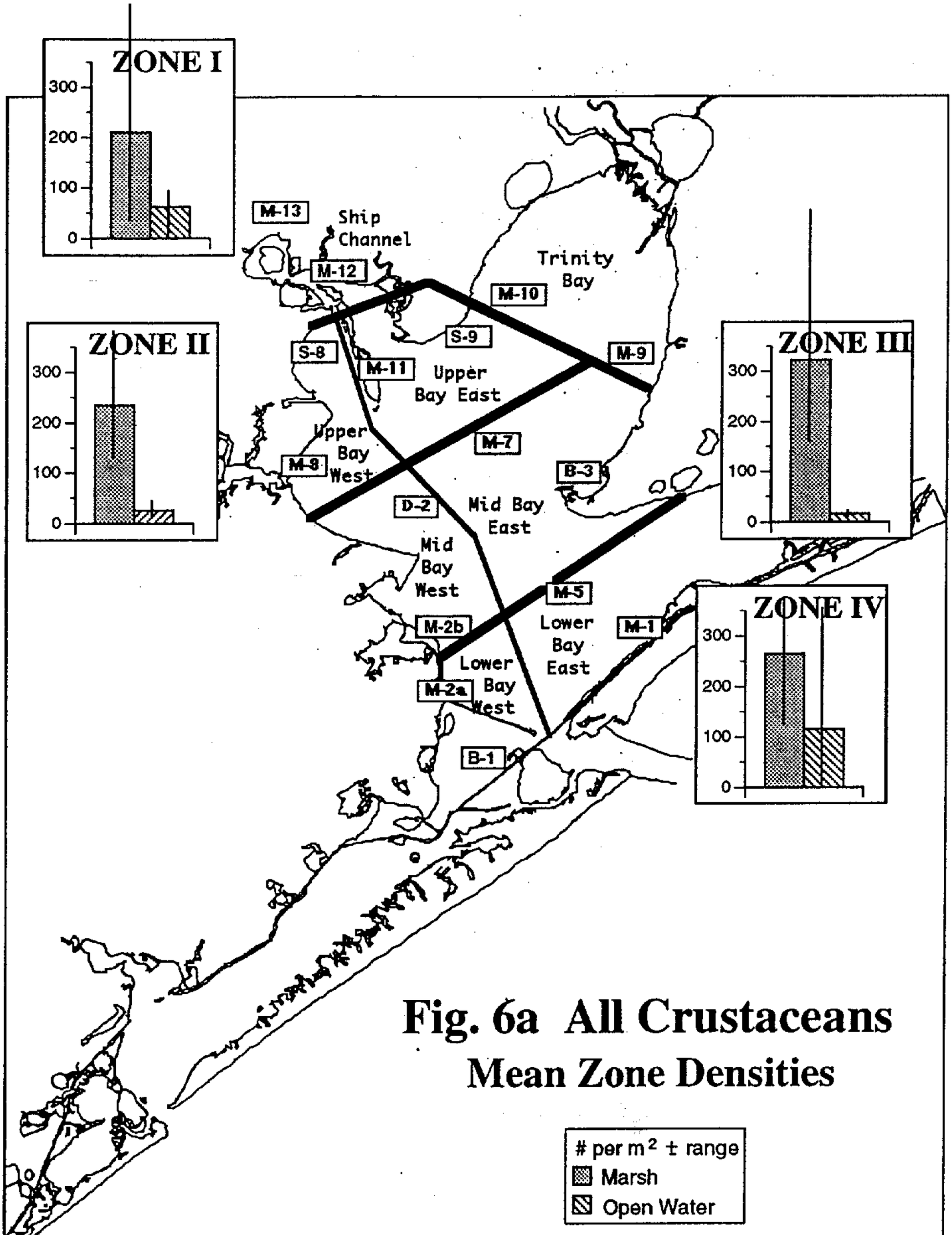


Fig. 6a All Crustaceans
Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

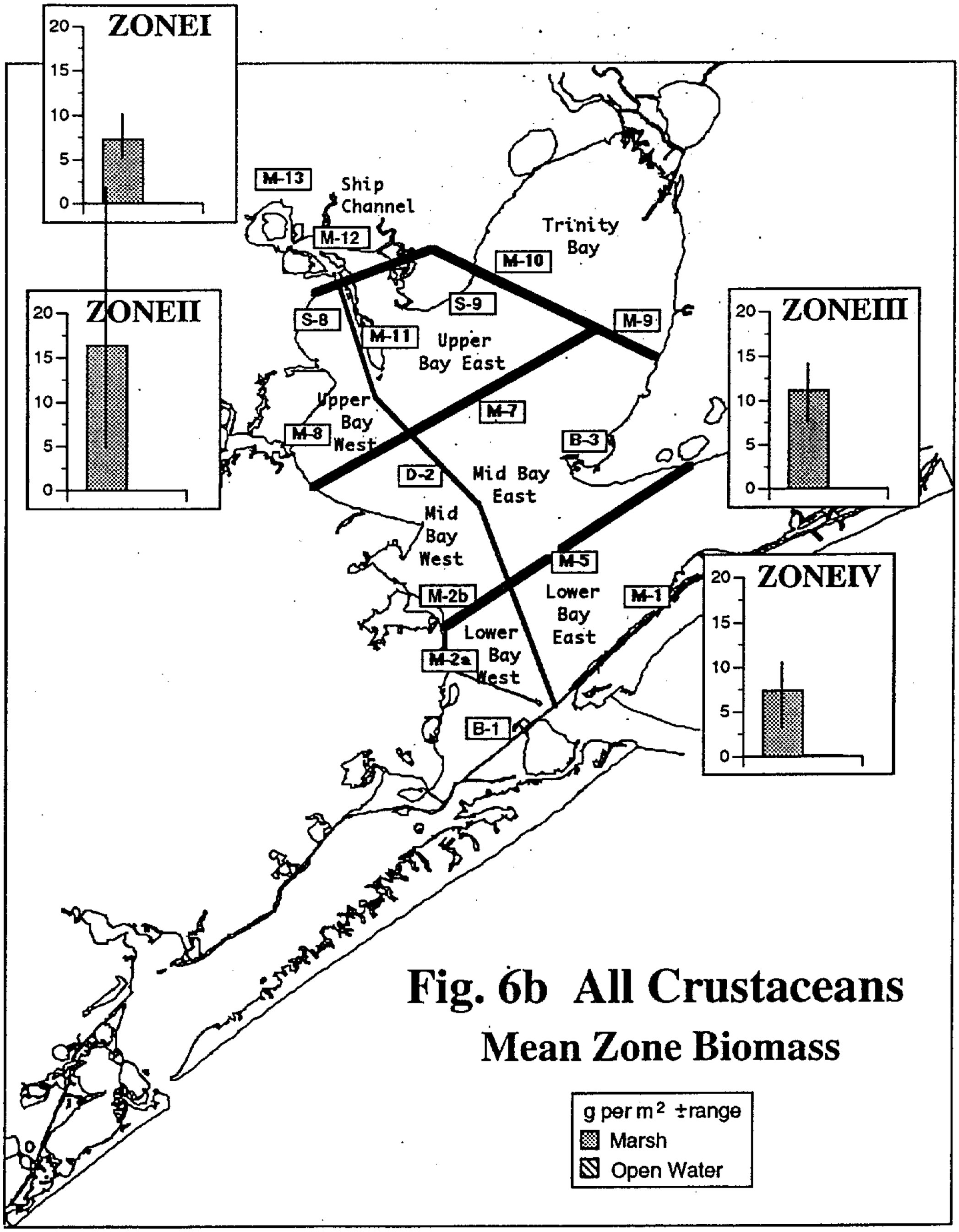


Fig. 6b All Crustaceans Mean Zone Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

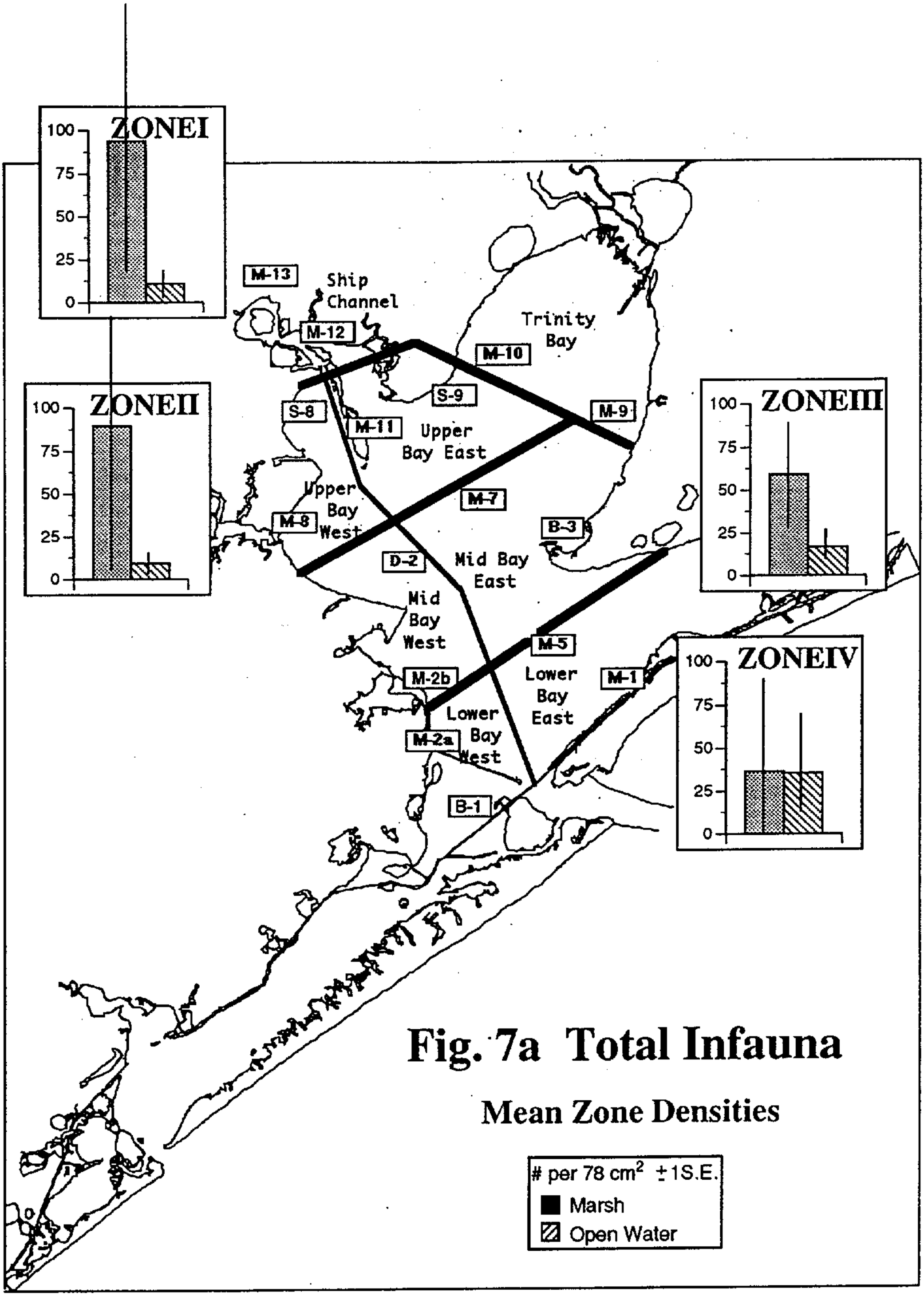
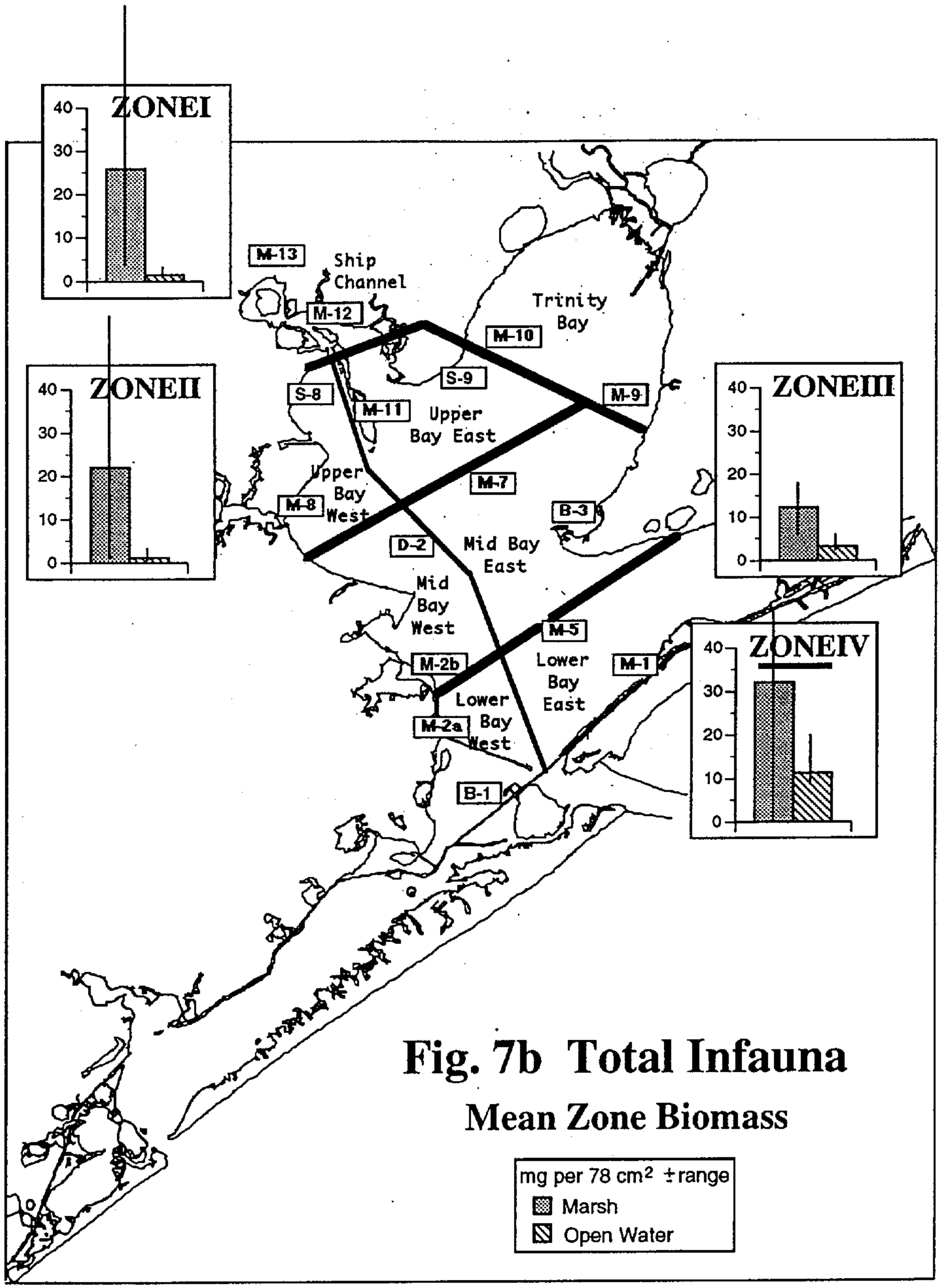


Fig. 7a Total Infauna

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

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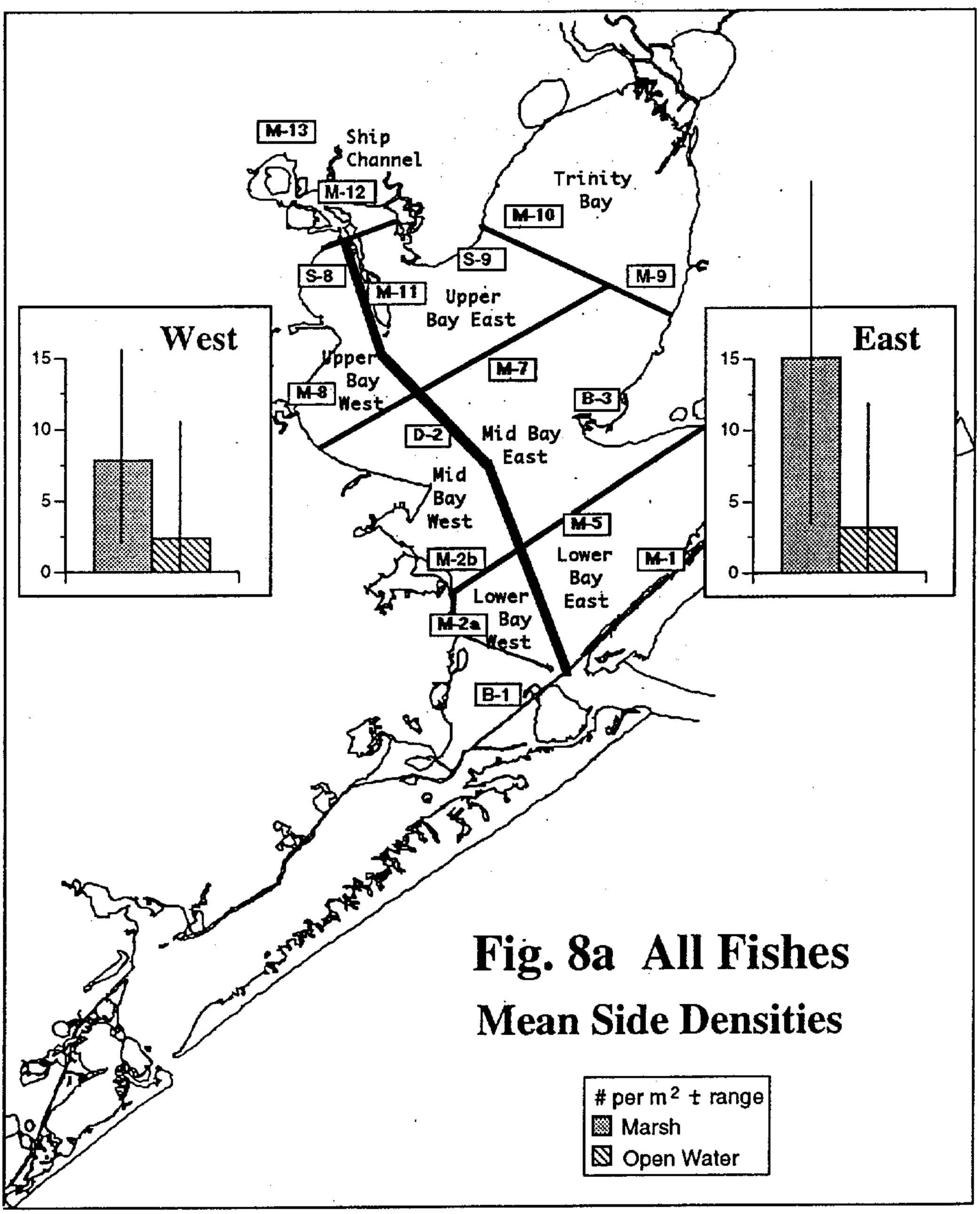
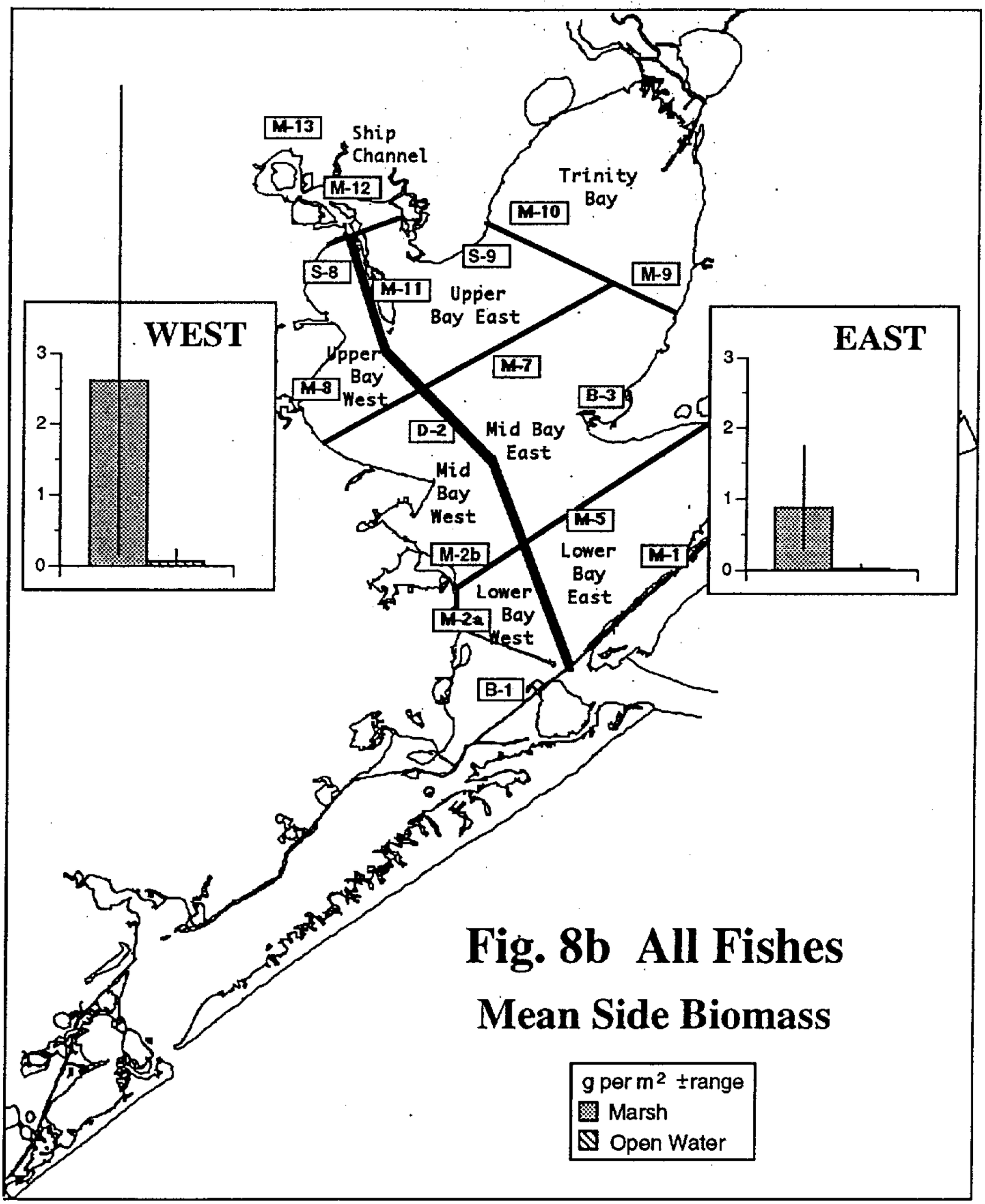


Fig. 8a All Fishes
Mean Side Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)

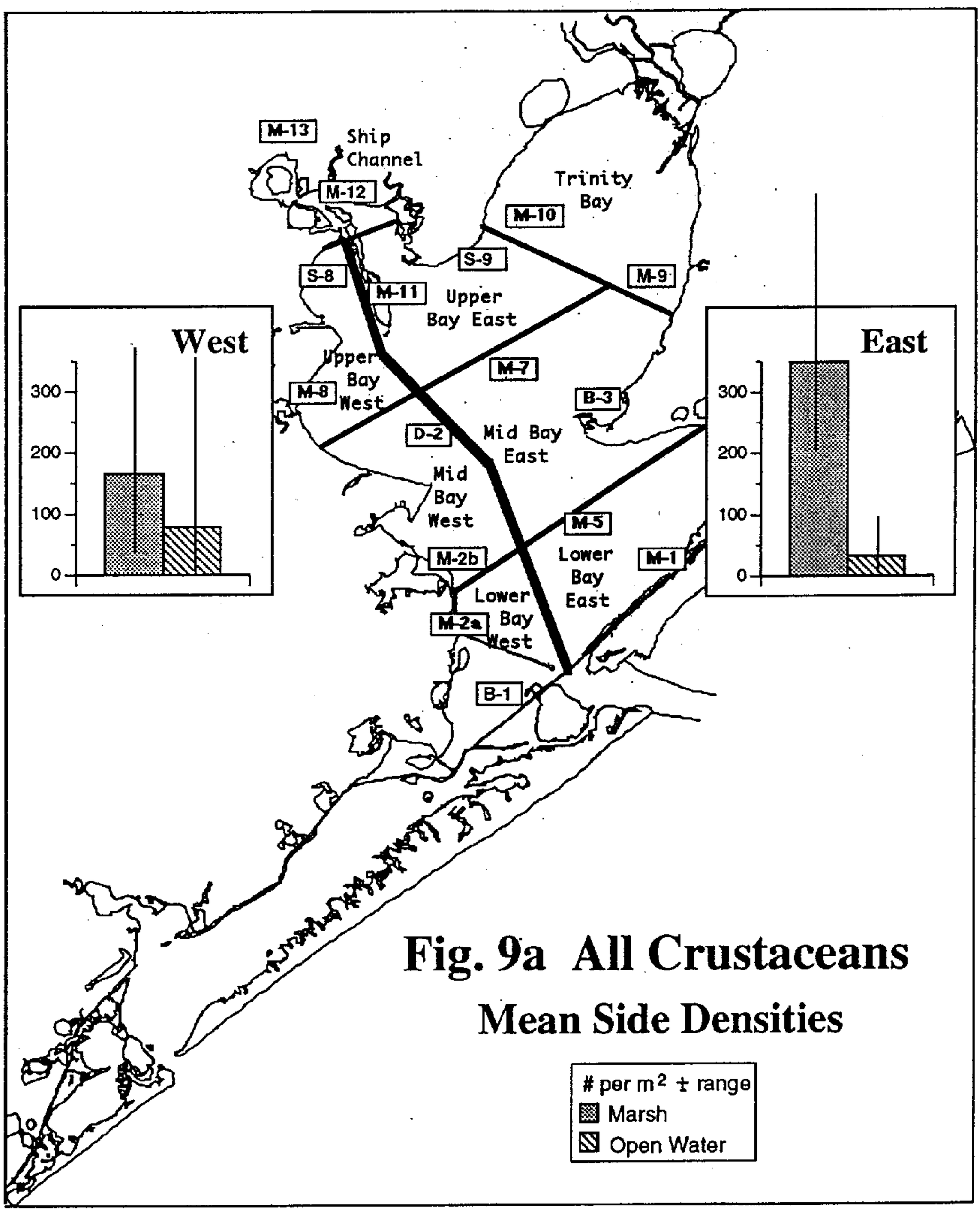


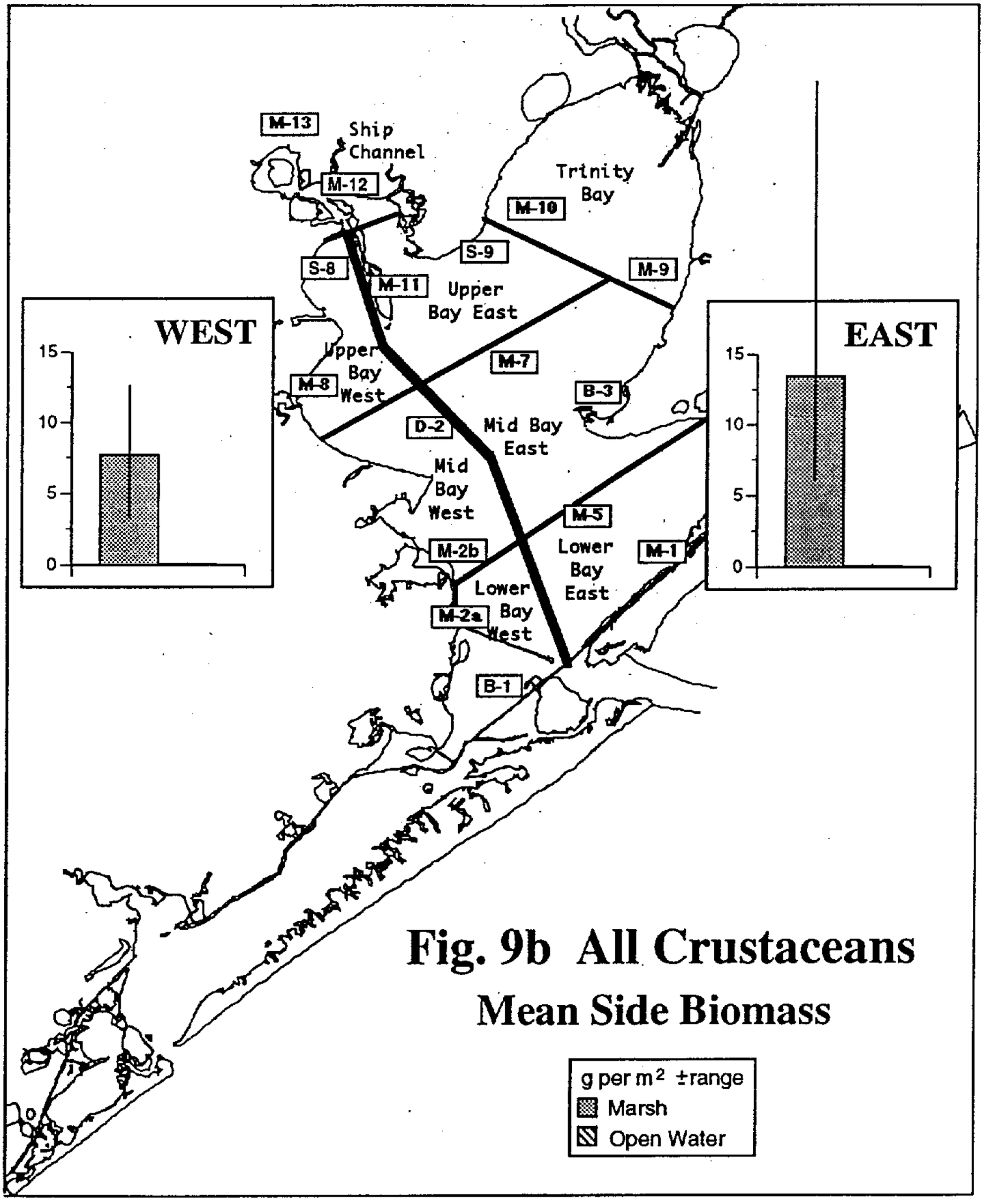
Fig. 9a All Crustaceans

Mean Side Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

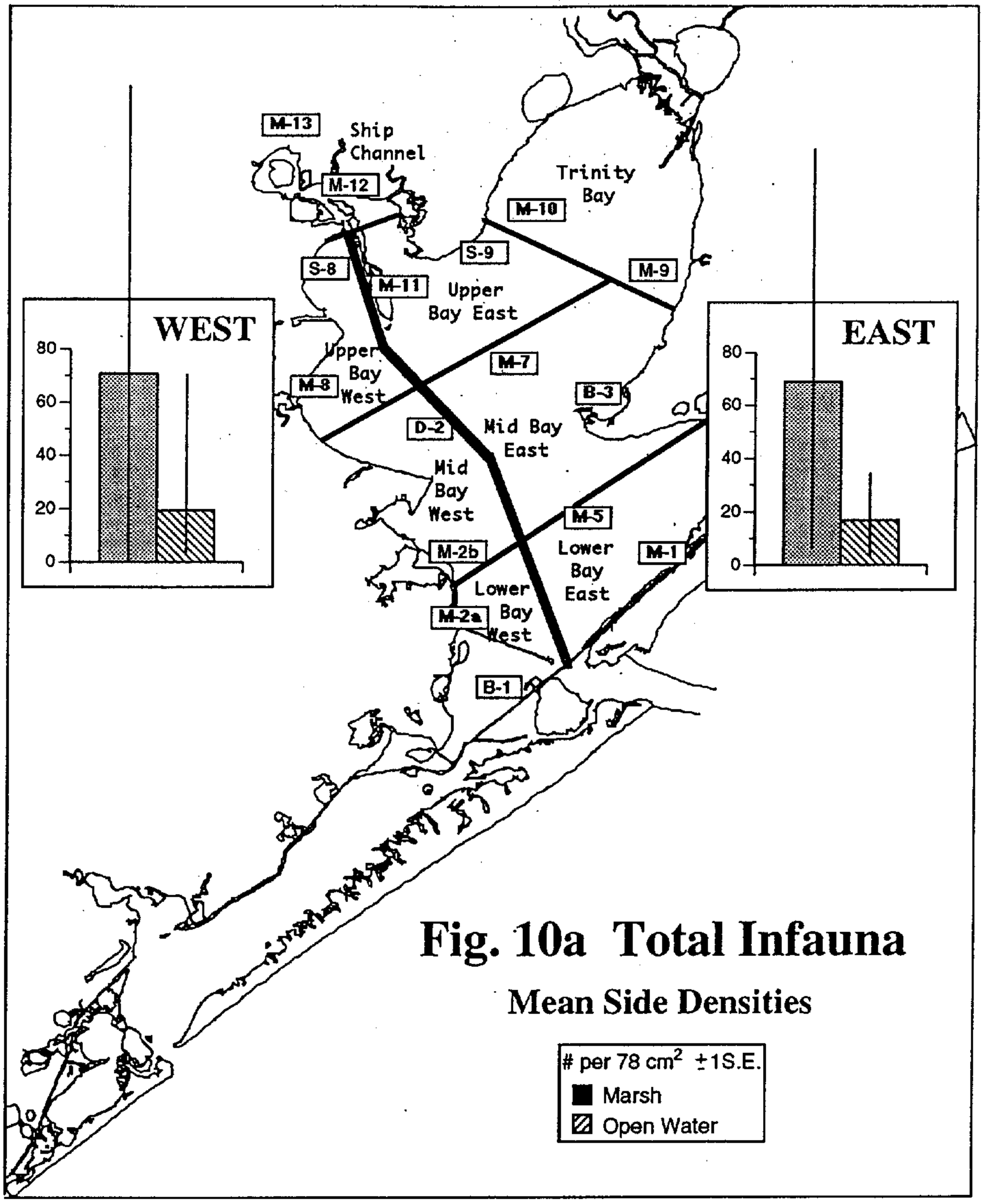
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

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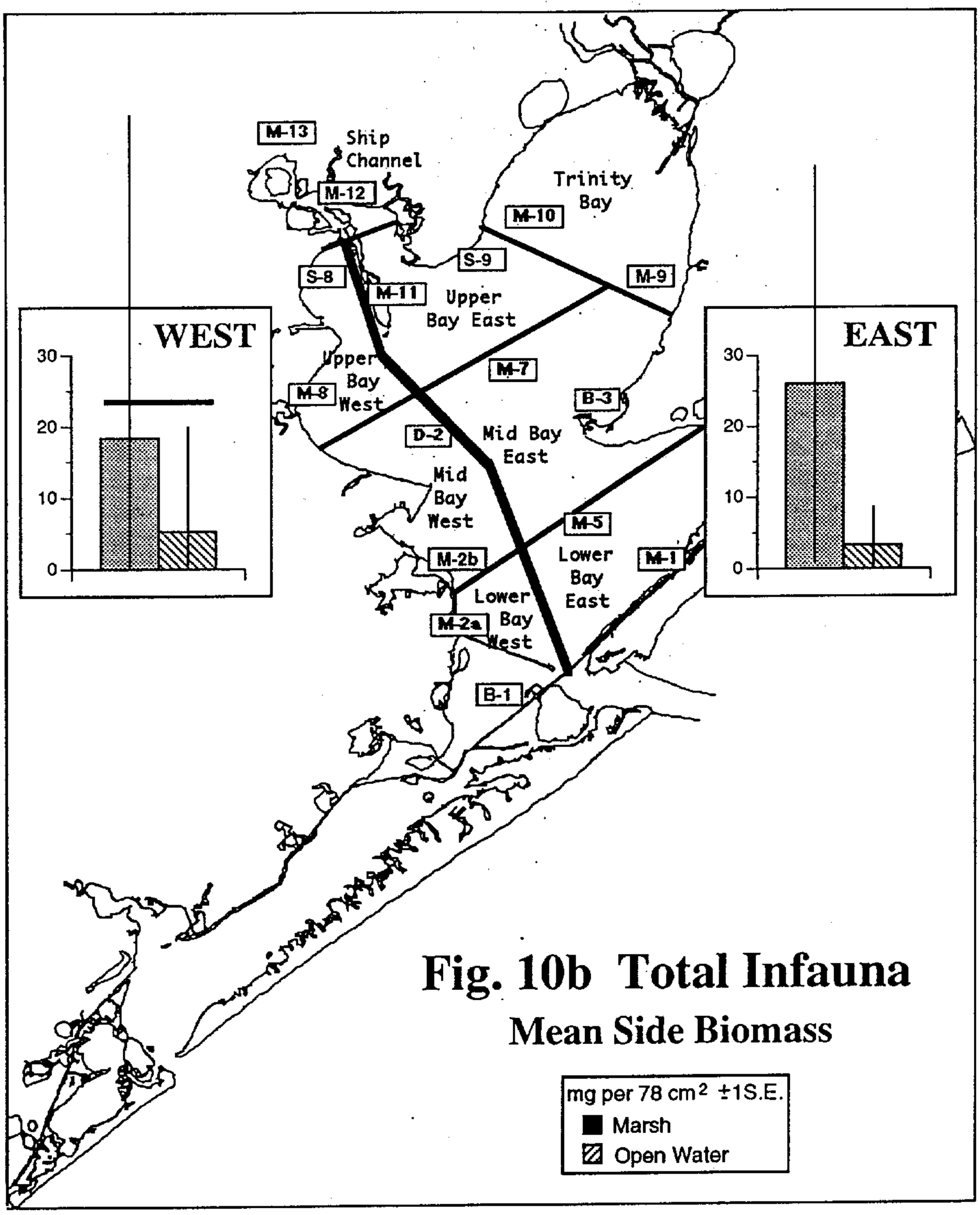

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

Discussion

Community Composition

The community of mobile estuarine fishes and crustaceans was similar throughout the bay. The same species reoccurred and were abundant at every site. Moreover, the composition among these species was more related to habitat type than to location in the bay. Among dominant nekton found in both habitats, the bay anchovy, Atlantic croaker and mysids were mainly associated with open water and penaeid shrimps, blue crab and spotted seatrout were mainly associated with marshes. Certain dominant species such as among palaemonids (grass shrimps), cyprinodontids killifishes) and gobiids (gobies) were entirely restricted to marsh habitat. None of the numerically dominant species in open water were restricted there.

Abundant species were further characterized as transient juveniles of marine species and as major contributors to food chains. Nearly all of the transients are species of importance as commercial or recreational fisheries. These included white shrimp, brown shrimp, blue crab, Atlantic croaker and spotted seatrout. The contributors to food chains were a more diverse group including the juveniles of transient species mentioned above and resident species often described as bait because they occur in such large numbers throughout the system. The resident species that are believed to be important to food chains included bay anchovies, killifishes, gobies, grass shrimps and mysids.

Among infauna, annelid worms (polychaetes and oligochaetes) were most numerous and had highest biomass followed by peracarid crustaceans (amphipods and tanadaceans) and bivalve mollucs.

Habitat Utilization

Usually, the densities and biomasses of fishes, crustaceans and infauna were significantly higher in the marsh than in open water. But these differences were largely determined by dominance of particular species which were not the same in marsh and open water. For instance, overall numbers and biomass of crustaceans were affected mainly by shrimps and crabs in the marsh and mainly by mysids in open water. Likewise, overall numbers and biomass of fishes resulted from the dominance of gobies, killifishes and spotted seatrout in the marsh and from dominance of bay anchovy and Atlantic croaker in open water.

Overall, annelids and peracarids were significantly more numerous in marsh habitat, while molluscs demonstrated no consistant habitat related

pattern. The high numbers of infauna in marsh demonstrates the potential importance of this habitat as a foraging area for aquatic predators.

Areawise Utilization

In general, the eastern and lower bay areas had higher abundance and biomass of fish and decapod crustacean fauna compared to the western and uppermost areas of the system. Greater differences in densities and biomass between marsh and open water reflected this pattern, with the lower and eastern areas having the most fishes and crustaceans in the marsh and the upper and western bay areas having the fewest.

Fishes were more abundant on the eastern side, but had greater biomass on the western side, indicating relatively larger sizes on the western side. Size differences appeared to result from differences between species (large anchovies in the western area versus small gobies in the eastern area). By contrast, crustaceans were both more numerous and had greater biomass on the eastern versus the western side of the bay. The high densities and biomass in the marsh on the eastern side were attributable to large numbers of brown shrimp, white shrimp and grass shrimp. Interestingly, blue crabs did not conform to the pattern of the other decapods. Blue crabs were roughly equivalent in both density and biomass between the eastern and western sides of the system.

Fishes in the uppermost bay zones were less different in density between marsh and open water than in the lower bay zones. This pattern was due to localized occurrence of bay anchovy and Atlantic croaker in open water in the upper bay in association with unvegetated shorelines. More bay anchovies and Atlantic croaker were found along these barren shorelines (with sparse or no stands of marsh) compared to other areas, suggesting that these are important areas for open water fishes. By contrast, marsh associated fishes like spotted seatrout occurred in abundance only in areas wherever marshes dominated the shoreline.

Distributions of most crustaceans did not fall into zonal patterns like fishes. Brown shrimp, white shrimp, blue crab and grass shrimp were consistently more numerous and had more biomass in marsh habitat and were evenly distributed throughout all zones. Mysids were the exception with more abundance in open water in the uppermost and lower zones, but not in the middle and intermediate zones.

On the area-sized scale of two sites per cell, differences in patterns due to localized distributions became even more apparent. These cells allowed us to partition the bay into eight areal subunits designated as the

Upper Ship Channel (SC), Trinity Bay (TB), Upper Bay West (UW), Upper Bay East (UE), Mid Bay West (MW), Mid Bay East (ME), Lower Bay West (LW) and Lower Bay East (LE).

Fishes were more numerous in marshes and showed greatest differences between marsh and open water at cells MW, LW, LE, ME and UE. By comparison, cells TB, SC and UW had least numbers of fishes and lowest differences between marsh and open water. The opposite pattern emerged for fish biomass, confirming that smaller sizes of fishes were associated with marshes in the eastern bay. Bay anchovies were more numerous in the upper bay in open water at cells SC and TB. Likewise, Atlantic croaker were most abundant at SC and mainly in open water. These distributions are in areas with few marshes along the shoreline, confirming that both the bay anchovy and Atlantic croaker are characteristic open water species. On the other hand, spotted seatrout, gobies and toungefish were lowest in abundance and biomass at SC and UW, areas with few marshes, confirming the importance of marsh association to these species.

Relationships between abundance and biomass of crustaceans did not reflect animal size differences, but did indicate habitat differences among cells. Crustacean abundance in cell SC was not different between habitats and abundance was low in SC, UW and MW compared to other cells. Grass shrimps, in particular, were not abundant in marshes of cells SC, UW and MW. Mysids, by contrast, were comparatively abundant at SC and TB suggesting importance as open water species. Mysids were also abundant at LW and LE, confirming a possible affiliation with uppermost and lowermost zones reported previously. Densities were lowest for brown shrimp at UW, for white shrimp at UW and LW, and for grass shrimp at SC. Nursery utilization for these shrimp species was highly related to marsh habitat throughout. Blue crab were also highly associated with marsh habitat, but were evenly distributed throughout the bay. This may indicate that the system has more widespread potential in terms of nursery utilization for blue crab than shrimp.

Areawise, infaunal densities and biomass were roughly inversely related to distributions of fishes and decapod crustaceans. Some of the highest densities and biomass of infauna were in cells SC and UW in the upper and western system where fish and decapod numbers were low. Corresponding lowest infaunal numbers occurred in cells LW, LE and ME in the lower and eastern system where predator numbers were relatively high. These data point out the especially important relationship between annelids and peracarids as prey and small fishes, shrimps and crabs as predators.

Summary

During the fall of 1990 marsh and open water habitats were dominated by differing numerically dominant species throughout the bay. Marsh fauna was characterized by white shrimp, brown shrimp, blue crab, grass shrimp, spotted seatrout, killifishes and gobies. Open water fauna was characterized by mysids, bay anchovies and Atlantic croaker.

2) The eastern side of the bay contained the greatest abundance of marsh fauna, mainly crustaceans, and had greatest differences between marsh and open water habitats. The western side of the bay had larger fish sizes and the least difference in fish abundance between marsh and open water.

3) The greatest abundance and biomass of marsh fishes and crustaceans were in the lower half of the bay in Zones III and IV. These lower bay marshes also had correspondingly greater numbers of brown shrimp, white shrimp and spotted seatrout.

4) The least numbers of marsh fishes and crustaceans were in the upper bay in Zone II, incorporating barren shorelines near Seabrook, LaPorte and the western part of Trinity Bay.

5) The most abundance of open water fishes, including bay anchovy and Atlantic croaker were in Zone I, incorporating the Houston Ship Channel and Trinity delta. Mysids were most abundant in the upper bay Zone I and in the lower bay Zone IV.

6) Cells having the most marsh fishes were the Mid Bay East, Lower Bay East, and Lower Bay West. Cells with the most crustaceans were the Mid Bay East and Trinity Bay.

7) The cell with the least number of marsh fishes was the Upper Bay West. The cell with the least number of marsh crustaceans was the Houston Ship Channel.

8) Cells having greatest numbers of bay anchovy in open water were Ship Channel and Trinity Bay cells. Atlantic croaker was also most abundant in open water in the Ship Channel.

9) Cells having the most brown shrimp in marsh habitat were Mid Bay East and Trinity Bay; the most white shrimp in marsh habitat were Lower Bay East and Upper Bay East; and the most spotted seatrout in marsh were Lower Bay West and Trinity Bay.

10) Blue crabs were evenly associated with marsh habitat throughout the bay.

11) Infauna showed higher densities and biomass in marsh habitat compared to open water in most areas of the bay.

12) Lower densities of infauna in the lower bay appeared to reflect a relationship to higher numbers of predators.

Conclusions

Our data indicate that marshes created in the lower and eastern sides of Galveston Bay have the best chance of achieving significant gains in abundance and biomass of fish and decapod crustacean fauna. Notably, these are areas where large marshes already exist in East Bay and Trinity Bay.

Marshes created along barren shorelines could also hypothetically achieve significant biological gain, but the risk of failure may be high in these areas. They incorporate areas of active erosion and marsh creation would supplant open water habitat with high abundances of characteristic fauna.

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APPENDICES

(Appendix Tables 1-4, Appendix Figures 1-63.)

Appendix Table 1. Mean densities (number per m sq. +/- Std. Error) of Nekton in Marsh and Open Water habitats at sites in the Houston Ship Channel, Trinity Bay and Upper Galveston Bay.

ZONE I

	Ash Point - M10				Tabb's Bay - M12				Brownwood - M13				Double Bayou - M9			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
All Fishes	17.9	2.44	0.1	0.04	2.0	0.51	1.0	0.30	5.8	2.92	10.7	3.64	6.5	0.57	12.0	9.28
Bait Fishes	2.4	1.82	0.0	0.00	0.5	0.18	0.6	0.24	2.0	1.23	10.1	3.62	0.1	0.10	9.8	9.82
Anchoa mitchilli	2.4	1.82	0.0	0.00	0.0	0.00	0.6	0.24	1.9	1.14	10.1	3.62	0.0	0.00	9.8	9.82
Micropogonias undulatus	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.1	0.02	0.0	0.00	0.0	0.00
Commercial Fishes	1.7	0.79	0.0	0.00	0.5	0.24	0.0	0.00	0.1	0.10	0.1	0.04	0.6	0.25	0.2	0.16
Sciaenidae	1.7	0.79	0.0	0.00	0.5	0.24	0.2	0.08	0.1	0.10	0.2	0.02	0.7	0.33	0.2	0.16
Cynoscion nebulosus	1.7	0.79	0.0	0.00	0.5	0.24	0.0	0.00	0.0	0.00	0.1	0.04	0.6	0.25	0.2	0.16
Cyprinodontidae	0.0	0.00	0.0	0.00	0.2	0.11	0.0	0.00	1.2	1.15	0.0	0.00	0.0	0.00	0.0	0.00
Gobiidae	12.5	2.13	0.0	0.02	0.6	0.25	0.2	0.04	2.2	2.09	0.3	0.07	5.3	0.53	0.9	0.24
Gobiosoma bosci	11.5	2.76	0.0	0.02	0.5	0.24	0.1	0.04	2.2	2.09	0.2	0.09	4.9	0.43	0.6	0.19
Symphurus plagiusa	0.7	0.29	0.0	0.01	0.0	0.00	0.1	0.03	0.2	0.11	0.1	0.04	0.0	0.00	0.0	0.00
All Crustaceans	465.0	187.54	4.1	1.19	127.4	18.62	93.6	20.40	35.2	11.02	70.4	12.60	211.5	56.04	81.6	15.81
Penaeid Shrimp	29.8	8.93	0.7	0.38	59.8	9.60	1.5	0.26	8.5	4.17	2.0	0.17	46.3	11.10	6.6	0.32
Penaeus aztecus	7.3	2.76	0.2	0.11	3.8	1.03	0.1	0.08	5.5	2.42	0.1	0.05	7.2	1.95	0.1	0.14
Penaeus setiferus	22.5	6.41	0.5	0.32	55.1	9.66	1.4	0.30	1.7	1.24	1.9	0.19	39.1	10.48	6.4	0.40
Callinectes sapidus	13.3	2.94	0.2	0.15	22.9	2.51	0.9	0.28	18.4	6.13	0.5	0.30	11.1	2.58	0.7	0.45
Mysidae	0.0	0.00	3.1	0.76	4.5	3.43	91.1	20.29	0.0	0.00	67.8	12.56	0.0	0.00	73.4	16.02
Grass Shrimp	421.3	160.54	0.0	0.00	38.6	7.54	0.0	0.00	7.1	3.14	0.0	0.00	151.7	46.33	0.0	0.00
Palaemonetes pugio	404.9	167.06	0.0	0.00	37.2	6.62	0.0	0.00	6.0	2.32	0.0	0.00	136.8	46.75	0.0	0.00

ZONE II

	Atkinson Island -M11				Seabrook - M8				LaPorte - S8				Houston Point - S9			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
All Fishes	3.5	1.02	0.9	0.27	4.3	2.02	1.5	1.09	3.7	1.90	1.6	0.50	13.1	4.83	1.4	0.25
Bait Fishes	0.1	0.10	0.3	0.17	0.4	0.38	1.1	1.10	0.4	0.27	1.1	0.48	0.0	0.00	0.7	0.27
Anchoa mitchilli	0.1	0.10	0.3	0.17	0.4	0.38	1.1	1.10	0.0	0.00	1.1	0.48	0.0	0.00	0.7	0.27
Micropogonias undulatus	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.01	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
Commercial Fishes	0.7	0.40	0.0	0.00	0.3	0.18	0.0	0.01	0.1	0.10	0.0	0.00	0.0	0.00	0.0	0.01
Sciaenidae	0.7	0.40	0.0	0.02	0.3	0.18	0.0	0.02	0.2	0.11	0.3	0.11	0.0	0.00	0.0	0.01
Cynoscion nebulosus	0.7	0.40	0.0	0.00	0.1	0.10	0.0	0.00	0.1	0.10	0.0	0.00	0.0	0.00	0.0	0.00
Cyprinodontidae	0.3	0.18	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	1.3	0.76	0.0	0.00
Gobiidae	1.6	0.60	0.5	0.15	2.0	1.17	0.3	0.06	2.1	1.81	0.1	0.02	10.4	5.01	0.6	0.03
Gobiosoma bosci	1.4	0.51	0.5	0.15	1.8	1.06	0.2	0.09	1.9	1.68	0.0	0.01	9.7	4.89	0.5	0.08
Symphurus plagiusa	0.5	0.18	0.0	0.00	0.2	0.19	0.1	0.05	0.0	0.00	0.1	0.02	0.3	0.18	0.1	0.04
All Crustaceans	236.9	53.93	23.9	11.61	128.1	36.02	44.7	12.05	195.4	83.64	22.2	4.24	379.2	112.24	11.8	1.60
Penaeid Shrimp	55.8	12.88	0.1	0.10	5.9	2.39	0.8	0.18	3.9	0.78	0.5	0.12	69.6	28.80	1.7	0.17
Penaeus aztecus	7.2	3.31	0.1	0.05	1.9	0.61	0.4	0.12	2.3	0.72	0.1	0.05	3.5	1.38	0.6	0.31
Penaeus setiferus	48.4	11.14	0.0	0.05	3.9	1.79	0.5	0.17	1.6	0.29	0.4	0.09	66.2	28.78	1.1	0.33
Callinectes sapidus	42.2	10.87	0.0	0.00	24.1	9.65	1.9	1.07	32.5	9.86	0.8	0.39	21.7	4.89	3.7	0.63
Mysidae	1.4	0.87	23.7	11.65	0.0	0.00	39.5	10.62	3.6	2.45	19.9	3.85	0.5	0.45	6.3	1.42
Grass Shrimp	134.6	54.74	0.0	0.01	94.0	28.42	0.0	0.00	154.1	74.28	0.0	0.01	277.5	105.57	0.0	0.01
Palaemonetes pugio	126.5	53.85	0.0	0.00	46.8	22.52	0.0	0.00	107.8	51.01	0.0	0.00	231.8	101.03	0.0	0.01

Appendix Table 1 (cont.). Mean densities (number per m sq. +/- Std. Error) of Nekton in Marsh and Open Water habitats at sites in Middle and Lower Galveston Bay.

ZONE III

	Ving-et-un Islands - B3				Redfish - D2				Moses Lake - M2b				Smith Point - M7			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
All Fishes	27.6	11.39	0.2	0.04	11.3	2.67	1.4	0.61	9.1	0.69	2.2	1.79	24.6	4.04	4.9	0.67
Bait Fishes	10.6	6.65	0.0	0.00	0.1	0.10	0.2	0.04	1.3	0.51	0.0	0.00	0.2	0.11	3.5	0.64
Anchoa mitchilli	10.6	6.65	0.0	0.00	0.0	0.00	0.2	0.04	0.0	0.00	0.0	0.00	0.0	0.00	3.5	0.64
Micropogonias undulatus	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.01	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
Commercial Fishes	1.2	0.42	0.0	0.00	0.8	0.27	0.0	0.00	0.2	0.11	0.1	0.07	1.2	0.27	0.0	0.00
Sciaenidae	1.3	0.33	0.0	0.00	0.8	0.27	0.5	0.46	0.2	0.11	0.1	0.07	1.2	0.27	0.0	0.02
Cynoscion nebulosus	0.9	0.33	0.0	0.00	0.8	0.27	0.0	0.00	0.1	0.10	0.1	0.07	1.2	0.27	0.0	0.00
Cyprinodontidae	0.3	0.29	0.0	0.00	0.1	0.10	0.0	0.00	1.3	0.51	0.0	0.00	0.7	0.40	0.0	0.00
Gobiidae	11.4	3.84	0.2	0.06	7.0	2.04	0.5	0.18	5.2	1.05	1.1	0.64	19.6	4.35	0.3	0.10
Gobiosoma bosci	8.4	4.84	0.0	0.00	5.7	2.36	0.0	0.02	3.7	1.56	0.0	0.01	16.5	3.30	0.2	0.05
Symphurus plagiusa	3.0	1.09	0.1	0.07	0.8	0.35	0.2	0.14	0.6	0.11	1.0	1.03	2.2	0.76	0.4	0.09
All Crustaceans	313.1	59.30	24.7	7.67	163.2	50.66	14.9	1.94	179.8	39.70	17.8	6.92	632.5	74.39	9.6	1.76
Penaeid Shrimp	25.1	12.22	0.4	0.19	42.1	13.34	0.7	0.23	38.4	8.92	3.6	1.26	49.3	5.73	0.4	0.13
Penaeus aztecus	5.1	1.83	0.1	0.03	8.0	4.29	0.1	0.03	5.0	1.16	0.0	0.03	11.1	1.52	0.0	0.03
Penaeus setiferus	20.0	10.50	0.3	0.17	34.1	9.27	0.7	0.20	32.5	9.05	3.3	1.20	38.3	5.60	0.4	0.13
Callinectes sapidus	27.2	3.05	0.1	0.08	19.8	2.67	0.3	0.18	11.4	2.29	0.0	0.00	24.4	2.78	0.1	0.08
Mysidae	16.3	5.63	24.3	7.76	23.5	21.18	13.5	1.84	0.5	0.45	14.3	5.90	8.1	3.50	9.0	1.79
Grass Shrimp	236.3	58.78	0.0	0.00	69.5	26.73	0.1	0.04	123.8	30.15	0.0	0.00	546.0	71.41	0.0	0.01
Palaemonetes pugio	162.0	60.63	0.0	0.00	37.9	19.42	0.0	0.00	117.5	29.54	0.0	0.00	406.9	80.72	0.0	0.00

ZONE IV

	Pelican Spit - B1				Bolivar Peninsula - M1				Texas City Dike - M2a				Bird Island - M5			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
All Fishes	10.7	1.19	0.6	0.14	12.4	2.47	6.1	1.46	15.8	4.68	0.1	0.04	14.5	2.90	0.3	0.19
Bait Fishes	0.5	0.48	0.1	0.07	0.1	0.10	4.2	1.13	1.4	0.79	0.0	0.00	0.0	0.00	0.2	0.21
Anchoa mitchilli	0.5	0.48	0.1	0.07	0.0	0.00	4.2	1.13	1.2	0.74	0.0	0.00	0.0	0.00	0.2	0.21
Micropogonias undulatus	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.02
Commercial Fishes	0.4	0.16	0.1	0.03	0.3	0.18	0.3	0.14	1.8	0.62	0.1	0.04	0.4	0.22	0.0	0.00
Sciaenidae	0.3	0.10	0.1	0.02	0.4	0.27	0.3	0.14	1.9	0.57	0.1	0.04	0.4	0.22	0.0	0.02
Cynoscion nebulosus	0.3	0.10	0.0	0.00	0.3	0.18	0.2	0.12	1.8	0.62	0.0	0.00	0.4	0.22	0.0	0.00
Cyprinodontidae	0.9	0.87	0.0	0.00	0.2	0.19	0.0	0.00	0.0	0.00	0.0	0.00	0.1	0.10	0.0	0.00
Gobiidae	4.9	0.57	0.3	0.04	11.3	2.50	1.6	0.28	8.3	1.54	0.0	0.01	12.7	2.58	0.0	0.00
Gobiosoma bosci	0.2	0.19	0.0	0.01	4.6	0.90	0.6	0.13	6.3	1.85	0.0	0.00	2.5	0.51	0.0	0.00
Symphurus plagiusa	2.8	1.07	0.1	0.04	0.2	0.19	0.0	0.00	3.6	2.80	0.0	0.01	0.1	0.10	0.0	0.00
All Crustaceans	125.1	44.10	356.5	39.90	208.1	45.90	97.5	13.06	373.1	69.44	5.0	1.99	350.1	53.02	6.1	1.79
Penaeid Shrimp	14.0	2.07	0.8	0.28	60.7	39.71	2.0	0.52	6.7	3.71	0.4	0.25	89.9	18.10	2.1	0.78
Penaeus aztecus	6.9	2.82	0.0	0.03	4.6	0.57	0.0	0.00	1.9	0.74	0.0	0.00	5.0	0.68	0.0	0.00
Penaeus setiferus	7.0	2.56	0.8	0.28	56.1	39.81	2.0	0.52	4.8	3.33	0.4	0.25	84.9	17.44	2.1	0.78
Callinectes sapidus	7.9	2.97	0.3	0.13	5.6	1.69	0.2	0.09	17.3	6.10	0.1	0.08	19.0	2.60	0.2	0.23
Mysidae	8.6	7.44	355.0	39.49	0.0	0.00	92.4	12.51	65.4	46.35	4.3	1.82	0.0	0.00	3.6	1.16
Grass Shrimp	87.2	39.69	0.0	0.01	119.0	41.23	0.7	0.44	264.2	30.95	0.0	0.02	220.7	36.52	0.1	0.08
Palaemonetes pugio	61.2	27.76	0.0	0.00	97.9	36.22	0.0	0.00	87.6	45.41	0.0	0.00	134.8	19.19	0.1	0.08

Appendix Table 2. Mean Biomass (g dry weight per m sq. +/- Std. Error) of Nekton in Marsh and Open Water habitats at sites in the Houston Ship Channel, Trinity Bay and Upper Galveston Bay.

ZONE I

	Ash Point - M10				Tabb's Bay - M12				Brownwood - M19				Double Bayou - M9			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
All Fishes	0.7714	0.2294	0.0006	0.0002	3.9243	3.3925	0.0626	0.0161	0.6644	0.5949	0.2369	0.0572	0.5580	0.9107	0.0662	0.0661
Bait Fishes	0.0716	0.0562	0.0001	0.0001	3.7752	3.3792	0.0325	0.0096	0.5742	0.5915	0.2212	0.0555	0.1675	0.1675	0.0562	0.0562
Anchoa mitchilli	0.0716	0.0562	0.0001	0.0001	0.0000	0.0000	0.0211	0.0060	0.0973	0.0599	0.2212	0.0555	0.0000	0.0000	0.0562	0.0562
Micropogonias undulatus	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0028	0.0028	0.0000	0.0000	0.0003	0.0001	0.0000	0.0000	0.0000	0.0000
Commercial Fishes	0.4755	0.2323	0.0000	0.0000	0.0280	0.0213	0.0000	0.0000	0.0004	0.0004	0.0059	0.0027	0.2643	0.1279	0.0006	0.0005
Sciaenidae	0.4755	0.2323	0.0000	0.0000	0.0280	0.0213	0.0428	0.0226	0.0004	0.0004	0.0060	0.0017	0.2925	0.1535	0.0006	0.0005
Cynoscion nebulosus	0.4755	0.2323	0.0000	0.0000	0.0280	0.0213	0.0000	0.0000	0.0000	0.0000	0.0059	0.0027	0.2643	0.1279	0.0006	0.0005
Cyprinodontidae	0.0000	0.0000	0.0000	0.0000	0.0742	0.0448	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gobiidae	0.1999	0.0374	0.0003	0.0001	0.0042	0.0024	0.0008	0.0003	0.0695	0.0684	0.0012	0.0007	0.0855	0.0099	0.0024	0.0005
Gobiosoma bosci	0.1756	0.0487	0.0003	0.0001	0.0036	0.0022	0.0006	0.0003	0.0695	0.0684	0.0010	0.0007	0.0800	0.0100	0.0016	0.0002
Symphurus plagiusa	0.0050	0.0012	0.0001	0.0000	0.0000	0.0000	0.0012	0.0005	0.0078	0.0060	0.0003	0.0001	0.0000	0.0000	0.0000	0.0000
All Crustaceans	10.2881	2.3236	0.0260	0.0090	5.2212	1.5012	0.0534	0.0134	7.5382	4.3345	0.0848	0.0103	6.0837	1.4318	0.0561	0.0080
Penaeid Shrimp	3.2591	0.5580	0.0243	0.0087	1.6667	0.8981	0.0188	0.0069	0.7831	0.4365	0.0598	0.0110	2.9296	0.8022	0.0287	0.0059
Penaeus aztecus	1.1084	0.5096	0.0137	0.0083	0.2568	0.1053	0.0024	0.0023	0.6195	0.3474	0.0021	0.0021	1.2097	0.4534	0.0005	0.0005
Penaeus setiferus	2.1507	0.3267	0.0103	0.0059	1.6088	0.9185	0.0164	0.0078	0.1596	0.0932	0.0577	0.0104	1.7199	0.4580	0.0281	0.0062
Callinectes sapidus	2.5854	0.5708	0.0005	0.0005	2.0334	1.7091	0.0041	0.0019	6.4697	3.8275	0.0019	0.0017	1.2458	0.2723	0.0014	0.0012
Mysidae	0.0000	0.0000	0.0012	0.0004	0.0010	0.0007	0.0304	0.0077	0.0000	0.0000	0.0229	0.0045	0.0000	0.0000	0.0234	0.0053
Grass Shrimp	4.4392	1.4770	0.0000	0.0000	1.2835	0.2313	0.0000	0.0000	0.1950	0.1002	0.0000	0.0000	1.9036	0.6447	0.0000	0.0000
Palaemonetes pugio	4.1556	1.4874	0.0000	0.0000	1.2737	0.2231	0.0000	0.0000	0.1770	0.0847	0.0000	0.0000	1.7540	0.6428	0.0000	0.0000

ZONE II

	Atkinson Island -M11				Seabrook - M8				LaPorte - S8				Houston Point - S9			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
All Fishes	0.2963	0.0771	0.0478	0.0192	0.1554	0.0577	0.0141	0.0044	3.5191	2.8770	0.0692	0.0179	1.3296	0.4328	0.0209	0.0049
Bait Fishes	0.0046	0.0046	0.0052	0.0036	0.0427	0.0427	0.0041	0.0041	3.4407	2.8789	0.0259	0.0093	0.0000	0.0000	0.0141	0.0053
Anchoa mitchilli	0.0046	0.0046	0.0052	0.0036	0.0427	0.0427	0.0041	0.0041	0.0000	0.0000	0.0259	0.0093	0.0000	0.0000	0.0141	0.0053
Micropogonias undulatus	0.0000	0.0000	0.0070	0.0070	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0015	0.0015
Commercial Fishes	0.0757	0.0704	0.0000	0.0000	0.0008	0.0007	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sciaenidae	0.0757	0.0704	0.0075	0.0075	0.0008	0.0007	0.0014	0.0013	0.0067	0.0066	0.0406	0.0167	0.0000	0.0000	0.0015	0.0015
Cynoscion nebulosus	0.0757	0.0704	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cyprinodontidae	0.1146	0.0690	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.6096	0.4242	0.0000	0.0000
Gobiidae	0.0272	0.0124	0.0006	0.0002	0.0456	0.0265	0.0011	0.0010	0.0298	0.0162	0.0003	0.0001	0.2717	0.1194	0.0016	0.0004
Gobiosoma bosci	0.0157	0.0061	0.0006	0.0002	0.0434	0.0250	0.0011	0.0010	0.0225	0.0176	0.0001	0.0000	0.2248	0.1051	0.0014	0.0004
Symphurus plagiusa	0.0557	0.0331	0.0000	0.0000	0.0008	0.0008	0.0019	0.0014	0.0000	0.0000	0.0002	0.0001	0.0011	0.0008	0.0035	0.0026
All Crustaceans	13.4273	3.1306	0.0098	0.0032	4.8394	0.8920	0.0782	0.0131	12.6779	3.8373	0.0540	0.0240	34.8141	10.8076	0.0252	0.0046
Penaeid Shrimp	8.6991	3.2545	0.0018	0.0018	0.5103	0.2373	0.0416	0.0065	0.9280	0.4042	0.0416	0.0243	19.3983	11.9679	0.0122	0.0037
Penaeus aztecus	0.4990	0.1488	0.0003	0.0003	0.1508	0.0615	0.0336	0.0105	0.8333	0.3875	0.0310	0.0271	0.5529	0.2830	0.0065	0.0039
Penaeus setiferus	8.1999	3.1070	0.0015	0.0015	0.3595	0.2196	0.0080	0.0045	0.0947	0.0765	0.0108	0.0068	18.8453	12.0946	0.0036	0.0017
Callinectes sapidus	1.8030	0.7755	0.0000	0.0000	2.4094	0.6958	0.0047	0.0026	8.9832	3.6371	0.0011	0.0008	9.9738	4.4056	0.0108	0.0021
Mysidae	0.0005	0.0003	0.0077	0.0036	0.0000	0.0000	0.0214	0.0079	0.0012	0.0008	0.0067	0.0013	0.0002	0.0002	0.0021	0.0005
Grass Shrimp	2.6342	1.0104	0.0000	0.0000	1.8305	0.8793	0.0000	0.0000	2.6665	1.3123	0.0000	0.0000	5.0352	1.8822	0.0000	0.0000
Palaemonetes pugio	2.5688	0.9907	0.0000	0.0000	1.4585	0.8693	0.0000	0.0000	2.1136	1.0437	0.0000	0.0000	4.6290	1.8326	0.0000	0.0000

Appendix Table 2.(cont.). Mean Biomass (g dry weight per m sq. +/- Std. Error) of Nekton in Marsh and Open Water habitats at sites in Middle and Lower Galveston Bay.

ZONE III

	Ving-et-un Islands - B3				Redfish - D2				Moses Lake - M2b				Smith Point - M7			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
All Fishes	0.8502	0.0501	0.0016	0.0006	1.2233	0.4644	0.0692	0.0430	3.9194	1.5508	0.0310	0.0165	1.7742	0.7235	0.0259	0.0041
Bait Fishes	0.1078	0.0654	0.0000	0.0000	0.3737	0.3737	0.0156	0.0050	3.2952	1.6383	0.0000	0.0000	0.6660	0.6660	0.0139	0.0023
Anchoa mitchilli	0.1078	0.0654	0.0000	0.0000	0.0000	0.0000	0.0156	0.0050	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0139	0.0023
Micropogonias undulatus	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0071	0.0027
Commercial Fishes	0.0938	0.0432	0.0000	0.0000	0.3635	0.1509	0.0000	0.0000	0.1009	0.1008	0.0001	0.0001	0.4010	0.2194	0.0000	0.0000
Sciaenidae	0.1823	0.0283	0.0000	0.0000	0.3635	0.1509	0.0044	0.0044	0.1499	0.0963	0.0001	0.0001	0.4010	0.2194	0.0098	0.0046
Cynoscion nebulosus	0.0666	0.0450	0.0000	0.0000	0.3635	0.1509	0.0000	0.0000	0.1009	0.1008	0.0001	0.0001	0.4010	0.2194	0.0000	0.0000
Cyprinodontidae	0.0894	0.0894	0.0000	0.0000	0.0347	0.0347	0.0000	0.0000	0.1739	0.0599	0.0000	0.0000	0.1727	0.1003	0.0000	0.0000
Gobiidae	0.3143	0.0492	0.0012	0.0007	0.1910	0.0422	0.0009	0.0003	0.0512	0.0127	0.0030	0.0020	0.3598	0.0667	0.0003	0.0001
Gobiosoma bosci	0.2314	0.0925	0.0000	0.0000	0.1554	0.0489	0.0000	0.0000	0.0433	0.0154	0.0000	0.0000	0.3081	0.0717	0.0002	0.0001
Symphurus plagiusa	0.0493	0.0171	0.0003	0.0003	0.0781	0.0719	0.0003	0.0002	0.1788	0.1062	0.0000	0.0000	0.0509	0.0260	0.0017	0.0005
All Crustaceans	7.7313	0.6614	0.0201	0.0062	12.7846	2.9098	0.0260	0.0197	9.7200	1.8669	0.0156	0.0036	14.4142	2.2010	0.0132	0.0067
Penaeid Shrimp	0.9035	0.4383	0.0112	0.0045	2.8195	0.8163	0.0213	0.0191	2.5431	0.5441	0.0107	0.0025	0.7656	0.1006	0.0098	0.0064
Penaeus aztecus	0.8277	0.3984	0.0083	0.0031	0.7165	0.2409	0.0194	0.0193	1.0170	0.1370	0.0001	0.0000	0.6126	0.0526	0.0001	0.0000
Penaeus setiferus	0.0758	0.0403	0.0029	0.0020	2.1030	0.6006	0.0019	0.0006	1.5255	0.6398	0.0106	0.0026	0.1531	0.0687	0.0097	0.0064
Callinectes sapidus	2.6584	0.9464	0.0003	0.0003	8.9302	2.9615	0.0002	0.0001	3.1140	1.0319	0.0000	0.0000	3.2426	0.8992	0.0001	0.0001
Mysidae	0.0056	0.0019	0.0086	0.0026	0.0081	0.0073	0.0041	0.0005	0.0002	0.0002	0.0049	0.0020	0.0028	0.0012	0.0030	0.0006
Grass Shrimp	4.0754	1.2397	0.0000	0.0000	0.8665	0.4350	0.0000	0.0000	3.5270	0.8041	0.0000	0.0000	10.3441	2.0277	0.0000	0.0000
Palaemonetes pugio	3.0906	1.2625	0.0000	0.0000	0.6765	0.3131	0.0000	0.0000	3.4672	0.7984	0.0000	0.0000	8.9961	2.1172	0.0000	0.0000

ZONE IV

	Pelican Spit - B1				Bolivar Peninsula - M1				Texas City Dike - M2a				Bird Island - M5			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
All Fishes	6.8493	6.5776	0.0462	0.0165	0.8388	0.4128	0.0198	0.0086	0.7159	0.2356	0.0002	0.0001	0.5910	0.0794	0.0029	0.0016
Bait Fishes	0.0213	0.0213	0.0244	0.0166	0.3063	0.3063	0.0176	0.0085	0.2179	0.1889	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
Anchoa mitchilli	0.0213	0.0213	0.0068	0.0068	0.0000	0.0000	0.0176	0.0085	0.0220	0.0141	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
Micropogonias undulatus	0.0000	0.0000	0.0112	0.0079	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Commercial Fishes	6.5783	6.5680	0.0001	0.0000	0.0163	0.0094	0.0002	0.0001	0.2192	0.0981	0.0001	0.0001	0.0207	0.0144	0.0000	0.0000
Sciaenidae	0.1898	0.1797	0.0209	0.0124	0.0734	0.0636	0.0002	0.0001	0.2219	0.0967	0.0001	0.0001	0.0207	0.0144	0.0000	0.0000
Cynoscion nebulosus	0.1898	0.1797	0.0000	0.0000	0.0163	0.0094	0.0002	0.0001	0.2192	0.0981	0.0000	0.0000	0.0207	0.0144	0.0000	0.0000
Cyprinodontidae	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gobiidae	0.1462	0.0189	0.0008	0.0002	0.4342	0.0821	0.0019	0.0003	0.1961	0.0155	0.0000	0.0000	0.4607	0.0506	0.0000	0.0000
Gobiosoma bosci	0.0177	0.0177	0.0000	0.0000	0.1000	0.0360	0.0008	0.0004	0.0996	0.0293	0.0000	0.0000	0.0356	0.0148	0.0000	0.0000
Symphurus plagiusa	0.0437	0.0153	0.0006	0.0002	0.0002	0.0002	0.0000	0.0000	0.0656	0.0539	0.0000	0.0000	0.0004	0.0004	0.0000	0.0000
All Crustaceans	5.3858	0.3858	0.1280	0.0153	10.7564	4.6157	0.0401	0.0042	3.2931	0.5773	0.0039	0.0021	10.0379	1.6122	0.1866	0.1816
Penaeid Shrimp	0.6013	0.1542	0.0039	0.0019	5.8209	4.6596	0.0038	0.0008	0.3768	0.1488	0.0021	0.0018	3.2181	1.1066	0.0031	0.0016
Penaeus aztecus	0.3739	0.1199	0.0000	0.0000	0.6130	0.2558	0.0000	0.0000	0.2602	0.1511	0.0000	0.0000	0.4286	0.1058	0.0000	0.0000
Penaeus setiferus	0.2273	0.1545	0.0039	0.0019	5.2080	4.4222	0.0038	0.0008	0.1166	0.0891	0.0021	0.0018	2.7896	1.0128	0.0031	0.0016
Callinectes sapidus	1.1292	0.3361	0.0026	0.0019	0.7549	0.3606	0.0002	0.0001	0.0776	0.0567	0.0001	0.0001	2.7662	1.7602	0.1822	0.1821
Mysidae	0.0029	0.0026	0.1191	0.0135	0.0000	0.0000	0.0323	0.0038	0.0221	0.0160	0.0015	0.0006	0.0000	0.0000	0.0012	0.0004
Grass Shrimp	1.6461	0.7104	0.0000	0.0000	2.5611	0.9461	0.0004	0.0002	2.4832	0.4855	0.0000	0.0000	3.0953	0.3843	0.0002	0.0002
Palaemonetes pugio	1.4638	0.6433	0.0000	0.0000	2.4434	0.9317	0.0000	0.0000	1.3528	0.7840	0.0000	0.0000	2.8223	0.3281	0.0002	0.0002

Appendix Table 3. Mean densities (number per 78 cm sq. +/- Std. Error) of Benthos in Marsh and Open Water habitats at sites in the Houston Ship Channel, Trinity Bay, and Upper, Middle, and Lower Galveston Bay.

ZONE I

	Ash Point - M10				Tabb's Bay - M12				Brownwood - M13				Double Bayou - M9			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
Annelids	47.5	22.18	12.8	0.75	18.3	7.03	2.8	1.80	129.3	119.63	5.0	1.47	82.8	28.16	14.0	6.63
Molluscs	1.0	0.58	0.5	0.29	0.0	0.00	0.0	0.00	0.5	0.29	0.3	0.25	4.0	1.41	0.0	0.00
Others	1.0	1.00	0.8	0.48	0.0	0.00	0.0	0.00	5.3	5.25	0.8	0.48	8.0	4.78	0.3	0.25
Peracarids	3.0	2.68	1.0	1.00	0.0	0.00	0.0	0.00	42.3	41.92	0.0	0.00	30.5	17.04	3.8	1.89
Total Infauna	53.5	22.70	15.0	0.41	18.5	6.95	2.8	1.80	177.3	166.96	6.0	1.58	127.3	51.80	19.3	8.11

ZONE II

	Atkinson Island -M11				Seabrook - M8				LaPorte - S8				Houston Point - S9			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
Annelids	5.0	1.68	1.0	0.00	99.3	66.25	14.3	6.22	41.8	35.78	12.3	5.02	123.8	76.89	4.5	1.55
Molluscs	0.5	0.29	0.5	0.50	1.8	1.11	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.5	0.50
Others	0.5	0.50	0.8	0.75	0.3	0.25	0.5	0.29	0.3	0.25	0.3	0.25	0.8	0.48	0.5	0.29
Peracarids	0.0	0.00	0.5	0.50	52.8	49.47	0.0	0.00	0.3	0.25	0.0	0.00	30.0	25.47	0.0	0.00
Total Infauna	6.0	2.00	3.0	1.22	154.3	114.91	15.8	6.43	42.8	36.10	13.0	5.02	155.3	102.19	5.5	1.94

ZONE III

	Ving-et-un Islands - B3				Redfish - D2				Moses Lake - M2b				Smith Point - M7			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
Annelids	25.3	7.16	17.3	3.79	38.3	15.36	26.5	3.97	76.8	24.28	7.0	2.27	15.8	2.10	9.5	2.40
Molluscs	1.8	1.03	0.3	0.25	0.0	0.00	0.3	0.25	0.3	0.25	0.8	0.48	1.0	0.71	0.0	0.00
Others	3.0	1.08	1.0	1.00	1.0	0.71	0.3	0.25	2.0	1.41	0.0	0.00	4.0	1.47	0.0	0.00
Peracarids	26.0	15.04	1.5	0.50	18.3	6.50	0.3	0.25	11.5	5.55	2.0	1.08	4.8	2.56	0.3	0.25
Total Infauna	58.8	20.71	20.0	4.26	59.5	21.59	27.5	3.66	90.5	31.16	9.8	3.50	27.8	5.15	10.3	2.25

ZONE IV

	Pelican Spit - B1				Bolivar Peninsula - M1				Texas City Dike - M2a				Bird Island - M5			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
Annelids	0.0	0.00	40.5	5.24	80.3	19.65	28.0	5.89	16.3	3.82	8.0	1.41	30.5	5.11	19.0	3.44
Molluscs	0.0	0.00	5.8	3.30	0.8	0.48	0.3	0.25	0.0	0.00	1.8	1.03	0.0	0.00	1.5	0.96
Others	0.0	0.00	18.3	7.31	0.8	0.75	3.3	0.85	1.5	0.65	1.5	0.96	0.3	0.25	3.3	0.75
Peracarids	0.0	0.00	4.3	1.80	7.3	3.92	2.5	1.19	3.0	1.29	0.5	0.29	1.0	0.71	1.0	0.41
Total Infauna	0.0	0.00	69.5	10.73	90.0	21.86	34.3	6.38	23.3	5.11	12.0	2.80	31.8	4.96	26.5	3.50

Appendix Table 4. Mean Biomass (g dry weight per 78 cm sq. +/- Std. Error) of Benthos in Marsh and Open Water habitats at sites in the Houston Ship Channel, Trinity Bay, and Upper, Middle, and Lower Galveston Bay.

ZONE I

	Ash Point - M10				Tabb's Bay - M12				Brownwood - M13				Double Bayou - M9			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
Annelids	14.2333	8.4669	1.0000	0.0577	3.4333	0.0882	0.3500	0.2291	64.2500	63.2773	0.5667	0.1856	9.1000	4.0673	2.5000	1.5373
Molluscs	0.0667	0.0667	1.0167	0.9918	0.0000	0.0000	0.0000	0.0000	0.0167	0.0167	0.0000	0.0000	0.4667	0.4177	0.0000	0.0000
Others	0.9667	0.9667	0.0833	0.0601	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1667	0.1202	0.7667	0.7167	0.0167	0.0167
Peracarids	0.0167	0.0167	0.1333	0.1333	0.0000	0.0000	0.0000	0.0000	0.0167	0.0167	0.0000	0.0000	0.4167	0.2167	0.3333	0.2404
Total Infauna	18.1833	10.5972	2.2333	1.0370	3.4333	0.0882	0.3500	0.2291	64.2833	63.2657	0.7333	0.2906	17.3833	4.1045	2.9167	1.5161

ZONE II

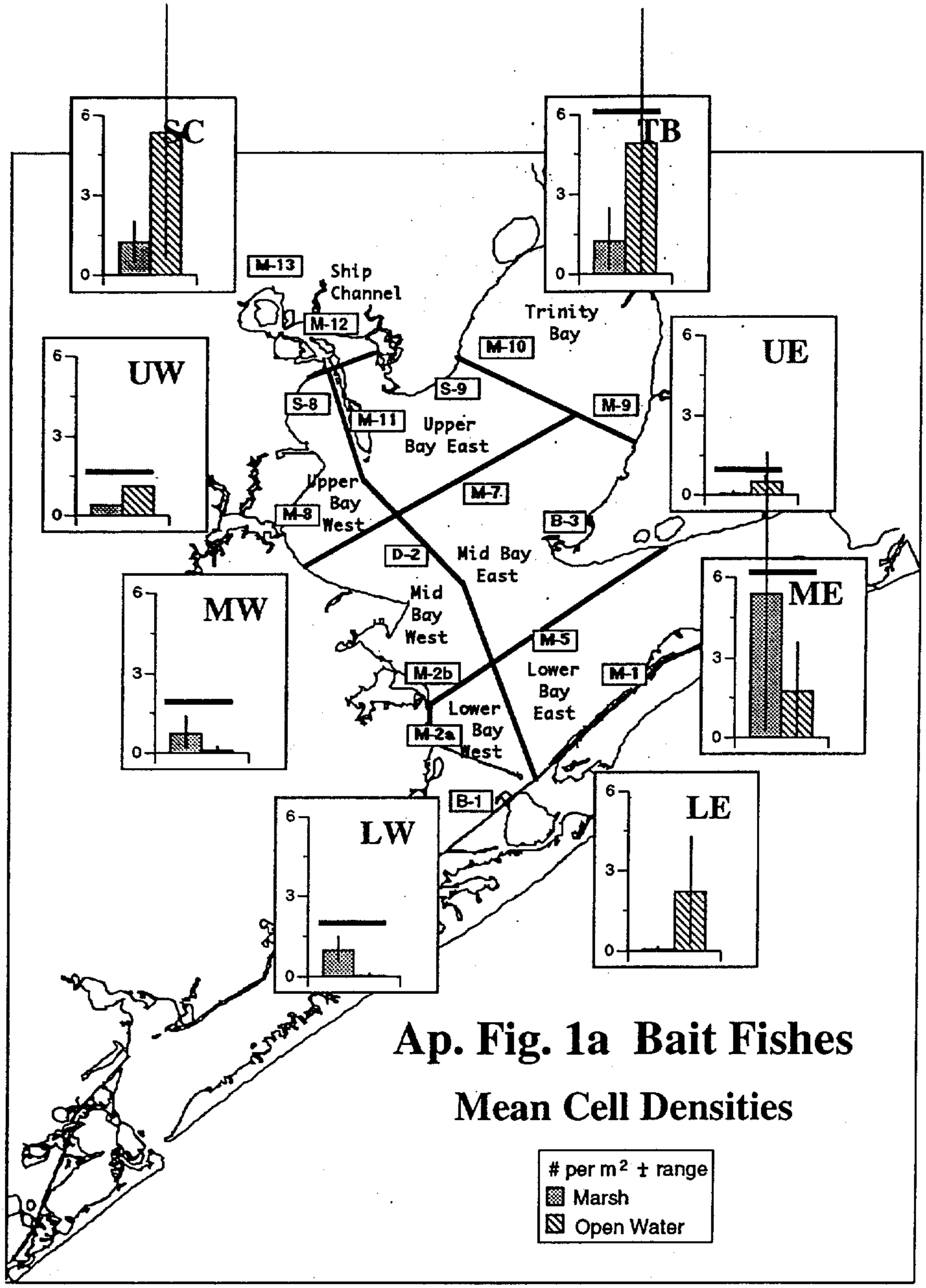
	Atkinson Island -M11				Seabrook - M8				LaPorte - S8				Houston Point - S9			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
Annelids	0.3667	0.1453	0.0500	0.0000	9.5667	4.0834	1.0000	0.6658	19.0000	15.5087	1.8000	0.9000	25.3000	7.9379	0.2000	0.0000
Molluscs	0.0667	0.0667	0.0000	0.0000	0.2500	0.2255	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Others	0.2000	0.2000	0.0000	0.0000	0.0167	0.0167	0.0833	0.0601	0.0000	0.0000	0.1333	0.1333	0.1333	0.1333	0.0333	0.0167
Peracarids	0.0000	0.0000	0.0167	0.0167	0.1667	0.1667	0.0000	0.0000	0.0167	0.0167	0.0000	0.0000	0.2000	0.1155	0.0000	0.0000
Total Infauna	0.6333	0.2028	0.0833	0.0333	10.5000	4.6115	1.2167	0.7452	19.8833	16.3916	3.1333	2.0366	57.0333	24.1431	0.2333	0.0167

ZONE III

	Ving-et-un Islands - B3				Redfish - D2				Moses Lake - M2b				Smith Point - M7			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
Annelids	16.1667	6.9341	0.7333	0.0882	14.5333	5.5119	2.7000	0.6506	5.1000	2.4583	2.6000	1.1000	3.5333	1.7130	1.9333	0.2603
Molluscs	0.2000	0.2000	1.3333	1.3333	0.0000	0.0000	0.0167	0.0167	0.0000	0.0000	2.6000	2.3544	0.0333	0.0167	0.0000	0.0000
Others	0.6500	0.5752	0.4667	0.4667	0.2333	0.2333	0.0167	0.0167	0.0667	0.0667	0.0000	0.0000	1.2667	0.6119	0.0000	0.0000
Peracarids	0.8667	0.4256	0.0500	0.0000	0.8667	0.4667	0.0000	0.0000	0.3833	0.1691	0.4667	0.2906	0.2333	0.1453	0.0167	0.0167
Total Infauna	17.8833	6.9627	2.5833	1.8836	17.1000	6.2024	2.7333	0.6585	5.5500	2.5250	5.6667	1.8415	8.6000	2.5201	2.0167	0.2489

ZONE IV

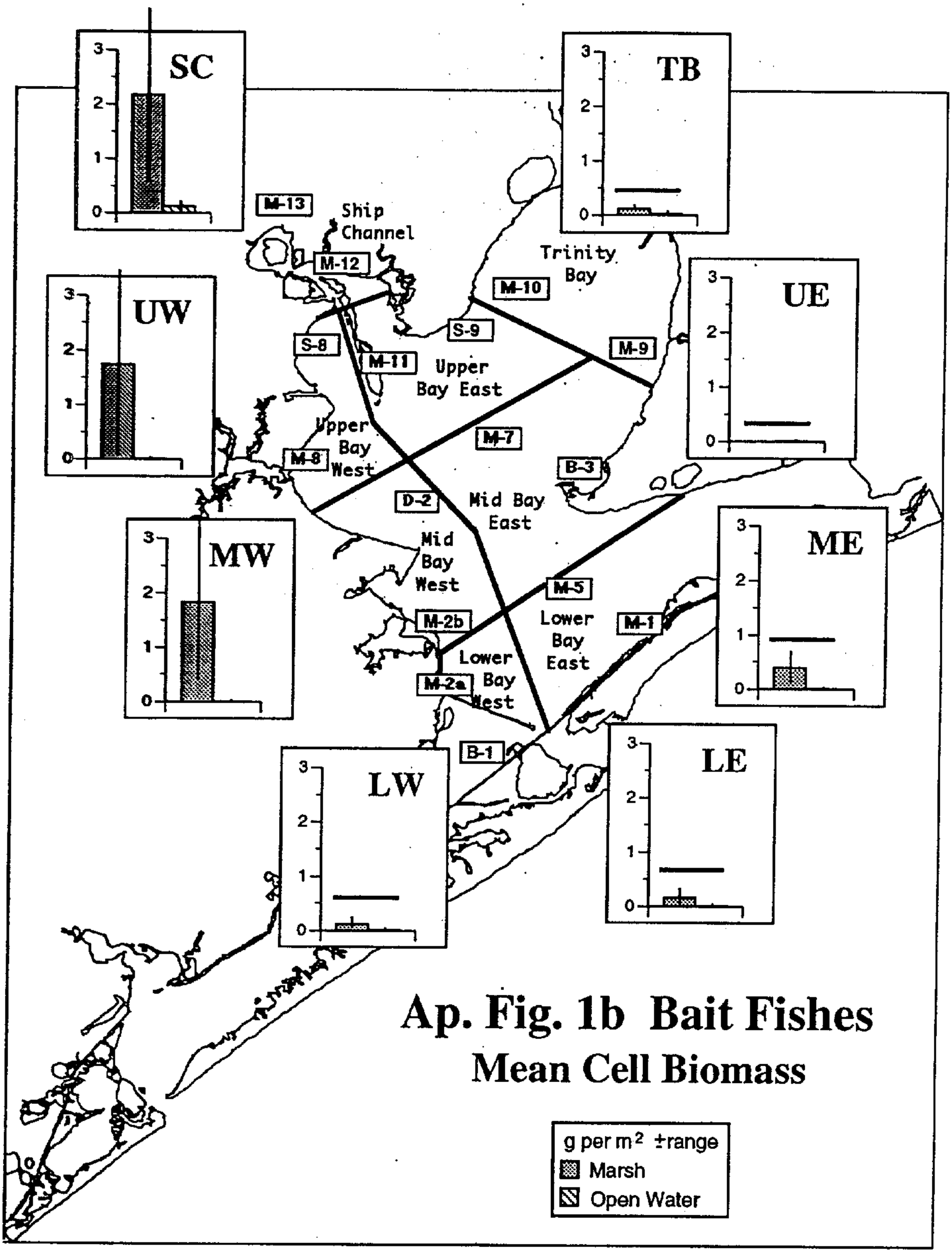
	Pelican Spit - B1				Bolivar Peninsula - M1				Texas City Dike - M2a				Bird Island - M5			
Species	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.	Marsh	S.E.	Open Water	S.E.
Annelids	0.0000	0.0000	10.8667	0.9684	45.6333	16.1084	7.6000	4.0501	1.1000	0.4163	7.1000	1.0583	40.1000	30.1251	4.6667	0.6173
Molluscs	0.0000	0.0000	0.9333	0.8833	0.7333	0.6360	0.0000	0.0000	0.0000	0.0000	0.9667	0.9667	0.0000	0.0000	0.7667	0.7667
Others	0.0000	0.0000	5.8000	4.2454	0.0167	0.0167	0.6000	0.2000	0.5667	0.3844	0.1000	0.1000	0.0167	0.0167	2.8333	1.1289
Peracarids	0.0000	0.0000	0.2333	0.1833	0.2167	0.0833	0.0500	0.0289	0.1833	0.1590	0.0167	0.0167	0.0167	0.0167	0.0250	0.0250
Total Infauna	0.0000	0.0000	19.9167	8.2982	46.4000	14.3557	8.2833	4.0293	7.7000	4.2028	8.2000	2.0040	40.1333	30.1306	9.3500	1.0000



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

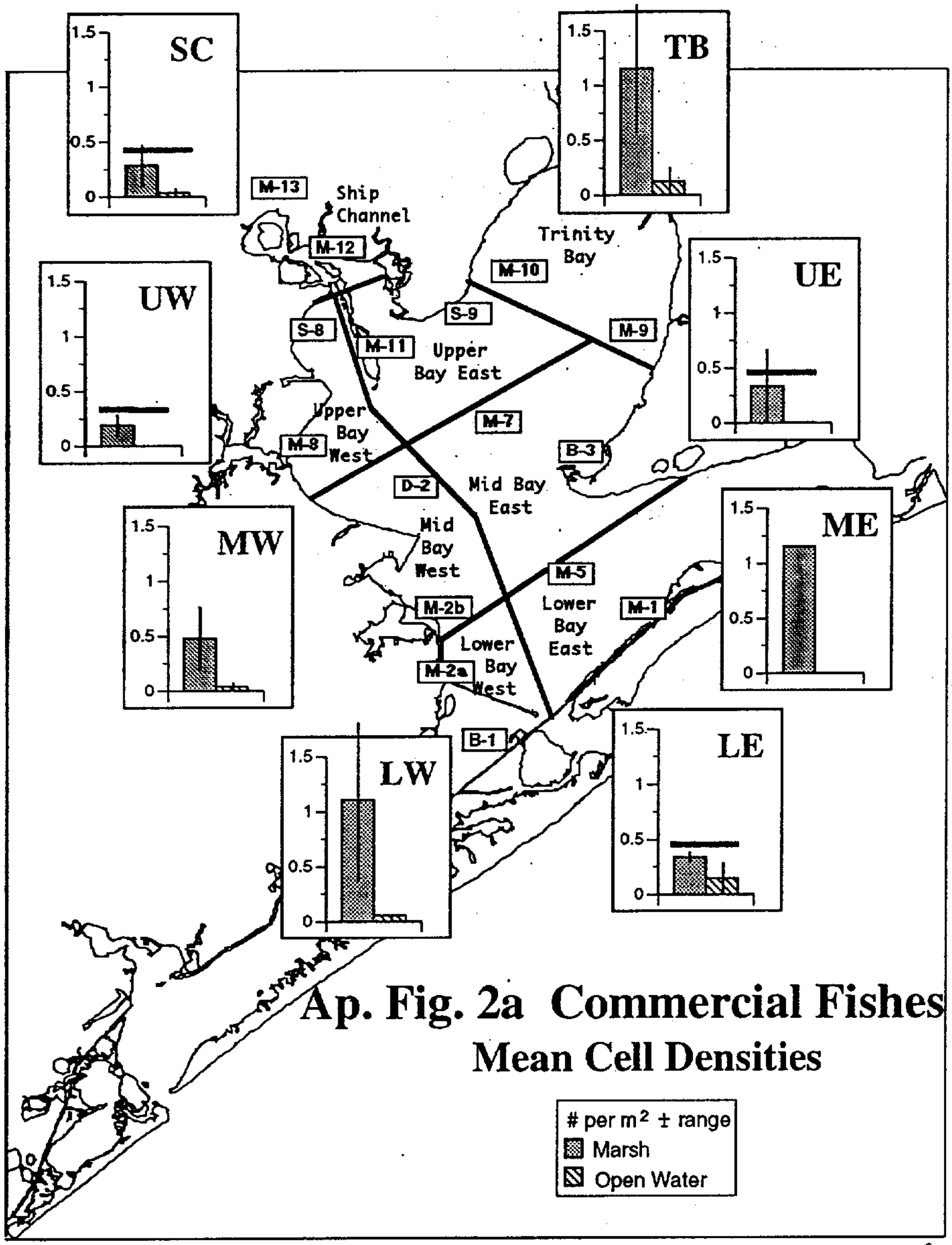


50

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



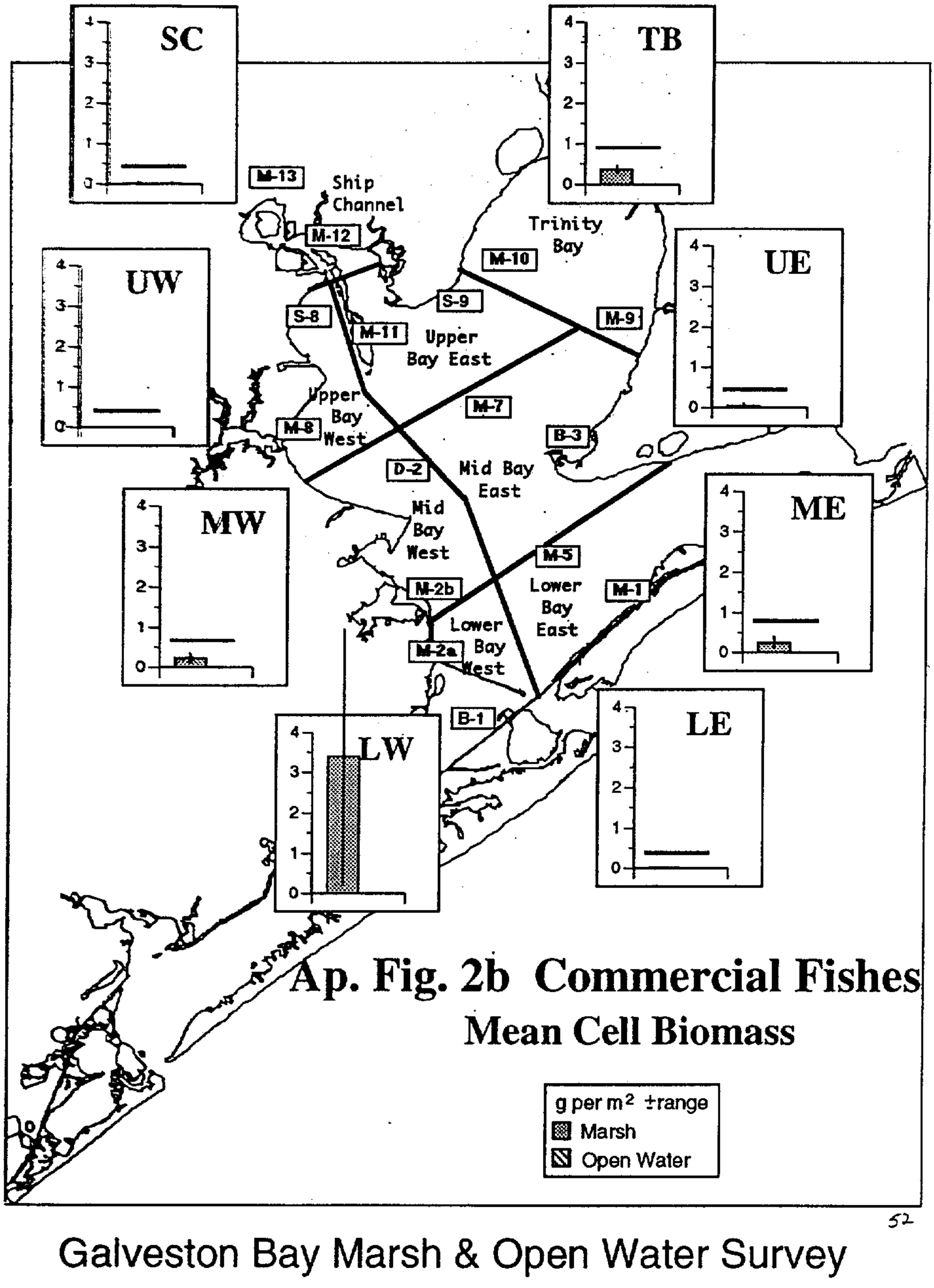
Ap. Fig. 2a Commercial Fishes

Mean Cell Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

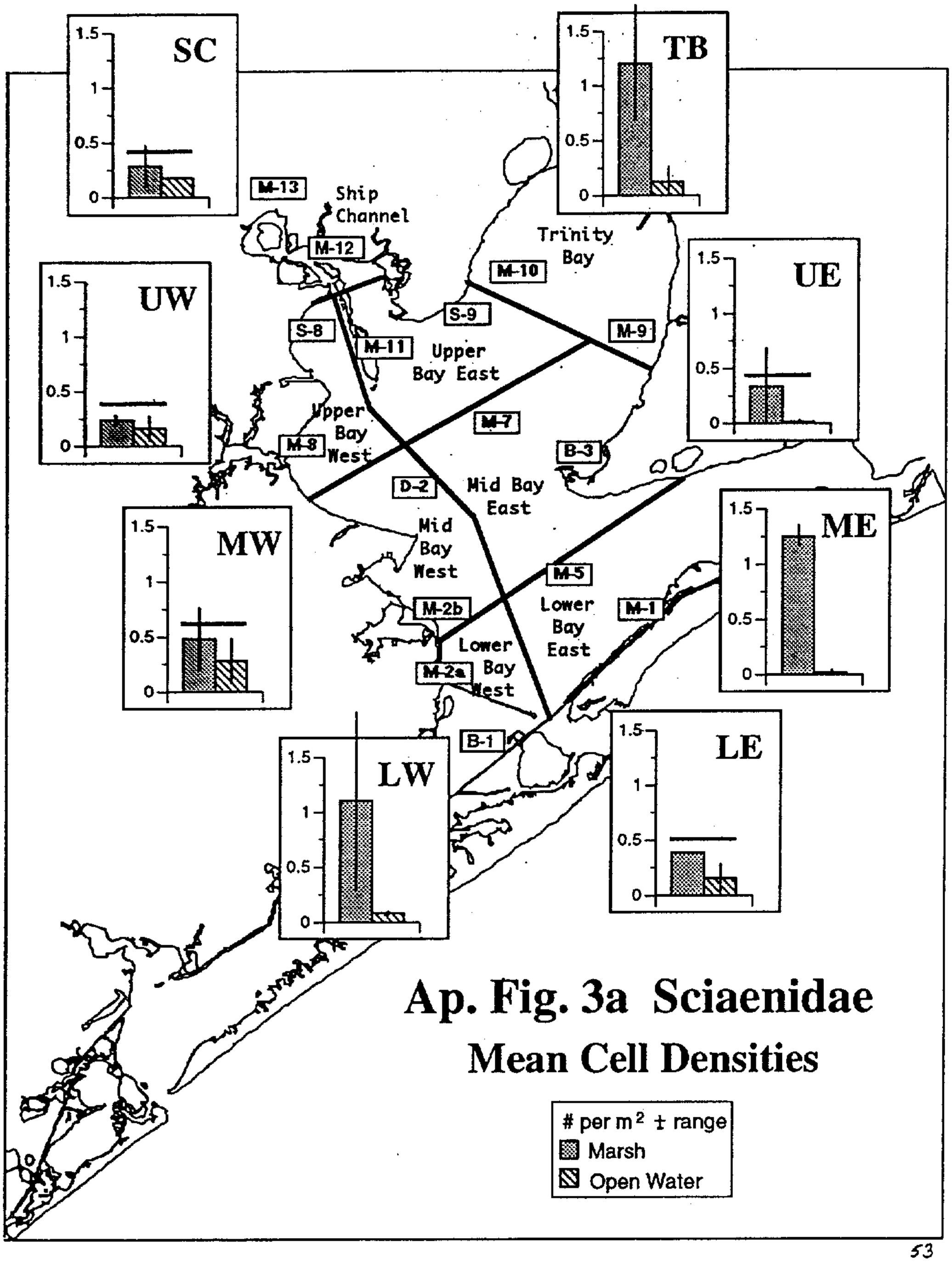


52

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

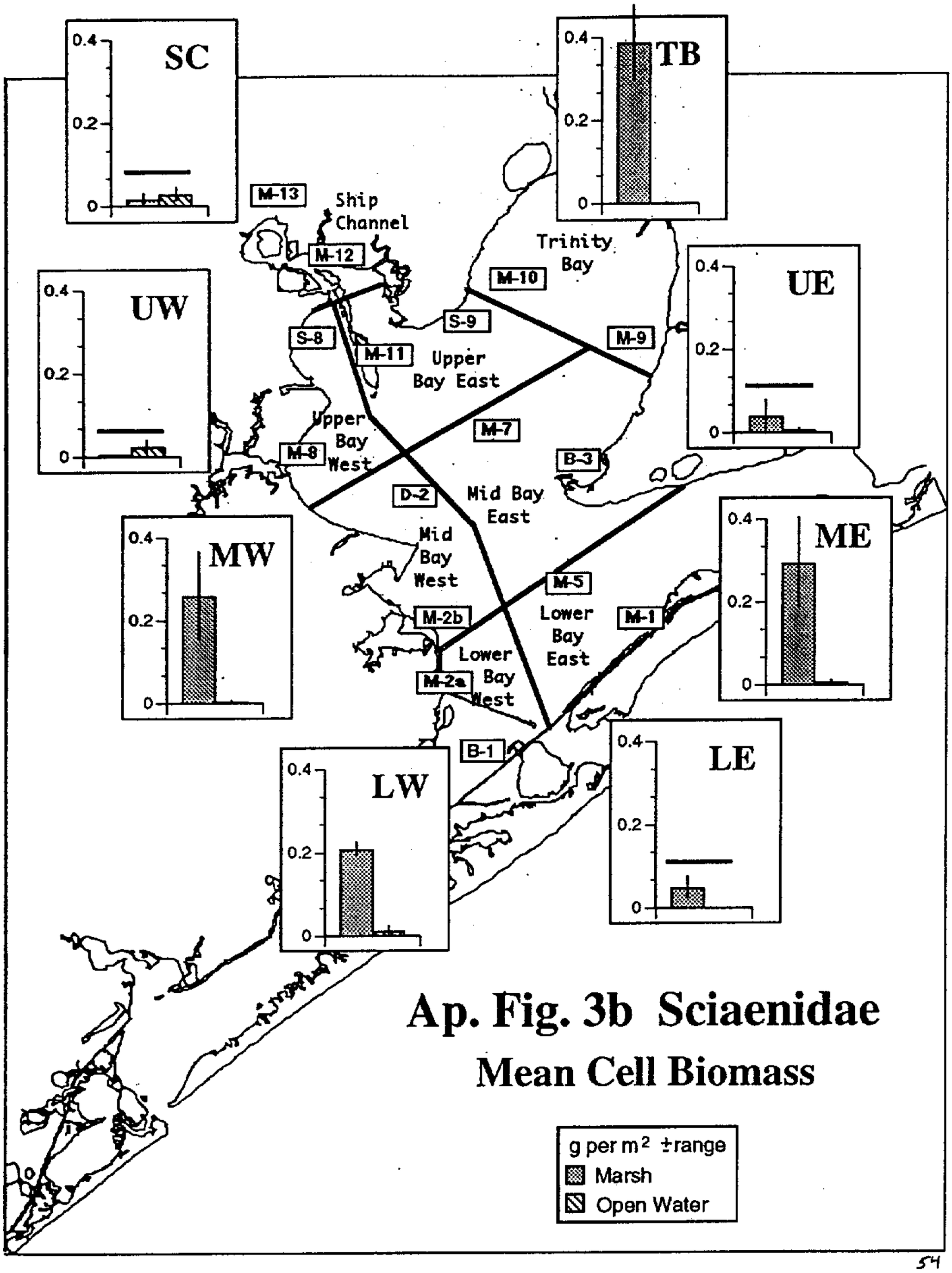
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



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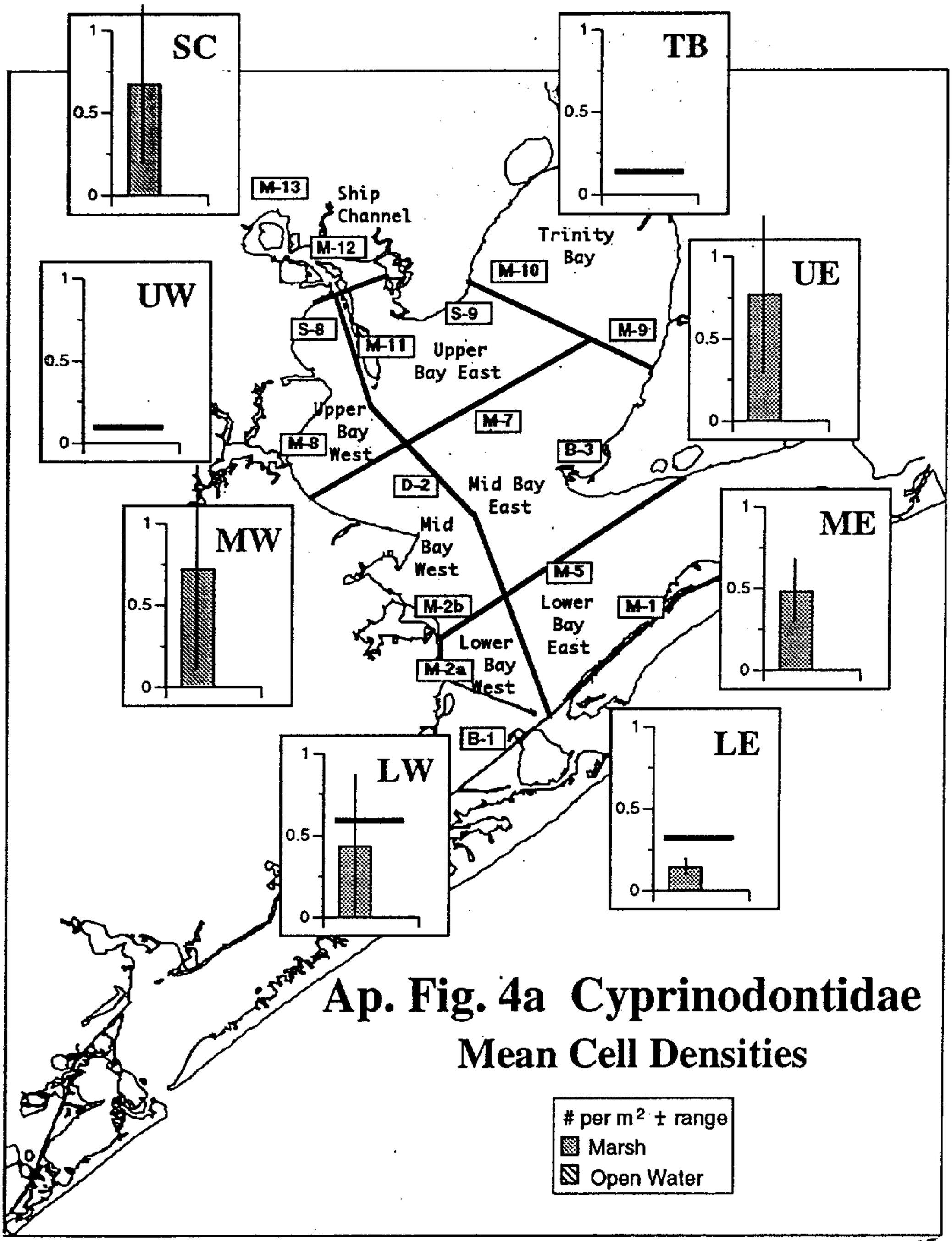
Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



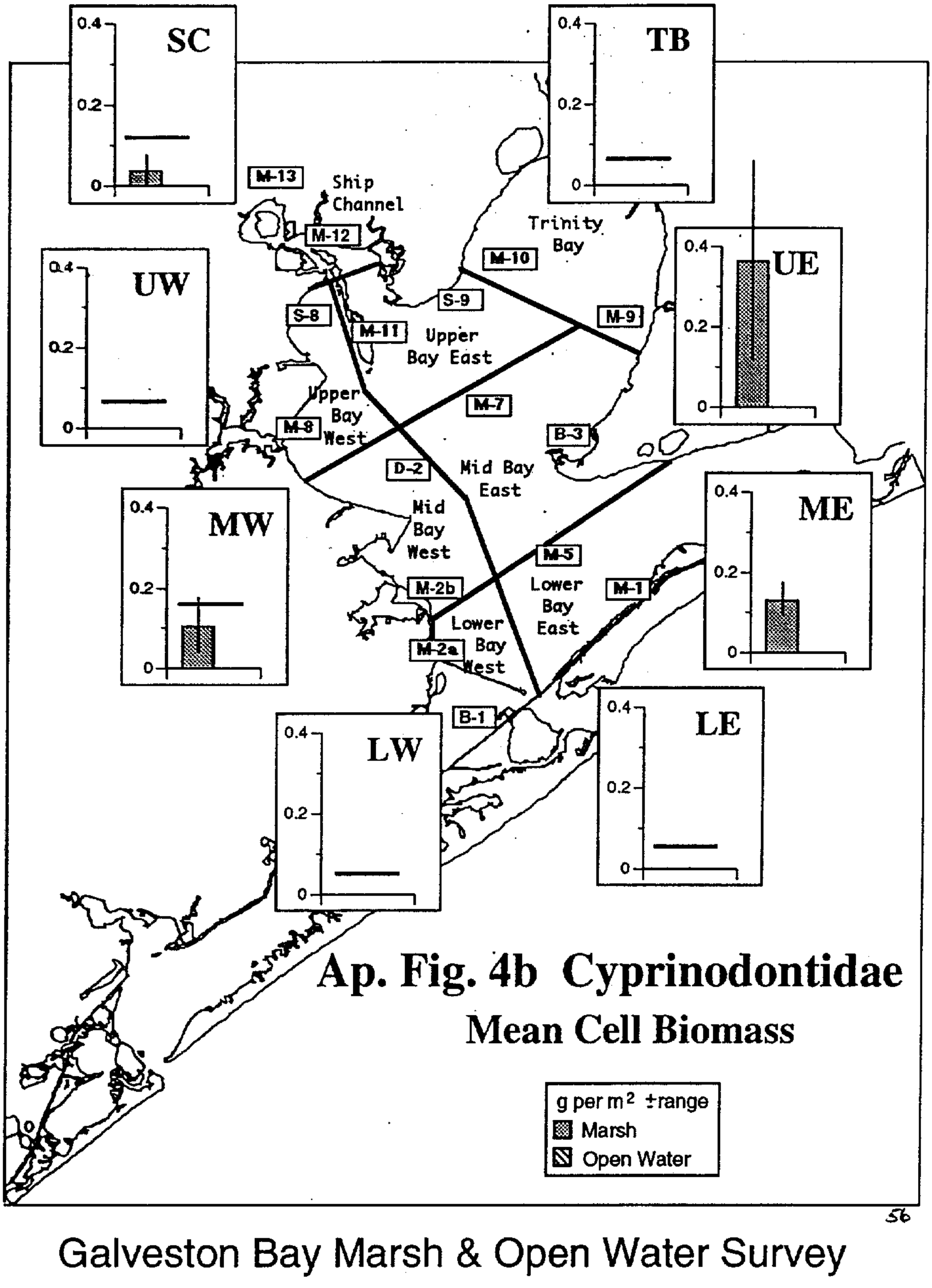
Ap. Fig. 4a Cyprinodontidae

Mean Cell Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

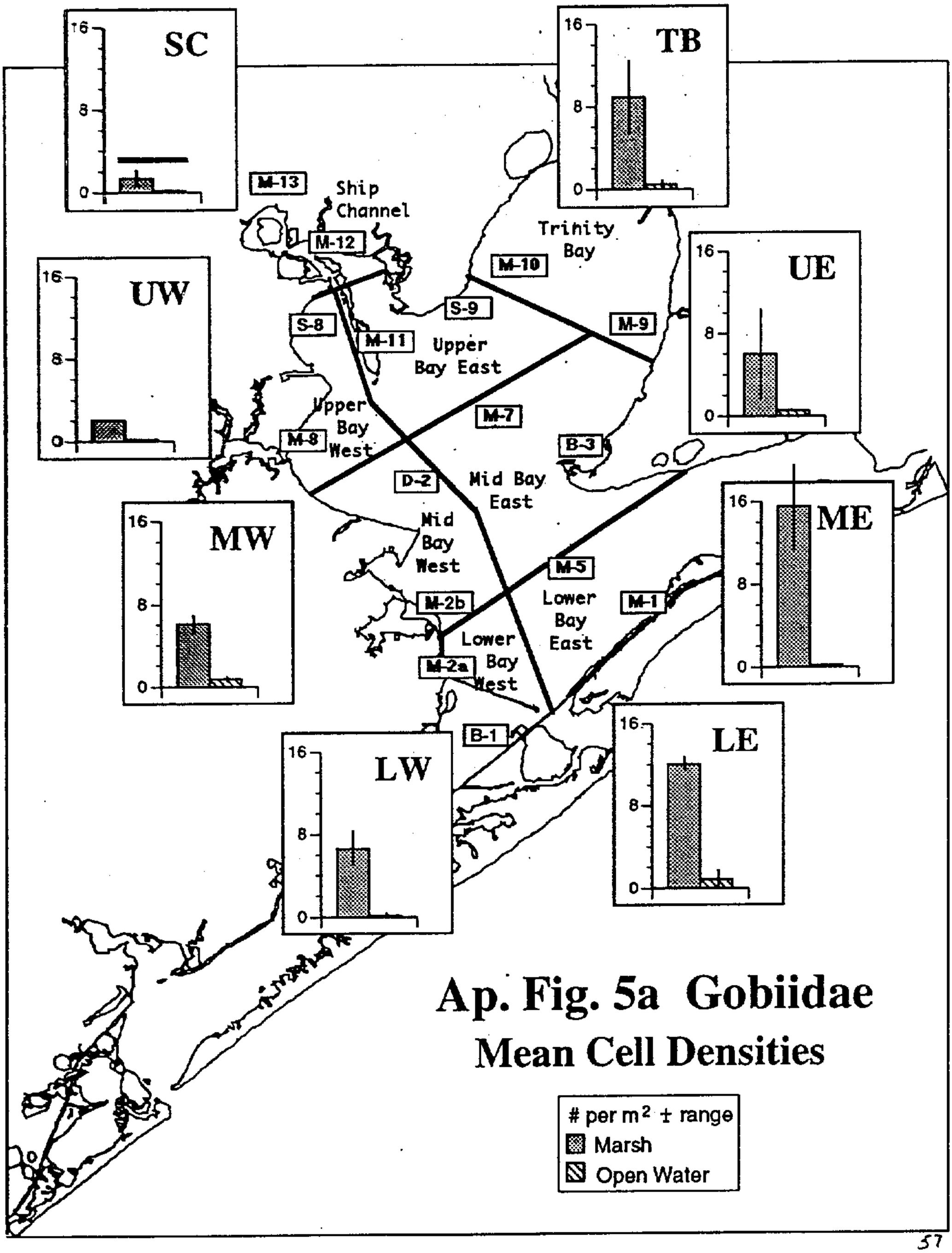
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

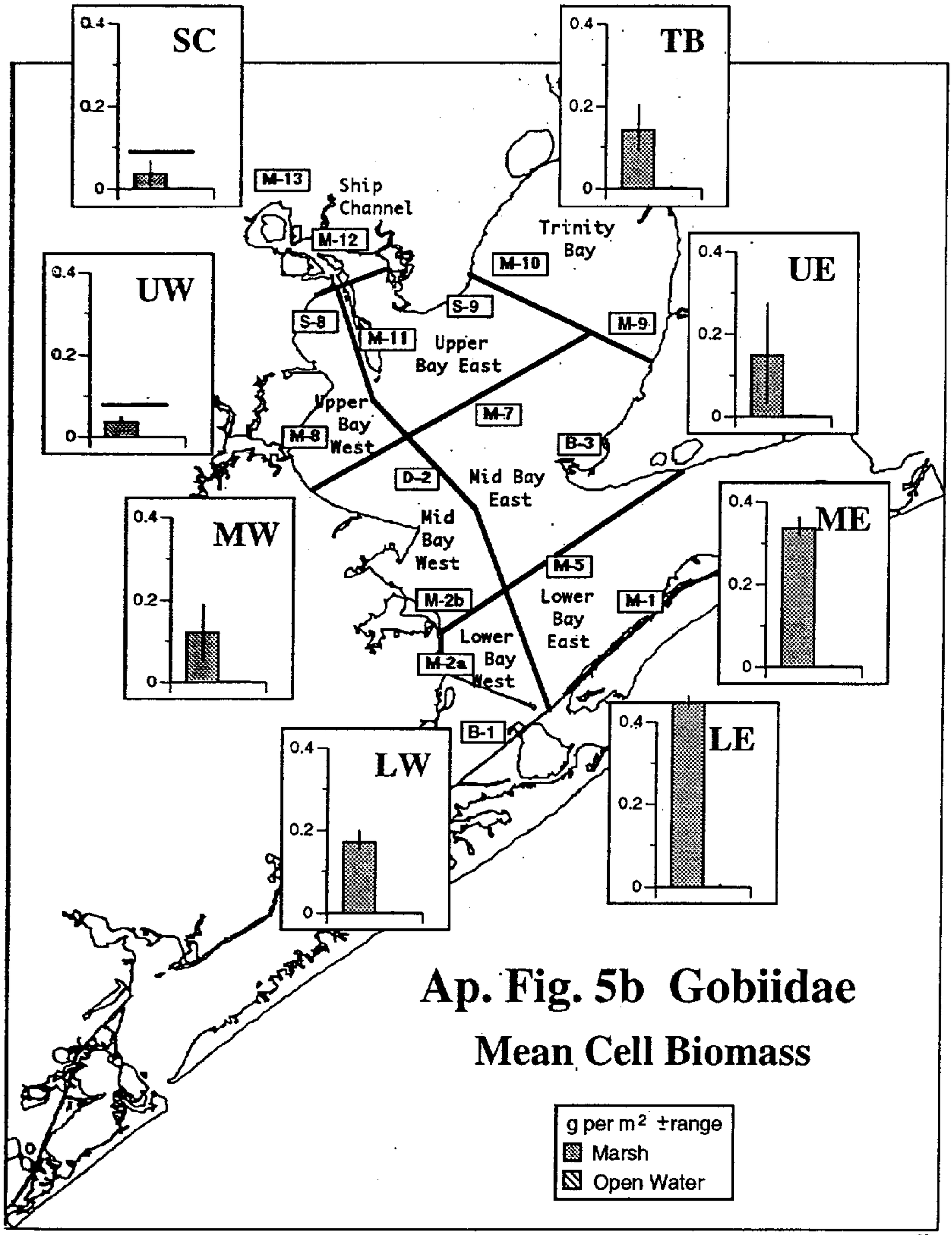


57

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

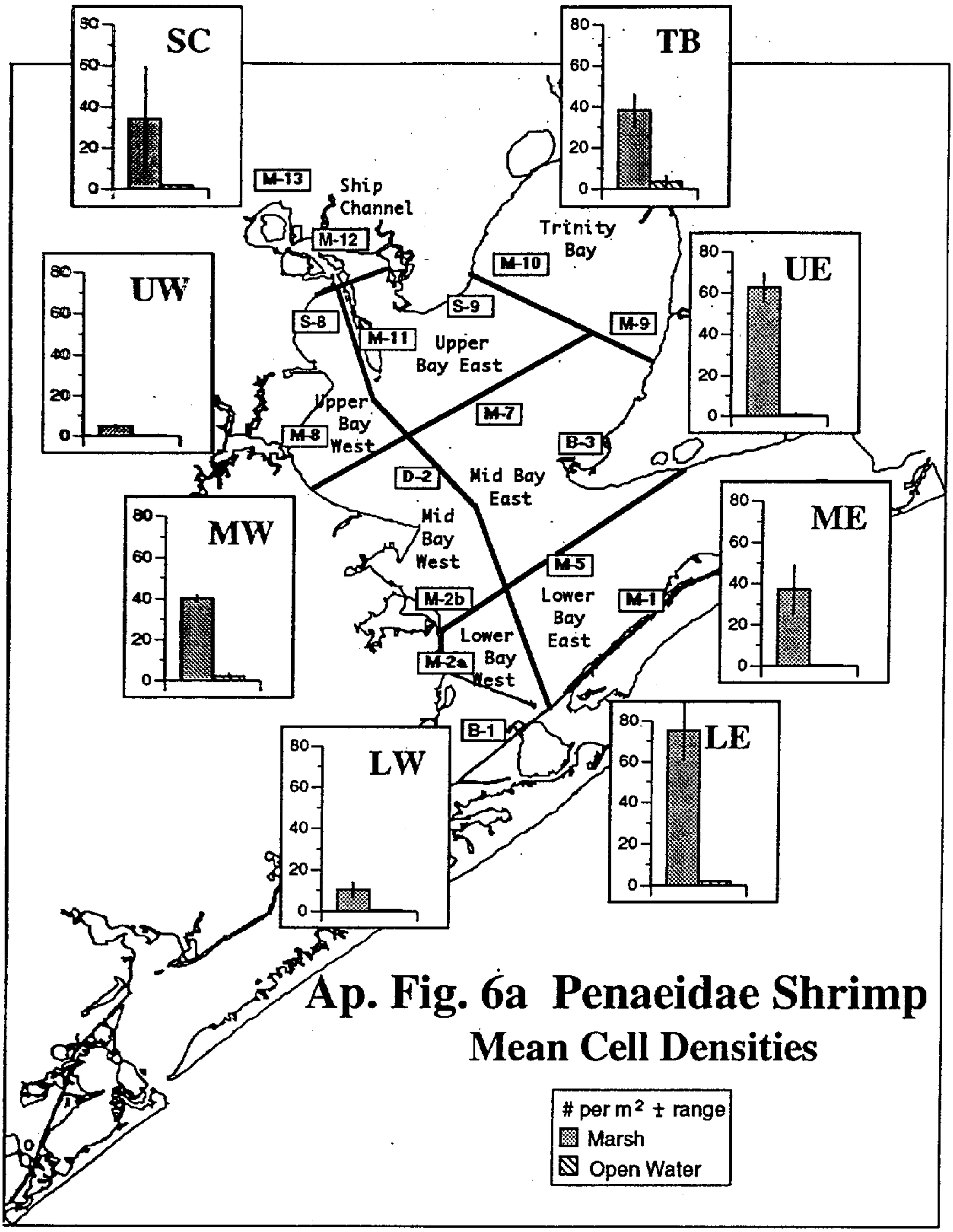
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



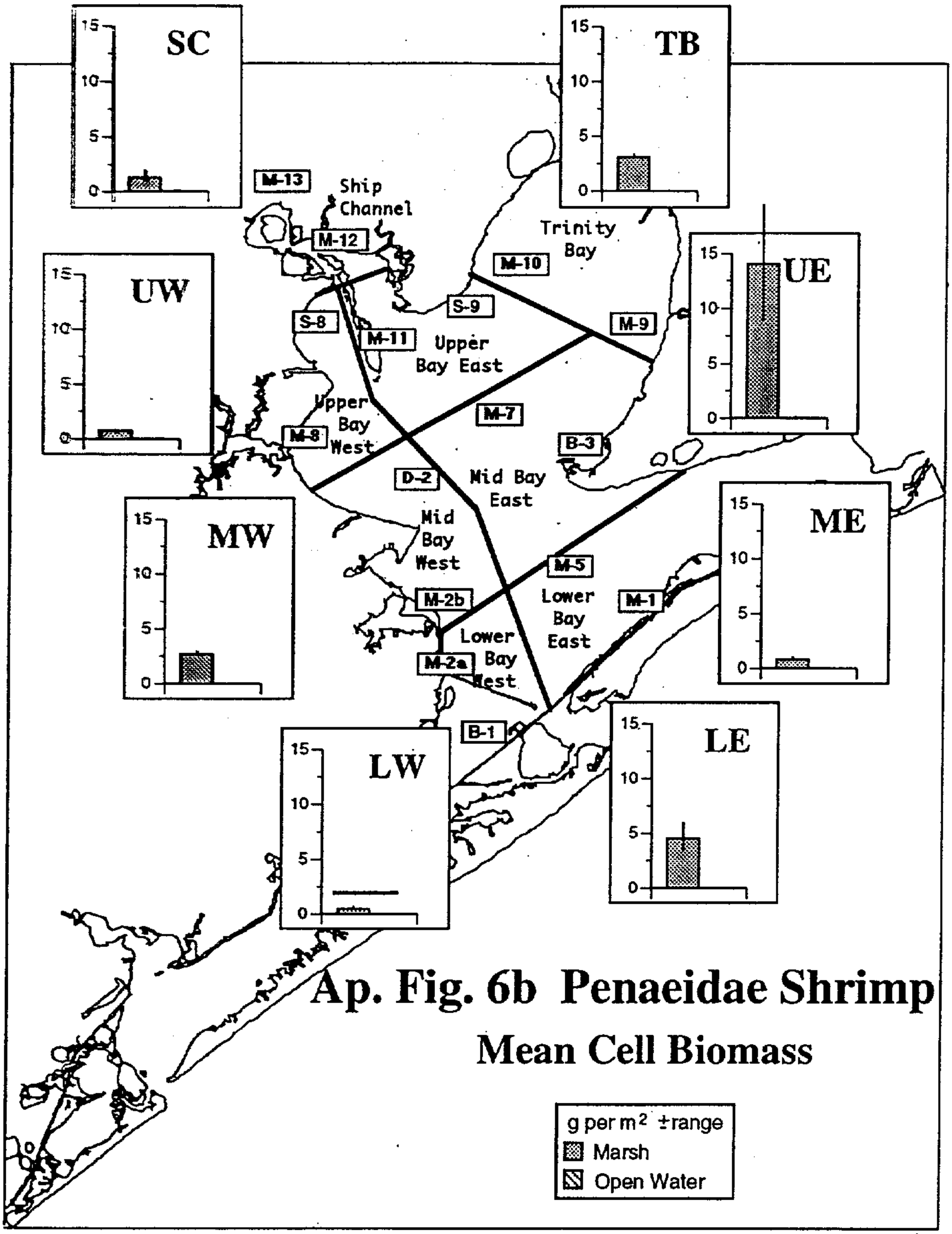
Ap. Fig. 6a Penaeidae Shrimp

Mean Cell Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

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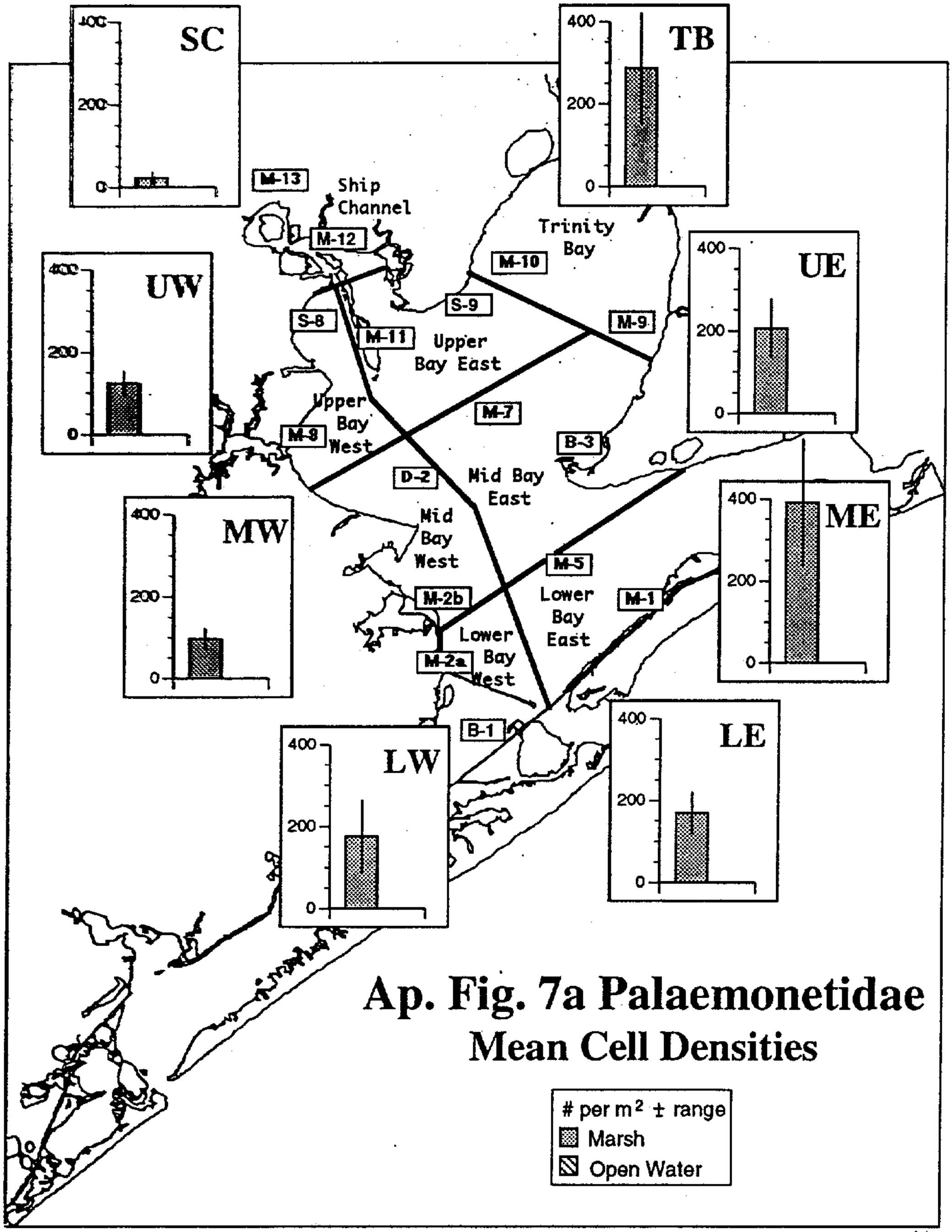
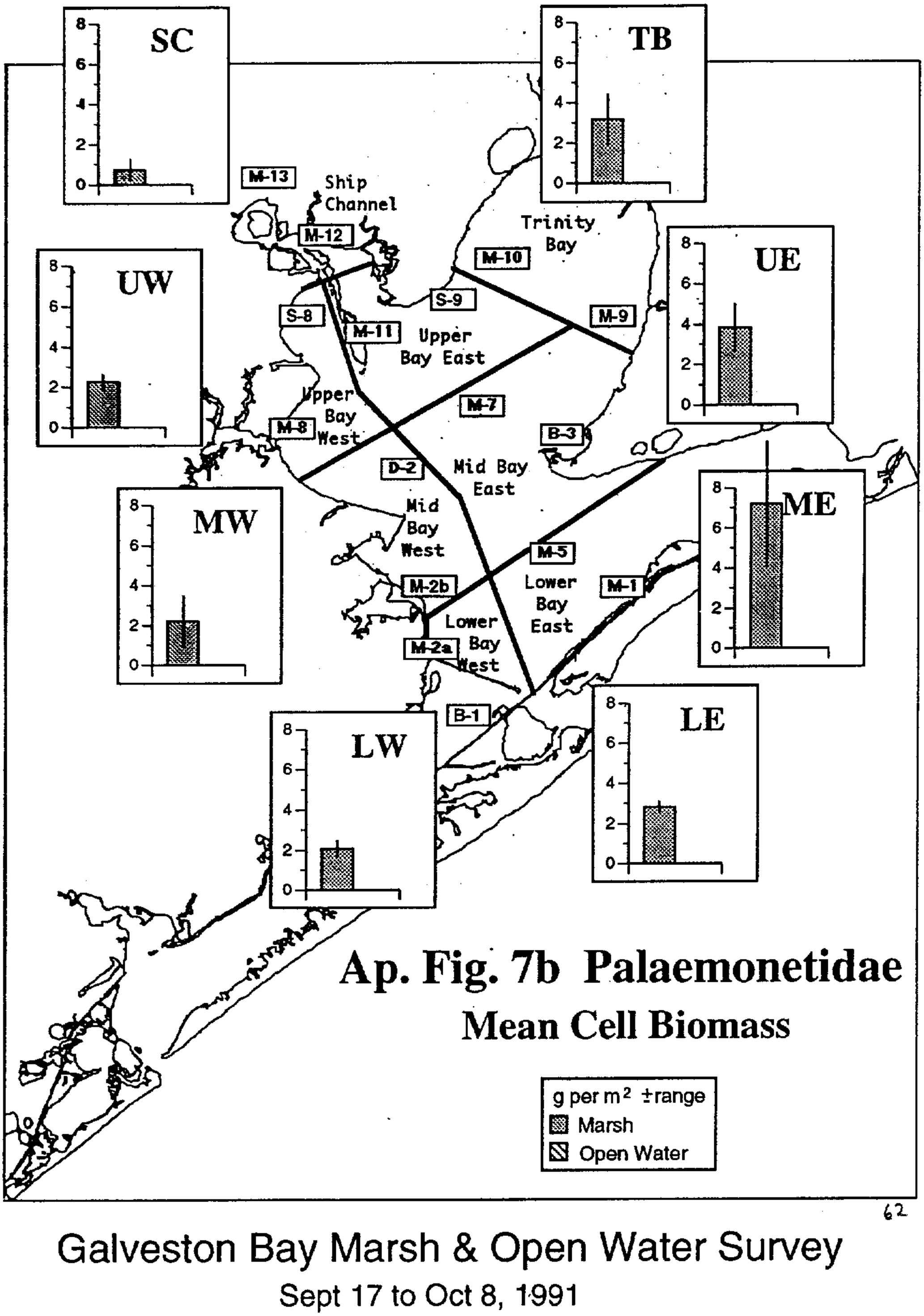


Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

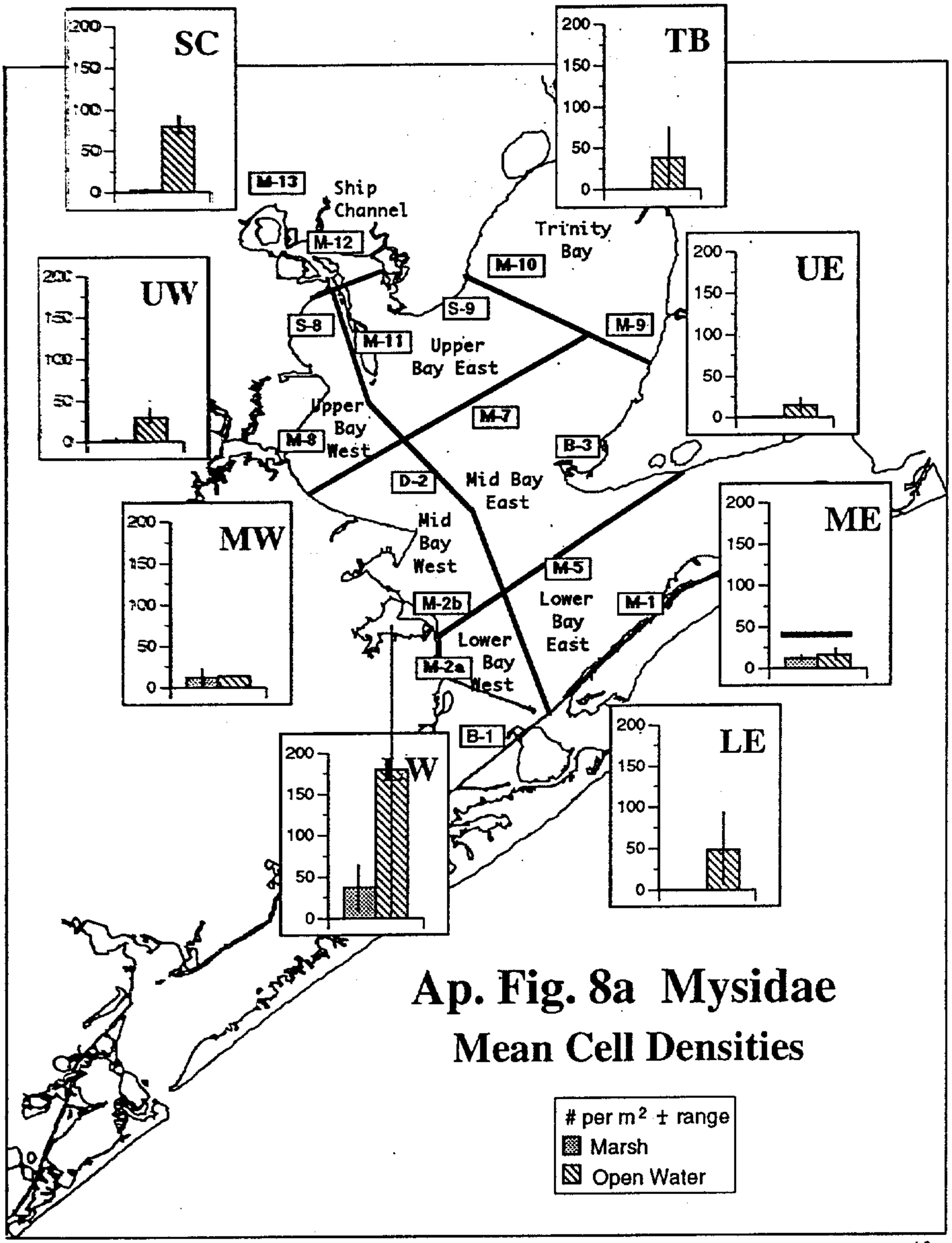
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



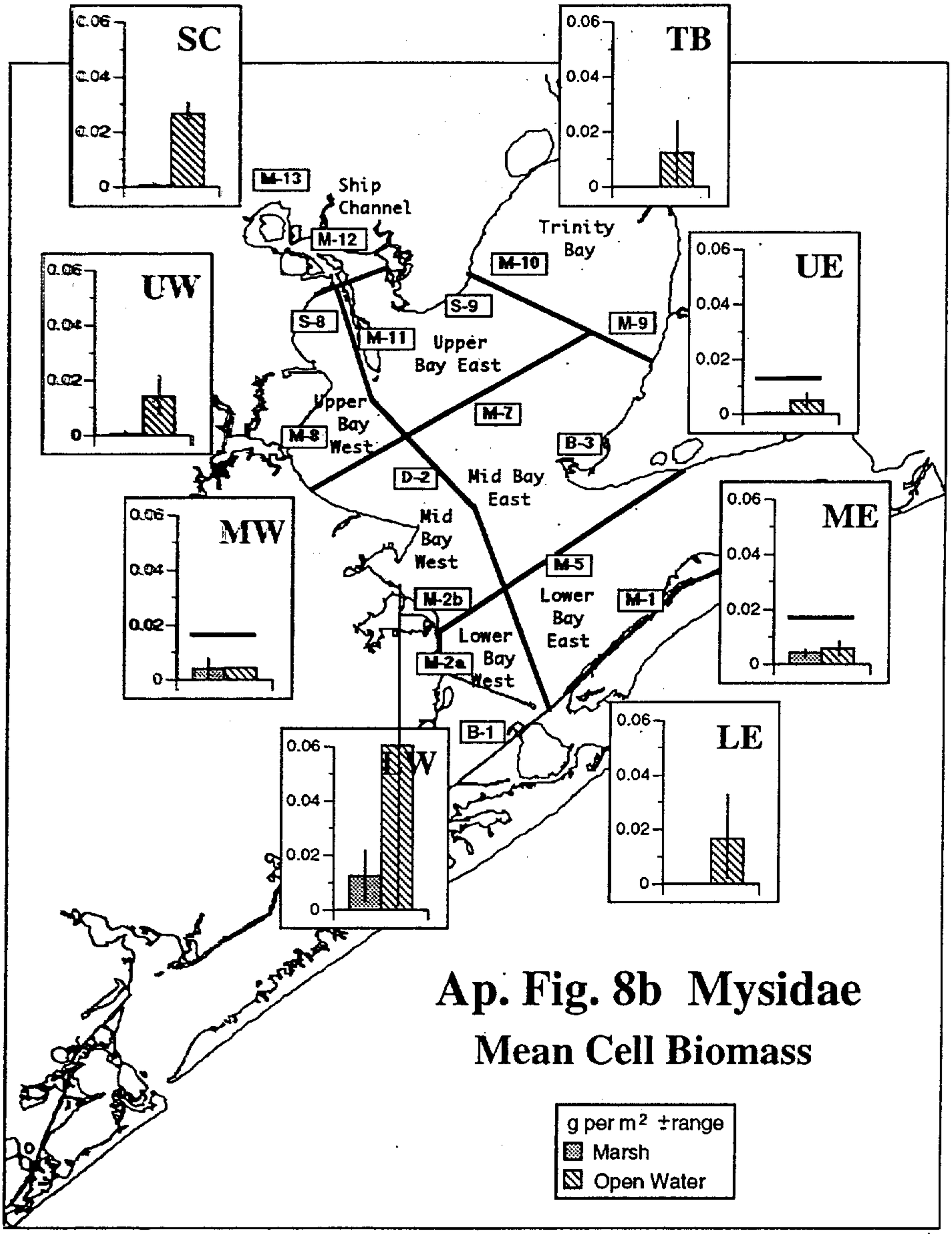
Ap. Fig. 8a Mysidae

Mean Cell Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Ap. Fig. 8b Mysidae

Mean Cell Biomass

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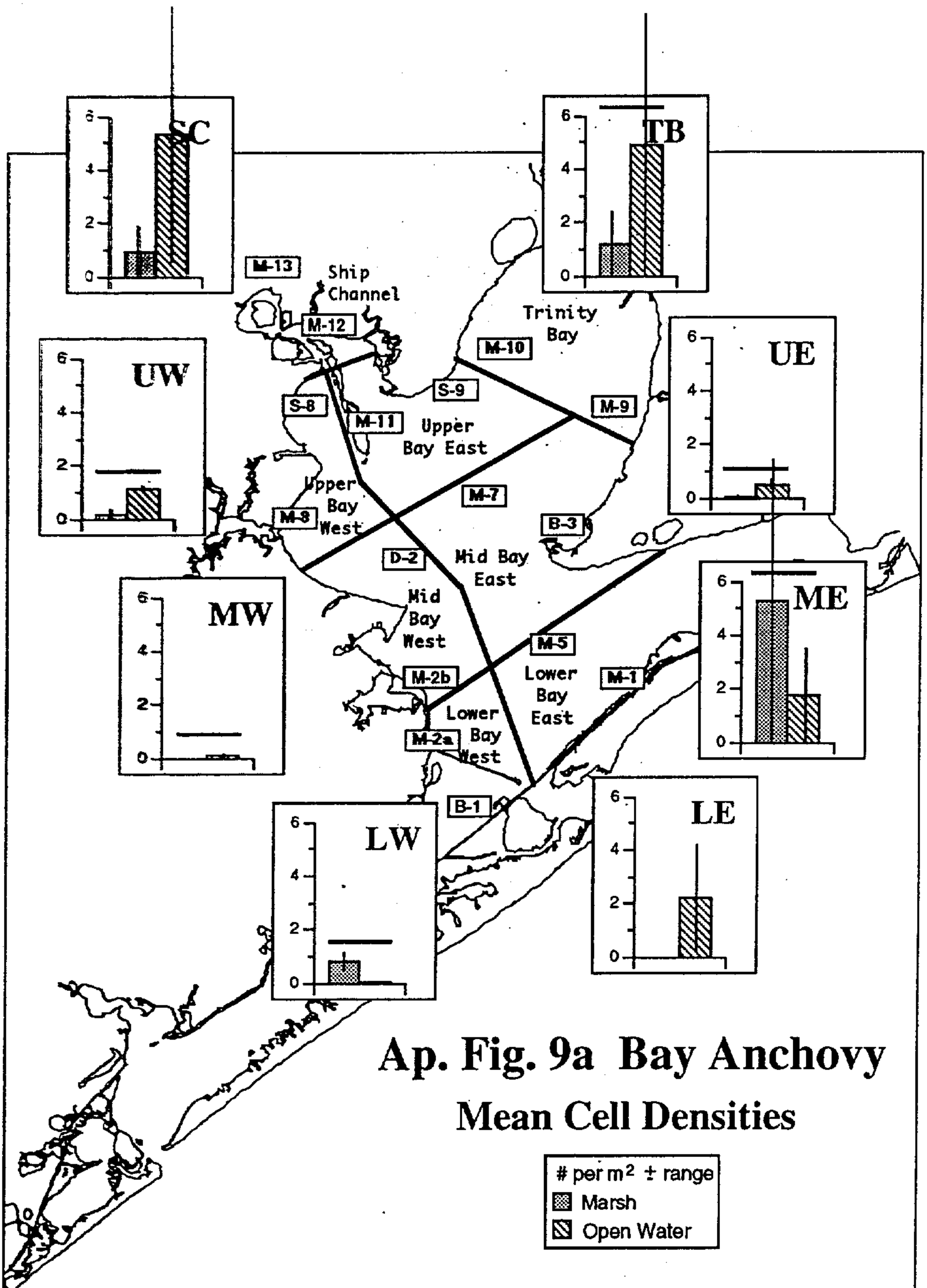
Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



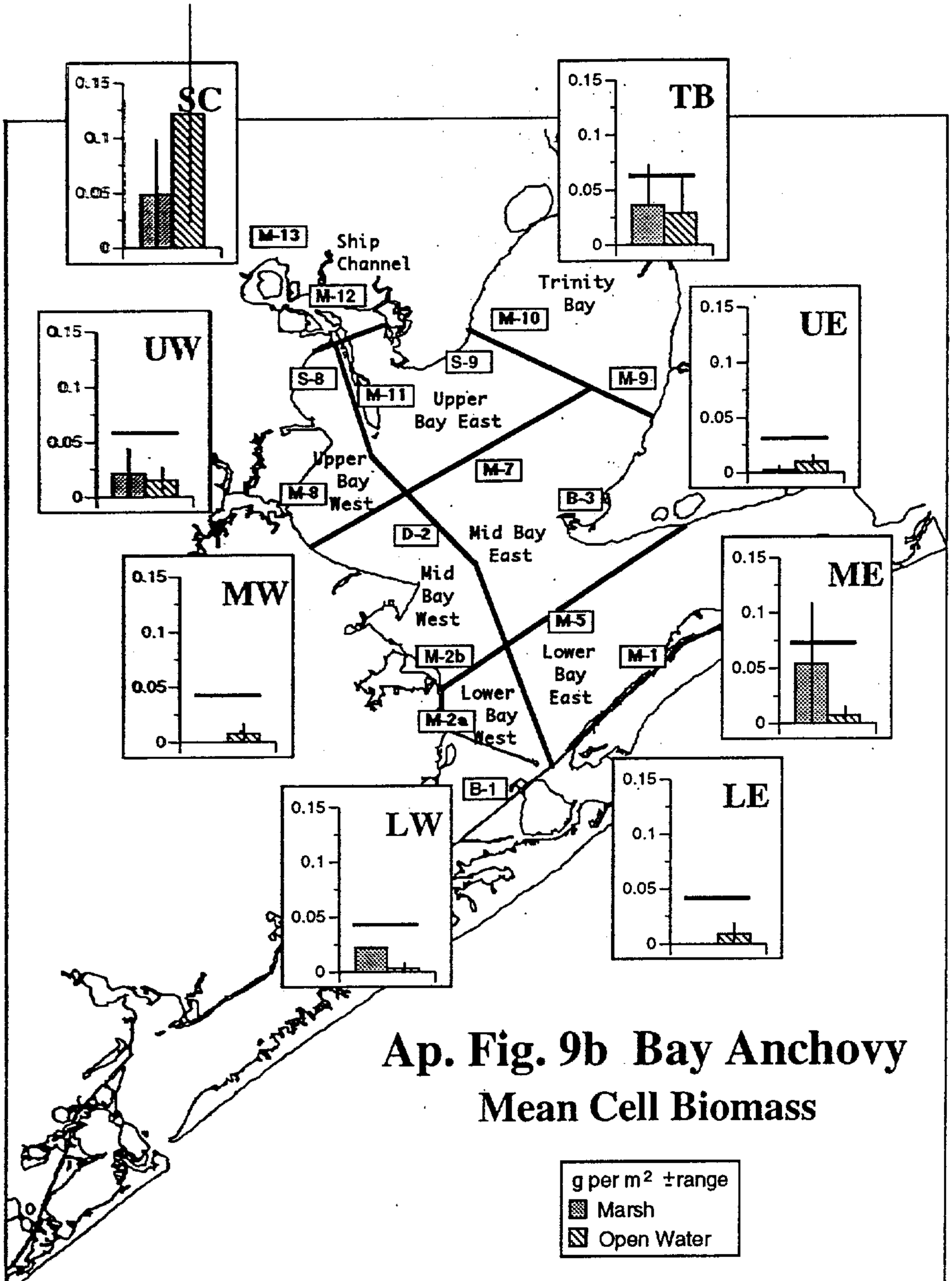
Ap. Fig. 9a Bay Anchovy

Mean Cell Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



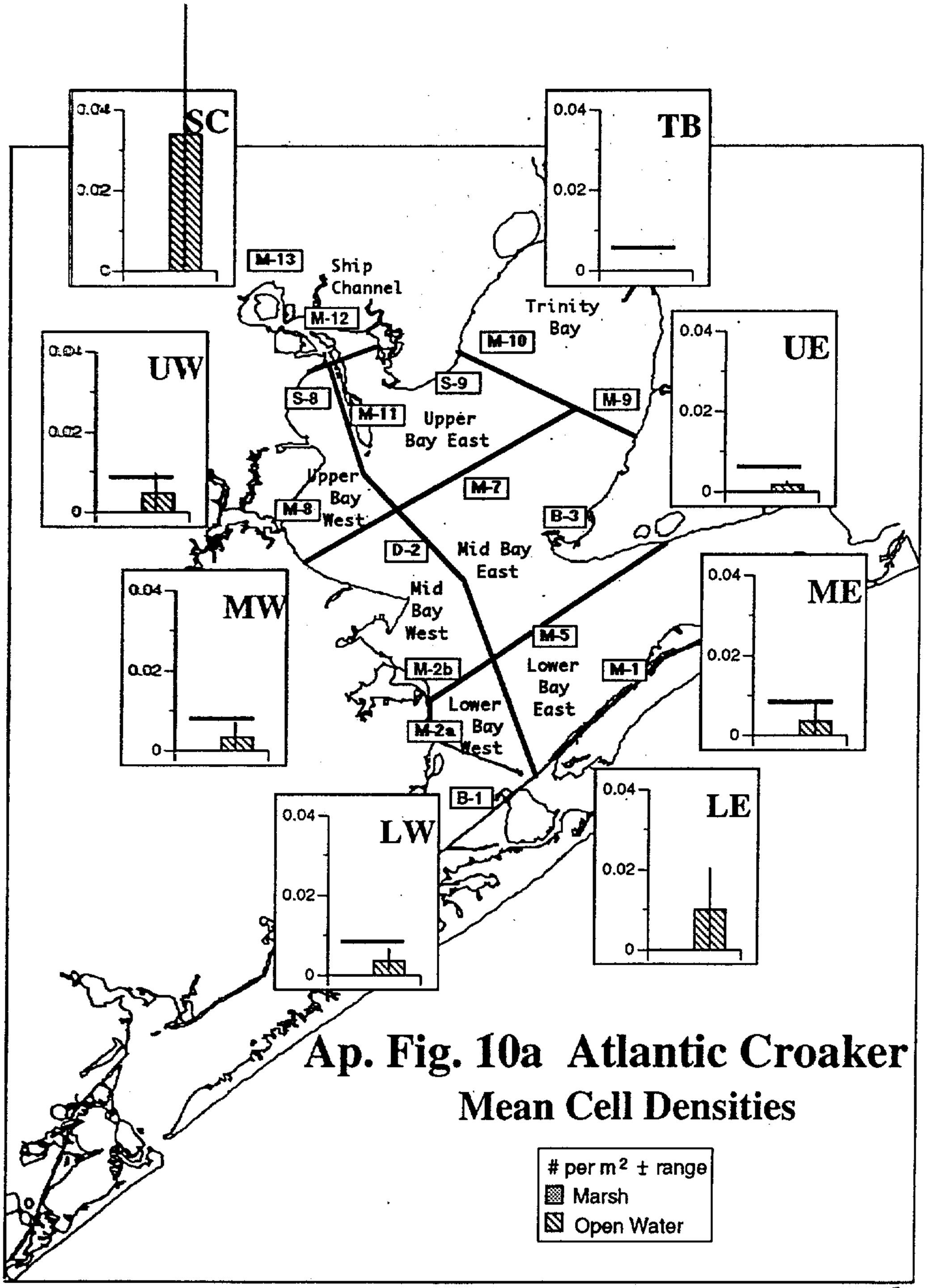
Ap. Fig. 9b Bay Anchovy

Mean Cell Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



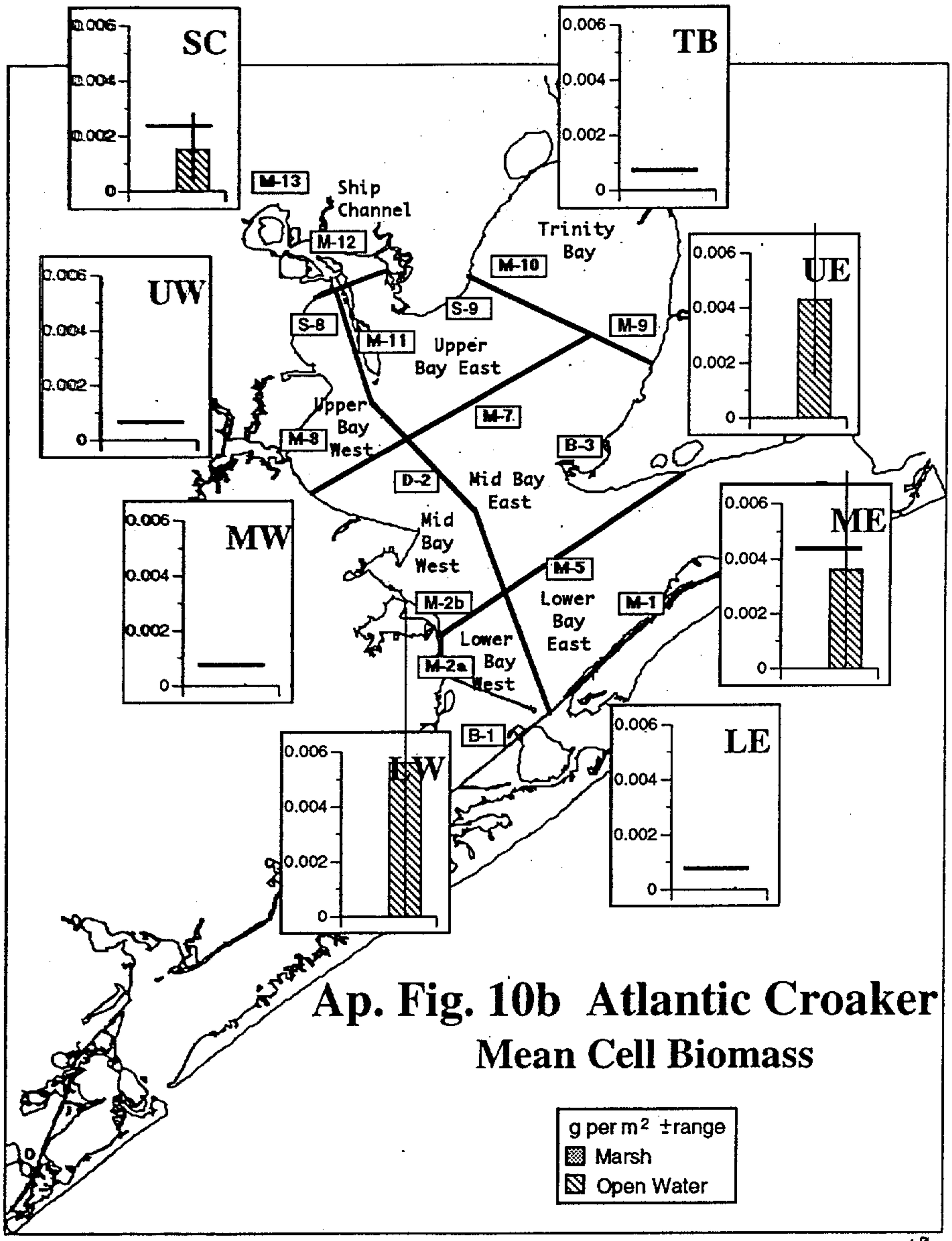
Ap. Fig. 10a Atlantic Croaker

Mean Cell Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



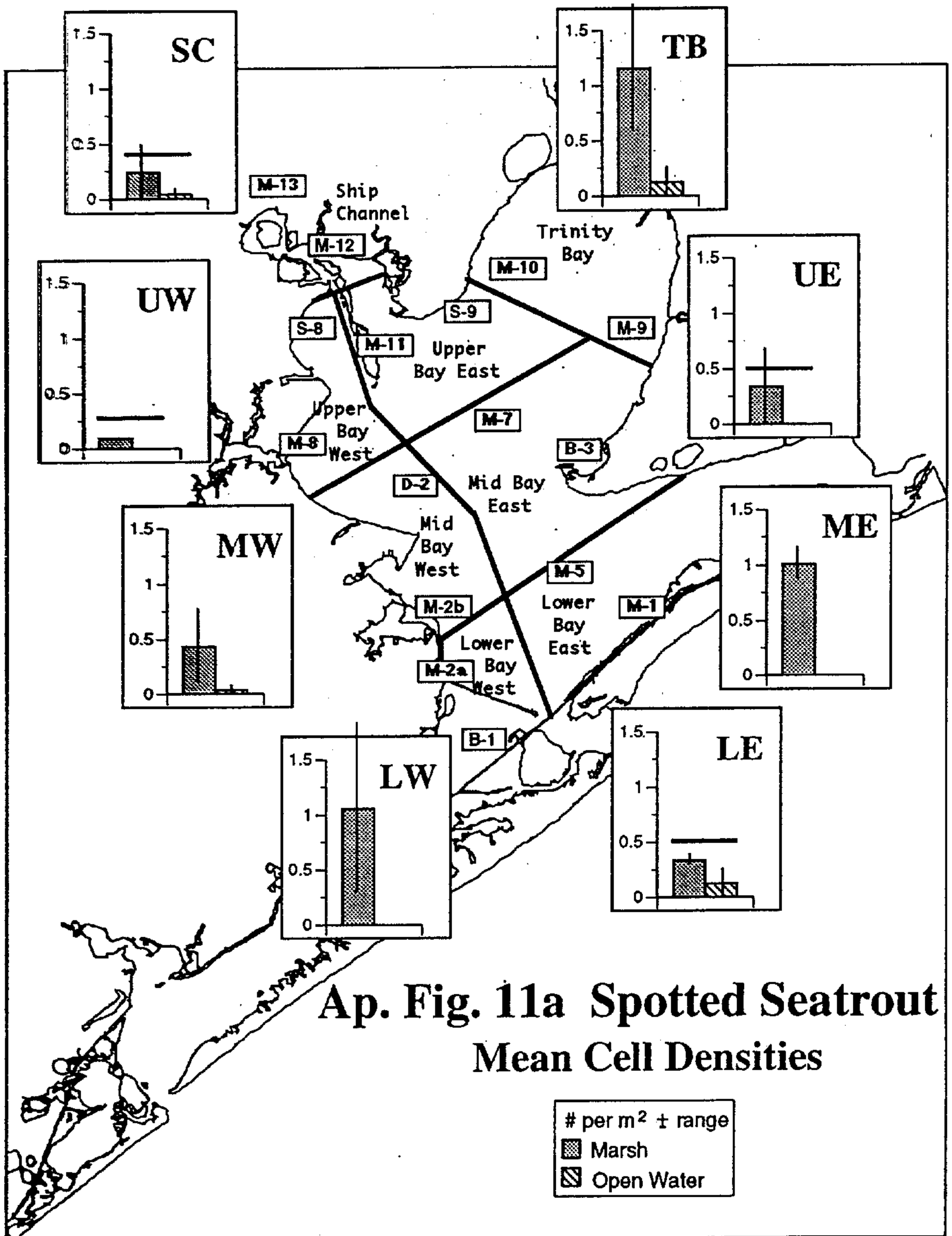
Ap. Fig. 10b Atlantic Croaker

Mean Cell Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Ap. Fig. 11a Spotted Seatrout

Mean Cell Densities

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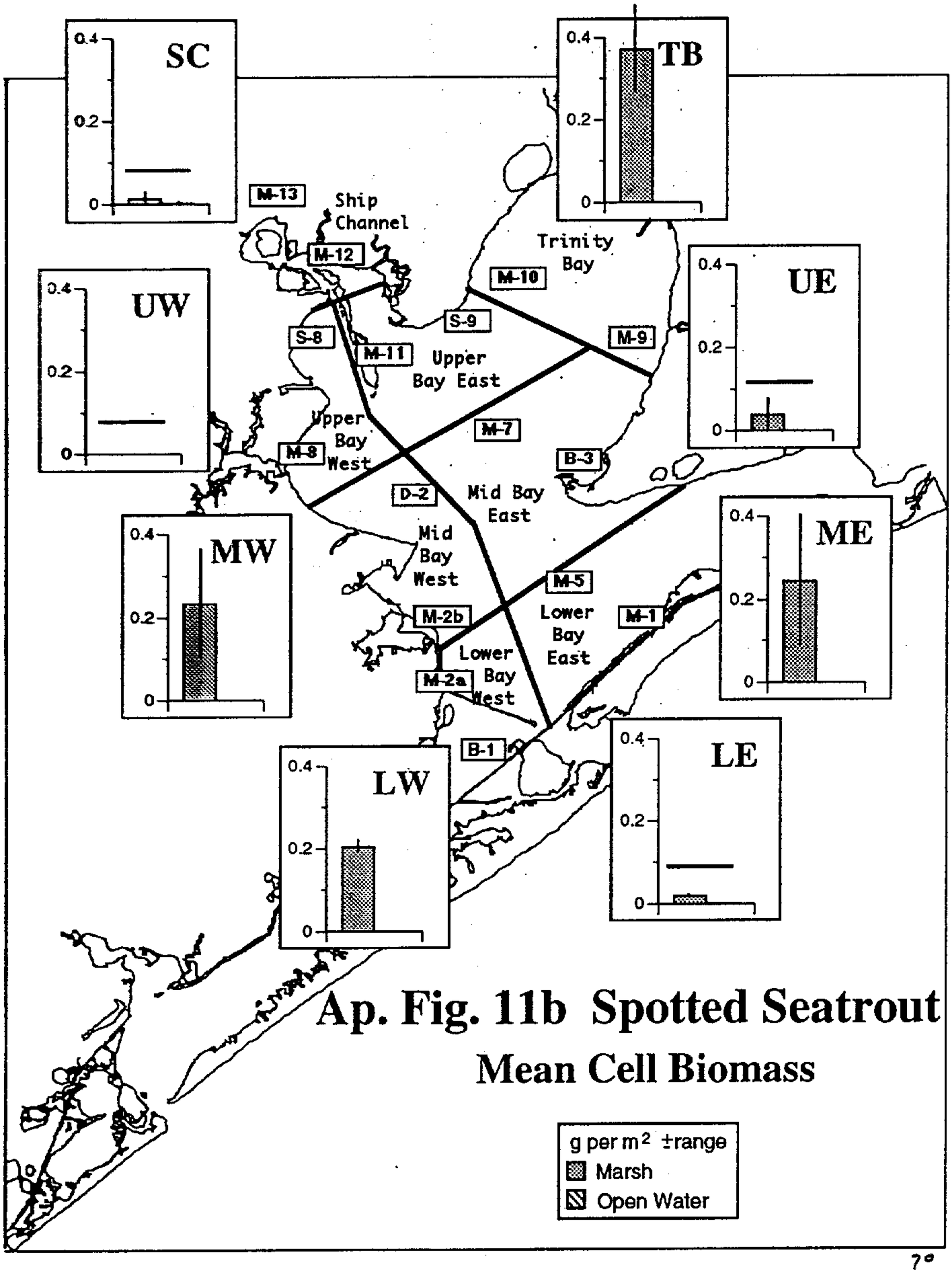
Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



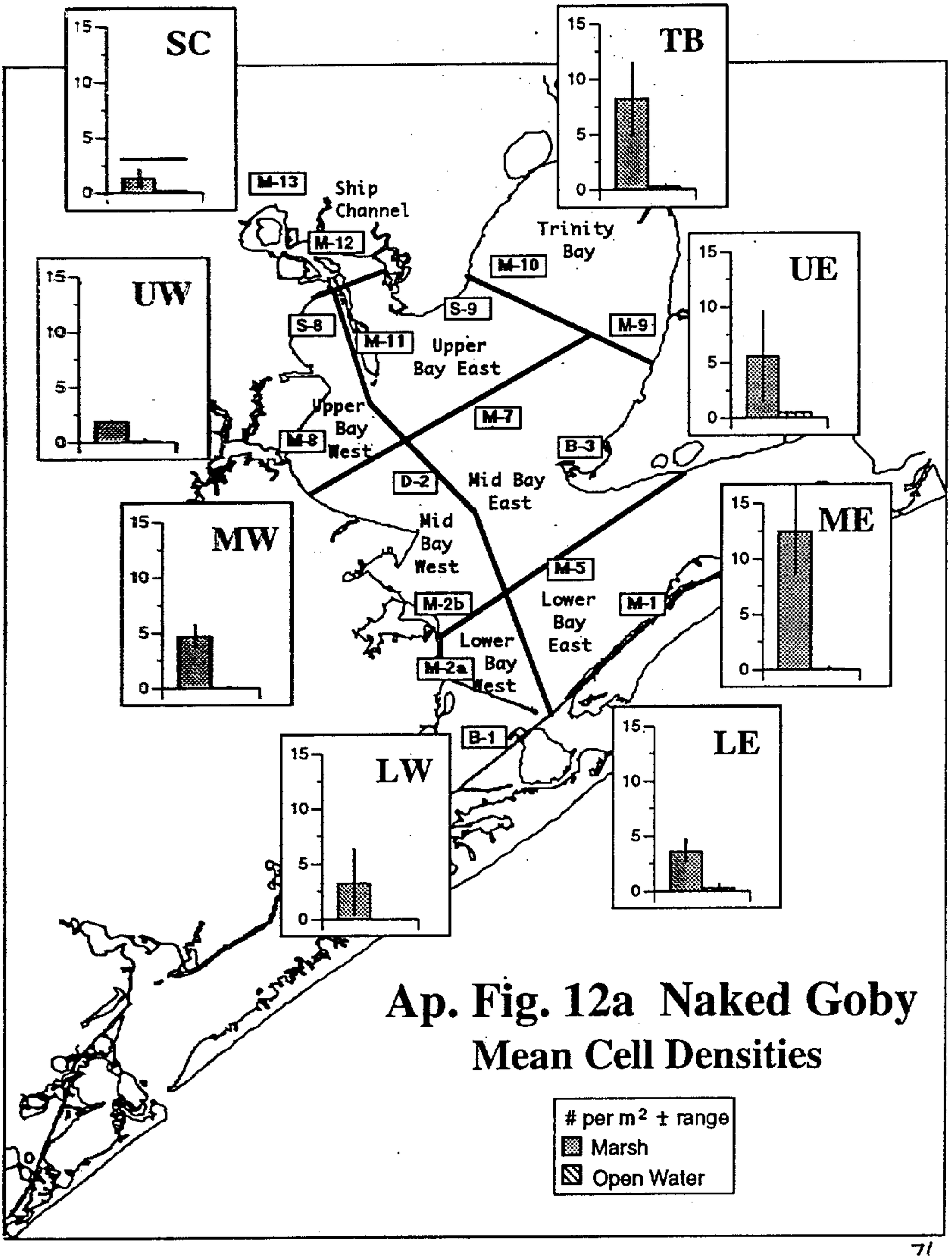
Ap. Fig. 11b Spotted Seatrout

Mean Cell Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)

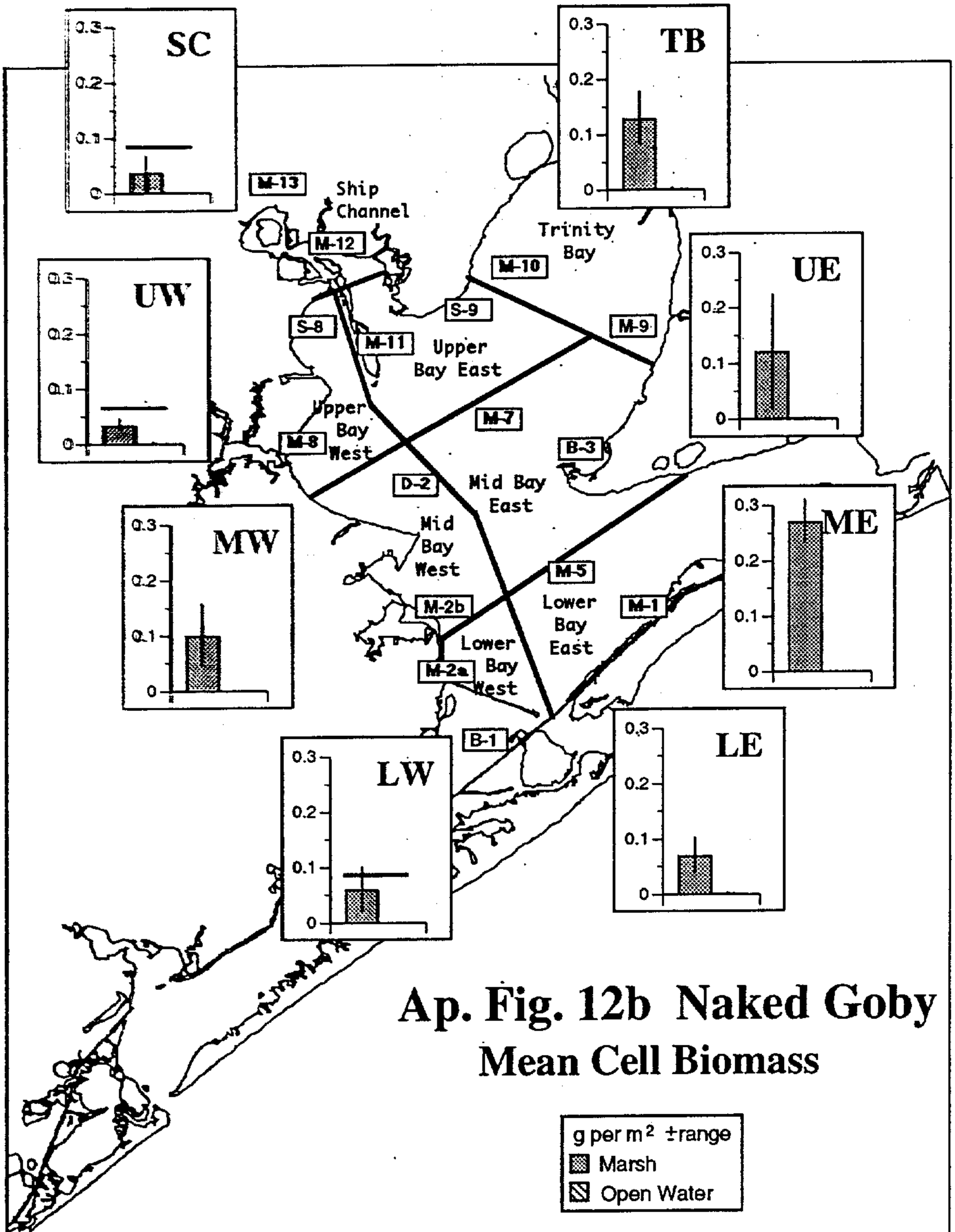


Ap. Fig. 12a Naked Goby
Mean Cell Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



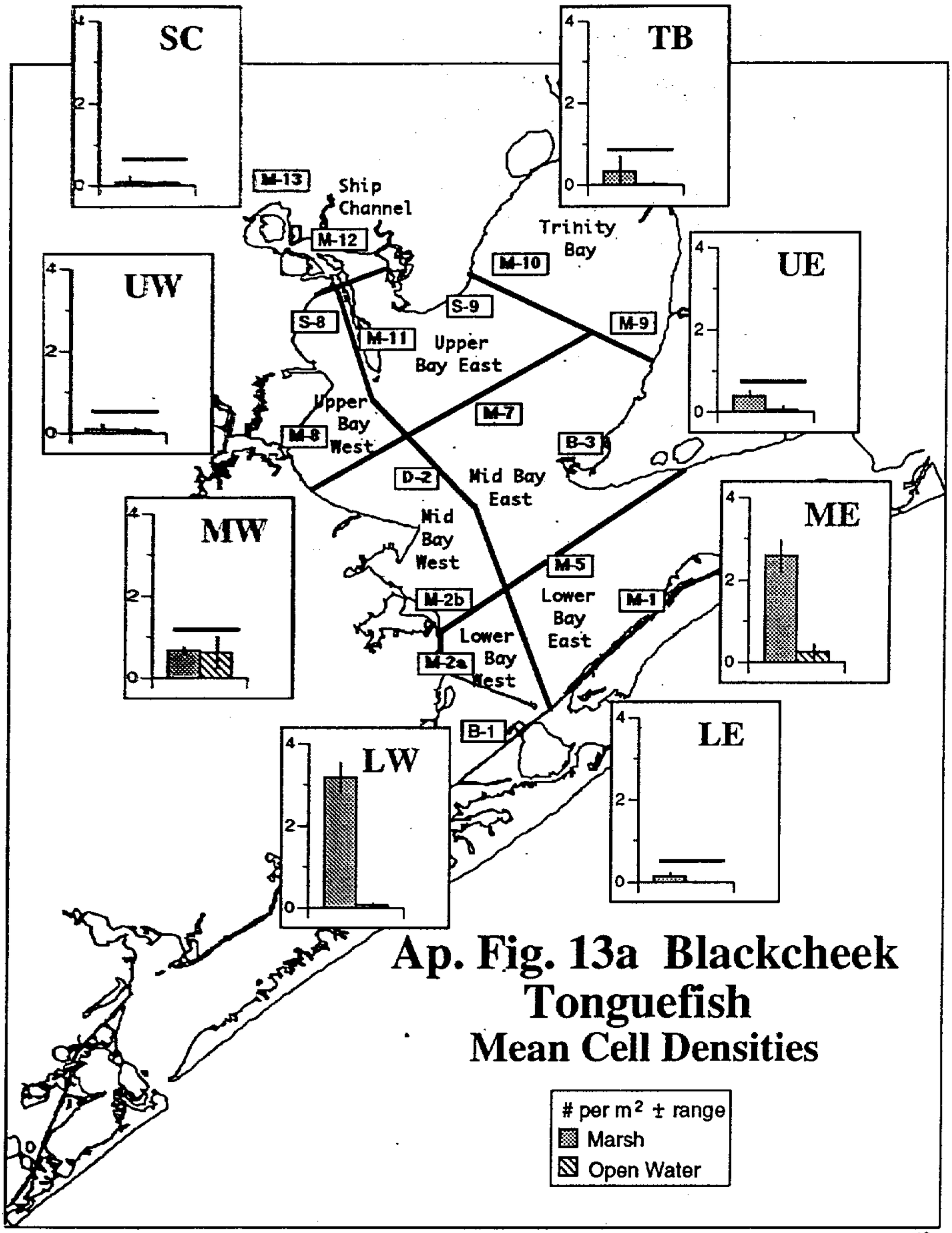
Ap. Fig. 12b Naked Goby

Mean Cell Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

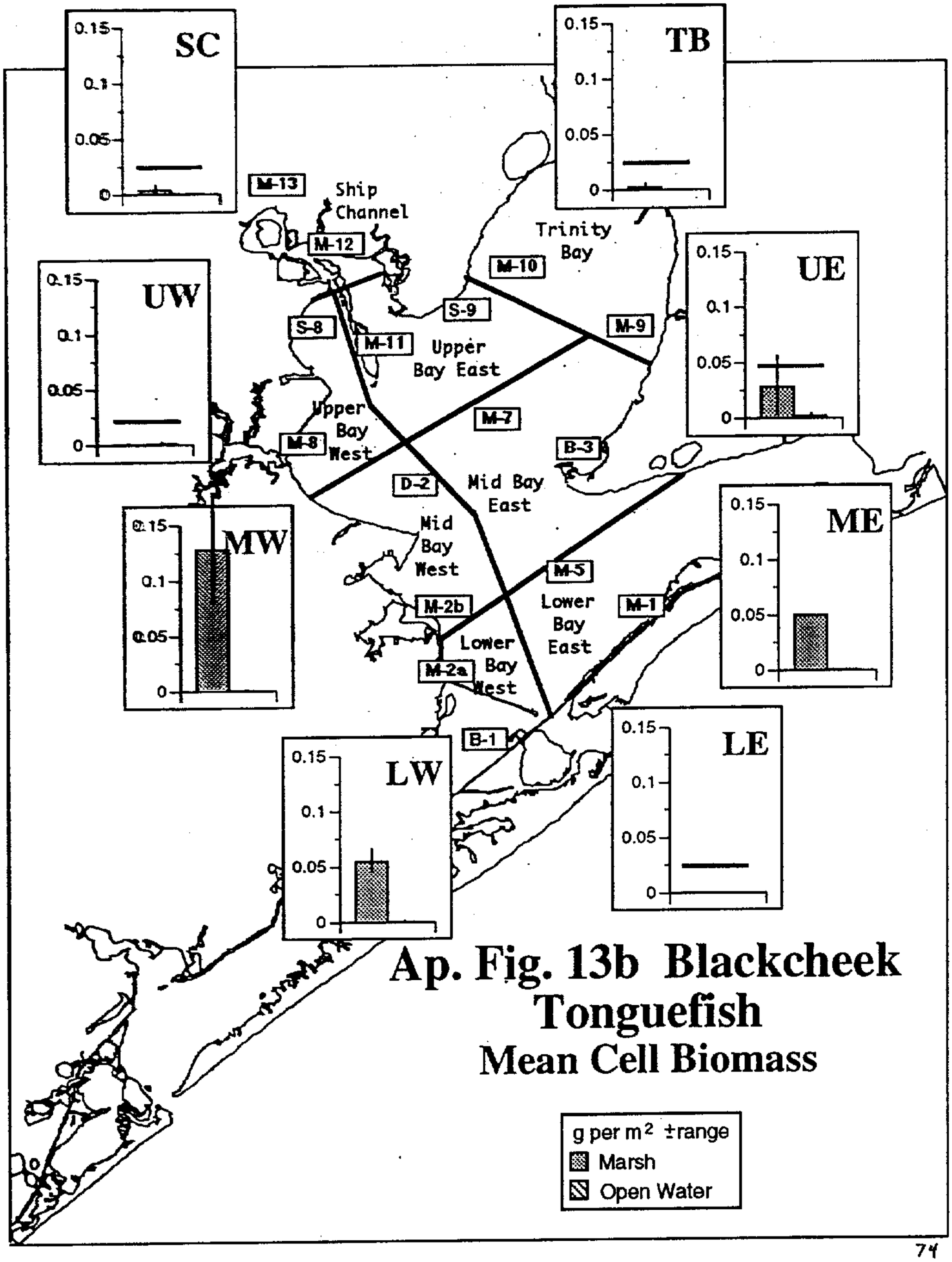
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

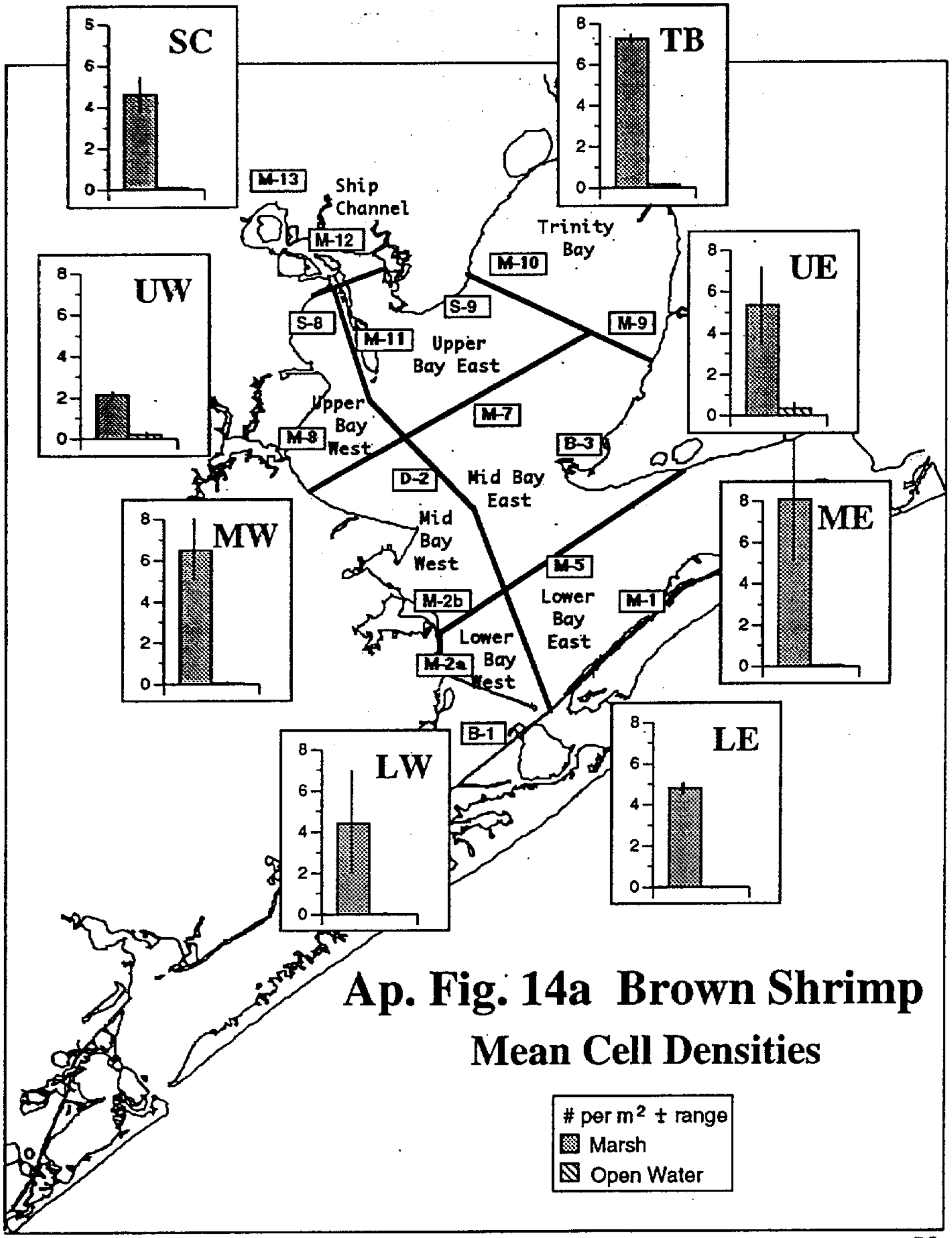


Ap. Fig. 13b Blackcheek Tonguefish Mean Cell Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



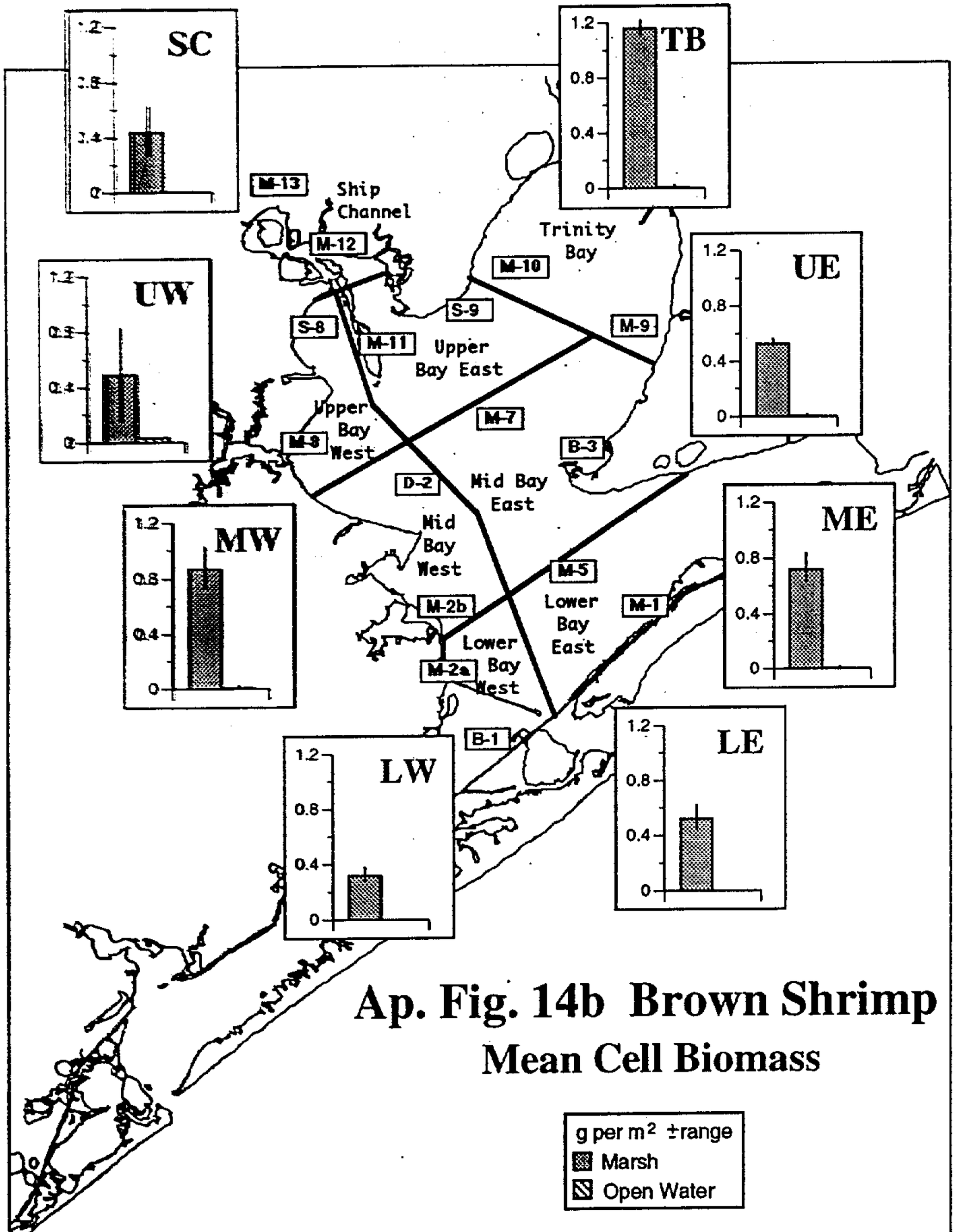
Ap. Fig. 14a Brown Shrimp

Mean Cell Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



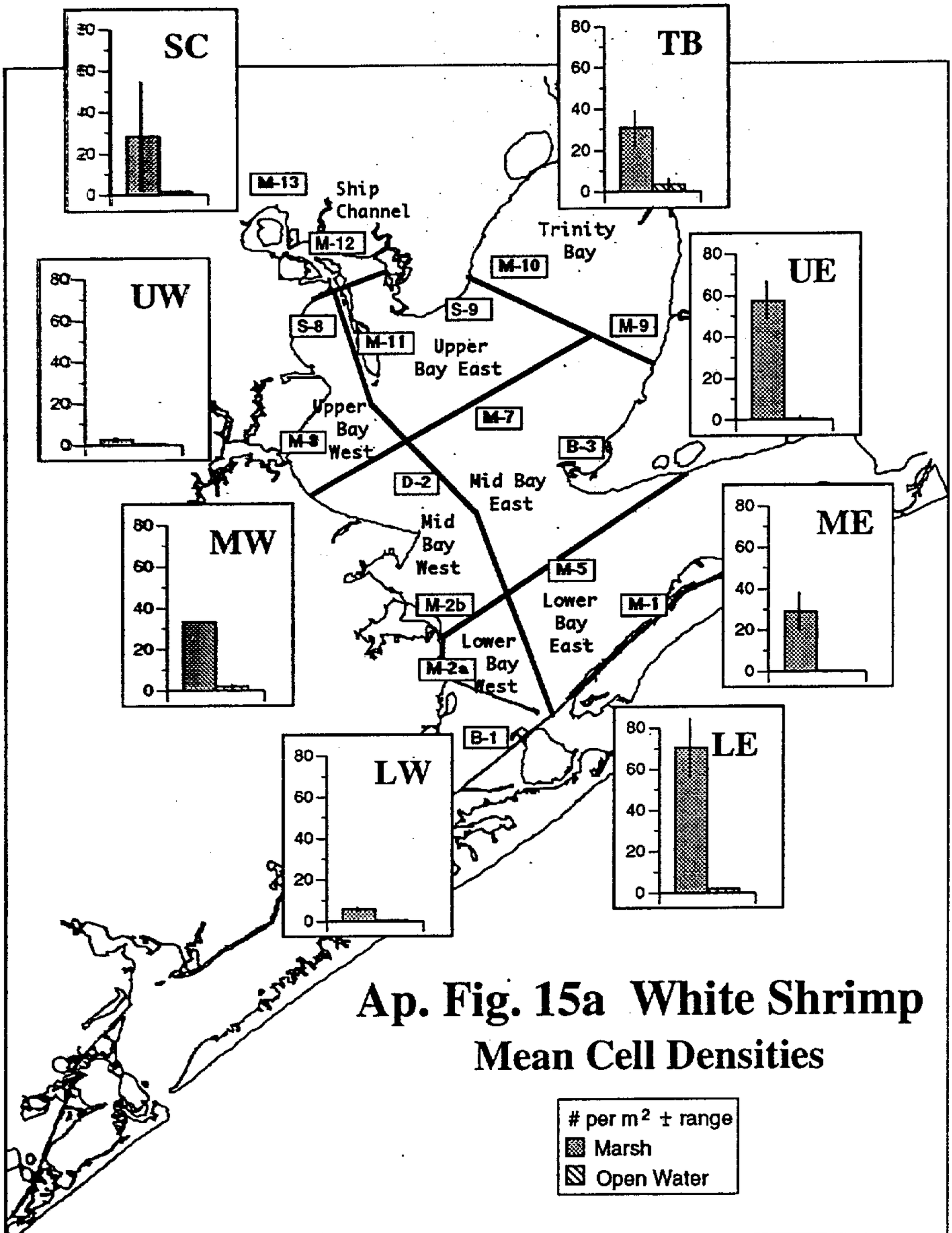
Ap. Fig. 14b Brown Shrimp

Mean Cell Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

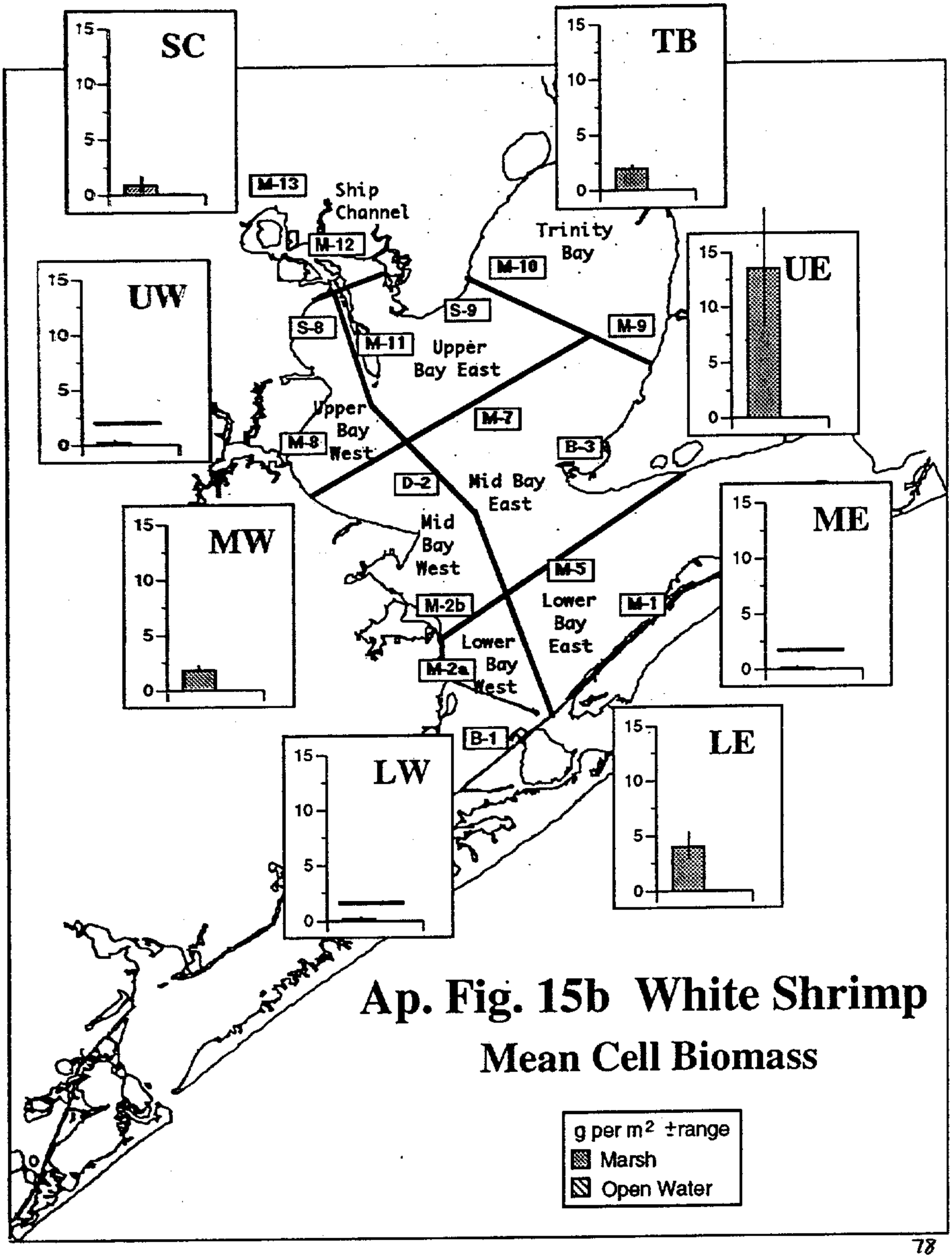


Ap. Fig. 15a White Shrimp
Mean Cell Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

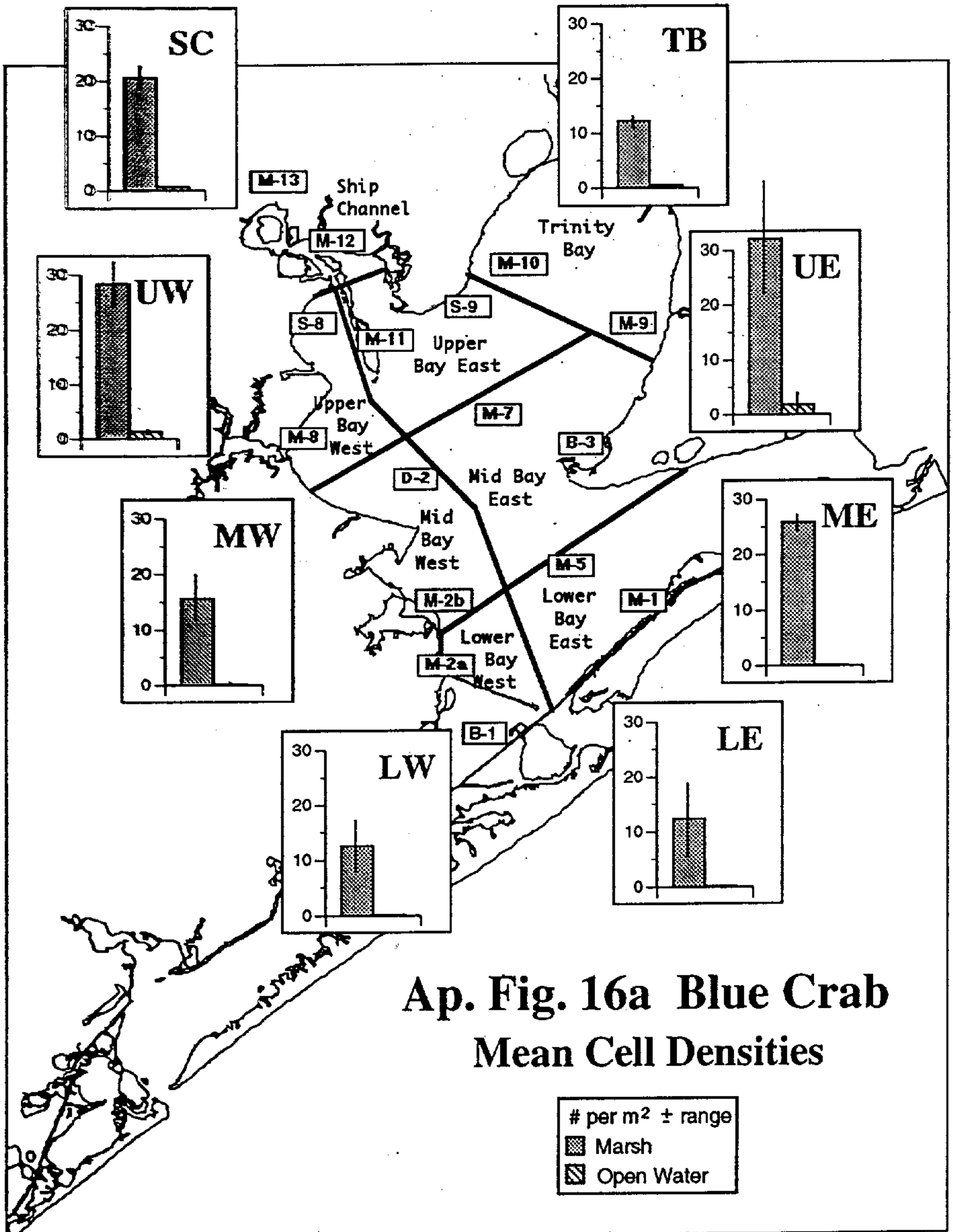
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



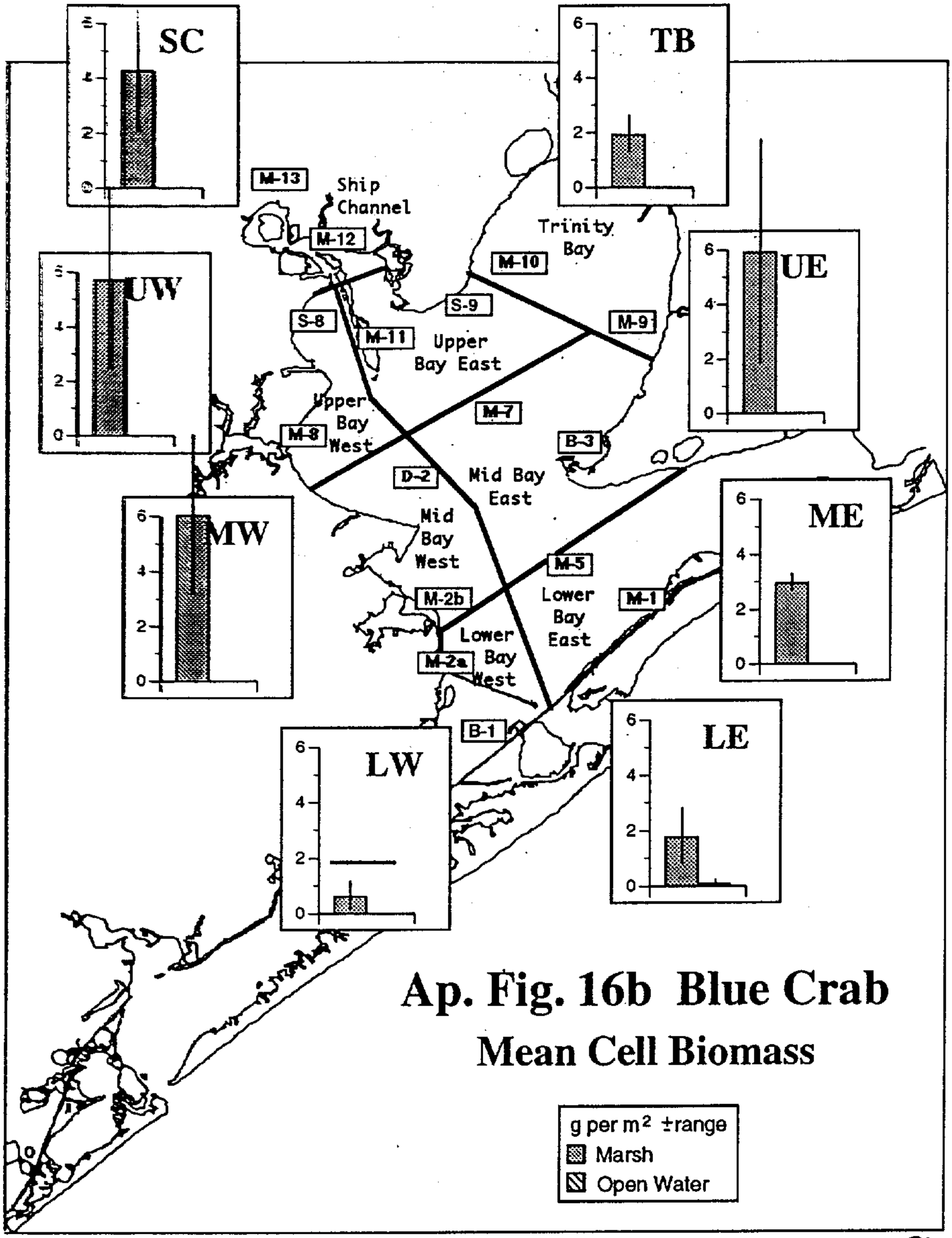
Ap. Fig. 16a Blue Crab

Mean Cell Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



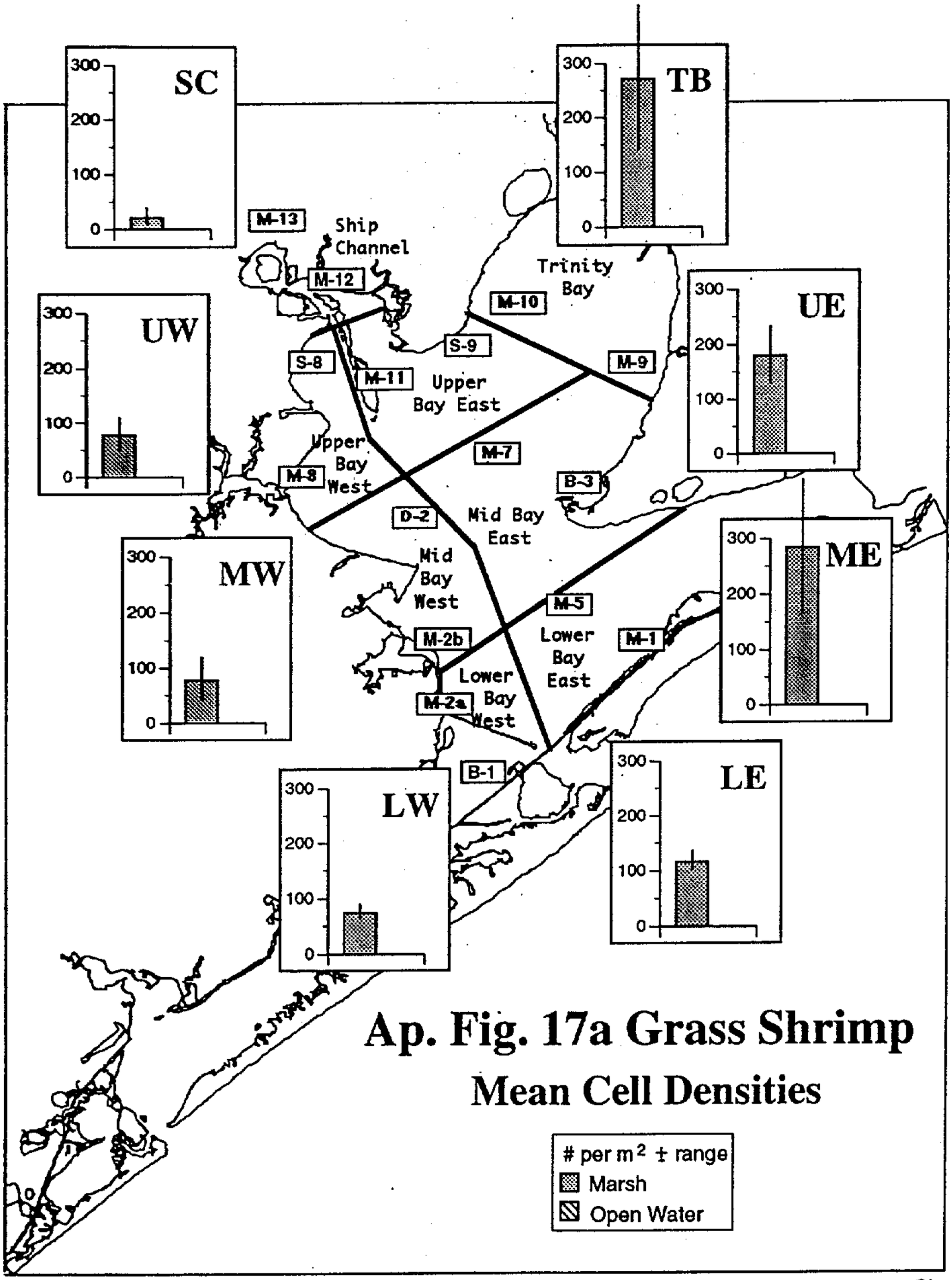
Ap. Fig. 16b Blue Crab

Mean Cell Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Ap. Fig. 17a Grass Shrimp

Mean Cell Densities

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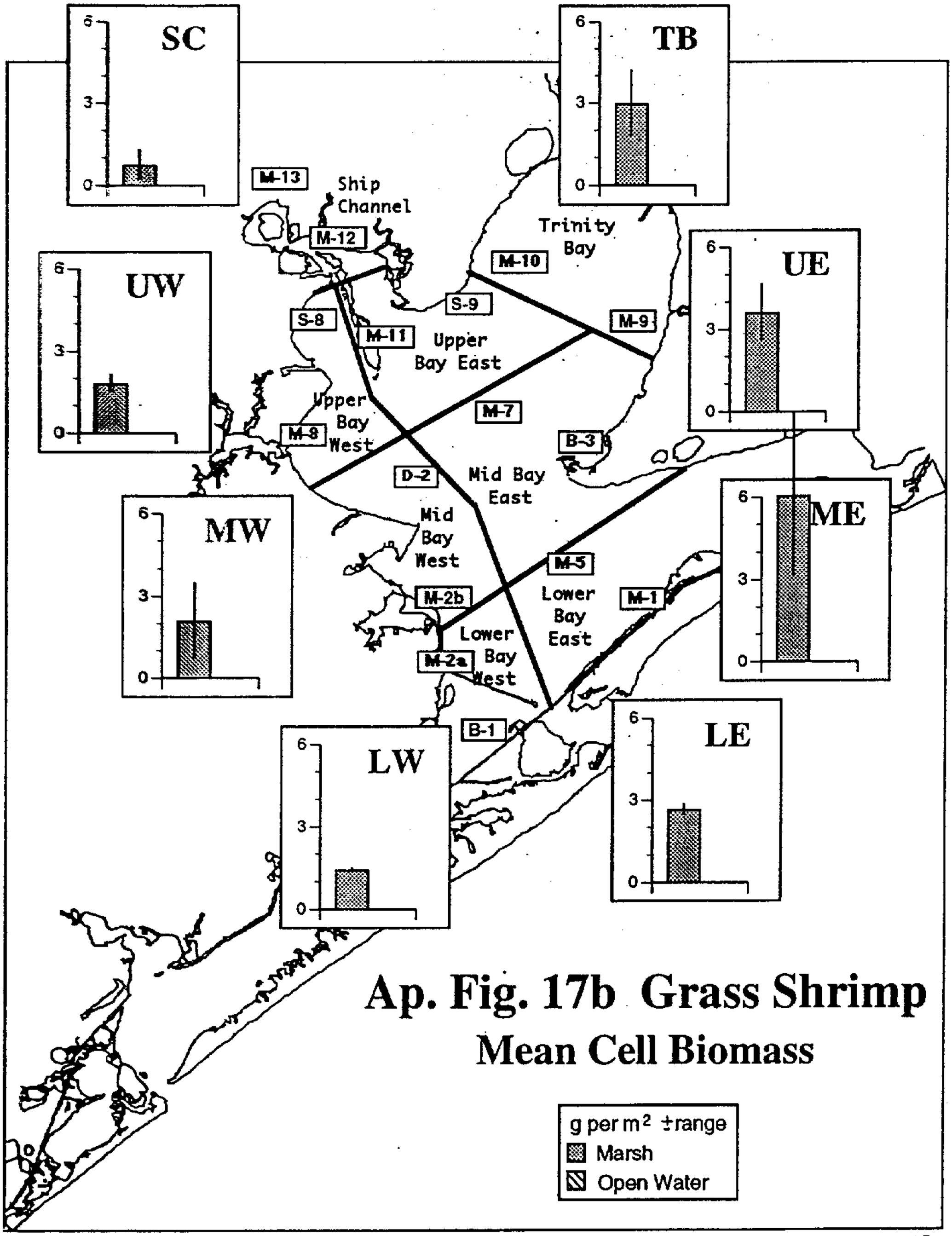
Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)

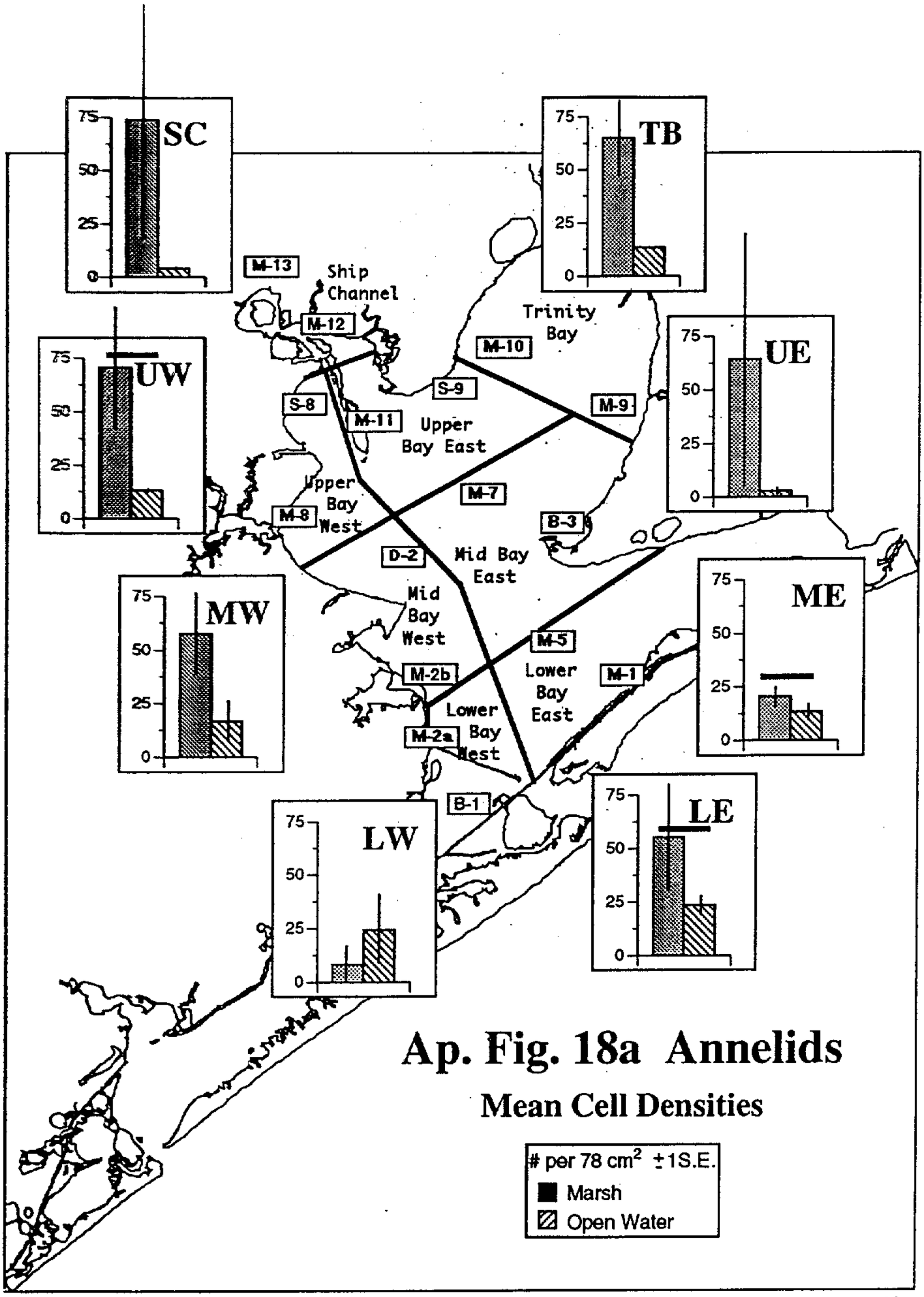


82

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Ap. Fig. 18a Annelids

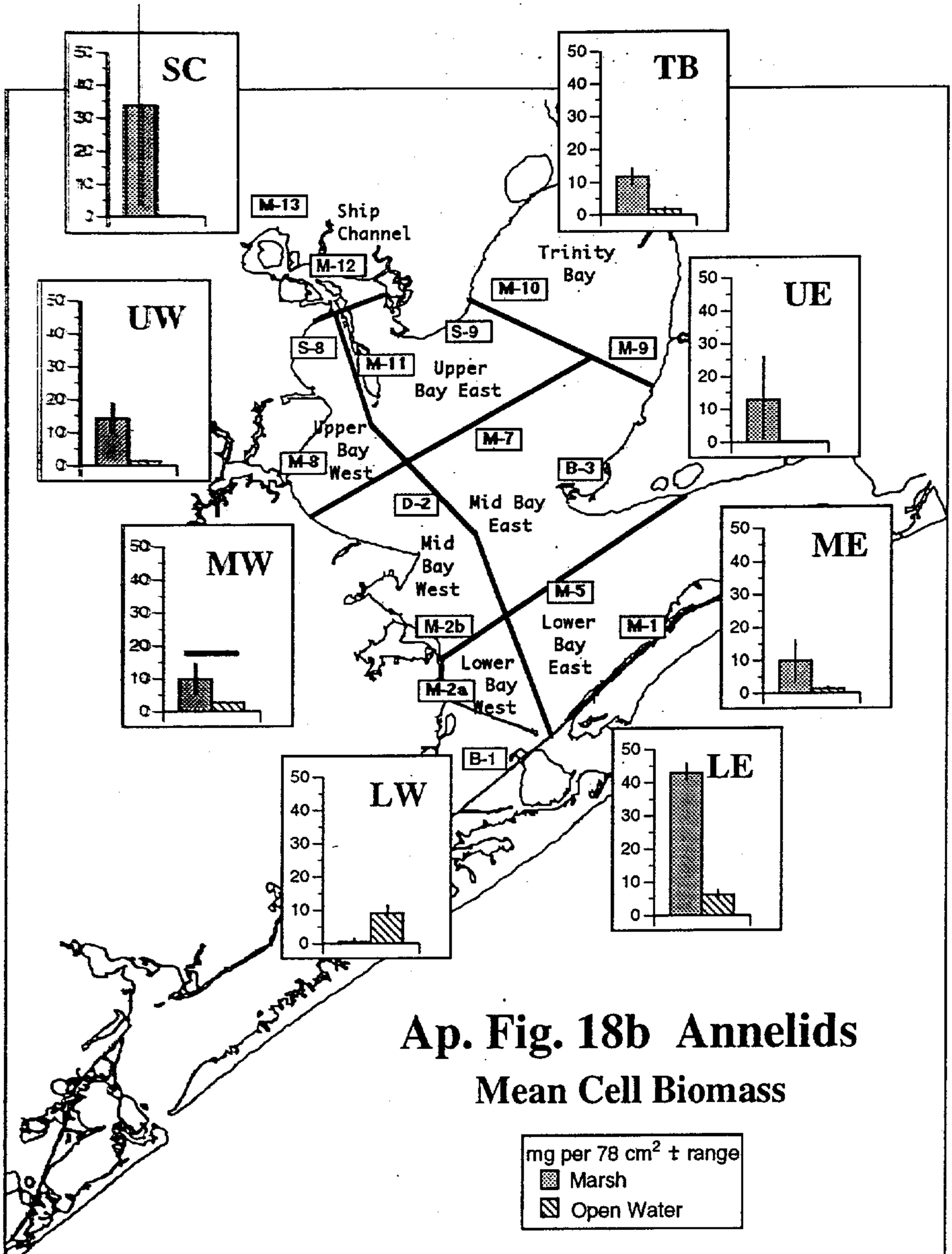
Mean Cell Densities

83

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Ap. Fig. 18b Annelids

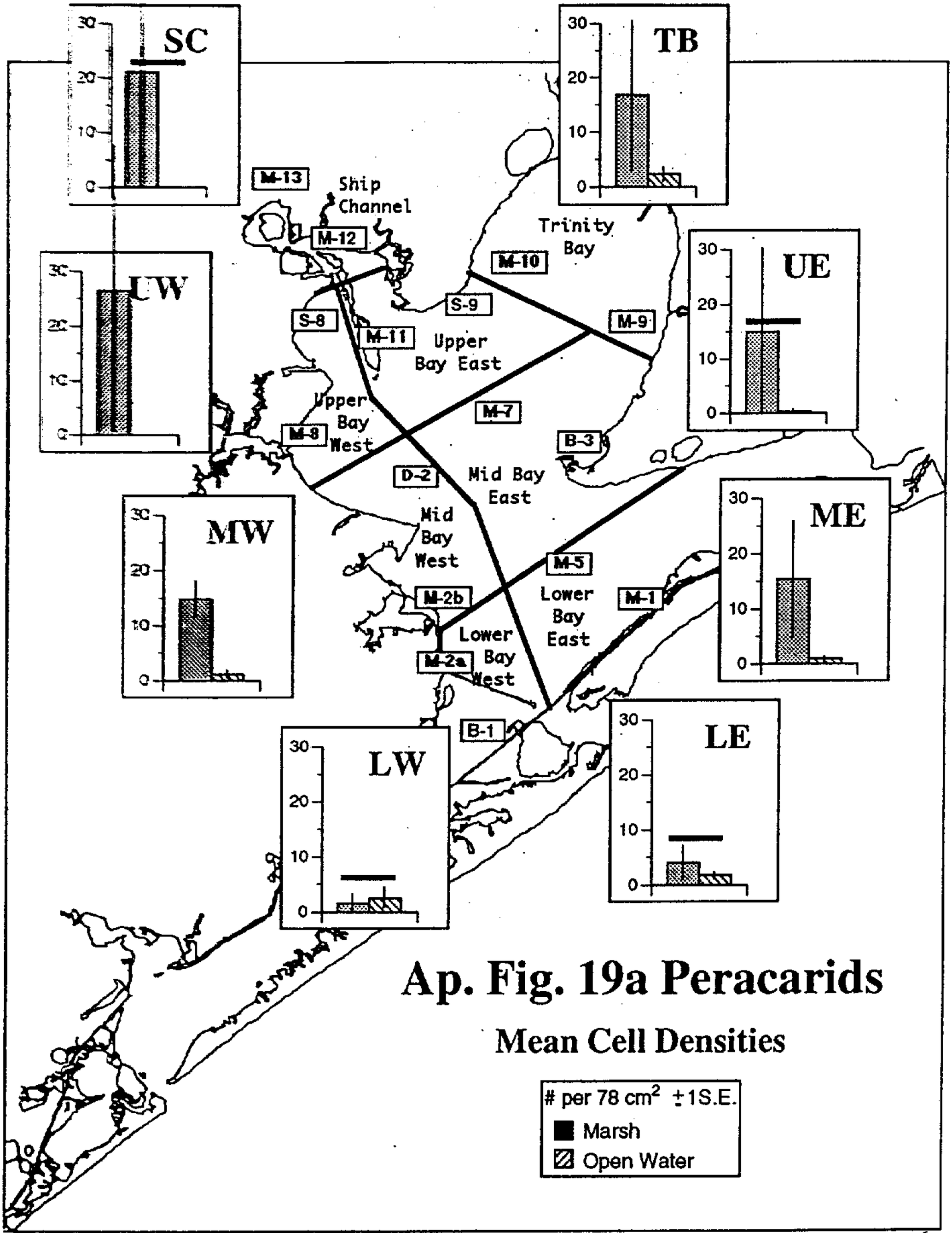
Mean Cell Biomass

84

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Ap. Fig. 19a Peracarids

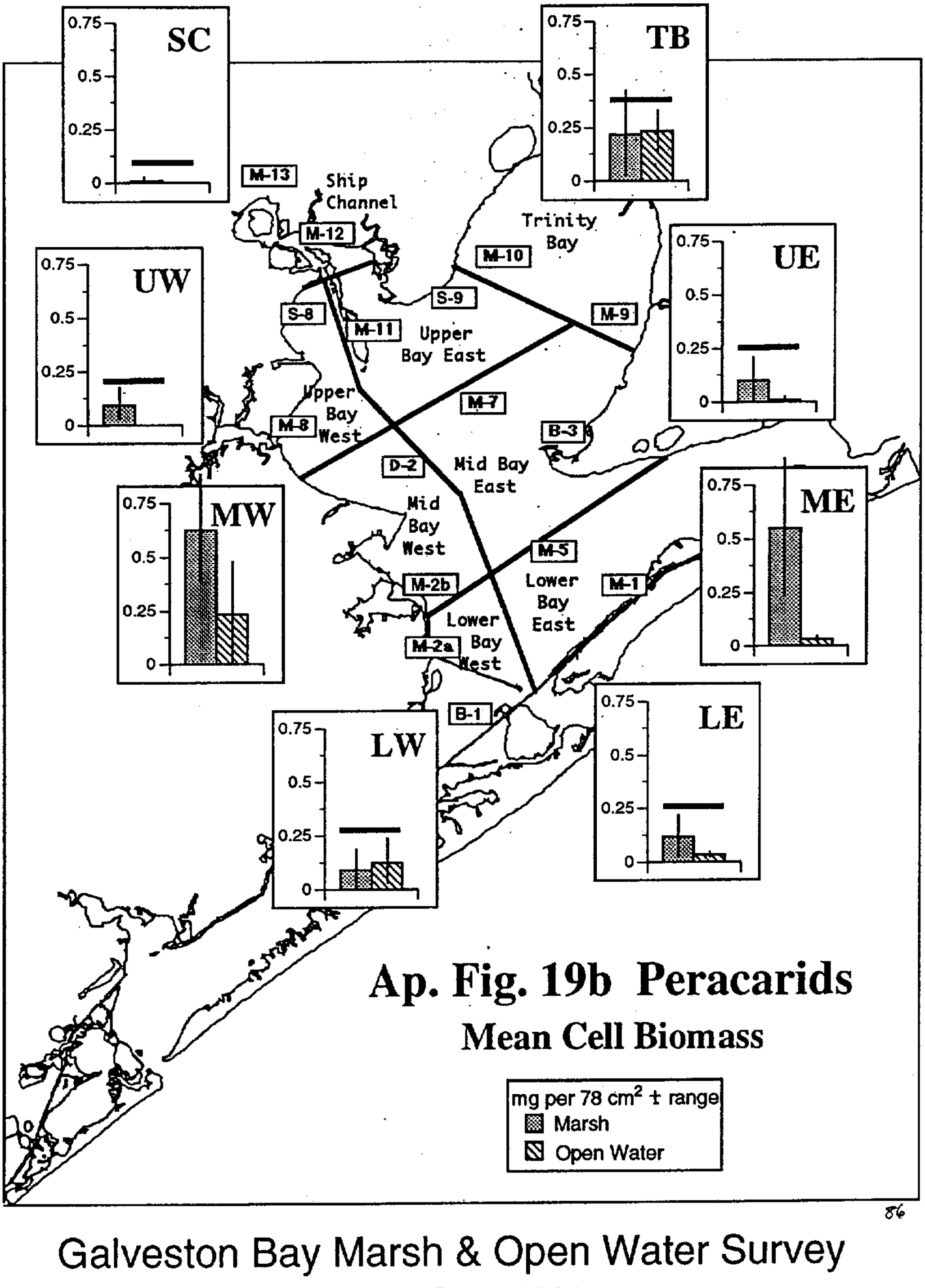
Mean Cell Densities

85

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

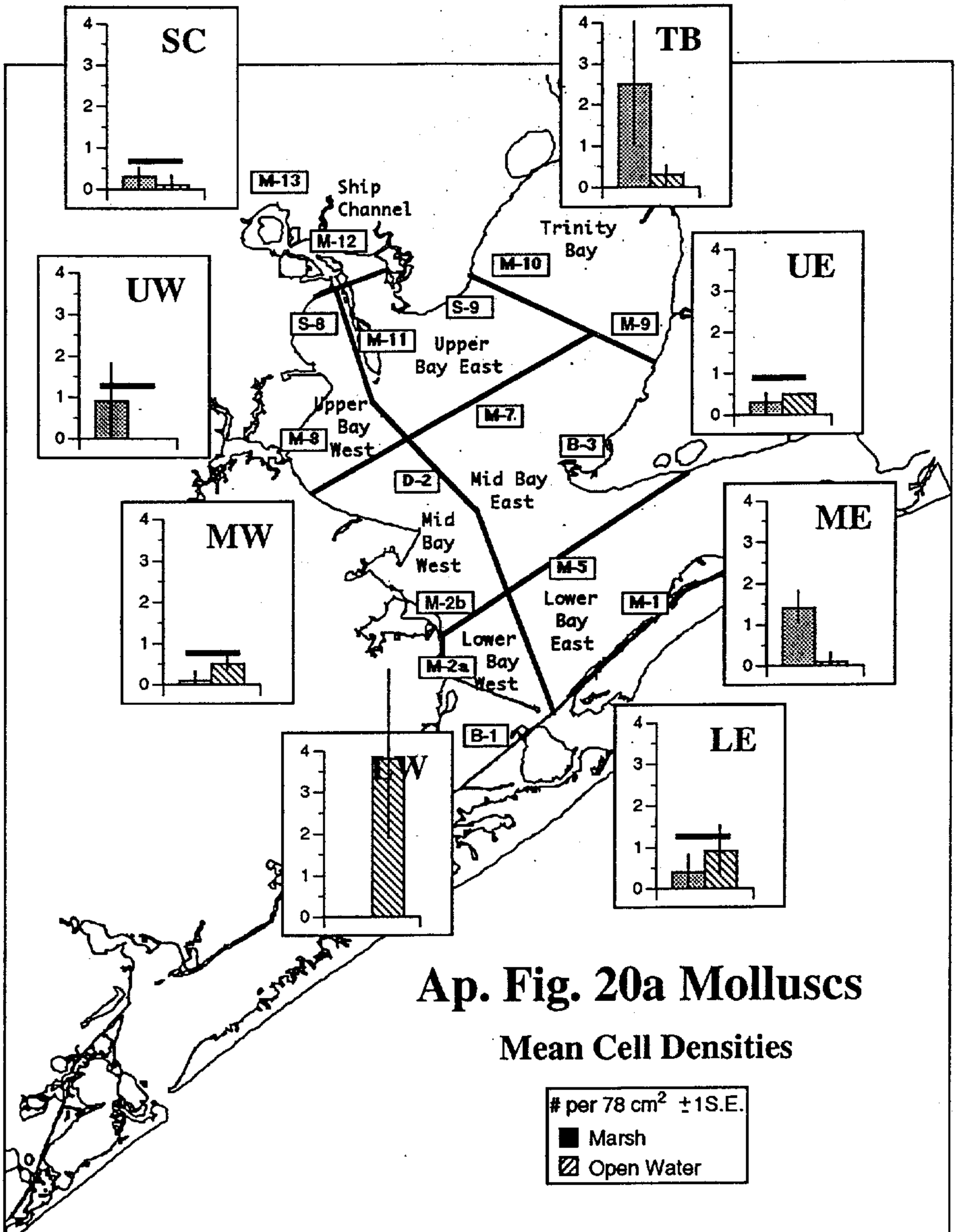
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Ap. Fig. 20a Molluscs

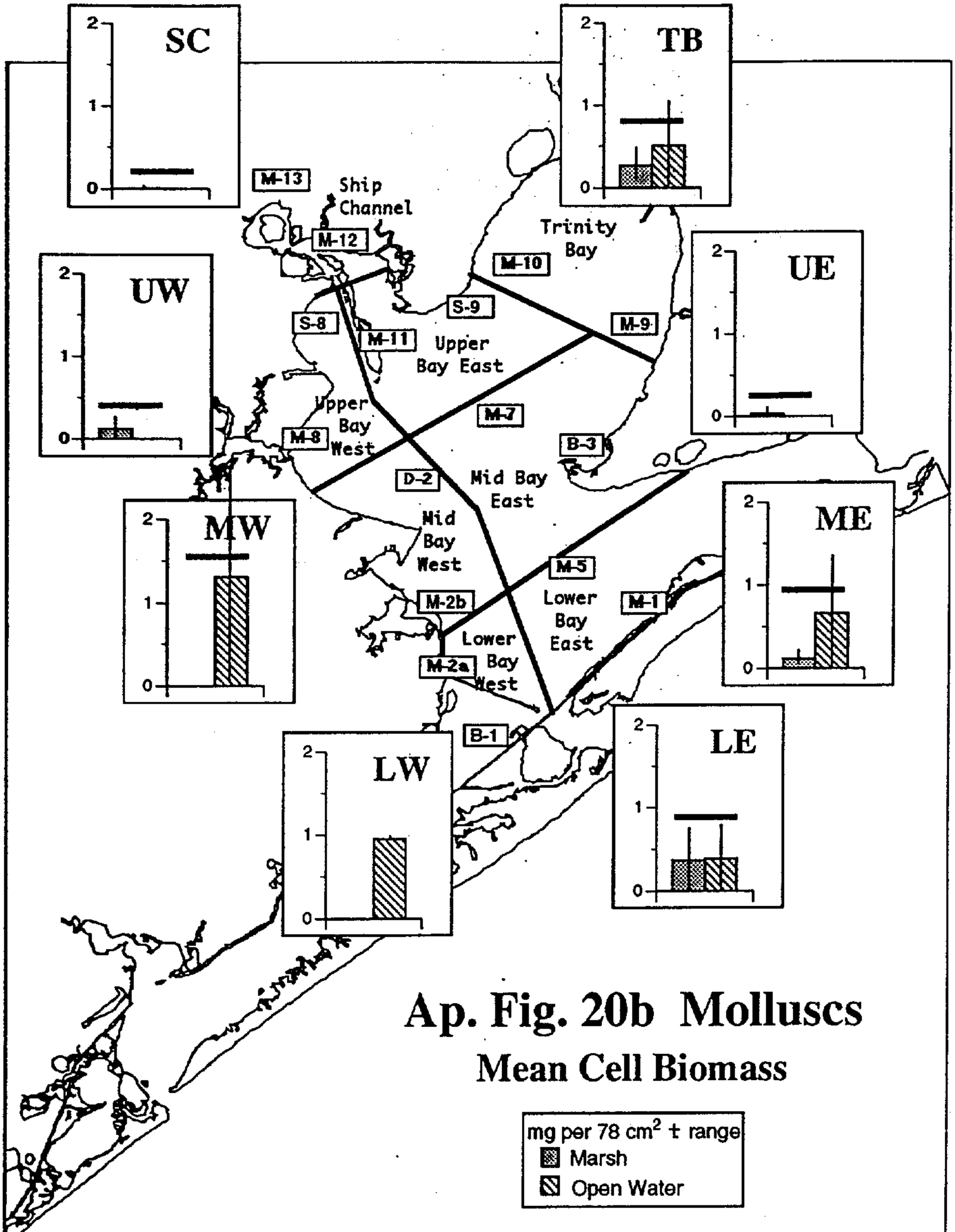
Mean Cell Densities

87

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



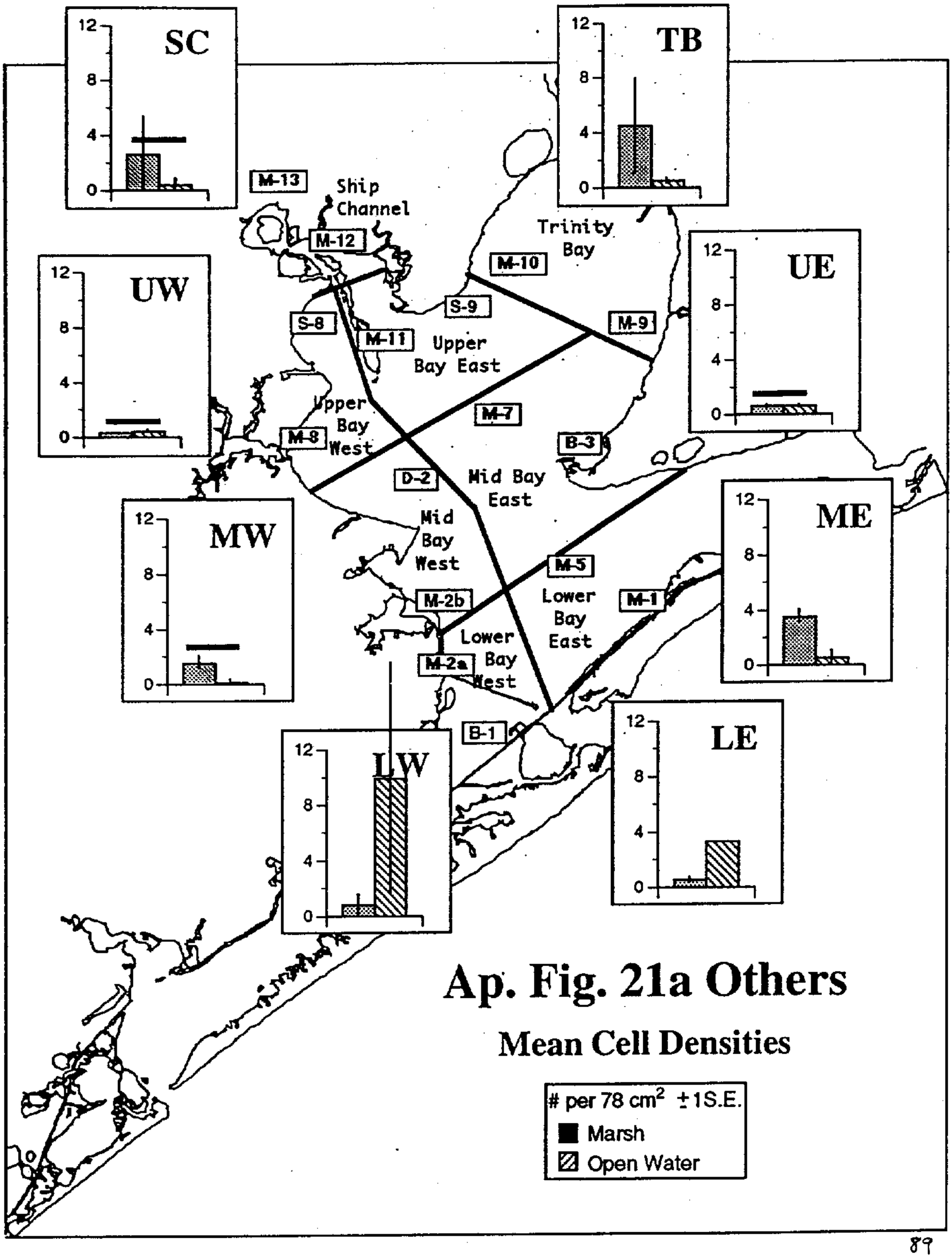
Ap. Fig. 20b Molluscs

Mean Cell Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Ap. Fig. 21a Others

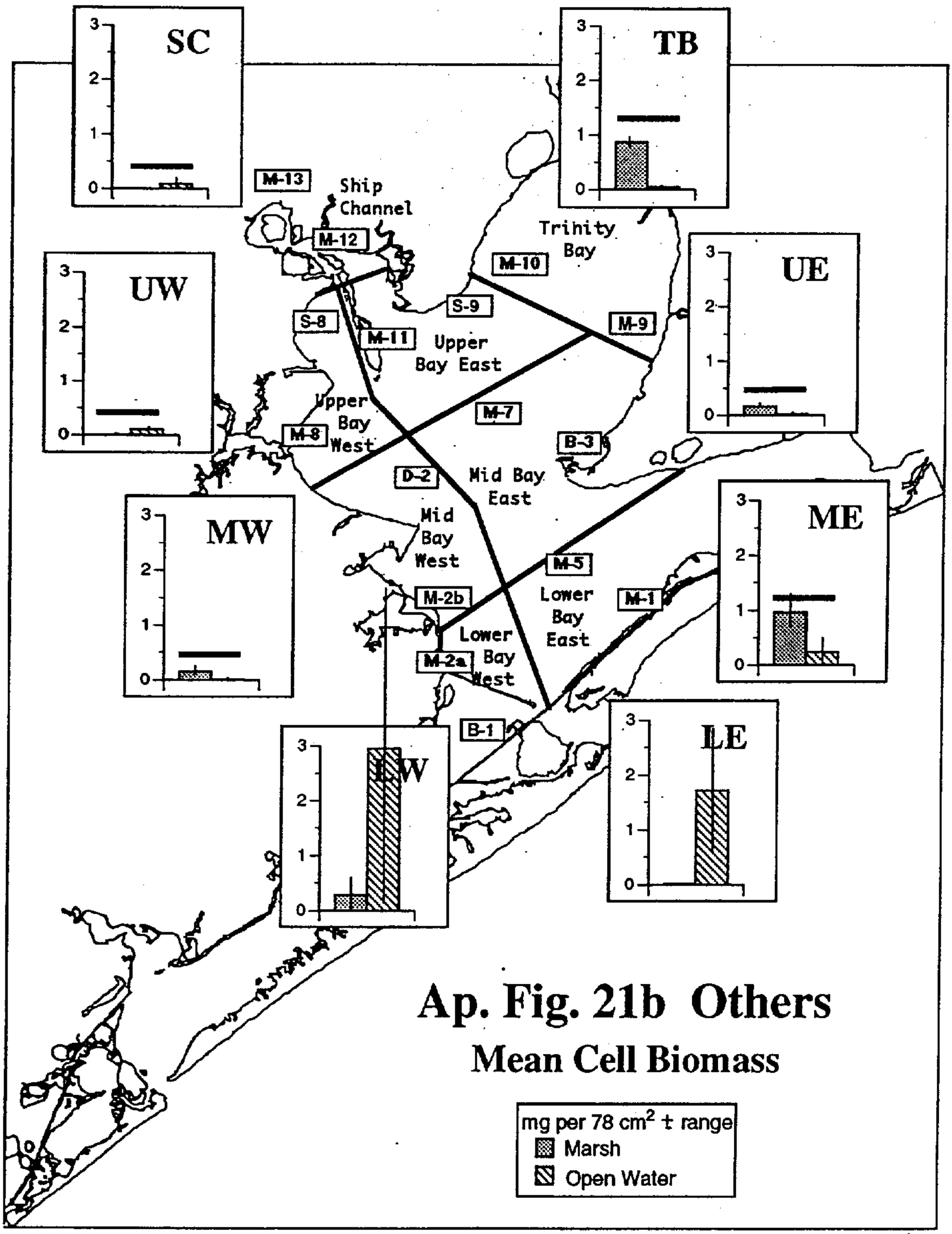
Mean Cell Densities

89

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)

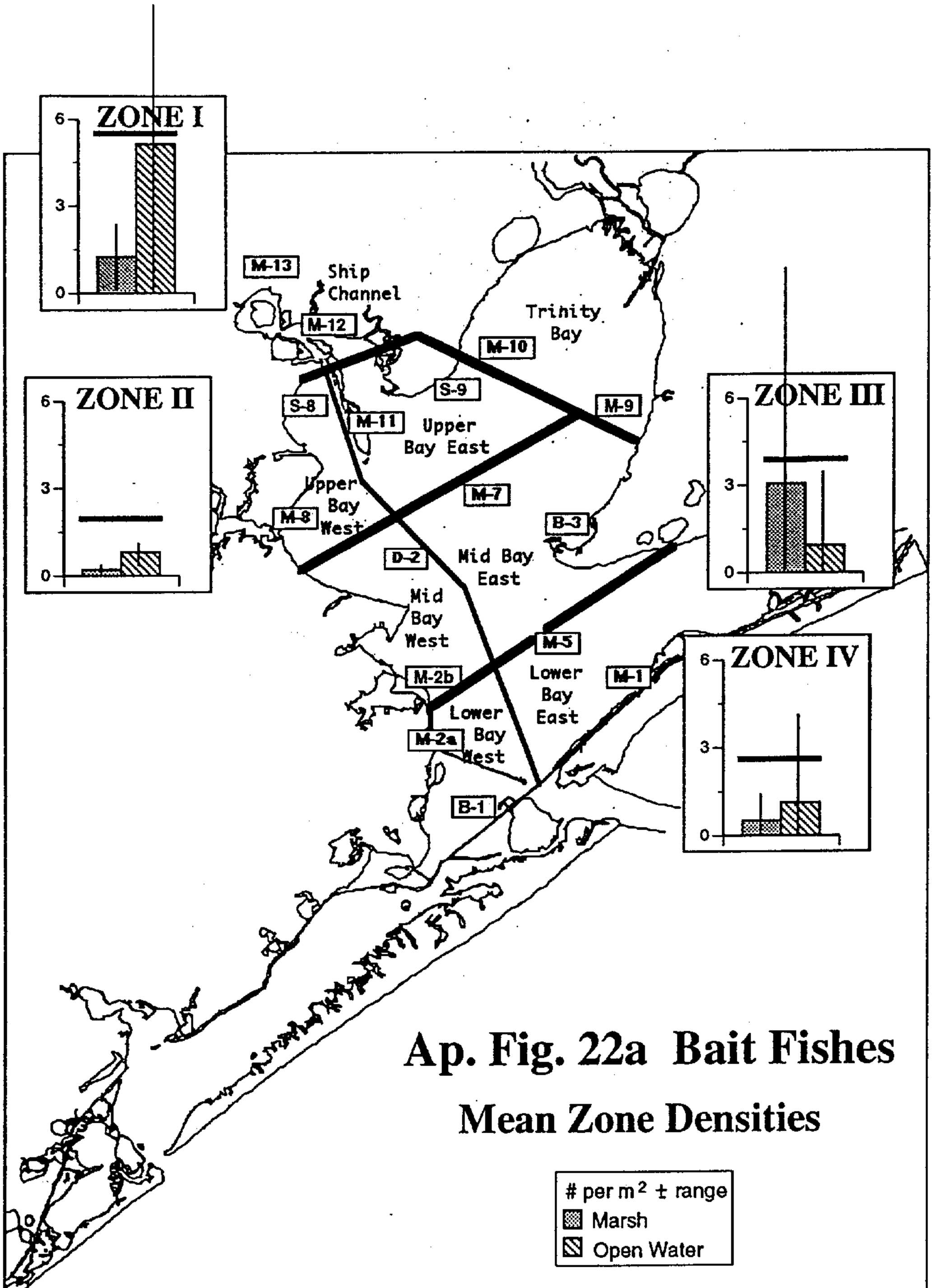


90

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Ap. Fig. 22a Bait Fishes

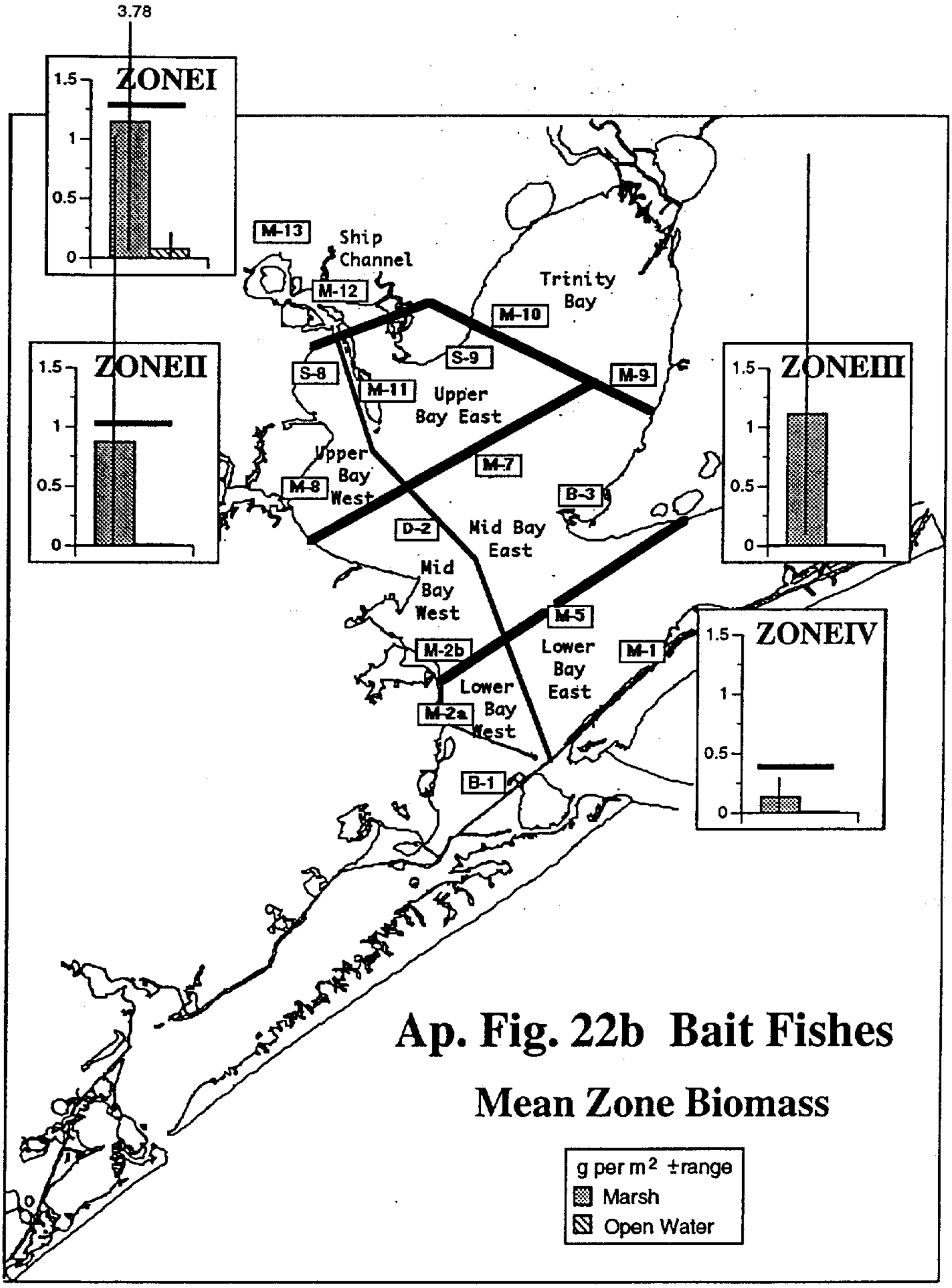
Mean Zone Densities

91

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

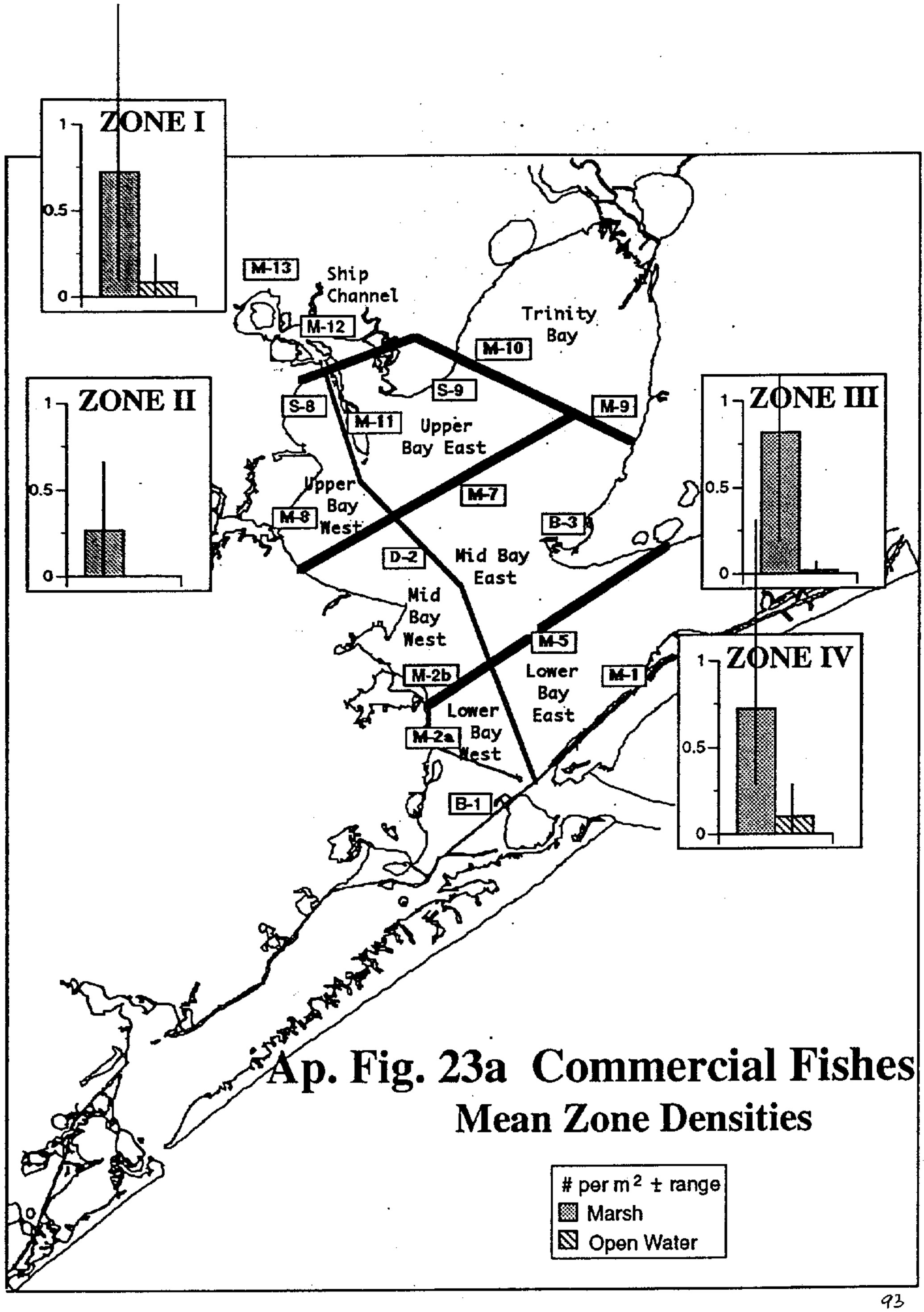


92

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Ap. Fig. 23a Commercial Fishes

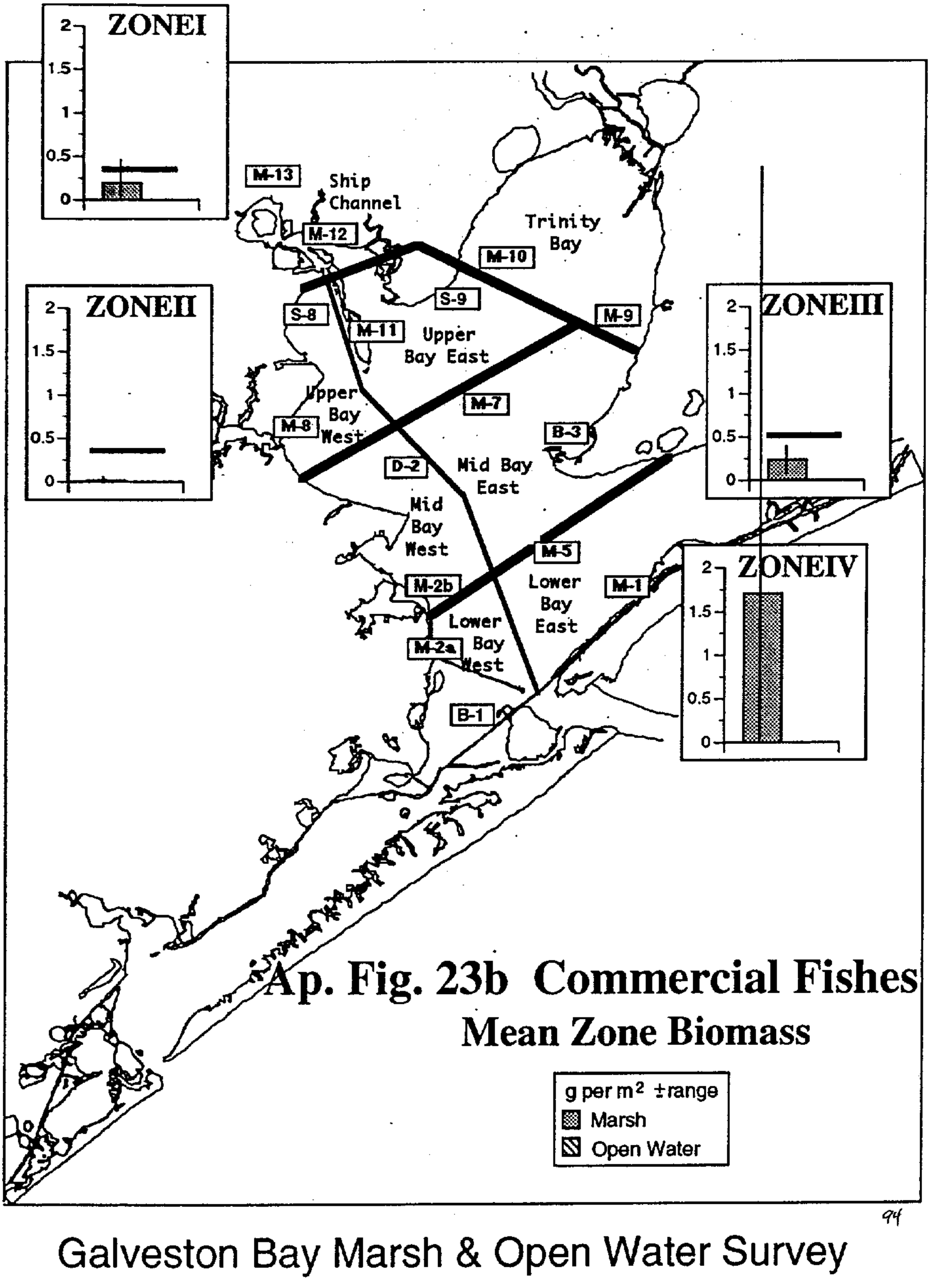
Mean Zone Densities

93

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)

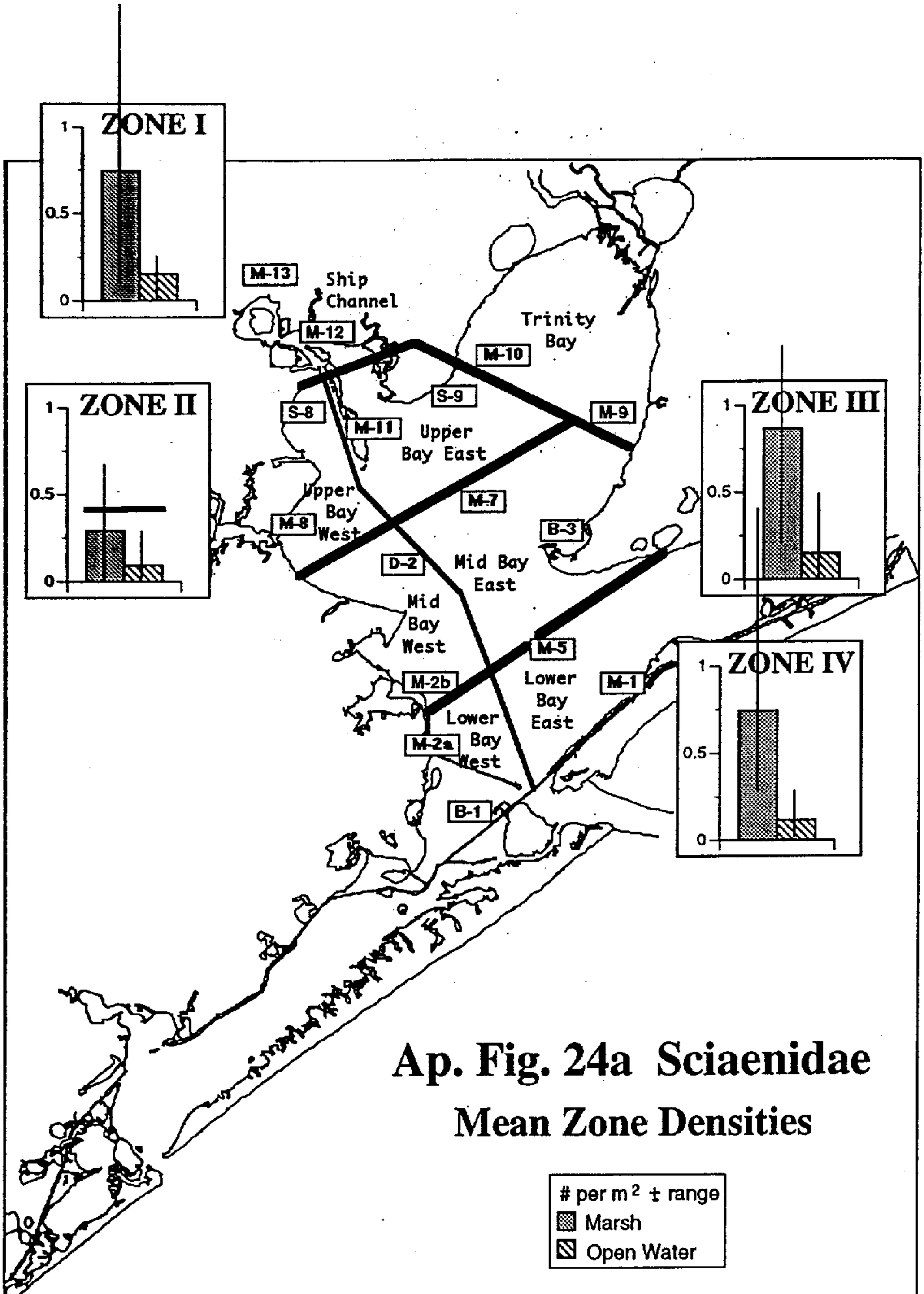


94

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



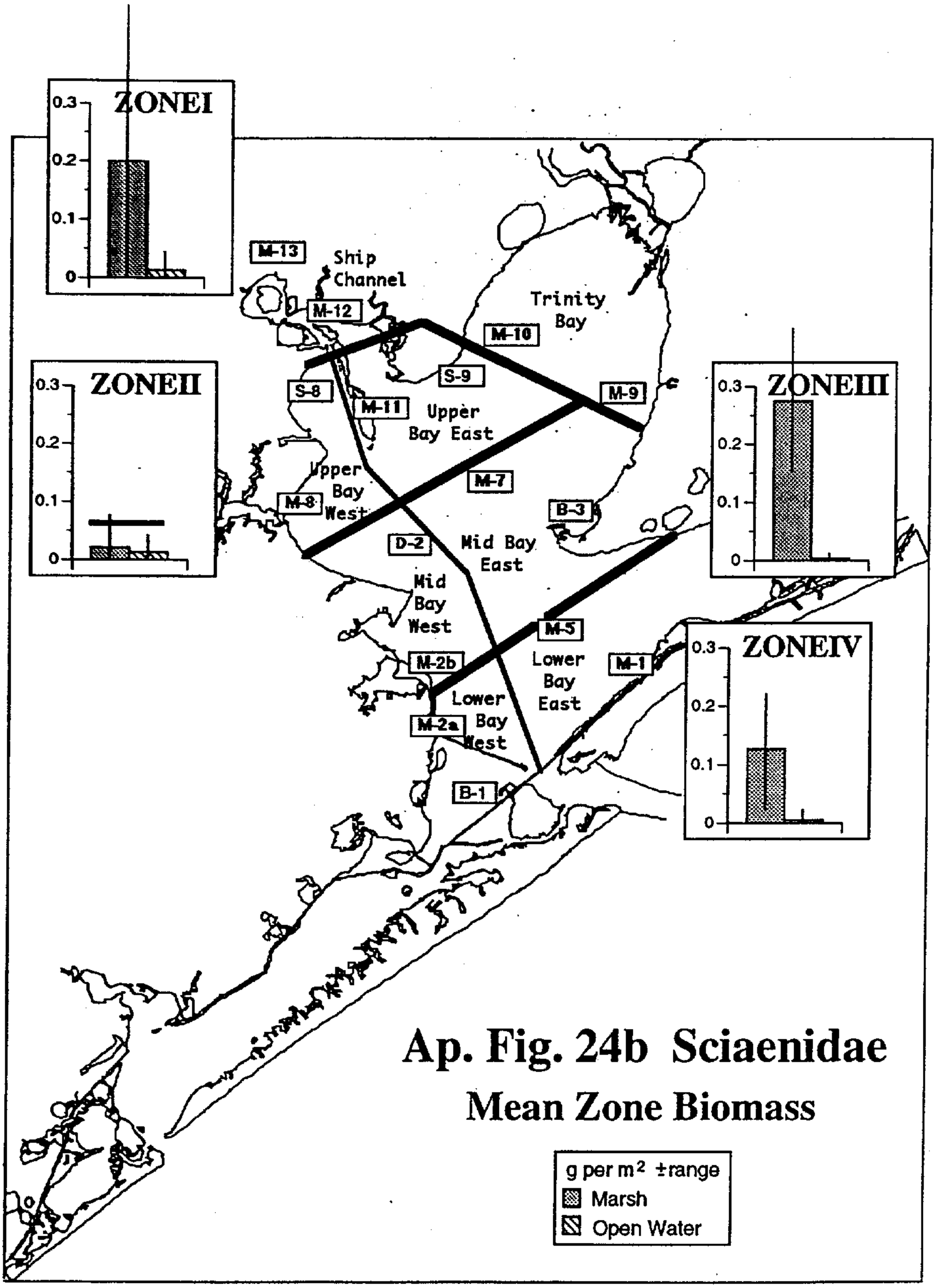
Ap. Fig. 24a Sciaenidae

Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)

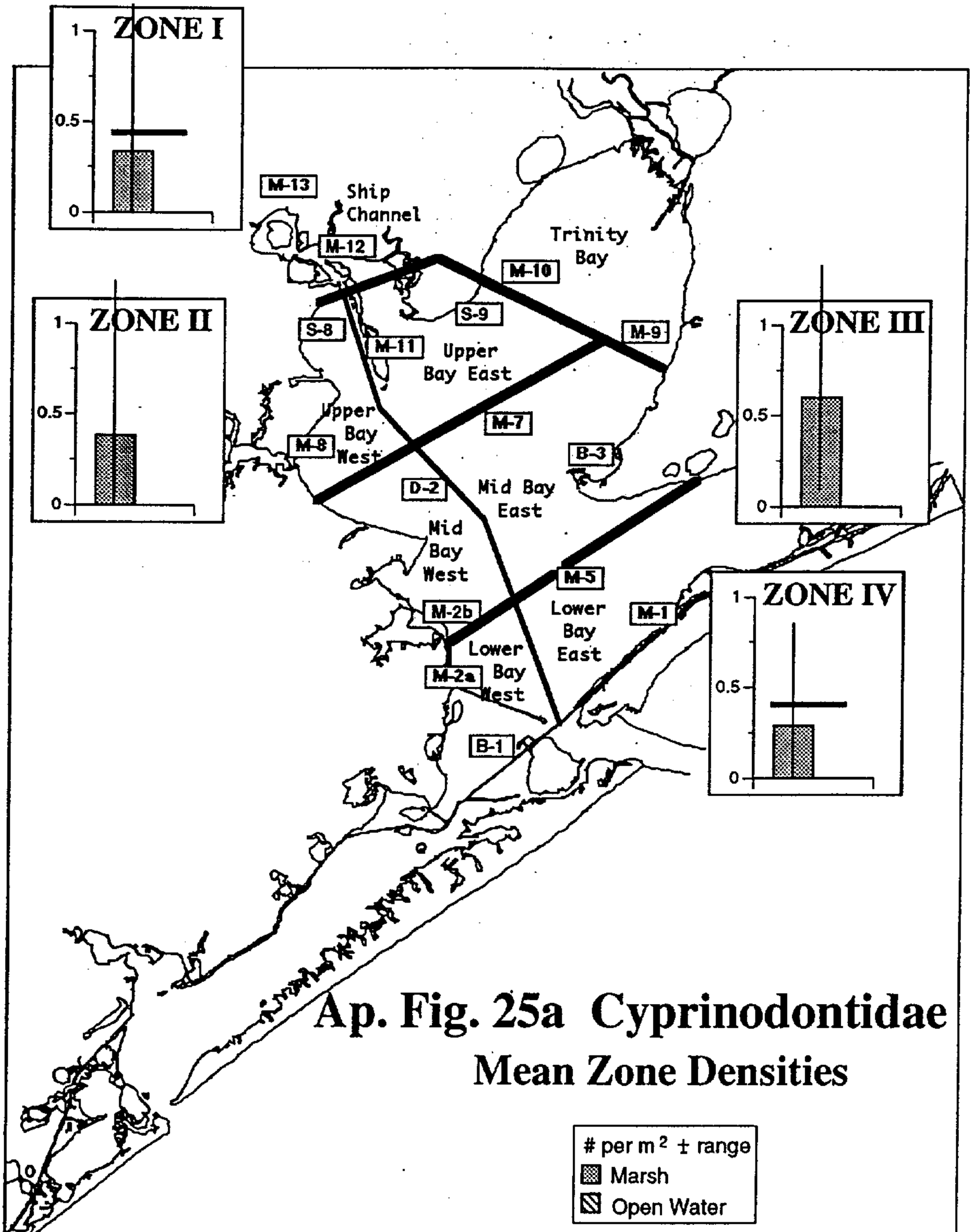


96

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



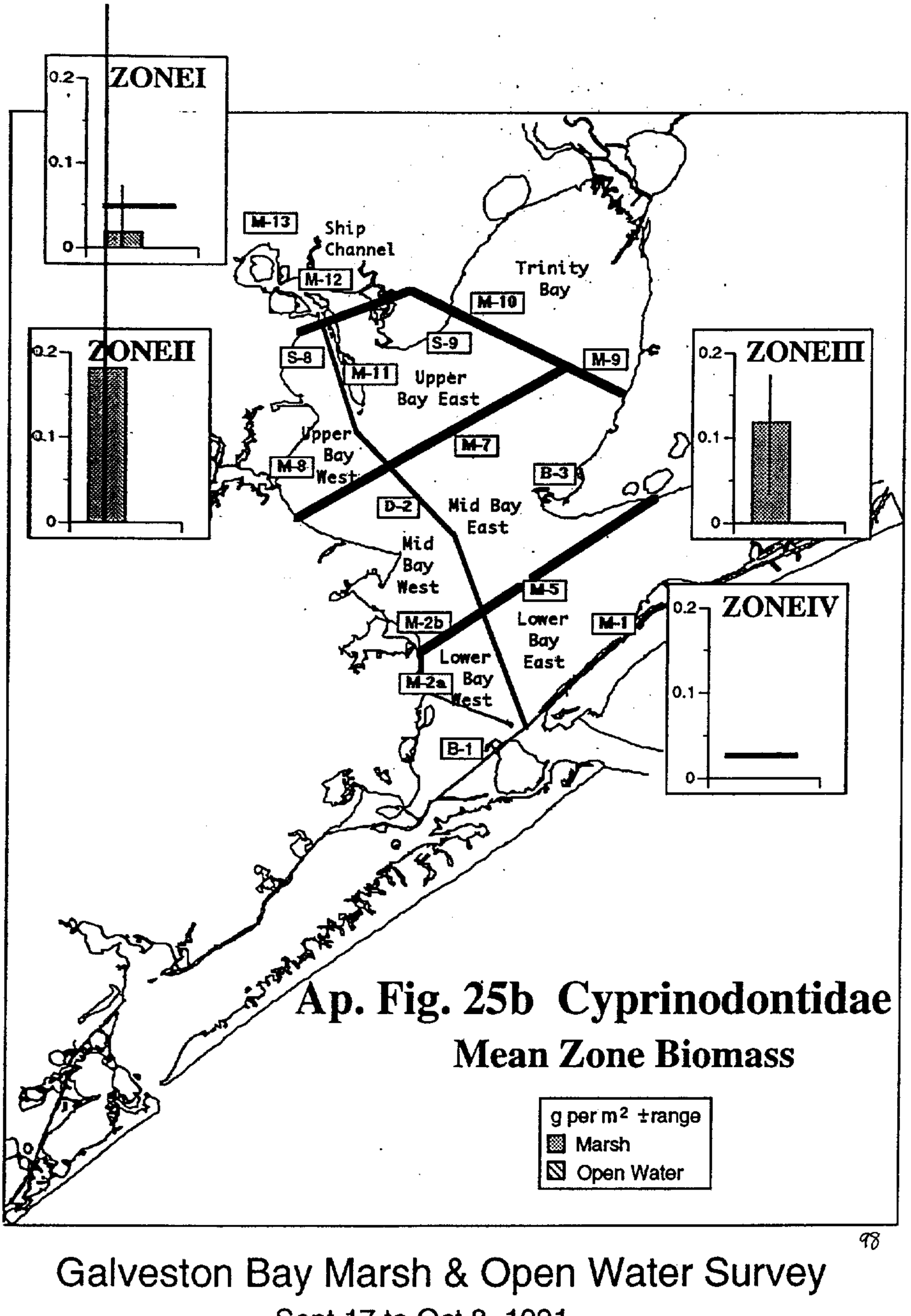
Ap. Fig. 25a Cyprinodontidae

Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

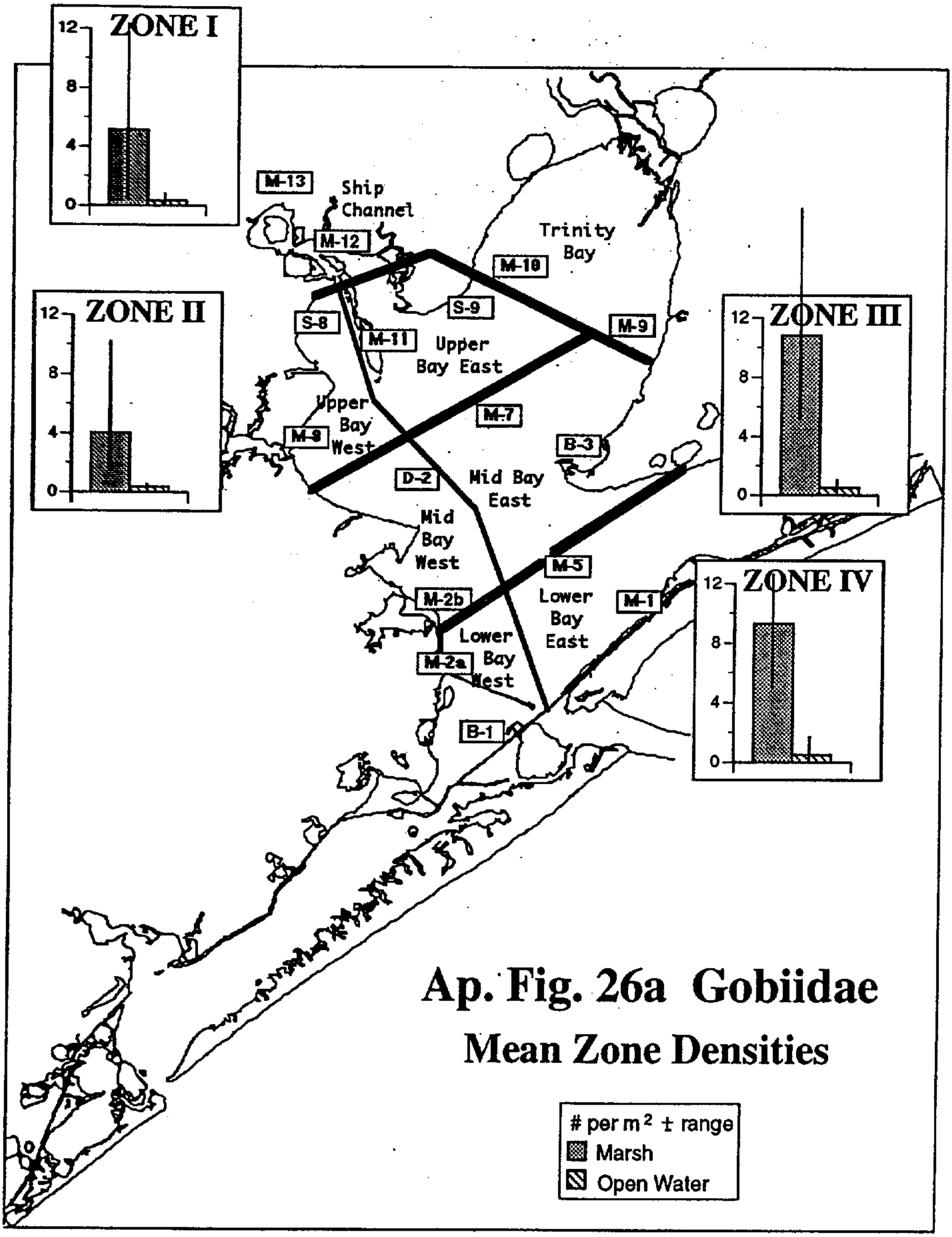
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Ap. Fig. 26a Gobiidae

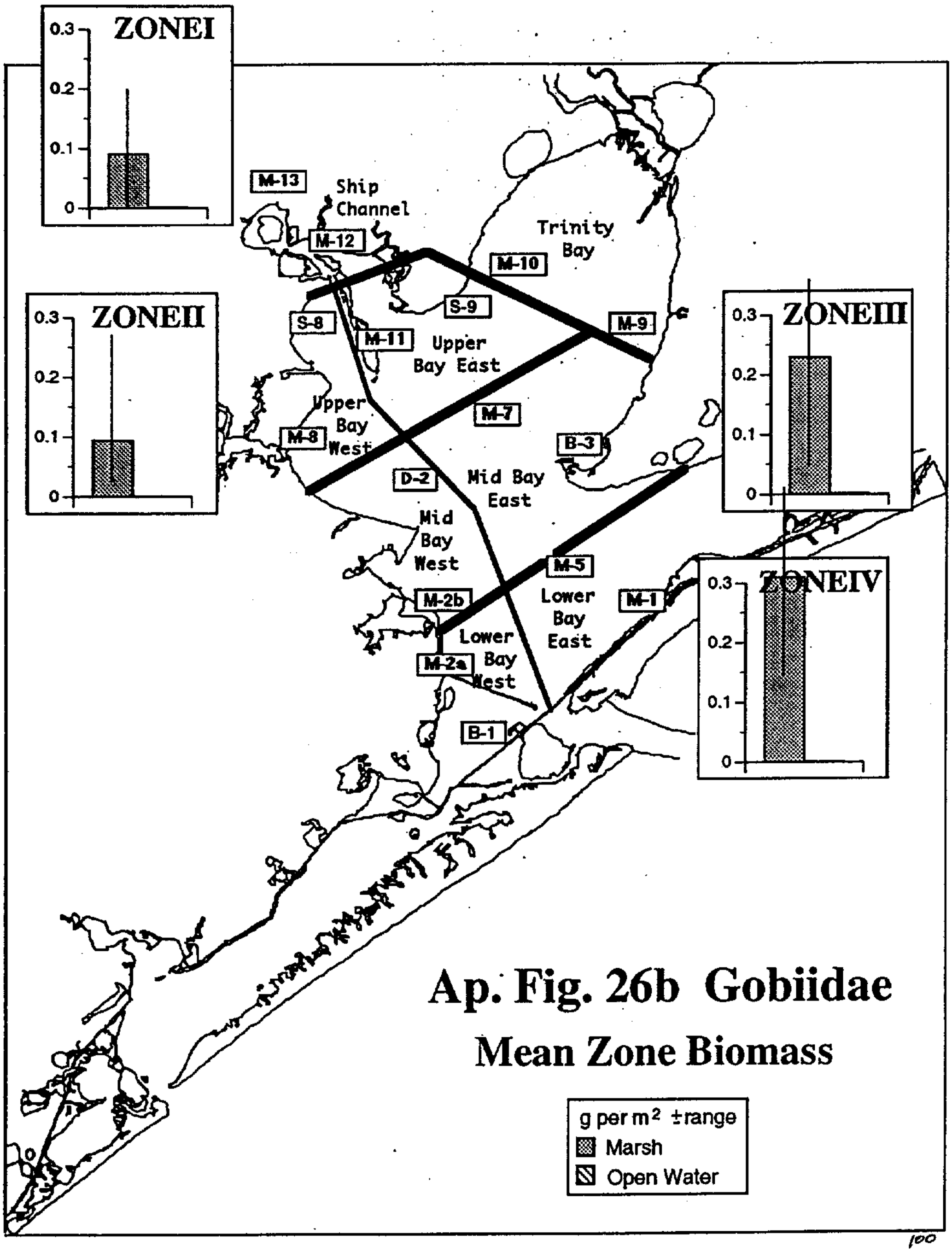
Mean Zone Densities

99

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

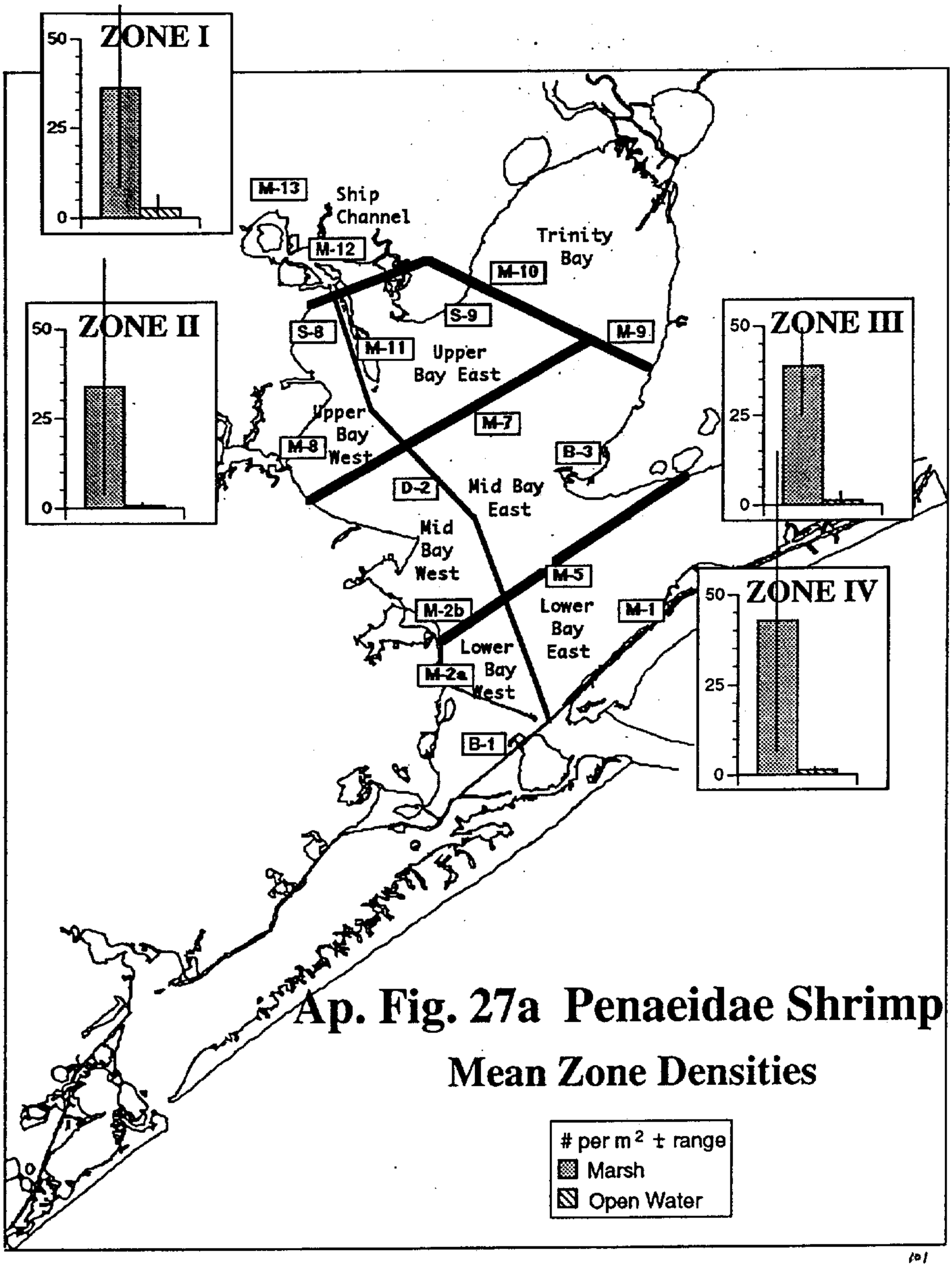
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

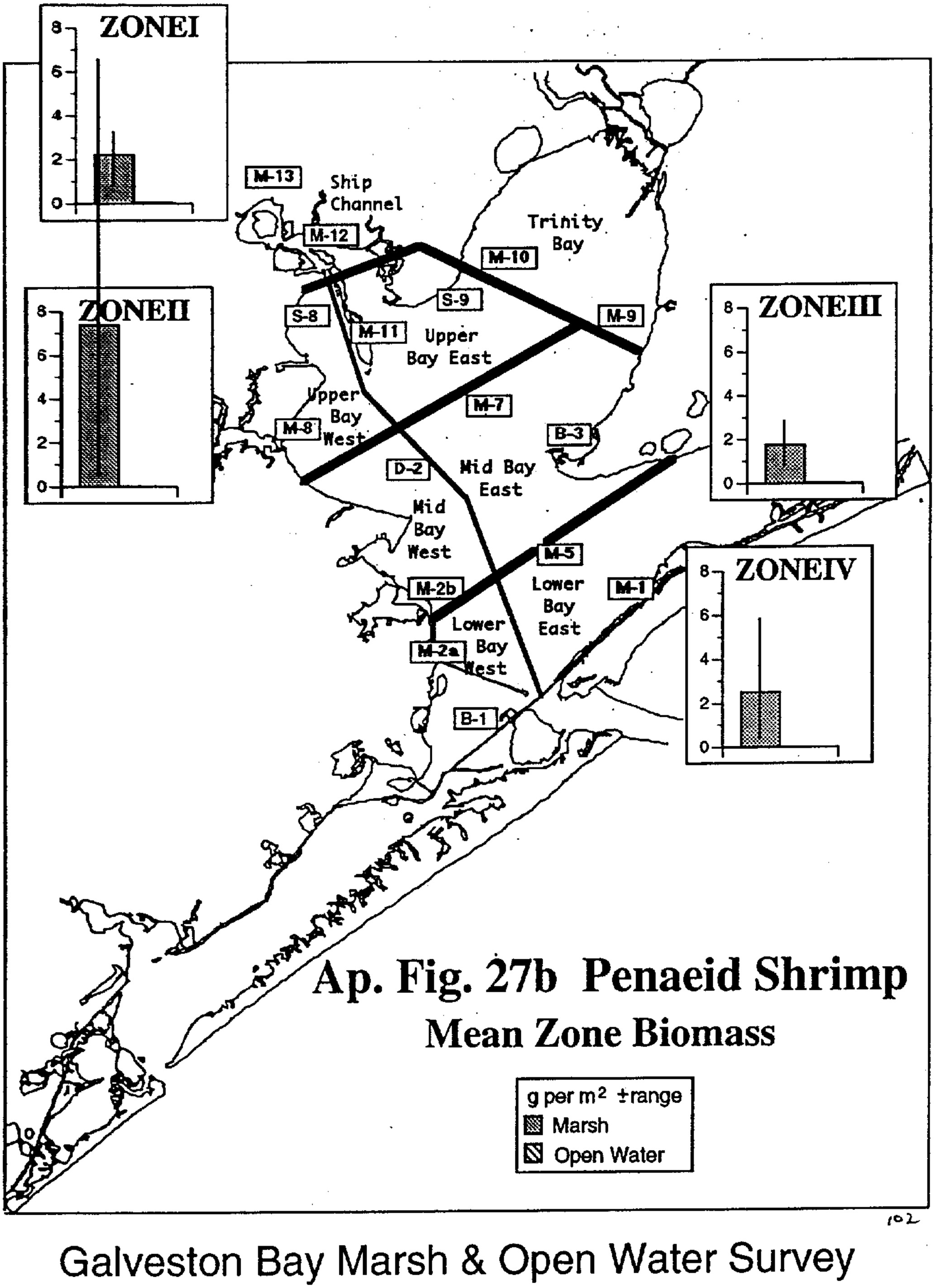
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

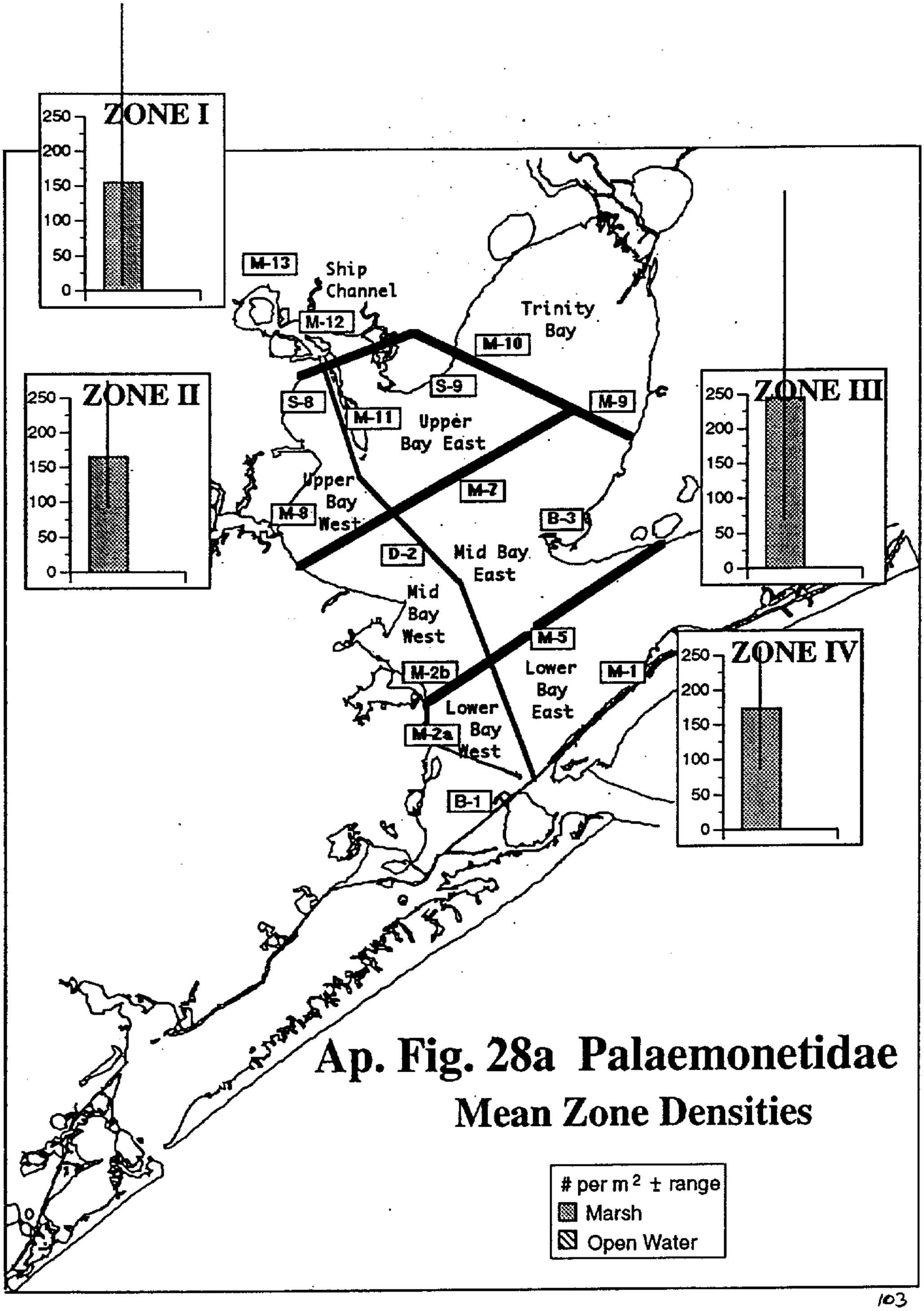


Ap. Fig. 27b Penaeid Shrimp Mean Zone Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

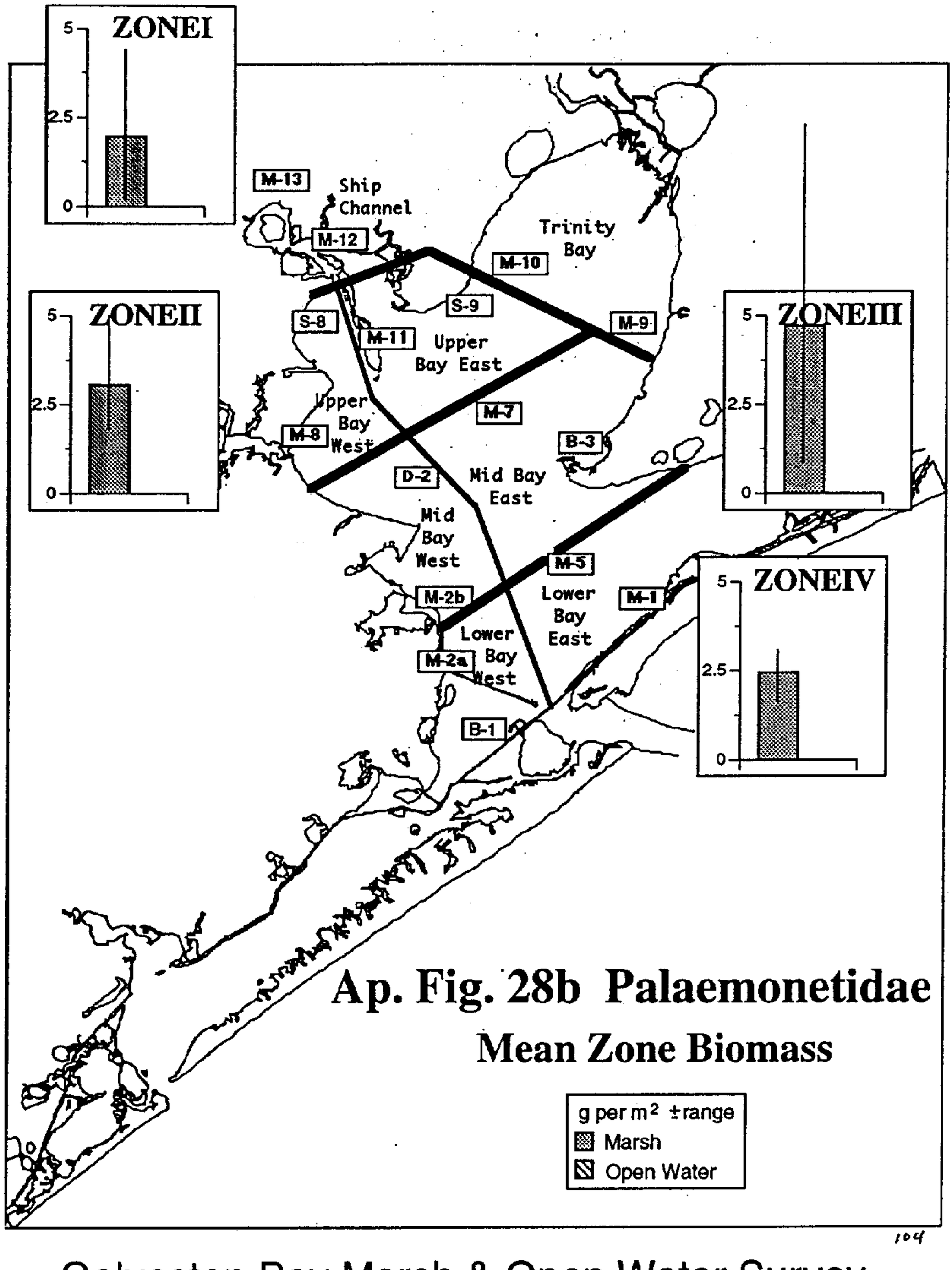


Ap. Fig. 28a Palaemonetidae
Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

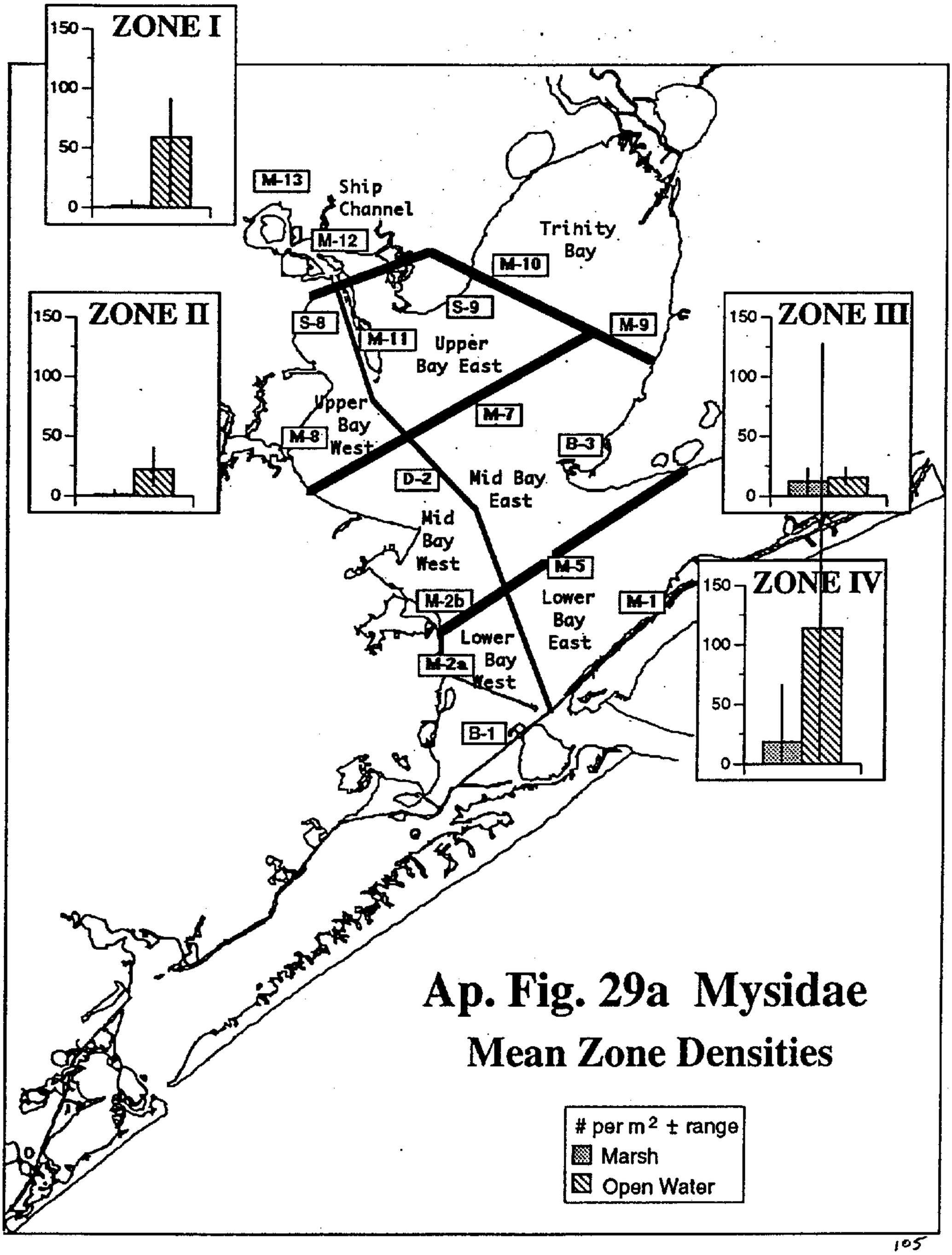
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

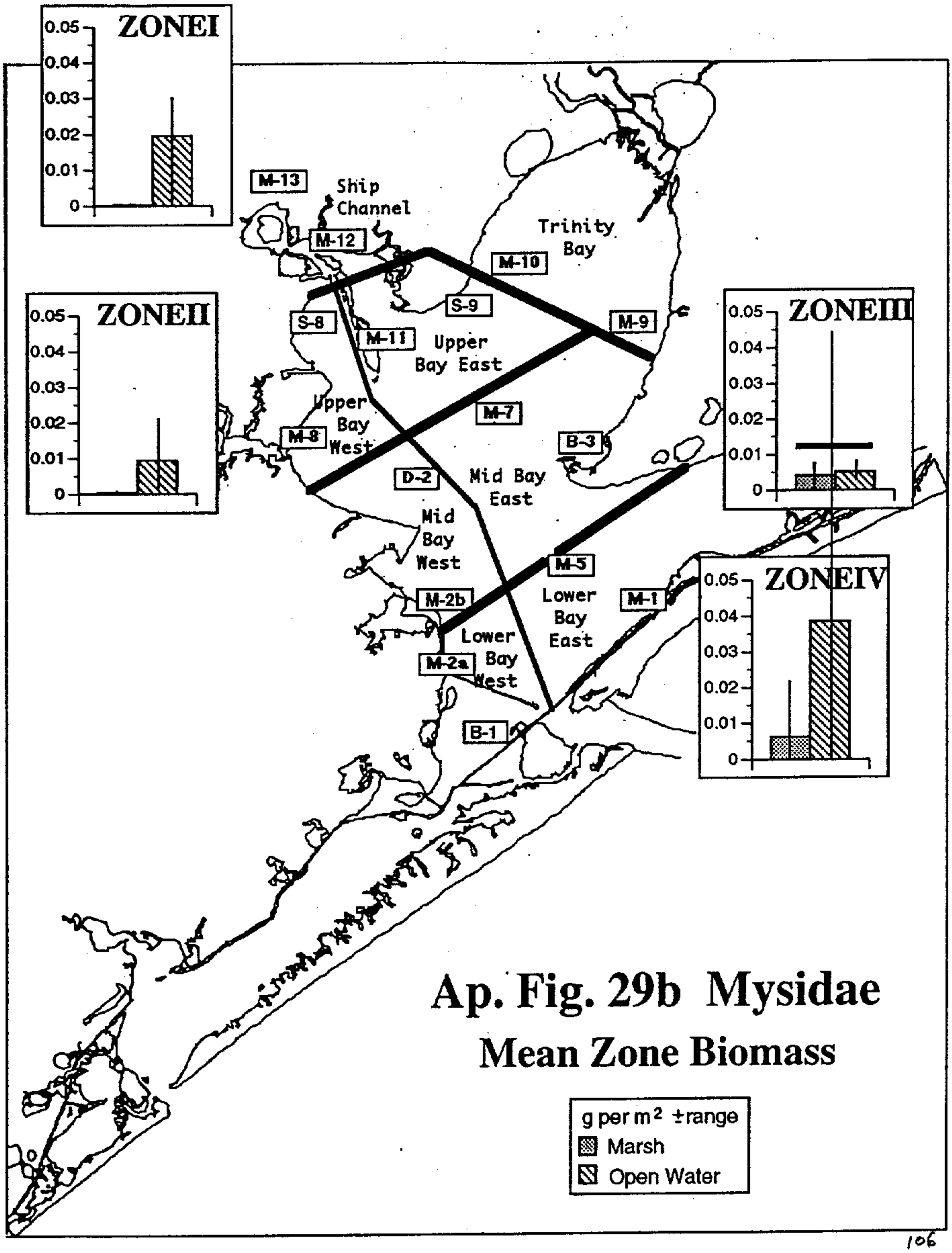
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

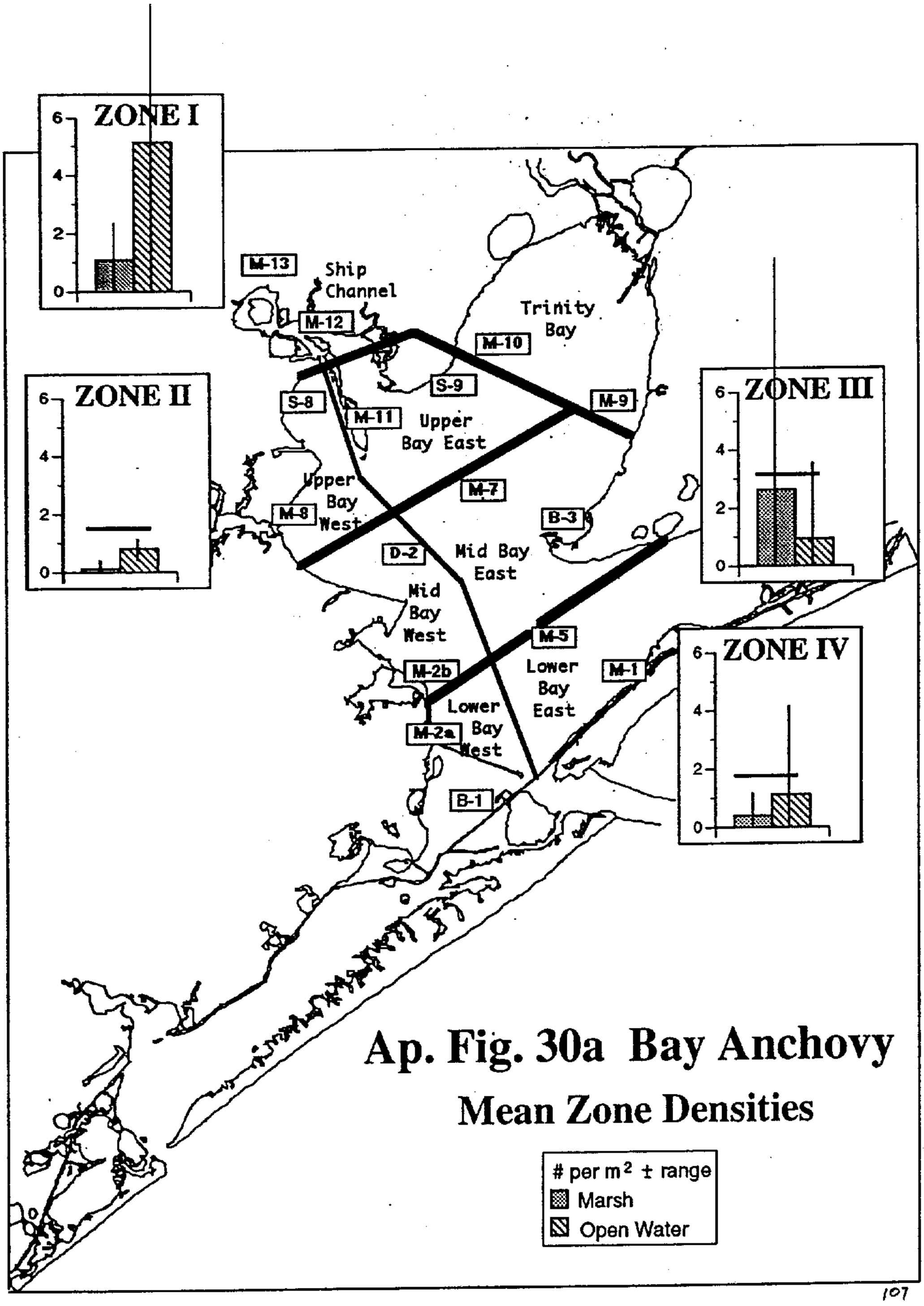


Ap. Fig. 29b Mysidae Mean Zone Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

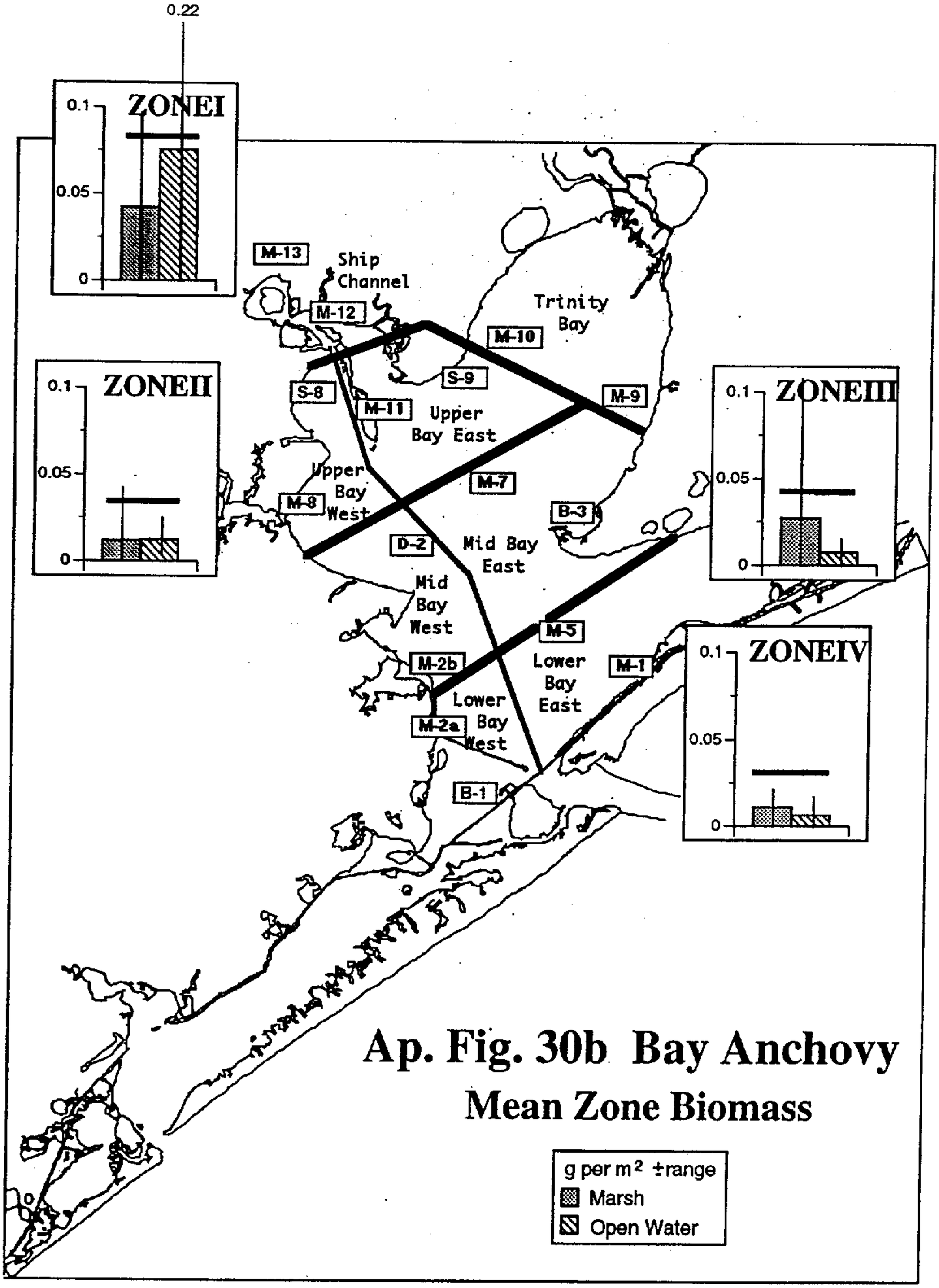


Ap. Fig. 30a Bay Anchovy

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

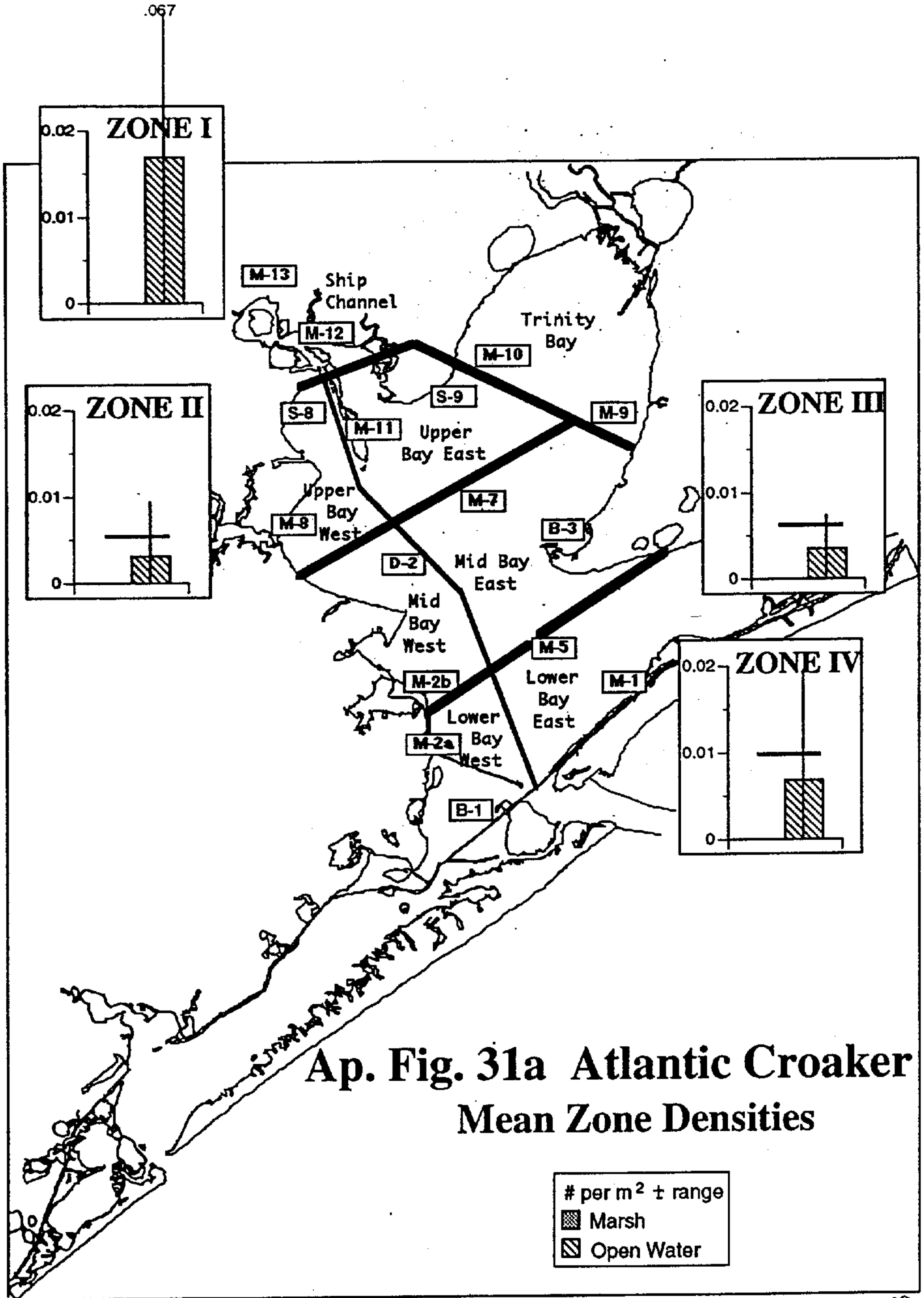
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



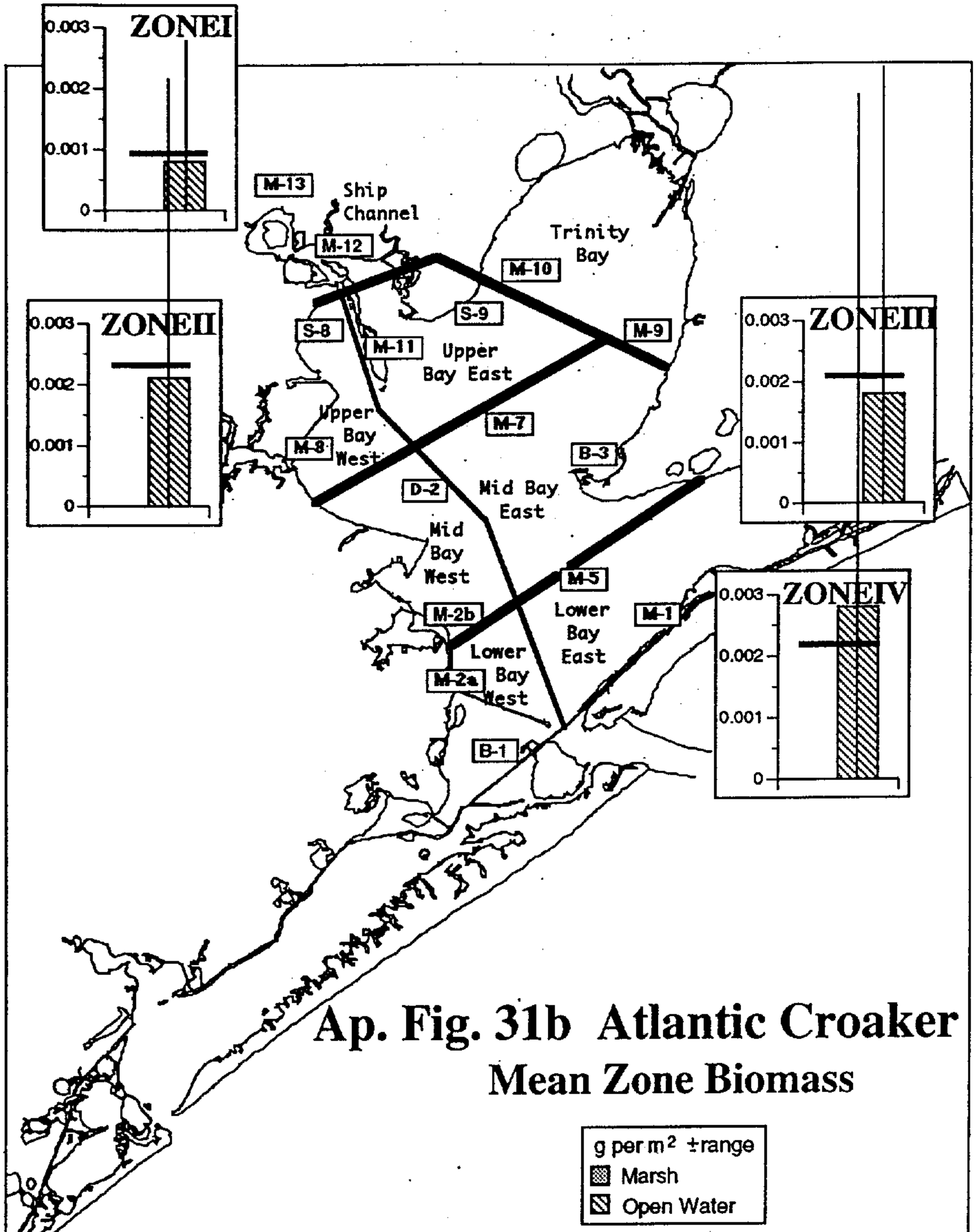
Ap. Fig. 31a Atlantic Croaker

Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Ap. Fig. 31b Atlantic Croaker

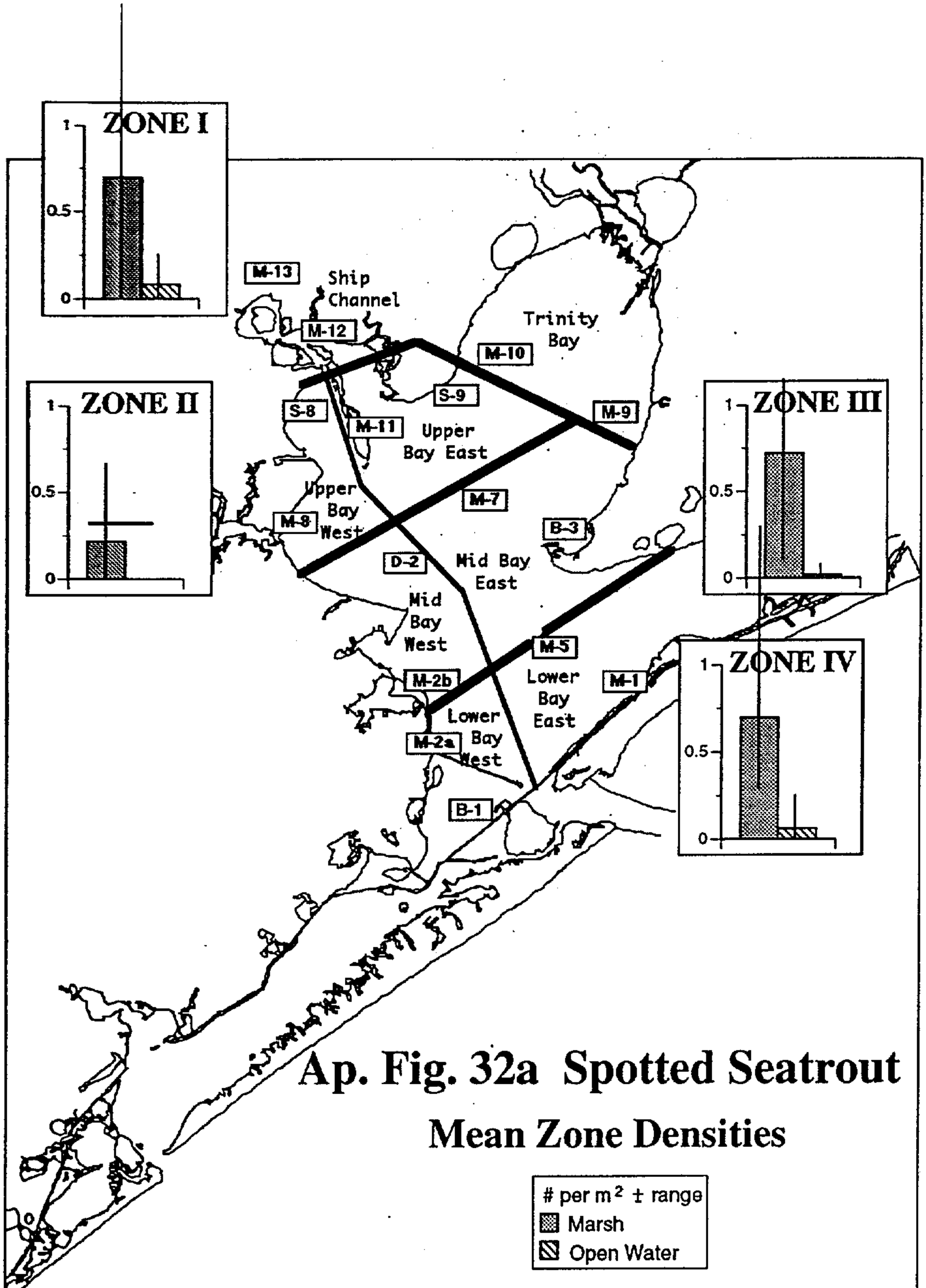
Mean Zone Biomass

11 D

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



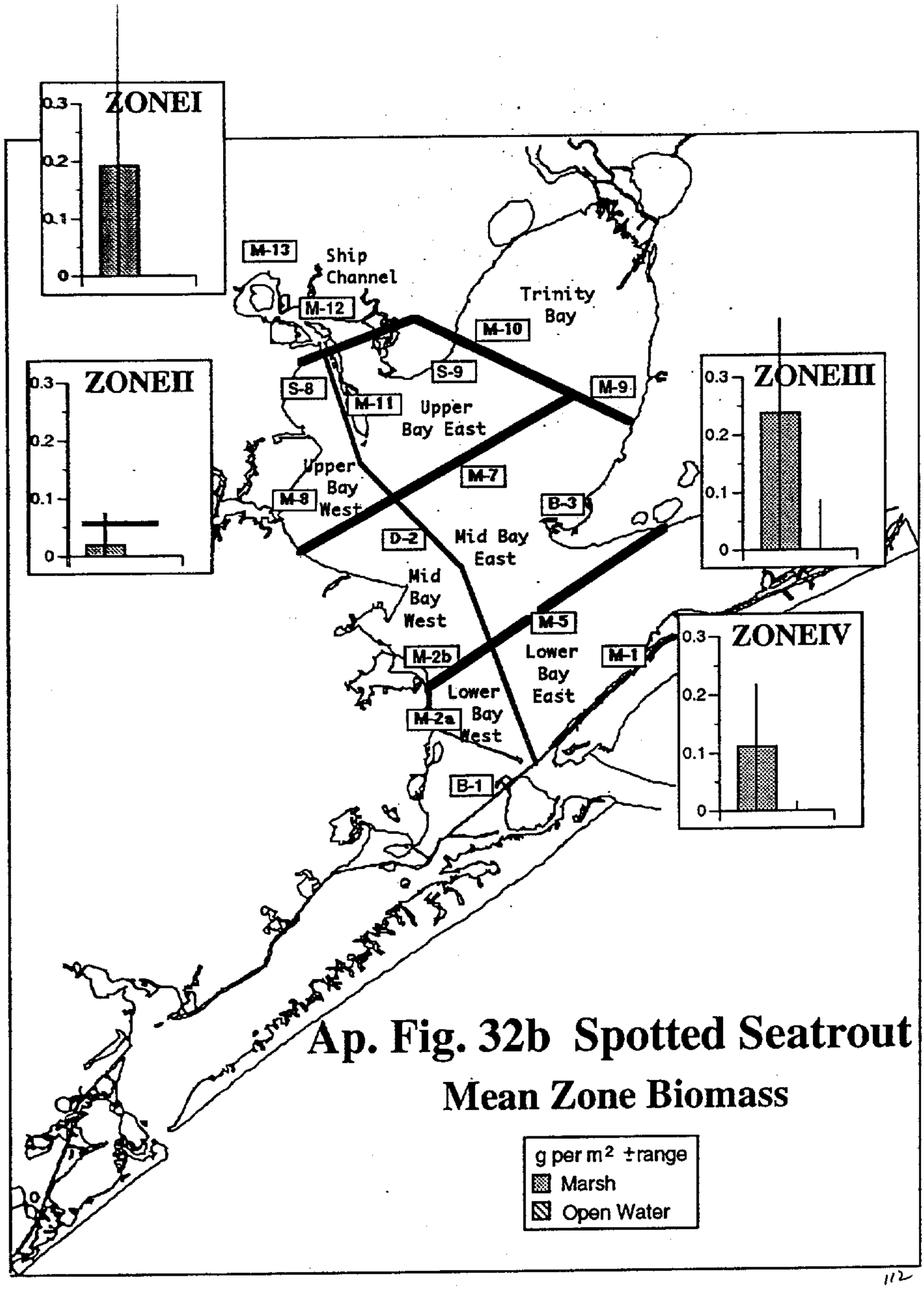
Ap. Fig. 32a Spotted Seatrout

Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

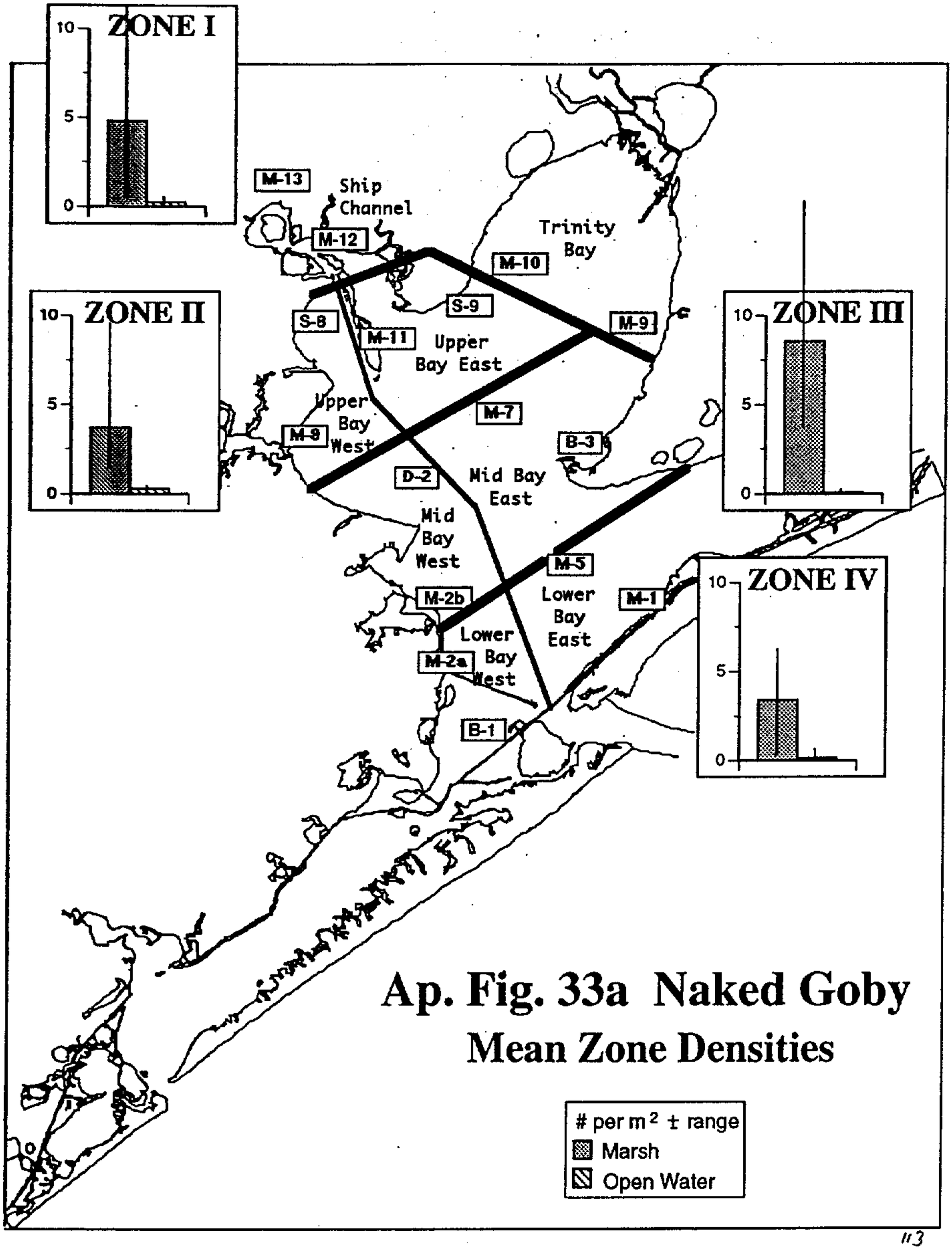
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)

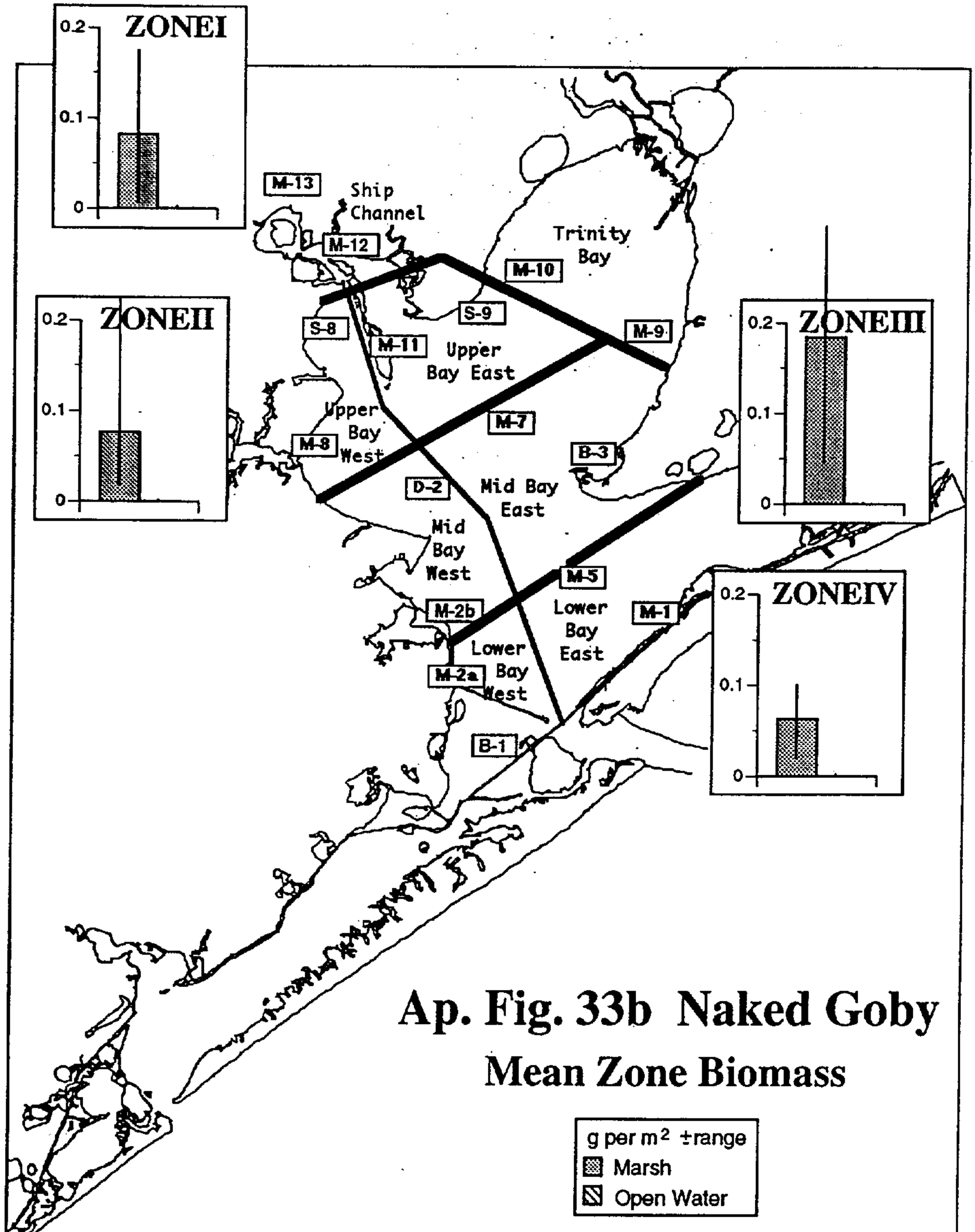


Ap. Fig. 33a Naked Goby
Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



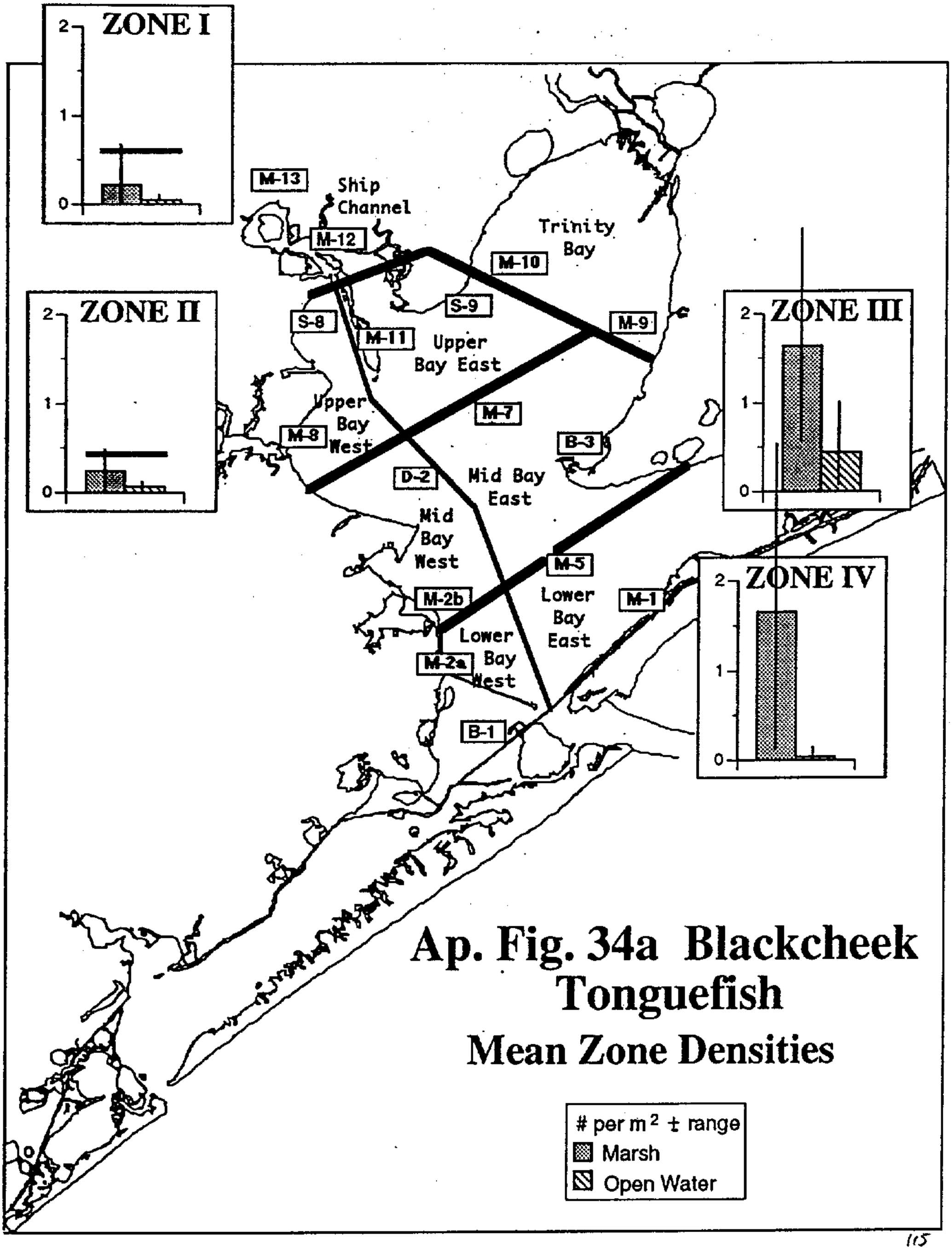
Ap. Fig. 33b Naked Goby

Mean Zone Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

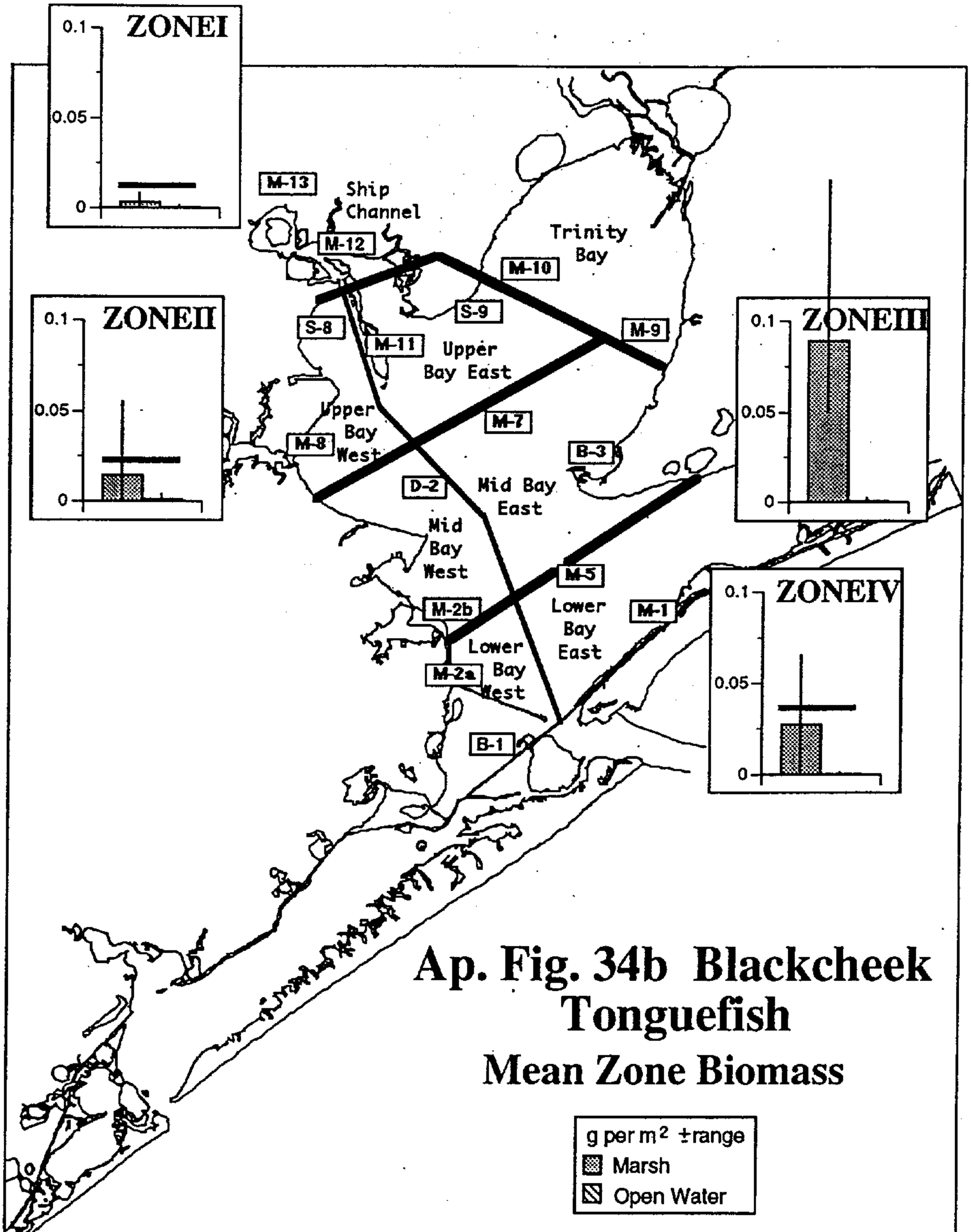
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



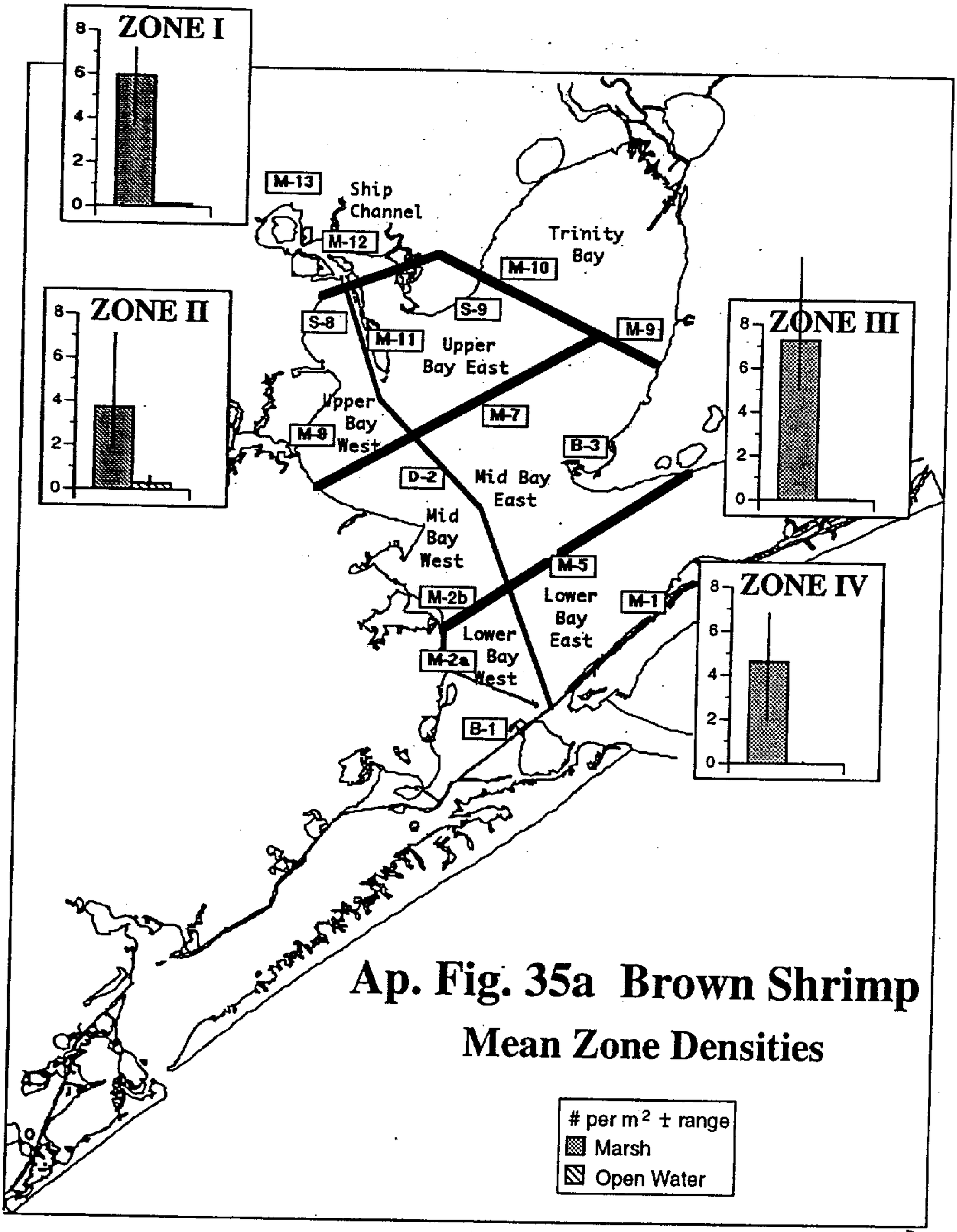
Ap. Fig. 34b Blackcheek Tonguefish

Mean Zone Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



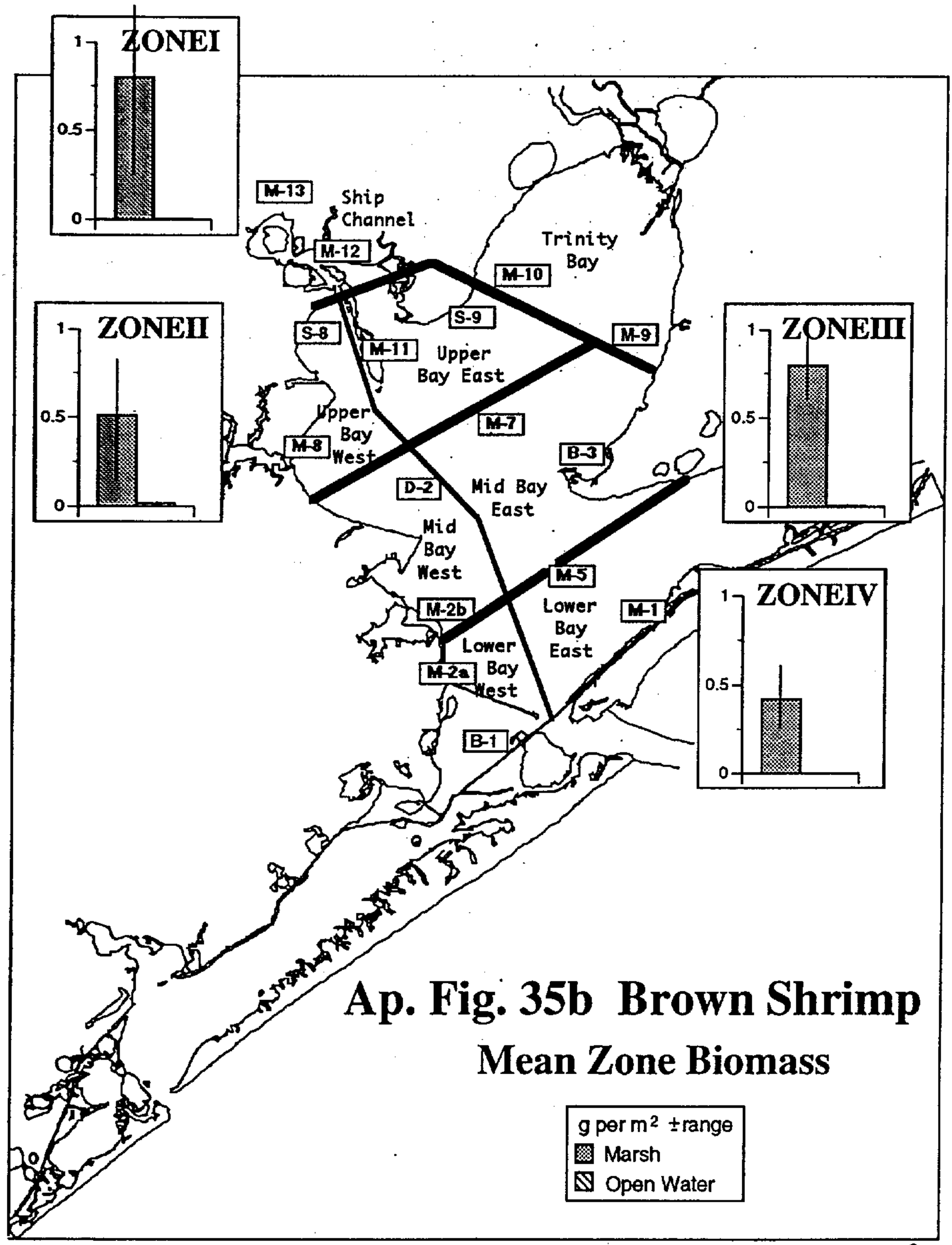
Ap. Fig. 35a Brown Shrimp

Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

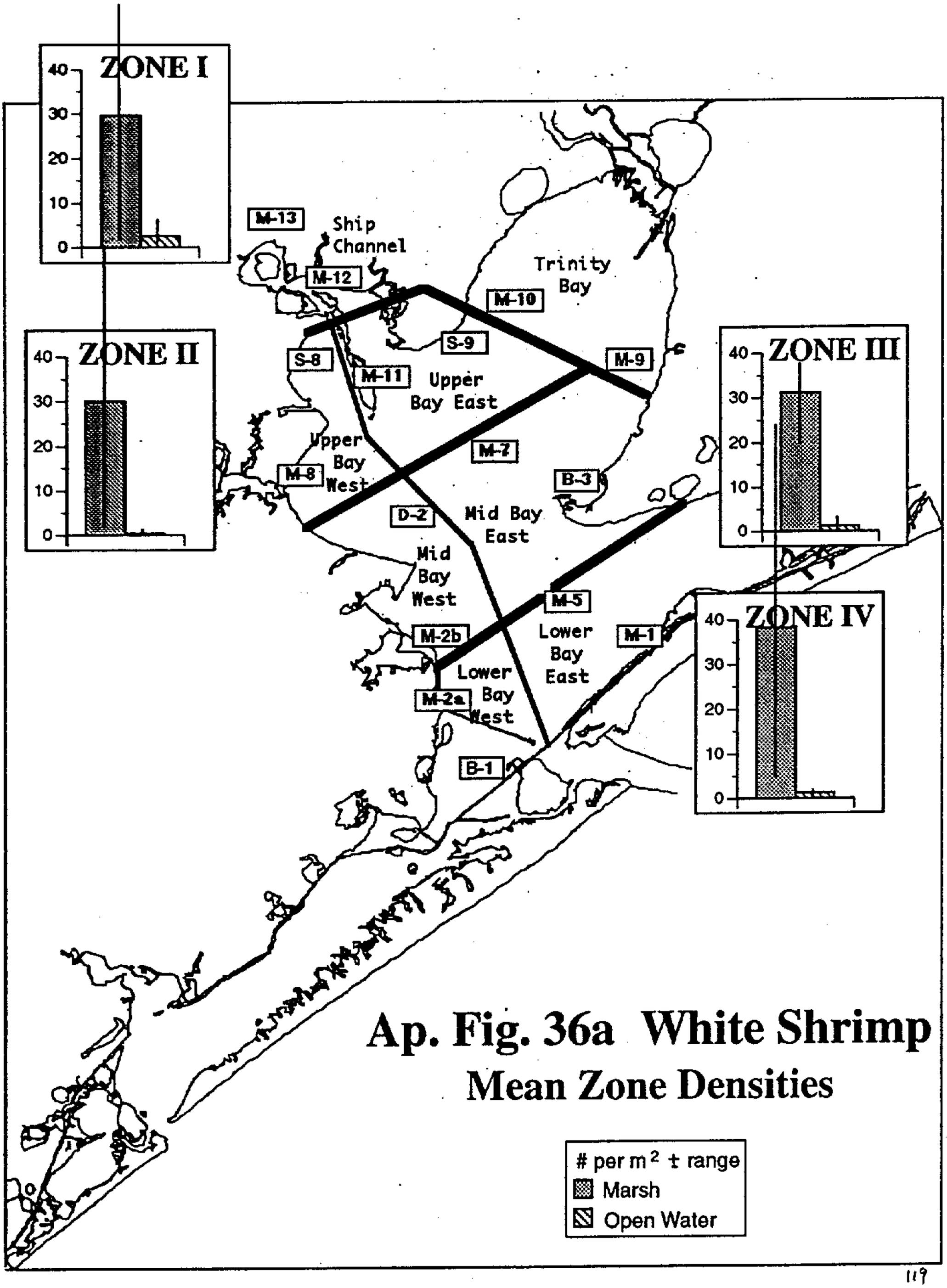
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



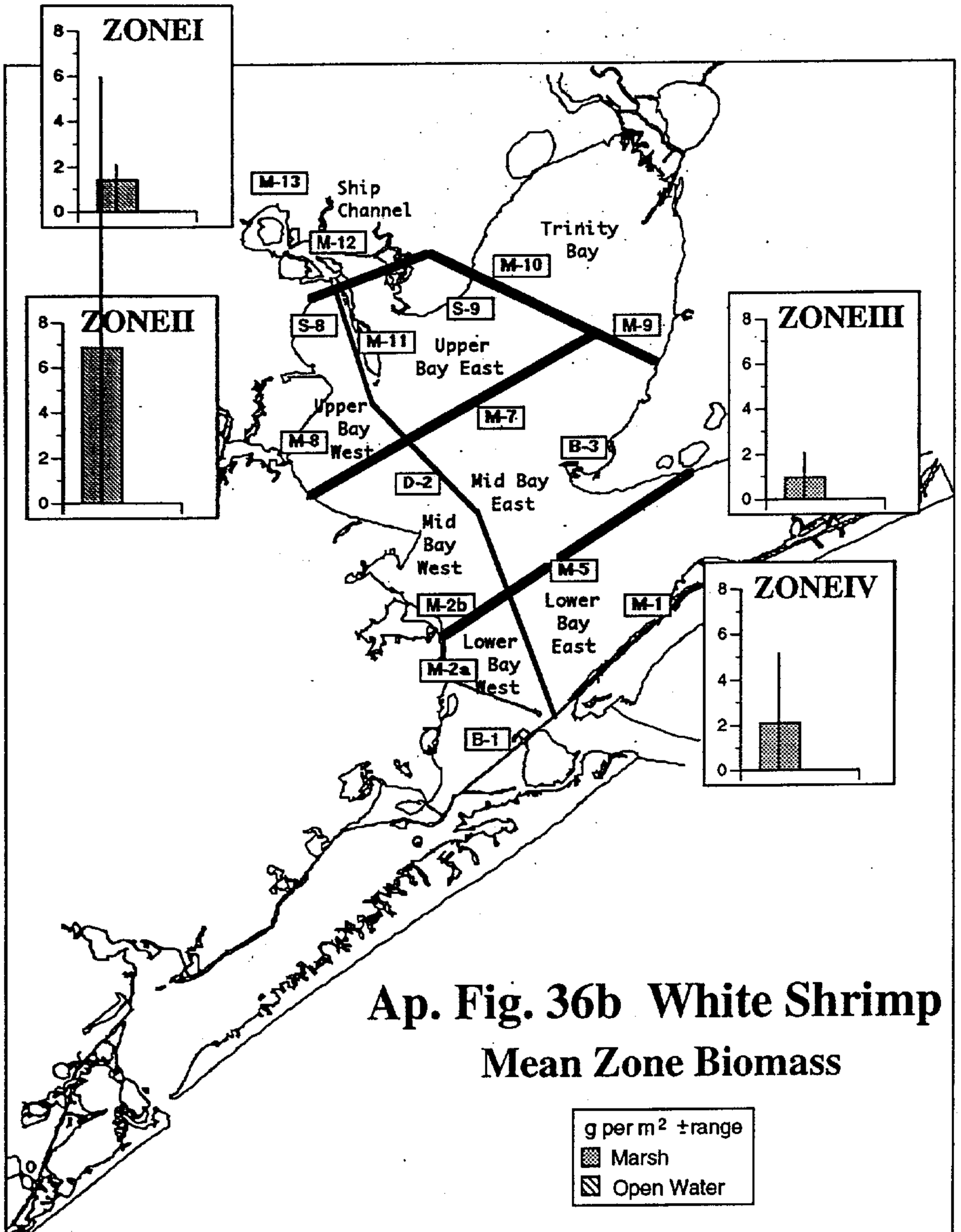
Ap. Fig. 36a White Shrimp

Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



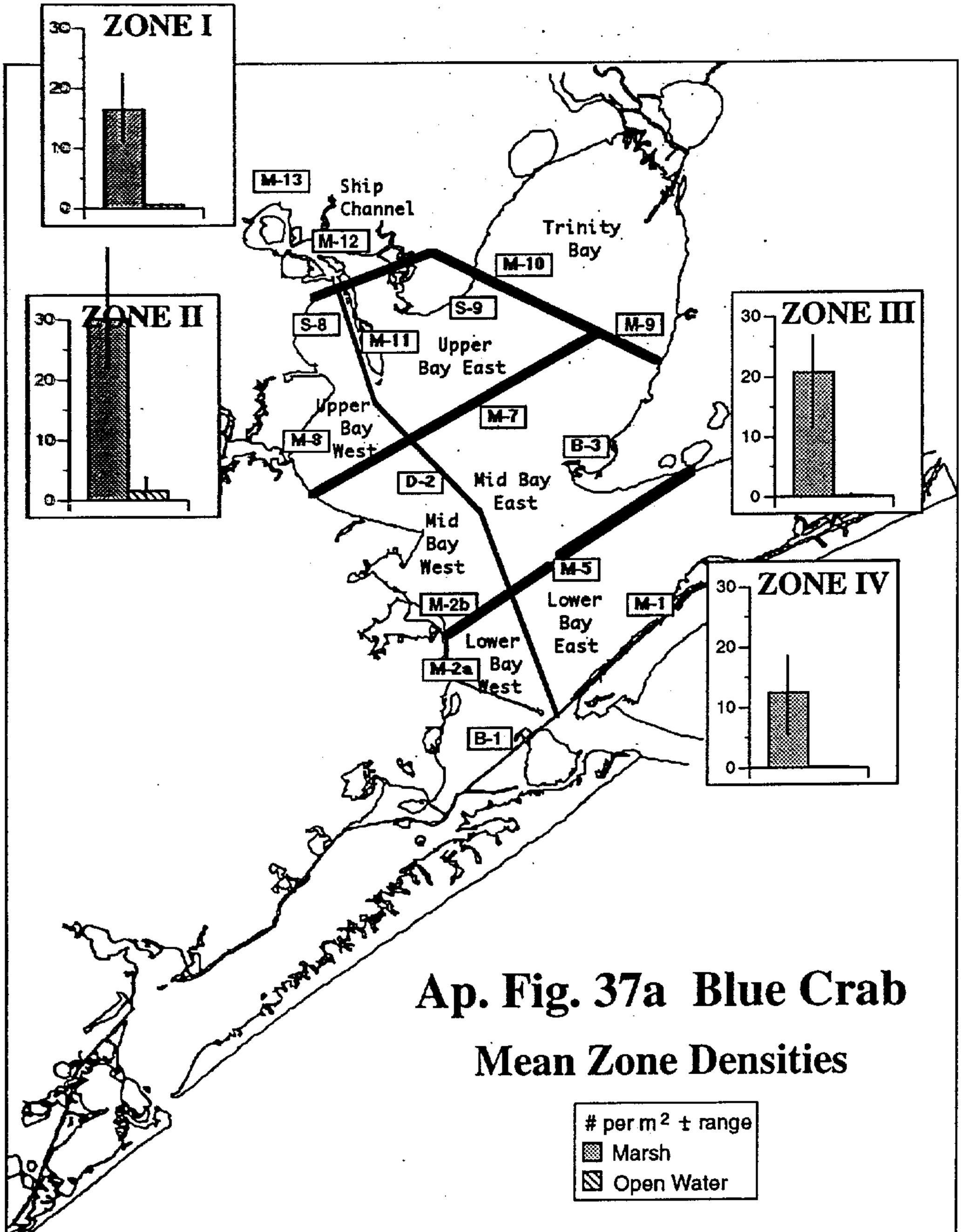
Ap. Fig. 36b White Shrimp

Mean Zone Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



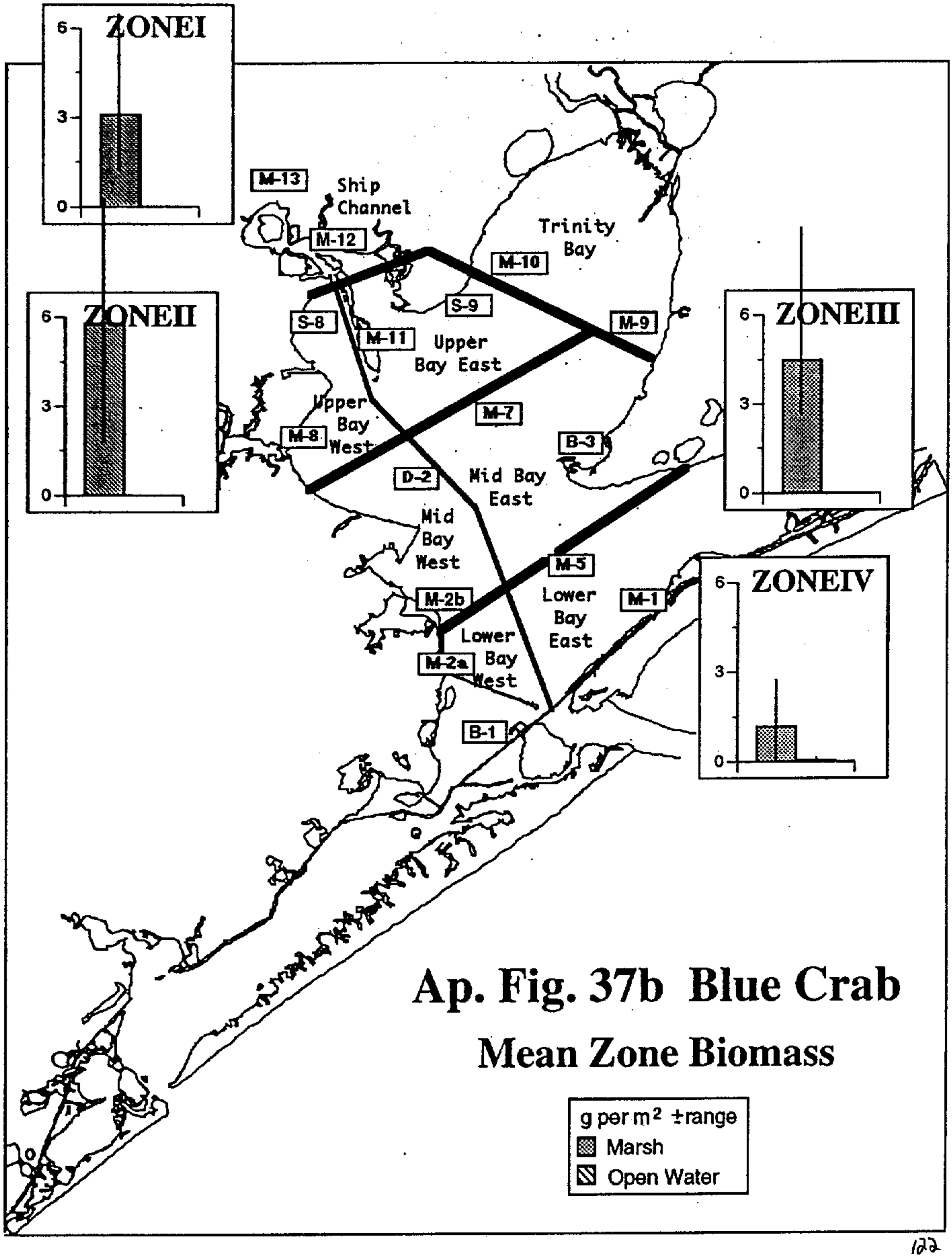
Ap. Fig. 37a Blue Crab

Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



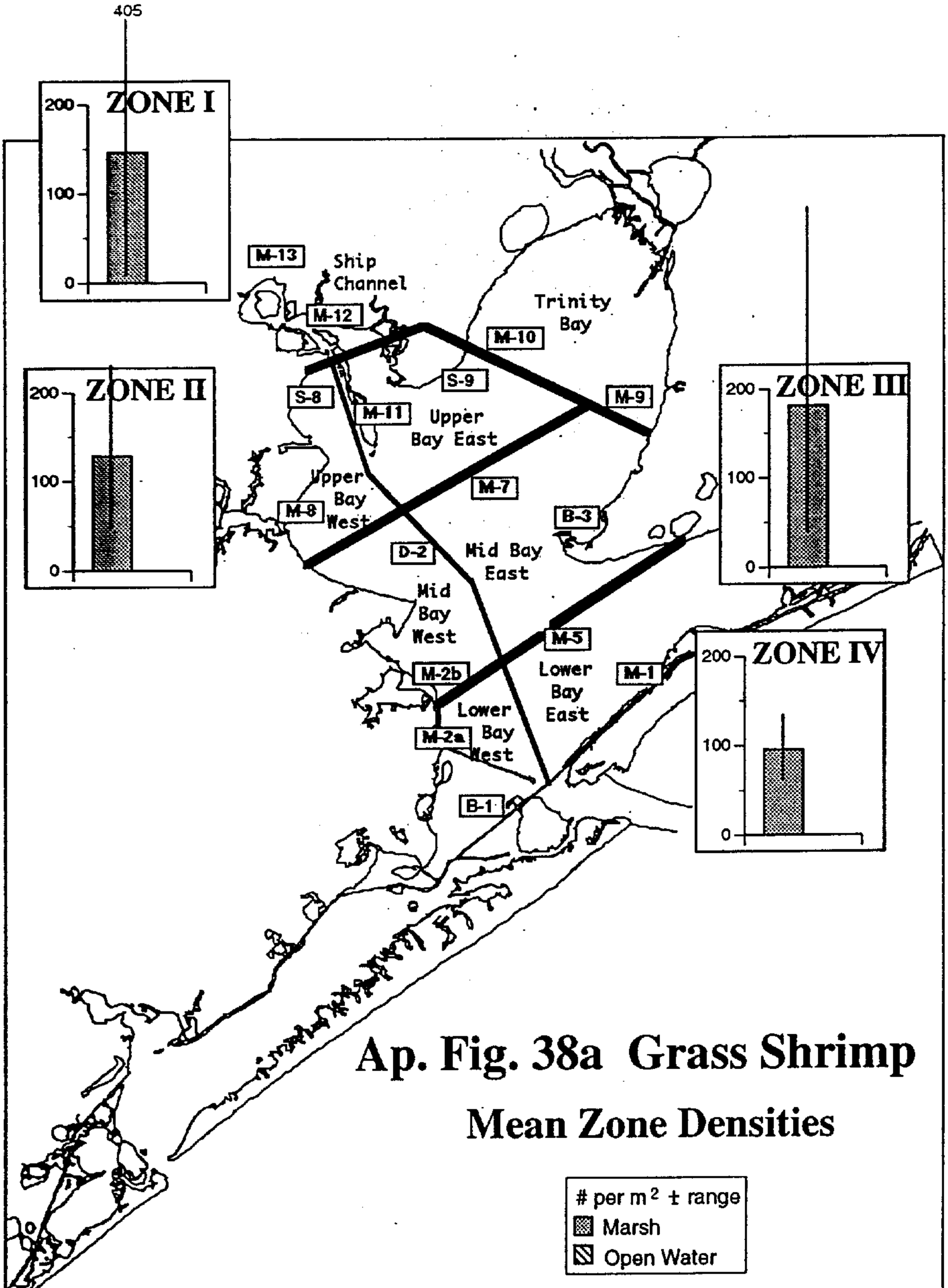
Ap. Fig. 37b Blue Crab

Mean Zone Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Ap. Fig. 38a Grass Shrimp

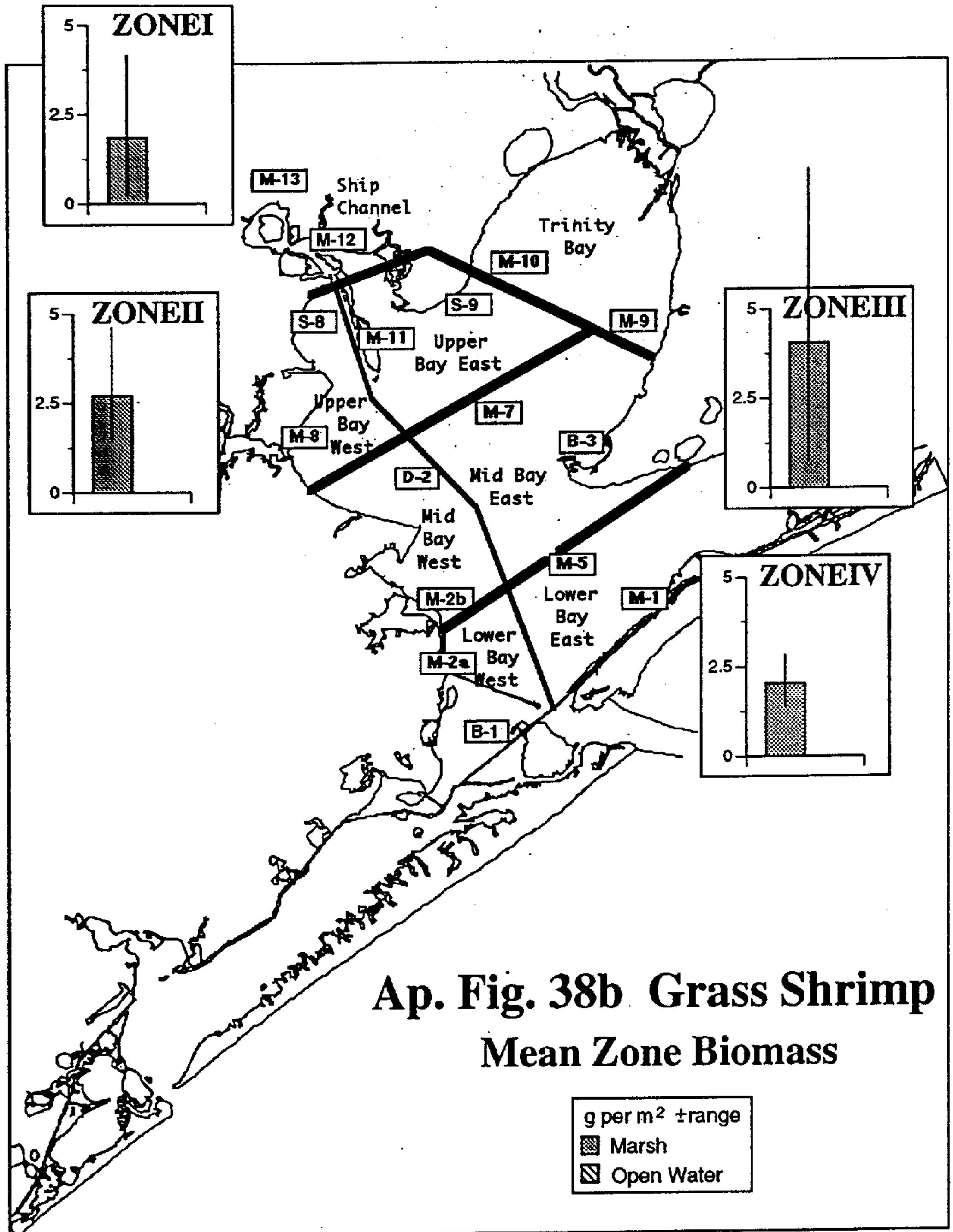
Mean Zone Densities

23

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

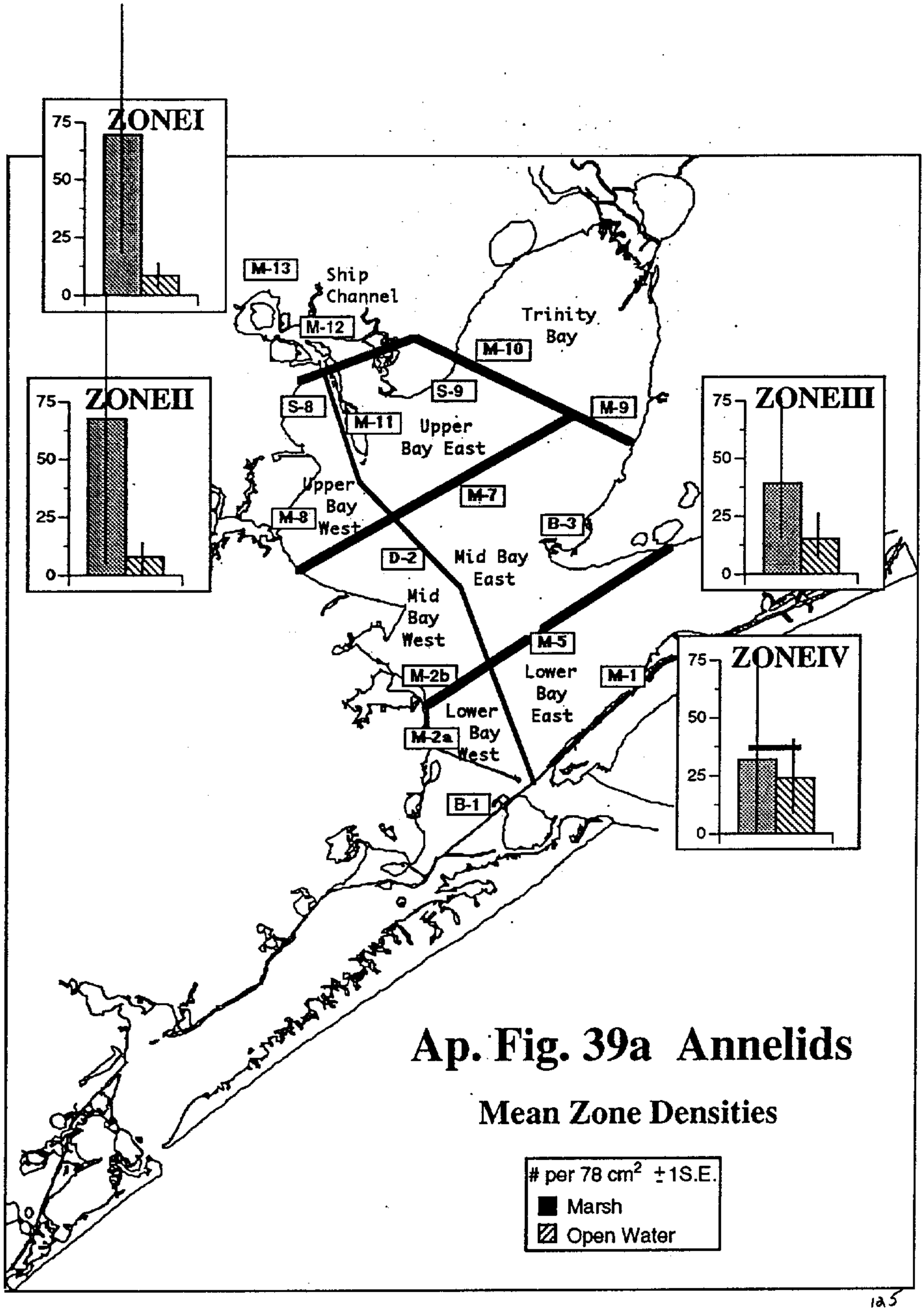
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



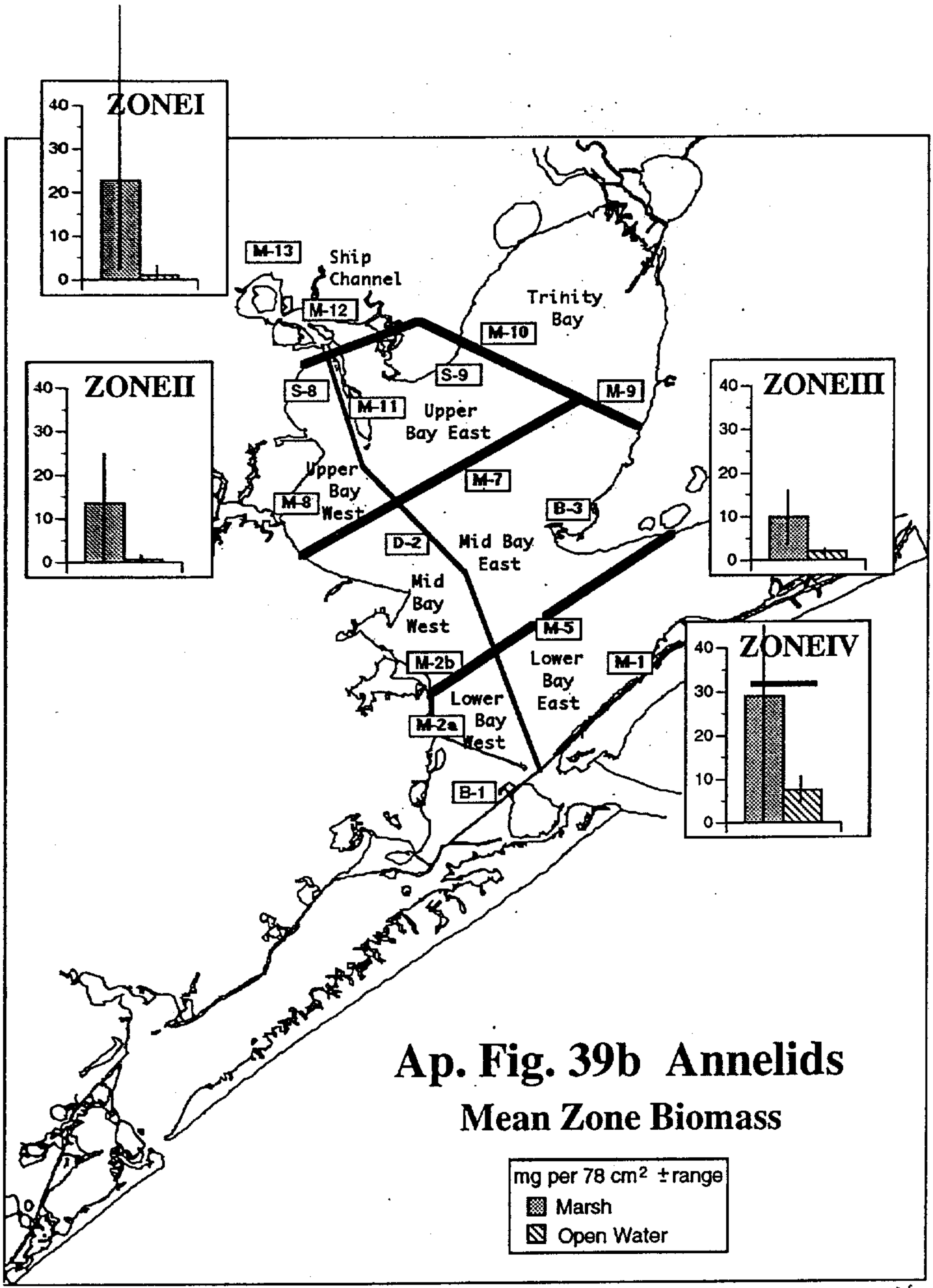
Ap. Fig. 39a Annelids

Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

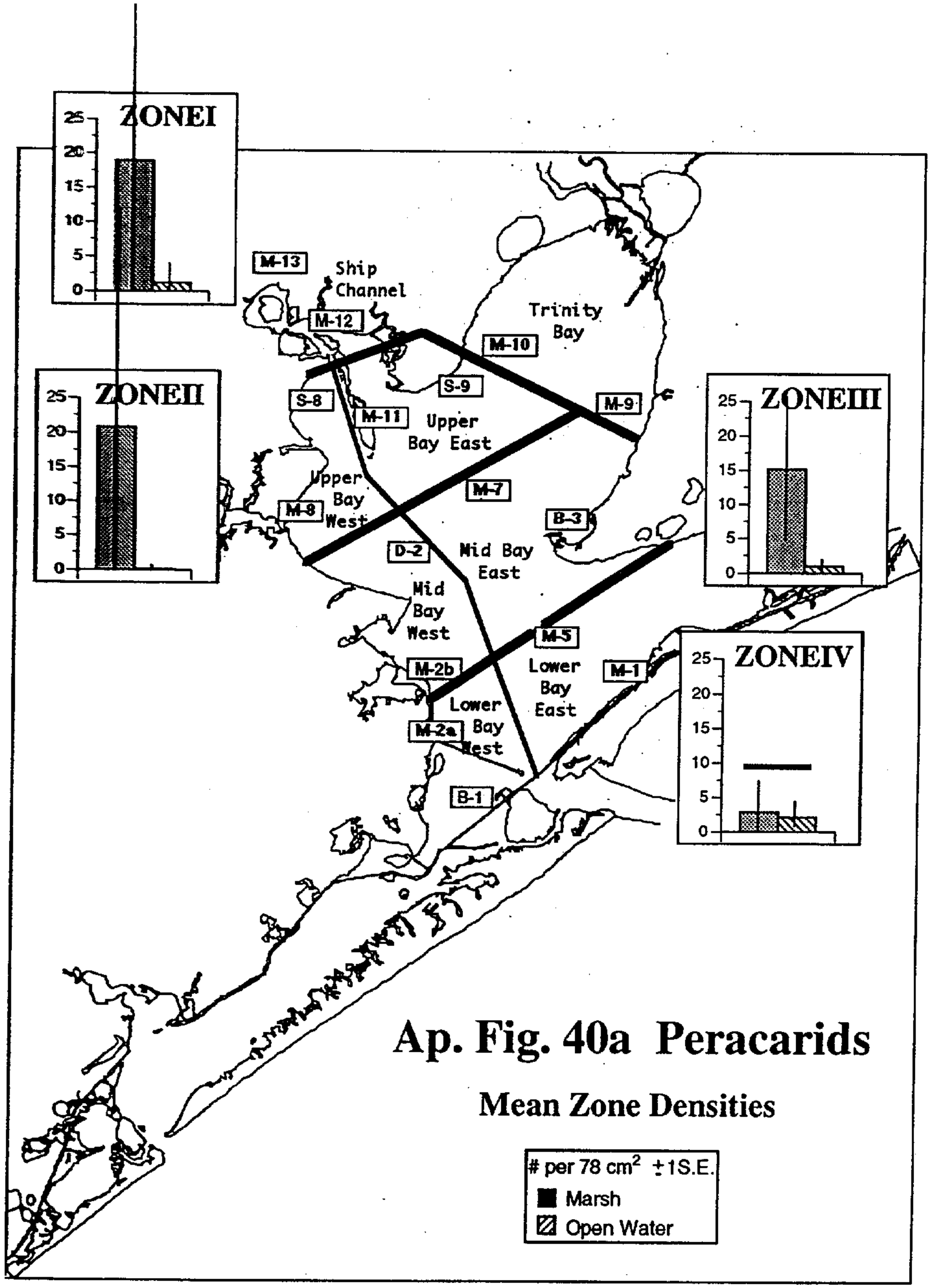
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



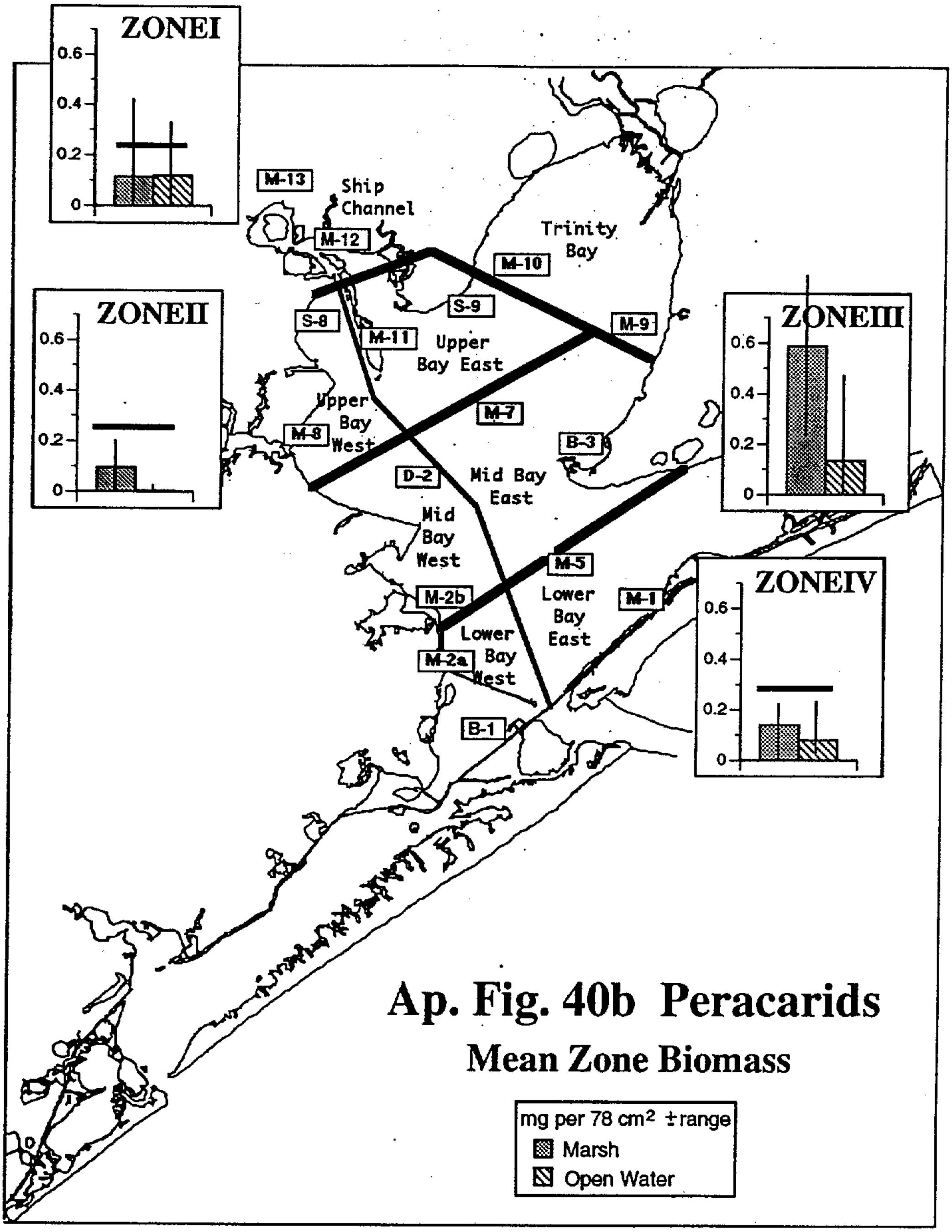
Ap. Fig. 40a Peracarids

Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



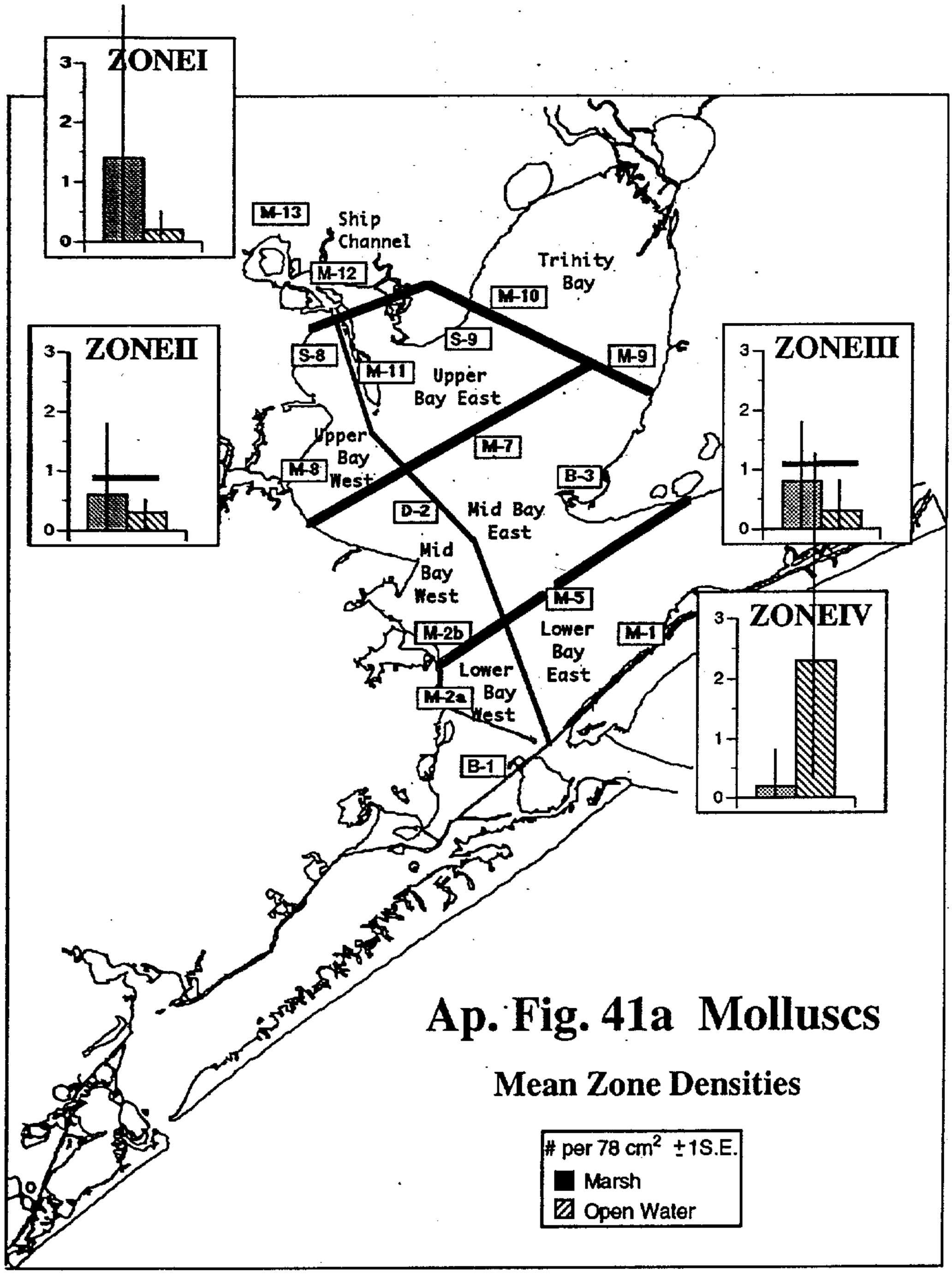
Ap. Fig. 40b Peracarids

Mean Zone Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



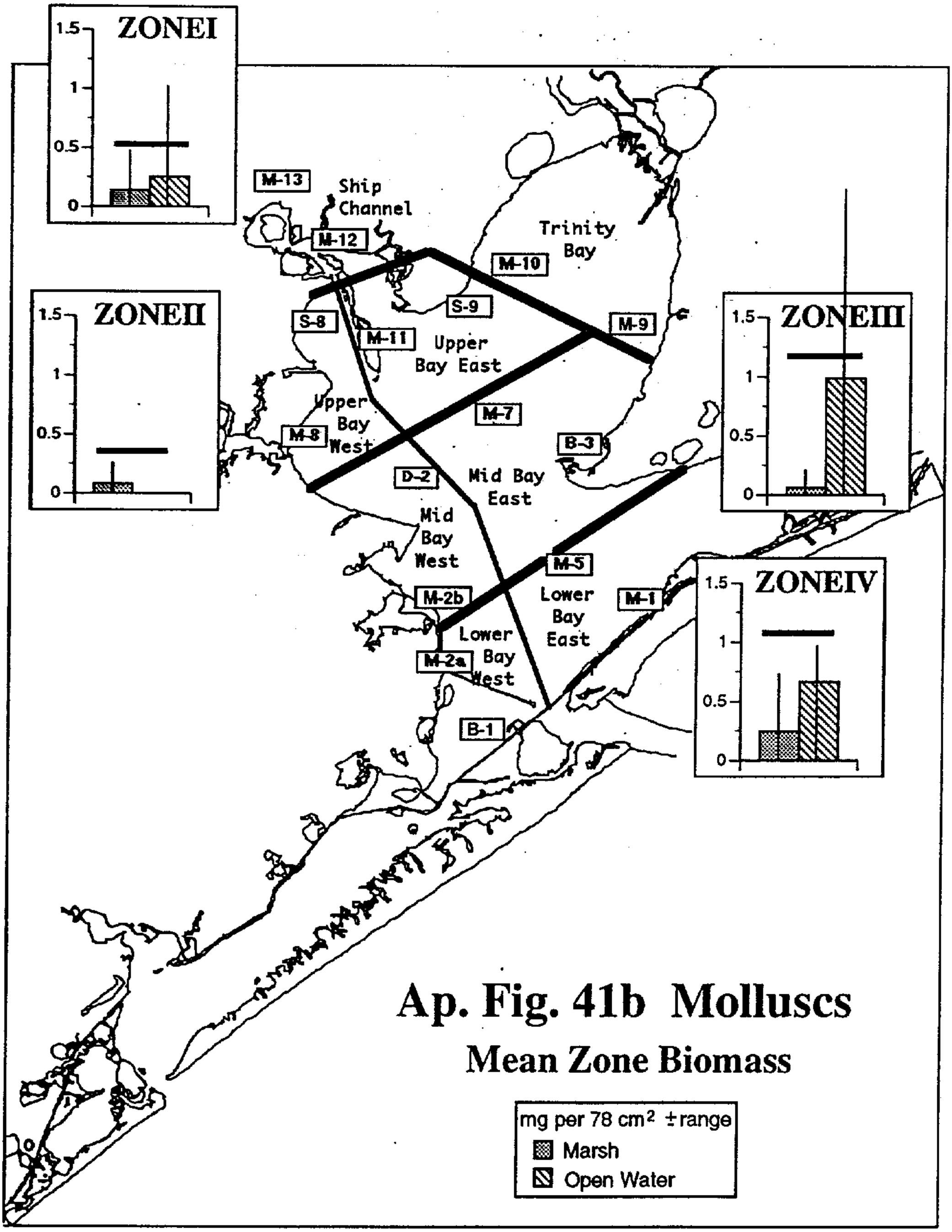
Ap. Fig. 41a Molluscs

Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



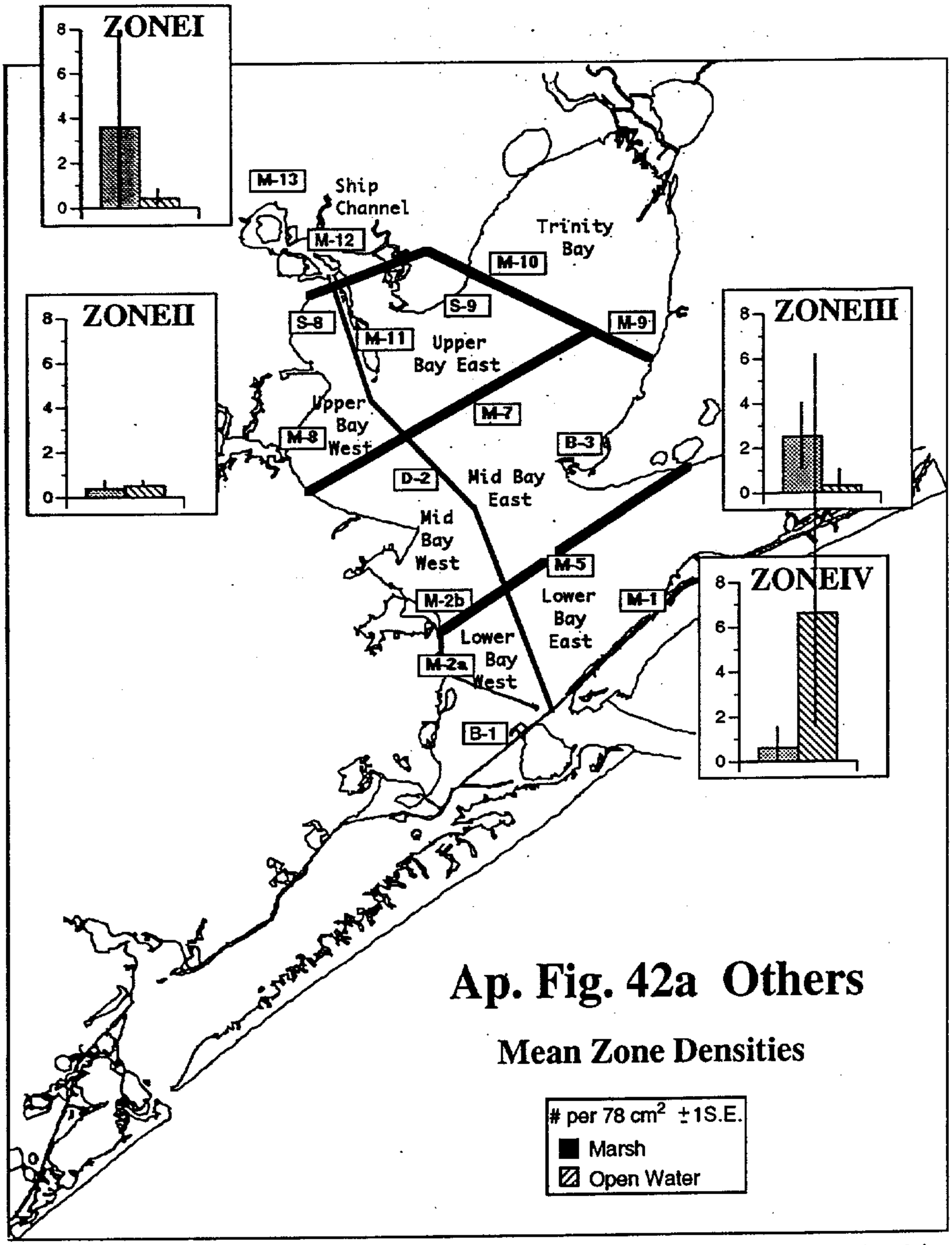
Ap. Fig. 41b Molluscs

Mean Zone Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



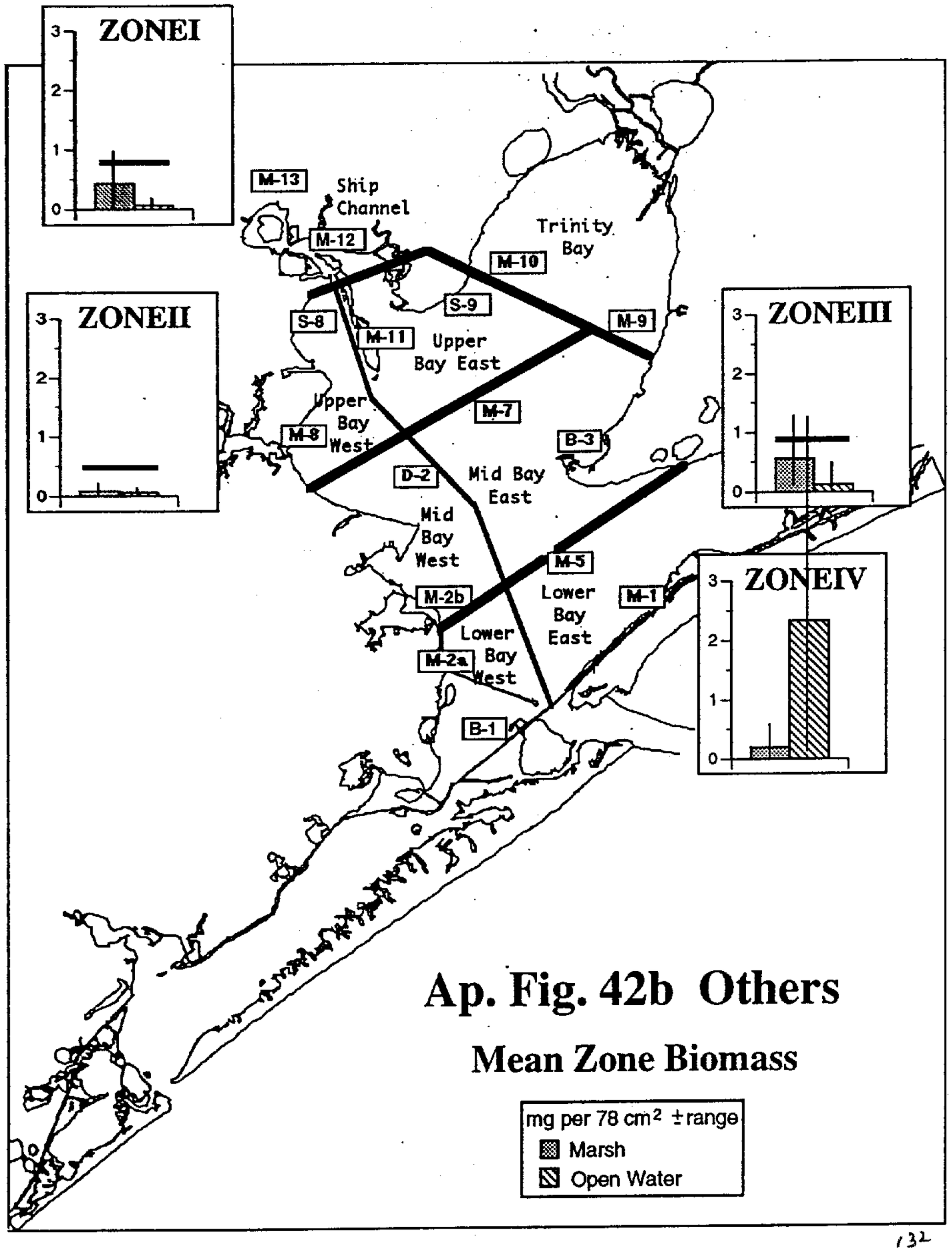
Ap. Fig. 42a Others

Mean Zone Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

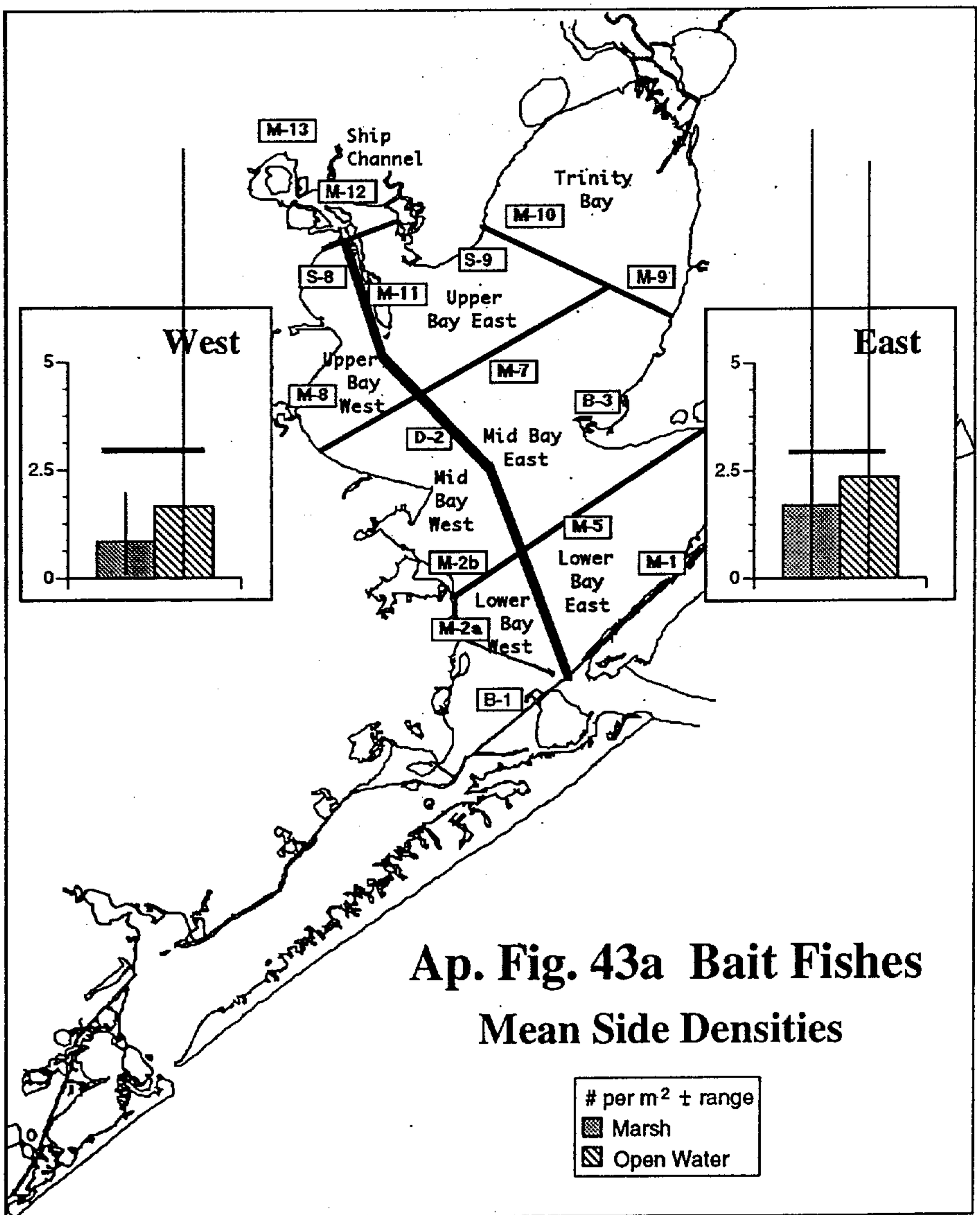
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



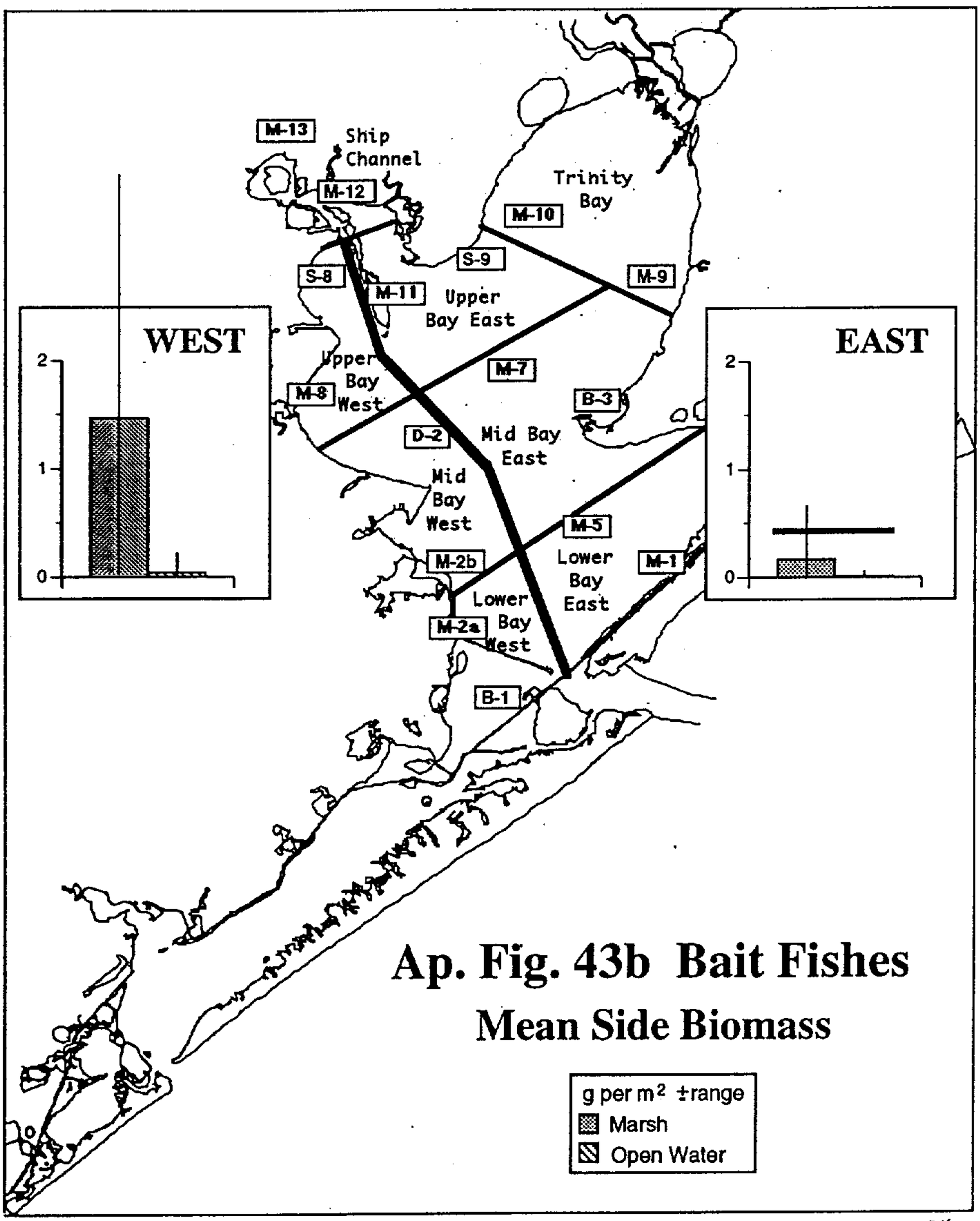
Ap. Fig. 43a Bait Fishes

Mean Side Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

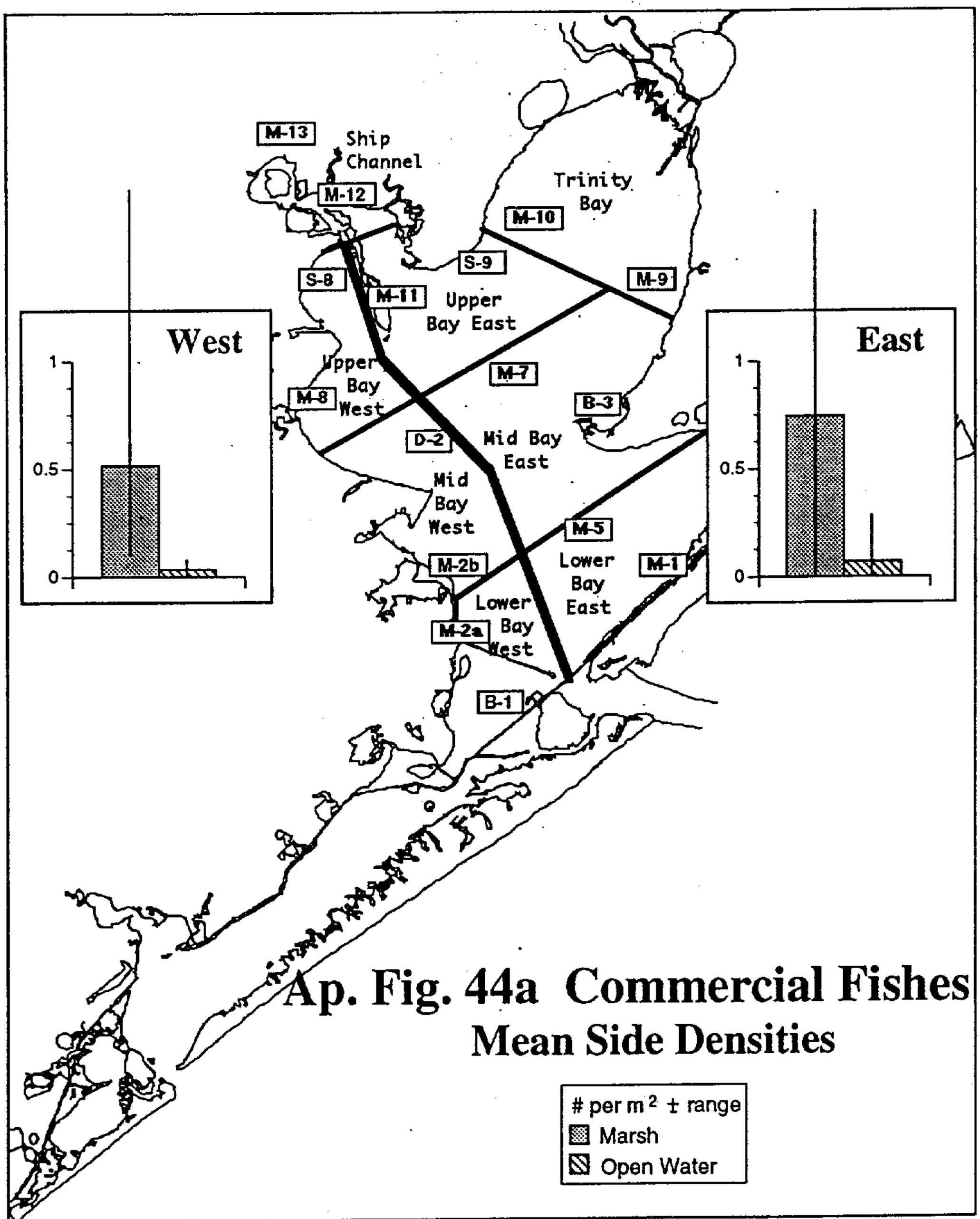
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



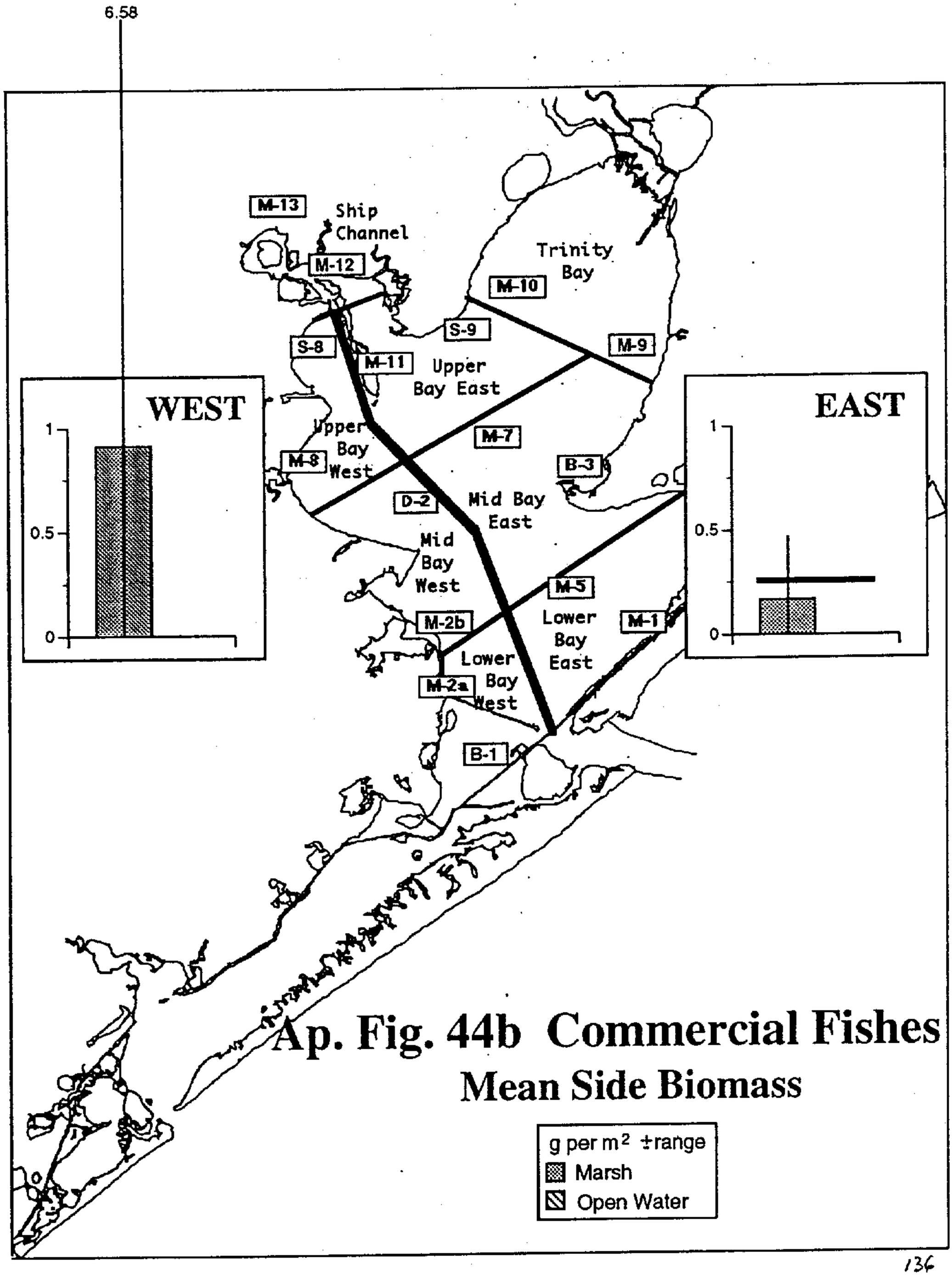
Ap. Fig. 44a Commercial Fishes

Mean Side Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

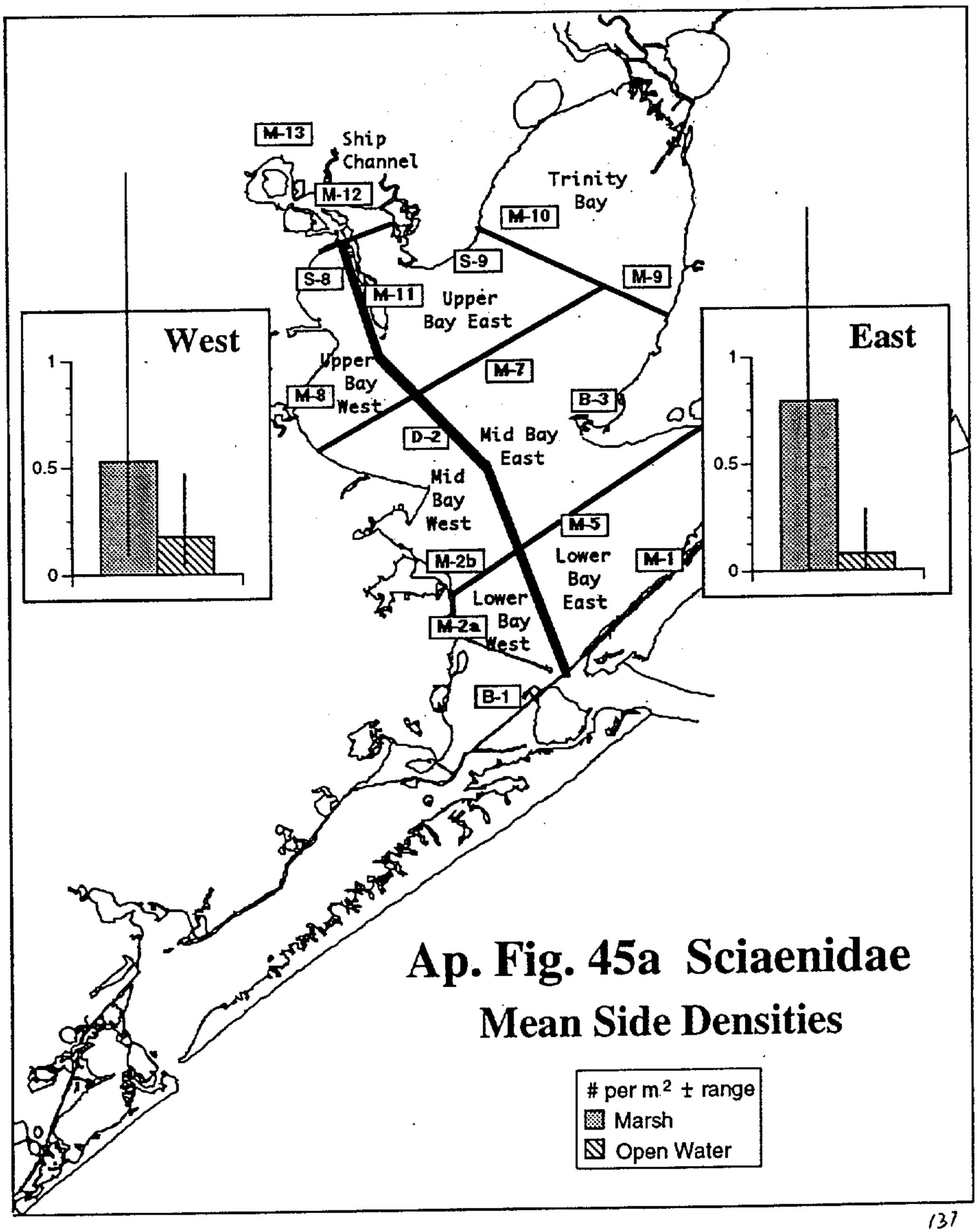
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



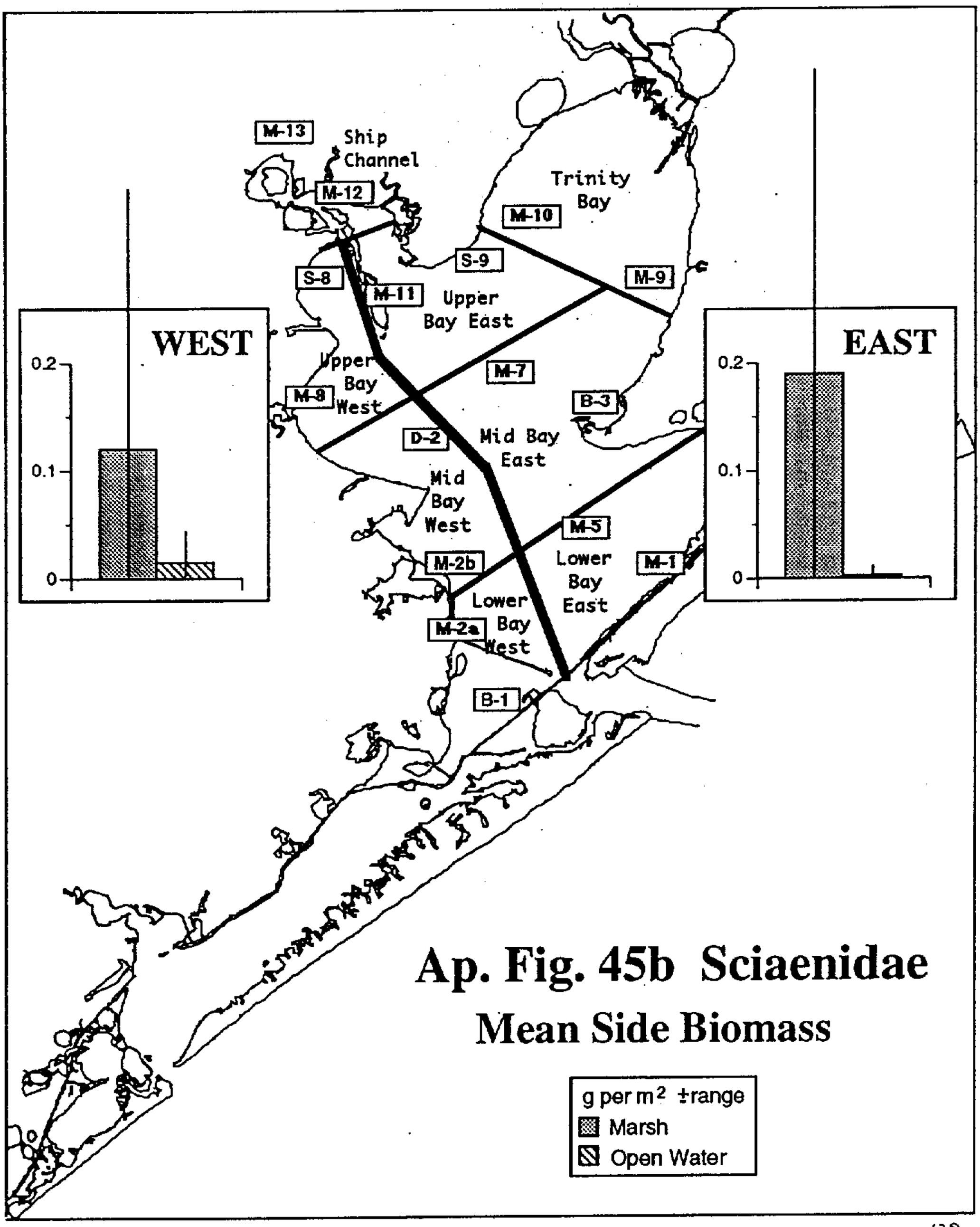
Ap. Fig. 45a Sciaenidae

Mean Side Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

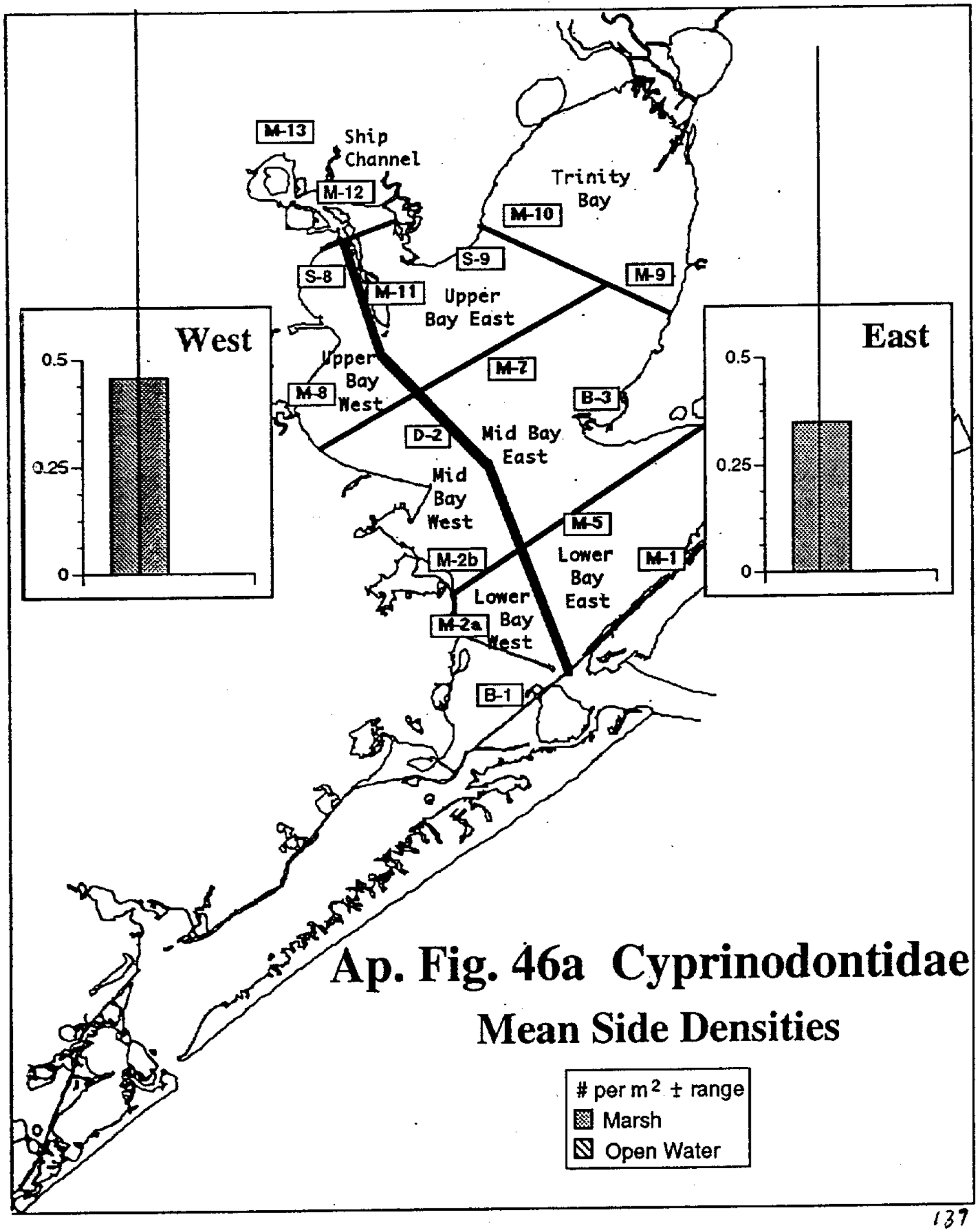
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



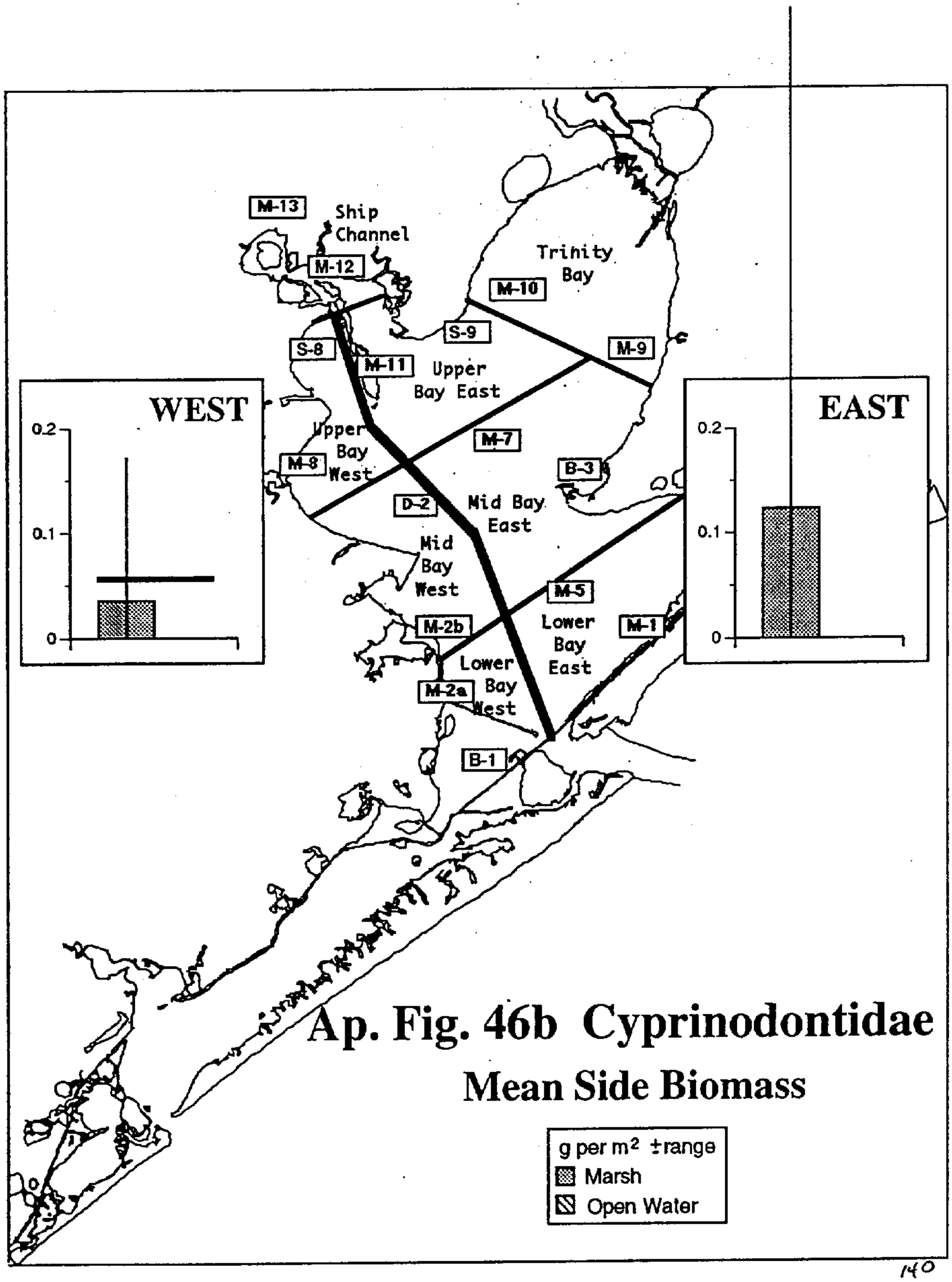
Ap. Fig. 46a Cyprinodontidae

Mean Side Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

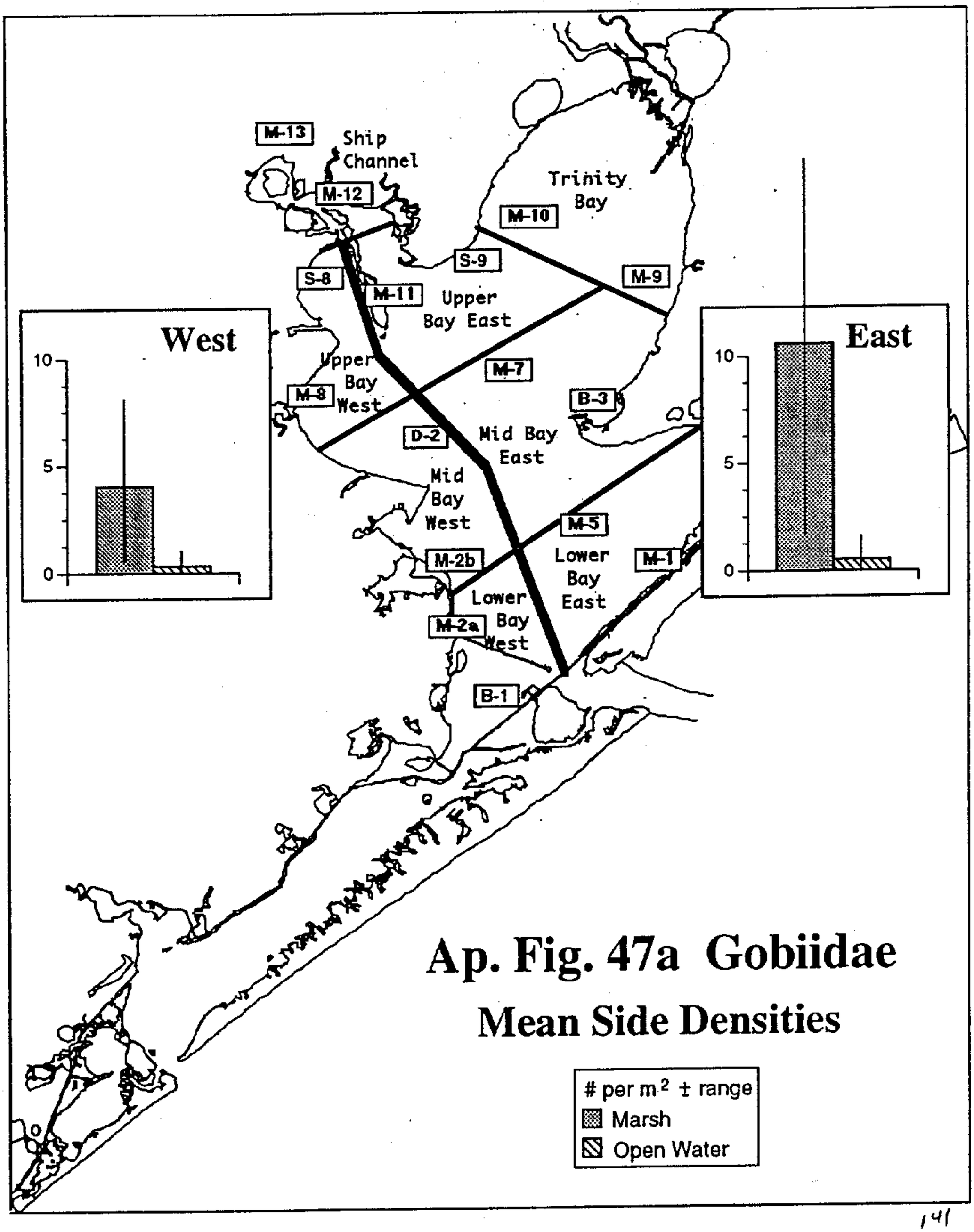
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



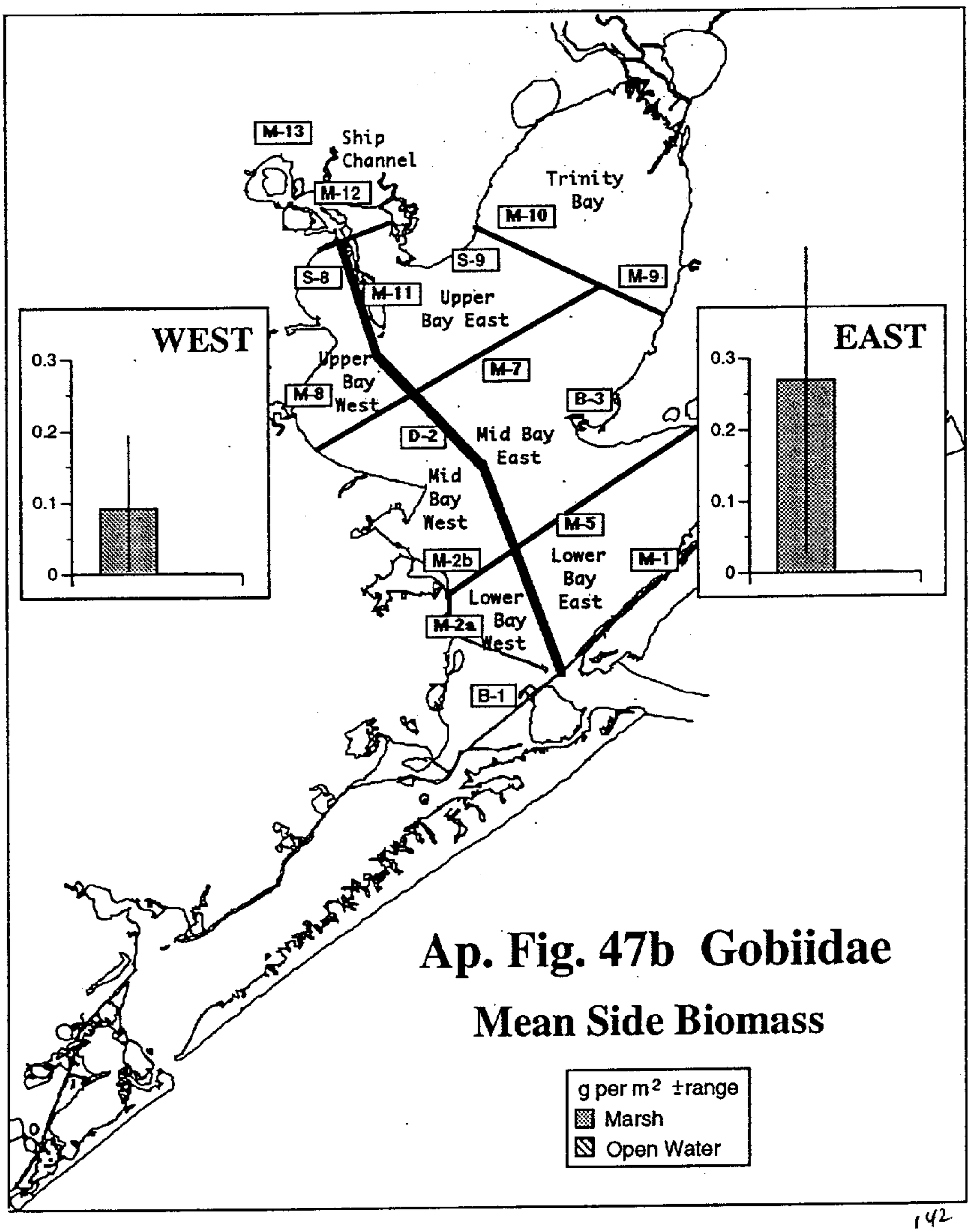
Ap. Fig. 47a Gobiidae

Mean Side Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

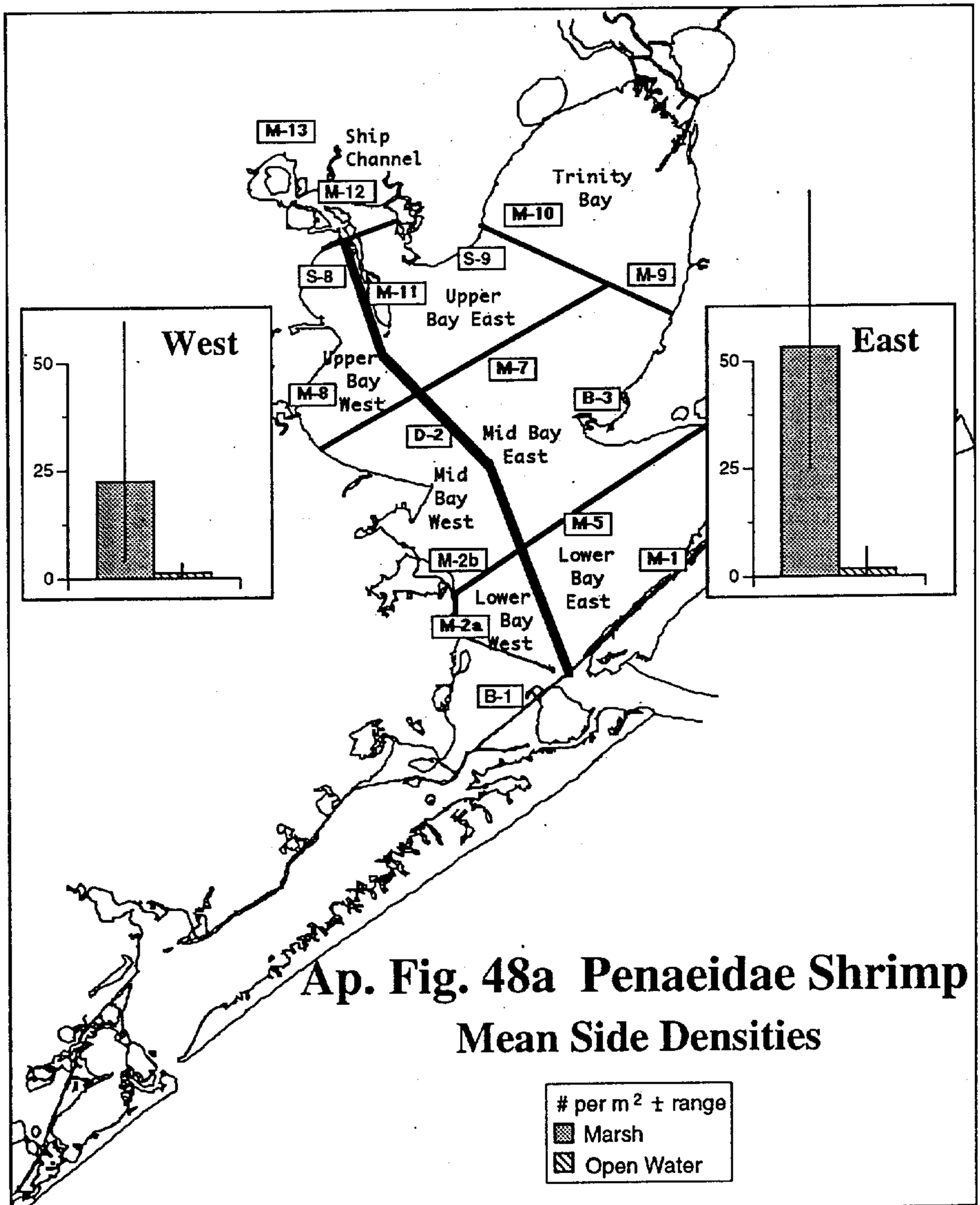
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



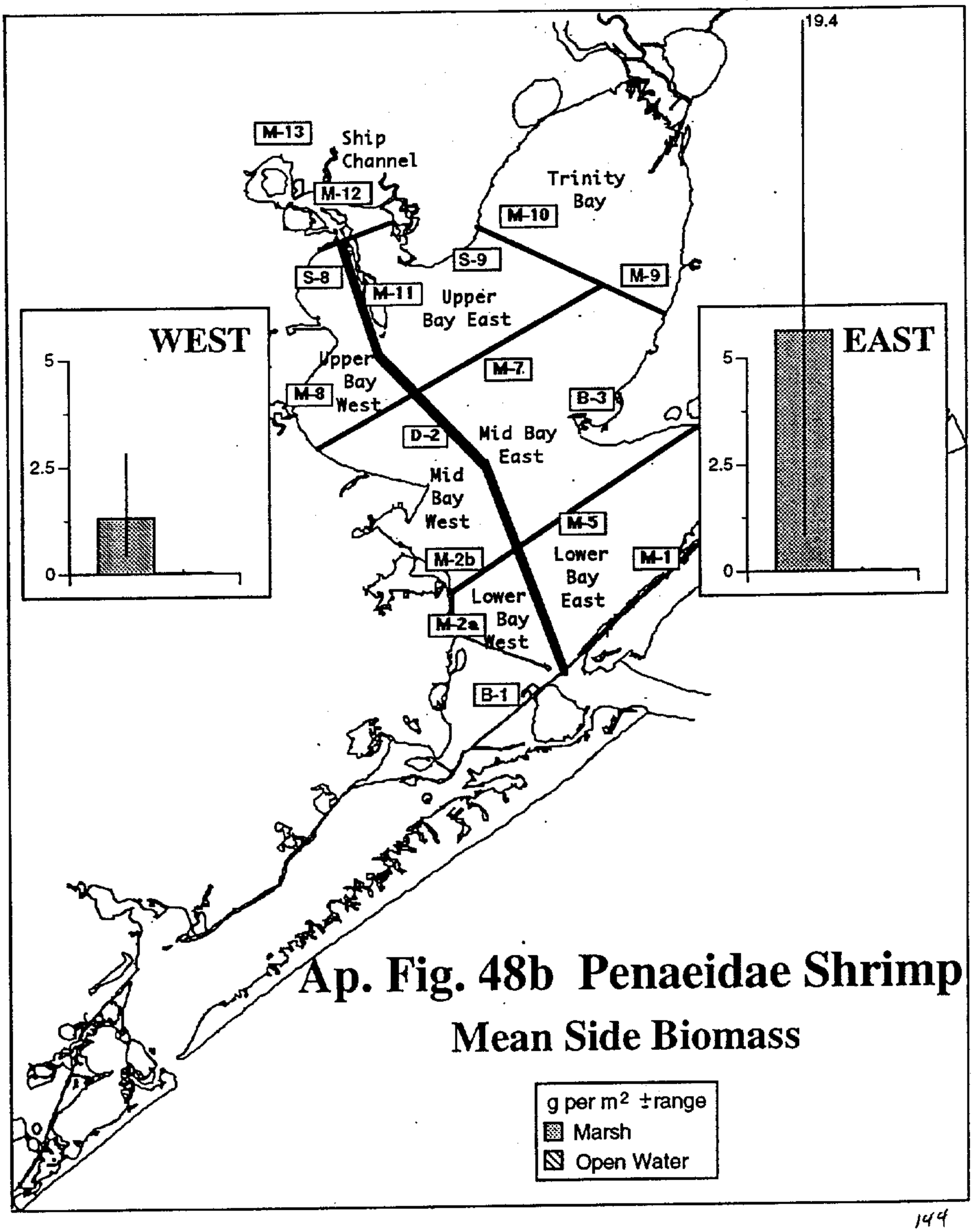
Ap. Fig. 48a Penaeidae Shrimp

Mean Side Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

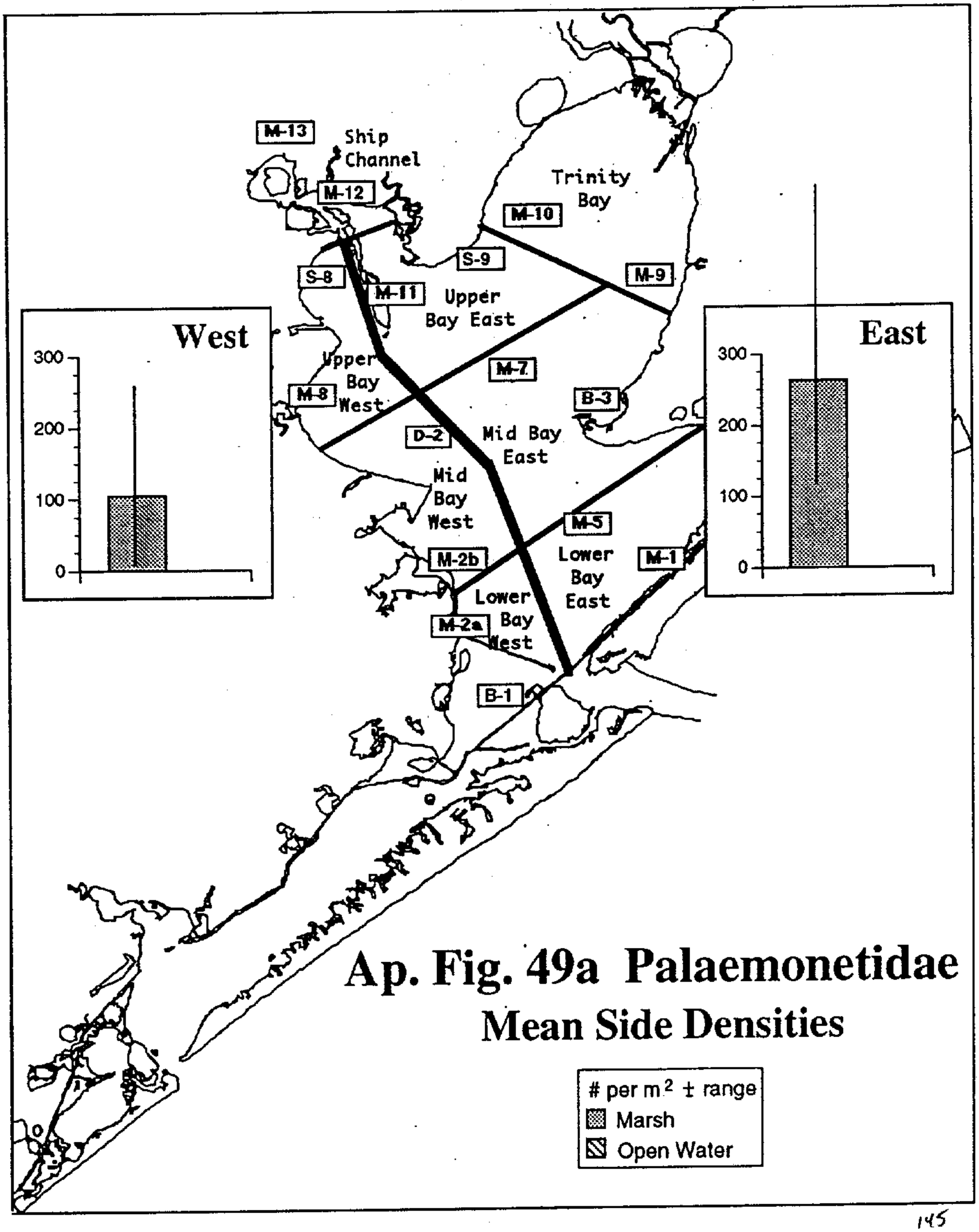
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



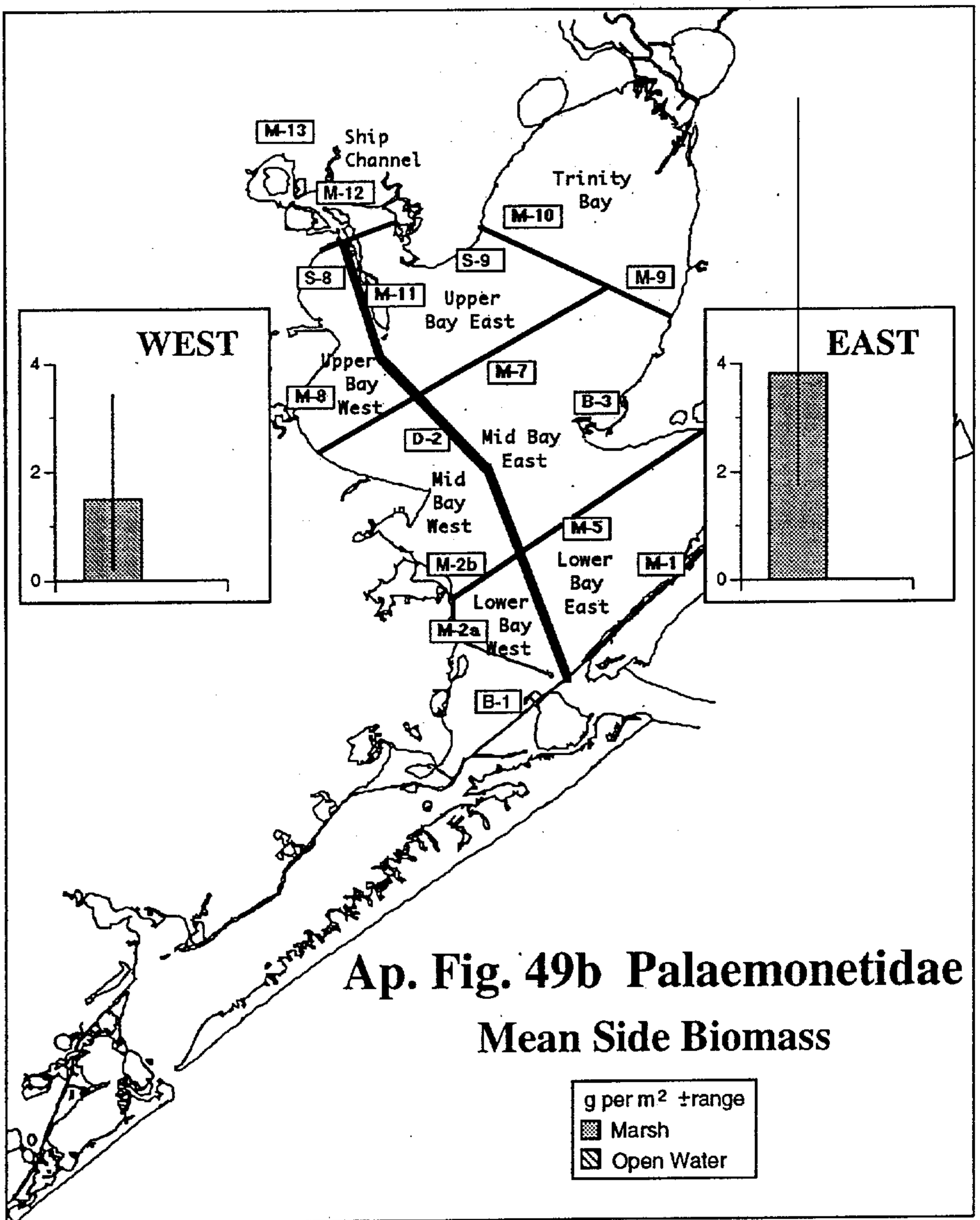
Ap. Fig. 49a Palaemonetidae

Mean Side Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

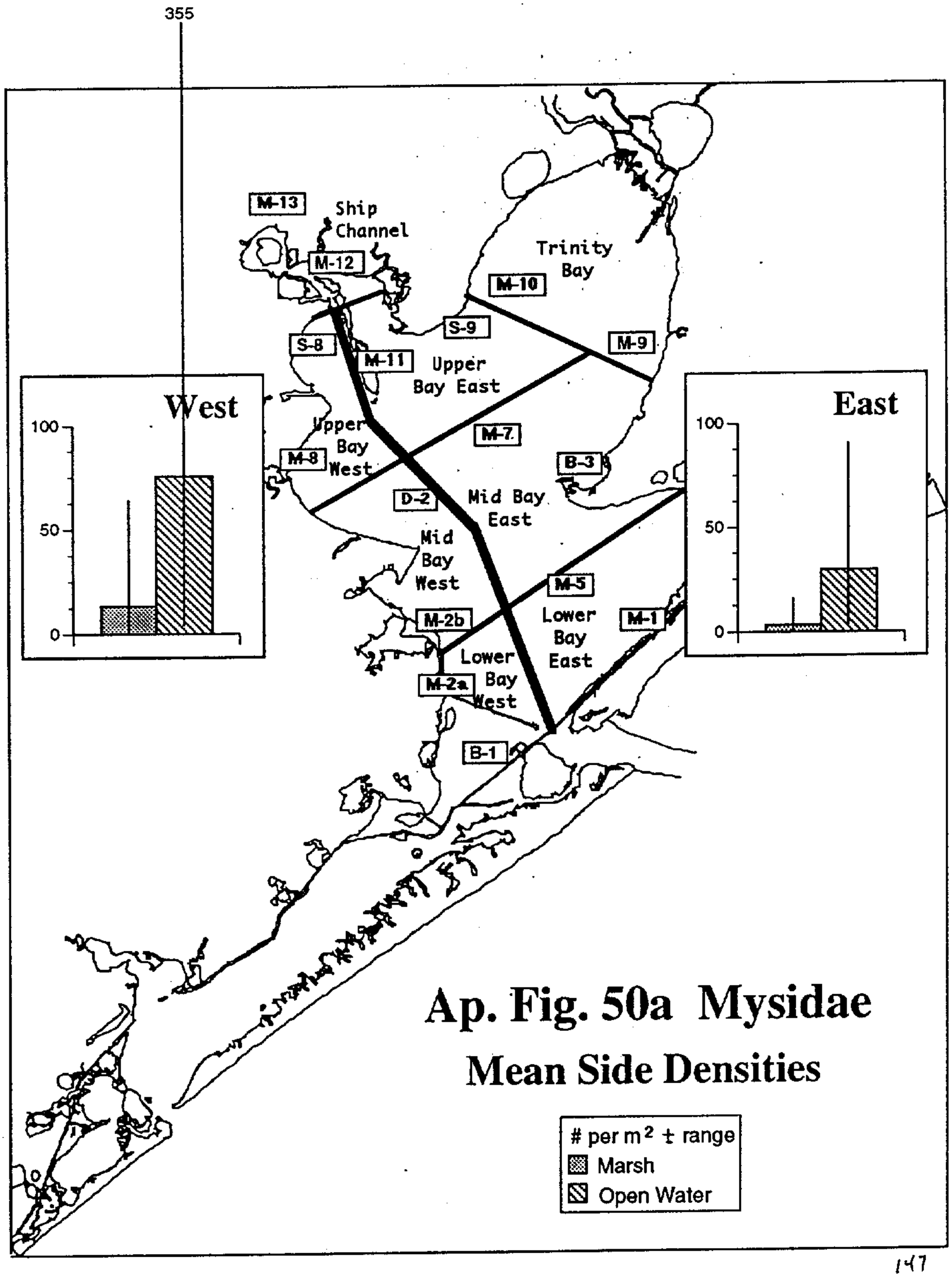
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

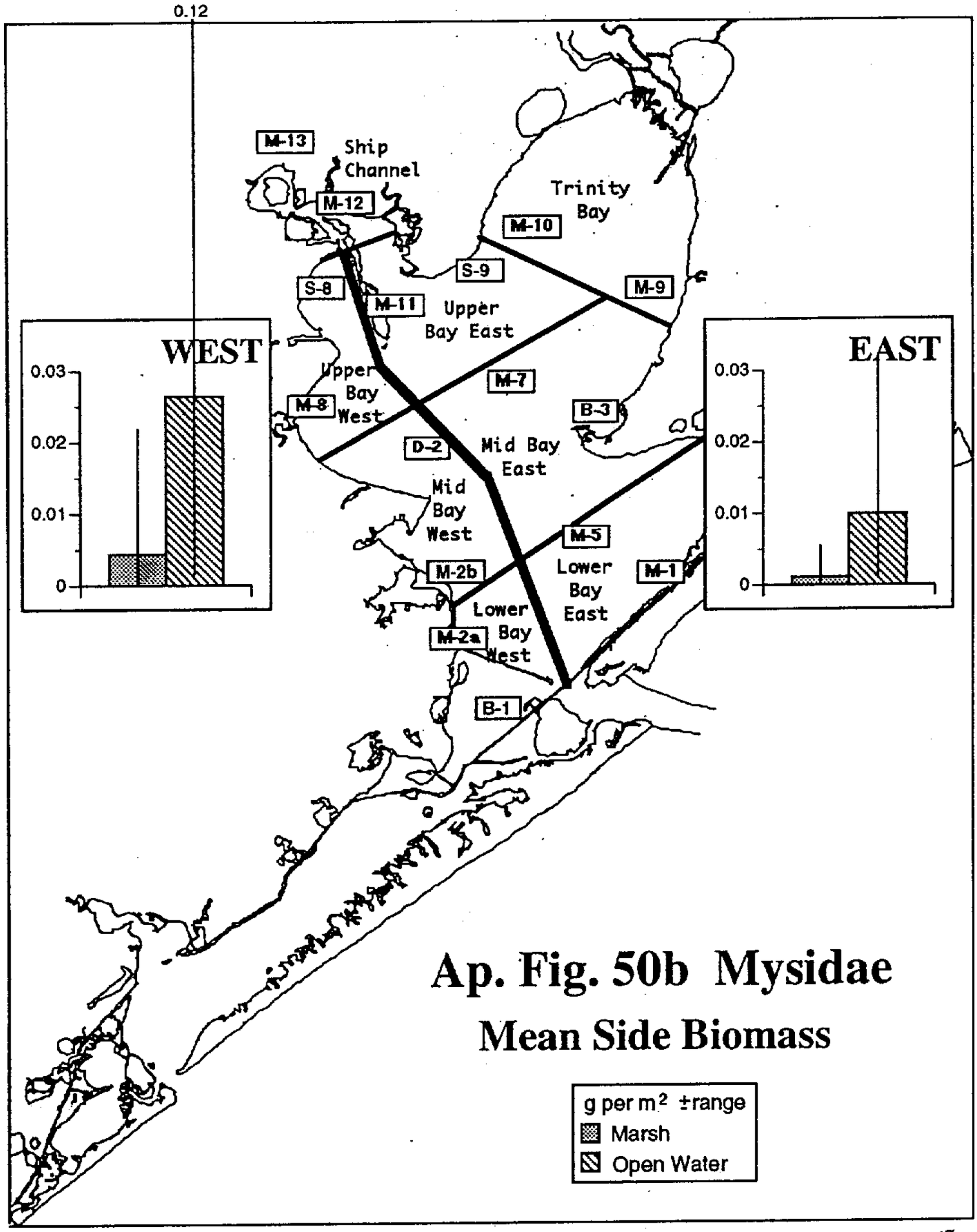
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

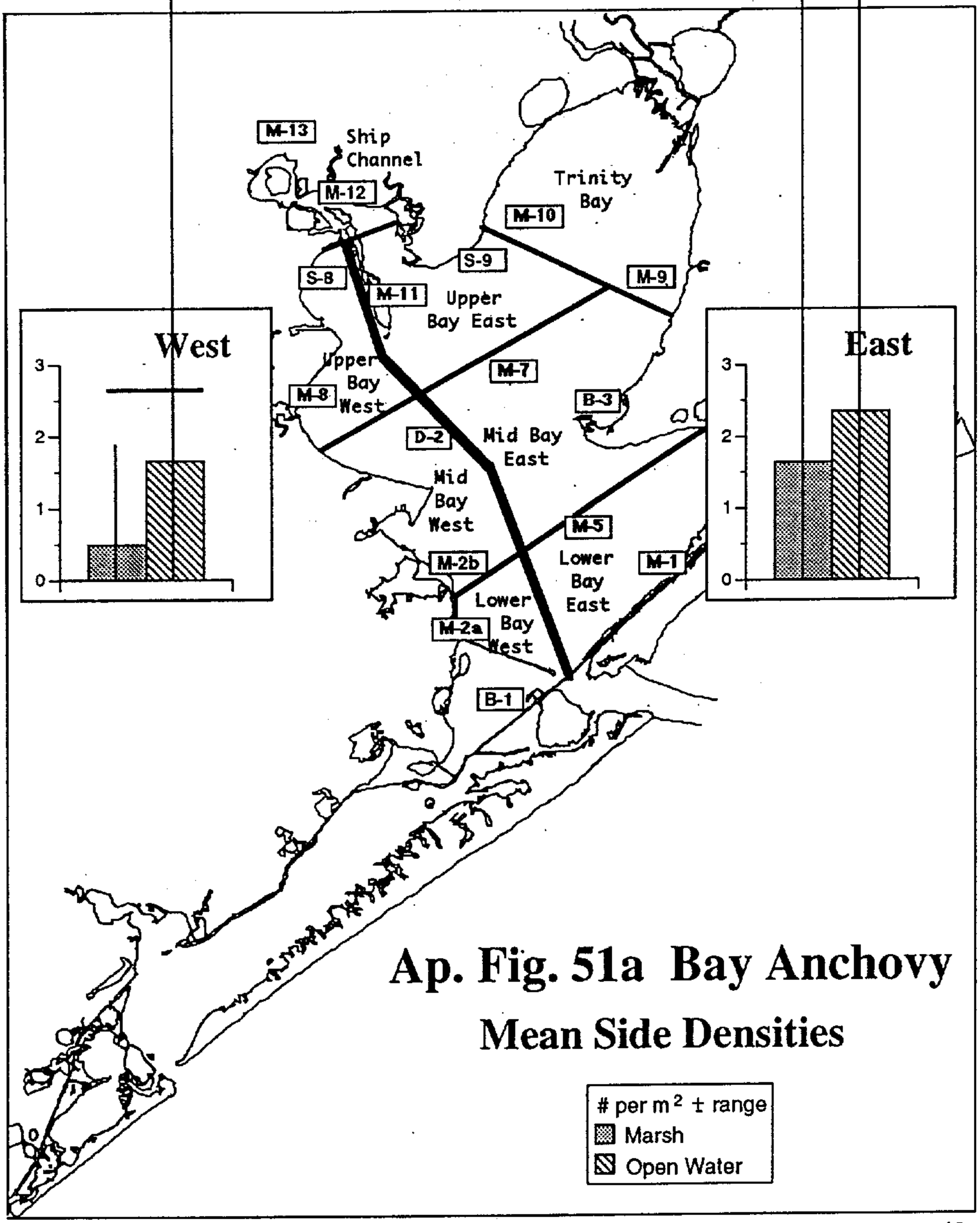
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

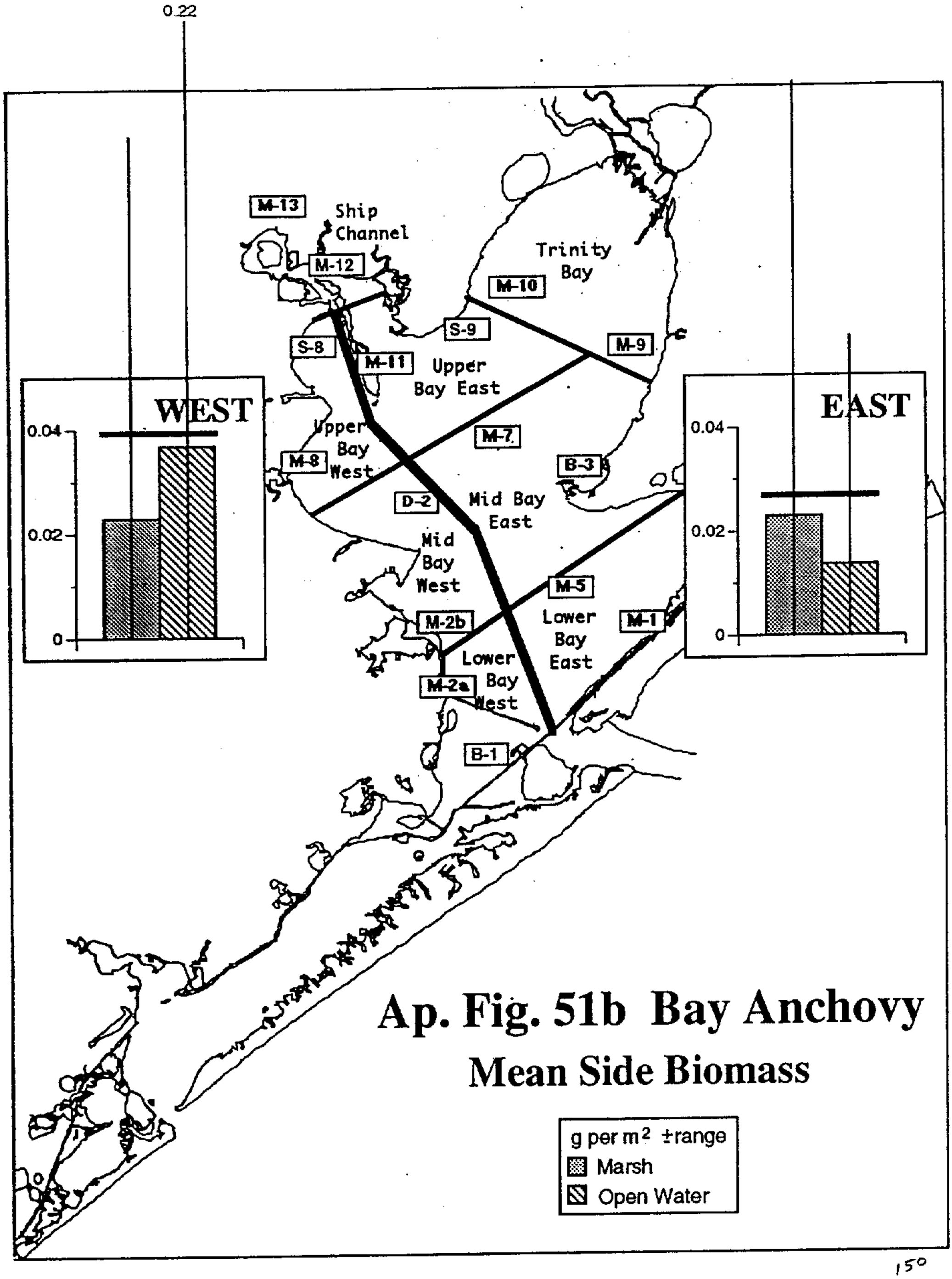
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

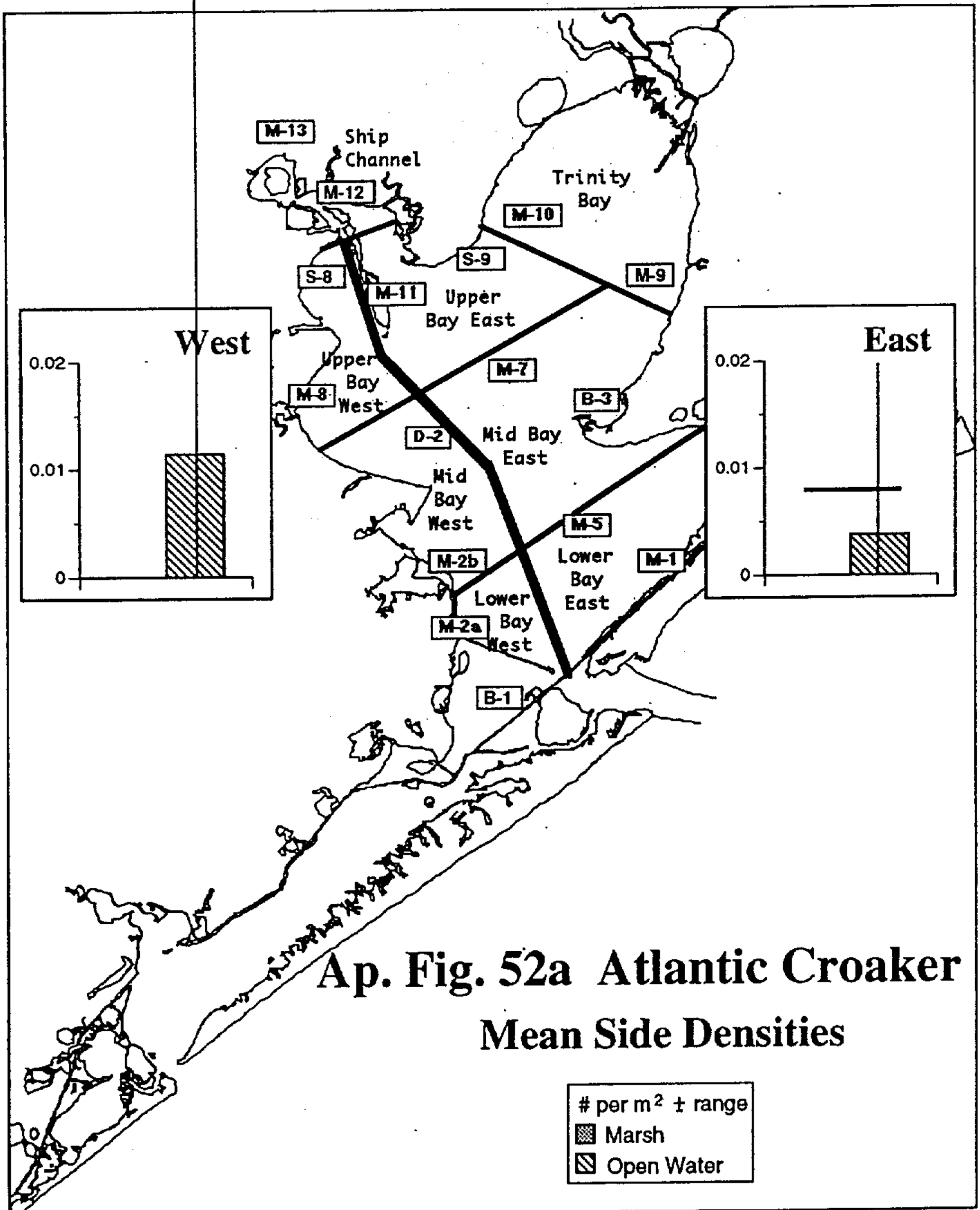


150

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



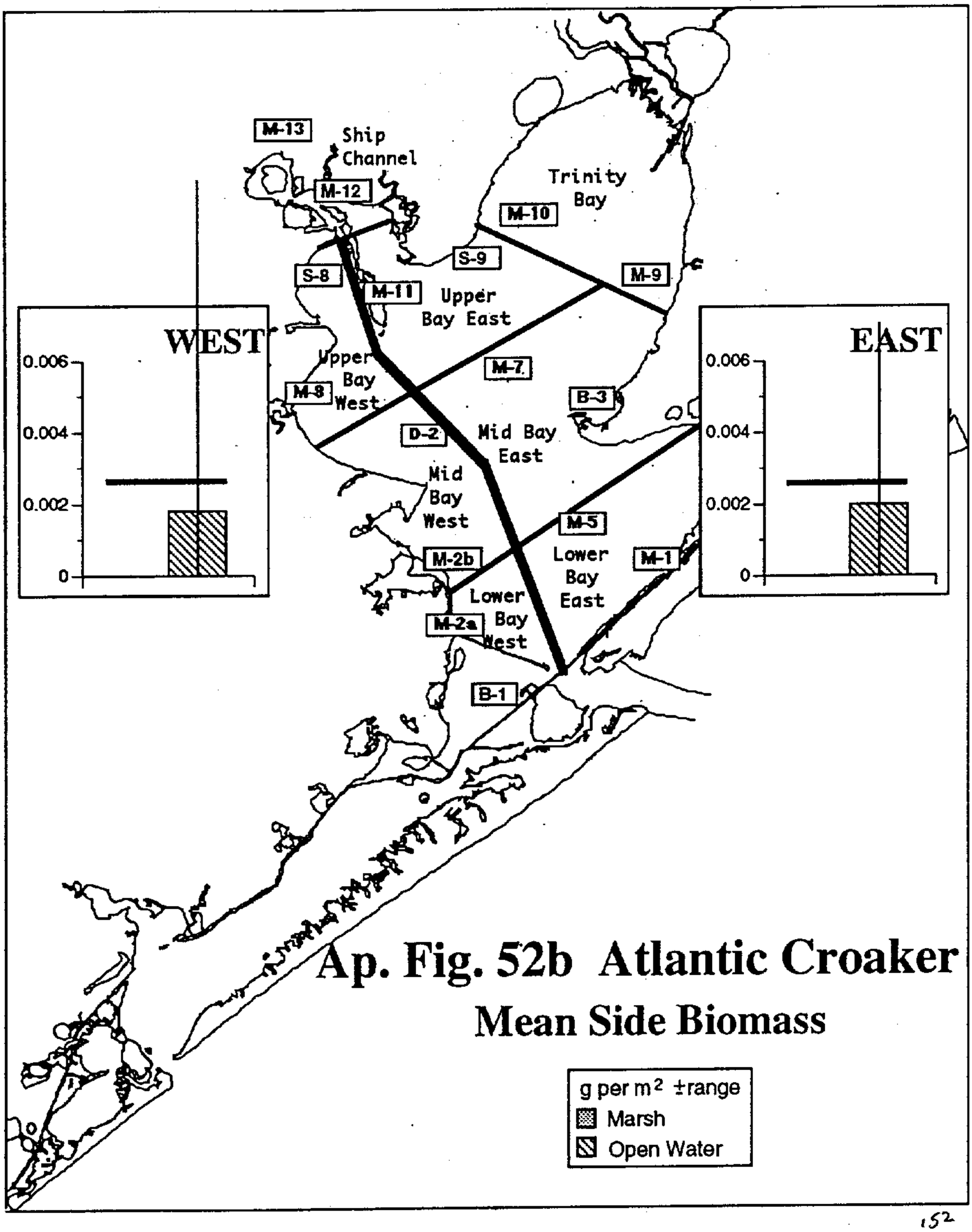
Ap. Fig. 52a Atlantic Croaker

Mean Side Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



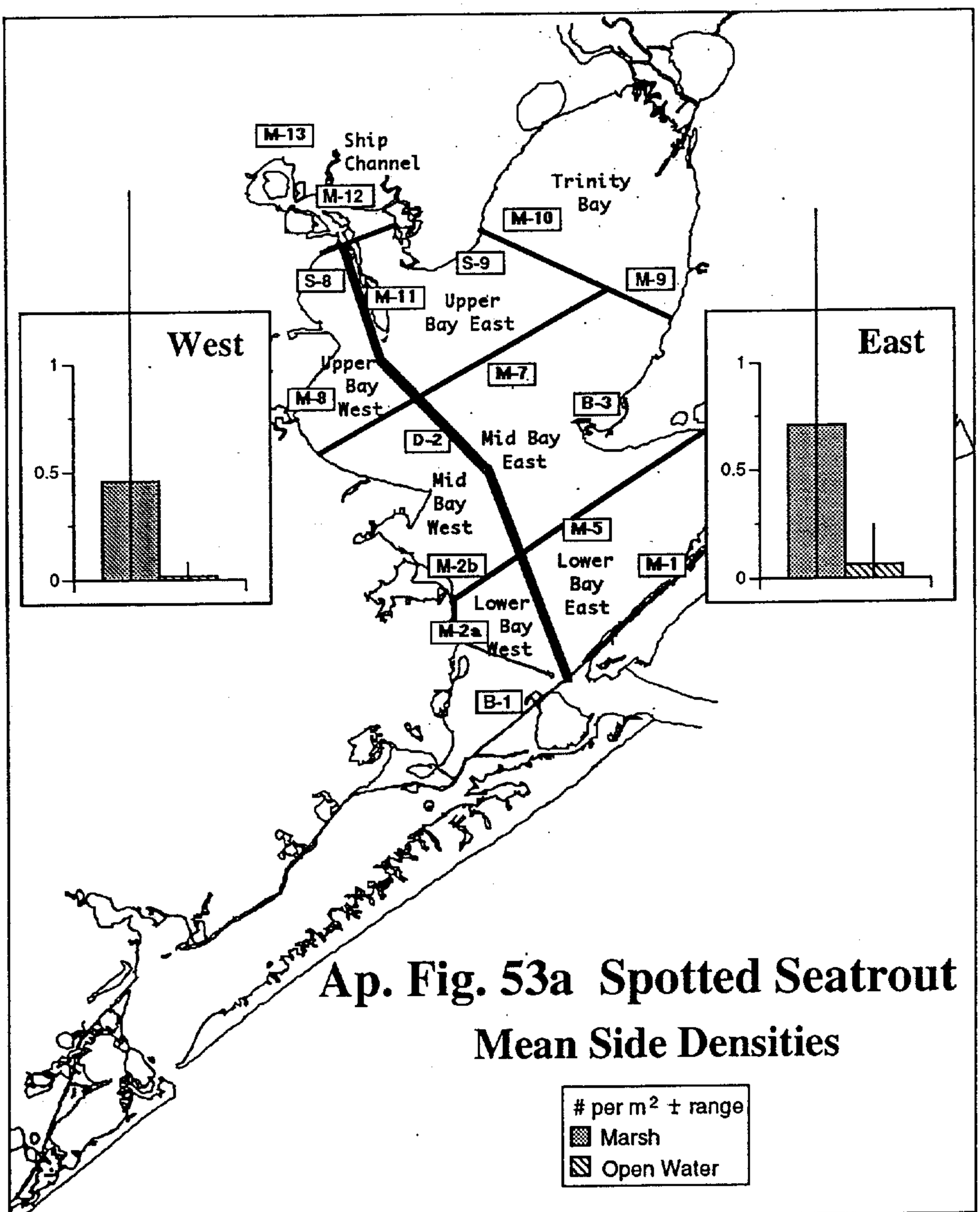
Ap. Fig. 52b Atlantic Croaker

Mean Side Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Ap. Fig. 53a Spotted Seatrout

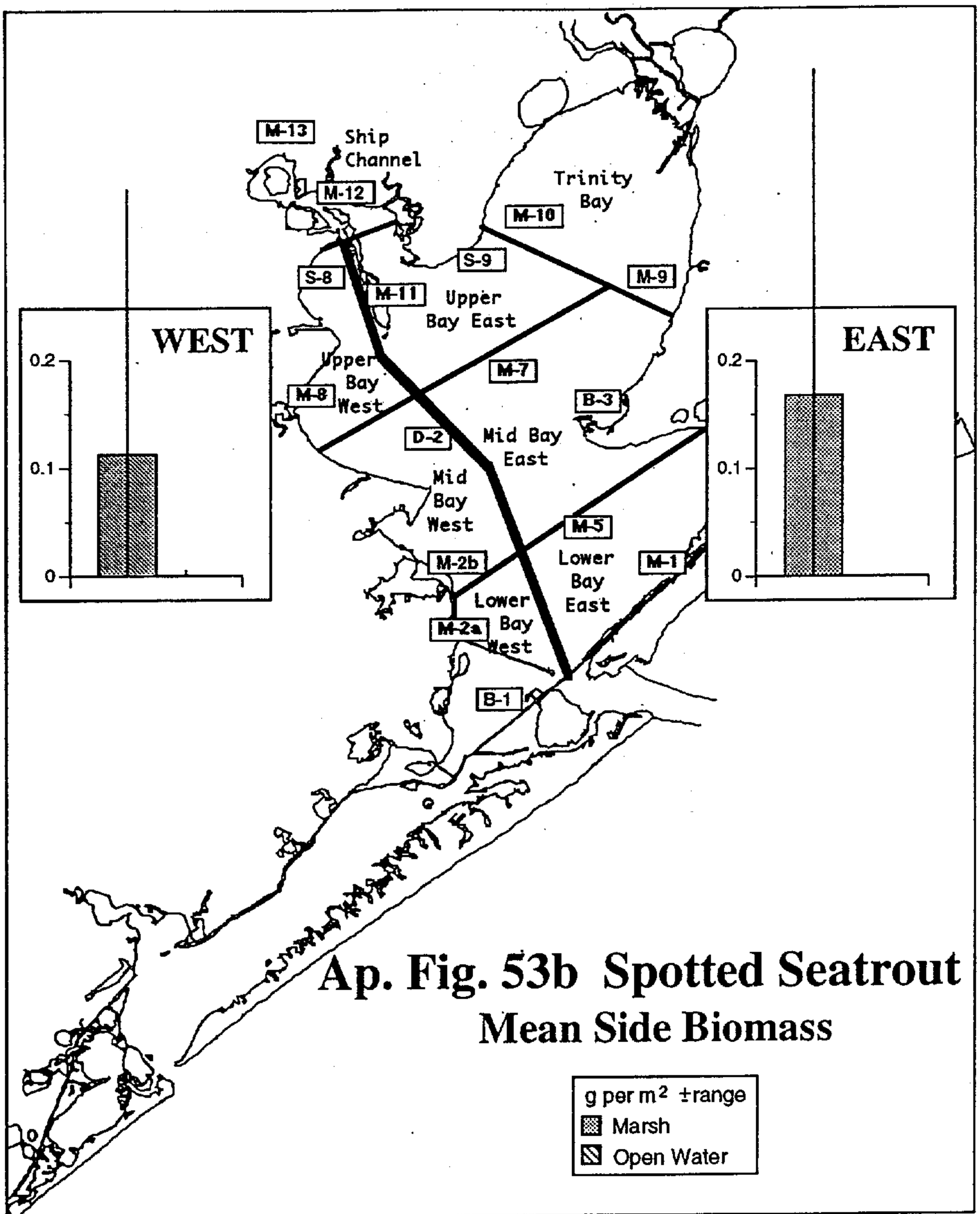
Mean Side Densities

153

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



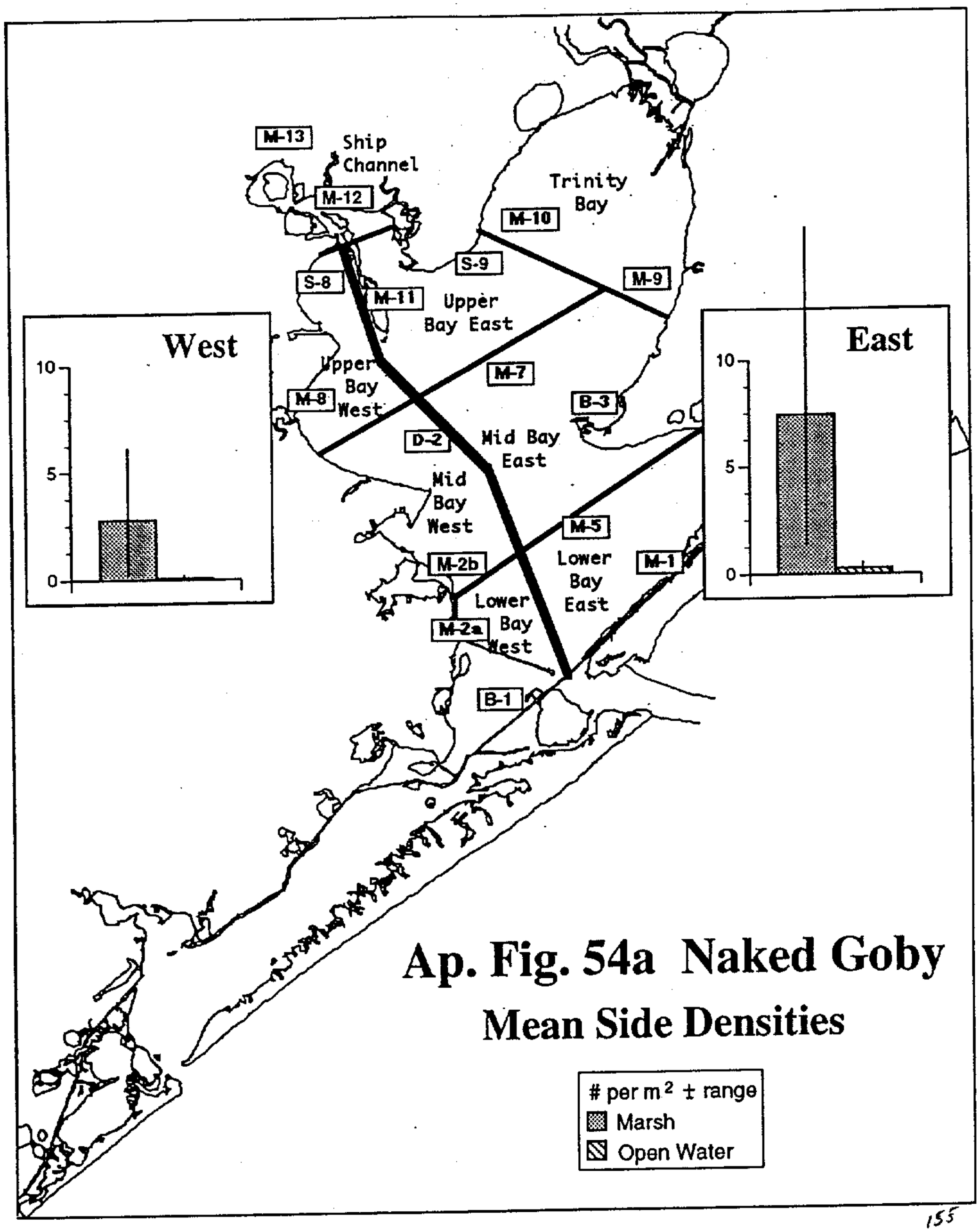
Ap. Fig. 53b Spotted Seatrout

Mean Side Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Ap. Fig. 54a Naked Goby

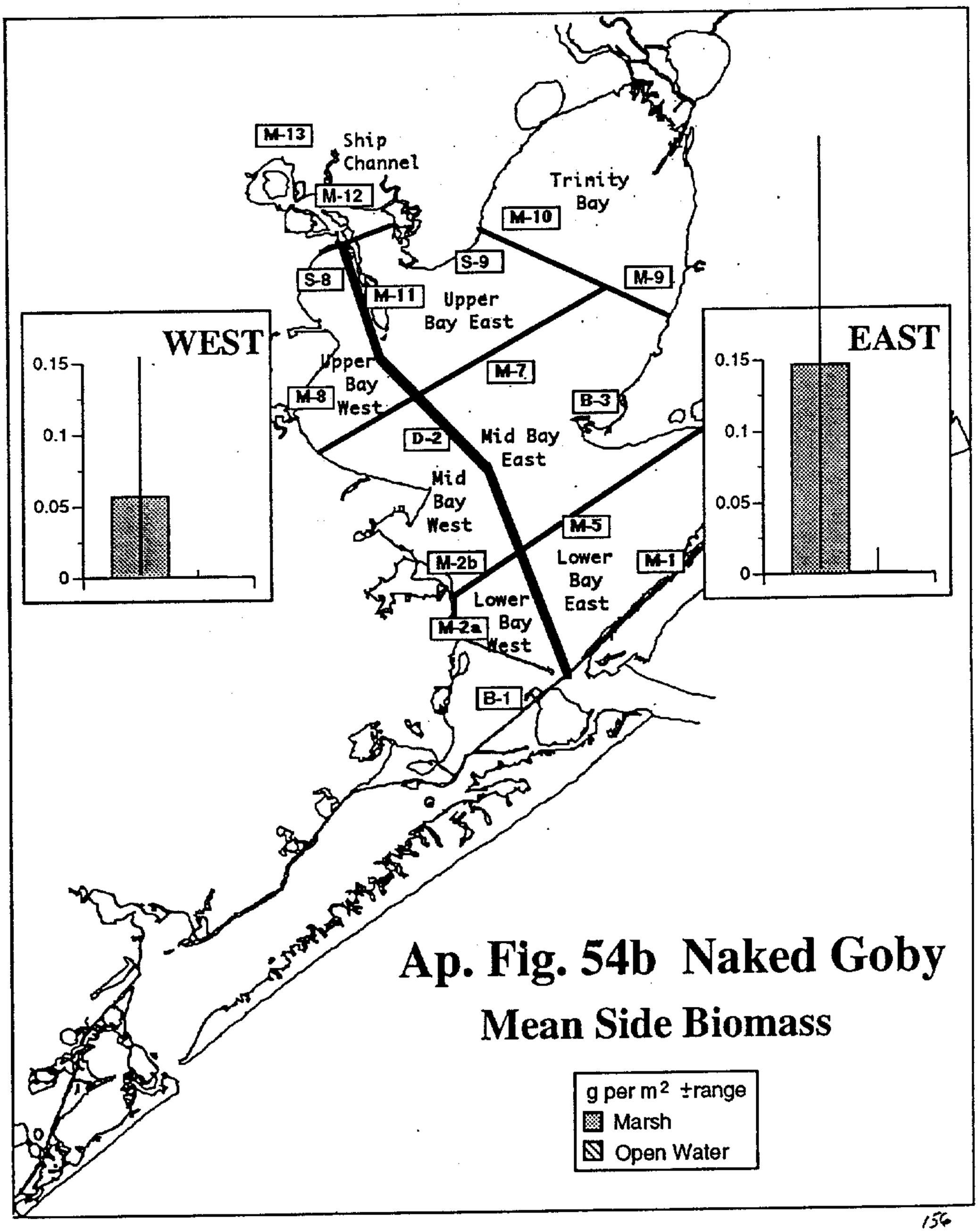
Mean Side Densities

155

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

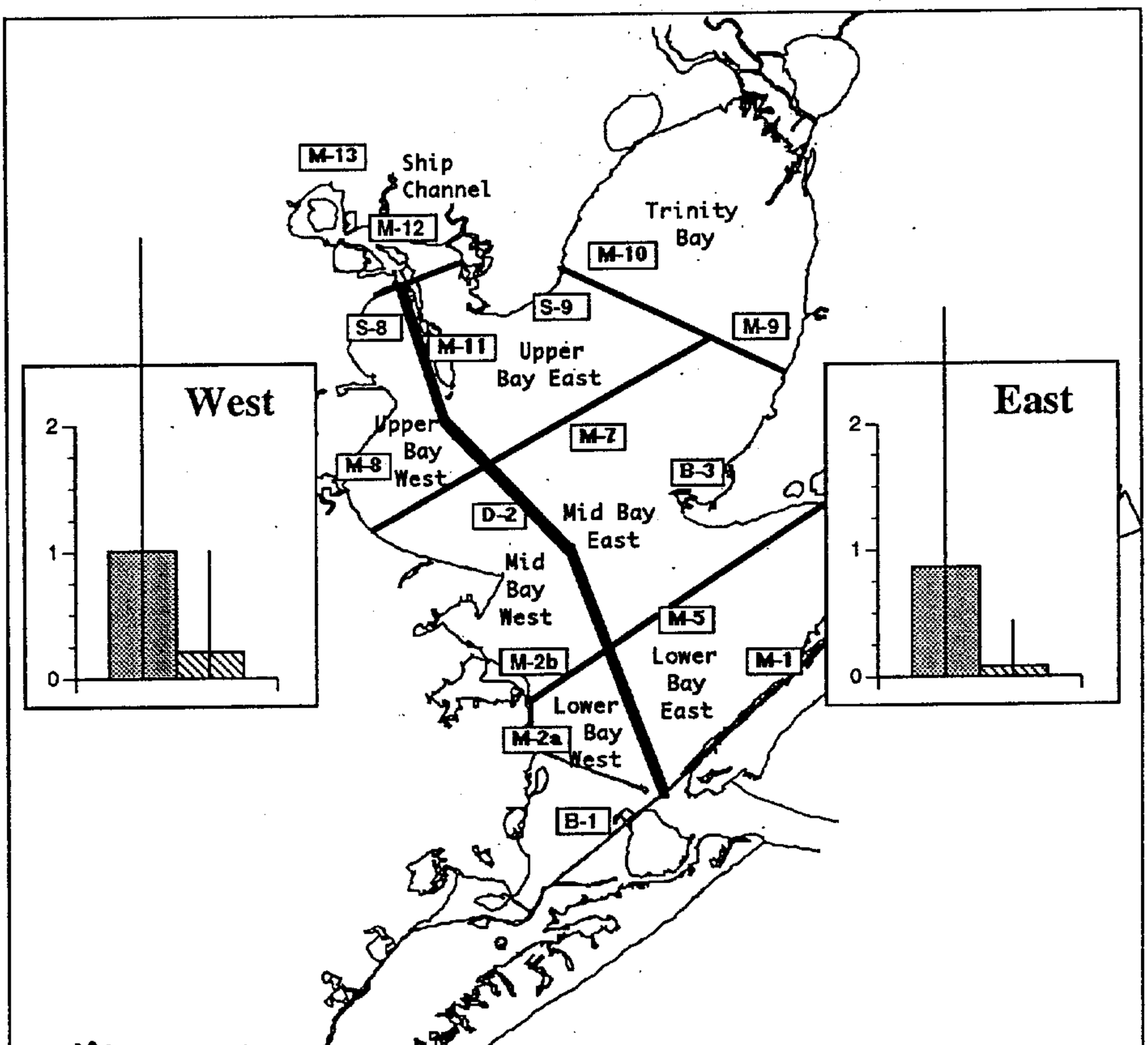
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

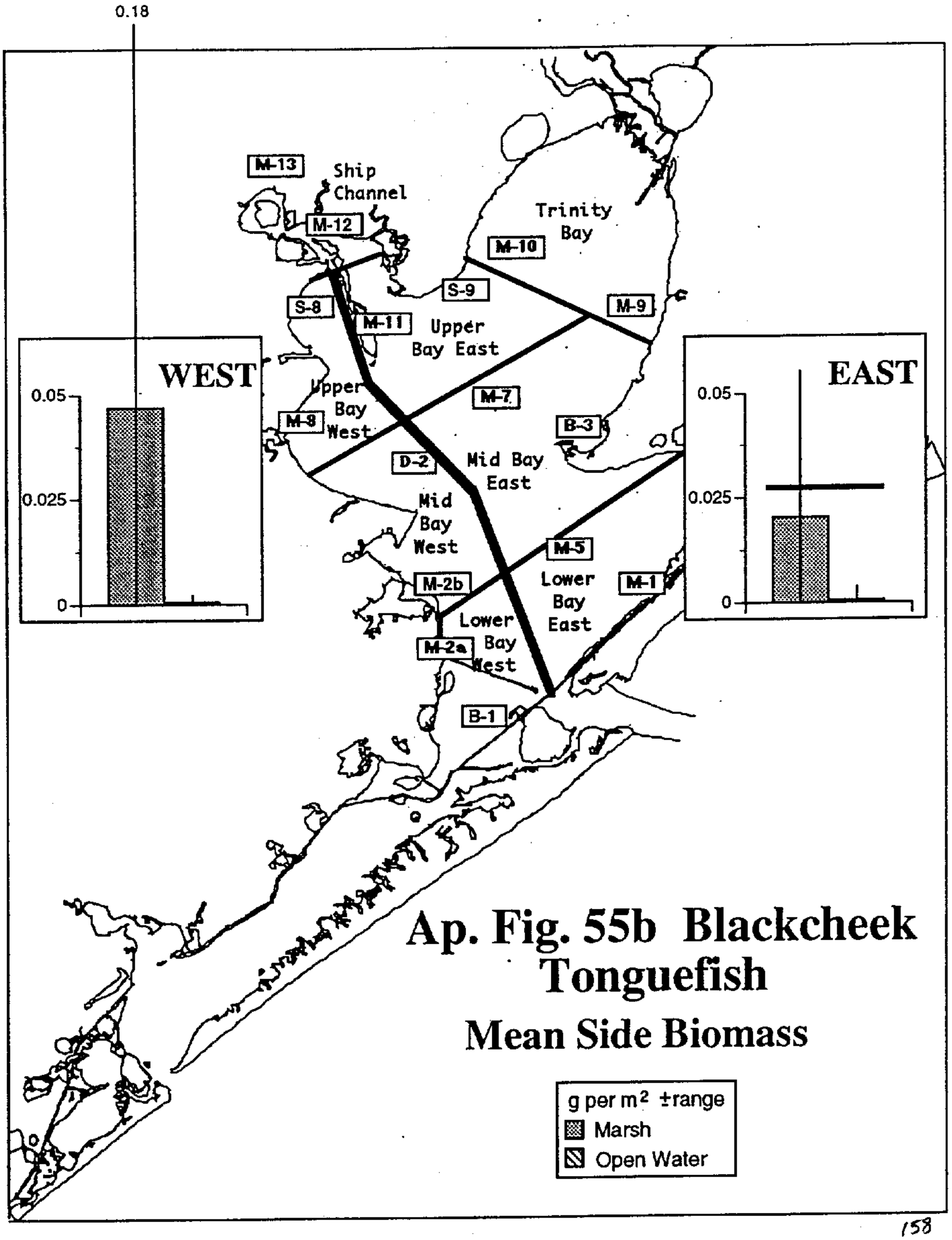
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



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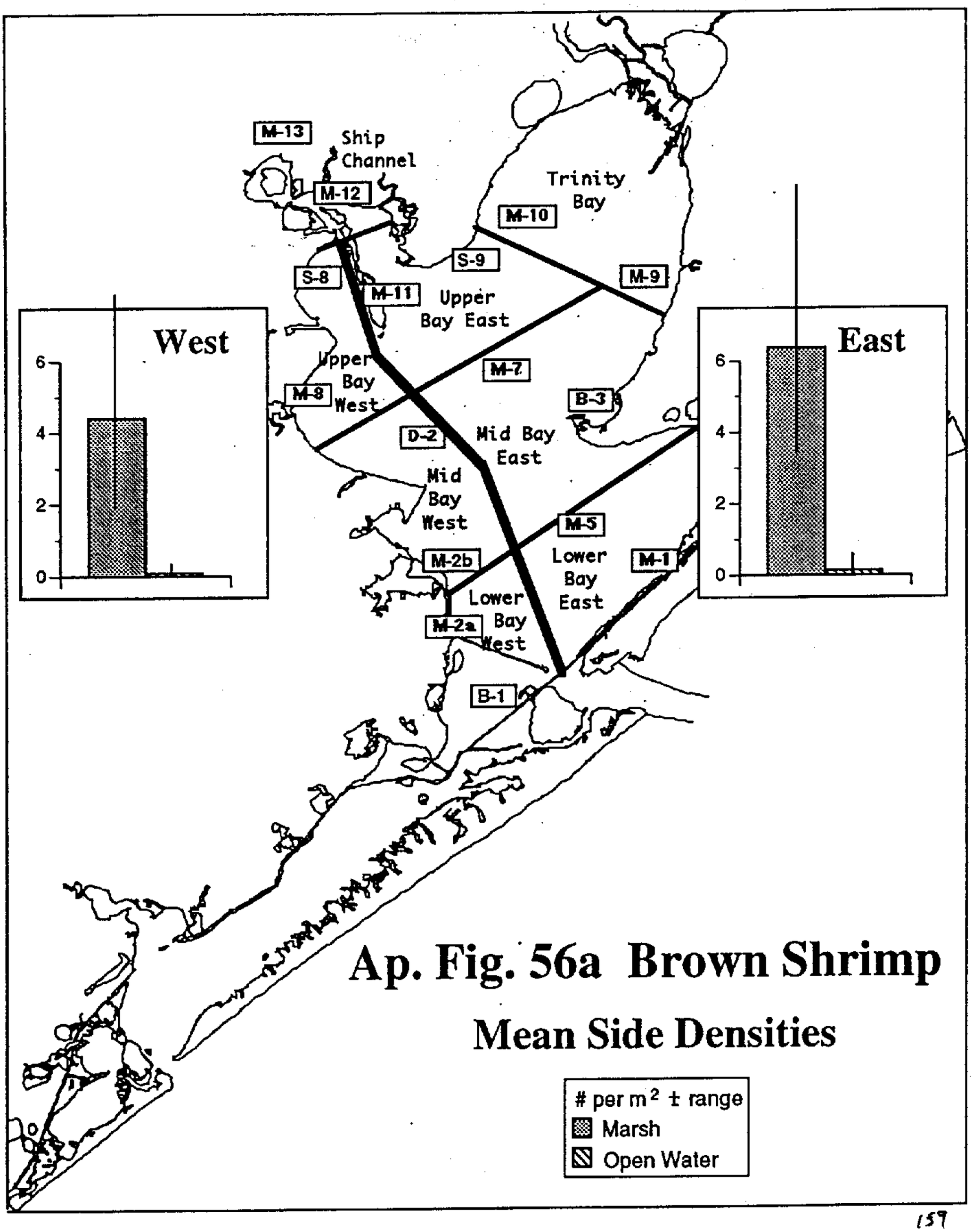
Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

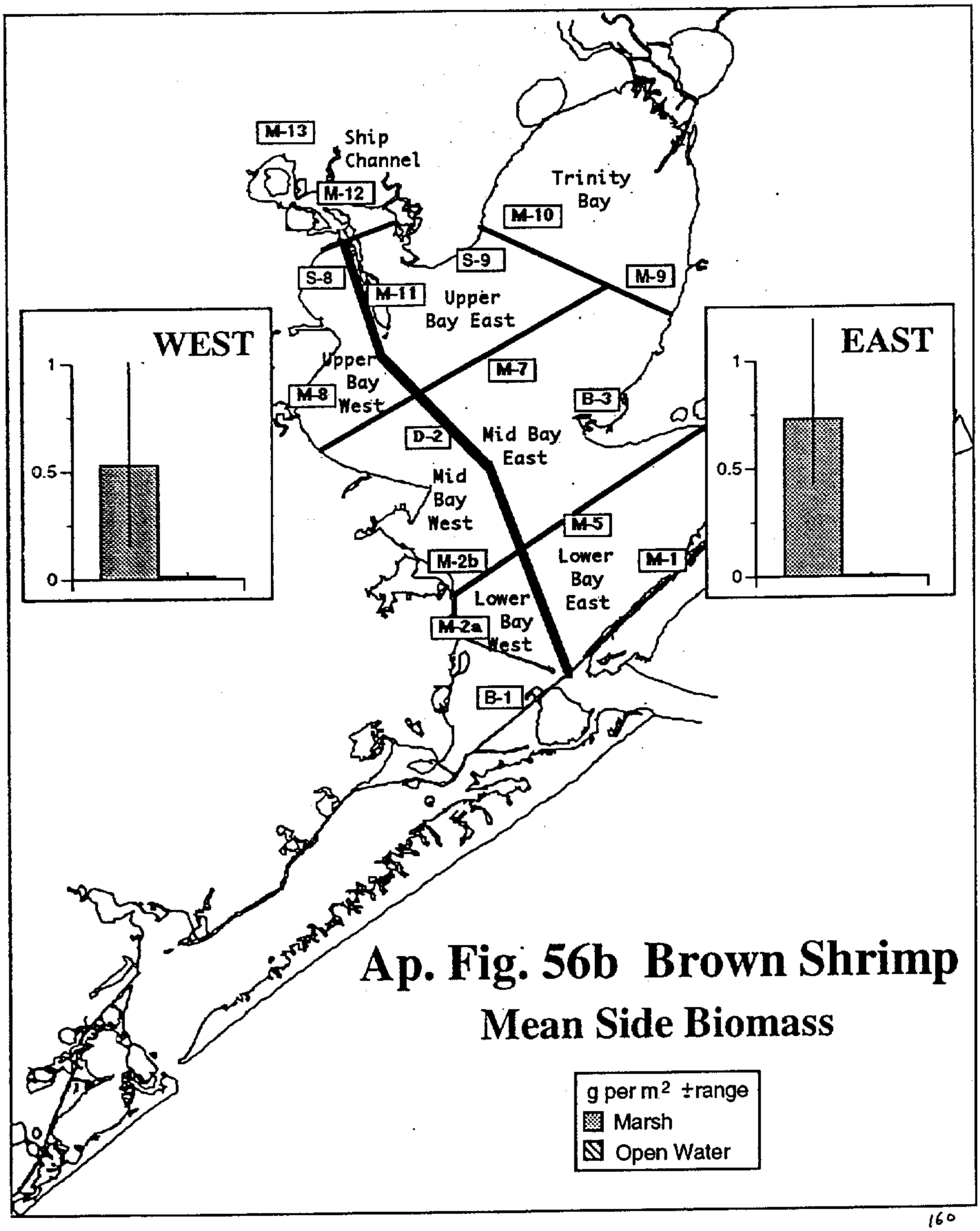
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

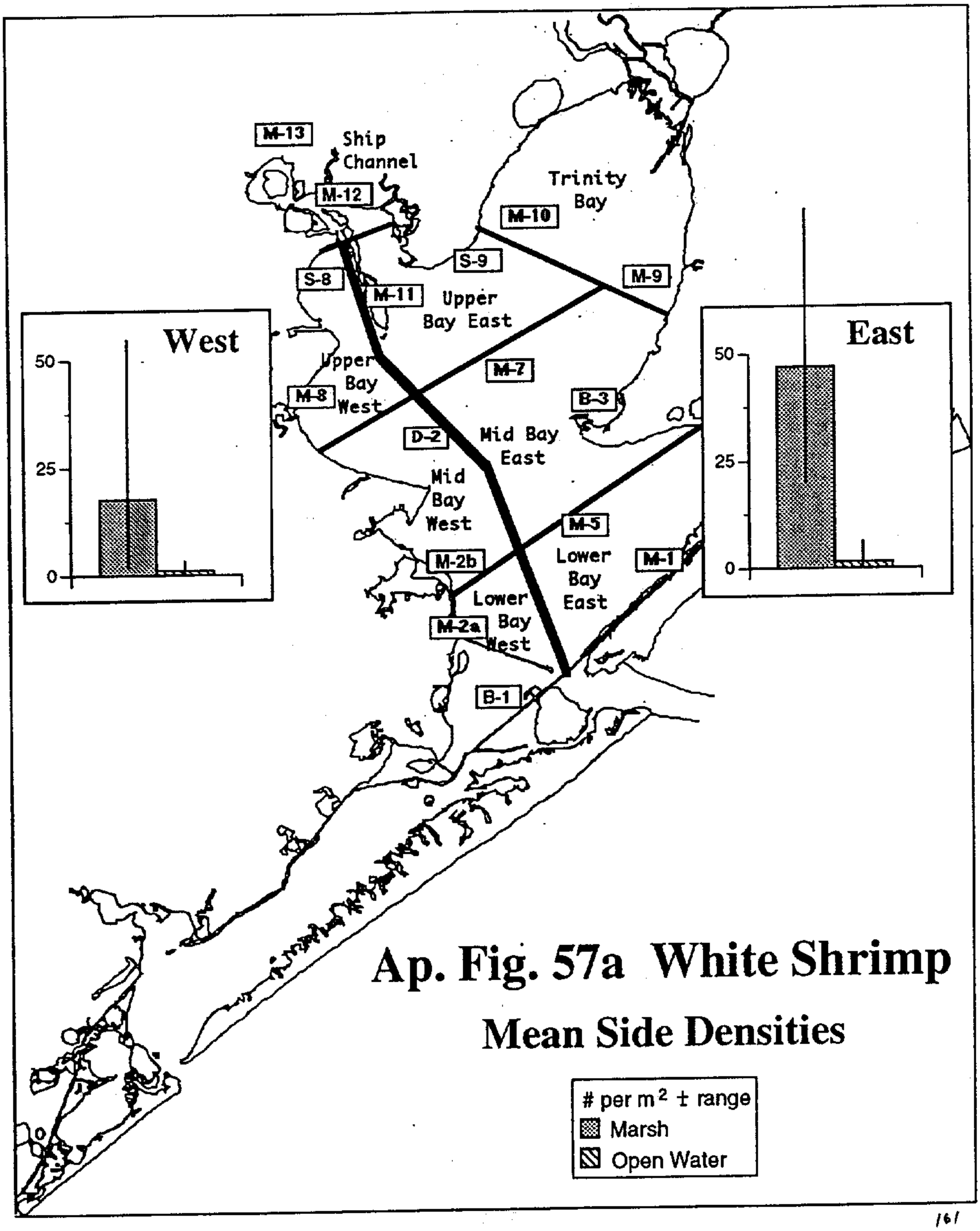
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

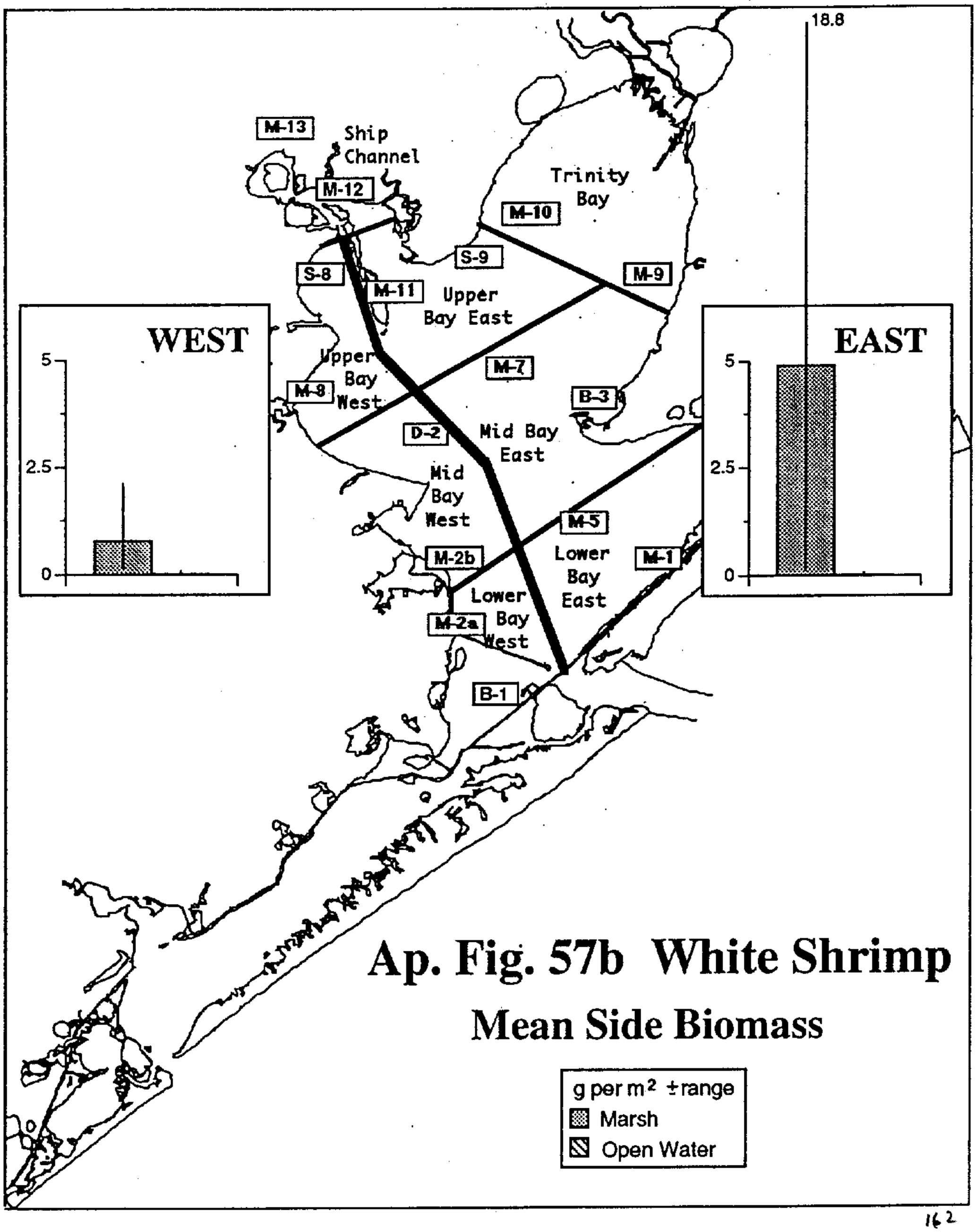
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

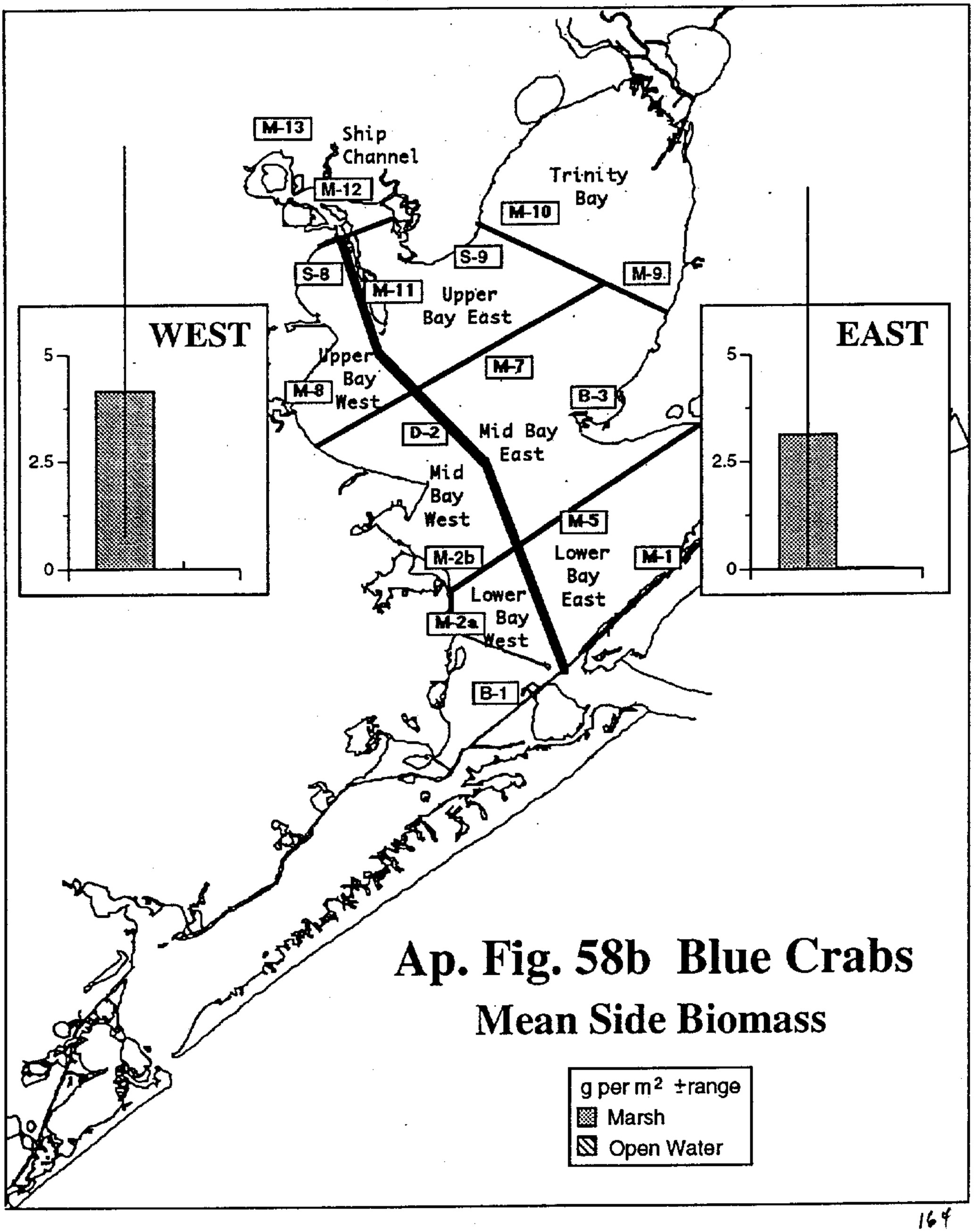
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

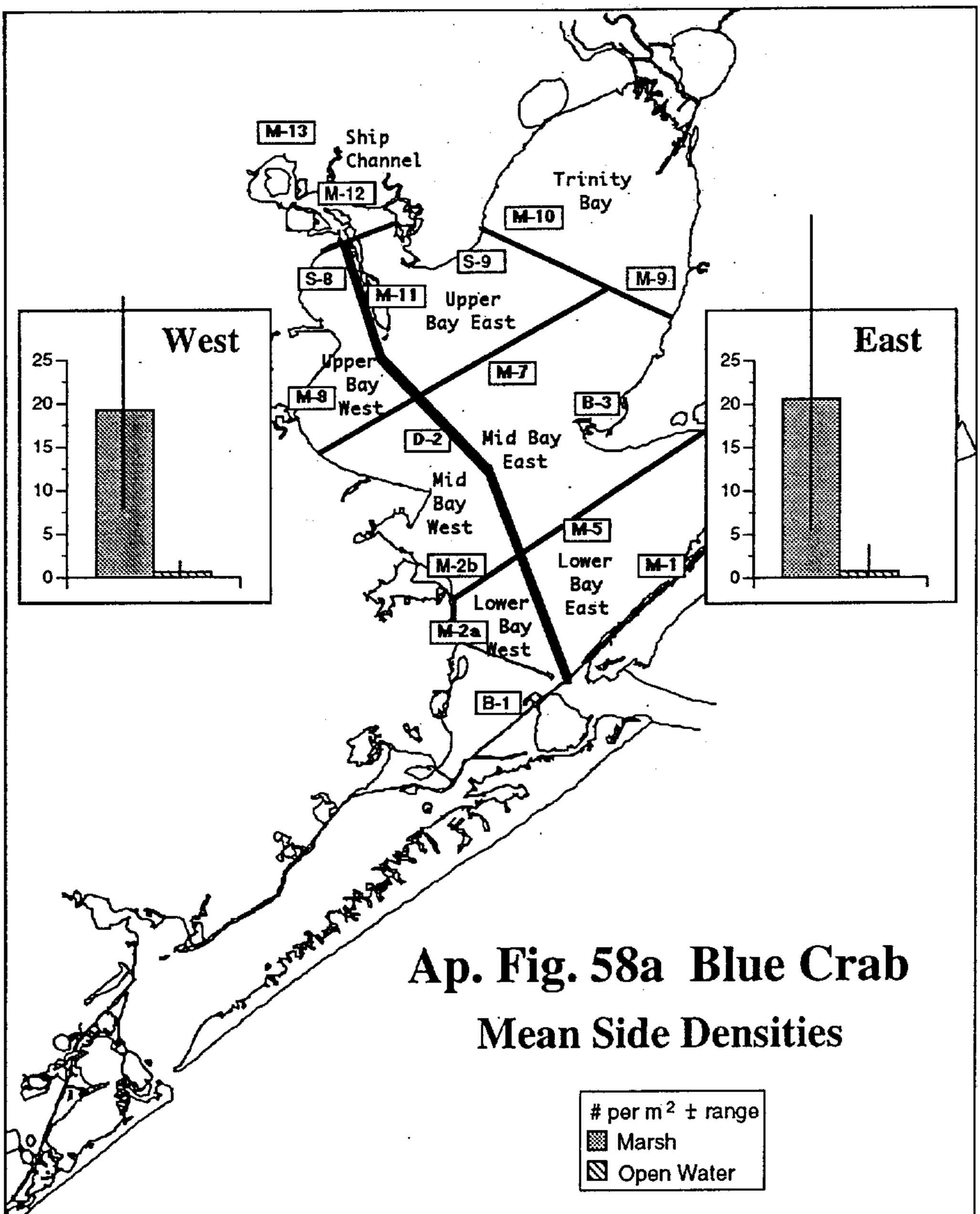
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



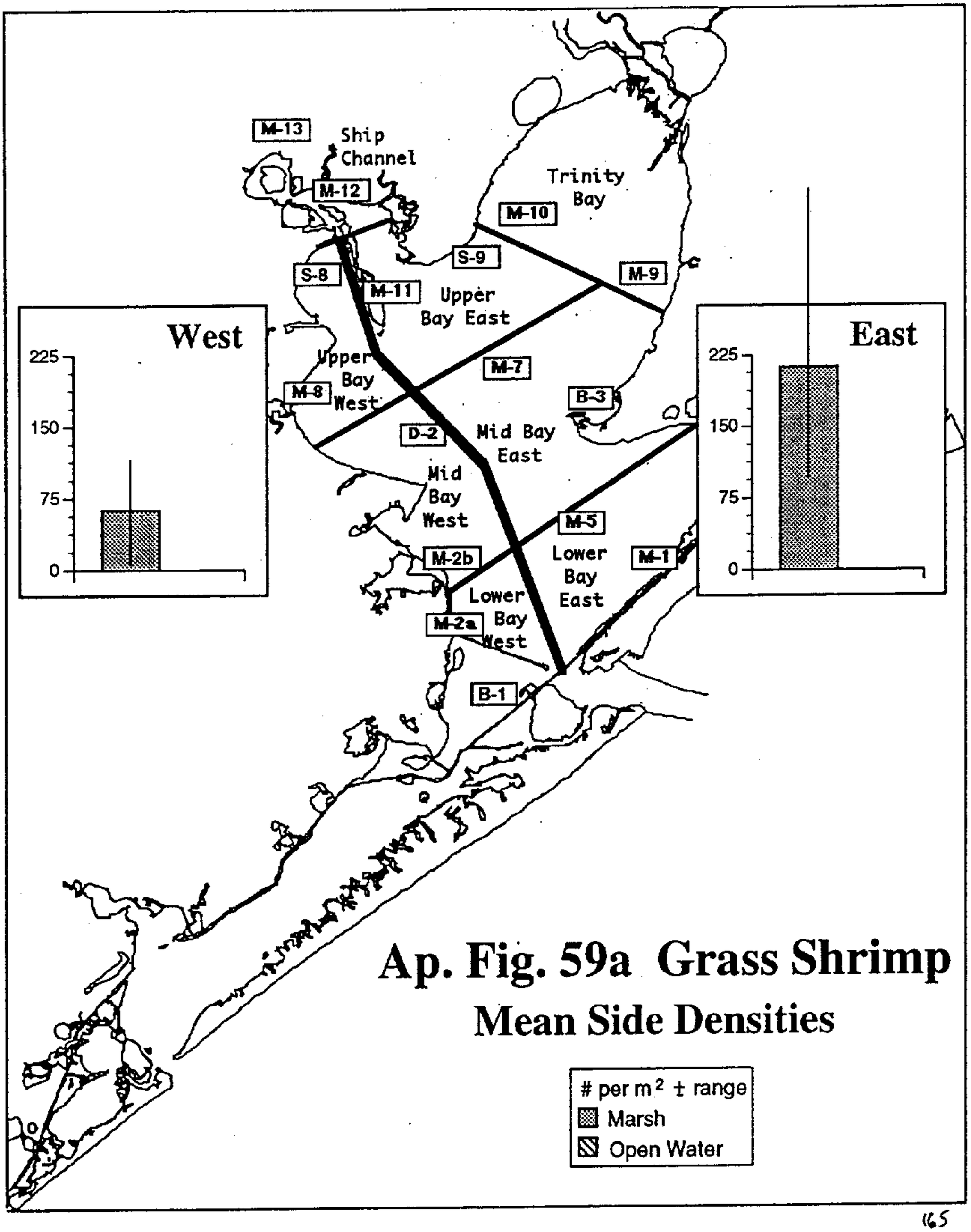
Ap. Fig. 58a Blue Crab

Mean Side Densities

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Ap. Fig. 59a Grass Shrimp

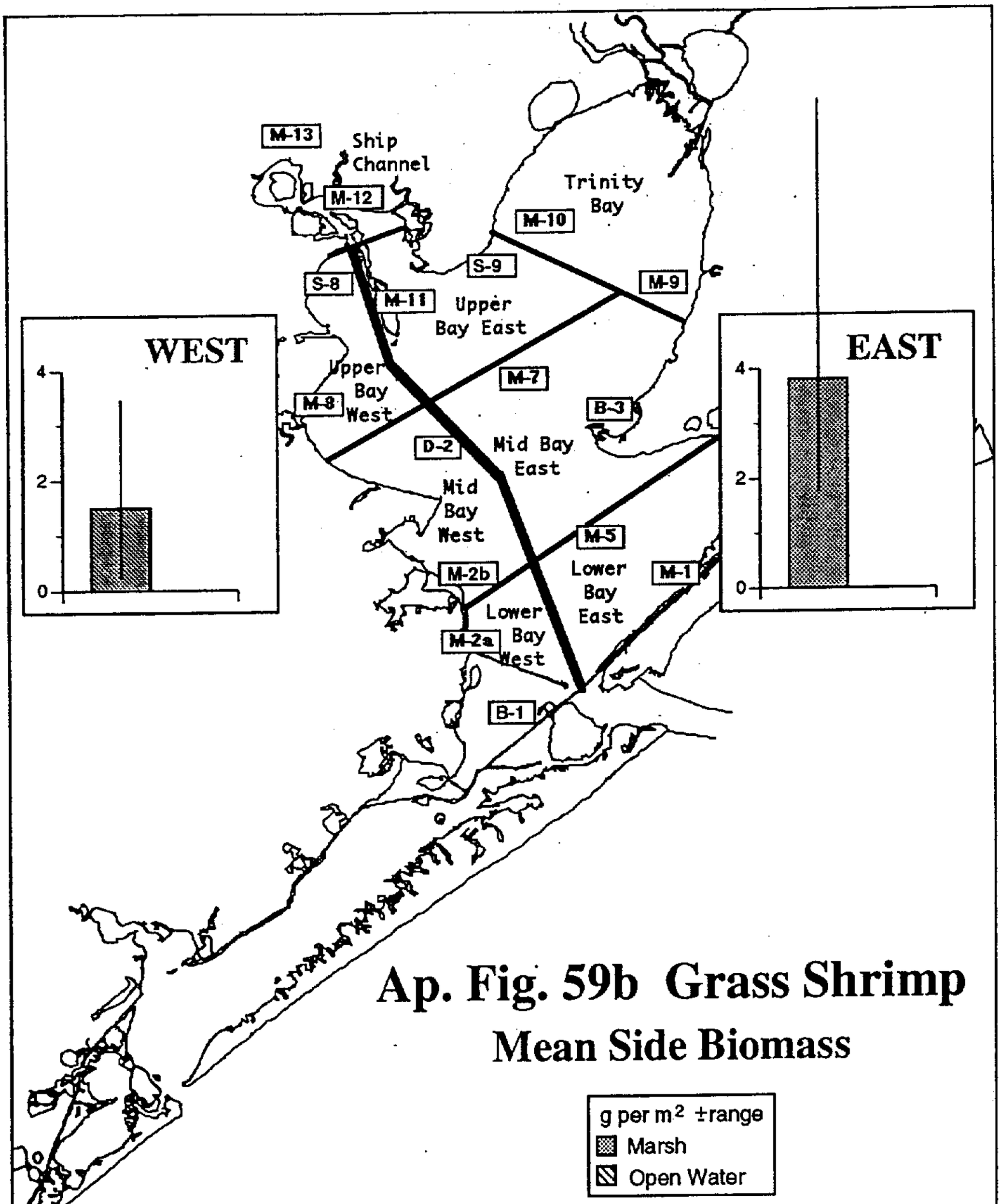
Mean Side Densities

per m² ± range
Marsh
Open Water

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

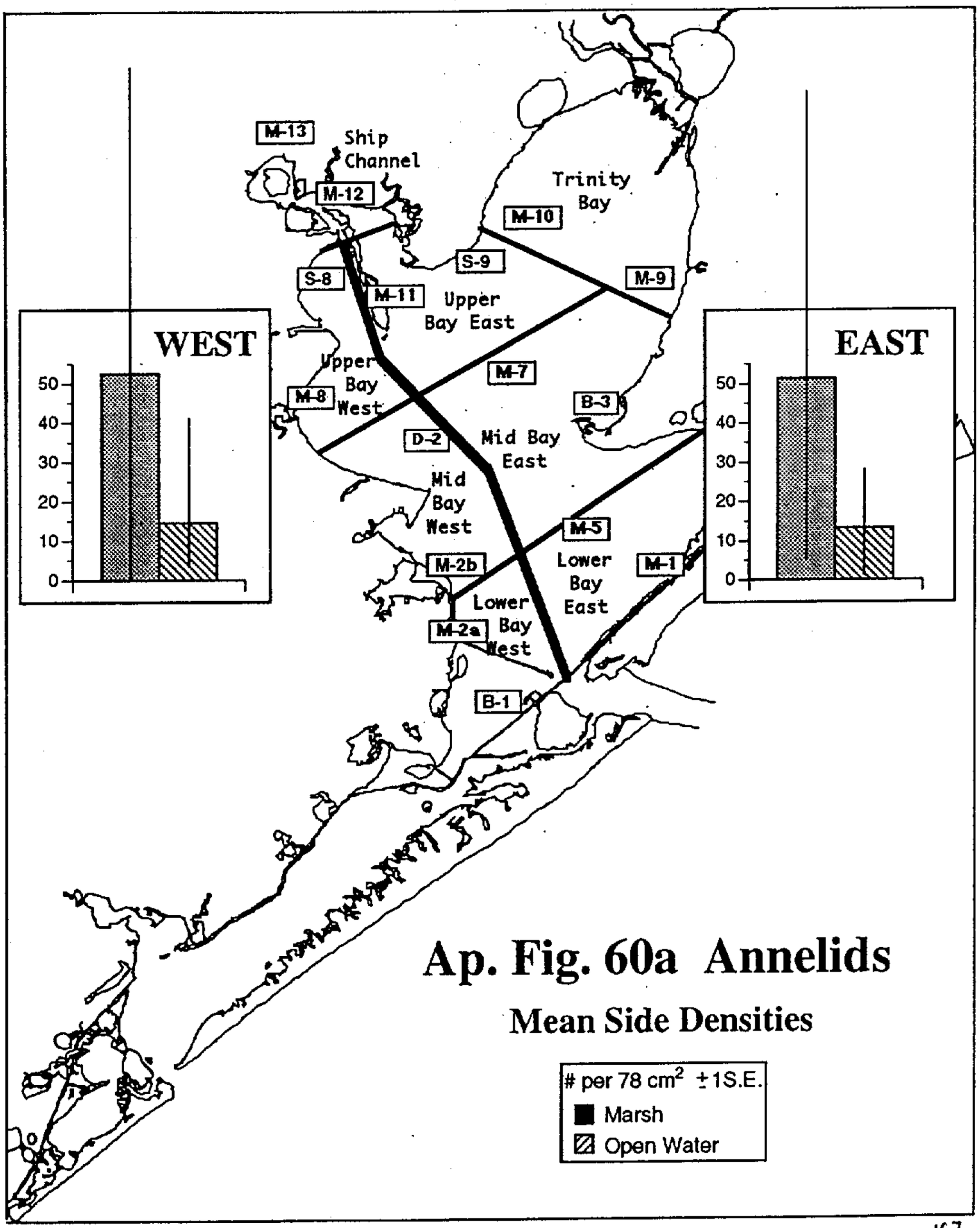
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

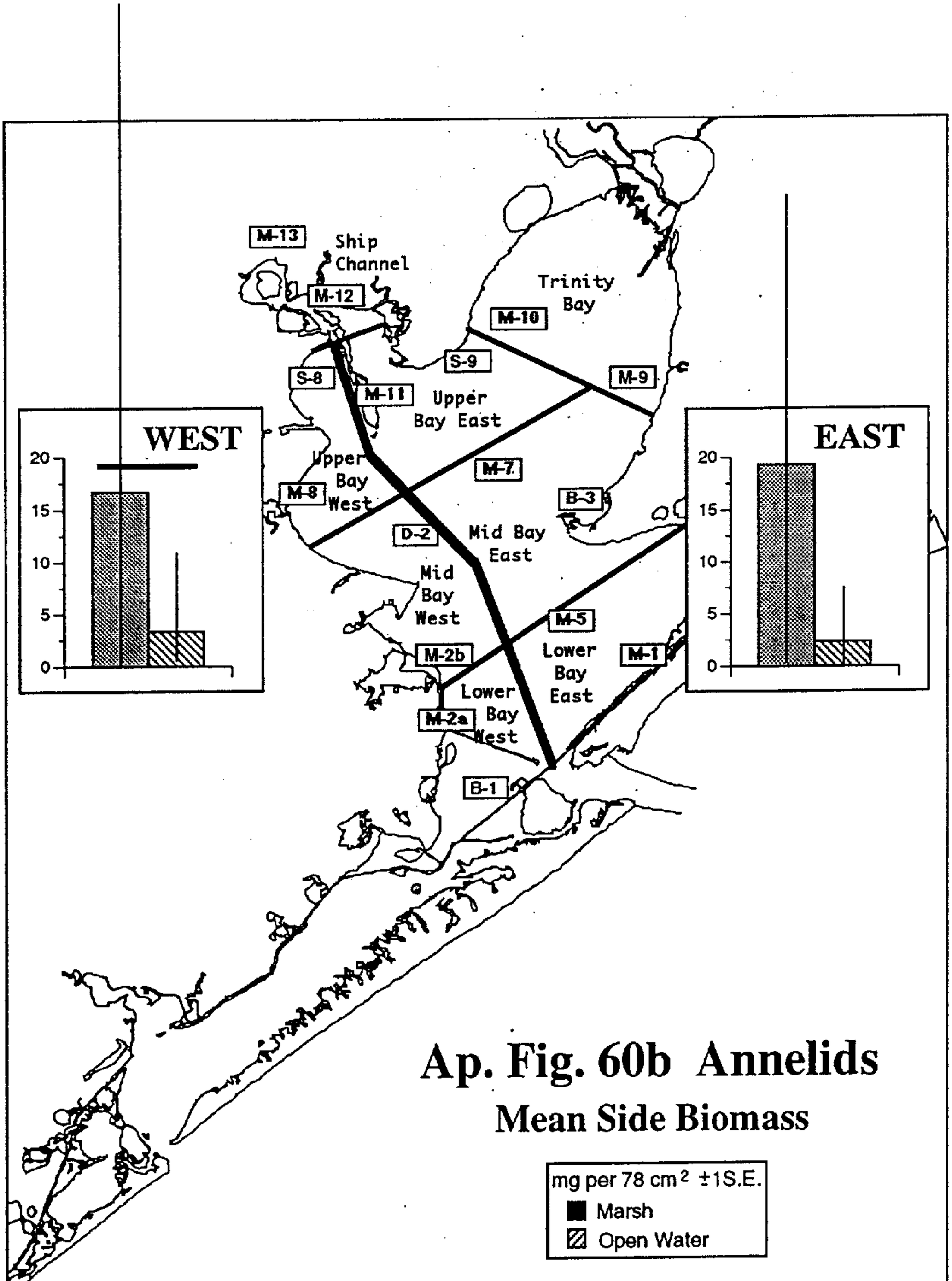
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

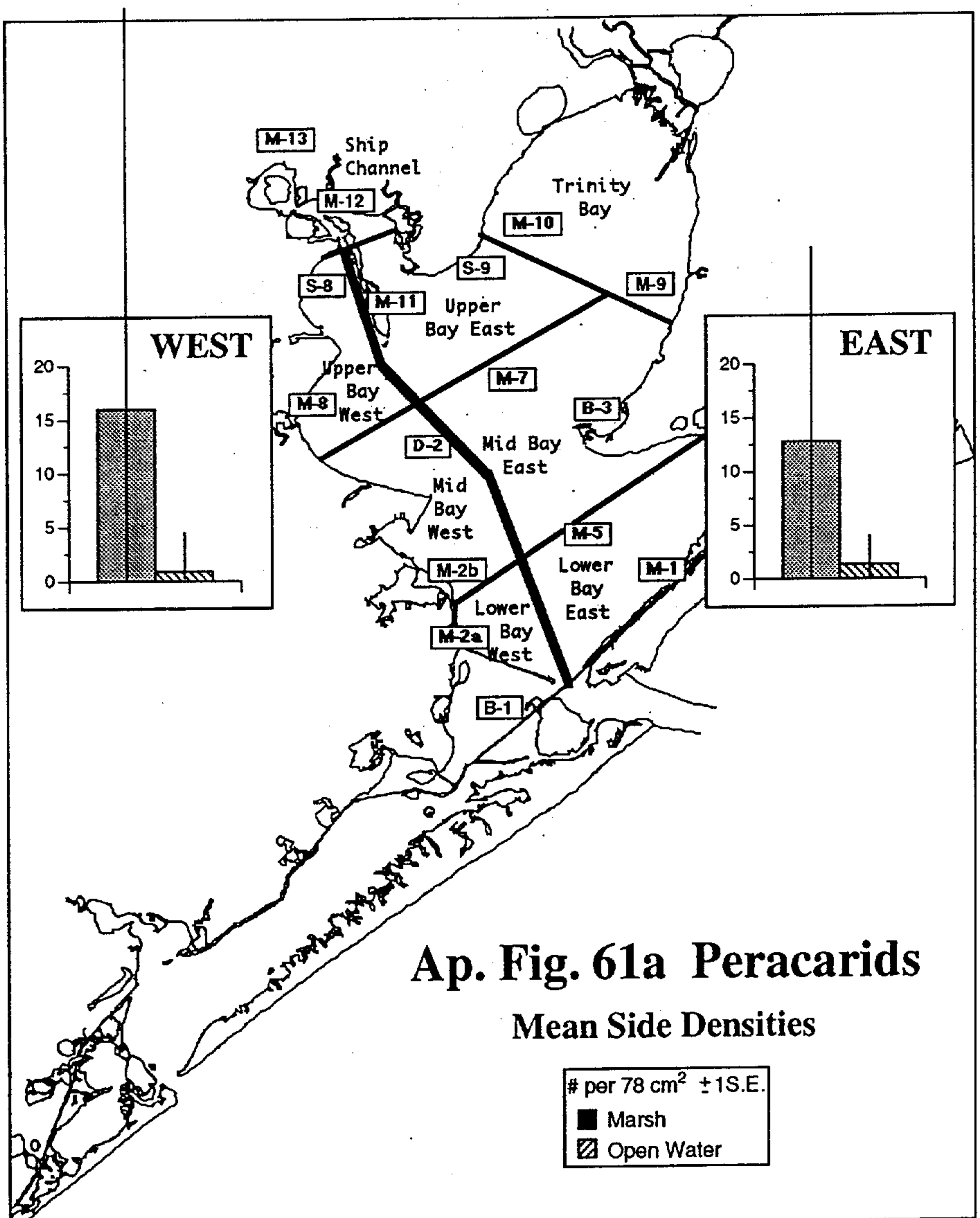
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

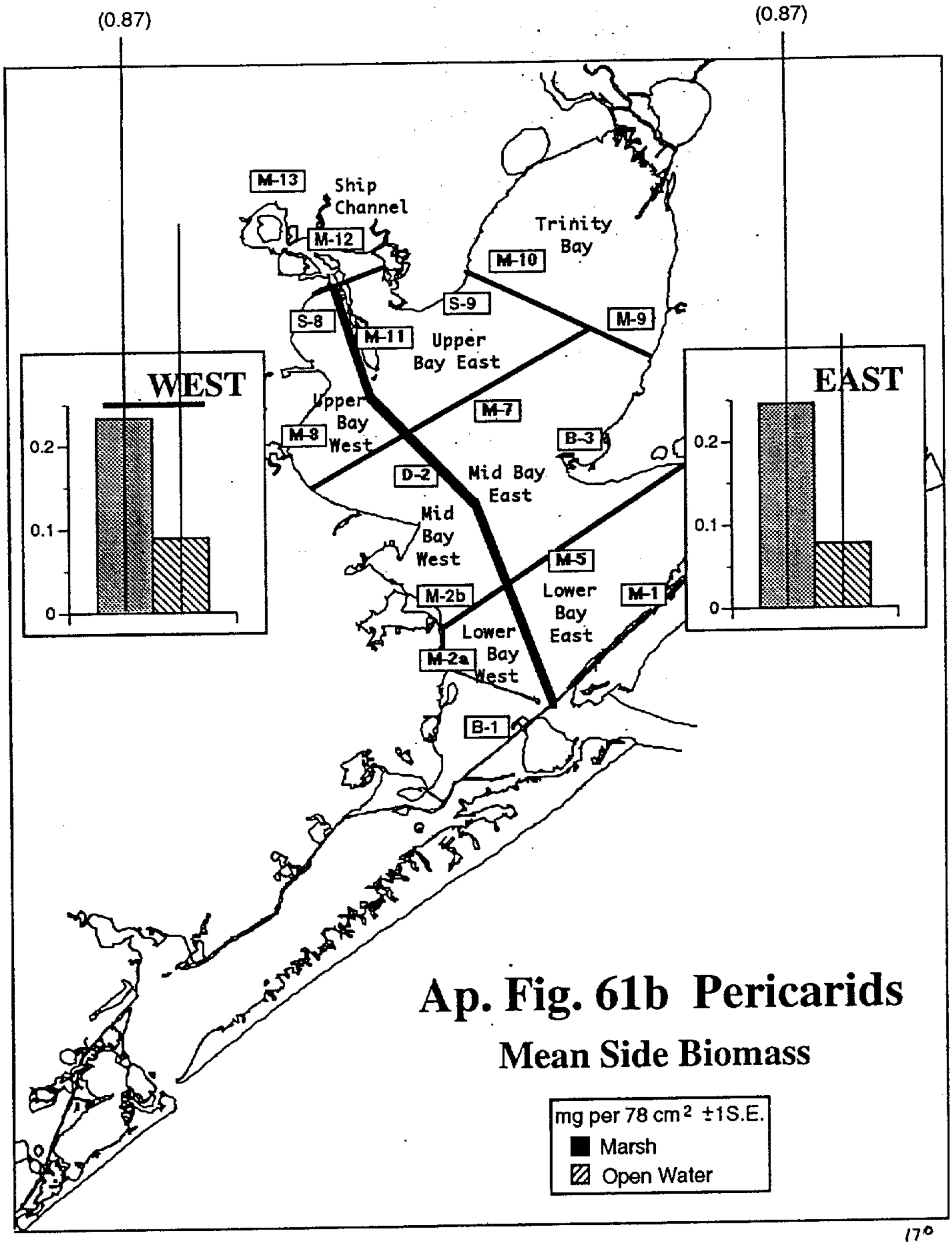
(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)



Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

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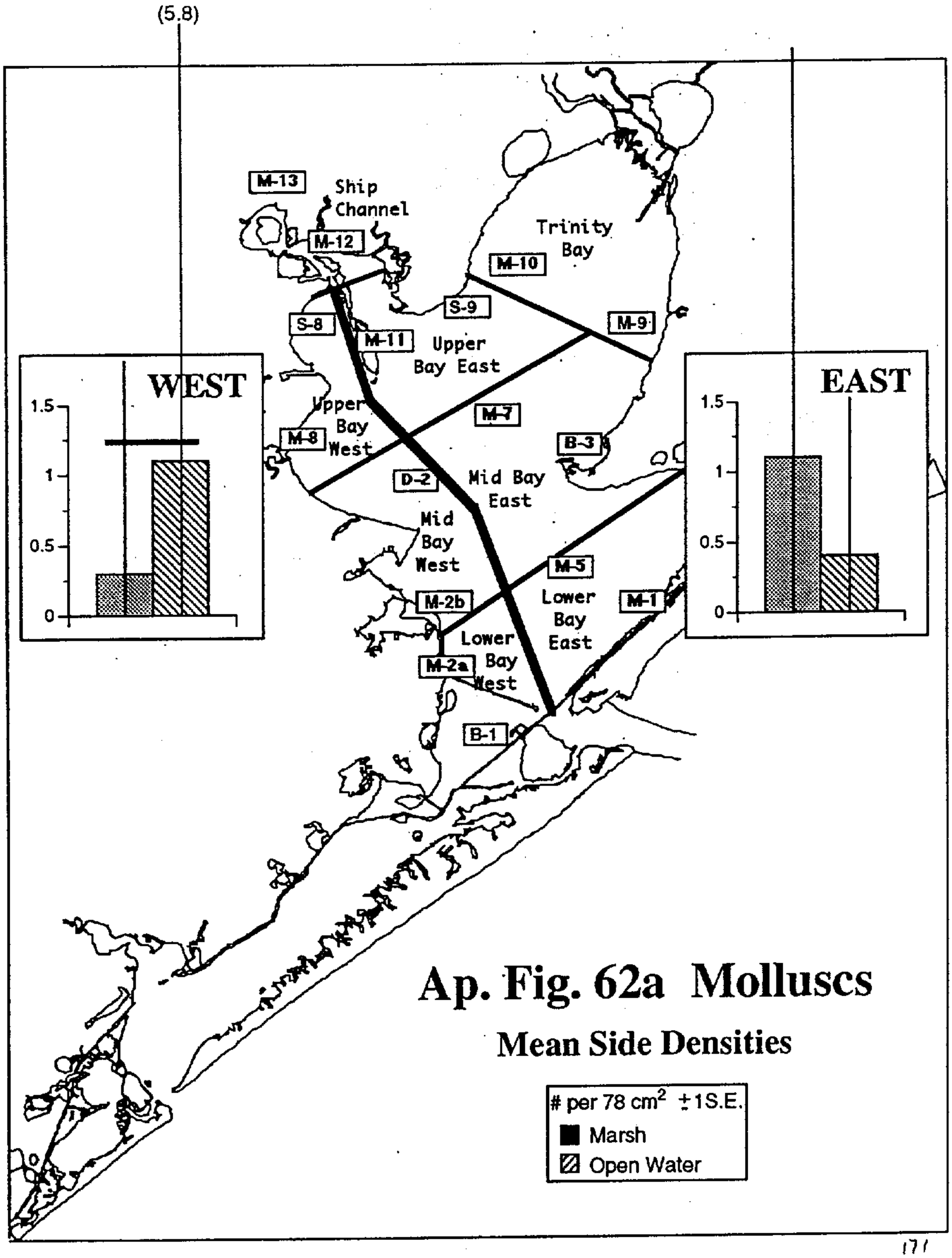

Ap. Fig. 62a Molluscs

Mean Side Densities

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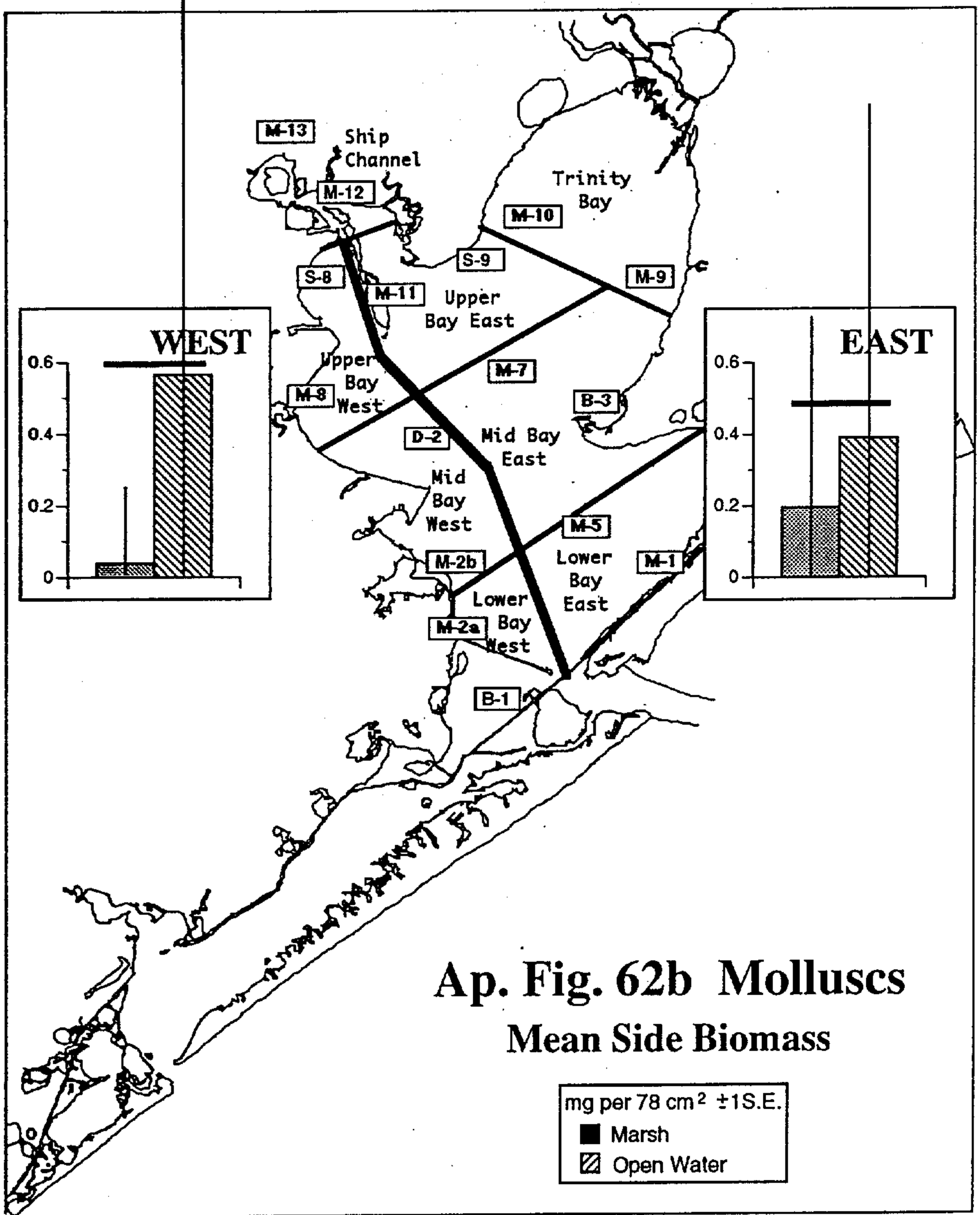
Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)

(2.6)



Ap. Fig. 62b Molluscs

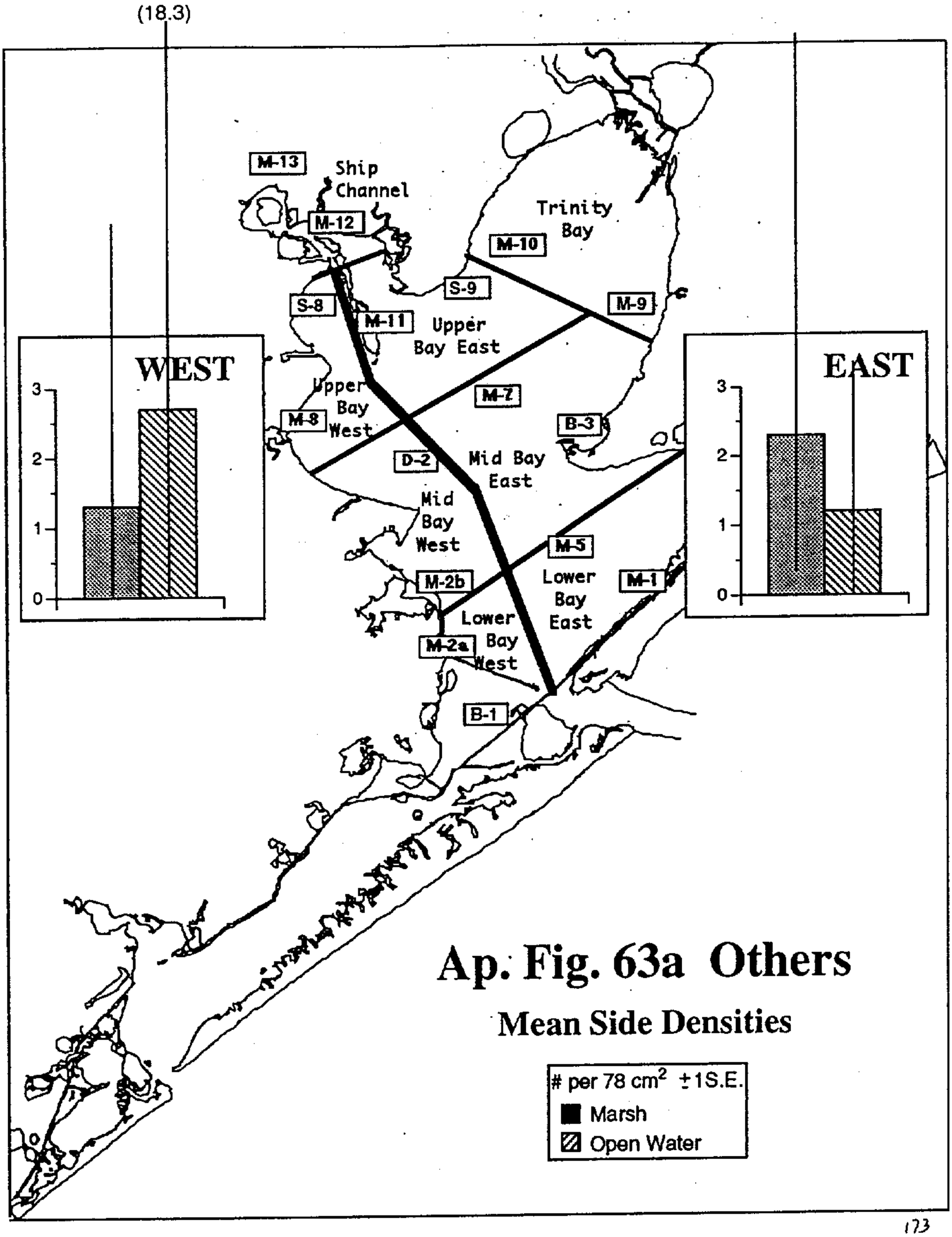
Mean Side Biomass

172

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, $P > 0.05$.)

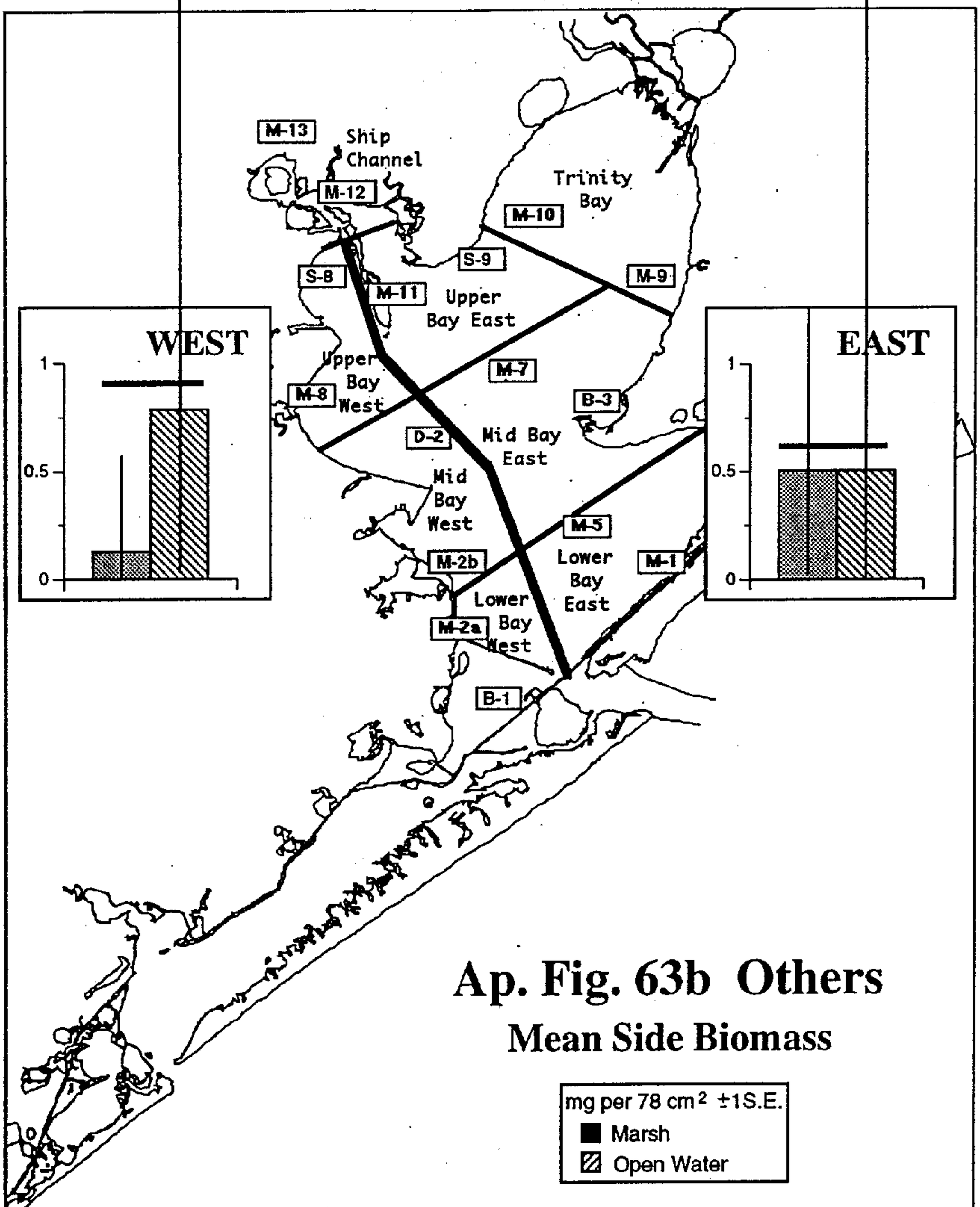


Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

(Note: The open water sites are shown on the map; corresponding marsh sites are not shown, but are located on nearest shorelines; a line above the Marsh & Open Water Bars indicates that means are not significantly different - ANOVA contrasting procedure, P > 0.05.)

(5.8)



Ap. Fig. 63b Others

Mean Side Biomass

Galveston Bay Marsh & Open Water Survey

Sept 17 to Oct 8, 1991

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