

Section 9

Conclusions

The key findings of the Mission Bay Water and Sediment Testing project are summarized here. When evaluating the importance of these results, it's important to remember that they represent data from a single 18 month period. The winter of 2001-2002 was unusually dry, and the results obtained between November 2001 and October 2002 should reflect processes that influence the bay during a dry year. However, San Diego received a substantial amount of precipitation between October 2002 and May 2003, and the data for this period should be more indicative of "normal" conditions.

Water Quality

- 1) During the summer, sea surface temperatures in the eastern portion of Mission Bay (back bay - Tecolote Creek inlet, Cudahy Creek inlet) were consistently higher than temperatures near the mouth of the bay (Ventura Point). During the winter, surface temperatures varied little throughout the bay, with occasional periods characterized by cooler water in the eastern portion of the bay than near the mouth
- 2) Surface salinity was correlated positively and statistically significantly with temperature in the back bay. Warmer, saline water was present in this area during the summer months, and cooler, fresher water was evident during the winter. The strength of this correlation decreased with distance from the inlet of Tecolote Creek, and statistical significance was observed between temperature and salinity only at the inlets of Tecolote and Cudahy Creeks and in Sail Bay.
- 3) Concentrations of nitrate in surface waters were highly variable in time and space. Nitrate concentrations generally were low, rarely exceeding 1.0 mg l^{-1} . Technical difficulties prevented the collection of valid nitrate data between November 2001 and March 2002.
- 4) Concentrations of phosphate in surface waters typically were higher in the back bay than near the mouth of Mission Bay. Phosphate levels throughout the bay were low ($<0.10 \text{ mg l}^{-1}$) from November 2001 through February 2002 and increased slowly during the spring and early summer, peaking in June and July before declining in the late summer and fall. Concentrations of phosphate tended to be low, seldom topping 1.0 mg l^{-1} , however elevated levels were observed in concert with rainfall events, especially in the back bay.
- 5) Silica concentrations in surface waters also were elevated near the inlets of Tecolote, Cudahy and Rose Creeks, compared to the other three sites. Levels of silica throughout the bay were high in the winter, declined into January then increased steadily, reaching maximum concentrations in October and November. Peak concentrations of silica were somewhat higher than those of other nutrients, reaching nearly 4.5 mg l^{-1} in February 2003. Elevated concentrations of silica were observed in both wet and dry winters.

- 6) Concentrations of cadmium, lead and zinc in the water generally were below detection limits, although zinc concentrations of 10-17 $\mu\text{g l}^{-1}$ were measured near Tecolote Creek, Rose Creek and Ventura Point in February 2002. During that same time, a zinc concentration of 47 $\mu\text{g l}^{-1}$ was measured in Sail Bay. Copper was detected more consistently than any other metal. In February, May and August 2002, copper was detected at Tecolote Creek, Cudahy Creek and Ventura Point, with highest levels at all sites during May. The highest concentration overall was 26.6 $\mu\text{g l}^{-1}$ at Tecolote Creek. At the other three sites, copper was detected during two of the three quarterly sampling events between February and August 2002.
- 7) Concentrations of organophosphorus pesticides in the water were below detection limits at all locations at all sampling times.

Plankton Community

- 8) Phytoplankton abundance and diversity were consistently highest at Ventura Point and lowest at the Rose Creek inlet. At all sites, phytoplankton abundance varied with time. Diatoms typically were more abundant than dinoflagellates at all sites, especially during the summer months, although dinoflagellates tended to dominate during the winter.
- 9) Four different temporal patterns were apparent at the six sites. At Ventura Point, the phytoplankton community seemed to reflect abundance and composition trends from the coastal environment more than Mission Bay. Abundance varied throughout the year, with peaks during all seasons. In Sail Bay and Fiesta Bay, phytoplankton communities exhibited pronounced peaks in the spring and fall. Both peaks were composed primarily of diatoms, although the spring diatom peak in Sail Bay was followed rapidly by a sharp rise in populations of dinoflagellates. The Rose Creek inlet showed consistently low phytoplankton densities during 2002 but a pronounced spring bloom in 2003. In the back bay, summer diatom blooms dominated the system, including a large and long-lasting bloom of the chain-forming diatom *Chaetoceros decipiens* between April and July 2002 near the Tecolote Creek inlet.
- 10) Among all sites collectively, phytoplankton diversity, as measured with the Shannon-Wiener diversity index, was correlated negatively with concentrations of phosphate and silica. This pattern was not observed between diversity and concentrations of nitrate.
- 11) Information about planktonic larvae (meroplankton) was not separated from zooplankton data in the body of the report but is summarized briefly here. The abundance of planktonic larvae varied throughout the year at all sites. In general, meroplankton densities were highest in the spring, summer and fall, and lowest in the winter. Gastropod and bivalve larvae predominated during the summer and fall, respectively. Gastropod larvae were most abundant in Sail Bay, Fiesta Bay and the areas near Rose Creek and Ventura Point. Densities of larval bivalves, most likely mussels, were highest in Sail Bay, Fiesta Bay and near the inlet of Rose Creek.

- 12) Zooplankton abundances also varied throughout the year at all sites. Maximum densities exceeded 500,000 individuals m^{-3} near the Tecolote Creek inlet in mid summer, with a smaller secondary peak in fall. Similar patterns and timing also were observed near Cudahy and Rose Creeks, and in Fiesta Bay. In Sail Bay and near Ventura Point, abundance peaks were lower and occurred in late summer. At all sites, ciliates and copepods dominated the community.

Sediments

- 13) Sediments in the back bay generally were finer and less well sorted than sediments in Fiesta Bay, Sail Bay, and near Ventura Point. Median grain sizes near the inlets of Tecolote, Cudahy and Rose Creeks typically ranged from 40-60 μm . Sediments in Fiesta Bay and Sail Bay also were poorly sorted, but much coarser, with median grain sizes ranging from 80-120 μm . Sediments near Ventura Point were coarse sand (median grain size 130-140 μm) and well sorted, especially compared to the other five sites.
- 14) The sea floor near Ventura Point was covered by eel grass (*Zostera marina*) during the summer but not during the fall and winter. Small amounts of eel grass cover were observed in Sail Bay and Fiesta Bay, and in some of the back bay sites. Near the Rose Creek inlet, eel grass covered the sea floor densely throughout the year.
- 15) Sediment total organic content (TOC) was consistently higher near the inlet of Rose Creek than at any other site in Mission Bay. TOC was consistently lower in Sail Bay and Fiesta Bay, and lower still in the back bay. The lowest TOC values were measured in the sandy sediments near Ventura Point, however an elevated TOC value was measured at this site in August 2002, when sea grass densities were high. Seasonal and interannual variability were apparent in the data, with TOC higher at all sites in November 2002, compared to November 2001. what about after November 2002?

Benthic Fauna

- 16) Densities of meiofauna were substantially higher near Ventura Point than at any other site in Mission Bay. Maximum densities in March 2002 approached 200 individuals ml^{-1} of sediment in one sample.
- 17) Meiofaunal diversity was variable but generally low, seldom exceeding a Shannon-Wiener index of 1.2 during February or March 2002. During February, nematodes dominated the sediments in the back bay and at Ventura Point, while copepods and polychaete annelids dominated most of the other subsites. In March 2002, nematode dominance was similar to that observed in February, but foraminiferans replaced copepods and polychaetes as the dominant meiofauna at the other subsites.

Sediment Quality

- 18) Sediment concentrations of total copper and zinc were consistently higher near the inlet of Rose Creek than at any other site in Mission Bay (Figs. 18, 19). Copper and zinc concentrations were similar in sediments from the inlets of Tecolote and Cudahy Creeks, Fiesta Bay and Sail Bay, and consistently lowest in the sandy sediments near Ventura Point. An unusually high zinc measurement was made at Rose Creek in May 2002, perhaps indicating a localized patch of zinc-rich sediments.
- 19) Elevated levels of polycyclic aromatic hydrocarbons (PAH) were detected in the sediments near the three creek inlets, especially near Cudahy Creek. The channel through which Cudahy Creek flows just before emptying into Mission Bay is open and passes near railroad tracks supported by railroad ties that likely were treated with creosote. Creosote is a complex mixture of compounds, including a number of PAHs such as acenaphthene and naphthalene. Elevated concentrations of both of these compounds were found in the sediments near the creek inlets.
- 20) Total recoverable petroleum hydrocarbons (TRPH) also were detected in the sediments near the three creek inlets at greater concentrations than those observed in the rest of the bay (Fig. 21). Concentrations of TRPH were higher at all sites in August 2002 than during any other time while the quarterly sampling was underway.
- 21) The pesticide chlordane was detected at potentially hazardous levels to aquatic organisms near the Tecolote Creek inlet. Chlordane also was identified near Cudahy and Rose Creeks, but concentrations typically were lower than those in the sediments near Tecolote Creek. Interestingly, relationships between toxicity and chlordane were not statistically significant for either bioassay organism tested in this study.
- 22) Sediments from Mission Bay displayed varying degrees of toxicity to test animals. Highest levels of mortality were caused by sediments collected near the inlets of Rose and Tecolote Creeks in February 2002.