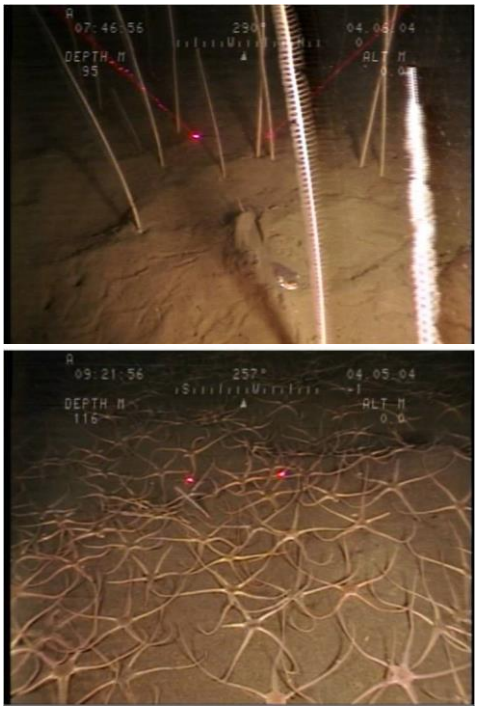
Cordell Bank National Marine Sanctuary

Soft Sediment Characterization and Contaminants

Management Issue

Although the focal point of Cordell Bank National Marine Sanctuary (CBNMS or Sanctuary) is the rocky, high relief bank, the majority of habitat within the sanctuary is soft sediment. This habitat type has been underrepresented in characterization, research, and monitoring activities and therefore there is little information about the habitat, species that rely on it, and potential stressors such as contaminants. Characterization of this habitat is needed to better assess management strategies and to assess the risks that contaminants play in this habitat.



Sea pens (top) and brittle stars (bottom) on soft sediment habitat in CBNMS as observed during a camera sled survey in 2004. Photos: CBNMS

Description

Soft sediment habitat is the most abundant habitat type on earth and plays an important role in marine ecosystems in nutrient cycling and as a substrate for infauna and epifauna, which are then a part of the benthic trophic system. Characterization is needed to better understand the ecosystem and to assess management strategies such as proposed changes to Essential Fish Habitat.

Soft sediments are a repository for contaminants that settle out of the water column. Contaminants can have ecological and human health consequences, through the degradation of habitat, bioaccumulation of toxins in top predators, loss of species and communities, and human consumption of contaminated organisms. Although Cordell Bank National Marine Sanctuary is an offshore and remote site, it is relatively close to the large metropolis of San Francisco providing the potential sources for high contaminant levels in the sanctuary. Urban runoff, extensive agricultural lands, historic mining operations, shipping activity, and military activities could all contribute contaminants to the benthic habitat of CBNMS. Contaminant concentrations and distribution in benthic habitats of the Sanctuary are poorly understood; however preliminary analysis of samples collected within the sanctuary indicates low levels of Dichloro-Diphenyl-Trichloroethane (DDT), polychlorinated biphenyls (PCB), and polycyclic aromatic hydrocarbons (PAH). Nevertheless, data suggest that accumulation of DDT, PAHs, and PCBs may be occurring in the depths of Bodega Canyon (a feature just north of the Sanctuary), a pattern that holds true for other canyons in central California. Further work is needed to understand contaminant concentrations, transport pathways, changes in contaminant concentrations over time, and potential biological impacts.

Questions and Information Needs

1) What is the spatial extent of soft sediment habitat in the sanctuary?

2) What is the distribution and abundance of soft sediment infauna and epifauna in the sanctuary?

3) How well are current and proposed management strategies protecting this habitat?

4) What are the concentrations of various contaminants within benthic habitats of CBNMS?

5) What regions and seafloor features within the Sanctuary have the highest concentrations of contaminants?

6) What are the potential sources and pathways transporting contaminants to the sanctuary?

7) How do patterns of contaminant transport and accumulation vary seasonally and inter-annually as a function of oceanographic conditions?

8) What are the rates of re-suspension of contaminants in different habitats/regions of the sanctuary and how do these vary seasonally and inter-annually as a function of oceanographic conditions?

9) Based on contaminant distribution patterns and life history strategies, are there particular species assemblages that have a higher probability to be negatively impacted by contaminants through direct contact, ingestion, or bioaccumulation?

10) Are there certain species within the offshore environment that can be used as biological indicators to measure changes in contaminants through time?

Scientific Approach and Actions

- Analyze 2007 soft sediment camera sled survey imagery for epifauna
- Refine and expand report based on 2004 camera sled epifauna imagery analysis
- Incorporate soft sediment surveys into sanctuary annual visual survey monitoring plan
- Determine best sampling protocol for soft sediment surveys
- Develop a contaminant accumulation model based on existing oceanographic and geologic data and known sources of contaminants to predict patterns of contaminant distribution within the Sanctuary
- Use contaminant accumulation model results to design an adaptive sampling program to characterize the distribution and concentration of contaminants
- Sample sediments and tissues from infaunal organisms and analyze for chemical contaminants, including organic compounds (e.g., DDT, PAH, PCB), pharmaceuticals, and heavy metals
- Integrate benthic contaminant data with models of ocean currents to determine transport pathways and accumulation under various oceanographic conditions
- Integrate benthic contaminant data with models of seafloor sediment mobility to understand re-suspension of contaminants under various oceanographic conditions
- Integrate benthic contaminant data with infaunal data to assess levels of risk to various species assemblages
- Determine the feasibility of using specific offshore species as biological indicators of contaminant levels and develop protocols for monitoring contaminants

Key Partners and Information Sources

NOAA National Center for Coastal Ocean Science, University of California, Davis Bodega Marine Laboratory, United States Geological Survey, Moss Landing Marine Laboratories, Southern California Coastal Water Research Project, U. S. Environmental Protection Agency. San Francisco Public Utilities District

Management Support Products

- Characterization report of sanctuary soft sediment habitat including epifauna and infauna
- Maps of soft sediment habitat and contaminant concentrations to illustrate spatial distribution within the Sanctuary and to determine overall concentrations within the Sanctuary compared to surrounding nearshore and offshore regions
- Models of transport pathways and re-suspension patterns to understand major sources of contaminants
- Assessment of species assemblages most sensitive to contaminants
- Assessment of how contaminant concentrations can change with varying oceanographic conditions, including predictions of contaminant patterns resulting from global climate change
- Development of monitoring protocol to assess changes in contaminant levels through time

Planned Use of Products and Actions

- Use characterization to assess management strategies
- Use information on likely sources of contaminants to develop strategies for reducing the levels of contaminants reaching the coastal environment
- Work with NOAA partners to understand the impacts of contaminants to various fisheries and human health
- Understand the potential for changing contaminant levels due to changes in oceanographic conditions with climate change
- Interpret research results in support of outreach and education projects that inspire resource protection and stewardship

Soft Sediment Characterization and Contaminants

Program References

CBNMS Management Plan

- Conservation Science Action Plan, strategy CS-3, CS-4, CS-5

CBNMS Condition Report

- Contaminant concentrations in sanctuary habitats (question 7)

ONMS Performance Measures

- By 2015, 100% of the sanctuary system is adequately characterized.
- Number of sites in which habitat quality, based on long-term monitoring data, is being maintained or improved.