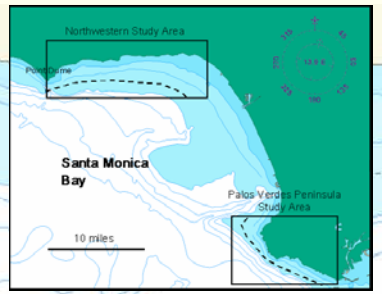
Santa Monica Bay Nearshore Habitat Mapping Project

Kvitek *et al.*- Seafloor Mapping Lab, California State University Monterey Bay



Regional map showing the two approximate survey areas along the northwestern shore and Palos Verdes Peninsula of Santa Monica Bay. Actual survey areas extended from the shore out to the shallowest extent of USGS Santa Monica Bay hydrographic data (indicated by the dashed line). Historically these two areas supported abundant kelp forests and rockfish populations that have declined during recent decades.

Project Summary

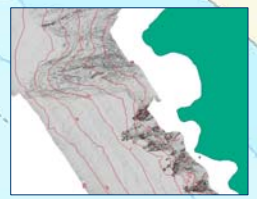
The goals of the Santa Monica Bay Mapping Project (SMBMP) were to **(1)** create a high-resolution basemap of seafloor habitats within the Santa Monica Bay nearshore environment (~0-50m water depth), and where appropriate to **(2)** determine the extent of sediment covering rocky substrate that historically supported kelp forests. This work mapped the locations of natural substrates suitable for kelp forest and rockfish replenishment within the nearshore region of Santa Monica Bay, resulting in information critical to the design and success of restoration programs targeting these marine species.

The Geographic Information System (GIS) products presented here are the result of two hydrographic surveys conducted by the California State University Monterey Bay (CSUMB) Seafloor Mapping Lab (SFML) during summer 2001 and spring 2002. The surveys covered two study areas totaling 30 miles of Santa Monica Bay coastline, including the north shore from Pt. Dume to Topanga Canyon, and the Palos Verdes Peninsula from Malaga Cove to Pt. Fermin. Acoustic remote sensing (multibeam, sidescan sonar, and sub-bottom profiling), sediment sampling, and underwater video (for ground truthing) data were combined with public domain results from deeper water hydrographic surveys conducted by the U.S. Geological Survey (USGS) and historic kelp cover information from the California Department of Fish and Game to present the most complete characterization to date of Santa Monica Bay marine habitats. Only the SFML data are presented here.

Creation of High-resolution Seafloor Maps

Multibeam bathymetry (and sidescan sonar) data was collected using a Reson 8101 sonar system from aboard the Seafloor Mapping Lab's 27ft vessel *R/V* MacGinitie

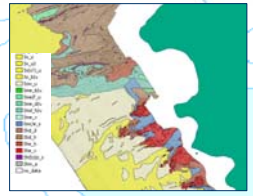
Bathymetric data were post-processed using CARIS HIPS hydrographic data cleaning system software. Corrected soundings were exported as decimated x,y,z ASCII text files (shoal biased) with 2m spacing and used in additional programs to generate a 2m bathymetry grid.



10m interval contour lines were produced from a 2m bathymetry grid

2m slope grid produced from a 2m bathymetry grid

Automated rugosity analysis was also applied to the 2m grid as a way of delineating rocky versus sedimentary habitats. This algorithm calculates a planar area to surface area ratio for each cell in a DEM grid using the elevation of the cell and its eight neighbors. Flat areas (green) will result in ratios near 1, while bumpy, high relief areas (red) will exhibit higher rugosity values. ArcView® 3.x extension *Surface Areas and Ratios from Elevation Grids* (surfgrids.avx, Jenness Enterprises- www.jennessent.com)



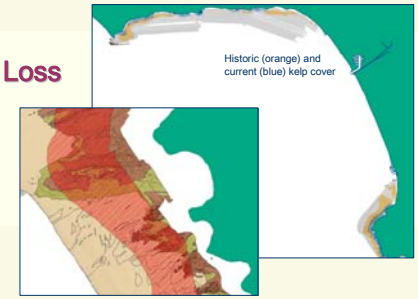
Moss Landing Marine Lab's Center for Habitat Studies created more detailed habitat interpretations from the bathymetry data and sidescan sonar images provided by the SFML and USGS. See Greene et al. 1999 for the habitat classification scheme. (Oceanologica Acta. Vol 22: 6. pp. 663-678)

In ArcGIS®, multibeam bathymetry DEMs and the video imagery were used to trace polygons outlining different types of substrate (rocky substrate, degraded (sediment dusted) rocky substrate, and sediment).

Scientific Objective

Extensive development and erosion of coastal watersheds have long been suspected of negatively impacting coastal marine habitats. The scientific objective of this study was to provide evidence for the evaluation of the hypothesis that the dramatic declines in kelp forests of Santa Monica Bay (SMB), California, might be attributed, in part, to sediment deposition and the resultant loss of near shore rocky habitat. GIS tools were used to compare kelp coverage from 1893, 1912, 1989 and 1999 SMB surveys to identify areas of significant kelp loss over time. The current distribution of rocky habitat was determined using acoustic remote sensing (multibeam bathymetry, sidescan sonar, and sub-bottom profiling) and video substrate verification. These data were used to determine whether or not rocky habitat capable of supporting kelp was still present within the areas of kelp loss or if it had been lost due to sedimentation.

Kelp Loss



ArcGIS® 8 (ESRI) was used to compare kelp cover results from 1893, 1912, 1989 and 1999 surveys to identify areas of significant kelp loss in the Santa Monica Bay over time. These data were obtained from historic National Oceanographic and Atmospheric Administration (NOAA) charts and California Department of Fish and Game (CDFG) shapefile data. The kelp layers were combined into two categories: historical kelp data (1893 and 1912) and current kelp data (1989 and 1999), illustrating the maximal extents of kelp within those time periods. Coverage footprints from the historical and current kelp data were subtracted to form polygons (red area) that represented areas of kelp loss.

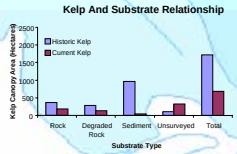


Figure 2 Historic and current kelp canopy coverage

Sedimentation of Historic Kelp Forests

Kelp loss and current kelp canopy area over four different present-day substrate types (rock, degraded rock, sediment, and unsurveyed) in the SMBMP study site. Substrate types interpreted from acoustic and other survey data collected for this study. Unsurveyed areas were either too shallow or had kelp canopy so dense it precluded multibeam data collection. Total height of each bar indicates historic plus current kelp coverage. Values associated with each bar denote percentages of kelp found on each substrate during the given time period (historic or current)

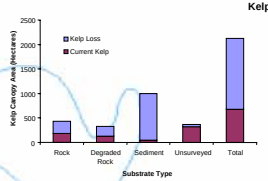


Figure 3 Historic Coverage. Kelp loss calculated within historic kelp areas only for this analysis.

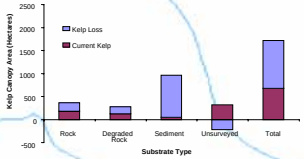


Figure 4 Historic+Current Coverage. Kelp loss calculated using net change in total kelp coverage (historic minus current) for this analysis.

Results and Conclusions

Results confirmed extensive kelp loss within the study area (Fig. 2). Kelp loss was calculated in two ways: within the area of historic kelp coverage only (Fig 3) and throughout the current and historic coverage area (Fig. 4). Both methods gave comparable results, with the exception of a net gain ("negative loss") of kelp cover in unsurveyed areas using the latter method (Fig. 4). Most of the kelp losses occurred over what is now buried or degraded (sediment "dusted") rocky habitat, suggesting that watershed erosion and sediment runoff may have been factors contributing to both habitat and kelp loss. The conditions of other former kelp areas along the north coast suggest that there has been a decline in large boulder material that once entered the bay via the watershed drainages providing suitable substrate for kelp recruitment. Along the Palos Verdes Peninsula (PVP), however, much of the kelp loss has occurred in deeper water (15 - 30 m water depth) over what is still very clean and exposed rocky substrate, suggesting factors other than loss of available rocky habitat, e.g. water clarity and quality. Other areas of SMB kelp loss are associated with sites where there is no evidence of there ever having been rocky habitat, suggesting that the missing kelp once grew directly on the sediment surface or attached to biogenic substrates (e.g. worm tubes) that are no longer present. All quantitative and geospatial data collected and produced for this project are available in GIS format on a DVD ROM disk, and on-line at http://seafloor.csumb.edu/SFMLwebDATA.htm.