U.S. Army Corps
of Engineers

Explore 9

The California Coastline
Cape San Martin to Pt. Conception

The Year of the Coast

The beauty and physical diversity represented by California's coast, bays, harbors and estuaries are exceptional. Uniquely spectacular scenery features mountains dropping steeply to rocky shores, rolling headlands and bluffs, fertile marshes, wide sandy beaches and dramatic vistas extending some 1,100 miles from Oregon to the Mexican border.

The sea acts as the coast's chief architect, and continual changes take place as waves, rains and winds reshape shoreline contours. Currents and tides continually refresh and nourish coastal lands and waters, where life forms are as diverse as their habitats. Here the mighty whale and the tiniest of organisms, salt marsh plants and towering redwoods, live together with man in an intricately balanced state of interdependence.

The coast means something different to each individual. Some cherish the fresh salt air, the sea breezes and the opportunities for contemplative solitude. Others enjoy the coast as a place to picnic and swim, to fish, sun or sail, while many choose to search for driftwood or study the mysteries of rocky tide pools. Many choose bird-watching in coastal bays, marshes and lagoons, while others value the potential for commercial and recreational development.

To the U.S. Army Corps of Engineers, California's bay and coastal areas mean a continuing dedication to management and preservation through effective coastal engineering, interdisciplinary investigations, exercise of regulatory authority, flood prevention and water quality control, harbor development and protection, and conservation of fish and wildlife.

To assist you in developing a greater knowledge and appreciation for California's coastline and its valuable resources, the Corps of Engineers has prepared a series of brochures which highlight both natural and man-made features. The sites included in each brochure were selected for their unique scenic significance, recreational opportunities and accessibility. Related information on various natural phenomena such as tidal action, beach formation and movement of currents has also been included, along with reference to numerous indigenous plants and animals. Such detail provides the visitor with the opportunity to gain an increased understanding of the many fascinating aspects of coastal areas.

Bring your camera and binoculars, your curiosity and sense of adventure and join us in exploring nature's wonderful gifts.

Cape San Martin to Point Conception

The 140-mile stretch of shoreline between Cape San Martin and Point Conception offers numerous opportunities for enjoying the beautiful California coast. The area's physical features are diverse and fascinating, with near-shore areas displaying steep cliffs and rocky headlands dropping off to broad, sandy beaches.

Morro Rock, the mudflats and marshes of Morro Bay, Pismo State Beach and the Santa Maria dune fields create one of the most physically varied contiguous areas along the entire coastline. The rugged cliffs, pocket beaches, sea stacks, river valleys, and rolling hills common to this region create an extraordinarily scenic landscape.

Point Conception is itself one of the most significant physical features of the California coastline. North and south of the Point, coastal characteristics vary in many ways. The climate to the north tends to be moderate, while the climate to the south is sub-tropical. Typically, the ocean to the north has cold water temperatures and intensified wave action, while the sea to the south has warmer water and lower energy waves. The northern shoreline tends to be predominantly rugged and rocky; the southern shores feature long stretches of wide, sandy beaches. Rainfall and humidity are more frequent north of Point Conception. As a result, coastal vegetation is generally different in the southern regions.

The coast between Cape San Martin and Point Conception is also historically significant. Evidence indicates that Indian tribes known as the Oak Grove People and the Hunting People lived here some 10,000 years ago. Chumash Indians were found to occupy the region surrounding Morro Bay when Gaspar de Portola's party made camp there in 1769. With the establishment of the Franciscan missions in the late 1700s and early 1800s, however, the Chumash culture virtually disappeared. During the Spanish and Mexican era, large land grants, called *ranchos,* dominated the region. When California became a state in 1850, however, financial and legal problems caused many of these large land holdings to be subdivided. Further subdivision took place in the 1880s with the development of diversified farming. Today, ranching, tourism and the oil industry create the base for the area's economy.

As you explore this beautiful area of the California coast, the Corps of Engineers hopes that you will gain a greater appreciation of its many valued resources and scenic qualities.

Cape
San Martin
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Piedras Blancas
San Simeon and W.R.
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Santa Maria
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Surf 8
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Point Arguello
Jalama Beach
County Park 9
101
Point Conception
0 5 10 20 Miles

1 San Simeon and W.R. Hearst Memorial Beach

Between the rocky headland of Cape San Martin, approximately 55 miles south of Monterey, and the fair-weather anchorage at San Simeon, Highway 1 closely follows the coastline. Also known as the Cabrillo Highway, this route offers exceptional ocean vistas from numerous turnouts along the way. The cliffs here, a result of the erosion of chaparral-covered hills, are backed by the southern boundaries of the Santa Lucia Range. In this area, the mountains gradually decrease in elevation as they continue southward.

The highway crosses the San Luis Obispo County line near Ragged Point, a high, tree-covered cliff with accessible, wide, sandy beaches on either side. South of Ragged Point the coastline is marked by low, rolling pastures.

About 10 miles downcoast from Ragged Point is Piedras Blancas. The lighthouse on the Point, built in 1875, is now automated and operates under the jurisdiction of the U.S. Coast Guard. All buildings at Piedras Blancas are inaccessible to the public.

A few miles south of Piedras Blancas, turn right off the Cabrillo Highway onto San Simeon Road. Here you can visit the small community of San Simeon, a former whaling village established in the 1800s. Past the Sebastian store, continue across a narrow bridge to reach W.R. Hearst Memorial Beach.

This crescent-shaped beach is protected by San Simeon Point, which lies immediately upcoast. As a fair-weather anchorage, this port is used during the summer by fishermen and recreational boaters. Winter's southerly storms and waves, however, turn the anchorage into a treacherous trap for the unwary. A fishing pier and picnic facilities make this an attractive recreational area. The gently sloping, relatively stable beach is partially fed by sediments and sand brought downstream by Arroyo del Puerto. The creek empties into the sea just upcoast of the

Ragged Point

Lighthouses

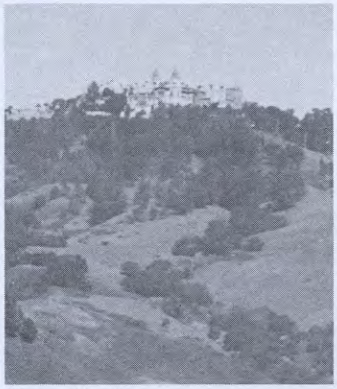
Since the 1850s, California's lighthouses have guided mariners through heavy storms and dense fogs. For more than a century, both lights and foghorns have warned of protruding rocky headlands, hazardous offshore rocks, and dangerous shoals. Lighthouses were, in fact, one of the first series of buildings to be constructed along California's coast.

Piedras Blancas lighthouse in early 1900s.

In the early days, lighthouses required as many as four keepers, who were often referred to as "wickies." The oil lamps originally used, as well as the oil vapor lamps and fog signals later employed, demanded almost continual attention. With the introduction of Augustine Fresnel's sophisticated lens in the early 1850s, lighthouses became significantly more effective. Today, all lighthouses along California's coast are automatically operated, and the services of the traditional keeper are no longer required.

The Piedras Blancas lighthouse is one of the few visible to those traveling the coast highway between Cape San Martin and Point Conception. The original light weighed 5,000 pounds and contained a Fresnel lens measuring six feet in diameter and 14 feet in height. In 1949, a storm badly damaged the lantern room. The original lens was removed and is on display in the village of Cambria. A 24-inch rotating optic lens capable of transmitting beams up to 23 miles is now operating at the lighthouse.

Visitors enjoying W.R. Hearst Memorial Beach



Hearst Castle

Shoreline near San Simeon State Beach

San Simeon pier. Perch, rockfish and red snapper populate the waters, providing excellent pier-fishing opportunities.

Inland, on top of "Enchanted Hill," is Hearst Castle, one of California's most popular tourist attractions. A state historical monument, this magnificent edifice was built over a 25-year period during the early 1900s to house the vast art and antique collection of publishing tycoon William Randolph Hearst.

San Simeon Beach State Park, a short distance downcoast, offers visitors the opportunity to experience the wonder and beauty of the open coastline. Here, San Simeon Creek crosses a barrier beach to the sea.

From the San Simeon area, continue south toward Cayucos across coastal marine terraces. Glimpses of the old coast highway are occasionally visible.

2 Cayucos Beach

Continue south along Highway 1 through the Cambria Valley to reach Cayucos Beach, a 14-acre beach park located about 18 miles south of San Simeon. Between San Simeon and Cayucos, the highway winds inland through a relatively arid area shielded from sea breezes and moisture by a series of coastal hills. Access is limited to the small pocket beaches and rocky headlands which dominate this region of the coast.

The highway returns to the Pacific close to Point Estero, the northern terminus of Estero Bay and the northern tip of the San Luis Range. Cayucos Beach is one of many public beaches along 13-mile Estero Bay. To reach the beach, exit from Highway 1 on North Ocean Avenue.

Cayucos Creek enters the sea at Cayucos and serves as a major sand source. In winter, the beach is steep, as winter beaches typically are. In summer, low-energy waves redeposit the sand that migrates to offshore bars during winter periods of high-energy wave action. The summer beach is typified by a relatively flat beach face and a bermed, or mounded, formation parallel to the shoreline.

The municipal fishing pier at Cayucos complements the beach's recreational opportunities. Beneath the pier, numerous marine animals, including mussels and barnacles, cling to the pier's pilings at locations based on their adaptability to various tide levels.

Two miles south, on the upcoast end of Atascadero Beach, is an offshore oil terminal. Here, during loading operations, oil is pumped aboard offshore buoy-moored tankers through

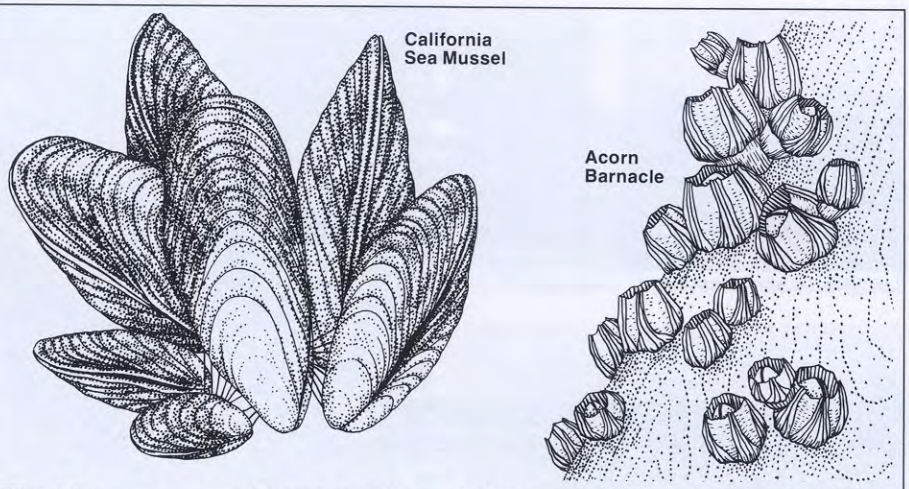
Caution

To enjoy fully the California coast, it is important to be aware of the area's innate, and often unexpected, hazards.

Frequent landslides make hiking at the base of cliffs and along cliff tops dangerous. Because loose materials can suddenly cascade to the water below, walking should be restricted to areas well away from cliff edges.

Swimmers, divers, surfers and others using coastal waters should be aware of dangerous rip currents. Wet suits are often necessary to provide insulation from cold water temperatures.

Those exploring tide pools or climbing rocks near the water's edge should be watchful of incoming tides. Non-slip, protective footgear should always be worn during coastal explorations.



Piling Life

The pilings supporting coastal docks and piers provide the ideal habitat for numerous species of organisms. Thousands of minute inhabitants have, in fact, been found to occupy a single square inch of piling surface. Mussels and barnacles are usually the more visible inhabitants; however, other small crustaceans, worms and starfish, along with numerous microscopic organisms, also thrive here. These marine organisms live at different depths on the pilings based on their ability to adapt to the varying temperatures and other factors such as splash and tidal inundations.

One species of barnacle typically found on pilings is the acorn barnacle. It is common from Alaska to Southern California. The grayish white shell of these small crustaceans is cone-shaped with deep vertical ribs. In addition to occupying pilings, the tenacious barnacle clings to rocks, the hulls of ships, and is frequently found attached to whales and other sea creatures.

The California sea mussel is a wedge-shaped bivalve commonly found at mid- and low-tide zones. Although edible, sea mussels take on poisonous qualities during certain seasons —generally under quarantine from May through August. The glossy black shells of the sea mussel are visible in massive clusters on pilings and shoreline rocks, firmly attached by numerous thread-like appendages.

submarine pipelines and hoses connected to the vessels. This crude oil is later taken to refineries.

To reach Atascadero Beach, turn off Highway 1 at a sign indicating the beach's location and turn right on Yerba Buena Drive. Atascadero Beach is a classic wave-fronting beach backed by sand dunes. The dunes are planted with ice plant to help reduce their natural tendency to migrate inland. The beach provides an excellent vantage point from which to view dramatic Morro Rock. This 578-foot dome-shaped rock is one of the central coast's major landmarks.

3 Morro Rock

To visit Morro Rock, exit from Highway 1 to the city of Morro Bay and make a right turn on Main Street. Make another right turn on Beach Street, turn right on Embarcadero, then right again on Collin Drive.

Morro Rock, often called the "Gibraltar of the Pacific," marks the entrance to Morro Bay. This magnificent giant has served as an important navigational landmark since 1542, when Spanish explorer Juan Cabrillo named it *El Morro,* "the Moor," for its resemblance to a domed turban. Believed to be 24 million years old, the rock was once below the earth's surface. Less resistant materials slowly eroded away, leaving behind the resistant volcanic "plug." Nine other similar plugs are also in the area. All are visible in a series that continues southeasterly to a point just south of San Luis Obispo. Morro Rock, now designated as an ecological reserve under the jurisdiction of the State of California, protects the endangered peregrine falcon.

Visitors to Morro Rock will note that the rock's southwest side has been blasted away. Boulders from this quarry operation were used in the construction of the nearby breakwater and a causeway which now connects the rock to the mainland.

To protect Morro Bay's busy fishing port from destructive wave action, the Corps of Engineers has constructed two breakwaters and a stone revetment. The channel is periodically dredged to remove sediments transported by longshore currents.

Morro Bay itself, located on the seaward edge of the Los Osos Valley, has approximately 474 acres of marshlands

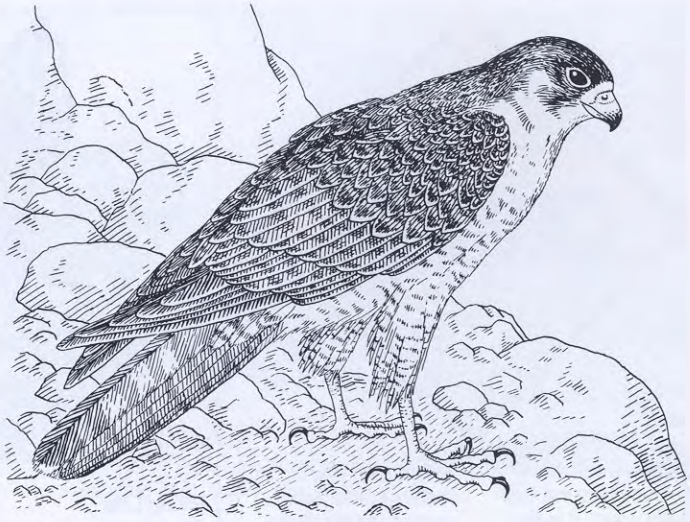
San Simeon State Beach

Eroded marine terrace south of San Simeon

Municipal fishing pier at Cayucos Beach

Morro Rock as seen from Atascadero Beach

Fishing boats at Morro Bay Harbor



Peregrine Falcon

The peregrine falcon, an endangered species, is recognizable by its large talons, blue-gray body feathers and the black markings on its crown and cheek areas. Its body size is similar to that of the common crow, yet its wing span averages three feet. The peregrine falcon has pointed wings, a narrow tail and is one of the fastest flying birds, reaching up to 200 mph in a dive. In the Morro Bay area, the peregrine falcon feeds on terns, coots, wild ducks and a variety of marsh birds.

The peregrine, also known as the duck hawk, lays its eggs high on rocky ledges in shapeless nests made of a few sticks. Nests are often used for a number of years. From two to four reddish, spotted eggs are laid during each nesting season.

Local and state preservation efforts are being directed toward increasing the small peregrine falcon population on Morro Rock, which, during earlier years, was nearly destroyed by falconry and the extensive use of pesticides.

surrounding much of its perimeter. The Bay is separated from the Pacific by a 4.5-mile-long sand spit that varies in width from 1,000 to 2,000 feet. Its flat, coastal beach is backed by extensive, migrating sand dunes which have grown to heights of 85 feet. The spit was formed as a result of sea level changes and the influence of Point Buchon to the south and Point Cayucos to the north. Closed to vehicles, the sand spit offers outstanding opportunities for bird-watching and nature study. Morro Bay State Park encompasses Morro Rock and the spit, as well as the marshlands and mudflats that surround the Bay.

Morro Bay Harbor is the only natural, landlocked anchorage along the San Luis Obispo / Santa Barbara County coastline. The harbor is home port for a large commercial fishing fleet and numerous recreational and sport-fishing boats.

Because of the area's geographical position and local meteorological conditions, winter months tend to be warm and primarily sunny. Between June and September, however, coastal fogs are prevalent.

Morro Rock

4 Museum of Natural History

Morro Bay's Museum of Natural History contains outstanding interpretive exhibits and excellent vistas of Morro Bay, Morro Rock and the spit. To reach the museum, return across the paved roadway from Morro Rock. Turn right at the T-intersection and continue past the Coast Guard Station. From Beach Street make another right turn on Main and continue to the Morro Bay State Park entrance located on the Bay's eastern perimeter. A campground and boat marina are located near the museum parking lot. The museum, located at the end of a short walk up the hill, has a well-informed staff who have an extensive knowledge of this scenic and ecologically important area.

The bay's estuary and mudflats, visible from the museum's windows, are

Morro Bay Entrance

Two breakwaters built by the Corps of Engineers protect the entrance to Morro Bay. Each was carefully engineered and designed to calm the waters in the entrance channel.

The north breakwater, which is 1,885 feet long, extends south from Morro Rock. The breakwater was reconstructed in 1964, following a severe storm that nearly destroyed the original structure. The current breakwater, made primarily of locally quarried rock, is built to withstand 30-foot waves breaking on the structure.

The south breakwater, built in 1946, extends into the Pacific from the Morro Bay sand spit. This 1,832-foot-long structure and the breakwater to the north define the mouth of the bay's entrance channel.

A revetment, or stone dike, also constructed by the Corps of Engineers, runs along the edges of the paved road connecting Morro Rock with the mainland. The revetment follows the channel's eastern edge for 1,600 feet. A former entrance to Morro Bay was located between the rock and the land, where the roadway now runs.

North breakwater at entrance to Morro Bay

Vista of Morro Bay from Museum of Natural History

Snowy egret feeding in Turri Creek

fed by the fresh waters of Los Osos and Chorro Creeks. Exposed during low tide, the mudflats support beds of eel grass as well as a large population of waterfowl and invertebrates such as clams and scallops. The less well-known nudibranch, a shell-less marine snail, and the carnivorous moon snail, whose primary diet is clams, also populate the area. These extensive tidal flats serve as a primary resting and feeding site for birds traveling along the Pacific Flyway, the migratory pathway along the coast. The area also serves as a highly valued marine nursery for many anadromous fish species. Such species live in the ocean, but when they are ready to spawn they travel back to the same freshwater areas where they were born.

In addition to serving many other valued purposes, Morro Bay is a major area for the production of Pacific oysters. Originally imported from Japan, the cultivation of Pacific oysters became a Morro Bay industry in 1932. Annually, during spring months, seed oysters are planted in the bay. During periods of extremely low tide, exposed beds can be observed in the tidal flats southwest of the museum. Within 12 to 18 months, the seedlings are replanted in prepared fattening grounds. Harvesting occurs between October and April.

After visiting the Museum of Natural History, drive around the perimeter of the campground to a boulevard stop sign. Turn right and follow South Bay Boulevard around the edge of the bay. Along this roadway, note the fascinating network of meandering waterways that channels ocean tides and incoming freshwater streams. The pattern created by the channels resembles the structure of trees whose trunks extend outward into increasingly small branches. Several turnouts provide fine opportunities for photographers and bird-watchers.

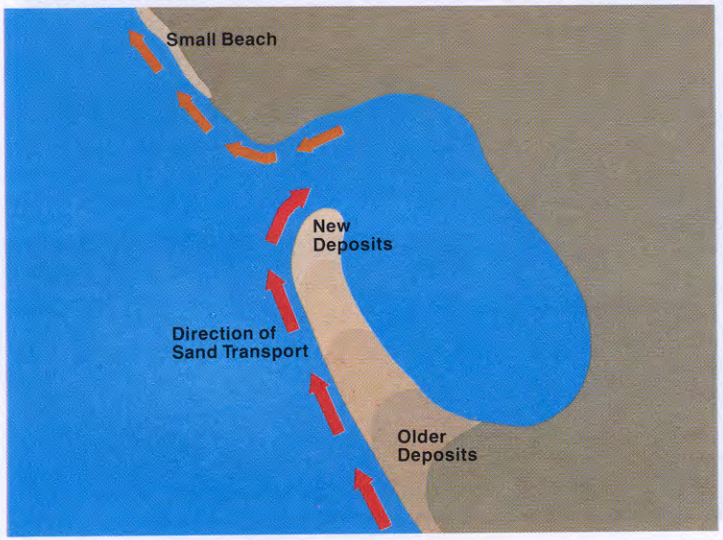
An unmarked viewing platform, built on the edge of the bay by the Morro Coast Audubon Society, provides a worthwhile stop for those interested in bird-watching. Wading birds, such as snowy egrets and great blue herons, along with gulls, are in abundance here, particularly during low tide. Green beds of eel grass are also evident. To reach the Audubon platform, continue south on South Bay Boulevard and turn right on Santa Ysabel to Third Street. Turn right on Third and continue to its end. Make another right on an unnamed road which leads to a parking lot and a pathway leading to the viewing area.

After visiting the Audubon lookout, proceed to Montaña de Oro

Sand Spit Formation

Sand spits are beach formations often found at the mouths of coastal streams, rivers, lagoons and estuaries. The process of sand spit formation begins as sand is made available from upcoast erosion and stream discharge. The eroded materials are picked up and carried along by longshore currents traveling parallel to the shoreline. As calmer, headland-protected waters of an embayment are encountered, sands drop out and are deposited. These sands eventually create *sand spits,* raised formations surrounded by water at the outward tip, across the embayment. The direction in which the spit points indicates the predominant direction of sand transport.

Eventually, the combination of erosion, sand transport and spit formation results in a shoreline in dynamic equilibrium with the wave energy of the area. This equilibrium maintains the spit, since new sand added to the tip is equal to the sand removed by winds and tidal currents.

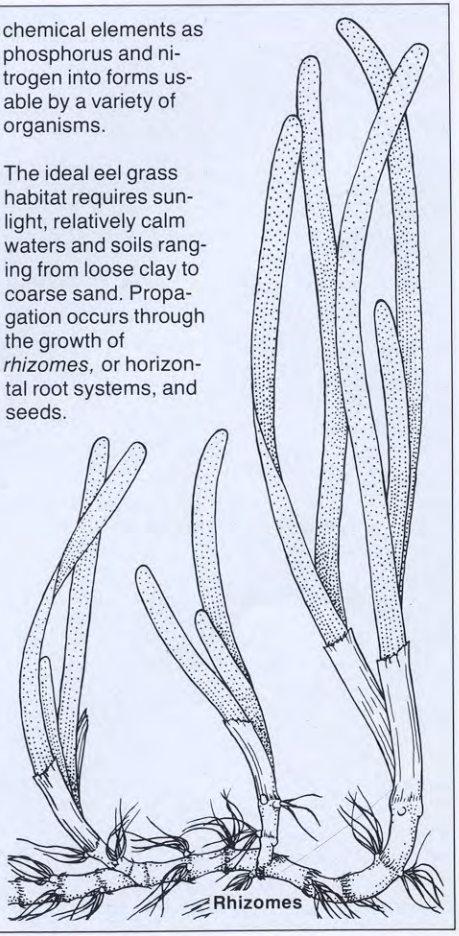


Eel Grass

Although most marine plants are algae, there are a few flowering plants that grow strictly under marine conditions. Eel grass is such a plant. Eel grass is primarily found in harbors and bays and at the mouths of estuaries and creeks. Recognizable by its bright green color, this perennial plant has narrow, flat blades that can grow to a length of three feet.

Eel grass plays an important role in the ecological balance of the areas in which it grows. The plant provides a major source of food for a variety of waterfowl and fish. Mollusks, crabs, shrimp and sea urchins feed on the plant's *detritus,* or decayed portions. Eel grass beds also shelter many small organisms from predators and convert such chemical elements as phosphorus and nitrogen into forms usable by a variety of organisms.

The ideal eel grass habitat requires sunlight, relatively calm waters and soils ranging from loose clay to coarse sand. Propagation occurs through the growth of *rhizomes,* or horizontal root systems, and seeds.



State Park. To reach this beautiful park, return to Third Street, continue to Santa Ysabel and turn left. After one block, make a right turn on Fourth Street and continue to Ramona Avenue. Make a right turn on Ramona, then a left turn on Pine Avenue to reach Los Osos Valley Road. Turn right on Los Osos and continue through extensive, rolling farmlands directly to Montaña de Oro. Enroute, note the outstanding vistas of Morro Bay, Morro Rock and the Pacific Ocean.

5 Montaña de Oro State Park

The Chumash Indians are believed to have occupied Montaña de Oro and surrounding areas during a period from 200 to 9,000 years ago. Today, Montaña de Oro, or "Mountain of Gold," is a 5,600-acre state recreational area. Abundant varieties of low shrubs grow here, nourished by the cool, moist ocean air. Numerous hiking trails wind along the wave-cut terraces. Much of the park is covered with relic sand dunes believed to have been formed during a period of unusually high winds that followed the Ice Age. Campsites, protected from the ocean by canyon walls and tall trees, are located somewhat inland from the shoreline.

The park's coastline is primarily rocky, with only narrow pocket beaches along the shore. Unusual rock formations are perhaps one of the most dramatic features of Montaña de Oro's rugged shoreline. The rocks here are believed to have been uplifted and broken during a prehistoric shifting of the earth's crust and turbulent earthquake activity. Hundreds of sea stacks lie immediately offshore resulting in a loud, booming surf. The stacks were once part of the shoreline, but, because of their hard composition, they have remained behind as the waves eroded away less-resistant materials.

Spooner Cove, located on the park's north shore, is a good place to study the interesting, highly eroded shoreline rocks. Also, opportunities to explore tide pools are excellent at Spooner Cove and a sandy beach welcomes beachcombers. Visitors should, however, be aware of the potential dangers of large, unexpected waves and incoming tides.

Morro Bay wetlands as seen from South Bay Boulevard

Value of Coastal Wetlands

California's coastal wetlands serve many valuable purposes. These intricately balanced nearshore areas create environments where terrestrial plants and animals, marine life, insects and thousands of microorganisms live together in mutual interdependence.

In addition to their innate scenic qualities, wetlands serve as shoreline stabilizers, protecting inland areas from erosive wave action and storm damage. They provide nesting, feeding and resting sites for untold numbers of species, and serve as ecologically important marine nurseries for a variety of inshore fish and shellfish.

Wetlands also act as absorbers of pollutants, and are highly productive, producing enormous amounts of detritus that are eventually utilized by many marine organisms.

Federal and state agencies not only identify wetlands as productive and valuable public resources but consider any unnecessary alteration or disturbance contrary to the public interest.

Audubon viewing platform

Dramatic rock formations at Spooner Cove in Montaña de Oro

Fishing from Port San Luis Wharf

Clam diggers on Avila State Beach

A walkway from Spooner Cove's parking lot leads across the bluffs to the edge of high cliffs where an enterprising businessman, A. G. Spooner II, developed a successful trading company in the early 1900s. Trade goods included animal hides, beans, grains and dairy products from nearby agricultural lands. A wharf was built out from the cliffs and a hand-dug tunnel provided the avenue for transporting goods to waiting ships. At low tide, evidence of the former tunnel can still be seen.

Point Buchon, just downcoast from Spooner Cove, marks the southern end of Estero Bay.

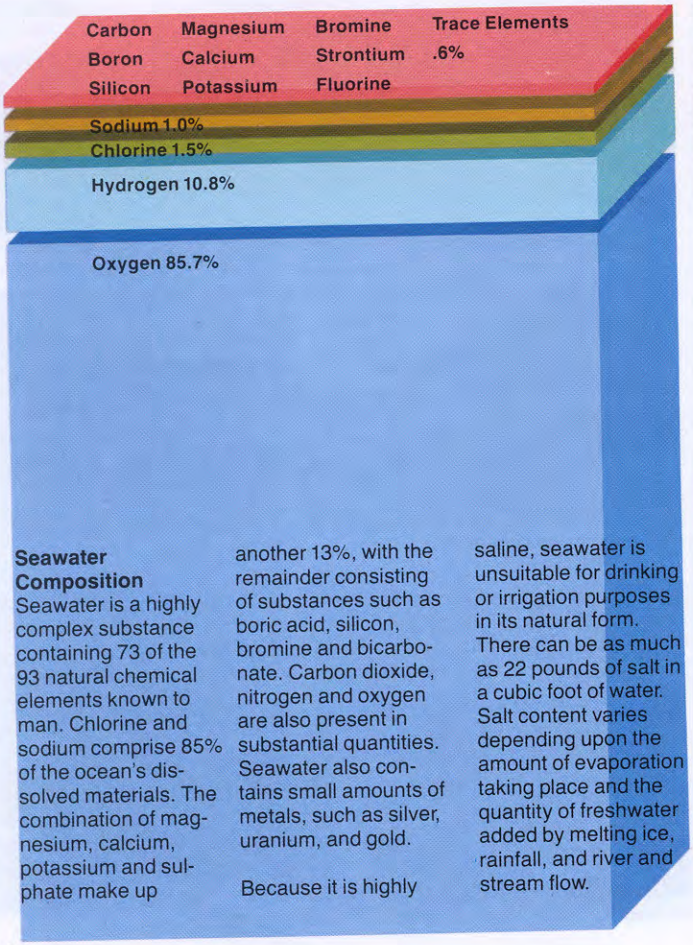
From Montaña de Oro return to Los Osos Valley Road to the town of Los Osos. Turn right on South Bay Boulevard and return to Highway 1 south. Take the Avila Beach exit to visit Avila State Beach and Port San Luis.

6 Avila State Beach and Port San Luis

The rugged coastline between Montaña de Oro and Port San Luis, 11 miles downcoast, is characterized by cliffs ranging up to 60 feet high and offshore rocks that sometimes extend a mile offshore. Access to this section of the coast is limited. To the south, however, are numerous accessible points of interest, including Avila State Beach and Port San Luis.

En route to these scenic locations, visitors can stop at the Diablo Canyon Nuclear Information Center, located 7 miles south of downtown San Luis Obispo. Traveling through the San Luis Obispo Creek Valley, large oil storage tanks dot the hills. These tanks serve as the link between inland oil fields, distribution centers and tankers calling on Port San Luis. The backshore portion of San Luis Obispo Creek, which empties into the sea near the town of Avila Beach, is defined as an estuary. A continuous supply of freshwater flows downstream and mixes with salt water carried into the estuary by incoming tides. As a result, an ideal environment is created for organisms that flourish in varying degrees of salinity. The estuary serves as a marine nursery for birds and anadromous fish which feed on the large population of estuarine invertebrates.

Avila State Beach, located near the town of Avila Beach, is approximately one-half mile long. It consists primarily of medium and coarse sands. Much of the sand that supplies this beach is brought downstream by San Luis Obispo Creek. The beach exhibits the seasonal variations typical of most West Coast beaches.



Seawater Composition
Seawater is a highly complex substance containing 73 of the 93 natural chemical elements known to man. Chlorine and sodium comprise 85% of the ocean's dissolved materials. The combination of magnesium, calcium, potassium and sulphate make up another 13%, with the remainder consisting of substances such as boric acid, silicon, bromine and bicarbonate. Carbon dioxide, nitrogen and oxygen are also present in substantial quantities. Seawater also contains small amounts of metals, such as silver, uranium, and gold.

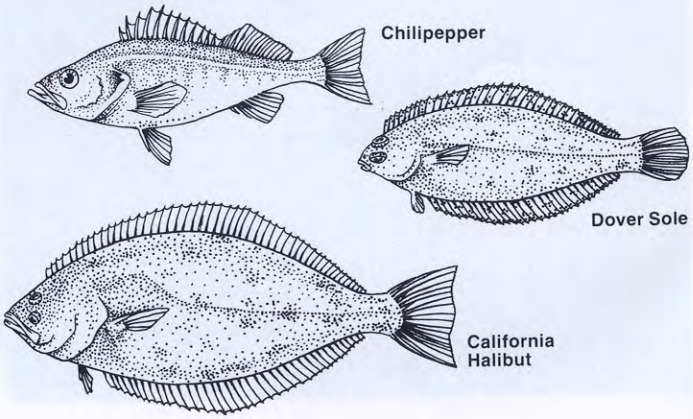
Because it is highly saline, seawater is unsuitable for drinking or irrigation purposes in its natural form. There can be as much as 22 pounds of salt in a cubic foot of water. Salt content varies depending upon the amount of evaporation taking place and the quantity of freshwater added by melting ice, rainfall, and river and stream flow.

Bottom Fish
Bottom fish, which live near the ocean floor, are important to the state's fishing industry. Three of the more common species to central California are the California halibut, the dover sole and the chilipepper.

The California halibut is a flat fish that belongs to the left-eye flounder family, although more than 40 percent of its population have both eyes on the right side. It is distinguished by its many sharp teeth, large mouth and high arch in the lateral line above the pectoral, or chest, fin. California halibut can grow to a weight of 72 pounds and a length of five feet, and are usually found on sandy bottoms in shallow water less than 60 feet deep.

The Dover sole is also a flat fish and is readily identifiable by an unusually large amount of viscous body secretion. It has large eyes and a small mouth and can grow to a length of 30 inches. Preferring predominantly muddy areas, adult females can release as many as 250,000 eggs during a single spawning period.

The chilipepper, a common variety of rockfish, give birth to their young after they develop inside the female. The adult fish grow to a maximum length of 22 inches and can attain an age of 16 years. The chilipepper is commercially important from Fort Bragg to Santa Barbara.



Port San Luis Wharf, a commercial fishing pier, is located in a protected anchorage area created by Point San Luis. Lying just upcoast from Avila Beach at the north end of San Luis Obispo Bay, the town of Port San Luis serves as a commercial fishing center where catches include salmon, steelhead, rockfish, blue bass and a variety of bottom fish. Sports fishermen and recreational boaters also dock here.

A 2,400-foot rubblemound, or piled-stone, breakwater extends from Point San Luis. The breakwater was completed by the Corps of Engineers in 1913 to protect the wharf and anchorage area from excessive wave action. The crest of the breakwater, measuring 20 feet in width, extends six feet above the average high-water line.

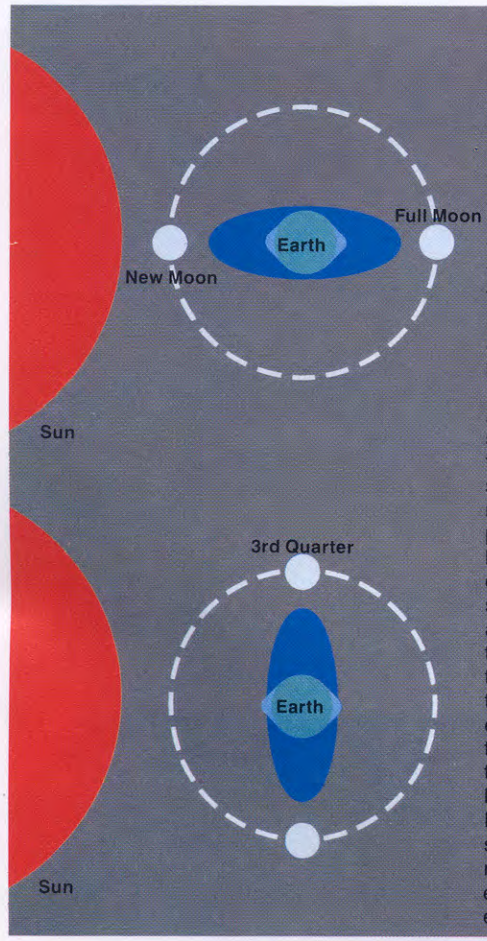
Port San Luis served as one of the West Coast's major oil ports during World War II. In earlier historic times, it was a pirate's rendezvous later known as Port Harford. Three piers — the Port San Luis Wharf to the west, an oil pier, and the county fishing pier to the east — are evidence of the marine activity in the area.

After visiting Avila Beach and the Port San Luis area, return to Highway 101. Continue south to Pismo Beach, a city widely renowned for its Pismo clams. The area's wide, flat beaches and acres of shifting sand dunes offer countless opportunities for enjoying the open coast.

7 Pismo State Beach

To reach Pismo State Beach, which extends for nearly six miles south of the town of Pismo Beach into the northern portion of the vast Santa Maria Dunes, exit from Highway 101 at the Pismo Beach exit. Then follow Highway 1 south across Avila Creek Bridge and turn right on Roosevelt Drive.

Pismo State Beach offers numerous recreational facilities and is also an important ecological preserve. A 1,700-foot lighted fishing pier and a camping area are located near the north end. Here, party boats can be chartered for deep-sea fishing. Also near the beach's northern end is the Pismo Lake Ecological Reserve. This 54-acre fish and wildlife habitat, established in 1977, is primarily a freshwater marsh. The marsh is fed by Meadow Creek. Cattails,



Tides

Tides, believed by early seafarers to result from the activity of sea monsters, are the rise and fall of the ocean surface. Tides are primarily caused by the relationships of the sun, the moon and the earth system. Of these, the interaction between the earth and the moon is predominant.

As the moon or the sun pulls the sea's waters upward on one side of the earth as a result of gravitational pull, another water bulge simultaneously occurs on the opposite side of the earth as the result of centrifugal force. The waters midway between these points experience low tide. During the course of a day, two high tides and two low tides can occur. Depending on the position of the moon in relationship to the earth's equator, however, some areas experience only one high and one low tide, and some areas have mixed tides. The different forms of tides at different locations around the earth are the result of the size and shape of the ocean basins.

When the moon, earth and sun are in a straight line, their gravitational effects and the corresponding centrifugal bulges on the other side of the earth combine to produce exceptionally high and low tides known as spring tides. These tides occur during the new and full moon. When the sun, the earth and the moon form a right angle, gravitational and corresponding centrifugal forces do not work together, causing neap tides, or periods of low tidal range. Neap tides take place when the moon is in its first and last quarters.

Sand dunes at Pismo State Beach

Fence controlling dune development

tules and willows are prevalent here, along with dozens of bird species and a variety of small animals. An area just south of the State Beach has been designated as a State Vehicle Recreational Area. In addition, a large part of the beach has been set aside as a nature preserve.

The gently sloping, unusually wide, flat shoreline at Pismo State Beach has a hard surface as a result of the relentless pounding of the surf. Visitors can drive along this roadlike surface, a unique feature that is enjoyed by thousands annually. The fine, sandy beach also provides a habitat for the Pismo clam, a large, thick-shelled mollusk that has helped create the area's reputation as a clamming center. Local park rangers should be consulted regarding specific clamming seasons and locations. The beach here is usually strewn with Pismo clam shells which serve as fine mementos of this unique area. Surf fishing is another popular attraction of Pismo State Beach.

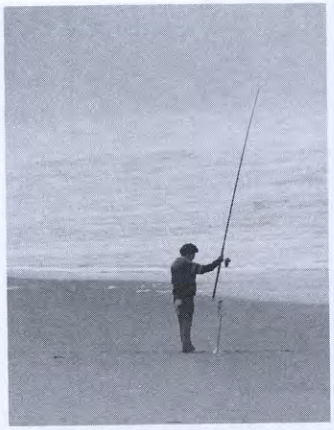
The spectacular dunes that back much of the beach area provide a habitat for wildlife such as coyotes and weasels. Many of the dunes have been planted with European dune grass to help stabilize their otherwise continual inland migration. The Chumash Indians once camped at Pismo Beach, primarily for the purpose of harvesting the Pismo clam, other shellfish and marine life. Mounds of shells, occasionally visible in the shifting sands, identify former campsites. The word *Pismo,* a Chumash word, comes from the lumps of natural asphalt which can still be found along the shore. In early days, this material was used for caulking and sealing.

The 15 miles of shoreline between Pismo Beach and Point Sal to the south are dominated by the Santa Maria dune fields, the most extensive along the California coast. The Santa Maria River, which enters the sea several miles south of Pismo Beach, serves as the major sand source. The dunes here are believed to belong to two eras. The

Sand ripples leeward of migrating dunes

Scarp created by high-energy waves

Scarps
Scarps, erosional features similar in appearance to steep miniature cliffs, can sometimes be seen along California's beaches. They occur when exceptionally high-energy waves erode away a near-shore area. Under extreme conditions, the process of cutting scarps as tall as a man can take only a matter of a few hours.



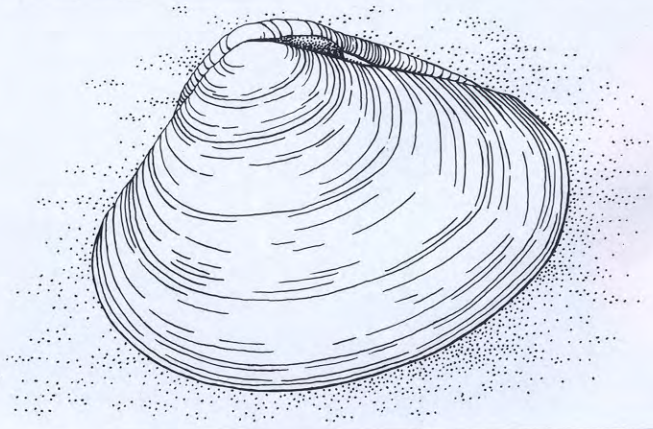
Enjoying the beach at Surf

Pismo Clams
The high oxygen content of advancing and receding tidal waters offers the ideal environment for the Pismo clam. This hardy bivalve, in fact, thrives only in such a rigorous environment.

The Pismo clam's growth progresses slowly for up to 35 years. The diameter of its shell can reach seven inches, making it one of the largest of the Pacific Coast clams. Its thick, grayish-white shell has narrow, darker bands indicating winter growth periods.

The Pismo is usually found buried in sand at a depth approximating its shell length. It is normally positioned with its hinged portion facing the sea.

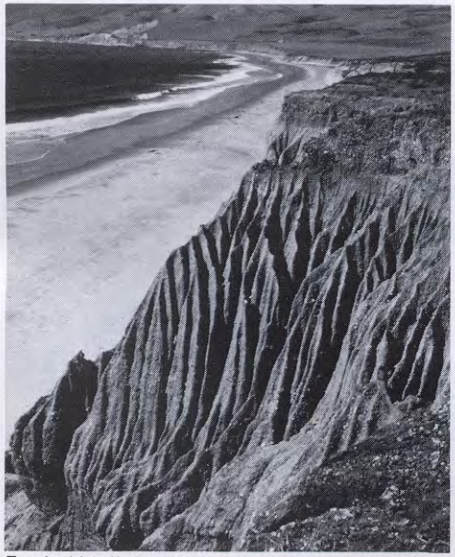
The Pismo clam shell has been found in 2,000-year-old Indian kitchen middens, or shell mounds, marking the site of primitive habitations. The clam's population has been substantially reduced since that time, primarily due to massive commercial harvesting. Although commercial harvesting has been prohibited since 1947, regulated sports digging is allowed.



more inland dunes, thought to date back to an interglacial time, are covered with vegetation. The dunes within a mile or two of the shore are younger and, although partially grass-covered, continue to move inland.

The means by which the dunes were originally formed is a perpetual process. Breezes pick up loose, dry particles and blow them up the windward slope of an existing dune hillock. The sand is deposited on the hillock's crest and then blown down the leeward side, causing the hillock to migrate inland. In this way, a series of individual dunes is created. In some areas the dunes are backed by a number of small freshwater lakes, such as Dune Lakes and Oso Flaco. The lakes result from accumulated runoff, from rainfall, that is prevented from draining to the sea by the impermeable dunes.

Rocky shoreline at northern end of Jalama County Beach Park



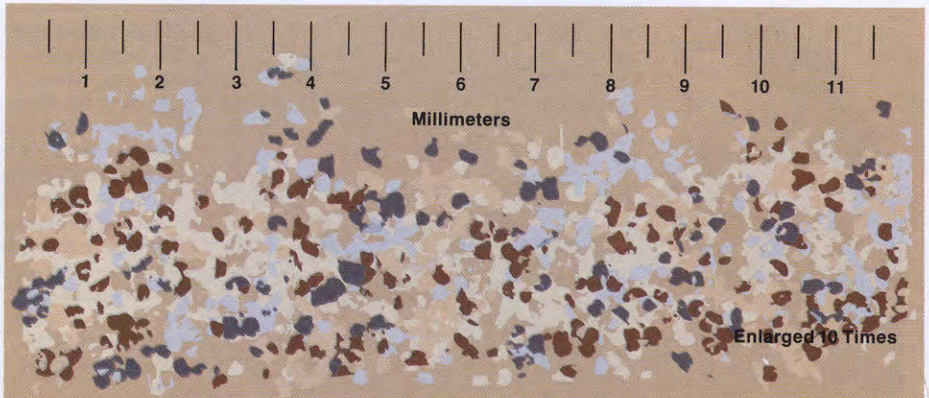
Eroded bluffs backing Jalama's sandy beach

8 Surf

The desolate, windswept beach at Surf is situated about 35 coastal miles south of the city of Pismo Beach. The highway route from Pismo to Surf, however, is approximately 60 miles. To visit this seemingly remote area, follow Highway 1 south through the fertile agricultural lands of the Santa Maria River Valley to the city of Lompoc. In Lompoc, take Highway 246 to its end, about 11 miles to the west. Because the road is sometimes closed during missile launchings, those interested in visiting Surf should inquire at one of the Vandenberg Air Force Base gates or call the Base headquarters. Vandenberg, one of the country's major aerospace centers, covers 98,400 acres and extends for 33 miles along the coast. Surf is located approximately in the center of this coastal area.

The coastline encompassed by Vandenberg is dominated by three major points of land. Each serves as the end of a range of mountains or hills, as is the case with many major coastal promontories. Just south of the Santa Maria dunes, Point Sal marks the western end of the Casmalia Hills. Point Purisima, approximately 12 miles south, identifies the extremity of the Purisima Hills, and Point Arguello, 15 miles further downcoast, serves as the terminus of the Santa Ynez Mountains. The coastline here is exceptionally rugged and rocky, with few accessible beaches. The Santa Ynez River enters the sea just north of Surf, annually supplying area beaches and dunes with about 50,000 cubic yards of sand during normal years and much more during heavy flood periods.

The dune-backed beach at Surf provides an ideal location for those who



Beach Sand

Beach sand results from the weathering of rock over long periods of time. The grinding process that results from rain, wind, stream and ocean wave action, breaks down sand materials into various sizes. The degree of coarseness is based upon the rock's original composition, as well as on local wave and current conditions, and the slope of the beach. Generally, steep beaches have coarser sands and flat beaches have finer sands. The period of time involved in transport and the steepness of the terrain over which sand is carried also have an effect on its ultimate size and shape.

Beach sands are naturally sorted, based on their ability to remain suspended in moving waves. Heavier, coarser sands drop out nearer the shoreline, while finer sands may be carried further up the beach face. When wave energy is high, such as during storms, only heavier sands are deposited on shore. That is why beach sands are coarser in the winter. The calmer wave action typical of summer periods allows finer-grained particles to drop out, resulting in the small-grained sands common to summer beaches.

Because of the series of physical changes that occur during the transformation process, sand is often not of the same composition as the rocks from which it originated. For instance, sand that is primarily quartz can result from the weathering of granite rock. Sand color, based on its mineral content, tells a great deal about coastal as well as inland geological composition. Dark sands similar to those at Cayucos, for example, result from a high iron content, while Pismo Beach's nearly white sand indicates a large quantity of quartz and feldspar.

prefer California's beaches in isolation. Swimming is dangerous except on the calmest of days. During storm periods, 20- to 30- foot breakers are not uncommon. Access to the long, sandy beach can be reached by walking from Surf's small parking area through a wire gate, then crossing the Southern Pacific Railroad tracks.

Both American and European dune grasses grow extensively here. The European variety is distinguished from the American species by its slightly shorter, thinner blades. Both serve as excellent dune stabilizers by slowing the sand's inland migration. In fact, these grasses are partially responsible for changing the topography of the dunes in central and northern California: from a perpendicular to a parallel orientation with the prevailing wind direction.

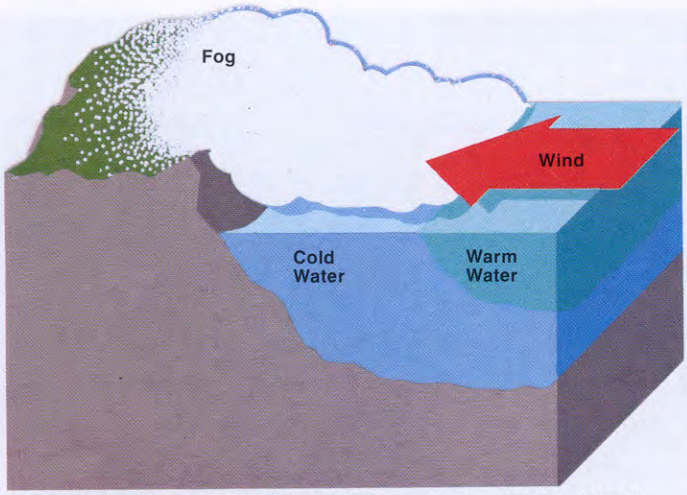
9 Jalama Beach County Park

After visiting Surf, return on Highway 246 to Lompoc and reconnect with Highway 1. Approximately four miles to the south, turn right on Jalama Road and continue approximately 14 miles to its end.

Jalama Beach County Park is a sandy pocket beach which retains its relatively stable configuration as a result of the protection provided by the rocky headlands lying both upcoast and downcoast. The beach is backed by the floodplain of Jalama Creek and the Santa Ynez Mountains which rise to some 3,000 feet within two miles of the sea. Swimming is discouraged because of the dangerous wave and current conditions caused by an offshore rock reef. Beachcombing, exploring tide pools and fishing for perch, rockfish and halibut, however, are popular pastimes. Campgrounds are also available.

The coast between Jalama and Point Conception, the prominent headland a few miles downcoast, is relatively undeveloped. Though inaccessible to automobiles, a trip by train provides scenic vistas of the rocky, isolated shoreline. In 1923, the country's worst peacetime naval disaster occurred near Point Arguello, about 10 miles north of Jalama, when nine American destroyers crashed on offshore rocks during a heavy fog.

Point Conception, often called the "Cape Horn of the Pacific," represents the physical dividing line between the coasts of Northern and Southern California. Its 52-foot lighthouse has warned maritime vessels of rocky hazards since 1856. It is at Point Conception that the California coastline changes from a north-south to an east-west orientation.



Coastal Fog
Fog, a weather feature common to the California coast, is appreciated for its cooling effects, for the moisture it provides coastal agricultural crops, and for the dramatic beauty it creates as it billows over coastal ranges. Mariners and those traveling by land and air, however, fear fog for the dangerous reduced-visibility conditions it can cause.

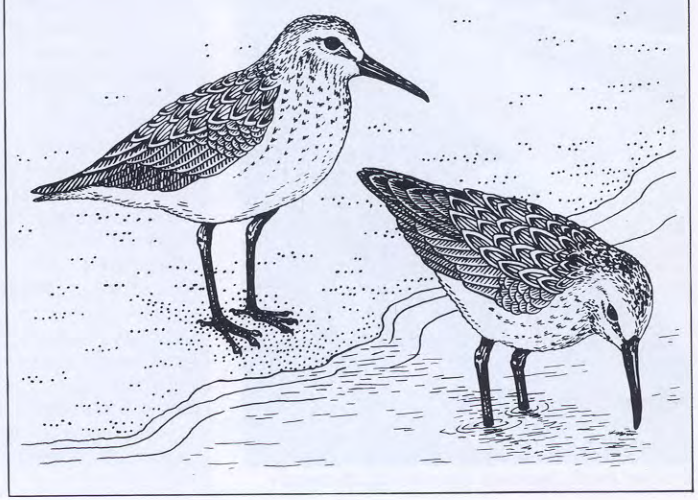
The combined effects of wind, water and temperature changes create fog. Coastal fogs begin when prevailing winds blow warm, moist air toward land. As this air approaches the coast, it blows over colder coastal water. This cools the air to its dew point, resulting in the formation of tiny, suspended droplets of water within the air mass. Together, these droplets form low clouds, or fog. As the air is drawn inland the warming effect of the inland temperatures causes the fog to dissipate.

Coastal fog banks can range in width from a few hundred yards to more than a hundred miles. Heights vary from 100 to more than 2,000 feet.

Western Sandpiper
Sandpipers, also known as "peeps," are one of the shore's most common and visible inhabitants. Of the many varieties of this species found in California, the western sandpiper is the most prevalent. It is a small bird with black legs and brownish feathers. Its black beak turns down slightly near the tip. At close range, a light-colored band is visible over the eyes.

The western sandpiper is often seen feeding in mudflats and scurrying along the water's edge as it watches for insects and small crustaceans left behind by receding tides. It is a gregarious bird that usually feeds in small groups and migrates in flocks of thousands.

Beaches and nearshore areas are excellent vantage points for observing numerous species of shorebirds. Because many are similar in appearance, a pair of binoculars and a bird-watcher's guide will aid identification.



The Year of the Coast

In keeping with President Carter's declaration of 1980 as "The Year of the Coast," the U.S. Army Corps of Engineers has joined other public agencies and private organizations in focusing attention on the need to manage, preserve and protect our nation's coastal areas. To assist in this worthwhile objective, the U.S. Army Corps of Engineers will, throughout 1980 and 1981, publish a series of brochures highlighting key natural and manmade features of the California Coast. It is hoped that this series will both inform the public of coastal features and processes and assist in the development of a greater appreciation of the critical need to insure the protection and management of coastal resources.

For additional details on these brochures and other public information and education programs available from the Corps of Engineers, please contact the following Public Affairs Offices:

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