



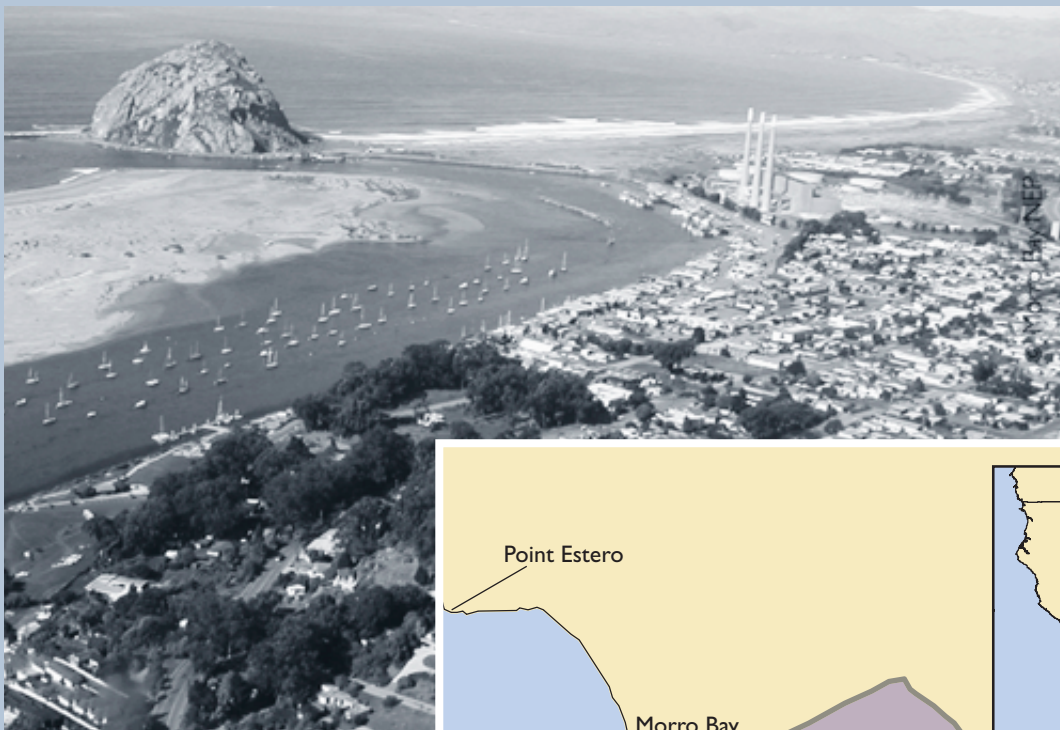
*This document contains overall and specific condition of the Morro Bay National Estuary Program from the National Estuary Program Coastal Condition Report. The entire report can be downloaded from <http://www.epa.gov/owow/oceans/nepccr/index.html>*

## National Estuary Program Coastal Condition Report

### Chapter 6: West Coast National Estuary Program Coastal Condition, Morro Bay National Estuary Program

June 2007

## Morro Bay National Estuary Program



[www.mbnep.org](http://www.mbnep.org)



### Background

Morro Bay is a 3.6-mi<sup>2</sup>, semi-enclosed body of water located along the central California coast. This shallow estuarine system includes a diverse array of wetland habitats, including subtidal and intertidal eelgrass beds, mudflats, salt marsh, and brackish and freshwater wetlands on the Bay fringe. The Morro Bay watershed covers approximately 75 mi<sup>2</sup> of San Luis Obispo County. The predominant land use in the watershed is rangeland for beef cattle, and other uses include irrigated agriculture, open space, and developed lands. The area is seismically active, and several earthquake faults

are located within or near the watershed. Morro Rock, a local landmark, is the most westerly visible in a chain of extinct volcanic plugs that divide the two coastal valleys that drain into the Bay (Morro Bay NEP, 2000).

Morro Bay is a major tourist attraction, with more than 25,000 people living within the Bay's watershed and an average of 1.5 million visitors per year. The area's economy is dominated by tourism and visitor-serving businesses, which generate 37% of all jobs and one-third of the general fund revenues for the City of Morro Bay. The Bay provides critical resources to fishing and recreational boating industries, with more than

100 commercial vessels providing a value of roughly \$7 million to the local economy. Recreational fishing takes place from shore, docks, piers, and a variety of boats, and catches include a diversity of species, such as Pacific halibut, shark, jacksmelt, black surfperch, and starry flounder. More than 270 acres of the estuary are leased for commercial shellfish operations focused on the Pacific oyster. The estuary and surrounding habitats are an important stop-over area on the Pacific Flyway for migratory birds and are home to 16 federally threatened or endangered species, some of which are found nowhere else in the world (Morro Bay NEP, 2000).

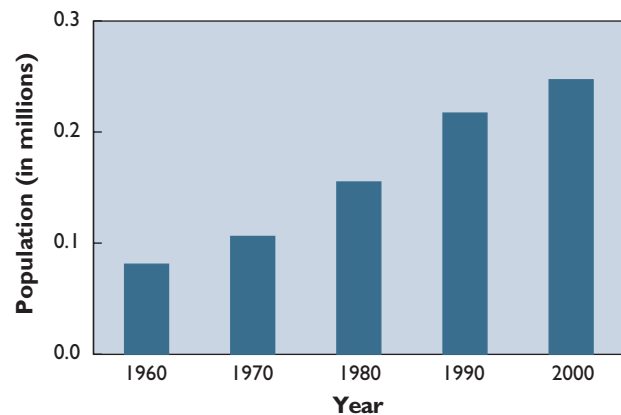
In 1995, the Morro Bay National Estuary Program (Morro Bay NEP) was established to address the environmental concerns facing this nationally significant estuary, and the program's *Morro Bay Comprehensive Conservation & Management Plan* was finalized in 2000 (Morro Bay NEP, 2000). The Morro Bay NEP study area includes Morro Bay, its watershed, and to some extent, Estero Bay from Point Buchon in the south to Point Estero in the north.

## Environmental Concerns

Erosion in the watershed and the resulting sedimentation of the estuary is one of the most severe threats facing Morro Bay. Sediment delivery has increased over time due to changes in land use, as well as to the alteration and loss of streams and flood plains. The Bay has lost more than a quarter of its tidal volume in the past century, and left unchecked, sedimentation will continue to degrade and destroy subtidal and intertidal habitats. In addition to sedimentation, development, and other land-use changes, changes in drainage patterns, erosion, and growth of invasive species such as *Arundo donax* (giant reed) in riparian corridors and veldt grass in the coastal dunes have contributed to the loss of natural habitat in the study area. Some obvious effects of habitat loss in Morro Bay include the likely extinction of the Morro Bay kangaroo rat and decreases in populations of steelhead trout, a federal endangered species (Morro Bay NEP, 2000).

## Population Pressures

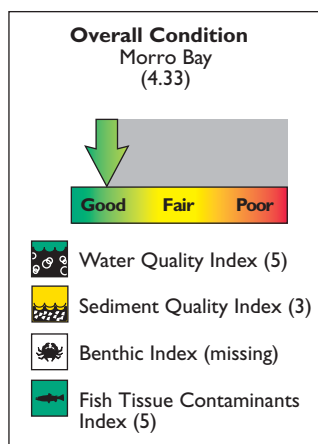
The population of the NOAA-designated coastal county (San Luis Obispo) coincident with the Morro Bay NEP estuarine study area increased by 204.4% during a 40-year period, from 0.08 million people in 1960 to 0.25 million people in 2000 (Figure 6-42) (U.S. Census Bureau, 1991; 2001). This rate of population growth for the Morro Bay NEP was the highest rate observed for any of the six West Coast NEPs and was more than double the average growth rate of 100.3% for the collective NEP-coincident coastal counties of the West Coast region. In contrast, San Luis Obispo County had the second-lowest population density (75 persons/mi<sup>2</sup>) of any of the West Coast NEPs (U.S. Census Bureau, 2001). This estuary is not surrounded by a large metropolitan area, but is a major recreational area and agricultural center for the local coastal community.



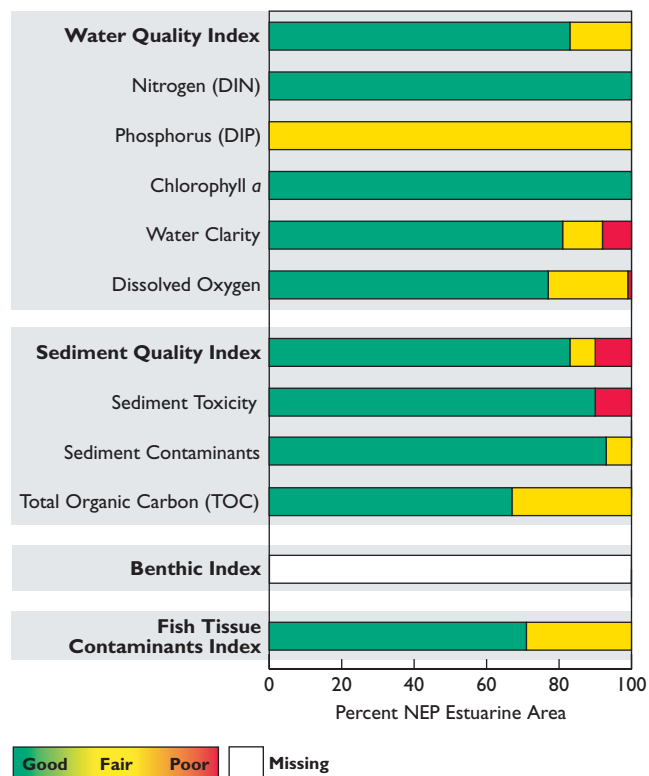
**Figure 6-42.** Population of the NOAA-designated coastal county of the Morro Bay NEP study area, 1960–2000 (U.S. Census Bureau, 1991; 2001)

## NCA Indices of Estuarine Condition—Morro Bay

The overall condition of Morro Bay is rated good based on three of the indices of estuarine condition used by the NCA (Figure 6-43). The water quality and fish tissue contaminants indices are rated good, and the sediment quality index is rated fair. Although data on the condition of the benthic community were collected for this estuary, Morro Bay could not be rated using an



**Figure 6-43.** The overall condition of the Morro Bay NEP estuarine area is good (U.S. EPA/NCA).



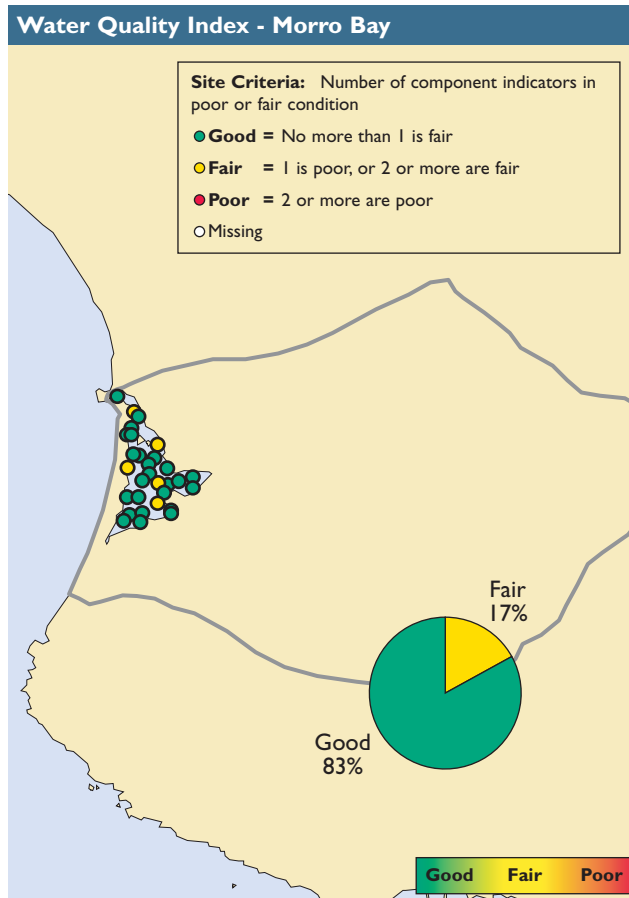
**Figure 6-44.** Percentage of NEP estuarine area achieving each ranking for all indices and component indicators — Morro Bay (U.S. EPA/NCA).

index based on deviations from the expected species richness. Figure 6-44 provides a summary of the percentage of estuarine area rated good, fair, poor, or missing for each parameter considered. This assessment is based on data collected by the Moss Landing Marine Laboratories, under contract to the SCWRRP, from 30 sites sampled in the Morro Bay NEP estuarine area in 2003. Please refer to Tables 1-24, 1-25, and 1-26 (Chapter 1) for a summary of the criteria used to develop the rating for each index and component indicator.



## Water Quality Index

Based on NCA survey results, the water quality index for Morro Bay is rated good (Figure 6-45). This index was developed using NCA data on five component indicators: DIN, DIP, chlorophyll *a*, water clarity, and dissolved oxygen. Seventeen percent of the estuarine area was rated fair for water quality, and 83% of the area was rated good. Diminished water quality was primarily due to limited water clarity and elevated levels of DIP.



**Figure 6-45.** Water quality index data for Morro Bay, 2003 (U.S. EPA/NCA).

**Dissolved Nitrogen and Phosphorus** | DIN concentrations in Morro Bay are rated good, but DIP concentrations are rated fair. Concentrations of DIN were rated good in 100% of the estuarine area, whereas fair DIP concentrations occurred in 100% of the area. In addition to natural inputs of nutrients from offshore coastal upwelling, high levels of urban and agricultural runoff may also be major contributors to the elevated nutrient levels found in Morro Bay.

**Chlorophyll *a*** | Chlorophyll *a* concentrations in Morro Bay are rated good, with 100% of the estuarine area rated good for this component indicator.

**Water Clarity** | Water clarity in Morro Bay is rated good. Approximately 8% of the estuarine area was rated poor for this component indicator, and 11% was rated fair.

**Dissolved Oxygen** | Dissolved oxygen conditions in Morro Bay are rated good, with 77% of the estuarine area rated good and 22% of the area rated fair. Only 1% of the estuarine area was rated poor for this component indicator; however, these measured values reflect daytime conditions, and some areas of the Bay may still experience hypoxic conditions at night.



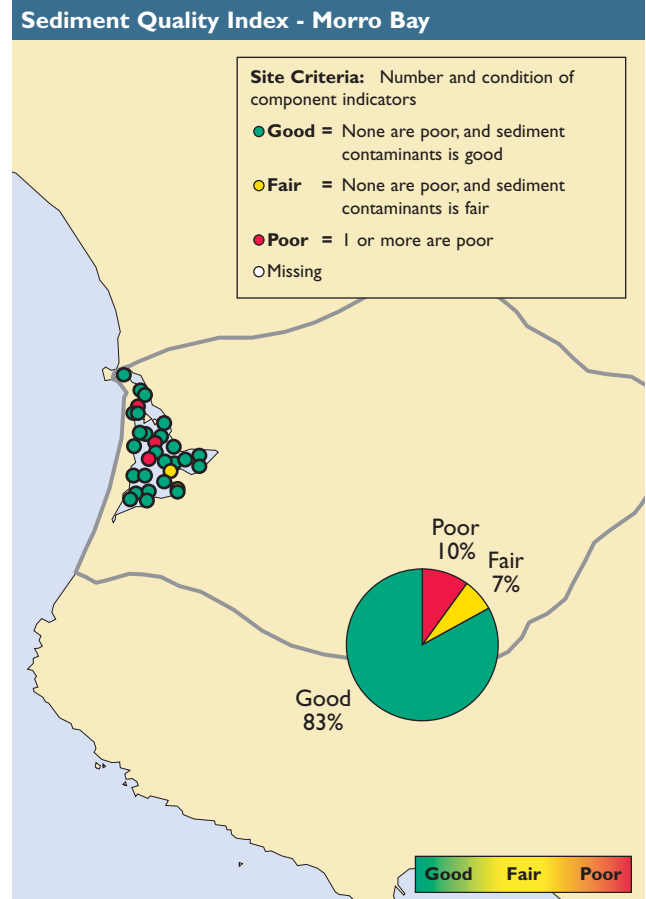
### Sediment Quality Index

The sediment quality index for Morro Bay is rated fair (Figure 6-46). This index was developed using NCA data on three component indicators: sediment toxicity, sediment contaminants, and sediment TOC. Ten percent of the estuarine area was rated poor for sediment quality, and 7% of the area was rated fair, primarily as a result of sediment toxicity.

**Sediment Toxicity** | Sediment toxicity for Morro Bay is rated poor, with 10% of the estuarine area rated poor for this component indicator.

**Sediment Contaminants** | Morro Bay is rated good for sediment contaminant concentrations because none of the estuarine area was rated poor for this component indicator and 7% of the area was rated fair.

**Total Organic Carbon** | Morro Bay is rated good for sediment TOC because 67% of the estuarine area



**Figure 6-46.** Sediment quality index data for Morro Bay, 2003 (U.S. EPA/NCA).

was rated good for TOC concentrations and the remaining 33% of the area was rated fair.



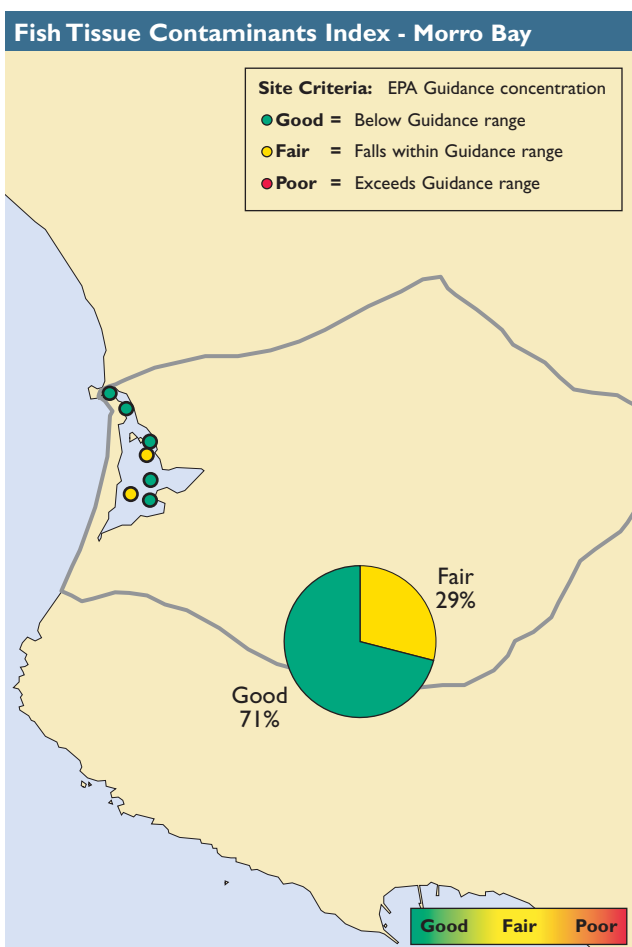
### Benthic Index

Currently, the condition of the benthic invertebrate communities in Morro Bay cannot be rated using an index based on deviations from the expected species richness because this approach requires a significant regression between salinity and the log of species richness. This relationship was not significant in the Morro Bay data collected during the 2003 NCA survey. The lack of a significant regression was probably due to an inadequate range in salinity because the Bay's salinity ranged only from 33.9 to 35.1 psu (or salinity values indicative of ocean water). Species richness in the Bay ranged between 2 and 19 species per sample.



### Fish Tissue Contaminants Index

The fish tissue contaminants index is rated good for Morro Bay, although this rating should be interpreted cautiously because of the small number of sample stations where fish tissues were obtained (7 of 30 stations). Figure 6-47 shows that fish tissue at 71% of stations (5 of 7) where fish were caught had tissue contaminant levels below EPA Advisory Guidance values using whole-fish contaminant concentrations. These risk calculations are appropriate for populations that consume whole fish. Samples from two Morro Bay stations were rated fair based on concentrations of mercury and DDT.



**Figure 6-47.** Fish tissue contaminants index data for Morro Bay, 2003 (U.S. EPA/NCA).



A great egret lazily takes flight across Morro Bay (Morro Bay NEP).

© Morro Bay NEP



## HIGHLIGHT

### Kids' Beach Cleanup Event and Aerial Art a Success

Two hundred second-grade students traveled from the Central Valley to Cayucos State Beach, CA, on May 13, 2005, for the Kids' Beach Clean-up Event. In an effort to protect marine resources, the students volunteered to collect trash and other debris from the beach to keep these materials from entering the ocean. The participating students were from Strathmore and Seville, CA, two small towns in the Central Valley county of Tulare. This was the first visit to the seashore for many

of the students. A week before the field trip, Morro Bay NEP staff member Cheryl Lesinski gave a classroom presentation to students that focused on the impacts that marine debris and pollution can have on beach resources. This project was funded by the California Coastal Commission's Whaletail License Plate program.

As part of the beach cleanup event, the entire group took part in an aerial art formation (see photo). Standing together in lines, the children spelled out the word "PROTECT" as a reminder to all Californians that the ocean is a valuable resource that needs our help (Morro Bay NEP, 2005).



California students involved in beach cleanup event (Morro Bay NEP).

## Morro Bay National Estuary Program Indicators of Estuarine Condition

The Morro Bay NEP and its partners employ a variety of monitoring methods and use a suite of indicators to track changes in water quality, suitable habitat areas, and the health of living resources in the Morro Bay estuary. The following section discusses selected key indicators that are used by the Morro Bay NEP to evaluate the health of the estuary and its watershed. Additional information is available at <http://www.mbnep.org>.

### Water and Sediment Quality

The Morro Bay NEP's Volunteer Monitoring Program (VMP) is the main program conducting water quality monitoring in the study area. The Morro Bay VMP monitors monthly for total coliform and *E. coli*, nutrients, dissolved oxygen levels, pH, salinity, flow, temperature, and HABs (Kitajima, 2003). In accordance with EPA's recommendations, the Morro Bay VMP has begun using *Enterococci* as the main pathogen indicator for marine waters (Morro Bay NEP, 2006b).

Ongoing monitoring indicates that bacterial contamination and nutrient over-enrichment are key water quality concerns in the estuary and watershed. From 2002 to 2004, bacteria sampling results indicated that the majority of the creek sites sampled were unsafe for human contact in at least 30% of the samples collected and that three of the seven sites in the estuary were unsafe in 10% to 20% of the samples collected (Morro Bay NEP, 2006a). High fecal bacteria levels are of concern for shellfish beds, as well as for human health impacts from recreational contact with creek and Bay waters. Two of the three commercial shellfish lease areas in Morro Bay are partially closed because of elevated bacteria levels, and all harvesting areas are closed following storm events (Morro Bay NEP, 2000; 2006a). High levels of nitrates and phosphates are present in portions of the Chorro and Los Osos drainages. These increased levels of nutrients are mostly attributed to agricultural runoff, WWTP effluent, grazing lands, and poorly functioning septic systems (Morro Bay NEP, 2000).

### Habitat Quality

One of the key indicator measures used to evaluate habitat changes in Morro Bay is the acres and/or linear miles of habitat protected and restored. Since 2001, more than 3,000 acres of valuable wildlife habitat have been permanently protected in the Morro Bay watershed, and 4.5 miles of stream habitat have been restored (Morro Bay NEP, 2006a).

The monitoring of changes in the areal extent of different estuarine habitat areas (e.g., eelgrass, mudflats, salt marsh) is also useful. In particular, the Morro Bay NEP has found that the number of acres of eelgrass in Morro Bay is a good indicator of the health of living resources in the watershed. In 2003, the estuary contained approximately 330 acres of subtidal and intertidal eelgrass, 380 acres of salt marsh, 1,200 acres of intertidal mud flats, and 175 acres of subtidal habitat (USACE, 2003). The Morro Bay eelgrass beds are some of the largest and healthiest in central and southern California and support the highest diversity of invertebrates of any habitat in the estuary (Morro Bay NEP, 2000).

Sediment deposition is being tracked carefully to observe its impact on habitat conditions in the Morro Bay estuary because modeling of future sedimentation has suggested that the area suitable for eelgrass could be reduced by 48% during the next 50 years if sedimentation rates are not slowed (USACE, 2003). One specific goal of the Morro Bay NEP is a 15% reduction in average annual sediment loads in stream and estuary waters by 2010 (Morro Bay NEP, 2000). The recently adopted sediment TMDL calls for a 50% reduction in average annual sediment load during the next 50 years (CCRWQCB, 2002a). Monitoring stations to track deposition rates in the estuary were recently established, and detailed bathymetric surveys of the Bay will provide ongoing information about overall sedimentation rates (Morro Bay NEP, 2006a).

The number of invasive species in Morro Bay is another potentially useful indicator that is still under development by the Morro Bay NEP, but which may become a useful measure for habitat quality and the health of living resources over time. Portions of the estuary's various habitat have been impacted by invasive plant species. During a habitat survey conducted in



1998, the invasive species cape ivy was a dominant plant in the herb layer of Chorro Creek and was also present along the lower reaches of Los Osos Creek (Morro Bay NEP, 2000).

### Living Resources

Measurements of macroinvertebrate populations and diversities are also used to indicate the health of living resources in Morro Bay. Benthic infauna have been monitored annually at a number of creek sites in the Morro Bay watershed. Water quality monitoring provides a snapshot of conditions at that time, whereas macroinvertebrate analysis reflects stream health over a longer time period because long-term water quality affects which species ultimately establish themselves or thrive in the estuary watershed (Kitajima, 2003). The abundance of macroinvertebrates and the ease of sampling also make benthic infauna good environmental indicators.

Central Coast steelhead trout have been listed as a federal threatened species by the NMFS because of declining habitat quality throughout the species range. By 2000, the steelhead population in Morro Bay had decreased to less than 1% of the 1950 population size. Anadromous (migratory) fish are good indicators of

resource health because they depend on the entire ecosystem, from the upper watershed to the coastal ocean, for their life cycle (Morro Bay NEP, 2000). Local population size and availability of habitat for this species are two of the indicators used to evaluate living resources in Morro Bay.

Morro Bay is also increasingly being recognized as an area that is critical in supporting resident and migratory bird species. Black brant and other migratory waterfowl utilize the Bay as an overwintering site and as a feeding and resting site during their migration along the Pacific Flyway. Surveys of the black brant population are used to study the density, age composition, and habitat delineation of this species. Average mid-winter, single-day counts of the brant have declined from about 7,000 in the 1930s to roughly 3,000 in 2000 (Roser, 2003). The Morro Bay NEP coordinates biannual surveys of shore-bird abundance and diversity, which have shown relatively stable trends since the mid-1990s (Morro Bay NEP, 2006a). The Audubon Society consistently rates Morro Bay as among the top 5 areas (out of 963 sites nationwide) for diversity of winter bird species, with around 200 species and more than 50,000 individual birds counted in a single day in December (Morro Bay NEP, 2000).



Schools of top smelt are common in Morro Bay (Morro Bay NEP).

## Current Projects, Accomplishments, and Future Goals

Some of the recent environmental success stories and restoration efforts in Morro Bay include the following:

- Project Clearwater (formerly the Morro Bay Watershed Enhancement Project) has helped farmers and ranchers improve land management practices. These efforts have resulted in the implementation of more than 235 BMPs and helped prevent more than 172,000 tons of soil erosion (CSLRCD, 2006).
- The 1,860-acre Maino Ranch Conservation Easement has been purchased to protect the natural resources, rural character, and working landscape of the Maino Ranch in the Morro Bay watershed. The easement greatly restricts the subdivision and development potential of the ranch (Morro Bay NEP, 2000).
- A 580-acre property spreading below Hollister Peak and across Chorro Creek has become one of California's newest ecological reserves. The Chorro Creek Ecological Reserve, once slated for a golf course and resort, includes approximately two miles of Chorro and San Luisito creeks, as well as large swaths of restorable flood plain near scenic Highway 1. The Morro Bay NEP is working with the California Department of Fish and Game to restore the natural floodplain and freshwater wetlands on this property (Morro Bay NEP, 2006a).
- The Morro Bay NEP's efforts to reduce bacterial pollution include working with the boating community, limiting cattle access to watershed creeks, and encouraging the implementation of a centralized WWTP for the bayside community of Los Osos, which is currently on individual septic systems (Morro Bay NEP, 2000).
- The Central Coast Regional Water Quality Control Board (CCRWQCB) has declared Morro Bay and its creeks as impaired waters for a number of pollutants and has adopted TMDLs covering the estuary and creeks for pathogens, sedimentation, nutrients, and dissolved oxygen (CCRWQCB, 2002a; 2002b; 2004a; 2004b; 2004c; 2005). The Morro Bay NEP is a key component of the implementation and monitoring for these efforts to improve water quality. Specific actions taken to control nutrient inputs to the Bay include implementing nitrogen-control measures for wastewater effluent, improving wastewater treatment in Los Osos, and assisting farmers and ranchers with BMPs (Morro Bay NEP, 2000; 2004).

## Conclusion

Based on data from the NCA survey, the overall condition of Morro Bay is rated good. The Morro Bay NEP considers the primary threats facing the estuary and its watershed to be erosion and sedimentation, bacterial contamination, low freshwater flows to the Bay, elevated levels of heavy metals and other toxics in Bay sediments, nutrient over-enrichment, loss of wildlife habitat, and the decline of the local steelhead trout population. The Morro Bay NEP is a collaborative effort that brings local citizens, local government, non-profit agencies, and landowners together to protect and restore the physical, biological, economic, and recreational values of the Morro Bay estuary. The primary goals of the NEP are to slow the process of Bay sedimentation; protect and enhance steelhead trout populations and habitat; protect and restore the integrity of the diverse habitats in the watershed and the wildlife that depend on them; promote public awareness and involvement in estuarine management through outreach, education, and volunteering; and ensure that estuary and creek waters are clean and fully support healthy eelgrass beds, safe recreational uses, and thriving fish and shellfish populations.