

**San Francisco – Oakland Bay Bridge
East Span Seismic Safety Project**

**BIOLOGICAL UTILIZATION OF EELGRASS BEDS IN
SAN FRANCISCO BAY - PILOT STUDY PLAN**

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Prepared by

A handwritten signature in black ink that reads "Keith W. Merkel". The signature is written in a cursive style with a large, prominent "K" and "M".

Keith W. Merkel
Merkel & Associates, Inc.

Reviewed by

A handwritten signature in black ink that reads "Ivy Edmonds-Hess". The signature is written in a cursive style with a large, prominent "I" and "H".

Ivy Edmonds-Hess
Parsons Brinckerhoff Quade & Douglas, Inc.

Approved by

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Mara Melandry
Caltrans District

Introduction

In order to mitigate for impacts to eelgrass habitats resulting from the San Francisco-Oakland Bay Bridge (SFOBB) East Span Seismic Safety Project (East Span Project), the California Department of Transportation (Caltrans) has committed to funding a Baywide Eelgrass Inventory and Resource Management Research Program (program). The program will provide the information necessary to manage eelgrass and other subtidal habitats throughout San Francisco Bay (Bay). Caltrans and the National Oceanic and Atmospheric Administration (NOAA) Fisheries jointly hold the management responsibility over the inventory and research program.

The first phases of the program have involved mapping the current eelgrass distribution throughout the Bay and developing a predictive model of eelgrass based on environmental parameters. As an additional part of the program, NOAA and Caltrans would like to investigate potential habitat utilization of eelgrass beds, including usage by fish and benthic invertebrate communities. The results of the pilot program will facilitate design of a more comprehensive investigation of resource utilization that would improve management of eelgrass habitat resources in the Bay by providing information on the status and ecological benefits of eelgrass within this highly dynamic ecosystem.

This study plan describes a pilot study that will investigate the role of eelgrass as habitat for fish, epibenthic macroinvertebrates, and benthic infauna within the Bay. The goal of the pilot study is to compare the composition of biological communities between eelgrass habitats and unvegetated habitats and gain information on the potential gear types and sampling methodologies for use in eelgrass sampling within the Bay. The information gathered during this study will help NOAA design future habitat utilization studies and perhaps develop a long-term monitoring plan for eelgrass beds. Based on previous studies (Allen 1999, Hoffman 1996, Merkel & Associates 2002), it is expected that eelgrass beds will contain a more diverse and abundant fish and invertebrate community than unvegetated areas. However, prior investigations within eelgrass habitats of the Bay have noted complications with effective sampling in eelgrass beds (ENTRIX 1997). It is anticipated that equipment regularly employed within other eelgrass habitats along the coast may allow for more effective sampling in the Bay eelgrass beds.

Few studies of eelgrass communities within the Bay have been conducted in recent years (Kitting 1993, ENTRIX 1997). ENTRIX (1997) conducted the most recent investigation of fish communities in the Bay for the Port of Oakland's Harbor Navigation Improvement Project. ENTRIX (1997) sampled fish communities within Oakland Harbor in the spring, summer, and fall of 1997. They collected fish in a variety of habitats including deep (> 6 meters [20 feet]) soft bottom sites, shallow (< 6 meters [20 feet]) soft bottom sites, and eelgrass beds using otter trawls, kodiak trawls, round haul nets, beach seines, long-lines, hook and lines, and minnow traps. The results of the

ENTRIX study indicated that eelgrass habitats were not much more species rich than other unvegetated areas. However, the study indicated that an accurate assessment of the communities in the eelgrass beds was restricted due to gear type and sampling methodology. In the current study, it is hoped that the sampling techniques used will assess eelgrass bed communities more accurately.

Methods

Study Sites

San Francisco Bay consists of approximately 100,000 hectares (250,000 acres) of open water and approximately 1,059 hectares (2,618 acres) of eelgrass (Merkel & Associates in progress). In order to sample a broad range of environmental conditions, varying distances from the ocean, and varying distances from rivers, nine possible study sites for the pilot studies have been established (Figure 1). In selecting sampling sites from the potential sites, consideration was given to environmental parameters such as water depth, eelgrass bed size, and site exposure, and logistical factors such as accessibility and the presence of debris. Another goal when selecting sites was the incorporation of previously collected data describing physical characteristics at these sites.

Nine sites have been identified for benthic infauna sampling. These sites are Point San Pablo, San Pablo Bay, Point Molate, Keil Cove, Richardson Bay, North Basin, Emeryville Flats, Crown Beach, and Bayfarm Island. At these nine sites, benthic samples will be collected inside and outside of eelgrass beds, with the exception of two sites that are entirely unvegetated (San Pablo Bay and North Basin).

For fish and epibenthic sampling, five possible sampling sites have been identified. These sites are located at Point San Pablo, Point Richmond, Richardson Bay, Crown Beach, and Bayfarm Island. Suitable sites for sampling the fish and epibenthic invertebrate communities are more limited due to the area required to complete the sampling, and the necessity to have little submerged debris. Point San Pablo is located on a shallow sandy shoal between Point San Pablo and Point Pinole and is the largest eelgrass bed in the Bay (Merkel & Associates in progress). Point Richmond is a small eelgrass bed located along a protected beach near the Richmond Channel. Richardson Bay is the second largest eelgrass bed in the Bay (Merkel & Associates in progress) and is located in Sausalito on the western side of the Bay. Richardson Bay is a large soft-bottom bay with no sandy shoreline. It also contains several marinas and moored boats, which may complicate sampling. The Crown Beach eelgrass is located along a sandy beach south of the SFOBB along the Alameda shoreline. Some researchers believe this may be an annual eelgrass bed (Fonseca *et al.* 2003, Talbot *et al.* in Merkel & Associates in progress), which could affect the eelgrass density at this site during the pilot fish study. Bayfarm Island is located on a sandy shoal near the Oakland Airport. All of the proposed sampling sites are situated in water depths of -0.5 to -1.5 meters (-1.6 to -4.9 feet) mean lower low water (MLLW).

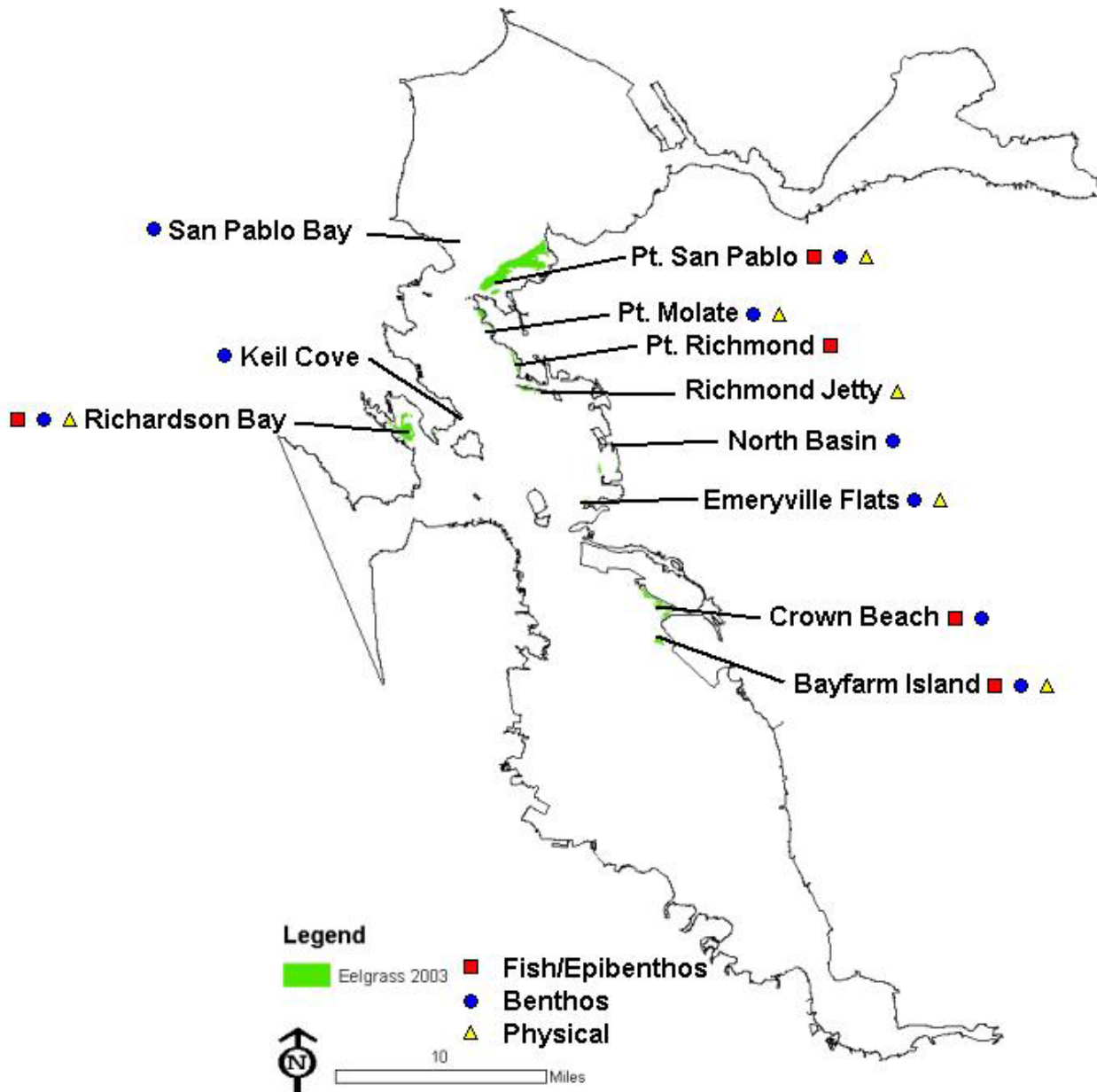


Figure 1. Sampling site locations for pilot eelgrass community studies in San Francisco Bay. Mapped eelgrass is from Merkel & Associates in progress.

An unvegetated reference station for each fish/epibenthic sampling site will be located within the vicinity of the site but at least 200 meters (656 feet) outside of the eelgrass bed. The reference sites will be used to compare fish and epibenthic utilization between eelgrass and non-eelgrass habitats.

Sampling Equipment and Methods

The benthic infauna samples were collected during the summer of 2003 in conjunction with sampling completed for the Baywide eelgrass inventory (Merkel & Associates in progress). Six grab samples were collected both within and outside the eelgrass beds. These samples will be analyzed in order to characterize benthic communities.

Fish and epibenthic invertebrate sampling will be conducted in June 2004. Three types of equipment will be utilized throughout the study for the purposes of collecting fish and epibenthic macroinvertebrates; purse seine, beach seine, and otter trawl. These gear types were chosen to be consistent with elements of other comprehensive studies of California bays and estuaries where eelgrass habitats have been effectively sampled. It is believed that these gear types will be the most logistically reasonable for a potential long-term study conducted either under the present contract or by agency staff. It will not be feasible to use every gear type at each station because of varying bathymetry and topography. It is anticipated that Point Richmond and Crown Beach will be the only sites where it will be possible to beach seine, based on the lack of beach at the other sites. Otter trawls and purse seines will be attempted at all sampling sites.

Three-fold replication following Allen (1999) will be done for all stations and gear for the fish/epibenthic sampling. Each replicate will be completed at a slightly different portion of the station to ensure that the same area is not sampled twice. Night sampling will not be conducted as an element of this pilot investigation because it is not essential to evaluating the effectiveness of a sampling program. However, night sampling should be considered for a larger-scale sampling program, if one is to be undertaken.

Data collection during the pilot program is intended to be limited to the biological metrics described below so as not to expend more funds than are necessary to evaluate sampling feasibility and sampling site suitability. For benthic infauna the data collection contemplated includes sorting to major taxonomic groups, enumerating organisms within the groups, and determining wet-weight biomass. Samples would then be archived for later review, in the event that a species level analysis was determined to be of future value.

Fish will be identified to species and individual counts, individual standard lengths, and biomass will be collected. When large catches of schooling or aggregating species occur, the catch will be sub-sampled using the following techniques, which conserve a variability co-factor for statistical analyses. If greater than 100 individuals of a species are caught in a replicate of any gear type, the standard length and weight will first be

determined for 30 randomly selected individuals. Next, the batch weight will be determined for 100 randomly selected individuals, not including those already measured. Finally, the batch weight will be determined for all of the remaining, uncounted individuals. The number of uncounted individuals will be estimated using the batch weight of the 100 randomly selected individuals. Qualitative observations of fish species that might not be captured within the sampling gear will also be recorded, when possible.

Data on epibenthic macroinvertebrates will be limited to identification of each individual to the lowest possible taxonomic level.

Trawl and open water work will be conducted from a 22-foot Boston Whaler. An additional 19-foot Boston Whaler to be provided by NOAA will function as a support boat on which to work-up the catch. A differential GPS will be used for survey positioning and navigation of trawl lines of a standard length. Trawl lengths shall be distance tows to standardize the bottom area covered irrespective of tow direction or currents.

Additionally, physical data will be collected for water temperature, dissolved oxygen, turbidity, salinity, and pH using a multi-parameter water quality meter. Where water depths allow, surface, mid-depth and bottom condition data will be collected.

The following summarizes the design specifications and deployment techniques for each sampling equipment type:

Purse Seine

The purse seine will be used to sample juvenile and adult fishes and macroinvertebrates in the water column of each site. The purse seine also samples demersal species when it is deployed in shallow water where the net reaches the bay bottom, as in the eelgrass beds of the present study. A 66-meter x 6-meter (217-foot x 20-foot) seine with 1.2-centimeter (0.5-inch) mesh in the wings and 0.6-centimeter (0.2-inch) mesh in the bag will be deployed from the research vessel. The area of coverage by the seine is 347 square meters (3,735 square feet).

Beach Seine

The beach seine consists of a 15.5-meter x 1.8-meter (51-foot x 5.9-foot) net with a 1.8 x 1.8 x 1.8-meter (5.9 x 5.9 x 5.9-foot) bag in the center. The seine has 1.2-centimeter (0.5-inch) mesh in the wings and 0.6-centimeter (0.2-inch) mesh in the bag. It will be utilized to sample waters between 0.0 and 2.0 meters (0.0 to 6.6 feet) in depth at the sites with accessible beaches. The beach seine will be positioned parallel to shore approximately 15 – 30 meters (49 - 98 feet) from the waters edge, depending on bottom contours. The seine will be held in place by two researchers for three minutes and then walked slowly to shore, keeping the leadline of the net in contact with the bottom. The area sampled for each haul will be recorded.

Otter Trawl

The semi-balloon otter trawl consists of a 3.2-meter (10.5-foot) trawl with 0.8-centimeter (0.3-inch) mesh in the body and 0.6-centimeter (0.2-inch) mesh in the cod end. The otter trawl will be deployed from the research vessel traveling between 1.5 and 2.0 knots along established 250-meter (820-foot) transects. The trawl will be used to sample adult and juvenile fish and macroinvertebrates near mid-depth and the bottom at each station.

Data Analysis

All project data will initially be recorded on hard copy datasheets and then transferred in the laboratory to digital database files. IDS Ecological Survey©, an ecological information management program, will be used to manage relational data from the project surveys. For each sampling event, data on species composition, abundance, density, and biomass at each site will be compiled.

Differences in density (individuals/square meter) and biomass (g/square meter) between stations and treatment (inside vs. outside eelgrass) will be analyzed using a two-way ANOVA. The data will be analyzed using Statistica '99 software for Windows (Statsoft Inc. 1999).

Following data analysis, the results of the pilot community characterization study will be compiled into a short report. The report will summarize the results of the investigations, focusing on the effectiveness of sampling efforts, the potential to sample within Bay eelgrass communities in a comparative manner with unvegetated shallows, and the potential for making use of such community characterization data as a future management tool. Parsons Brinckerhoff, Caltrans, and NOAA will review this report in a manner similar to the review process that has been used for other SFOBB eelgrass investigations. This pilot program is anticipated to lead to recommendations regarding the most effective way to sample eelgrass habitat communities within the Bay in order to characterize habitat utilization by biological resources.

Schedule of Work

The proposed pilot program will be conducted in three phases.

- Phase 1 will include the fish and epibenthic field-sampling program. This work will be conducted from June 14th through June 19th 2004.
- Phase 2 will entail data analysis and laboratory work-up for benthic samples. Phase 2 will be conducted from June 19th through August 2004.
- Phase 3 will entail the reporting effort associated with the investigation. This work will be conducted from August through September 2004.

Project Costs

The proposed cost to conduct the pilot community studies is approximately \$50,000. In addition, a portion of the field sampling work effort will be accomplished using contributions by NOAA staff and equipment from the Santa Rosa Office. At present, it is anticipated that NOAA will support the pilot study efforts by providing two staff biologists and a support vessel during Phase 1 of the project work.

Literature Cited

- Allan, L. G. 1999. Fisheries inventory and utilization of San Diego Bay, San Diego, California. Final Report: Sampling Period July 1994 to April 1999. Prepared for U.S. Navy and the San Diego Unified Port District
- ENTRIX. 1997. Habitat evaluation for Oakland's Harbor Navigation Improvement Project. Prepared for the Port of Oakland. December 17, 1997.
- Fonseca, M., Wyllie-Echeverria, S., Addison, C., and Wyllie-Echeverria, T. 2003. National Ocean Service joint pilot project on eelgrass (*Zostera marina* L.) recovery in San Francisco Bay. September 30, 2003.
- Hoffman, R. S. 1996. Data summary for Mission Bay/San Diego Bay beach seine study, January 1988 to July 1994. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Region, Long Beach.
- Kitting, C. L. 1993. Investigation of San Francisco Bay shallow-water habitats adjacent to the Bay Farm Island underwater excavation. A report for the U. S. Department of Commerce/NOAA, National Marine Fisheries Service, Long Beach and Santa Rosa, CA.
- Merkel & Associates. 2002. Long-term Monitoring and Pilot Revegetation Program for the Batiquitos Lagoon Enhancement Project Annual Report, January-December 1999. M&A Doc. No. 96-057-01-A99. Prepared for City of Carlsbad Planning Department and Port of Los Angeles, Environmental Management Division. San Diego, CA. Annual Report. June 2000.
- Merkel & Associates. Baywide Eelgrass (*Zostera marina* L.) Inventory in San Francisco Bay: Pre-survey Screening Model and Eelgrass Survey Report. In progress.
- Talbot, S. L., G. K. Sage, J. R. Rearick, and R. Muñiz Salazar. Genetic structure of *Zostera marina* in San Francisco Bay: Preliminary Results of Microsatellite Analyses. In: Merkel & Associates, Baywide Eelgrass (*Zostera marina* L.) Inventory in San Francisco Bay: Pre-survey Screening Model and Eelgrass Survey Report. In progress.