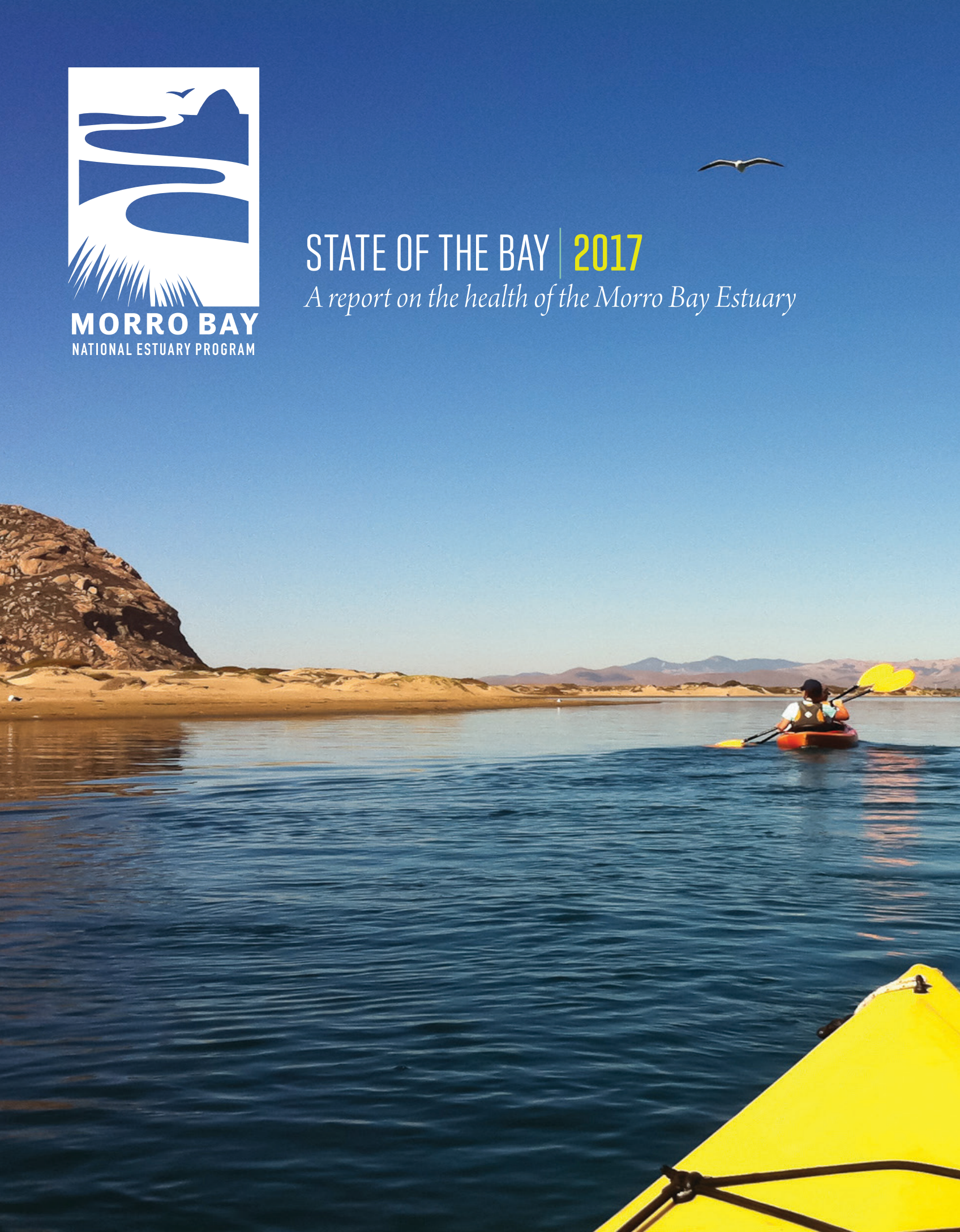
MORRO BAY
NATIONAL ESTUARY PROGRAM

STATE OF THE BAY | 2017

A report on the health of the Morro Bay Estuary



How healthy are the estuary and the lands that surround it?

Morro Bay is a unique place, its waters supporting a diversity of wildlife and a beautiful coastal community. It provides a living for some through fishing or tourism, while visitors and residents alike value its scenic beauty.

The Morro Bay National Estuary Program is a local non-profit that brings together citizens, government, non-profits, and landowners to protect and restore the Morro Bay estuary. Our efforts include restoration, monitoring, and education to preserve this nationally-recognized estuary.

This report examines the health of the Morro Bay estuary. This assessment, which is conducted every three years, provides important information on environmental trends, while guiding efforts to protect and restore this special place.

Morro Bay sand dunes

Questions Answered in this Report

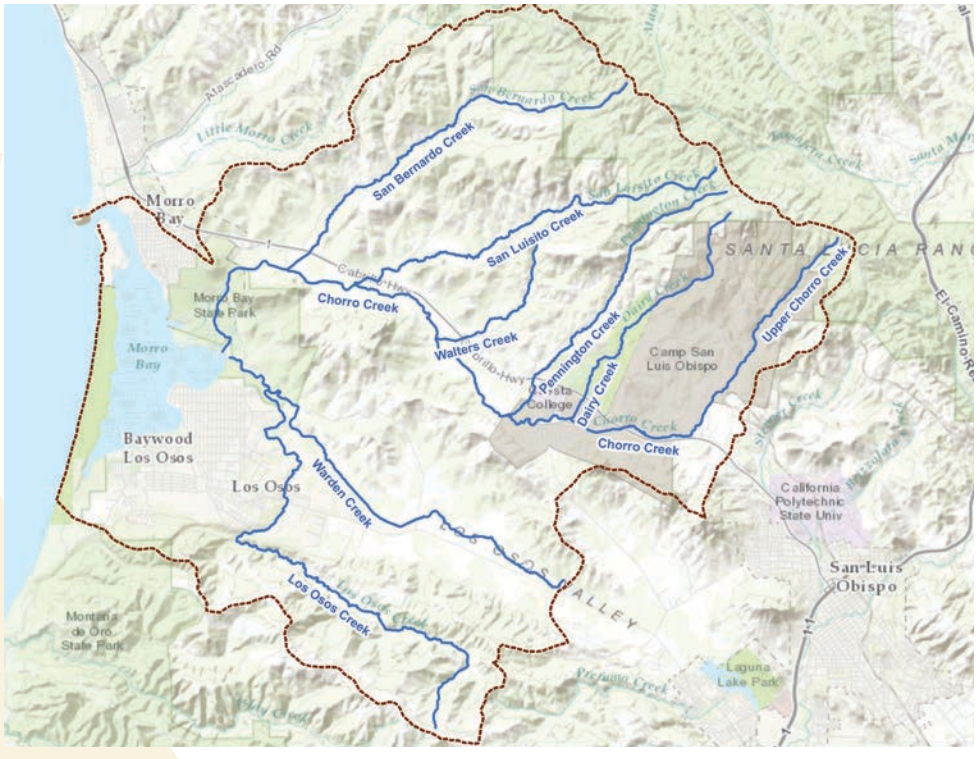
Cover photo by Russ White

Authored by Estuary Program Staff:

Ann Kitajima with great support from Lexie Bell, Karissa Willits, Rachel Pass, Cynthia Milhem, and Evan Mundahl.
A special thank you to Sara Markham for the beautiful eelgrass and wildlife illustrations.

The Estuary Program sincerely thanks its many partners, volunteers, and committee members for their tireless dedication to the Morro Bay Estuary and their continued support. This report was funded in part by a grant from the U.S. EPA.

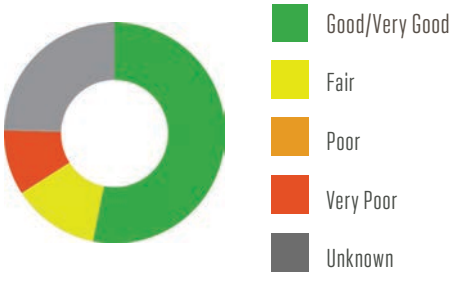
The Morro Bay Estuary and its Watershed



The Morro Bay watershed is a network of creeks that drain rainfall and other freshwater from 48,000 acres of land into Morro Bay. The bay itself is an estuary, a place where freshwater from land meets the salty water from the ocean, creating a rare environment along the California coast. The connection between the land and the estuary means that what happens on the land has a large impact on the health of the estuary.

How to Read the Estuary Health Symbols

The Estuary Health Symbols represent how the Morro Bay estuary and watershed are doing in terms of each of the indicator questions. These symbols show how much of the bay or watershed is considered in Good (green), Fair (yellow), Poor (orange), Very Poor (red), or Unknown (gray) health.



Is water in the creeks and bay clean enough for fish and aquatic life?

Some areas are healthy and others are degraded.

Plants, animals, birds, and aquatic life depend on clean water and healthy habitats. Just as we need oxygen to survive, the waters of our estuary and creeks must have a certain amount of oxygen in order to support a diversity of life. Human activities can have a negative impact on clean water. If we over-fertilize our yards or allow our cars to leak oil on the ground, stormwater running off the land picks up these pollutants and can wash them into our creeks and bay. This polluted stormwater can degrade the water quality and habitat quality. The Morro Bay National Estuary Program monitors the waters of the estuary and the creeks that drain into it to see if they are healthy enough to support wildlife.

Bay Oxygen Status

The map shows a score for dissolved oxygen (the amount of oxygen available in water for plants and animals) using monthly readings from 2002 through 2015 at seven monitoring sites around the estuary. Estuary Program volunteers paddle to these sites during the early morning hours to collect these measurements because oxygen levels are lowest before the sun comes up. Locations marked by a yellow dot have oxygen levels that are considered to be Fair. They are lower than ideal, but they still support healthy populations of fish and marine life. Sites colored orange are considered to have Poor oxygen levels, and those that are red have Very Poor levels. These sites may not support a diversity of aquatic life. These low oxygen conditions are partly due to the physical layout of the bay. The back bay's shallow waters do not get flushed out by the tide as frequently because they are farther from the bay mouth and the tidal channels. Shallow water also warms more quickly in the sun, and warm water cannot retain as much oxygen as cold water.

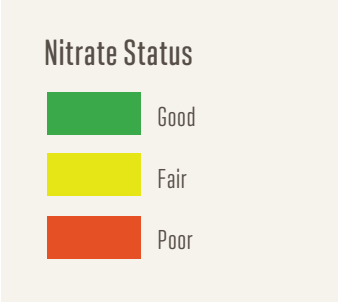
Bay Oxygen Status

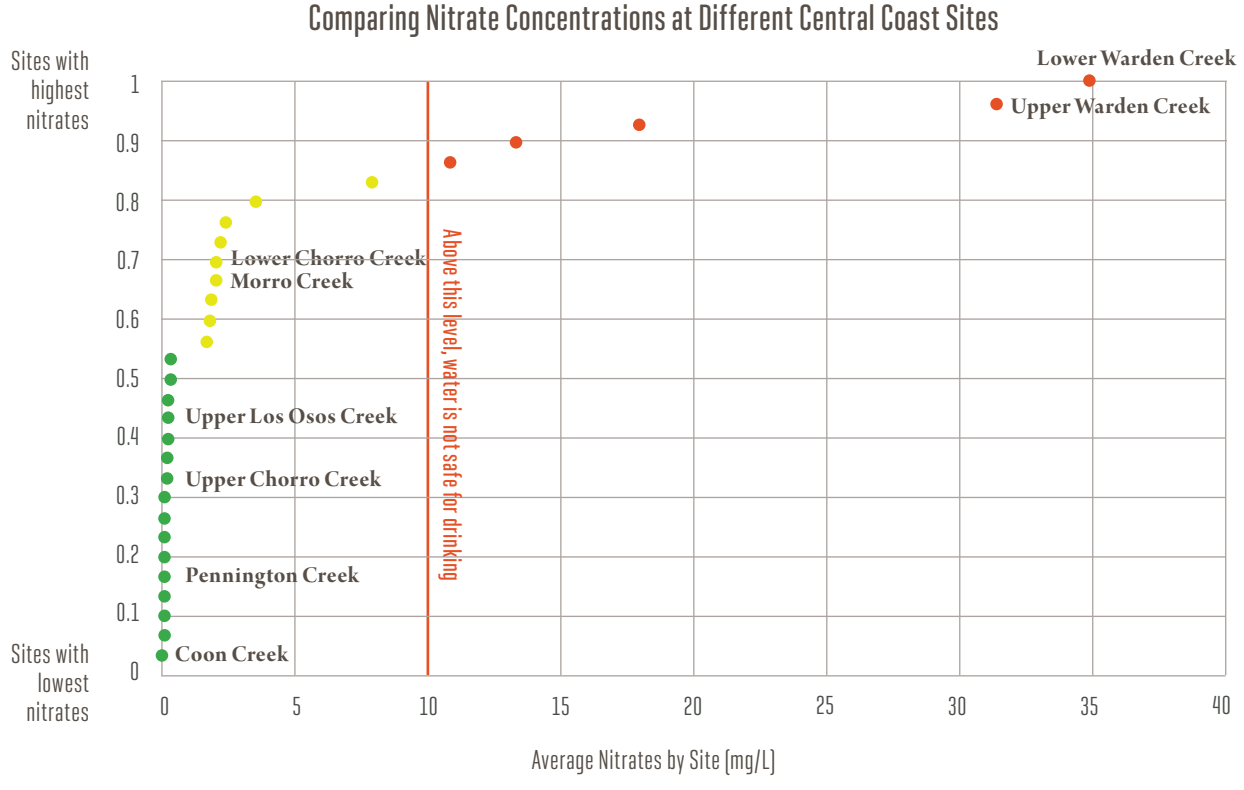
- Good/Very Good
- Fair
- Poor
- Very Poor

Nitrate Status in the Watershed

Our watershed creeks are important because they provide habitat for a wide variety of aquatic plants and animals that depend on clean water. Creek water quality is also important because the creeks empty into the Morro Bay estuary. Pollutants present in these freshwater sources can be transported into the estuary.

To understand the health of our watershed creeks, we analyzed nitrate data.





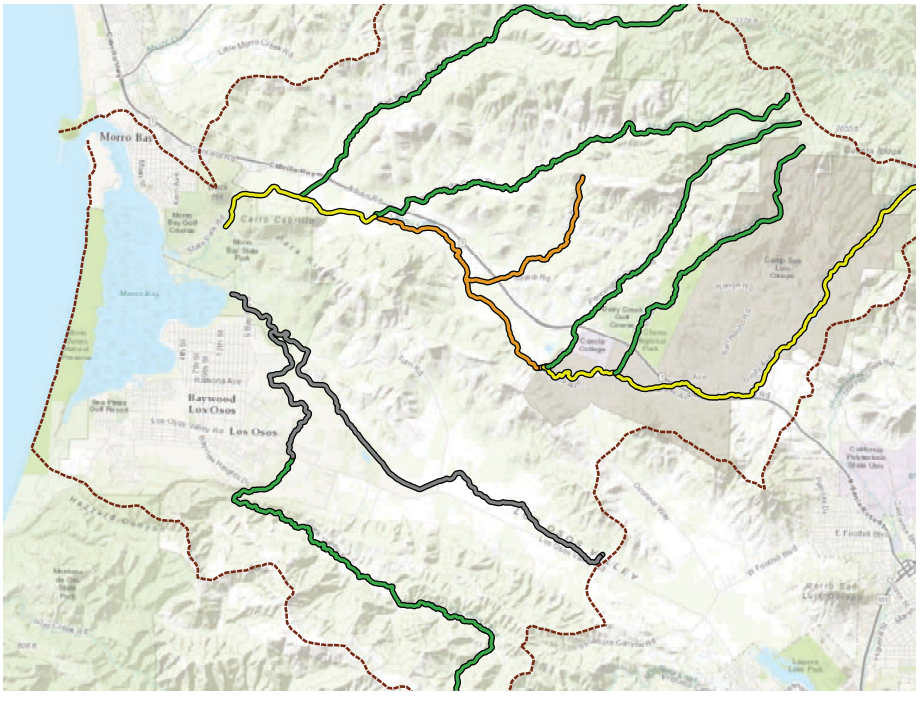
Nitrates are nutrients that are essential for life. Nitrates come from decomposing plants and waste from animals, and occur naturally in creeks. Nitrates can also come from excess fertilizer, treated wastewater, and animal waste. If too much nitrate is present in the water, it can create an imbalance that stimulates algae growth. This algae can consume oxygen in the water, leaving less for fish and plants. Thus, elevated nitrate levels often result in oxygen levels that are lower than desirable.

The graph above shows the average nitrate concentrations for our watershed creeks and a selection of creeks throughout the Central Coast. The average nitrate level was calculated for each location, and then the sites were ranked from the lowest to the highest nitrate levels. Creeks colored green are considered Very Good or Good, with nitrate levels low enough to leave adequate oxygen in the water to support the most sensitive aquatic life, including endangered steelhead. Creeks colored yellow are considered Fair and will support aquatic life at most times of the year. Creeks colored red are Very Poor, and their high nitrate levels mean that they regularly lack adequate oxygen to support sensitive aquatic life.

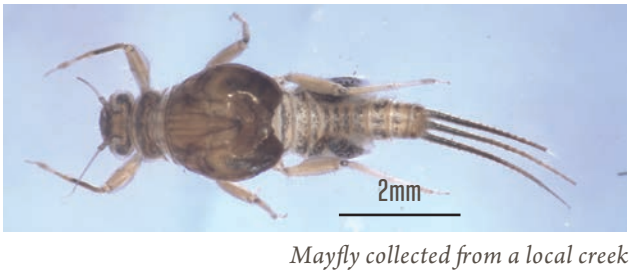
Volunteers monitor water quality on a local creek.

Creek Health in the Watershed

Volunteers monitor habitat conditions on a local creek.



Another indicator of creek water quality is the type of bugs that live there. Bugs that spend a portion of their life cycle in the creek have varying sensitivities to pollution and poor water quality conditions. We sample bugs from local creeks each spring and send them to a lab for counting and identification. If sensitive bugs such as stoneflies and mayflies are found in a creek, that indicates that the waters have high levels of oxygen, cool temperatures, and minimal pollutants. Other bugs, such as worms and snails, are tolerant of poor water quality and habitat. Based on the types of bugs living in a creek, we assign it a score according to a system developed by the state of California. The map above shows the averaged scores for all sites on each creek. The date range varies by site, with some data going back to the mid-1990s. The creeks colored green have a Good rating with water quality and habitat to support sensitive bugs and fish. Creeks colored yellow have a Fair rating and can still support robust aquatic life, but habitat quality is degraded and sensitive species may not thrive. Creeks with a Poor rating are colored orange. They suffer from poor water quality and habitat.



Mayfly collected from a local creek

Is Morro Bay safe for swimming?

Yes, in most areas.

The waters of Morro Bay, by turns glassy and choppy, attract visitors year-round. Sailing, fishing, surfing, kayaking, and paddleboarding are all popular pursuits. Clean water is an essential component for these recreational activities. If the water isn't clean, it can transmit bacteria, viruses, and protozoa that can cause illnesses in humans.

How do potentially harmful bacteria reach the bay? Sources could include sewage spills from treatment plants or boat waste holding tanks, or waste from wildlife or domestic animals.

To determine the safety of the waters, the Morro Bay National Estuary Program and its volunteers conduct monthly monitoring at eight bay-shoreline sites. Volunteers sample the waters and test for indicator bacteria. These are bacteria that tend to be present in the gut of warm-blooded animals, so detecting them in the water indicates that fecal matter may be present.

An Estuary Program volunteer collects a sample from Sharks Inlet. Volunteers collect samples and conduct analysis monthly at eight bay-shoreline sites to determine if bay waters are safe for swimming.

Bacteria Status in the Bay

- Good/Very Good
- Fair
- Poor
- Very Poor

The map shows the results of monthly sampling for enterococcus, an indicator bacteria for marine waters. Green drops are sites with good water quality measured in most of the samples from 2005 through 2016. Yellow drops indicate slightly elevated bacteria levels. Those sites exceeded the bacteria standard for safe swimming in 20% or less of the samples tested.

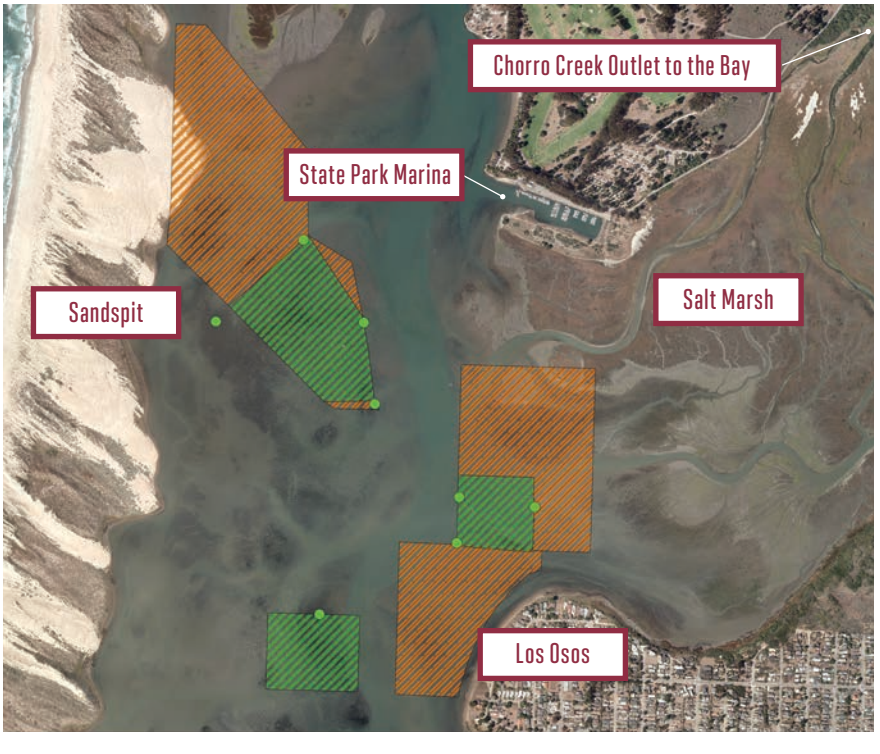
Is the bay clean enough to support commercial shellfish farming?

Yes, in active harvesting areas.

The waters of the Morro Bay estuary are clean enough to support fresh local seafood sources, such as oyster farming. Two commercial shellfish farms, Morro Bay Oyster Company and Grassy Bay Oyster Company, produce oysters locally. The farmers harvest oysters from designated areas that undergo regular testing to ensure that they meet water quality standards. The California Department of Public Health oversees this process.

This map shows active lease areas, where harvesting can occur, in green. These areas increased in 2015 when one farmer conducted additional testing to show good water quality. Harvesting is prohibited in inactive lease areas, shown in orange, due to historically poor water quality or lack of data. Poor water quality can be caused by sewage spills, storm-pollution runoff, or wildlife. The dots show regular testing locations. Their green color indicates bacteria levels safe for harvesting.

Photo of Pacific oysters courtesy of Grassy Bar Oyster Company



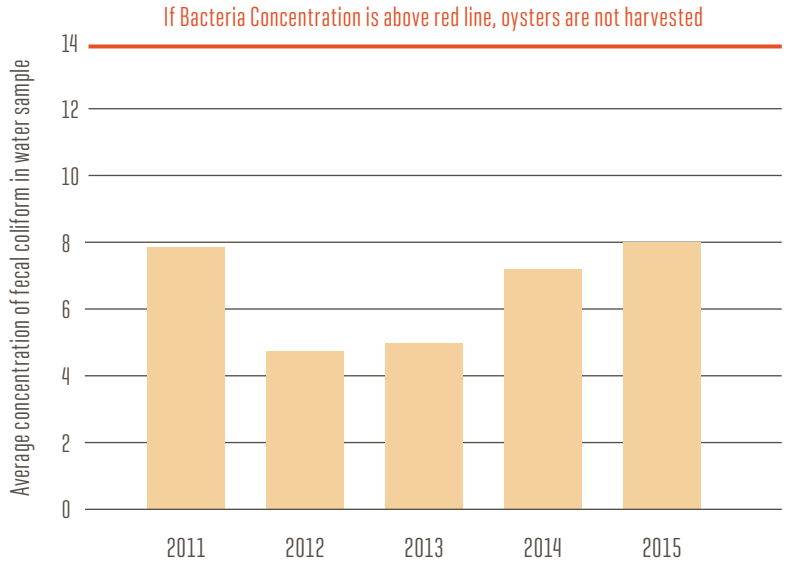
Bacteria (Fecal Coliform) Status

- Good
- Poor

Shellfish Lease Status

- Inactive Growing Area
- Active Growing Area

Average Concentration of Bacteria for One Oyster Farming Monitoring Site



This graph shows the average bacteria levels at one of the water quality testing sites. Bacteria levels must be below the red line in order for the oysters harvested from the site to be safe for people to eat. Bacteria levels at this site, as well as all sites pictured on the map, have been consistently safe over the last five years.

Pacific oyster illustration

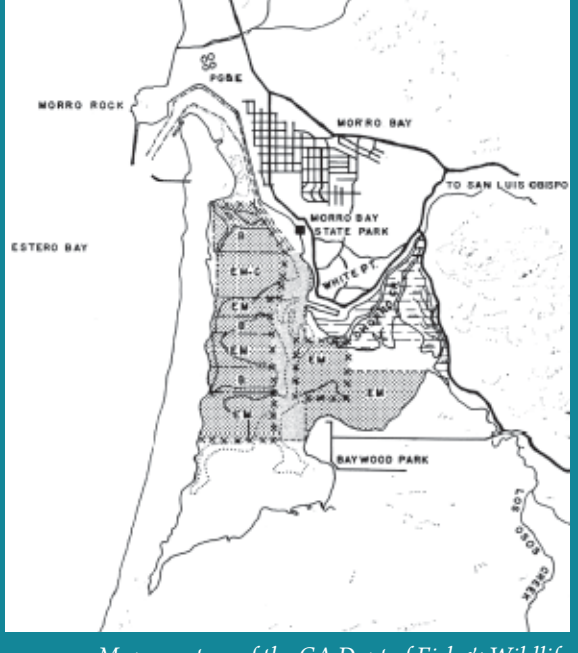
The History of the Oyster in Morro Bay

The oyster industry in California began with the Gold Rush. This influx of easterners wanted familiar foods, including the eastern oyster. Native oysters, with their darker meat and strong coppery flavor, did not appeal to eastern palates. Initially, oysters were shipped to California by boat from Washington state. With the completion of the transcontinental railroad in 1869, fresh eastern oysters could reach the west coast in three weeks. Oyster seed was also sent west, where it was raised to harvestable size, often in San Francisco Bay.

In 1910, the industry began declining in San Francisco, likely due to increasing industrial pollution and changing economics. In 1930, the California Department of Fish and Wildlife introduced the Pacific oyster from Japan. Pacific oysters far out-competed both the native Olympia oyster and the eastern oyster due to their lower production costs and mortality rates.

By 1935, over 70% of 2,300-acre Morro Bay was allotted for oyster growing (shaded dark gray on historic map). Farmers scattered seed oysters from boats at high tide and harvested them by hand at low tide after two years.

When trade with Japan was cut off during WWII, Morro Bay obtained seed from Washington state and became the leading oyster producing area in California. In 1964, Morro Bay's production peaked at nearly 250,000 pounds of shucked oysters harvested during the year. There are currently 75 acres available for oyster farming, which is only 3% of the bay's acreage.



Map courtesy of the CA Dept of Fish & Wildlife

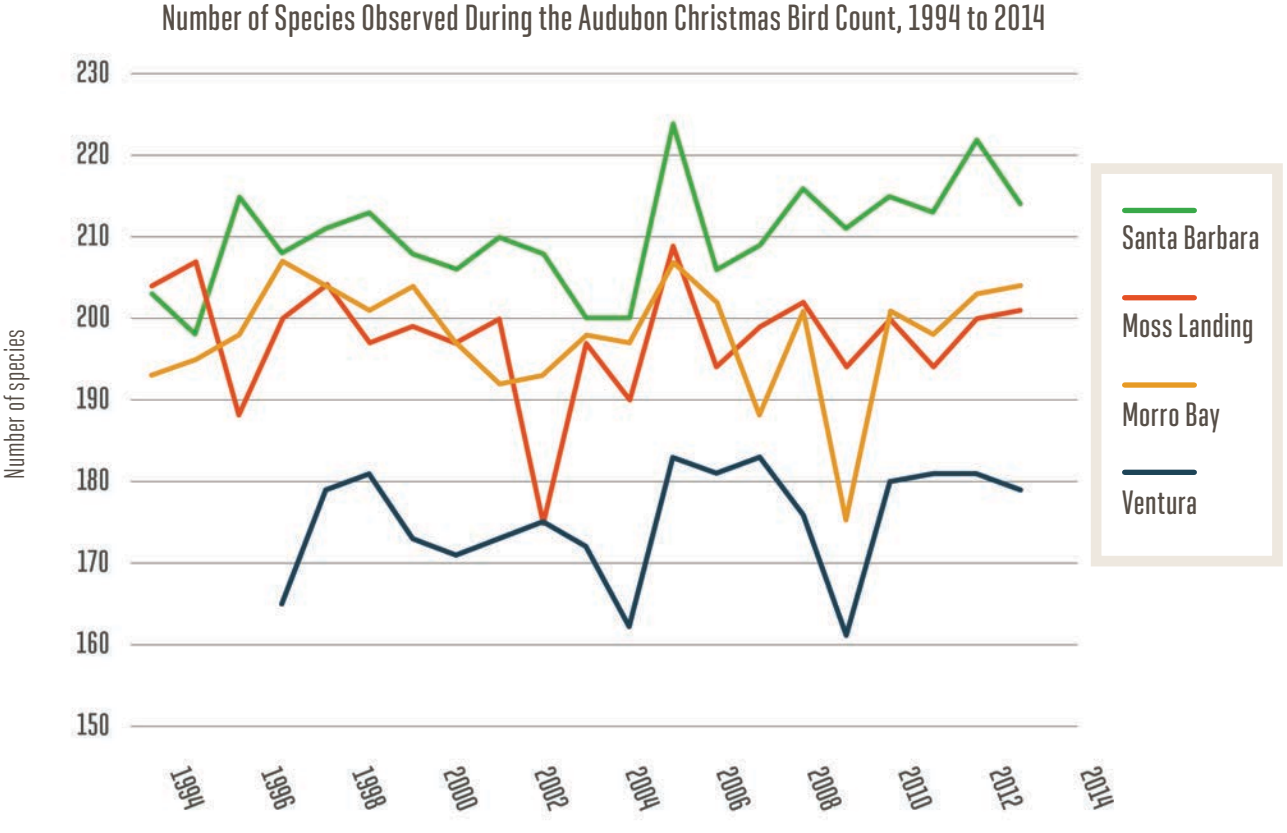
Are bird populations that depend on the bay habitat stable?

Yes, most bird populations in the Morro Bay area are stable, but some birds face difficult conditions or are changing their behavior due to forces such as climate change.

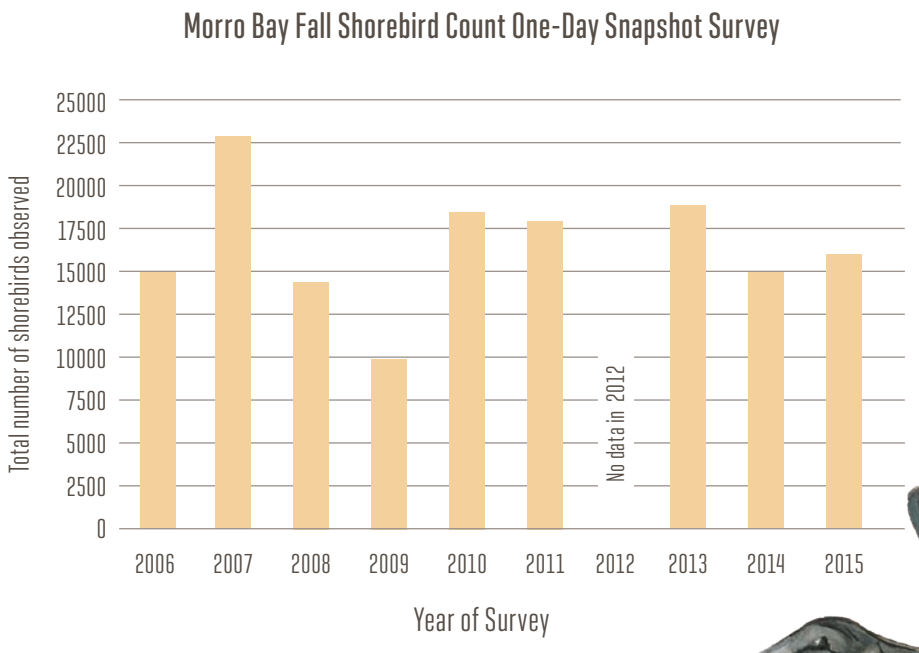
Birds have long been a symbol of a healthy and thriving environment. Morro Bay is known for its wide diversity of bird inhabitants and feathered visitors, including the white pelican, cormorant, peregrine falcon, and the black brant. The great diversity (more than 200 birds species live in and migrate through Morro Bay) indicates a healthy environment. In fact, birds play a role in keeping the bay healthy by dispersing native plant seeds and serving as a crucial link in the marine food web. The diversity and number of birds has established Morro Bay's reputation as a birder's paradise, contributing to a thriving ecotourism economy.

Willet photo courtesy of "Mike" Michael L. Baird

Regional Bird Populations



In many ways, bird populations associated with the bay are stable. A nationwide annual Christmas bird count, conducted by the National Audubon Society, shows that the diversity of birds in Morro Bay has stayed relatively stable over the last 20 years. Morro Bay's bird populations are comparable to Moss Landing and Santa Barbara, two similar coastal areas within the region.

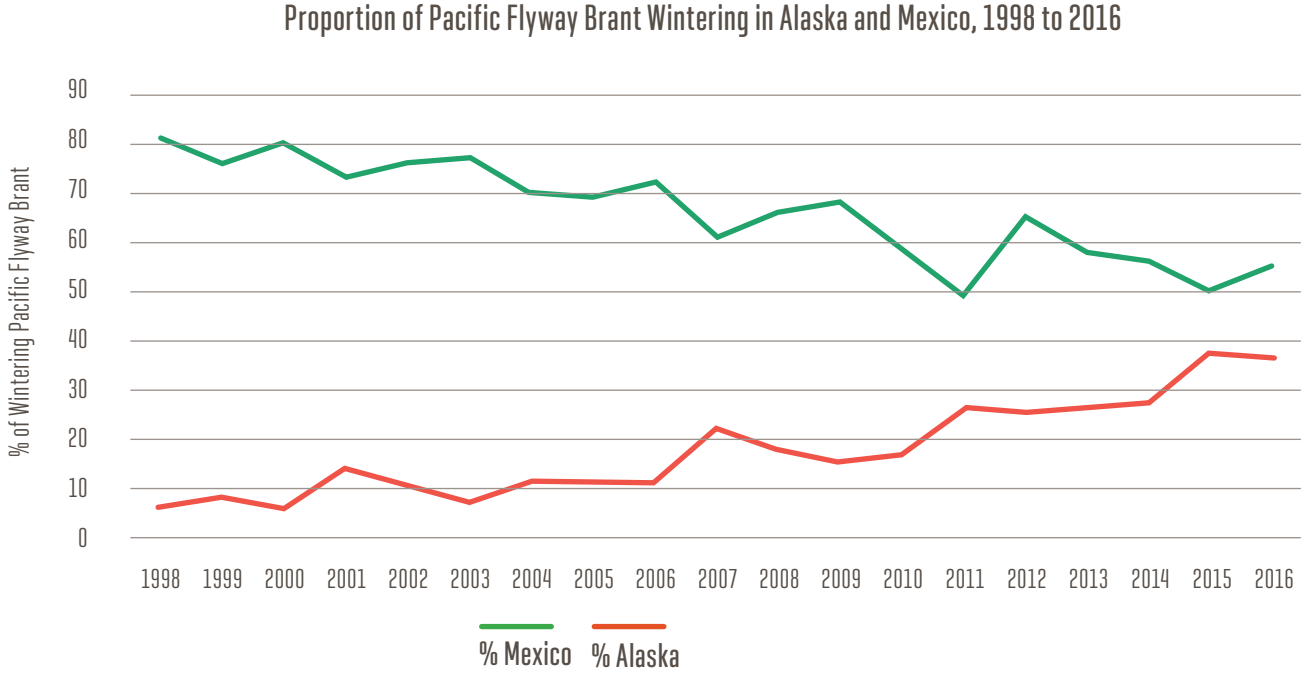


Morro Bay Shorebird Populations

Similarly, an annual one-day shorebird count has shown stable numbers of birds over the past decade. An average of approximately 16,000 birds has been counted annually every fall. Shorebirds include curlews, avocets, stilts, and many others.

Black brant illustration

Changing Migratory Patterns: A Closer Look at Black Brant



Another species facing challenges in the bay is the black brant. Traditionally, these small stocky geese migrate south from Alaska to escape winter on the tundra. Eelgrass is their primary source of food. Warming global temperatures mean that fewer brant are making the 3,000-mile journey each winter. The green line on the graph above shows the decreasing number of brant migrating south each winter, while the red line shows the increase in the number of brant remaining in Alaska year-round. This trend, in combination with Morro Bay's reduced eelgrass acreage, has severely decreased the number of brant we see here in the wintertime.

Does Morro Bay support healthy eelgrass beds?

No, the amount of eelgrass in the bay declined sharply, but the rate of loss appears to have stabilized.

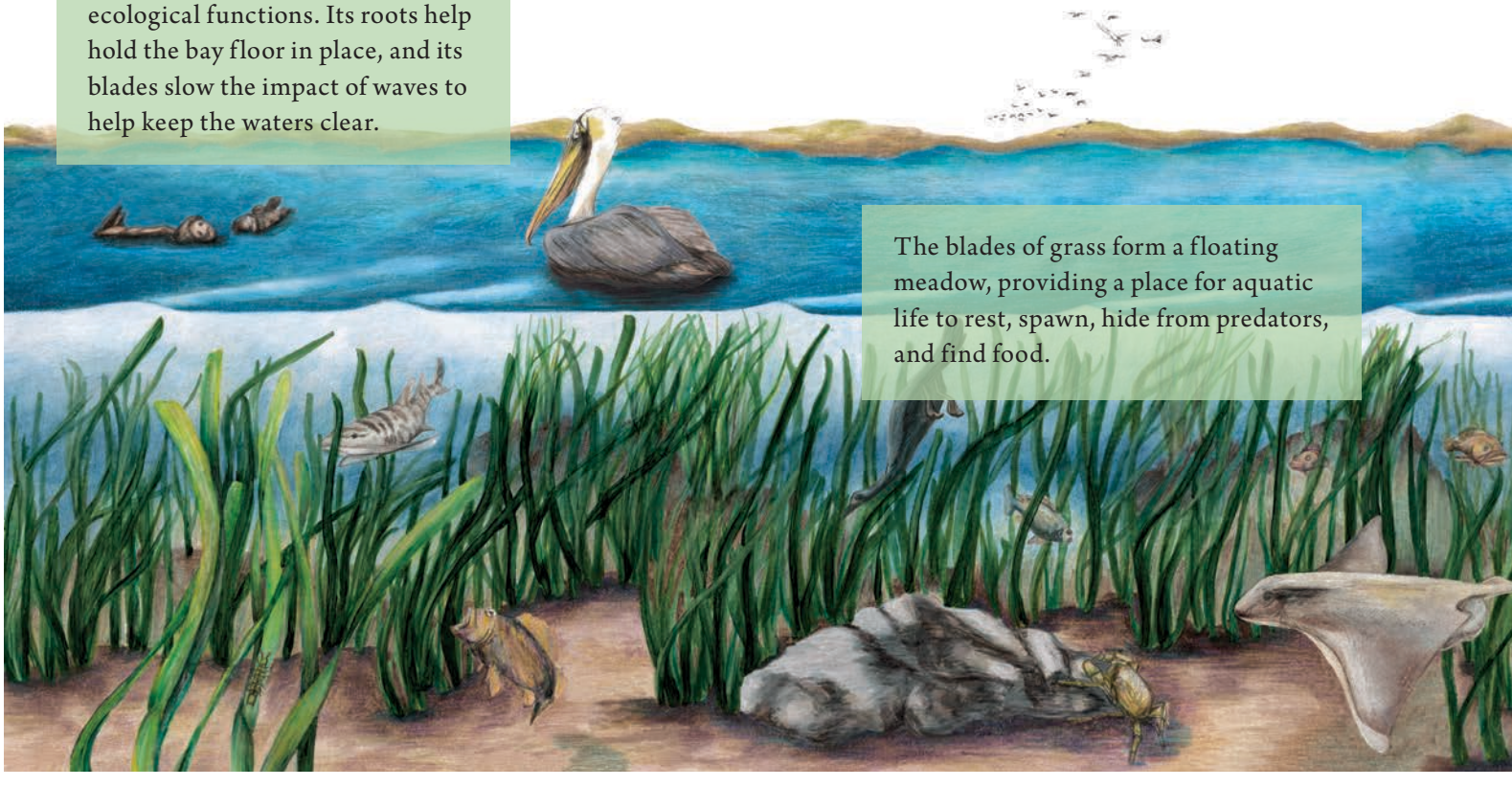
Historically, Morro Bay supported a healthy population of eelgrass, a submerged aquatic plant that grows in shallow marine and estuary environments. Eelgrass puts down roots in sandy soils and has long, ribbon-like leaves. Not a seaweed, eelgrass is a blooming, underwater grass. Despite Morro Bay's small size (over 400 Morro Bays would fit into San Francisco Bay), it supported the sixth-largest eelgrass area in California.

Due to the important role of eelgrass in the Morro Bay ecosystem, the Morro Bay National Estuary Program has been mapping it for the past 15 years. In 2007, our mapping efforts showed 344 acres of eelgrass in the bay. Over the next five years, eelgrass declined rapidly. Surveys in 2013 and 2015 indicated less than 20 acres in the bay, although the rate of loss appears to be stabilizing.

Since 2013, eelgrass acreage has held steady. Eelgrass bed loss has been in the mid and back bay. These areas have been impacted by the build-up of fine sediment over time, causing elevations to rise and the waters of the back bay to grow more shallow. This causes a variety of problems for eelgrass. Shallower waters leave eelgrass exposed during low tides, with the potential for it to dry out in the sun. Shallower waters also warm more quickly, and warm water cannot hold as much oxygen as cold water. The increase in fine sediment could even deprive eelgrass root structures of adequate oxygen. Additionally, when stirred up in the water, fine sediment can block out the light that eelgrass requires for photosynthesis. A shift in predator populations may also be affecting the eelgrass.

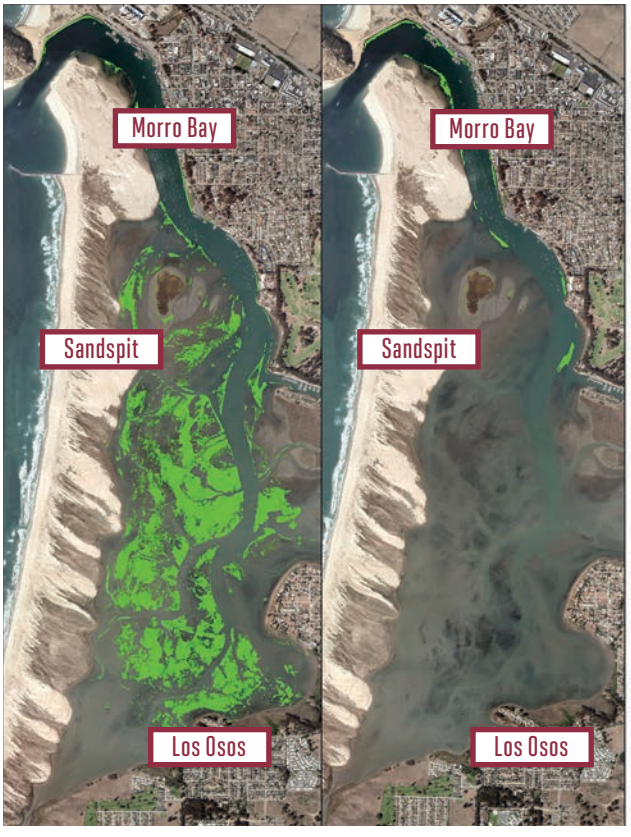
While we do not yet know the exact reasons for the decline, it is likely the result of multiple factors, including the build-up of sediment, changing water temperatures, and lower oxygen levels.

Eelgrass serves many essential ecological functions. Its roots help hold the bay floor in place, and its blades slow the impact of waves to help keep the waters clear.



The blades of grass form a floating meadow, providing a place for aquatic life to rest, spawn, hide from predators, and find food.

Eelgrass Acreage: 2007 and 2015

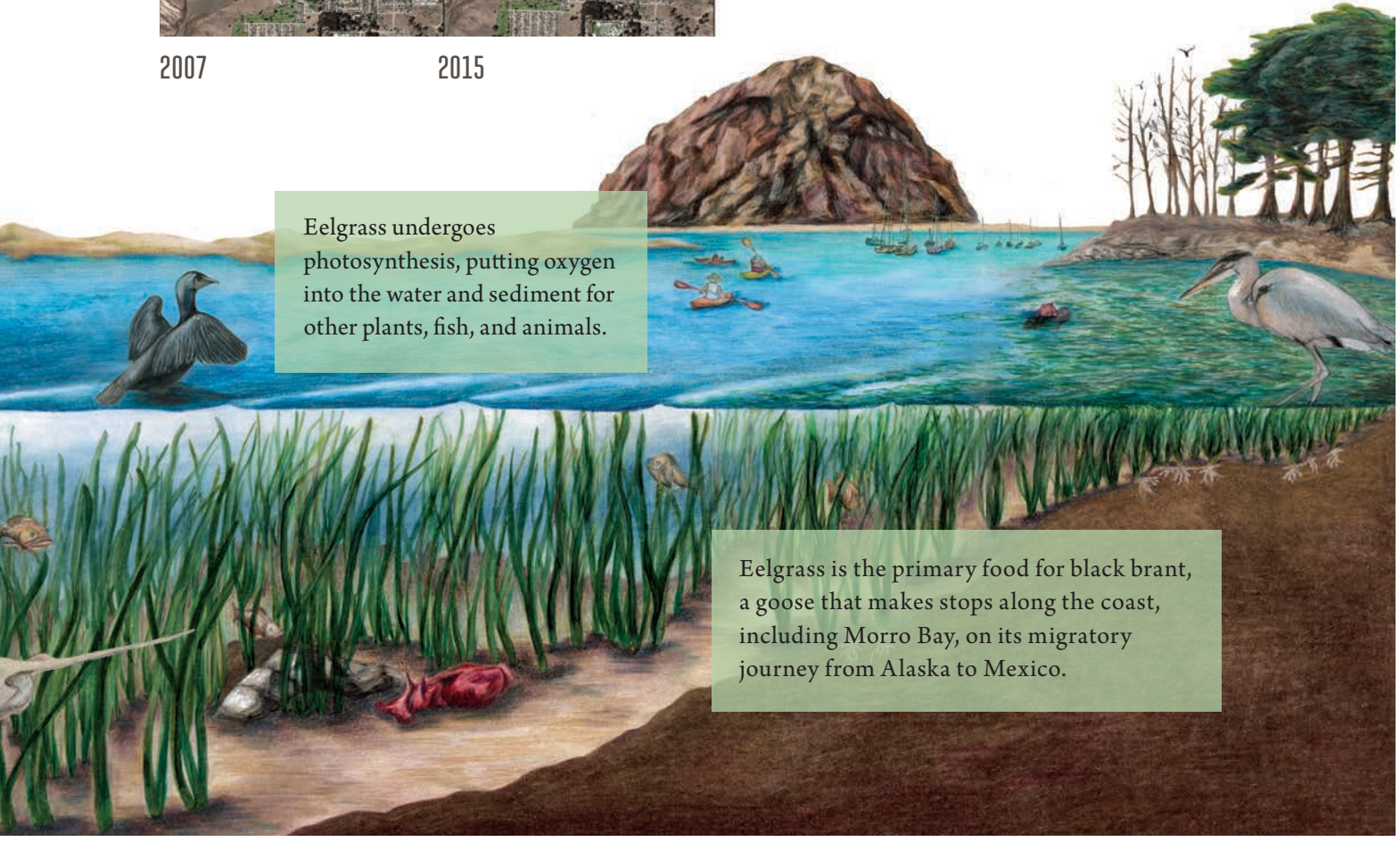


2007 2015

The image on the left shows eelgrass beds in 2007. Subsequent maps through 2013 showed a steady decline. The eelgrass acreage in 2015 was only 4% of what it was in 2007.

Partnering for Eelgrass

The Morro Bay National Estuary Program has sought funding and partnerships to better understand eelgrass losses in the bay. Future projects include mapping eelgrass across the bay, monitoring existing eelgrass beds, testing new restoration methods, and monitoring restoration beds from past planting efforts. Cal Poly research efforts include studying eelgrass genetics, bay water quality, and the impacts of eelgrass decline on other species such as birds and fish. Our goal is to better understand the reasons for eelgrass losses, in order to develop effective efforts to address them.



Eelgrass undergoes photosynthesis, putting oxygen into the water and sediment for other plants, fish, and animals.

Eelgrass is the primary food for black brant, a goose that makes stops along the coast, including Morro Bay, on its migratory journey from Alaska to Mexico.

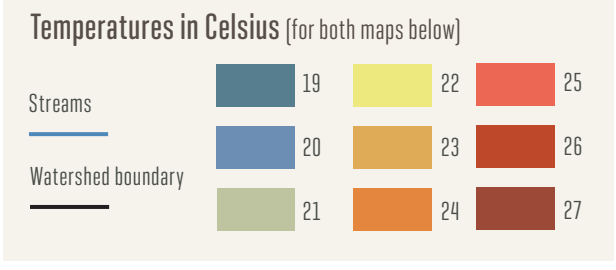
How will climate change likely affect the Morro Bay watershed and estuary?

Models and analyses continue to predict hotter, drier weather with more severe storm events and accelerating sea level rise.

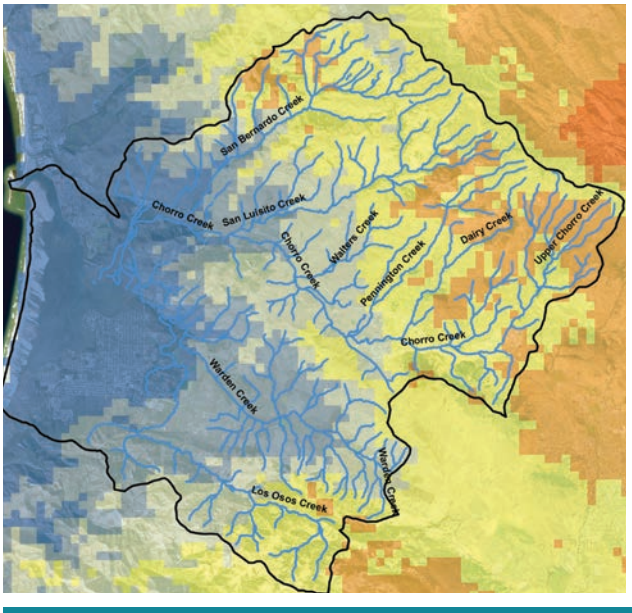
Floods, droughts, severe storms, wildfires—the impact of these events can be seen all around us, and all of these are exacerbated by global climate change. In an effort to understand how climate change might affect habitats and ecosystem processes in the Morro Bay estuary and its watershed, the Morro Bay National Estuary Program developed a climate vulnerability assessment. All climate change models agree that the Morro Bay climate will become drier and warmer in the future. Local climate dynamics will likely shift toward warmer surface and water temperatures, drier conditions, more intense storms, and continued sea level rise.

The Estuary Program assessed how these changes will impact our ability to protect and enhance the local ecosystem. For example, warmer average temperatures will likely lead to drier habitats, species population declines, changes to migratory patterns, more frequent algal blooms, and low dissolved oxygen levels. Since most sediment is transported in local creeks during big storms, a pattern of more intense storms can lead to increased erosion from creek banks, further accelerating the filling of Morro Bay. All of these potential impacts have a high likelihood of occurring and a high level of severity for the bay and watershed. The Estuary Program works to understand these potential impacts and implement projects to help address them.

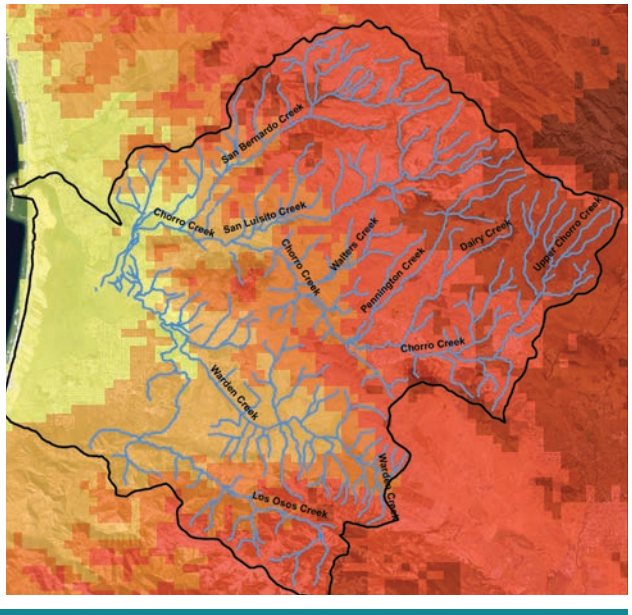
Morro Bay Temperatures Rising



Historic Average Maximum Temperature (1981 to 2010)



Projected Average Temperature (2070 to 2099)

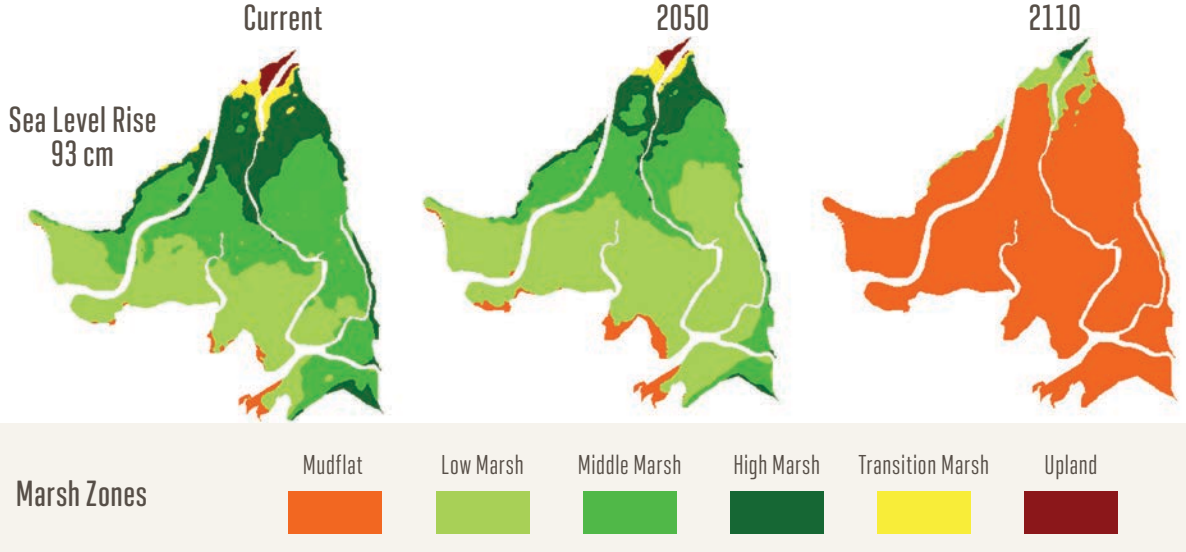


Historic average maximum temperatures for the last 30 years were calculated and compared to model results, which projected annual maximum temperature for the years 2070 to 2099 based on a moderate greenhouse gas emissions scenario. All models projected an increase of at least 3.6°F (2°C) in the average maximum temperature around downtown Morro Bay and the estuary.

A Glimpse of the Future: King Tides

King tides are the highest tides that occur during the year. During these extreme high-tide events, we can get an idea of what our coastline may look like with future sea level rise. King tides show us flooded areas that may be underwater in the future and infrastructure that may become compromised. You can learn more about king tides at california.kingtides.net.

Impacts of Sea Level Rise in Morro Bay



Another expected impact of climate change is sea level rise. Global sea levels are rising due to warming temperatures and glacial ice melt. Accelerating rates of sea level rise threaten low-lying coastal habitats and the ecosystem services they provide for human communities. While modeling indicates minimum impacts to infrastructure around the bay, impacts to the natural environment are expected to be more severe. To better understand future changes to sensitive tidal marsh habitats in Morro Bay, the U.S. Geological Survey and University of California, Los Angeles embarked on a multi-year study and modeling effort. The maps above demonstrate the shift from salt marsh habitat to primarily mudflats over the next century as sea levels rise. Models show similar impacts on Grassy Island. Loss of salt marshes means loss of habitat for fish, birds, and other animals. It also means loss of ecosystem services like protection against flooding and damage from storm events.

Do the estuary and watershed support a healthy population of steelhead?

No, the local steelhead population continues to be threatened even with some habitat improvements.

Steelhead, once abundant on the Central Coast, have decreased drastically. These unique fish require cold, clean water with healthy levels of oxygen. Degraded habitat, low water levels, migration barriers, and predators limit their numbers.

Steelhead are a special kind of rainbow trout found along the Pacific coast. They are born in streams like the ones in the Morro Bay watershed, migrate to the ocean to live for a few years, and then return to streams to spawn (lay their eggs). Unlike salmon, which die after they spawn, steelhead can repeat this cycle of migration and spawning. Steelhead can live for up to 11 years. As their life cycle requires healthy habitat in the creeks, estuaries, and oceans in order to thrive, they are a good indicator of overall ecosystem health.

In addition to clean water, steelhead require high quality habitat in our local creeks. They need deep pools to hide in, plants and trees to shade the water to keep it cool, and stream bottoms that are free of fine silt that can smother their eggs. They also need waterways that are free of migration barriers that prevent them from moving upstream to spawn and downstream to reach the ocean. Persistent drought also increases challenges for these fish. Low water levels lead to warmer temperatures and lower oxygen levels than what sensitive steelhead prefer. Low flow conditions also inhibit the ability of fish to travel freely, limiting their access to food and spawning areas.

Challenges for Steelhead

Passage Barriers

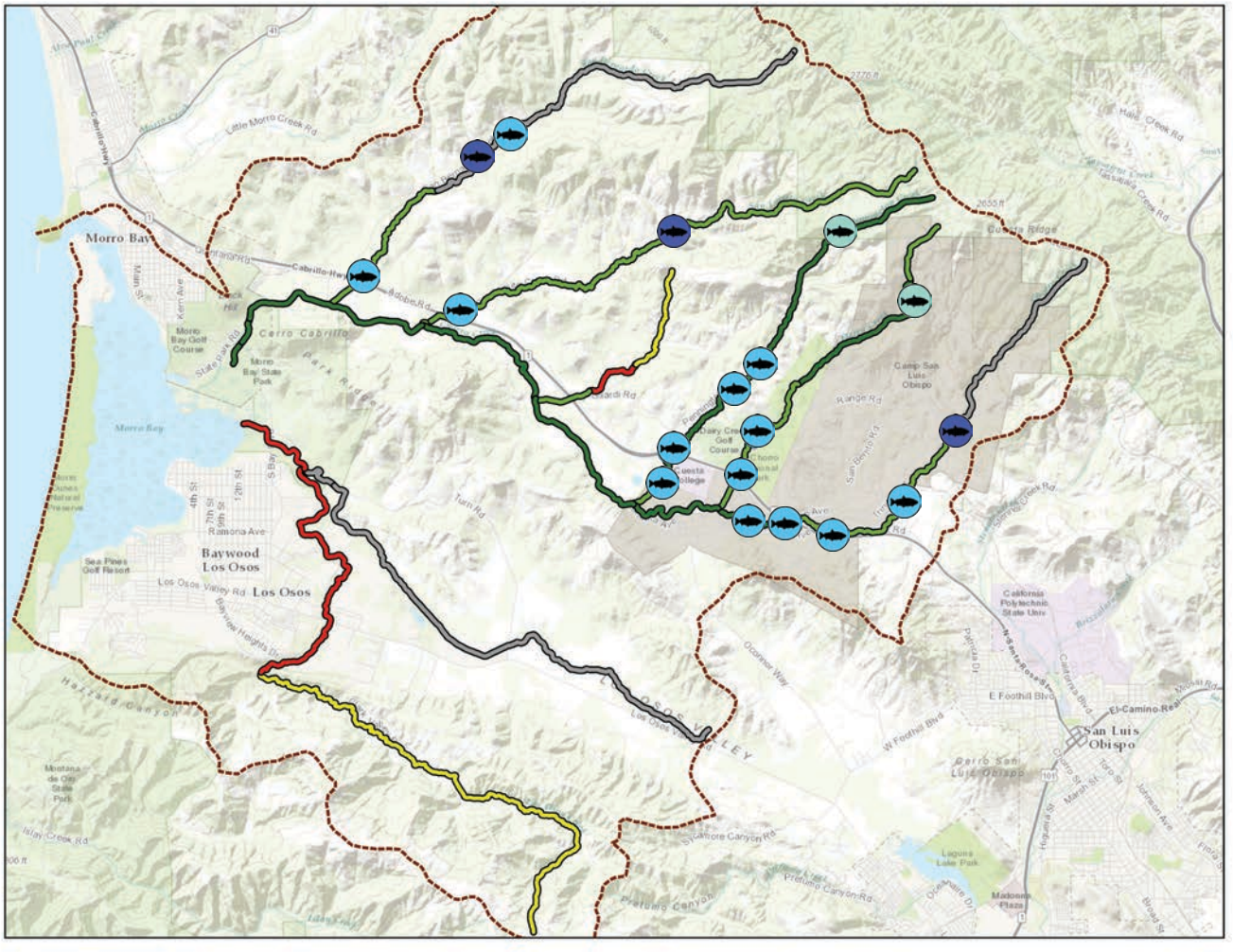
Steelhead cannot benefit from clean water and high quality habitat if their movements are blocked by migration barriers. Human structures such as bridges, culverts, and dams can act as barriers, particularly during the times of year when water flows are low. Some barriers are naturally-occurring, such as areas of creeks with too little water to swim through or extremely fast waters that prevent fish movement upstream. The bridge, pictured above, creates a partial barrier at certain times of year when flows are too low for fish to navigate this jump.

Photo courtesy of Freddy Otte

Hungry Predators

Aquatic invasive species such as Sacramento pikeminnow can have a devastating effect on local steelhead populations. Adult pikeminnow are voracious feeders whose diet includes frogs and fish, such as juvenile steelhead. They thrive in warmer waters and can live for more than 16 years. These fish are thought to have been introduced into our area for sport fishing. The 22-inch pikeminnow pictured above was captured from Chorro Creek. Removal of invasive species such as pikeminnow can greatly increase the chances of steelhead survival.

Steelhead Habitat and Fish Barrier Status



Fish Barriers

- Natural Total Barrier
- Partial Barrier
- Total Barrier

Steelhead Habitat Status

- Very Good
- Good
- Fair
- Poor
- Unknown
- Watershed boundary

The map above shows the quality of steelhead habitat throughout the watershed, taking into account the water quality, habitat quality (like tree cover and creek bottom conditions), and amount of water. The small blue circles with fish symbols indicate barriers to fish migration. Naturally-occurring barriers are colored light blue and can represent natural features like a steep slope or a waterfall. Total barriers, designated in dark blue, are those that are completely impassable to fish. Partial barriers, designated in the medium blue, are those that are not passable for some fish, such as at certain life stages like juveniles.

Adult steelhead photo courtesy of Nick Fernella

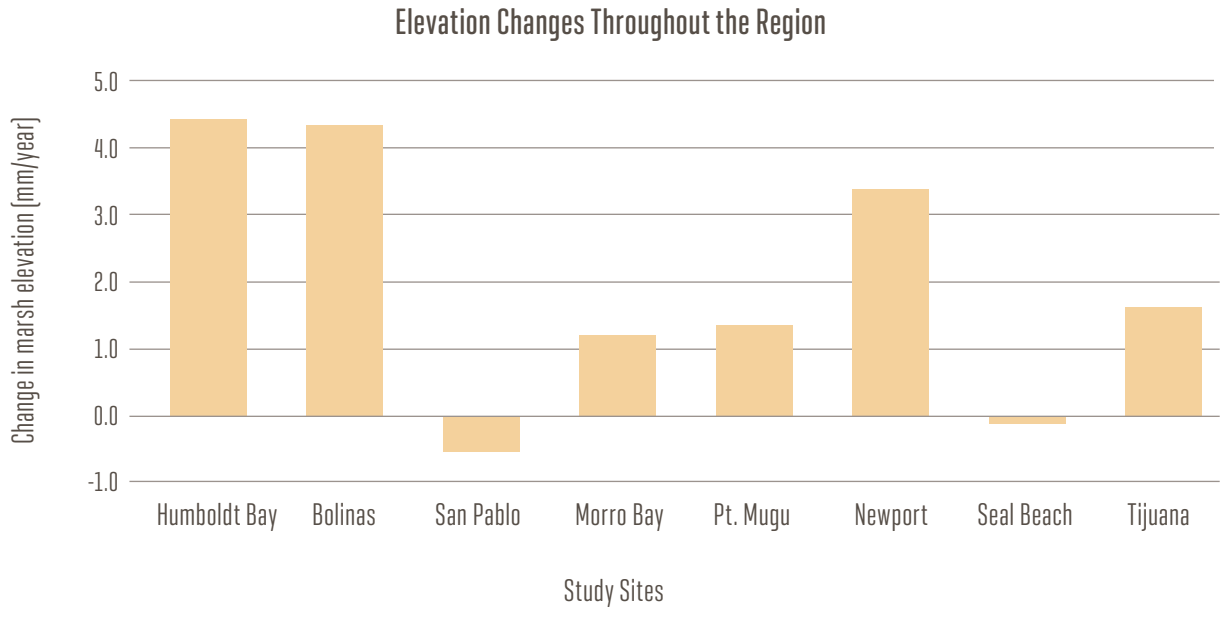
Is the bay filling in at an unnatural rate?

Yes, human activities within the watershed increase the flow of sediment to the estuary. The rate of sediment accumulation is comparable to other west coast estuaries.

Morro Bay is an estuary, a unique area where freshwater from land meets with the salt water of the ocean. These areas naturally fill with sediment as part of geological processes. Human activities such as development and poor land management can greatly accelerate this process. Sedimentation can also stem from natural phenomena such as ocean currents transporting sand, winds blowing sand from the dunes, and erosion in the watershed that flows through the creeks and drains into the estuary.

Sedimentation is concerning because it alters the estuary's depth, size, and habitat types. Over the years, the bottom of Chorro Creek under the South Bay Boulevard bridge has risen, and the salt marsh has doubled in size where Chorro and Los Osos Creeks enter the bay. Both indicate accelerated sedimentation.

To help address sedimentation in Morro Bay, the Morro Bay National Estuary Program focuses on two general approaches: (1) stopping sediment where it originates, and (2) capturing sediment in floodplains before it reaches the bay. Project examples using these approaches may include land protection (conservation agreements or acquisitions), and enhancement and restoration projects to improve habitat conditions.



The U.S. Geological Survey conducted an assessment of marsh elevation changes at eight sites in California from Humboldt Bay to the Tijuana Estuary. They installed Surface Elevation Tables along the main tidal sediment source in each marsh that measured elevation change and sediment build-up. The graph shows the annual sediment accumulation at each site. Negative values show a loss of marsh surface elevation. This preliminary data indicates a moderate rate of marsh elevation increase in Morro Bay relative to the other study sites. In all marshes in the study, the rate of sea level rise is expected to eventually outpace sediment accumulation, resulting in loss of this valuable yet vulnerable ecosystem by the end of this century.

Elevation Changes in the Morro Bay Salt Marsh

To assess the rates of sediment accumulation in the estuary, the Estuary Program and the University of San Francisco measured elevation change in the salt marsh. The study collected highly accurate measurements at six locations. The map shows the millimeters of average elevation increase between 2004 and 2015. Sediment continues to accumulate at a relatively constant rate at all stations, with a greater elevation change in the low stations (those farther from the Chorro Creek outlet). These rates in the low marsh are similar to recent rates of sea level rise, around 2 to 3 millimeters per year.

Stopping Erosion at the Source: Roads Improvements

Erosion from roads is a significant source of sediment to streams in the Morro Bay watershed and throughout California. During World War II, the military constructed dirt roads all around the watershed for training purposes. In part because of the steep terrain and erosive soils, these roads contribute significant amounts of sediment to local creeks during storm events. With funding from the State Water Board, the Morro Bay National Estuary Program recently partnered with landowners such as Cal Poly, Camp San Luis Obispo, and the U.S. Forest Service to repair dirt roads throughout the upper watershed. We completed a total of 58 projects over 11.4 miles of road. We estimate that this work will prevent 1,225 tons of sediment from reaching local creeks and the estuary each year for the next decade.

As part of the just-completed Morro Bay Watershed Road Erosion Prevention Project, a failing culvert is removed and heavy equipment reshapes a road crossing to reduce erosion during storms.

Are important natural areas being protected, enhanced, and restored?

Yes, over 4,000 acres have been protected and over 400 acres have been restored or enhanced.

Habitats are the natural environments where animals, plants, and other organisms live. In the Morro Bay estuary and the lands that surround it, these include salt marsh and mudflats, sand dune and coastal scrub, grasslands, riparian habitats along creeks, and many others. The Morro Bay National Estuary Program and its partners work to protect, enhance, and restore habitats to support naturally occurring plants and animals, which are those that are best adapted to our climate and soil and are present due to natural processes.

Our efforts include three main activities: **protection**, **enhancement**, and **restoration**. Protection means habitats are preserved by preventing development or other activities that might harm them. Protected lands include those owned by public entities such as California State Parks and the U.S. Forest Service. One tool for protecting lands is a conservation easement, which is an agreement with a willing landowner to limit future land uses to protect its value as habitat. A recent example of this in the watershed is a conservation easement between the Land Conservancy of San Luis Obispo County and Vintage Organics. This 226-acre farm in the Los Osos Valley produces organic flowers, vegetables, and seed along with some livestock. The agreement conserves this property in perpetuity as farmland and oak woodland and protects local water resources in nearby Los Osos Creek.

Enhancement means conducting work to improve habitat conditions. The Estuary Program enhances habitat through projects such as fencing cattle out of sensitive creek areas and removing derelict vessels from the bay that might sink and release toxics into the water.

Restoration refers to work that returns lands to conditions before human activities impacted them. Examples in the watershed include the Sweet Springs restoration effort. This 32-acre parcel owned by the Morro Coast Audubon Society is located on the shores of the bay. It provides habitat for countless species of birds as well as the endangered Morro shoulderband snail. Efforts at the site included removing invasive plants and replacing them with native vegetation to restore the coastal scrub habitat that was present before human intervention occurred.

For over ten years, the Estuary Program has supported the removal of boats that were in danger of sinking and a spill cleanup program to help protect the bay's waters from pollutants such as fuel and toxics.

Our Work to Protect, Enhance, and Restore

Protection: Conservation Easement

Conservation agreements with landowners allow historic practices like ranching and farming to continue, while protecting lands from future impacts such as development.

Restoration: Walters Creek

Project Completion in 2008

The Site Today

In this restoration project on a former military training area on Walters Creek, the area was returned to its natural state and non-native vegetation was removed and replaced with native plants. Eight years after the project, monitoring shows improvements in habitat and creek structure measurements.

Enhancement: Road Repair

This site shows how the structure of the road used to direct water to a low point, leading to failure of the road. In a recently-completed project, the Estuary Program treated sites like this one, repairing over 11 miles of road throughout the watershed. See page 17 to learn more about the project.

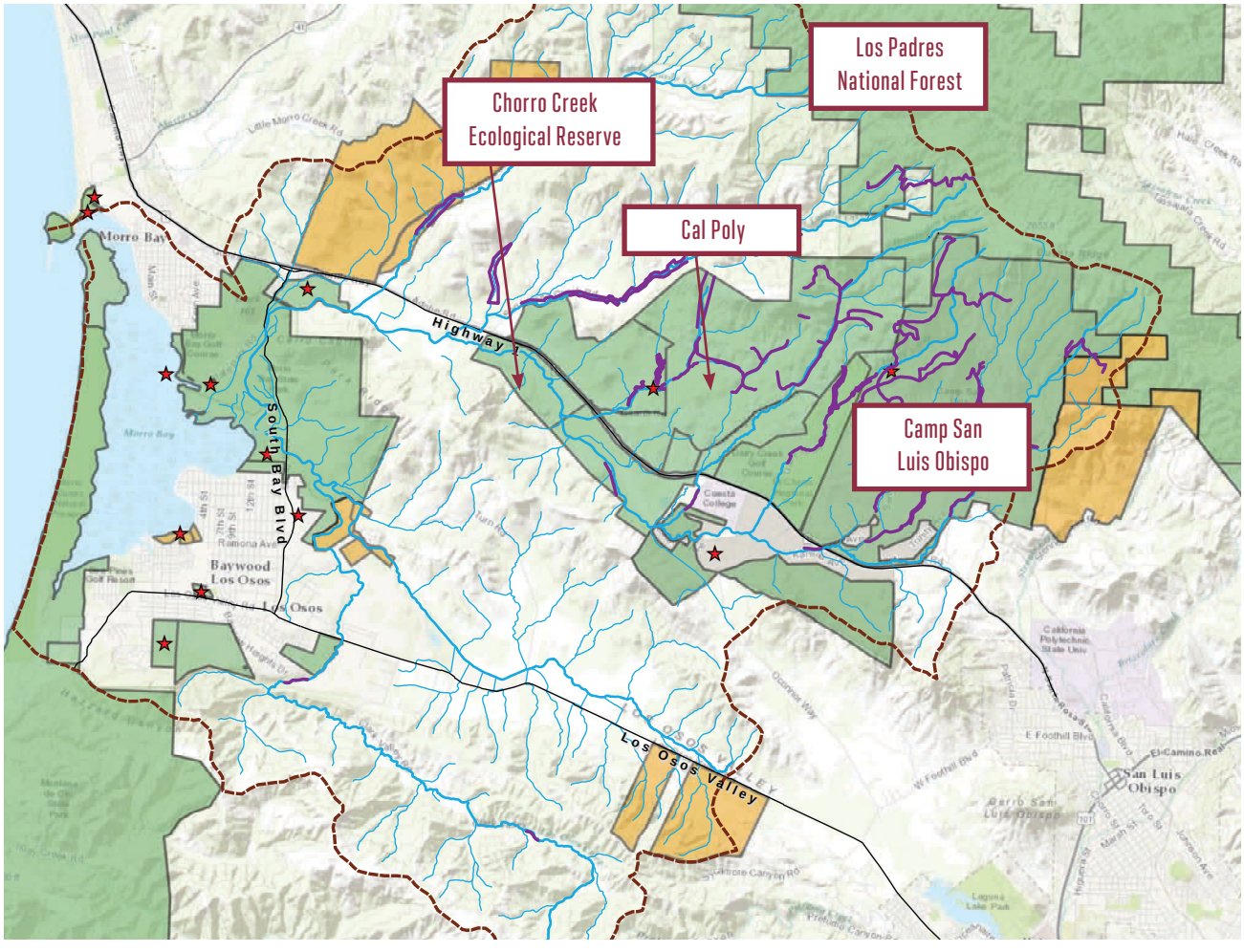
Enhancement: Riparian Fencing

Before

After

The before photo shows a local creek prior to the installation of fencing to keep cattle out of the sensitive riparian (creek corridor) area. In the years since fencing was installed, the vegetation surrounding the creek continues to grow. The plants shade the water, which keeps it cooler and helps maintain adequate oxygen levels for fish.

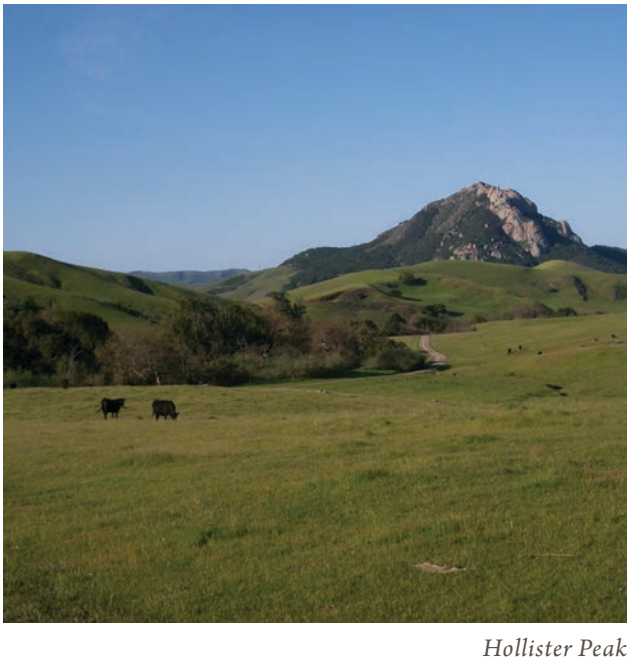
Morro Bay Watershed Habitat Protected, Enhanced, and Restored



The map summarizes the areas in the Morro Bay watershed that are protected, as well as locations of various types of improvement projects.

- Watershed boundary
- Watershed improvement projects along streams
- Watershed improvement projects
- Easements and private preserves
- Publicly-owned and managed open space
- Creeks

San Luis Obispo County, the City of Morro Bay, the Coastal San Luis Resource Conservation District, and others manage public open spaces included on the map.



Hollister Peak

Data Notes

The data used in this report is the cumulative work of many organizations. The data is informational and is not intended to be used for regulatory or decision-making activities. While every effort has been made to ensure accuracy, the Estuary Program and its partners assume no responsibility for errors and omissions, even if advised of the possibility of such damage.

Is water in the creeks and bay clean enough for fish and aquatic life?

The Central Coast Regional Water Quality Control Board (Water Board) updated the scoring method to use all available data and evaluate the proportion of samples exceeding the desirable threshold and the magnitude of each measurement relative to the threshold. Past analyses looked at only five years of data. The overall score for some sites and waterbodies changed, not necessarily due to changes in conditions, but because of the inclusion of more historical data. The nitrate graph shows cumulative distribution of nitrate as nitrogen data. The base map for the watershed image is courtesy of ESRI and OpenStreetMap contributors. The base aerial map for the bay is courtesy of Pinnacle Mapping Technologies.

Is Morro Bay safe for swimming?

The graph analyzes enterococcus data collected and analyzed by Estuary Program volunteers from 2005 through 2015 using the IDEXX method. The categories for assessment are based on the Water Board's criteria.

Is the bay clean enough to support commercial shellfish farming?

Data in the lease sites map and the graph of the geomeans of bacteria concentrations at one site were collected by the CA Department of Public Health from 2011 through 2015. The CA Department of Fish and Wildlife provided the historical map.

Are bird populations that depend on the bay habitat stable?

The Regional Bird Population data was from the Audubon Christmas Bird Count. The Morro Bay Shorebird Population data was from a Morro Coast Audubon Society-led one-day shorebird survey, which takes place each fall. The brant migratory pattern data was from the U.S. Fish and Wildlife Service.

Does Morro Bay support healthy eelgrass beds?

The eelgrass map from 2015 was from Merkel and Associates' sonar work in the May to July 2015 timeframe. The map image from 2007 was assembled from aerial imagery collected in the fall. The aerial image was courtesy of Pinnacle Mapping Technologies.

How will climate change likely affect the Morro Bay watershed and estuary?

The historical temperature data was from the Morro Bay Fire Department and Cal Poly's Irrigation Training and Research Center. The model to predict temperature change was a moderate one, the MIROC RCP 4.5 from 2070 to 2099. This used the moderate emissions scenario. The SLR analysis incorporated a moderate sea level rise scenario. The information comes from the USGS study, "Effects of climate change on tidal marshes along a latitudinal gradient in California."

Do the estuary and watershed support a healthy population of steelhead?

The updated barrier information came from the field-verified Passage Assessment Database, maintained by CalFish. The rating of creeks as steelhead habitat was developed with expert knowledge and analysis of stream flow, oxygen, temperature, habitat complexity, pool depth, canopy cover, bank vegetation, and exotic species presence, conducted by biologists from the Estuary Program, CA Department of Fish and Wildlife, CA Conservation Corps, and the City of San Luis Obispo.

Is the bay filling in at an unnatural rate?

Regional sediment data was collected by USGS starting in 2013, with readings taken each quarter. See above for the USGS document referenced for Climate Change. For more information on Surface Elevation Tables, see http://www.pwrc.usgs.gov/set/

Are important natural areas being protected, enhanced, and restored?

The map includes publicly and privately-protected lands and land where restoration and conservation projects have occurred. The map includes projects by partners such as Coastal San Luis Resource Conservation District, Land Conservancy of San Luis Obispo County, San Luis Obispo County, Morro Coast Audubon Society, and many others.

For more details on these data sources, please visit our website at MBNEP.org/library

What can you do to help keep Morro Bay clean and healthy?

Volunteer. Donate. Learn.

Brown pelican illustration

Volunteer Your Time for a Healthy Bay

The Estuary Program and its partners rely on countless volunteers to help with restoration, education, research, and monitoring efforts. From working with school groups to pulling weeds, from educating the public at community events to collecting water samples, you can pitch in on a wide variety of important tasks that benefit the bay. To find out more about volunteer opportunities around the estuary, visit our website at MBNEP.org/volunteer. And remember, you don't have to be part of an organized effort to make a difference. The next time you're at the beach or hiking your favorite trail, stop to pick up some trash that others have left behind. Even small actions like this can be a big help.

Donate to Support the Estuary Program

Donations support our monitoring, restoration, and education efforts. Every donation, regardless of size, helps protect this special place that we all treasure.

To learn more about how to make a difference, visit MBNEP.org to browse our online library and subscribe to our blog.

Learn Positive Habits that Help the Bay

Simple choices that you make every day can make a big difference for the estuary.

- Pick up after your pets. Their waste contains bacteria that can harm people and wildlife.
- Keep trash in the can, and recycle and reuse whenever possible.
- Mind the drains. Chemicals and trash poured down stormdrains eventually end up in local creeks and the bay.
- Be a responsible boater. Ensure that your boat is in good working order so that bacteria and toxins stay out of the bay.
- Every drop counts. By reducing your use, you leave more water for fish and other wildlife.

Photo courtesy of "Mike" Michael L. Baird

MORRO BAY
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Morro Bay National Estuary Program
601 Embarcadero, Suite 11 | Morro Bay, CA 93442
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