



STATE OF THE BAY | 2014

A report on the health of the Morro Bay Estuary



MORRO BAY
NATIONAL
ESTUARY
PROGRAM

Estuary Overlook | Mike Baird

Dark trails ebb and flow
Through cracks in seaweed cushion;
Rusty brown on blue *Lee Darling*

MORRO BAY WATERSHED

The Morro Bay **watershed** is a network of streams and creeks, which drains rainfall and other freshwater from 48,000 acres of land into Morro Bay. The **bay** itself is an **estuary**, a place where freshwater from the land mixes with the ocean's salty tides. The close connection between the watershed and the estuary means that what happens on land greatly impacts the health of the estuary.

Morro Bay is one of the largest and least disturbed estuaries remaining in central and southern California. Its sheltered waters, salt marshes, and eelgrass beds provide rare and important habitat for a diverse array of fishes, birds, shellfish, and other life. The estuary also contributes significantly to our local economy and way of life, supporting vibrant urban centers, commercial and recreational fishing, boating, kayaking, bird watching, and other outdoor recreation. The Morro Bay National Estuary Program brings citizens, government, non-profits, and landowners together to protect and restore the Morro Bay Estuary. The Estuary Program is a local, non-profit organization.



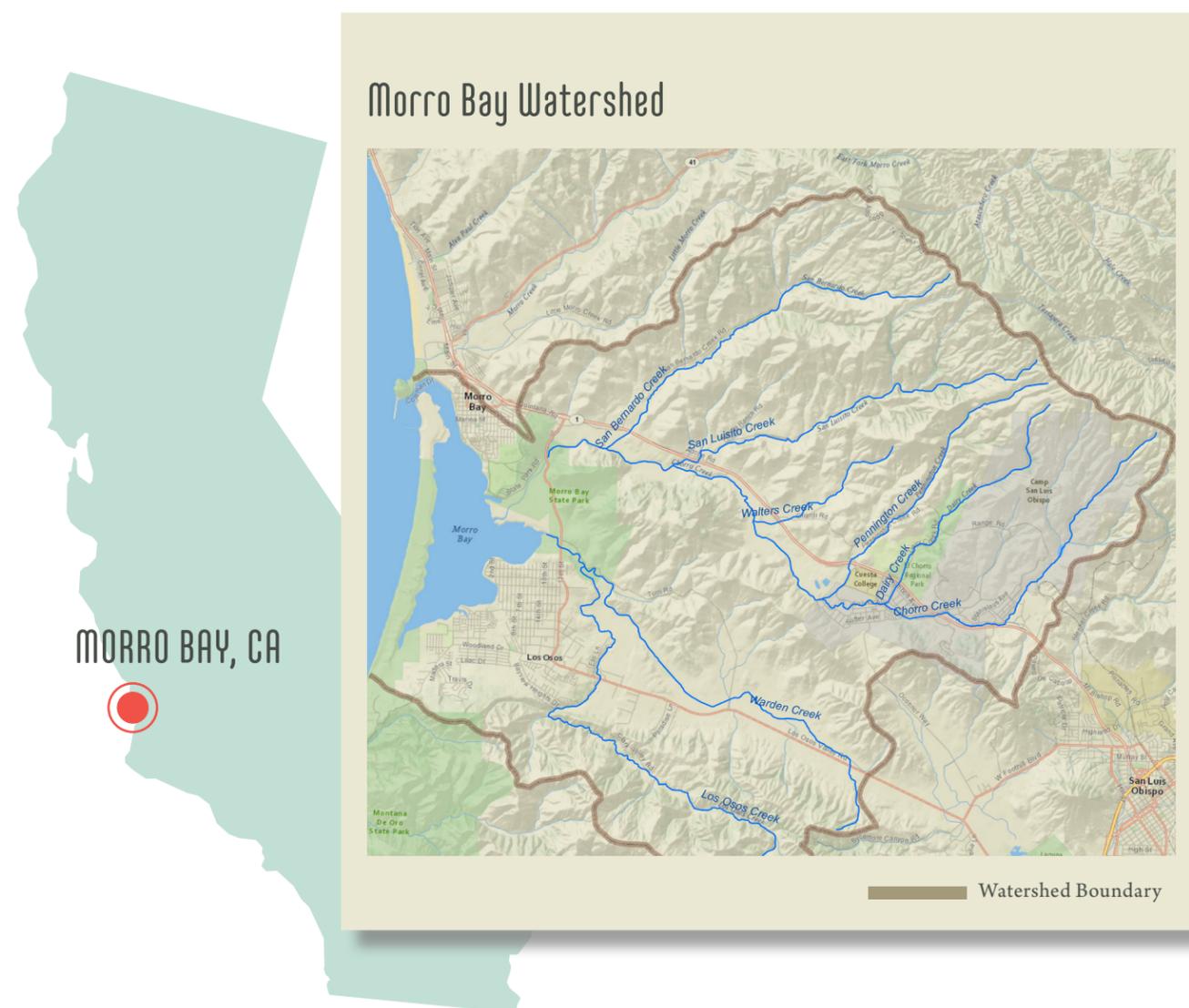
Morro Bay at Sunset

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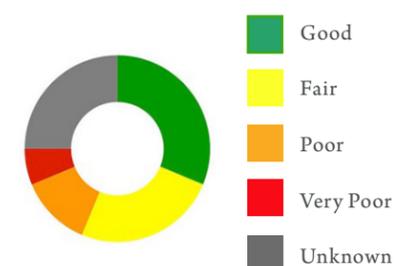
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The Estuary: Where Freshwater from Creeks Mixes With The Ocean's Salty Tides



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 question topics. 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. For example, the symbol at right shows how much of the watershed falls into each of these categories for the health of steelhead habitat in the watershed (see page 20 for the full explanation of the steelhead topic). Estuary Health Symbols have not yet been developed for the sediment or birds topics due to the complex nature of the datasets. These symbols will be developed for future State of the Bay reports.

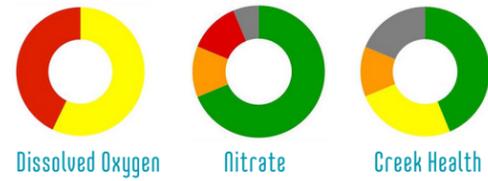


Is water in the creeks and bay clean enough for fish and aquatic life?

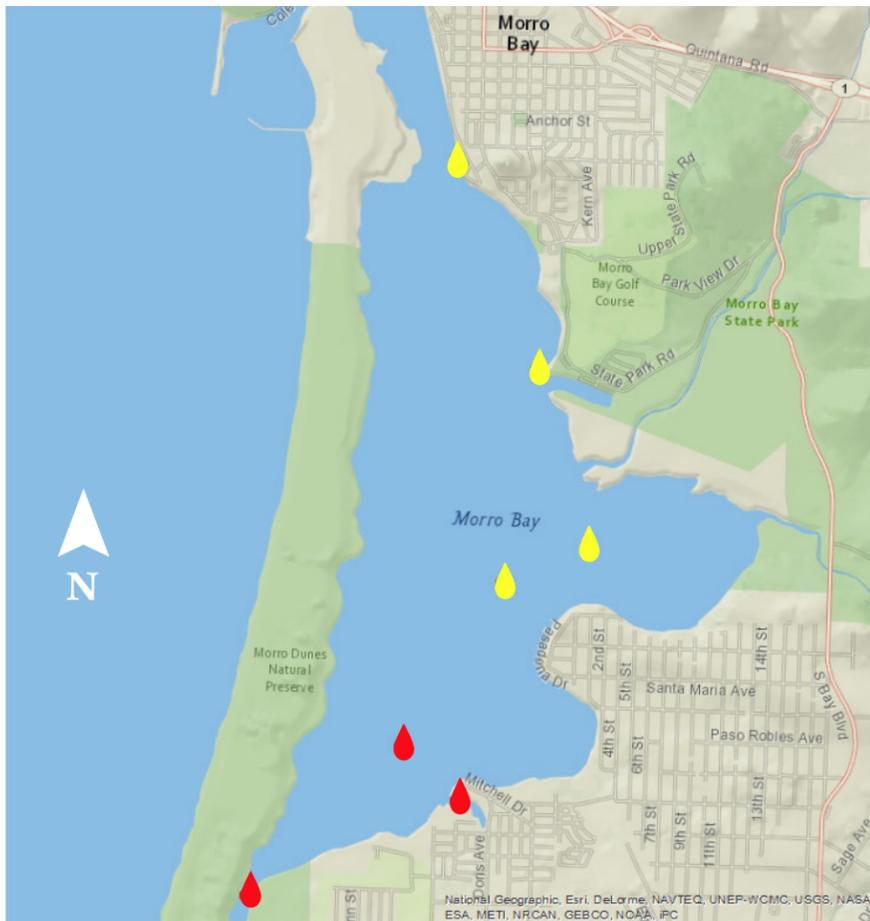
Some areas are healthy and others are degraded.

The Morro Bay estuary, creeks, and the areas that surround them are home to many types of fish, animals, plants, birds, and other wildlife. These creatures need clean water and healthy places to live, or **habitats**. The Morro Bay National Estuary Program monitors these qualities to determine if water quality and habitats are healthy enough to support flourishing populations of wildlife.

The map below shows average **dissolved oxygen** levels (the amount of oxygen available in the water for plants and animals to breathe) from 2008-2012 at different monitoring sites in the estuary. The map shows that most of the bay (locations with yellow drops) has dissolved oxygen levels that are lower than ideal.



These areas still support healthy populations of fish and marine plants, but further declines in dissolved oxygen could cause problems for these creatures. Sites in the back bay with red drops are very impacted for dissolved oxygen and may not support healthy aquatic life. This is partly due to the physical layout of the bay; water in the back bay is not well circulated because it is farthest from the harbor mouth and less influenced by tidal flushing. Additionally, the shallow depth in the back bay means water is more quickly warmed by the sun. Warm water cannot hold as much dissolved oxygen as cold water.

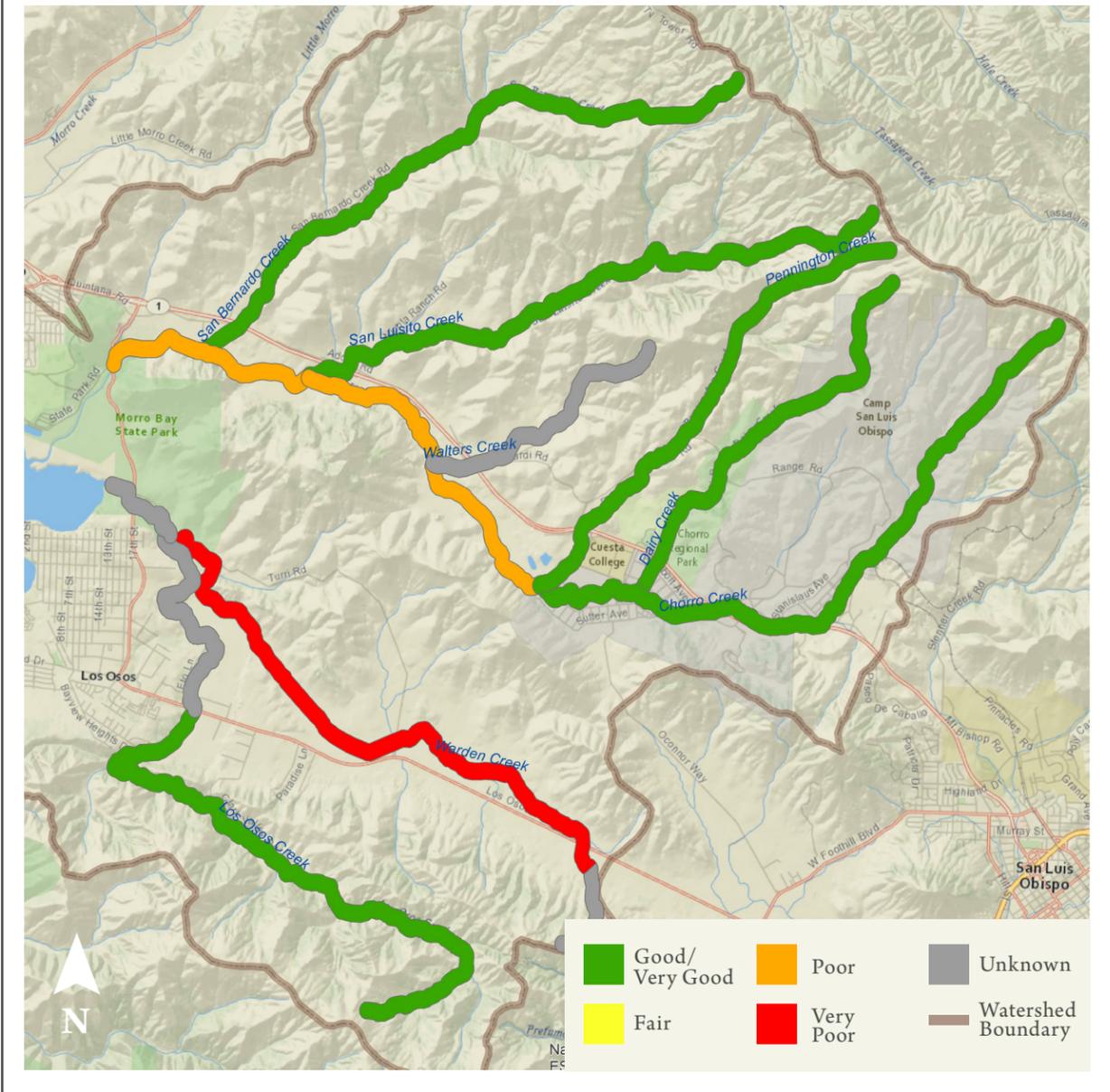


Harbor Seal | Mike Baird

Dissolved Oxygen Status in the Bay



Nitrate Status in the Watershed



Water quality in the creeks that feed the Morro Bay estuary varies greatly. Two important indicators illustrate this variability in the map above and on the following page.

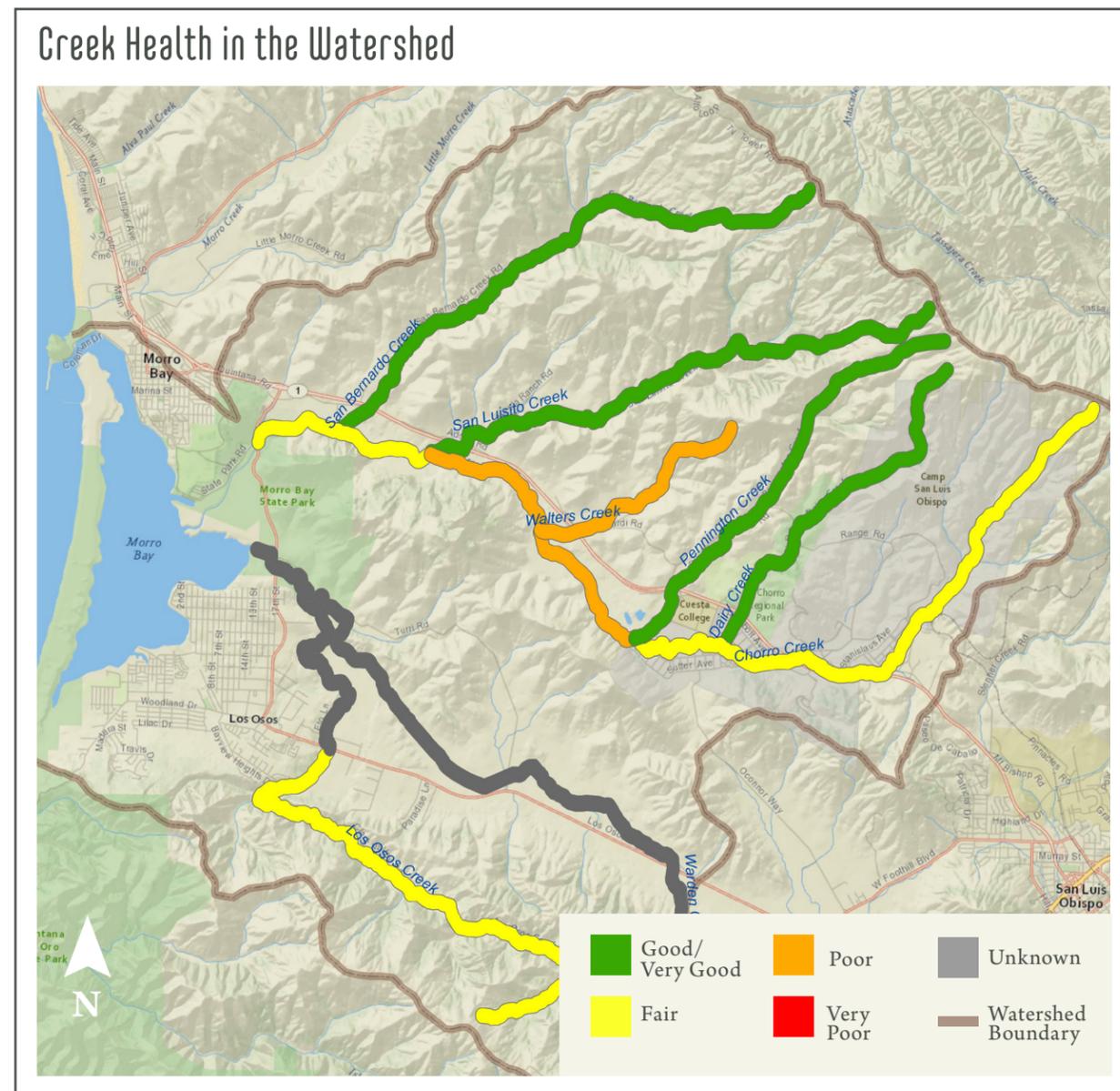
Nitrate comes from decomposing plant materials and waste from animals and plants. Nitrate occurs naturally in creeks, but too much nitrate can stimulate the growth of algae that consumes dissolved oxygen (oxygen available in the water for fish and other animals to breathe), making it difficult for other creatures to

survive. Nitrate levels can be elevated from excess fertilizers, treated wastewater, and animal waste being washed into creeks. The map above shows that nitrate levels (from 2008-2012) are good (green) in almost all the tributaries that feed Chorro Creek and in Los Osos Creek. There are some areas, like Walters Creek and parts of the Los Osos and Warden Creeks, that lack enough data to determine nitrate levels. Most of Warden Creek is severely impacted (red) because nitrate levels are consistently higher than water quality standards.

CREEK HEALTH SCORE

The third indicator of water quality in the creeks is the health of bugs in the creeks. Certain bugs start their life in creeks and require a healthy environment while living in the water. These bugs provide clues about how clean the water is. To support a diverse population of bugs, a creek must have cool, clean water with adequate levels of oxygen, and lots of rocks to provide protective cover. Some bugs are extremely sensitive to pollutants and can only survive in very clean water. Others, such as worms and snails, are tolerant of poor habitat contaminated with pollutants. Based on the

types of bugs found in the water, each creek is assigned a score, according to a system adopted by the state of California. The map below (data is from 2008-2012) shows that many creeks in the Morro Bay watershed receive a good rating (green), including most of the tributaries of Chorro Creek. However, parts of Chorro Creek and Los Osos Creek are scored as fair (yellow). These areas still support robust aquatic life, but habitat quality is degraded and some sensitive species cannot survive. Walters Creek and part of Chorro Creek earn a score of poor (orange), indicating poor habitat quality.



Is Morro Bay safe for swimming?

Yes, in most areas.



Many people enjoy recreating in and around Morro Bay – water sports such as kayaking, stand up paddleboarding, SCUBA diving, and surfing are on the rise. These types of activities all require contact with the water. So is the water in Morro Bay clean enough to safely swim and recreate? Most areas of the bay have good water quality that is safe for swimming and recreating. If the water is not safe, swimmers can become sick from ingesting bacteria, viruses, and protozoa. Indicator bacteria like Enterococcus and Escherichia coli (*E. coli*), found in the intestines of warm-blooded animals, help assess whether water is contaminated with fecal matter. The presence of these indicator organisms does not guarantee that

viruses and other serious pathogens are present, but the likelihood is higher. Potential pathogen sources include stormwater runoff, which can wash waste from wild and domestic animals and humans into the bay; leaking waste holding tanks on boats; sewage spills; and improperly maintained septic tanks.

The map below shows results from testing bacteria levels (Enterococcus) monthly at various sites along the bay. Green drops are sites that have good water quality safe for swimming. Yellow drops indicate slightly elevated bacteria levels. Those sites exceed the bacteria standard for swimming in 25% or less of samples tested.



Recreating in Morro Bay | staff photo



Is the bay filling in at an unnatural rate?

Yes, the flow of sediment to the bay is accelerated by human activities within the watershed. In addition, rainfall patterns greatly influence how much sediment is deposited in any given year.

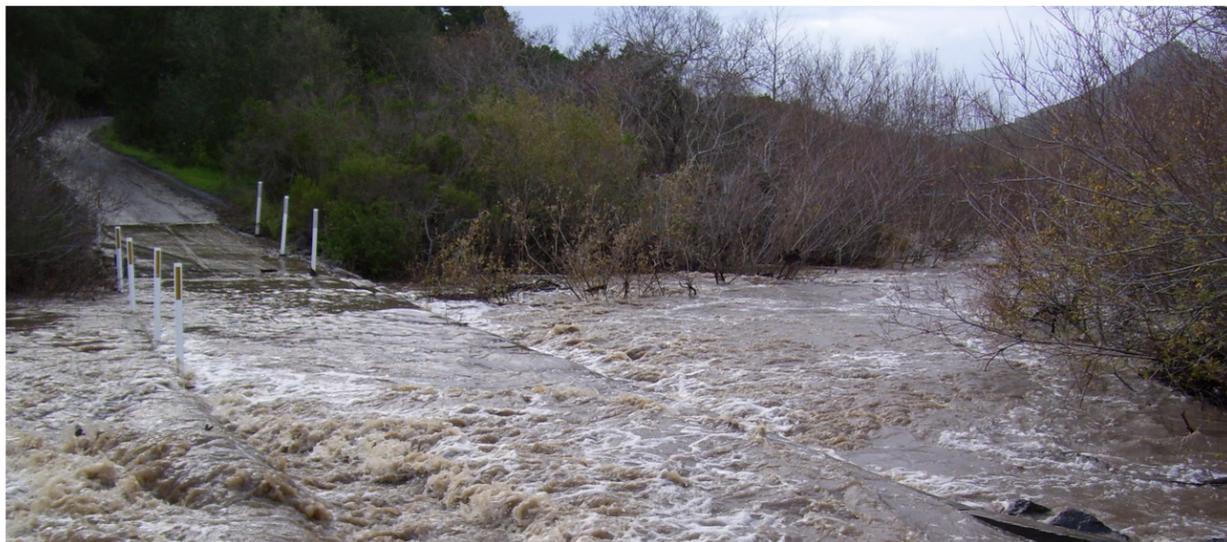
The accumulation of sediment in estuaries naturally occurs over thousands of years and in many places is accelerated by human activity. For the past 5,000 years, the Morro Bay estuary has gradually filled in from the natural process of erosion (the weathering of rocks and soil and the gradual movement of the resulting sediment downstream). Material deposited in the bay comes from several sources: ocean currents carrying sand into the bay, prevailing winds that blow sand from the dunes, and, most significantly, erosion in the watershed that is transported to the bay by creeks or directly from land.

Left to natural processes, it would take thousands of years for Morro Bay to fill up with sediment. However, human activities in the watershed, while vital to our local economy and food production, have increased sediment runoff to the bay. Increased sediment adversely impacts clean water and aquatic life. The collective result could shorten the lifespan

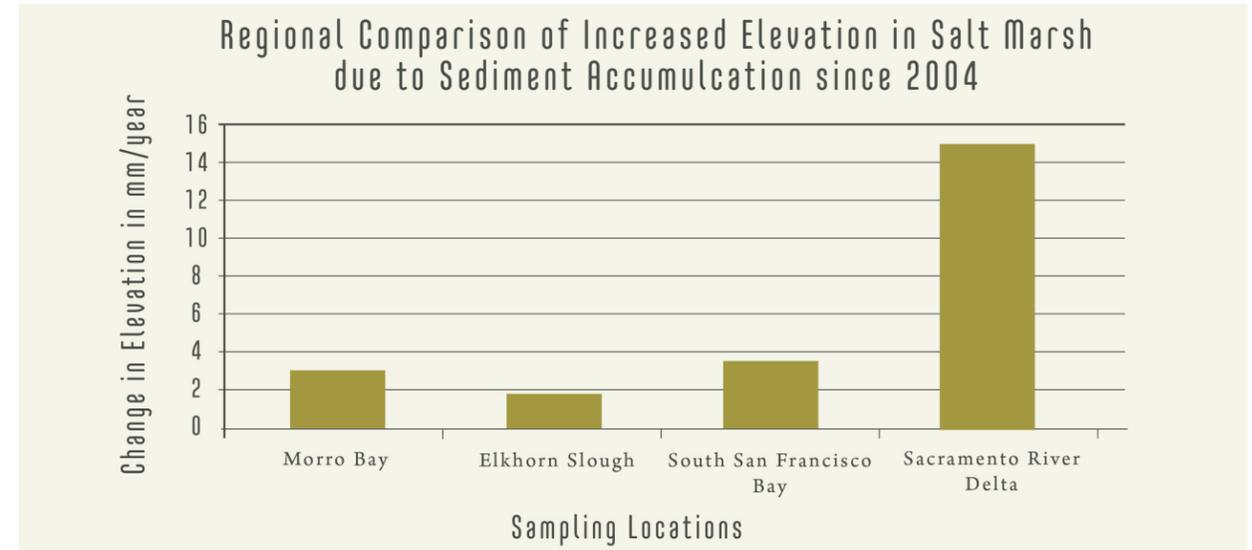
for Morro Bay unless conservation actions reduce the flow of sediment. The Estuary Program and partners implement a variety of projects and conservation practices to reduce this erosion throughout the watershed.

Further compounding sediment buildup is the altered circulation in the bay due to the jetty and causeway out to Morro Rock. This infrastructure is essential for harbor safety but also reduces tidal flushing and circulation. Sediment now tends to build up in the bay and periodic dredging is required to keep channels open for boats.

A decade ago, our understanding of how sediment was affecting the estuary focused on annual average totals of estimated sediment in the creeks; predictions based on that approach estimated that the entire bay would become a salt marsh within 300-400 years. In the past few years, a more nuanced and complex picture of



Intense rainfall leads to flooding of a local bridge | staff photo

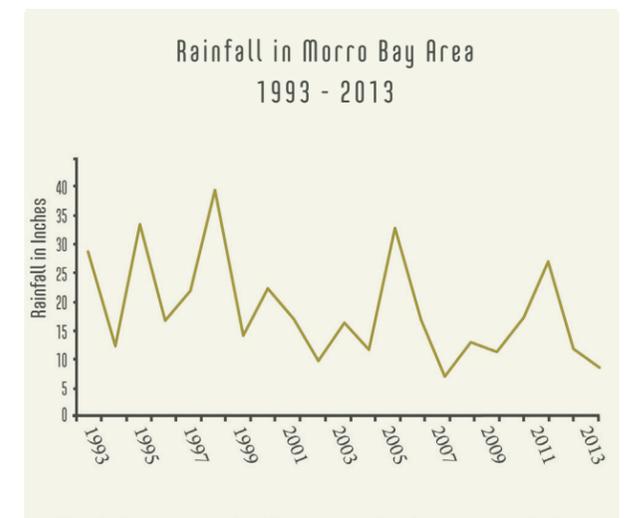
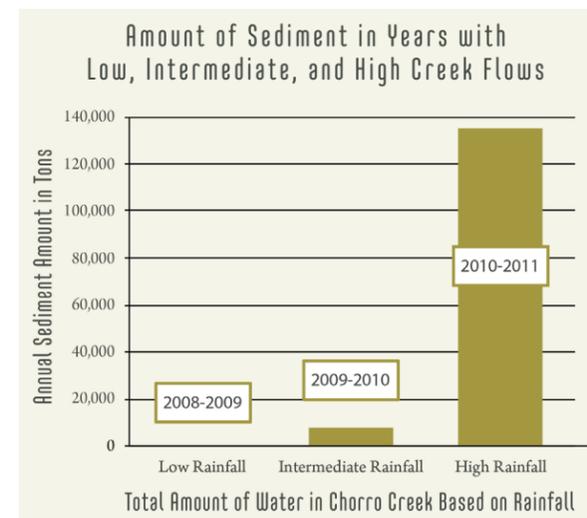


Comparison of Sedimentation in Other Estuaries

In order to gauge rates of sedimentation in the estuary, the Estuary Program and its partner, the University of San Francisco, measure the elevation of the marsh in various locations. Based on data collected since 2004, the amount of sediment accumulating in Morro Bay's marshes appears to be comparable to other estuaries in central California, but much less than the accumulation observed in the Sacramento River delta.

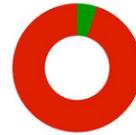
sedimentation has emerged. We now recognize that the majority of erosion occurs during episodic storm events – and that tracking annual averages of sediment runoff can be misleading. The impact of these storm events varies greatly, depending on the storm intensity and how saturated the ground is prior to any particular storm. Big, intense storms move much more sediment to the bay than small storms.

The chart at the bottom left shows that the amount of sediment flowing in Chorro Creek (which covers 60% of the watershed) varies greatly from year to year and is largely related to the total amount of water in the creek that year. The total amount of water is determined by the amount and intensity of rain. Annual total rainfall in the Morro Bay area since 1993 is shown in the bottom right chart.



Does Morro Bay support healthy eelgrass beds?

No, the amount of eelgrass in the bay is declining rapidly.



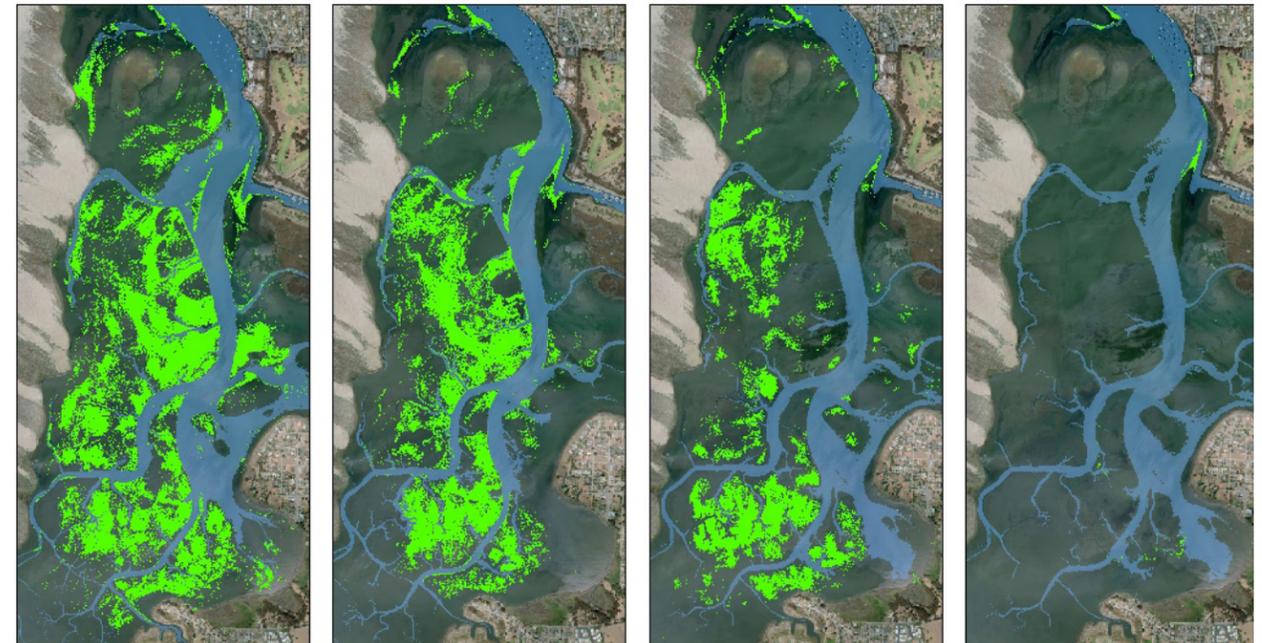
Eelgrass is the backbone of our bay. An underwater flowering plant, eelgrass helps keep the water clear by slowing wave action and allowing sediment to settle out of the water. Eelgrass also cleans the water by using excess nutrients to grow and provides food to birds and animals. Migratory birds like black brant depend on eelgrass to sustain them on their long journey south in the winter. Young fish use meadows of eelgrass for shelter and to find food. Because it is a plant just like on land, eelgrass also produces oxygen that fish and other marine creatures need to survive.

For the past half century, monitoring in Morro Bay has shown that our estuary sustains the only major eelgrass habitat between San Francisco and Los Angeles.

Historically, Morro Bay hosted the 6th largest eelgrass area in California.

Because of the regional importance of our local eelgrass meadows and the important role that eelgrass plays in supporting life in the bay, The Morro Bay National Estuary Program has monitored eelgrass in the bay for over a decade. A recent peak in 2007 at 344 acres was followed by steady decline over the last five years. Although eelgrass naturally oscillates over time, the recent decline to less than 20 acres in 2013 is cause for great concern. We have already seen consequences of this decline, with fewer black brant present in Morro Bay last winter. Continued loss could result in total loss of eelgrass from Morro Bay.

Loss of Eelgrass in Morro Bay from 2007 to 2013



2007

2009

2010

2013

Aerial photo courtesy of San Luis Obispo County, 2007



HORN SHARK

Horn Sharks sometimes use their pectoral fins to crawl along the seafloor and over rocks. This picture shows a horn shark crawling over eelgrass in Morro Bay.

Horn Shark | staff photo



BLACK BRANT

Morro Bay is one of the few layovers between Alaska and Baja California for the migratory black brant, which depend heavily on eelgrass as a primary food source. Brant breed on the coastal tundra in Alaska and winter along the Pacific coast from Alaska to Baja California and mainland Mexico.

Brant Eelgrass | Mike Baird



RED OCTOPUS

The Red Octopus has the largest and most complex brain, as well as the best eyes, of any invertebrate. The octopus can also move rapidly over sand or rocks by the use of its arms and suckers. They have three hearts — one that pumps blood through the body, and two more to pump blood through its gills.

Red Octopus | staff photo

What can cause eelgrass to decline?

Even though eelgrass can trap sediment and use excess nutrients, too much sediment or nutrients in the water can overwhelm eelgrass. Too much sediment can block sunlight that the plant needs to grow. Water polluted with excess nutrients encourages the growth of algae, which crowds out the eelgrass.

There is also evidence that wasting disease may be present in Morro Bay. This disease is highly contagious among eelgrass beds.



Eelgrass wasting disease pathogen | staff photo

- Eelgrass (Zostera Marina)
- Water-Subtidal Channels

What can we do to bring eelgrass back?

The Morro Bay National Estuary Program initiated a five-step eelgrass recovery strategy, including a pilot planting to see how transplanted eelgrass grows in the bay and a secondary planting effort for a total of about 3.5 acres planted. Future efforts will include ongoing monitoring and additional plantings until the goal of 80 acres of healthy eelgrass is reached.

Other steps you can take to help eelgrass:

- Use fertilizers and water sparingly on your lawn.
- Recreate carefully in the bay – don't scrape eelgrass beds with kayaks, paddleboards, or boat rudders.
- Volunteer for the Eelgrass Recovery Strategy. Visit our website to learn more mbnep.org/Our_Work/eelgrass.html and contact staff@mbnep.org for volunteer opportunities.

Is the bay clean enough to support commercial shellfish farming?

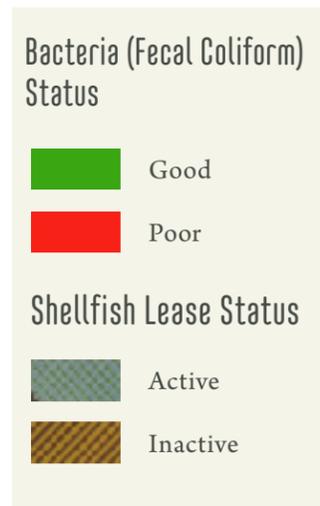
Yes, in currently active harvesting areas.



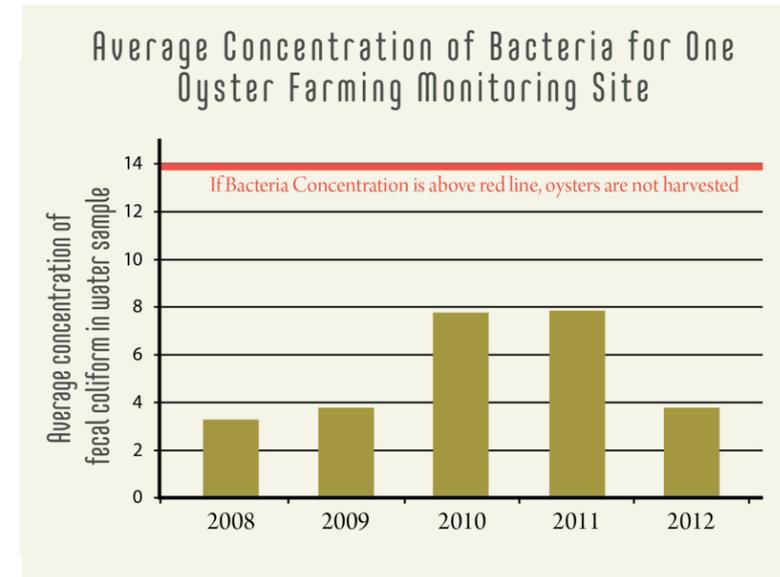
Morro Bay has a long, rich history of shellfish farming, starting with the introduction of the Pacific oyster in the early 1930s. In 2012, oyster farms in Morro Bay sold approximately one million oysters, generating \$600,000 in revenue.

Presently, there are two active oyster farming operations in Morro Bay – Grassy Bar Oyster Company (<http://www.grassybaroyster.com/>) and Morro Bay Oyster Company (<http://morrobayoysters.com/>). Both farming operations grow in designated, open

harvesting areas that are tested regularly to ensure the water is clean enough for oysters to be safe to eat. The California Department of Public Health regulates shellfish growing areas and determines where and when it is safe to harvest shellfish. The map below shows the current open harvesting areas. The dots indicate sites where water is collected to be tested for bacteria. Green dots indicate bacteria levels safe for harvesting. The areas that are hatched in yellow are prohibited for growing due to historically poor water quality or lack of water quality data.



The bar graph shows annual average bacteria levels for one of the water quality testing sites shown on the map. Bacteria levels must be below the red line on the graph in order for water quality to be safe for harvesting and eating shellfish. Bacteria levels at this site have been consistently safe over the last five years.

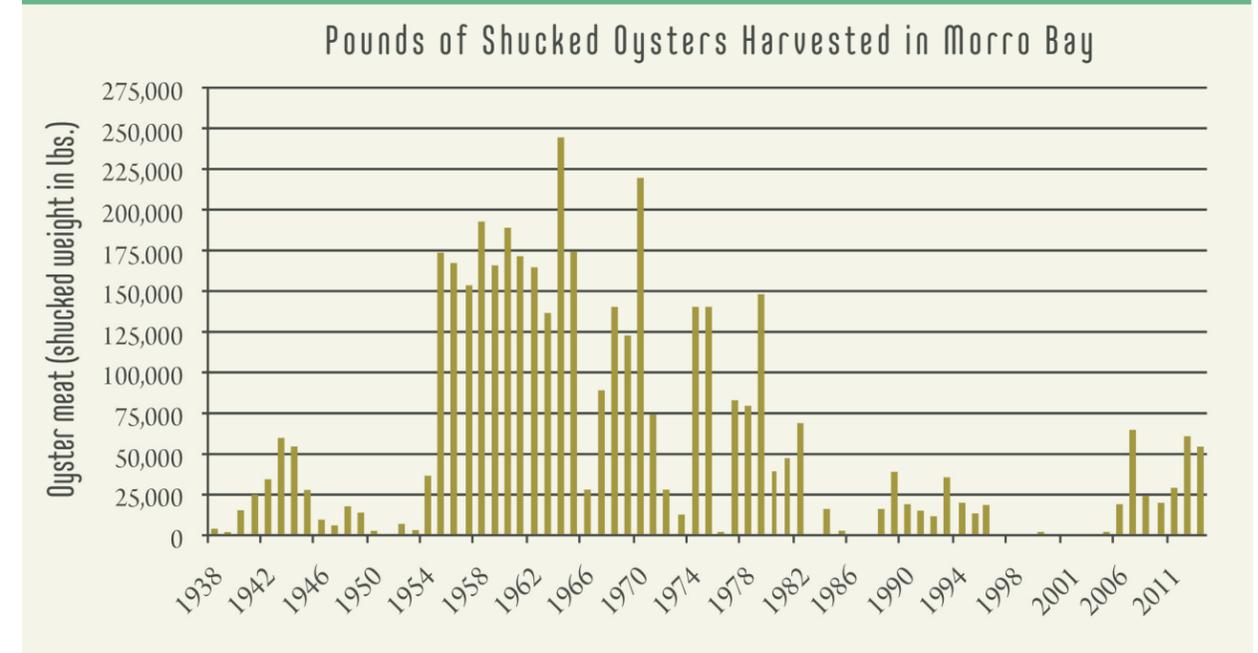


What causes water quality problems in the bay that might affect oyster production?

Shellfish lease sites may be temporarily closed when levels of disease-causing bacteria, viruses, and toxic algae blooms exceed health safety standards. High levels of bacteria can result from sewage spills, illegal discharges of waste from boats, and stormwater pollution running off the land and into the water. Spills of toxic materials can also shut down oyster production. Growers work closely with the California Department of Public Health to ensure that oysters are harvested only when the water is clean enough for them to be safe to eat.

How has oyster production in Morro Bay changed over time?

The Pacific oyster was introduced to Morro Bay by the Department of Fish and Game in the 1930s. By April 1935, 1,777 acres were allotted to oyster farming in the bay. During World War II, Morro Bay was the leading oyster producing area in the state. Production in Morro Bay has declined since that time, but it is still one of the top three oyster production areas in the state. The graph below shows pounds of shucked oysters harvested in Morro Bay from 1938 to 2012.



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

Yes, over 3,700 acres have been protected and over 400 acres have been restored or enhanced.

Healthy habitats provide homes to many plants and animals, protect water quality in the estuary, and preserve the scenic beauty and recreational opportunities that residents and visitors love about Morro Bay. There are many important habitats in the watershed and around the bay:

Saltmarshes and Mudflats



White pelicans on mudflats in Morro Bay | Mike Baird

Sand Dune and Coastal Scrub



Sand dune habitat in south end of Morro Bay | staff photo

Grassland/Upper Watershed



View of upper watershed from Camp San Luis Obispo | staff photo

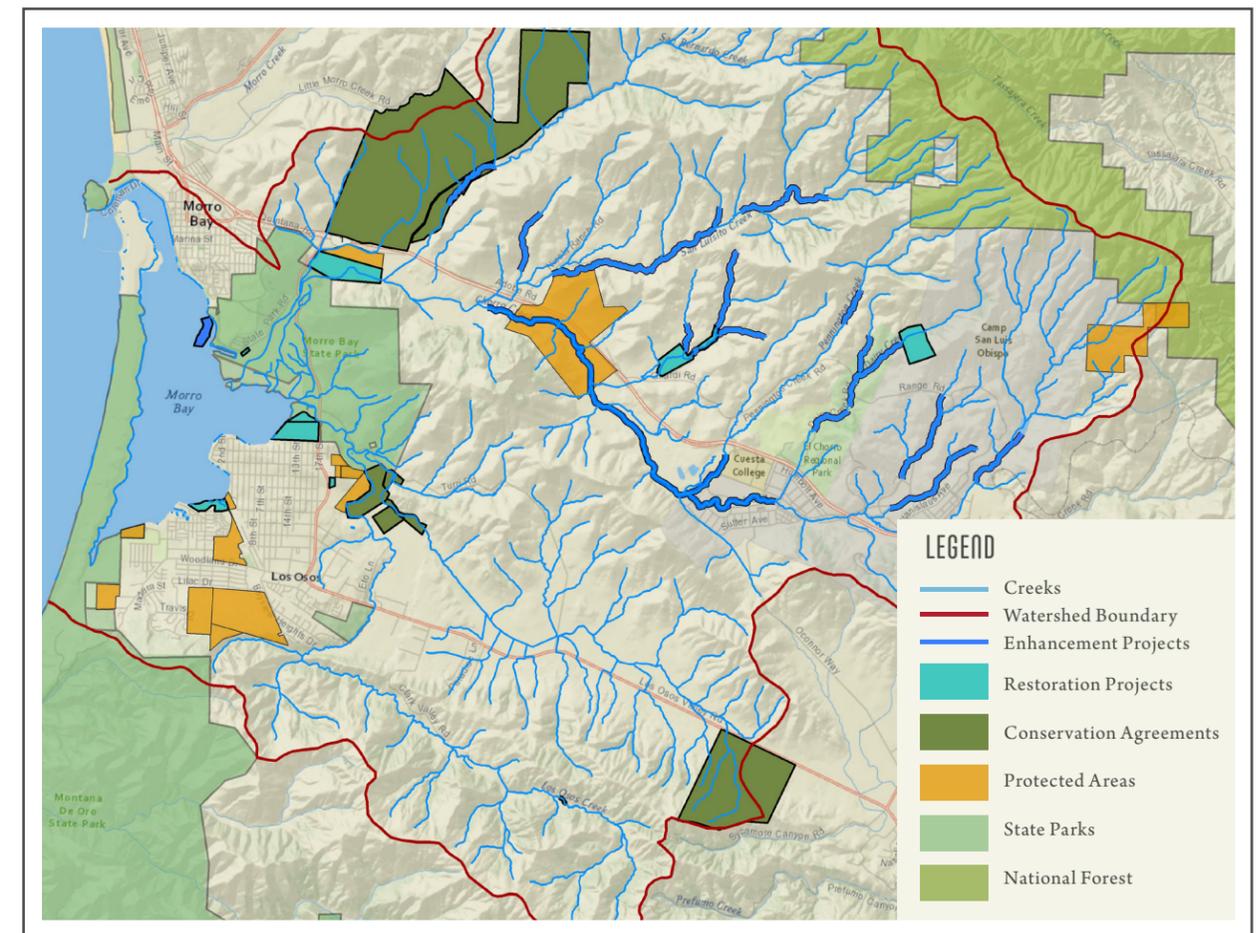
Riparian Habitats along Creeks



Riparian habitat along lower Chorro Creek | Alan Schmierer

The map below shows protected, enhanced, and restored habitats in the Morro Bay watershed. **Protected** means habitats are protected from development or other impactful activities in the future. Examples include lands owned by State or County Parks and lands that have a conservation easement (an agreement that allows continued uses like farming and ranching but limits future development). **Enhanced** refers to activities that improve habitat conditions – examples of activities that enhance habitats include fencing to reduce cattle access to creeks and removing derelict

vessels from the bay. **Restored** refers to activities that reestablish conditions on a property before alterations from human activities caused significant disturbance. For example, ongoing efforts to restore native vegetation at the Sweet Springs Preserve aim to reestablish the naturally occurring coastal scrub habitat. Other restoration efforts include the Eelgrass Recovery Strategy, which includes replanting in areas that historically supported eelgrass beds (see page 11 for more detailed information on this project).



Why is habitat protection and restoration important to our community?

Naturally occurring flora and fauna are integral to our bayside community. Plants and animals that are adapted to the local climate, soils, and weather patterns support the beautiful surroundings that we all enjoy. They also provide a number of important functions. For example, native plants outperform exotic species in controlling erosion and surviving on limited water. When natural habitats are protected and native animals thrive, balance is achieved and more life can be supported. Our community depends on a healthy environment for clean water, clean air, beautiful vistas, and economic opportunity. More intrinsically, being surrounded by nature draws many of us to live, work, and play around the estuary.

Are bird populations that depend on the bay habitat stable?

Yes, most bird populations in the Morro Bay watershed are stable, but some birds face difficult conditions.

Morro Bay is home to more than 200 types of birds and provides an important pit stop for birds that are migrating along the Pacific Coast. Bird watching is a popular pastime in Morro Bay and supports Morro Bay's growing eco-tourism industry. Many birds also play important roles in the estuary environment. Birds disperse the seeds of plants and help keep insect species in check. How bird populations are doing helps show how healthy the bay is. In Morro Bay, bird watching is an important part of the eco-tourism economy.

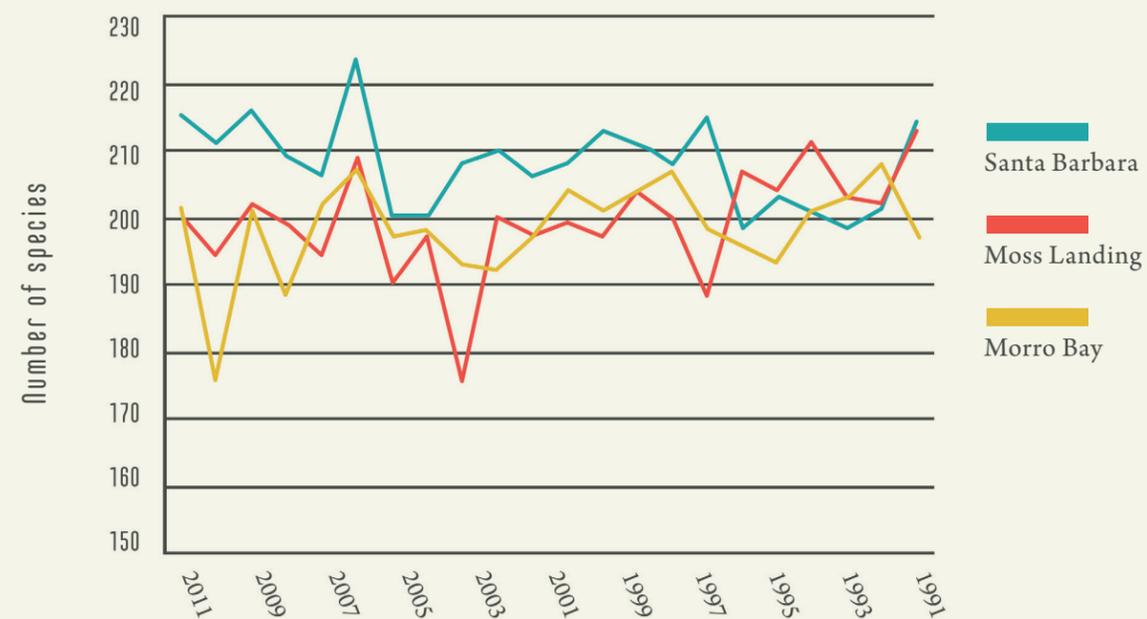
Along the California coast, birds face many obstacles to thriving in their native habitats. Compared to other estuaries along the coast, Morro Bay is supporting stable bird populations. This regional comparison is illustrated by the graph below. Using Christmas bird count data, the graph shows that bird populations in

Morro Bay have been relatively stable over the last decade and are comparable to populations in Santa Barbara and Moss Landing. Both of these sites also have similar participation rates to Morro Bay during the Christmas Bird Count. Data is collected by dedicated, well-versed local birders.

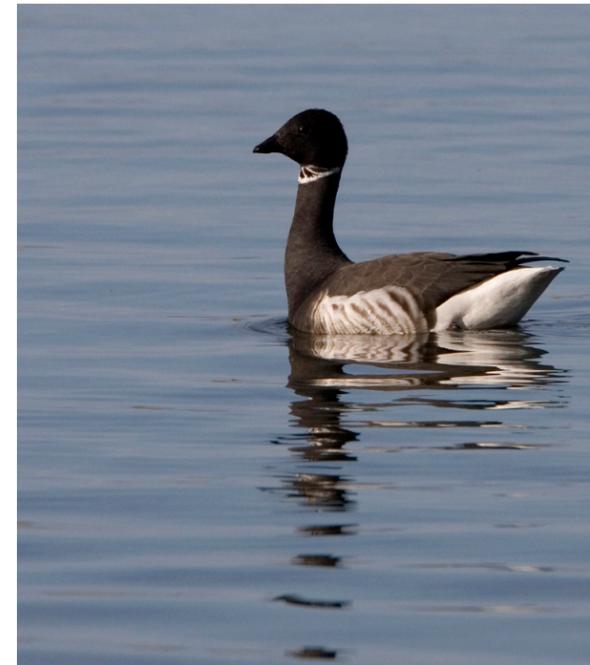
Christmas Bird Count

Across the nation, bird enthusiasts get together to count local bird populations on a day near the Christmas holiday. A great example of citizen science, anyone can volunteer to count birds. Data is collected and analyzed by the National Audubon Society.

Number of species observed during the Audubon Christmas Bird Count, 1990-2011



A few local bird species are of particular concern in the Morro Bay estuary and watershed. The threatened Western Snowy Plover nests on the Sand Spit and nearby Morro Strand State Beach. This bird requires special protections because it nests directly in the sand and is easily disturbed by human activities on the beach. In 2012, 174 nests were laid and 70 hatched, resulting in a 41% hatch rate. This hatch rate is lower than average for the species and the second lowest on record since 2002. These results are far from what is necessary to maintain a healthy population of this bird. Continuing local efforts by California State Parks and partners are crucial to preserving habitat and improving nesting rates.

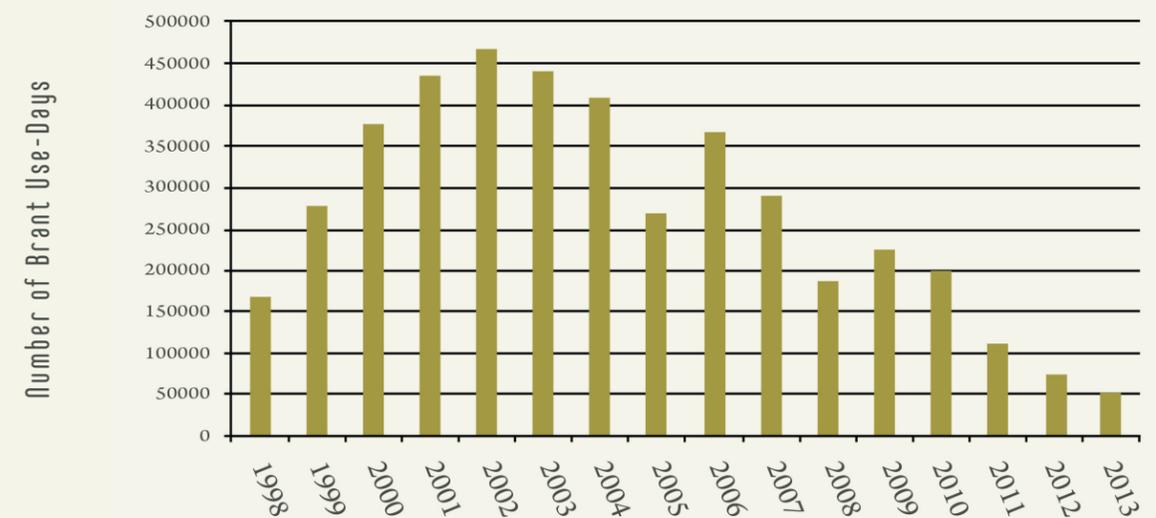


Black Brant | Mike Baird

Distance Flyers: The Black Brant

These small, stocky geese fly 3,000 miles or more from Alaska to California (and other southern points along the west coast) to escape winter on the tundra. Eelgrass is their primary source of food. (The state of eelgrass in Morro Bay is discussed in detail on page 10). Eelgrass has experienced a dramatic decline in Morro Bay, leaving little for the brant to eat. Local annual brant counts have shown a decline of over 80% since 2002 in number of days brant spend in the Morro Bay estuary during their migration. This measurement is a proxy for the number of birds relying on the estuary's eelgrass for essential nutrition during migration.

Number of Brant Use-Days on the Morro Bay Estuary During Winter Migration



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

Predictions suggest changes in precipitation patterns and amounts, sea level rise, and loss of important habitats.

Climate change refers to significant change in aspects of climate, such as temperature, precipitation, or wind patterns, over several decades or longer. While controversy remains concerning climate change, there is strong scientific consensus that the global climate is changing, with average global temperatures increasing. Many models suggest that this increase in temperature may affect weather patterns, precipitation, and sea level. These changes will have cascading effects on the environment and the economy.

A report commissioned by San Luis Obispo County outlined possible changes to climate in the region by the end of the century.

Predicted Impacts from Climate Change in San Luis Obispo County:

- Hotter, drier, and longer summers
- More severe storms in winter/spring
- Accelerating sea level rise
- Loss of coastal wetlands, marshes, and estuaries
- Declines in water availability and water quality for streams and rivers
- Less groundwater recharge
- Loss of native species and ecosystems
- Increase in wildfires by 200-300%
- Less grass growth for cattle on rangeland

These environmental changes can affect our society and economy in many ways:

- Impacts to fisheries will alter our local economy. Warming ocean water, ocean acidification, and loss of coastal wetlands will impact commercially important fish populations.
- More severe storm events are likely to cause increased coastal flooding and storm damage to local infrastructure.
- Changes to native species and ecosystems, increases in wildfires, and increases in invasive species can all affect important services that the environment provides to our community. For example, local recreation (kayaking, bird watching, fishing, etc.) will be impacted by reduced numbers of native birds and other species.
- We depend on wetlands to help reduce flooding. We depend on native habitats to help improve groundwater recharge. Loss of wetlands and habitats will reduce these benefits that the environment provides.
- Lower productivity on rangeland from altered precipitation patterns and loss of native species will impact our local cattle ranchers and other related businesses.

Addressing Climate Change

The Morro Bay National Estuary Program addresses climate change through conservation and monitoring efforts. For example, stream monitoring follows changes in flow over time in our local creeks. In addition, the Estuary Program participates in a county-

wide invasive species management effort that aims to anticipate new invasive species issues and address them before they spread. On the ground projects, such as erosion control, are designed to address increased storm events and other predicted climate change impacts.

Learn more about climate change in our local environment with the resources at right:

- Potential climate change effects in San Luis Obispo County: lgc.org/adaptation/slo/docs/SLOClimateWiseFinal.pdf.
- San Luis Obispo County Climate Action Plan: slocounty.ca.gov/planning/CAP.htm.
- Research on sea level rise along the California coast: pacinst.org/reports/sea_level_rise/index.htm.



Path in Sweet Springs Preserve flooded during January 2014 king tide. King tides are the highest winter season tides and provide a window into what sea level rise might look like. | OsosDave, flickr

What are Ecosystem Services?

“Ecosystem Services,” also called “Nature’s Benefits,” refers to services or products in which value is gained in the form of intact, functional ecosystems. In San Luis Obispo, some important activities dependent on ecosystem services include:

Recreation and Tourism	Water Quality, Quantity & Control	Agriculture & Timber
Fishing	Flood abatement	Pollination
Bird watching	Groundwater recharge	Soil stability
Hiking/Mountain biking	Sediment filtration	Cattle grazing
Kayaking	Water storage	Timber or firewood
Wine country touring	Hydroelectricity	Aquaculture
Camping	Removal of pollutants from waterways	Carbon storage

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

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



Like the miner's canary, the steelhead tells us about the health of our estuary and watershed. When steelhead thrive, we know the water is clean and plentiful and creeks are full of life. Steelhead, close relatives to salmon, are also a part of California's fishing heritage – Native Americans, early settlers, and modern fishermen once depended on them as a source of protein and economic opportunity.

Steelhead are a special kind of rainbow trout that are born in freshwater streams and then migrate to the ocean before they return to streams to spawn. Steelhead need cool, clean water in coastal streams, as well as places to hide, like deep pools, deposits of large woody debris, and large boulders. Spawning steelhead need to lay eggs in gravelly areas that lack fine sediment. In addition to having enough water in streams to survive, two of the most important water quality factors for steelhead are cool temperatures and adequate dissolved oxygen.

Many activities in the watershed can potentially affect steelhead habitat. Removal of plants and trees along stream edges increases water temperatures and

reduces woody debris and other protective cover. Activities that increase erosion and sediment in the streams impact the reproductive success of steelhead (see pages 8-9 for more information on sediment in the watershed).

Perhaps the most important factor in steelhead habitat is that the fish can actually access the habitat. Barriers in creeks can keep the fish from moving upstream to spawn and from moving downstream to enter the ocean. Road crossings and dams can act as barriers, depending on how much water is in the creek. In some parts of the watershed, high quality habitat is currently inaccessible to steelhead. As drought conditions persist, access to clean water and habitat for steelhead is limited.



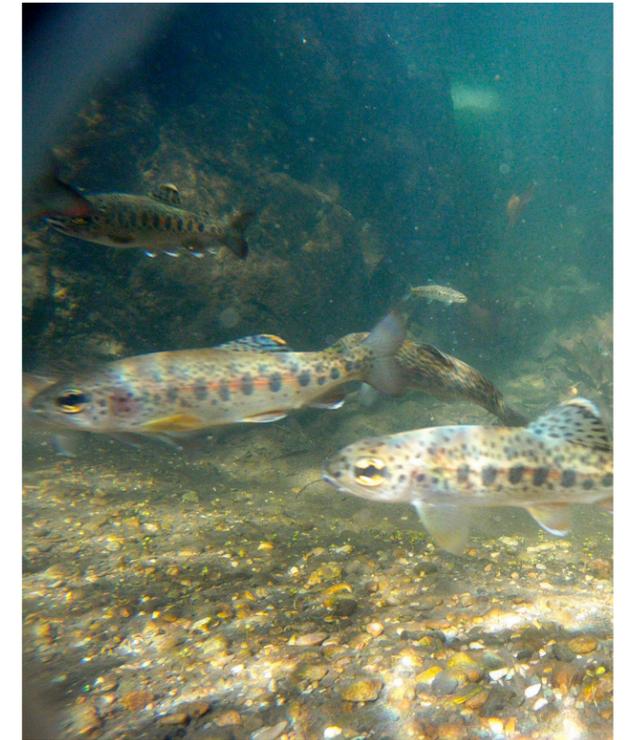
Steelhead hen painting | Flickr Ford

The California Conservation Corps with support from the Morro Bay National Estuary Program conducted snorkel surveys in Chorro Creek and its tributaries to document the local steelhead population. The map on the right shows where steelhead were observed during the 2012 survey, with the size of the circle indicating the number of fish observed in each location. Very few fish were observed past the fish barriers on upper Chorro Creek that are shown on map on page 22.

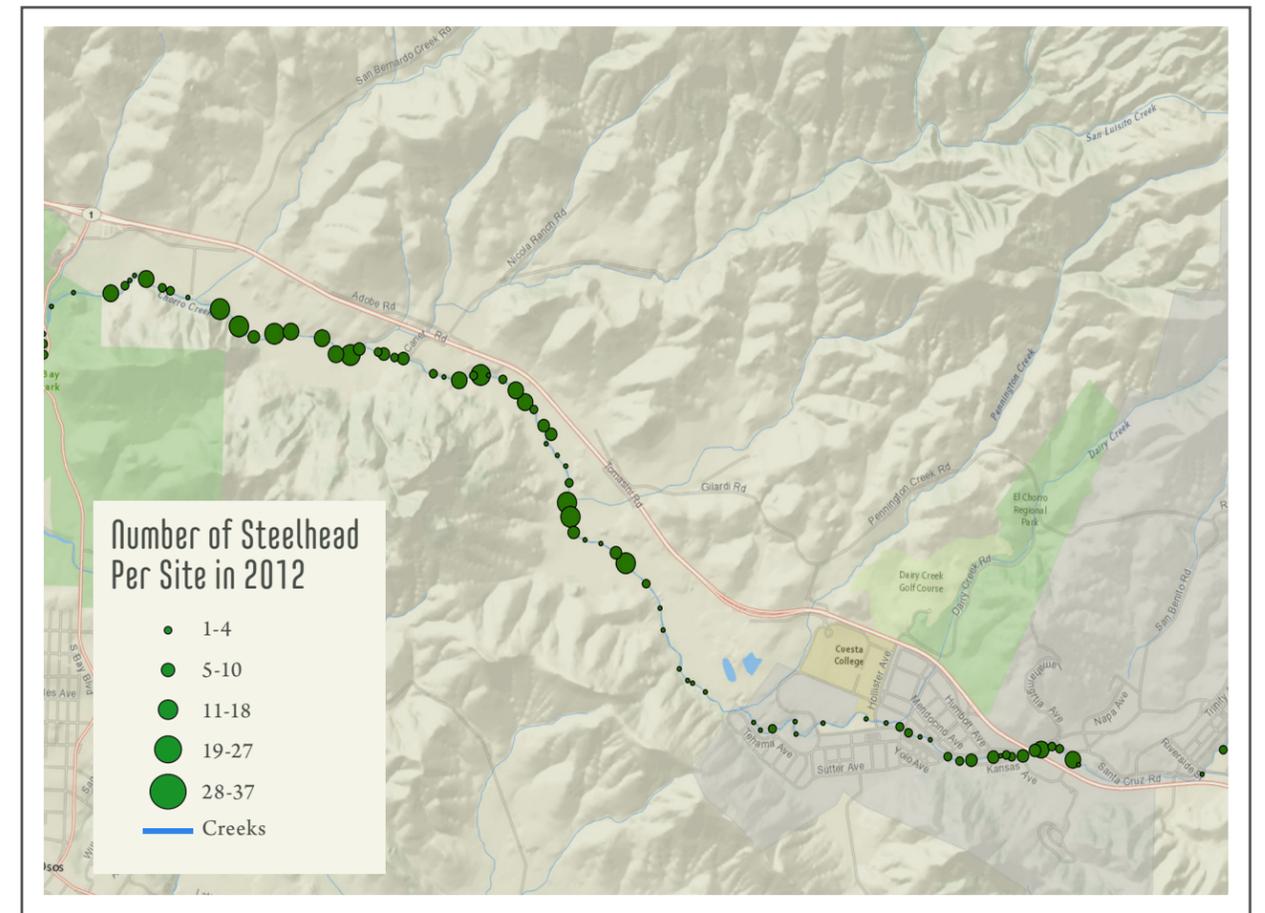
What are the Estuary Program and partners doing to support steelhead population recovery?

Some examples of work in our watershed to help improve steelhead populations:

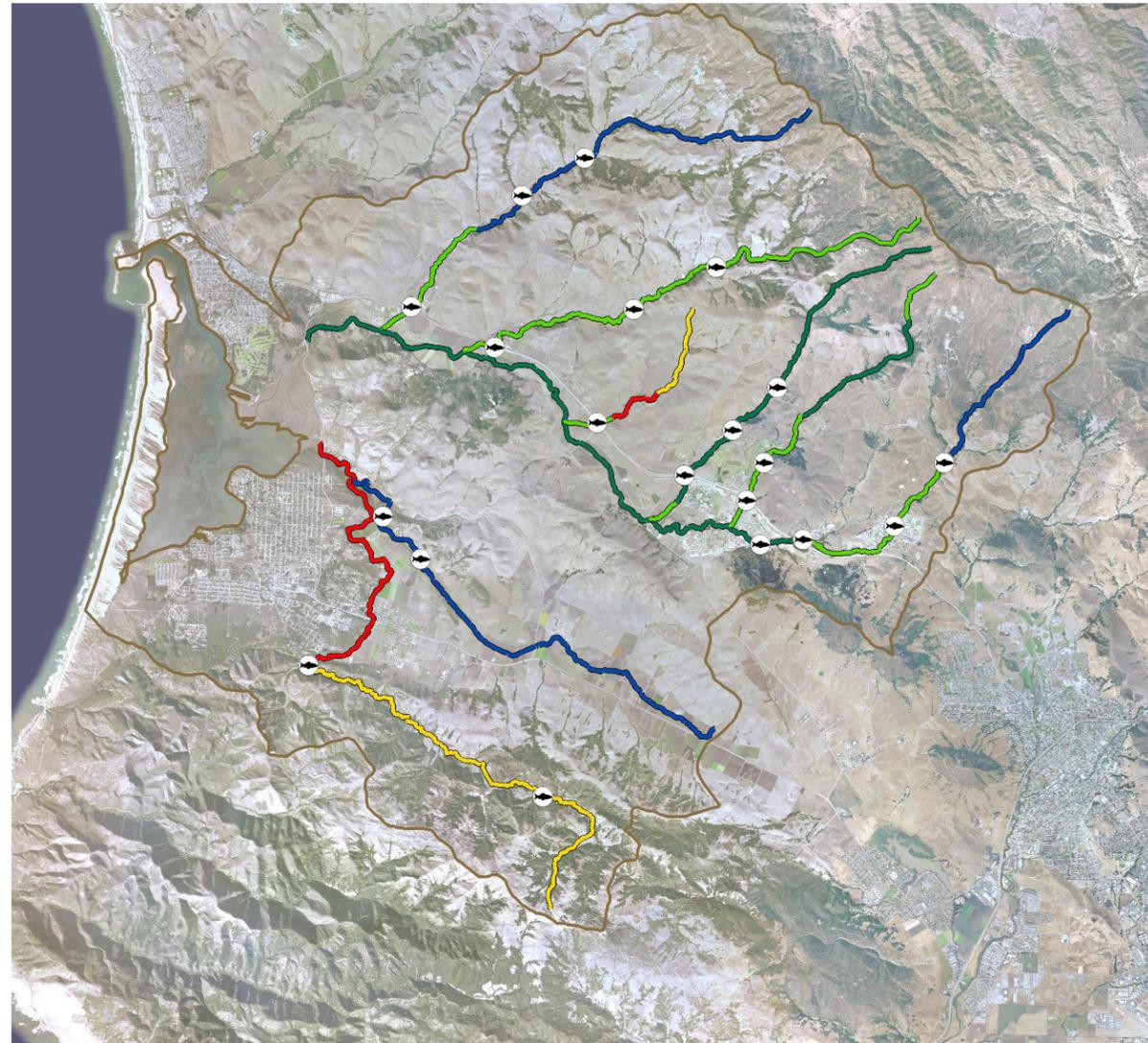
- Water conservation projects like rainwater harvesting and graywater systems can increase water available in streams and waterbodies for fish.
- Working closely with local landowners, the Estuary Program has completed many riparian fencing projects within the watershed. Fencing reduces cattle access to creeks, which improves water quality and vegetation growth along streams.
- Removal of some barriers on creeks has improved access for fish to high quality habitat.



Steelhead in Chorro Creek | staff photo



Steelhead Habitat Status



Steelhead Habitat Status

- Very Good
- Good
- Fair
- Poor
- Unknown

The map above shows the quality of steelhead habitat in the watershed and the presence of barriers within the streams (marked with a fish symbol). In some areas, not enough is known about the creek habitat to determine whether or not it could support healthy steelhead populations.



California Conservation Corps members assessing creek habitat | staff photo

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

Volunteer. Pledge to help keep water clean. Donate. And more!

Be a Bay Superhero!

Join us in keeping Morro Bay clean and healthy. There are many ways to make a difference. Take the Clean Water Pledge, volunteer, and donate to the Estuary Program.

Take the Clean Water Pledge

- Pick up after your pet – do your duty and remove their doody.
- Keep trash in the can – make sure your trash stays in the can and choose reusable and recyclable items.
- Watch your drains – dispose of chemicals and medicines properly, not down your home drain or storm drain.
- Turn off the tap – conserve water whenever possible.
- Join the hundreds of local residents who've taken the pledge to change their everyday actions and keep our bay clean.
- Take the pledge at mbnep.org.

Volunteer your time for a healthy bay

Every year, local residents and students volunteer over 1,000 hours to help the Estuary Program and its partners protect and restore Morro Bay. Would you like to pull weeds, collect water samples in creeks, or check for microscopic creatures in the bay? Plenty of opportunities exist. Check our website mbnep.org.

Donate to support the Estuary Program

Donations allow us to continue monitoring, restoration, and education programs. Every donation, regardless of size, helps keep the Morro Bay estuary clean and healthy for all of us.

Do even more for clean water

View our Bayside Living Guide online to see tips on bay-friendly yards, cars, and homes.

tinyurl.com/baysideguide

You can take the clean water pledge, learn about volunteer opportunities, or donate to the Estuary Program online. Go to mbnep.org.



Canoe in Sunset | Central Coast Outdoors

Authored by Estuary Program Staff with Support from Partners and Volunteers

Lexie Bell with great support from: Ann Kitajima, Tom Sanford, Kathryn Winfrey, Cynthia Milhem, and Adrienne Harris.

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.

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Data Notes

The data used in this report is the cumulative work of many organizations. The data 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 the water in creeks and bay clean enough for fish and aquatic life? (pp. 4-6)

Dissolved oxygen, nitrate, and creek health data from 2008-2012 were collected by Estuary Program staff and volunteers. The categories for creek health data are based on the Southern California Index of Biotic Integrity developed by the CA Department of Fish and Wildlife. The categories for dissolved oxygen and nitrate ranking are based on the Central Coast Regional Water Quality Control Board's (Water Board) assessment categories.

Is Morro Bay safe for swimming? (p. 7)

Bacteria data from 2008-2012 was collected and analyzed by Estuary Program staff and volunteers using the IDEXX method. The categories for bacteria are based on the Water Board's assessment categories.

Is the bay filling in at an unnatural rate? (pp. 8-9)

The annual sediment load data was estimated by the Estuary Program using data from automated samplers that were processed for suspended sediment content. The creek depth data came from the SLO County Water Resources Division of Public Works gauging station. Based on sampling from various storms, the creek flow data was used to extrapolate total annual sediment load.

Does Morro Bay support healthy eelgrass beds? (pp. 10-11)

Eelgrass maps were created using multi-spectral imagery captured at low-tide. Map data was verified by foot or kayak.

Is the bay clean enough to support commercial shellfish farming? (pp. 12-13)

Data in the lease sites map and the graph of bacteria concentrations at one site were collected by the CA Department of Public Health from 2008-2012. CA Department of Fish and Wildlife provided historical Pacific Oyster production data.

Are important natural areas being protected, enhanced, and restored? (pp. 14-15)

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, County of San Luis Obispo, Morro Coast Audubon Society, and many others.

Are bird populations that depend on the bay habitat stable? (pp. 16-17)

Black brant counts are done by experienced local birder, John Roser. Mr. Roser generously shares his data and methodology with the Estuary Program annually. Christmas Bird Count data is from the Audubon Christmas Bird Count online database. Snowy plover data was provided by CA State Parks.

Does the estuary and watershed support a healthy population of steelhead? (pp. 20-22)

The steelhead habitat map is based on a compilation of previous studies, creek assessments, and volunteer monitoring data. Expert knowledge was also incorporated from biologists from the Estuary Program, CA Department of Fish and Wildlife, CA Conservation Corps, and the City of San Luis Obispo. Data included stream flow, dissolved oxygen concentration, water temperature, habitat complexity, pool depths, canopy cover, bank vegetation, and exotic species presence.

Smoky gray seagulls,
Diving into the water,
Eager for their catch. Rebecca Schwind