PSBS #838

LE MERIDIEN EELGRASS MITIGATION PROJECT COMPARATIVE RESULTS OF THE 24-MONTH POST-PLANTING MONITORING PROGRAM (ACOE PERMIT #86-074-BB, 87-079-RH AND 88-220-LS)

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9 December 1992

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SUMMARY

The Le Meridien Eelgrass Mitigation site consists of an approximately 7000 square feet submerged sand plateau retained in an area bayward of existing eelgrass beds by a 200-foot long rock rip-rap dike. The site was designed and constructed to off-set the losses of eelgrass associated with the placement of docks and storm drains at the Le Meridien Hotel and the Old Ferry Landing developments. A total mitigation area of 3,400 square feet of eelgrass was required to be created at the mitigation site to off-set these impacts. An additional 1,371 square feet of eelgrass is required to replace impacts to sparse eelgrass beds which were covered by sand placement within the mitigation area to achieve a functional transplant site. In total, the mitigation area is required to achieve stable eelgrass beds of at least 4,771 square feet within a 5-year period with an additional two years of monitoring to ensure persistence of the beds.

The construction of the mitigation area was completed in mid and late April 1990. The site planting followed in early May following a brief stabilizing period during which the site was allowed to settle and the ambient waves and currents recontoured the site to create a smoother planting area.

On 21 May 1990, the initial site monitoring survey was conducted and it was determined that 6,730 square feet of mitigation area had been created and planted. Portions of this area were considered tenuous as to their survival due to steep slopes and extreme depths near the edges of the site. The site was again reviewed on 12 September to conduct the 3-month monitoring. During the 3-month monitoring, the site was found to support 6,593 square feet of planted area. During the 6-month monitoring total square footage of the bed was not determined due to the sparsity of exposed shoots associated with a winter dormancy. This is an atypical condition in the area and appears to have been brought on by extremely cold water temperatures. Examination of rhizomes indicated that the planted area was similar in size to that observed during the 3-month survey. Eelgrass losses between the initial monitoring period and the 3-month period had occurred at a few scattered locations within the bed. Primarily along the deeper fringes of the mitigation site to the south and along the rock dike to the east, however,these losses are not considered to be substantial. On 9 October 1991, the site was examined and found to support 6,160 square feet of eelgrass habitat by 4 November 1992, the bed had increased back to the original area created in May 1990 of 6,730 square feet This reflects a 0% reduction in area from the original planting area and exceeds the required mitigation area by 29%.

Mean shoot densities increased from 41.6 shoots/m^2 to 51.3 shoots/m^2 over the course of the 113 days between the first and second monitoring intervals. Mean shoot densities decreased to 28.4 shoots/m^2 between the 3-month and the 6-month monitoring periods.

Through the summer of 1991, eelgrass regrowth was substantial and shoot densities achieved a 357.5 shoots/m^2, up almost 700% from the 3-month densities and over 1,250% greater than the shoot densities at 6 months. By November of 1992, shoot densities had reached 397.7 shoots/m^2. This increase of 10% since the twelve month survey and an 856% overall shoot increase since May 1990 indicates that current indications are good that the site will continue to achieve the specified success requirements.

Of noteworthy significance is the rapid and extensive development of a hard bottom community on the rip-rap retaining dike. Over the course of the construction, planting, and monitoring, there has been a rapid colonization of the rock by numerous species of fishes and invertebrates. A substantial shift in the habitat has occurred between the 3-month and 6-month monitoring. The recruitment of the brown macroalga, *Sargassum muticum*, to this reef-like habitat has added to the complexity of the site. *Sargassum* is seasonally dominant on the rocks during the fall and winter months. Fish diversity and numbers declined during the winter months, following an established seasonal trend. Recent surveys suggest a notably higher summer season diversity.

This report provides a brief description of the site development and planting program. This report also details the results of the 24-month monitoring program conducted on the Le Meridien eelgrass mitigation site. In addition, the report provides a summary of the development and status of the ecology of the transplanted eelgrass bed and rock retaining structure.

BACKGROUND SITE DESIGN, CONSTRUCTION AND PLANTING

The Le Meridien eelgrass mitigation site is located in western San Diego Bay just off-shore of the Le Meridien Hotel, Coronado, California (Figure 1). The mitigation site was designed to expand an existing eelgrass bed bayward through a shallowing of a narrow fringe of the bay bottom along the deeper dredged portions of the central bay.

In order to accomplish this task, a rock rip-rap dike was to be constructed at the deeper fringe of the mitigation site. Sand was then to be backfilled between the dike and the existing eelgrass beds to create a flat plateau at -4.5 feet MLLW (Figure 2). Following the creation of the site, the area was to be planted using bareroot planting units on biodegradable anchors.

Site construction and planting generally followed the eelgrass mitigation plan prepared for the site (Pacific Southwest Biological Services 1990). However, due to a natural expansions of the inshore eelgrass beds into the identified transplant area, modifications to the mitigation site location were required to ensure protection of the natural bed and suitable creation of new eelgrass areas. The mitigation site was forced bayward into deeper water thus requiring substantially more rock and backfill sand than was previously anticipated. Further, due to the substantially deeper natural beds which the site was required

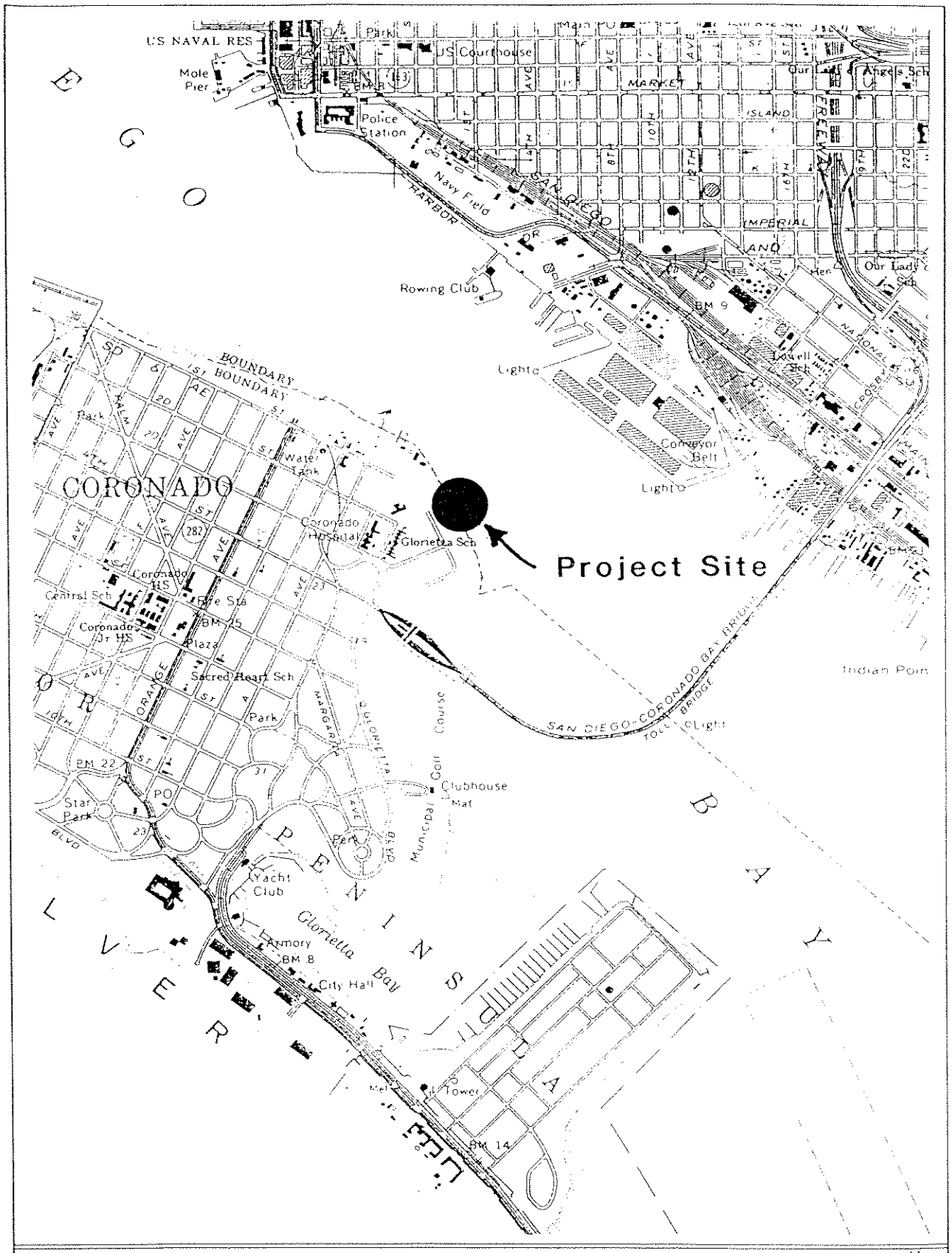

FIGURE 1. MITIGATION AREA VICINITY MAP
USGS 7.5' Point Loma Quadrangle

N

1" = 2000'

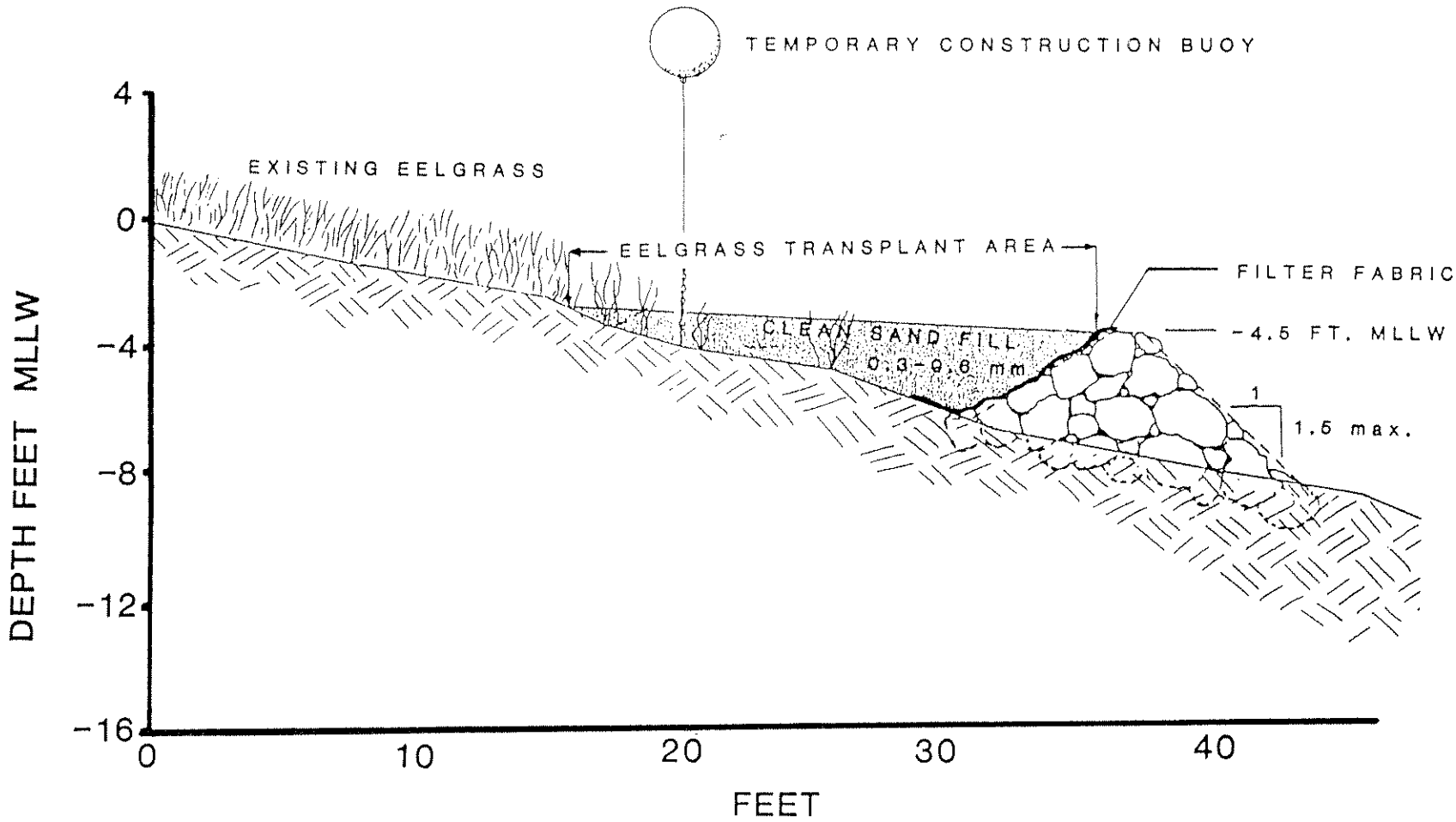

FIGURE 2. TYPICAL MITIGATION AREA DESIGN CROSS-SECTION

to merge with and inordinate additional construction costs it became infeasible to achieve a design plateau at -4.5 feet MLLW. For this reason, the site was designed to slope from -6.5 feet MLLW out to a depth of -7.0 feet MLLW at the retaining dike. The deeper planting depth increased the risk of failure due to changing water quality and reduced light penetrance. For this reason, the monitoring period was increased from 3 years to 5 years at the request of the resource agencies.

Site construction, including the staking of the site, placement of the rock retaining dike and backfilling the site with fine to medium grained river sand occurred between 12 April and 23 April 1990. Of the backfill sand, 64% of the material ranged between 0.1mm-0.4mm. A post placement settling period was allowed between the construction and planting phases of the project. During this period, sediment stakes were placed in numerous locations to determine if the site was stable enough for planting. When it was deemed that the site had reached a point of stability suitable for planting, the site was planted with eelgrass salvaged from the adjacent bed. Planting was completed on 4 May 1990. A total of 2880 planting units were placed on the site with inter-unit distances of 1.6 feet (0.5m). Additional units were placed in areas where erosion potential was considered to be greatest.

Monitoring requirements for the site include reviews at 0, 3, 6, 12, 24, 36, 48, and 60 month post-planting intervals. With combined impacts of the projects being mitigated at the site as well as the impacts of the mitigation program itself, the site is required to achieve a net stable eelgrass coverage of no less than 4771 square feet.

MONITORING METHODOLOGY

EELGRASS SURVEYS

The 24-month eelgrass survey was conducted by Keith W. Merkel and Robert S. Hoffman on 4 November 1992. Surveys employed the use of fixed transects spanning the width of the eelgrass bed. Parallel transects were spaced 10 feet apart and ran the length of the eelgrass transplant area. In total, 20 transects occur over the mitigation site. As a result of the lack of any open gaps within the transplant area, transect surveys along the fixed interval transects were not completed during the current survey effort. The total available habitat area has been previously determined and staked in the field.

To determine the shoot densities within the transplant site, a program of random quadrat sampling was employed. Multiple quadrats of 1/16th meter were randomly distributed over the site and shoots falling within each quadrat were counted. Means and standard errors for shoot counts were calculated for each sample interval.

DEVELOPMENT OF HABITATS

Over the course of the pre-construction, construction, planting, monitoring, and incidental inspections of the Le Meridien mitigation site, the project biologists have had an opportunity to observe the development of the mitigation area and have witnessed marked changes in the resources of the area. These changes are being monitored both systematically, on a quarterly basis (Hoffman and Merkel, unpublished data), and in a more general way. While the information collected is still in a rough form, it is interesting to note the gross changes observed. For this reason, incidental information on the community development trends observed have been incorporated into this report.

SURVEY RESULTS

The data collected during the field surveys was used to calculate the coverage of the eelgrass bed as required in the ultimate evaluation of success or failure of the site and to evaluate the growth and vigor of the transplanted eelgrass.

DISTRIBUTION AND COVER OF EELGRASS

The distribution and cover of the eelgrass shoots was not monitored during the 6-month survey due to the sparseness of exposed shoots which was attributed to seasonal conditions. Again due to the sparseness of exposed shoots current zones of eelgrass distribution were not mapped. However, examination of the substrate for eelgrass rhizomes revealed a similar configuration as that determined during the 3-month survey. During the 12-month survey, eelgrass distribution was found to generally follow the original planting area. As of the 24-month survey (Figure 3), distribution and cover of eelgrass is extending completely over the site. This area is similar in appearance to May 1990.

EELGRASS SHOOT DENSITY

Shoot densities were calculated to be 41.6 $\pm$ 3.7 shoots/m^2 (n=20) for the initial monitoring, 51.3 $\pm$ 2.2 shoots/m^2 (n=29) for the 3-month monitoring, 28.4 $\pm$ 22.3 shoots/m^2 (n=30) for the 6-month

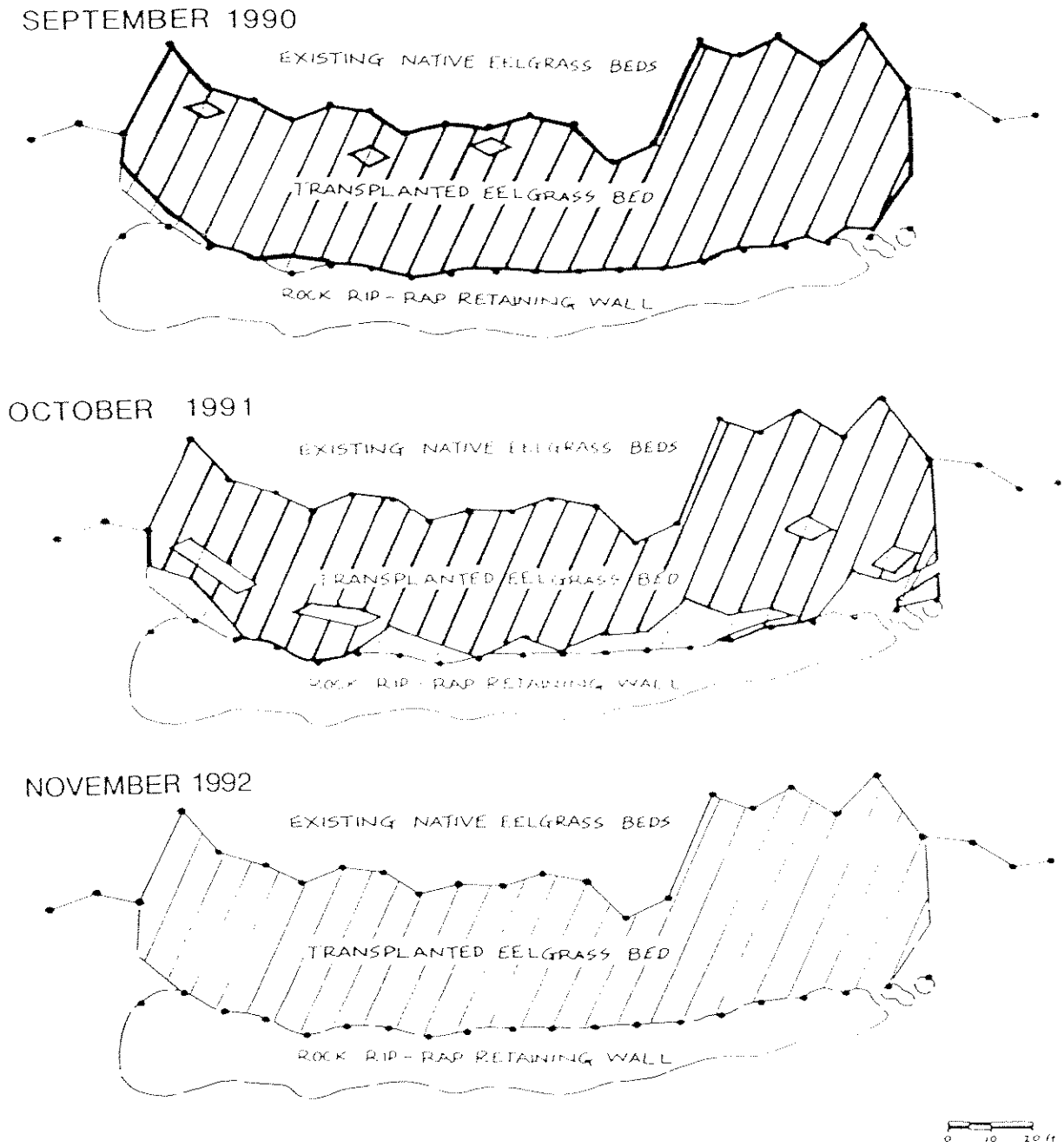

FIGURE 3. DISTRIBUTION OF EELGRASS WITHIN LE MERIDIEN MITIGATION AREA

monitoring, and 357.5 ± 9.7 shoots/m^2 (n=26) for the 12-month monitoring, and 397.7 ± 9.6 (n=21) during the current survey (Figure 4). The tremendous increase in shoot density during the previous survey period is more typical of other revegetation projects than were the slow increases observed through the first year. However, densities have not yet achieved those of adjacent native beds.

HABITAT DEVELOPMENT

Prior to the construction of the mitigation site, the area was comprised of a mud bottom supporting scattered eelgrass plants with long blades typical of deep water eelgrass. The bottom supported a general paucity of epibenthic macrofauna. Gobies (Gobiidae), Round Stingrays (*Urolophus halleri*), and the California Bubble Snail (*Bulla gouldiana*) were the most common organisms. Less common were the occasional sand bass (*Paralabrax* spp.), Diamond Turbot (*Hypsopsetta guttulata*), and California Halibut (*Paralichthys californicus*).

Within hours of the placement of the first rocks, the site had attracted several Barred Sand Bass (*Paralabrax nebulifer*) and Spotted Sand Bass (*Paralabrax maculatofasciatus*). Within three days of placing the first rocks, a Spiny Lobster (*Panuliris interruptus*) was observed in the rocks. Over the next several days, the site continued to accumulate fishes and invertebrates and on day seven, the first Kelp Bass (*Paralabrax clathratus*) and Opaleye (*Girella nigricans*) were observed on the rock dike. Octopus (*Octopus bimaculoides*) and lobster continued to move into the rocks at a fairly steady rate.

When the sand was placed over the mud bottom and against the rock rip-rap, an inordinate amount of demersal fish activity was observed on the new sands. There was a notable increase in both halibut and turbot numbers on the sandy sediments. Stingrays were less common on the sands than in the adjacent mud. Gobies colonized the sands within a matter of days. There was an initial multi-fold increase in the local *Bulla* population followed by a large increase in the population of predatory covered-lip nassa (*Nassarius tegula*) and a crash in the *Bulla* populations on the transplant area. Following planting, the site was observed to support a sparse array of eelgrass associated fauna as well as additional stingrays and sand bass.

During the course of planting and initial monitoring of the transplant site, the retaining structure had developed a remarkable assemblage of fish and invertebrates. An extremely large adult and two or more juvenile Specklefin Midshipman (*Porichthys myriaster*) had moved into a hole at the base of the rock. Black Surfperch (*Embiotica jacksoni*) and White Croaker (*Genyonemus lineatus*) were found to

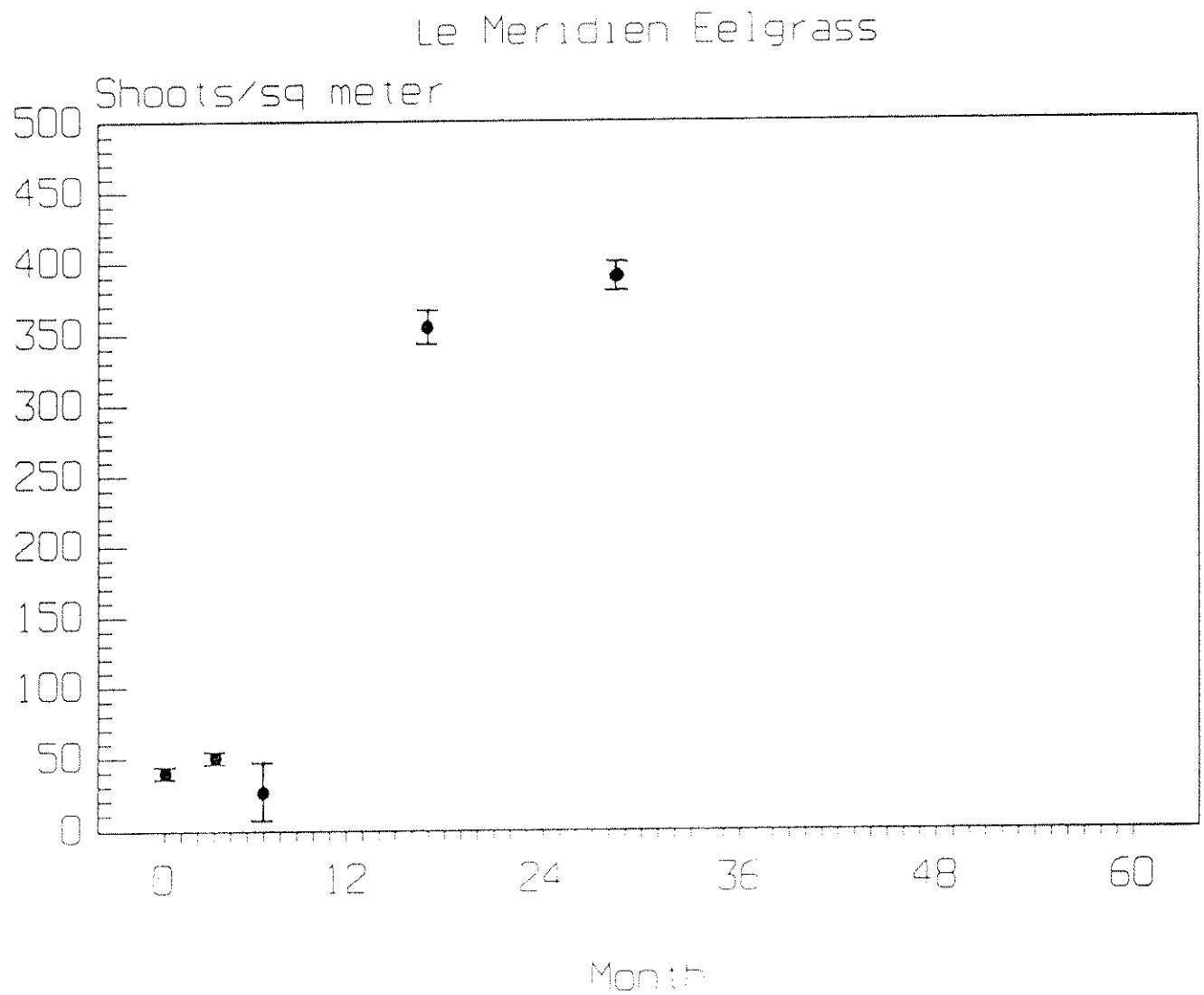

FIGURE 4. MEAN SHOOT DENSITY AND STANDARD ERRORS FOR THE EELGRASS TRANSPLANT AREA

occur on the rocks near the top of the structure. Kelp Bass, Spotted Sand Bass and Barred Sand Bass were extremely abundant on the rocks with 200-300 individuals being represented during the 3-month survey. Lobster on the structure numbered in excess of 40-50 individuals. Opaleye populations were fairly high and the encrusting invertebrate communities typically associated with such areas had begun to emerge fairly early. During the 3-month survey small patches of *Sargassum muticum* were observed growing along the inshore edge of the retaining wall and numerous tiny plants were located along the top of the rock structures. By the 6-month survey the Sargassum had grown to approximately 1 to 1.5 meter in height and had spread along the entire edge of the retaining wall. As was expected the site's development slowed during the winter months and fish numbers and diversity dropped radically.

During summer 1991 and the current surveys of the site, bass populations were back up from the winter conditions. Other species which appeared during the warmer periods include California Scorpionfish (*Scorpaena guttata*), Black Surfperch, and Opaleye.

Patterns of habitat utilization during 1992 paralleled that observed during 1991. Notably, the fall of 1992 brought about a tremendous accumulation of calcareous skeletons of bryozoans around the base of the rock reef. Over time such accumulations are expected to gradually change the character of the sediment from a silty mud bottom to one of a gravelly sand and pebble bottom in the immediate vicinity of the reef. The ultimate effects of such changes are not known at this time.

DISCUSSION

To date the eelgrass transplant has exhibited high survival and sustained coverage. Slow initial growth ratio and patchiness was observed during the first year of growth. This is in sharp contrast to transplants within Mission Bay and on the Chula Vista Wildlife Island in South San Diego Bay which rapidly expanded in coverage and shoot density from the onset of planting, but compares favorably with transplants at Sunroad Marina and initial transplants at Delta Beach at which significant seasonal diebacks were observed prior to subsequent growth and expansion. The deep water undoubtedly plays an important role in limiting the growth rates of the plants. Recent growth patterns are suggestive of an improved site condition and eelgrass beds are expected to continue to meet mitigation requirements.

In contrast to the eelgrass beds, the rock retaining structure has surpassed all expectations in its role as an artificial reef. As previously stated, the rate of habitat colonization has been phenomenal as

has the site tenacity of certain organisms such as the Specklefin Midshipman. The development of an encrusting cryptic community is expected to further this progression towards a highly diverse ecological community.

While the retaining berm was not designed specifically to function as a habitat resource, its early success as such should be examined in more detail and results utilized to assist in designing other such resource areas. This reef structure is currently being investigated as a portion of a fisheries habitat development survey being conducted by Robert S. Hoffman and Keith W. Merkel.

The next scheduled monitoring survey is to occur in June of 1993.

LITERATURE CITED

Pacific Southwest Biological Services, Inc. 1990. Eelgrass Mitigation for the Old Ferry Landing/Le Meridien Hotel Projects (U.S. Army Corps of Engineers Permits #86-074-BB, 87-079-RH & 88-220-LS). Prepared for ADI Properties & Pacific Developments, San Diego, CA.