U.S. Army Corps
of Engineers

Explore 7

The California Coastline
Golden Gate to Davenport

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 birdwatching 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 an 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.

The winter sky was a piercing blue and the ocean spray refreshing. The group in the chartered fishing boat watched the horizon expectantly for the sign they had waited hours to see. Then suddenly, it was there — a tall fountain of water exploding in the distance. In a matter of minutes, the boat was within 30 feet of two majestic grey whales. For a few moments, the people watched as the whales surfaced, submerged and resurfaced before disappearing into the ocean's depths.

The grey whales' semi-annual migration from the North Pacific to breeding grounds in Baja California is one of the many natural spectacles to be enjoyed along this coastal area. Here, too, one can feel alone with nature and enjoy undisturbed, scenic beauty. At many vista points, the silence is punctuated only by the pounding surf, the cries of gulls and the occasional barking of a sea lion.

The earliest inhabitants are believed to have been the Ohlone Indians. Blessed with a mild climate and abundant wildlife, numerous Ohlone tribes lived here for some 4,000 years before the Spanish colonists arrived in the last quarter of the eighteenth century. The Spanish were followed by whalers from around the world. In the early nineteenth century, whaling was an important industry. In less than 100 years, however, the whalers had stalked their prey to the verge of extinction. Today, these magnificent mammals, now protected by law, are replenishing their numbers.

When the whaling industry declined, farming became the economic mainstay of this area. Many of the first farmers were Portuguese. Their small holdings, with large white-washed barns and weather-beaten farmhouses, were reminiscent of a European landscape. Today, dairying, horticulture and vegetable-growing are the region's principal agricultural pursuits.

Perhaps the most characteristic feature of the coastline between the Golden Gate and Davenport is diversity of landscape. Within 75 miles, the narrow Coast Highway edges along tall cliffs, plunges to rocky shorelines, crosses verdant farmlands, and meanders along expansive beaches.

As you explore this section of the coast we hope you will gain a greater understanding of the natural processes that have shaped this serene and beautiful area.

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Davenport
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1 Bakers Beach and Lands End

The portion of the Golden Gate National Recreation Area that extends from the Golden Gate Bridge to San Francisco's Lands End offers breathtaking ocean vistas and two fine beaches.

Just off San Francisco's 49 Mile Drive near the western boundary of the Presidio, the 1,500-acre park-like headquarters of the Sixth U.S. Army, lies Bakers Beach. A hiking trail that winds from the beach's vista point offers spectacular views of the Golden Gate Bridge and the Marin coastal hills.

Bakers Beach is a mile-long, relatively steep stable pocket beach bounded by two rocky headlands. The headlands originally formed this fine-sand beach, and continue to contain its sand supply by trapping sediments carried along shore by the currents. In addition to protection provided by the two headlands, Bakers Beach is protected from the ocean's erosive power by the San Francisco Bar. This crescent-shaped sand bar lessens the wave energy approaching the shore. Situated about five miles seaward of the Golden Gate, it extends from Point Bonita, north of the Gate, to San Francisco's Ocean Beach.

A circular current called a *gyre* influences Bakers Beach. This current is created by the force of ebbing, or outgoing, Bay waters pushing through the narrow Golden Gate Channel. North of the Golden Gate, the gyre tends to move in a clockwise direction, but south of the Gate the gyre moves counterclockwise. The gyre affects the temperature and salinity of the near-shore waters, tending to make them warmer and less saline than unaffected waters. Fishermen will be interested to know that striped bass, unlike most ocean fish, are attracted to these waters and are a frequent catch here.

At the southwest end of Bakers Beach is Lobos Creek, the last of several streams that once flowed through San Francisco and provided the city with its freshwater supply. Beyond the creek is a picnic area shaded by Monterey pines which were planted in the nineteenth century. Prior to that time, only willows grew in this area.

From Bakers Beach, follow Lincoln Boulevard as it leaves the Presidio and becomes El Camino del Mar. Phelan Beach, a little-known but delightful pocket beach, is located off El Camino del Mar at the end of Seacliff Avenue. Leaving the beach, continue south on El Camino del Mar. The road becomes Legion of Honor Drive near

Caution
To fully enjoy this lovely coastal area it is important to be aware of its innate, and often unexpected, hazards.

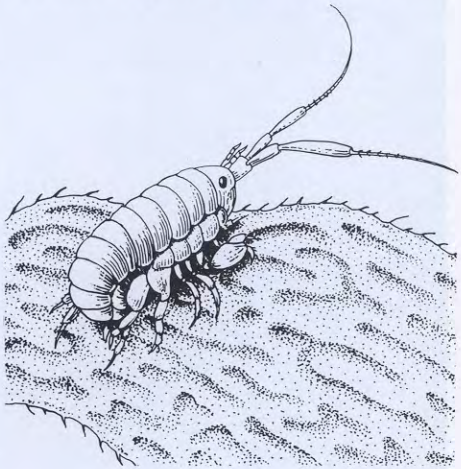
Frequent landslides make hiking on the cliffs hazardous. Walking should be restricted to areas well away from cliff edges, where loose rocky materials can suddenly slide to the water below.

Swimmers, surfers, fishermen and boaters should be aware of dangerous riptide conditions, and should stay clear of floating driftwood. Swimming and surfing often require wet suits because of the 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 when exploring the shoreline.

Sand Hoppers
Small scavenging insects called sand hoppers, also called "sand fleas," are common to California's sandy beaches.

Sand hoppers are named for the characteristic rapid thrusting of their hindparts which makes their jumping movements similar to that of fleas. Similar in appearance to miniature prawns, they have segmented, ivory-colored bodies and two antennae. The largest of the species grows to a length of about 2.5 inches.

Sand hoppers survive only above the water line. They can usually be found scavenging for algae and dead animal matter on the strands of kelp tossed ashore by waves. When disturbed, they dig into the sand and hide.



Phelan Beach as seen from El Camino del Mar

Cypress trees lining coastal cliffs in Lincoln Park

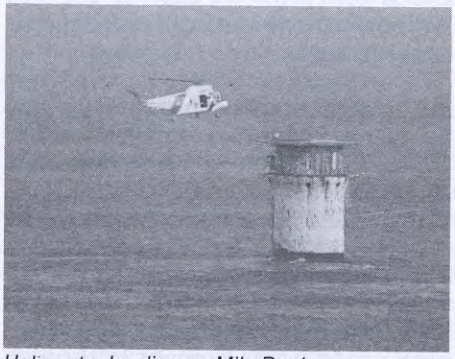
the Palace of the Legion of Honor, the San Francisco art museum built to commemorate the contributions of the City's French immigrants. Legion of Honor Drive winds through Lincoln Park and becomes 34th Avenue. Turn right off 34th Avenue, onto Geary Boulevard and continue to Point Lobos Avenue. A right turn on Merrie Way leads to a vista point and parking lot.

This area is known as Lands End. The cliffs here, like many along this portion of the coast, were once sediments on the ocean floor and are extremely unstable. Sandstone, which easily erodes, is one of the most common rocks here.

Lands End is a favorite spot for ship watchers, artists and others who can tolerate the frequently chilly fog. Brisk winds have shaped the cypress trees that line the cliffs. In the waters below, a recurring oceanic phenomenon makes fishing from the rocks a hazardous activity. When a group of wind-generated waves coming from different directions suddenly blend, they can create powerful and dangerous waves that reach high onto the rocks. Numerous fishermen have been swept away by these forceful waves.

North of Lands End, Mile Rock protrudes from the ocean, approximately two nautical miles from the Golden Gate. Mile Rock is thought to be the site of the 1901 shipwreck of the "Rio de Janeiro," in which 131 people lost their lives. Possibly because of the currents in this area, the ship has never been found. After this tragedy, the Mile Rock Light Station was built as a navigation aid. Mile Rock was a manned light station until 1965, when the Coast Guard installed an automated light.

Returning to Merrie Way, turn right onto Point Lobos Avenue and drive a short distance to the metered parking area near the Cliff House. This area is an excellent vantage point for viewing the rugged splendor of Point Lobos to the north and the broad expanse of Ocean Beach to the south.



Helicopter landing on Mile Rock

Seal Rocks as seen from Cliff House

View of Golden Gate Bridge from Bakers Beach

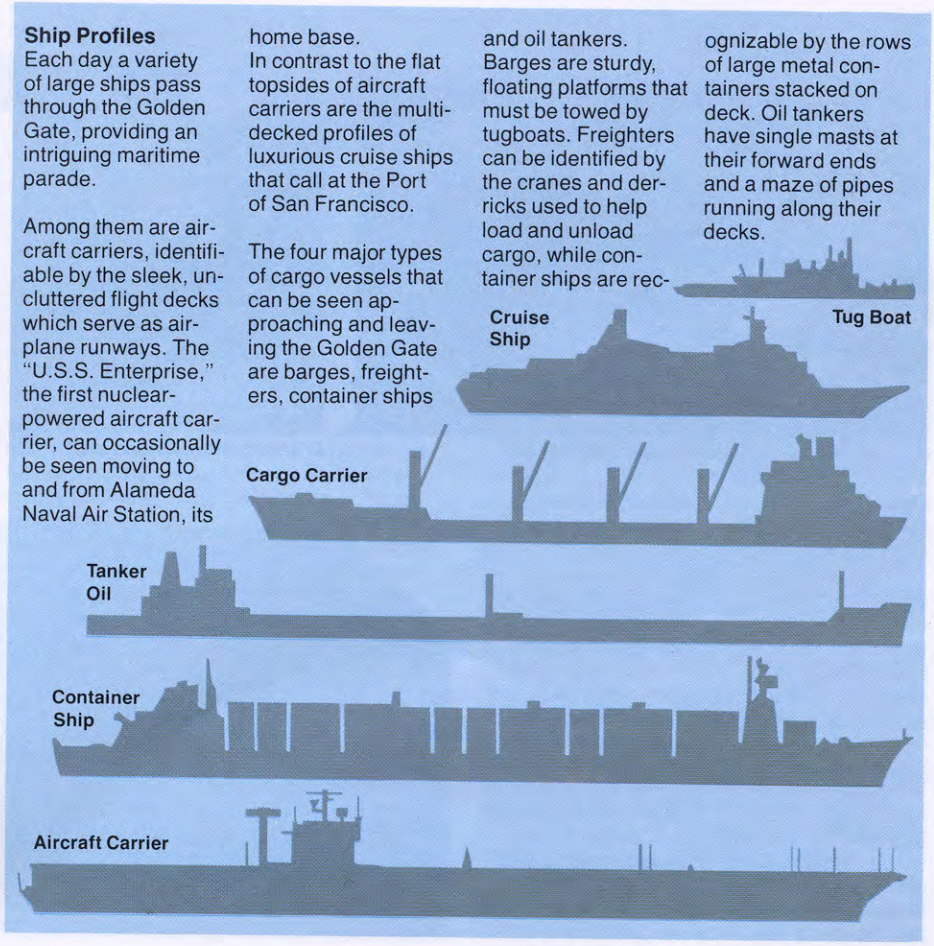
Ship Profiles

Each day a variety of large ships pass through the Golden Gate, providing an intriguing maritime parade.

Among them are aircraft carriers, identifiable by the sleek, uncluttered flight decks which serve as airplane runways. The "U.S.S. Enterprise," the first nuclear-powered aircraft carrier, can occasionally be seen moving to and from Alameda Naval Air Station, its home base.

In contrast to the flat topsides of aircraft carriers are the multi-decked profiles of luxurious cruise ships that call at the Port of San Francisco.

The four major types of cargo vessels that can be seen approaching and leaving the Golden Gate are barges, freighters, container ships and oil tankers. Barges are sturdy, floating platforms that must be towed by tugboats. Freighters can be identified by the cranes and derricks used to help load and unload cargo, while container ships are recognizable by the rows of large metal containers stacked on deck. Oil tankers have single masts at their forward ends and a maze of pipes running along their decks.



2 Point Lobos and Ocean Beach

Just north of the Cliff House is Point Lobos, the high, rounded headland between Lands End and Ocean Beach.

Spanish explorers originally named the headland, *Punta de los Lobos Marinos* — Point of the Sea Wolves — for the many sea lions that congregated on the rocks below.

The Cliff House, located just south of Point Lobos, has been a popular tourist attraction since the 1860s. Today, in addition to a restaurant and shops, the building houses a National Park Service museum. Adjacent to the Cliff House are the remains of the Sutro Baths, a public swimming facility built in 1896. A massive roof of colored glass once covered six swimming pools filled with ocean water brought in through an elaborate piping system. Each pool was heated to a different temperature. During the 1930s, business at the baths began to decline and over the years the pools were gradually closed. In 1966, the structure was destroyed by fire.

On the point overlooking the Cliff House, once the grounds of Adolph Sutro's mansion, is a park offering splendid views of the coastline.

Just below the Cliff House are Seal Rocks, home of a colony of Steller sea lions. Each year the seals migrate from here to breed at Año Nuevo State Reserve, 50 miles downcoast. Steller sea lions are the largest of their species and among the most boisterous. Some weigh up to a ton. The barks of the bulls can sometimes be heard more than a mile away.

Extending south from the Cliff House for about a mile along Ocean Beach is O'Shaughnessy's Sea Wall. This classically designed sea wall was built in 1924 to protect the inland area from the ocean's destructive force. The broad steps at the bottom of the sea wall absorb some of the energy of attacking waves. The upper part of the wall, curved slightly toward the water, is designed to thrust the waves upward, then hurl them back into the ocean. During the summer the steps become completely covered with collected sand, but the absence of erosion testifies to the wall's effectiveness.

Today, primarily due to increased construction costs, shorelines are often protected from erosion by rubble revetments, or large rocks lining the shore's banks. Unlike the rigid sea wall, these rock facings are designed to absorb the wave energy rather than reflect it back to sea.

Only remaining evidence of Sutro Baths

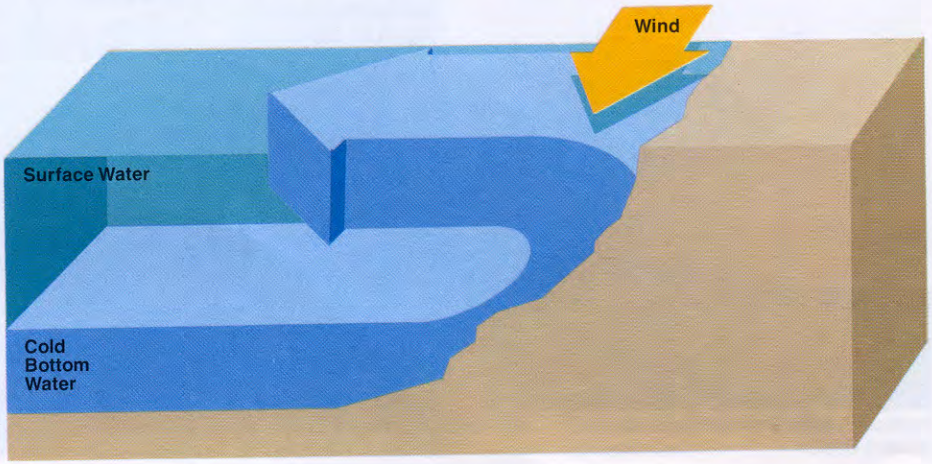
O'Shaughnessy's Sea Wall

Cliff House

Upwelling

Upwelling is an ocean process that dramatically affects coastal weather patterns and water temperatures. The phenomenon may occur when wind and coriolis effects push nearshore surface waters out to sea, bringing colder waters from the ocean bottom to replace the surface waters. Coriolis, a force resulting from the earth's rotation, causes a deflection of Northern Hemisphere waters to the right.

The effects of upwelling include increased coastal fog and the lowering of the temperature of nearshore coastal waters. Upwelling also brings nutrients from the ocean floor to the surface, which can result in a burst of microscopic growth called "plankton bloom."



South of the Cliff House, the Great Highway parallels five-mile-long Ocean Beach, a favorite surfing spot.

The sometimes confused wave patterns visible along Ocean Beach are affected by the submarine San Francisco Bar. Northwesterly waves refract, or bend, around the southern end of the Bar, making them appear to be coming from the southwest.

On a clear day the Farallon Islands can be seen on the horizon to the west. Located 26 miles from the Golden Gate Bridge the islands are actually within San Francisco's city and county limits. Declared a marine sanctuary, their rugged cliffs provide habitats for sea lions and seals, as well as nesting sites for numerous bird species.

During severe windstorms, sand drifts are blown from the dunes at the southern portion of Ocean Beach. It is interesting to note that the Great Highway was constructed by leveling the dunes along the shoreline and placing additional land fill. The Great Highway is often closed by wind-blown sand as nature tries to re-establish the dune field. Prior to development, much of San Francisco was covered with sand dunes formed more than 100,000 years ago when the sea level was about 100 feet lower than it is today.

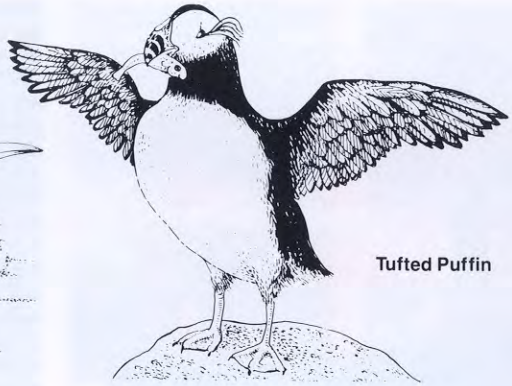
The Great Highway terminates at Highway 35, also called Skyline Boulevard. Continue south on Skyline to the turnout for Fort Funston, a popular launching point for hang gliding enthusiasts.

3 Fort Funston

Fort Funston was built for strategic defense purposes during the Spanish-American War and served as an important defense installation during three wars. The area is now a part of the Golden Gate National Recreation Area. The outpost's buildings have been removed.

Southwest of the parking lot, paths lead down to the beach, past a popular spot for launching hang gliders. The area is dominated by ice plant, a succulent that has been planted here to help stabilize the dunes.

About a half-mile north of Fort Funston's parking lot is Battery Davis, an immense World War II gun emplacement. At Battery Davis, a walk through the tunnel near the entrance leads to an old paved road that continues north over the dunes. Here



Birds of the Farallones

Twenty-six miles west of the Golden Gate, a portion of an underwater ridge rises above sea level for 16 miles to form the Farallon Islands. This grouping of five major islands and a dozen or more smaller ones provides an ideal environment for many species of marine birds. The birds find the islands' isolation and granite cliffs well-suited for nesting.

In 1901, the Farallon Islands were set aside as a National Wildlife Refuge. Now they are part of the 1,000-square-mile Point Reyes-Farallon Islands National Marine Sanctuary. Protected from human intervention, the bird population of the Farallones has grown to more than a quarter of a million. Two of the most intriguing species are the common murre and the tufted puffin.

Murres, with their white chests and black backs, resemble penguins. Each year, when young murres are nearly half-grown, the entire colony begins its winter migration by diving from cliff-top nests into the ocean far below. These breathtaking leaps and splash-landings provide young murres with their first flying and swimming lessons. In the mid-1800s, before chicken farmers became established in Sonoma County, millions of the murre's eggs were gathered for the San Francisco market.

About 50 pairs of the tufted puffin currently nest on the Farallones. These pigeon-sized birds are the most colorful of the islands' residents. They have dark, stocky bodies and white faces highlighted by yellowish tufts curving down behind their eyes. Their beaks are rounded, large and orange, and they have large, webbed red feet that serve as brakes during flight.

Sand drift on Great Highway near Ocean Beach

Shoreline riders at Fort Funston

Series of breaking waves

magnificent views of the western portion of San Francisco, including the towers of the Golden Gate Bridge, Mt. Davidson, John McLaren Park and San Bruno Mountain can be enjoyed. To the south is Lake Merced, which was once a coastal lagoon later separated from the ocean by the development of sand dunes. The lake, fed by freshwater springs, is a popular trout-fishing spot as well as an emergency water reservoir for San Francisco.

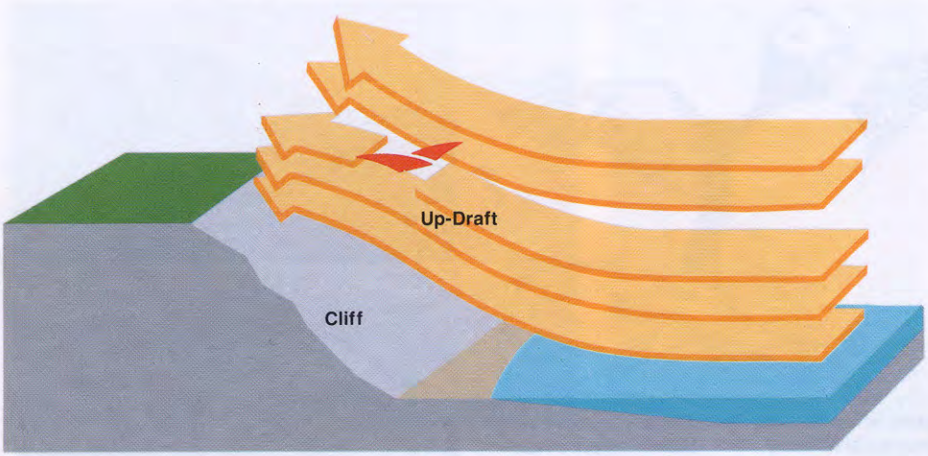
A few miles south of Fort Funston on Skyline Boulevard is Thornton State Beach, where horses can be hired for rides along the shore. What remains of the original ocean-fronting highway is visible here. The highway, which was built in the 1930s, extended halfway up the cliffs on the track bed of the old Ocean Shore Railroad, which was planned to connect San Francisco and Santa Cruz. Over the years, waves eroded the cliffs below the highway. Maintenance efforts were abandoned in 1957 after an earthquake caused major parts of the road to slip into the ocean.

The beach area between Thornton State Beach and Mussel Rock, two miles to the south, is known for its plentiful supply of sand dollars. The sand dollar is the skeletal remains of a sea animal in the same family as starfish and sea urchins. Occasionally, beachcombers find fossilized sand dollars here, some from two- to five-million years old.

At Mussel Rock the San Andreas Fault leaves the coast. It then crosses the Gulf of the Farallones and returns inland at Bolinas Bay.

To reach our next site, Pacifica's Sharp Park State Beach, take the Highway 1 exit from Skyline Boulevard. Exit from the highway on Paloma Avenue and turn right at the first stop sign. Continue to the end of Paloma, then make a left turn at Beach Boulevard.

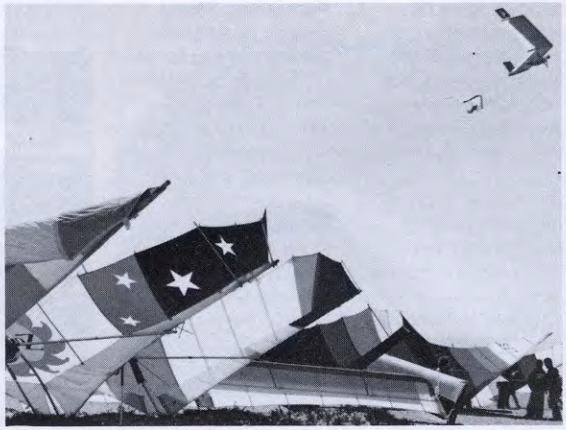
Patterns left by receding waves



Hang Gliding
Many of the bluffs along this area of California's coastline are favored take-off points for hang gliders. If the winds are right, enthusiasts of this exciting and often dangerous sport arrive, prepare their colorful winged gliders, and take running leaps off the cliffs. Once aloft they effortlessly glide in circles through the air, supported by winds called updrafts.

Updrafts are created when wind strikes the face of a cliff and is deflected upward. The strong predominant west-northwest winds create some of the best conditions for hang gliding.

Fort Funston's viewing platform



Hang gliders at Fort Funston

Glider soaring above dunes near Great Highway

4 Sharp Park State Beach and Pier

Sharp Park State Beach faces northwest, which is the predominant direction of waves along the Northern California coast. This means Sharp Park is a "wave-fronting beach," directly exposed to the full attack of the waves. Severe shoreline erosion occurs here. To provide limited protection for Beach Boulevard a rubble revetment was built along the shore. Some additional erosion protection is provided by the natural phenomenon of bar building. During high-wave conditions, sand is eroded from the beach and deposited in a bar form offshore. These shoal areas dissipate wave energy by causing the waves to break before they reach the shoreline. During periods of gentler waves, the sand migrates toward shore, building a wider beach.

In cooperation with the State of California, the Army Corps of Engineers is currently conducting a wave study here as part of the Coastal Data Information Program. A wave gage has been installed north of the fishing pier to collect data on the height, frequency and direction of local waves. Information collected by the gage is transmitted by telephone to San Diego where the data is analyzed by computer and correlated with data obtained from other gages scattered along the California coast. The study is assisting in the development of new methods to minimize beach erosion, as well as providing useful data for recreational boaters, fishermen, search and rescue units and those interested in coastal engineering.

Sharp Park Pier is a popular fishing spot. Catches here include the surf perch, smelt and an occasional striped bass. The pier's pilings provide an ideal habitat for a vast number of invertebrate organisms, many of them microscopic. Organisms live at various depths on the pilings depending upon how well they adapt to splash, high, middle and low-tide zones. At the high-tide zone some of the more recognizable organisms are barnacles, mussels and starfish.

To reconnect with the Coast Highway, proceed south on Beach Boulevard, turn left at Clarendon, then right onto Francisco Boulevard.

South of Pacifica the road begins to climb along the edges of cliffs that plunge hundreds of feet to the ocean below. The roadway here is dangerous during storms, hazardous in fog, and somewhat frightening even on

Rip current identifiable by broken wave front

Rip Currents

Rip currents occur unexpectedly along this section of the coast, representing an extreme danger to swimmers. By watching the waves carefully, however, it is possible to determine the location of these fast-moving, treacherous crosscurrents.

A narrow band of water cutting through the breaking waves usually indicates that the waters have run through an underwater channel in an offshore sand bar and are returning from the beach to the sea. This sets up reverse currents that are usually only a few yards wide but can carry unwary swimmers dangerously far offshore. Swimmers should not try to swim against a rip current, but should instead attempt to swim to either side and reach waves moving shoreward.

Patience rewards Pacifica surf fisherman

Clusters of mussels on pier's pilings

Sharp Park Pier

Devils Slide

a bright and sunny day. Not surprisingly, the area is called Devils Slide.

The cliffs here reveal much about the region's geologic history. Built up by marine sedimentation over hundreds of thousands of years, these once-flat sedimentary layers are now bent, upturned, and folded over as a result of earthquake activity. Earthquakes and ground water have also loosened the sedimentary layers, causing entire sections of the cliffs to collapse during rainstorms.

Continuing south to the town of Moss Beach, turn right on California Avenue to reach the parking lot for the James V. Fitzgerald Marine Reserve. This reserve is one of the richest intertidal areas on the California coast.

5 James V. Fitzgerald Marine Reserve

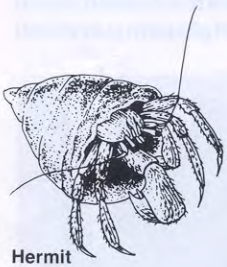
This outstanding San Mateo County marine reserve includes several miles of rocky coastline interspersed by sandy beaches. These rocky shores are good areas for snorkeling, scuba diving, and exploring tide pools.

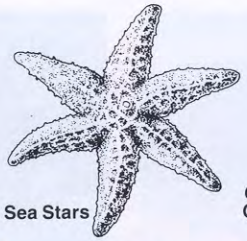
Within the eroded, rocky remains of marine terraces, the winds and waves have carved out channels and depressions to create tide pools. In the tide pools are myriad plants and animals protected under state law. Exposed to the forces of nature and the tampering of man, they struggle for survival in one of nature's harshest environments.

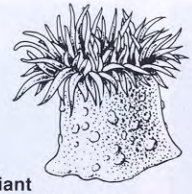
Life in the tide pools is dependent on the semi-diurnal, twice-daily, tides that surge over the rocks, providing moisture and nutrients. The crashing of the waves against the rocks adds oxygen to the water. This aeration is essential to the survival of most tide pool inhabitants.

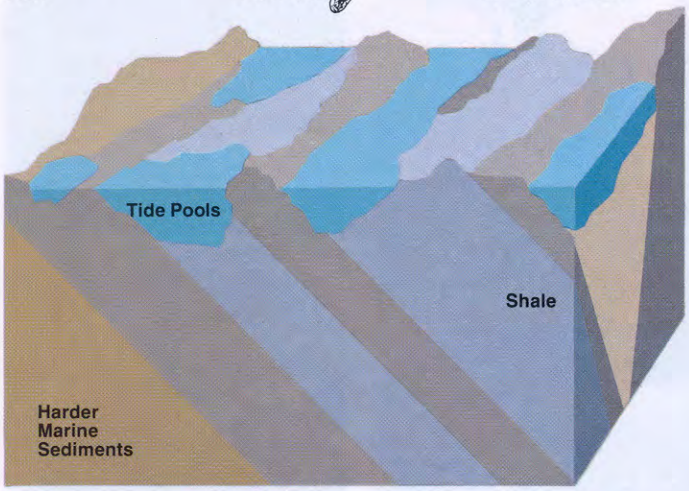
At first glance, only the most colorful plants and animals are evident. Among these are giant green anemones, some of which may be as much as 75 years old. Spiny, purple sea urchins, grazing animals that live on seaweed, are also evident. Closer observation, however, reveals an almost limitless variety of creatures, each involved in the simple instincts of finding food, escaping enemies and reproduction.

Just north of San Vicente Creek, near the steps at the entrance to the reserve, the trace of a fault can be seen on the cliff face. A fault is a fracture in the crust of the earth along which there is motion on either side. In this instance, several million-year-old









Tide Pool Formation Approximately seven million years ago, the area that now includes James V. Fitzgerald Marine Reserve was an immense mudflat that extended for many miles along the coast. Over geologic time, the mud was compressed into shale as other marine sediments were deposited. Subsequently, materials were uplifted by movements of the earth's crust. The exposed shale was then slowly eroded away by waves, resulting in the channels, crevices, cracks and ledges that form today's tide pools.

Tide Pool at James V. Fitzgerald Marine Reserve

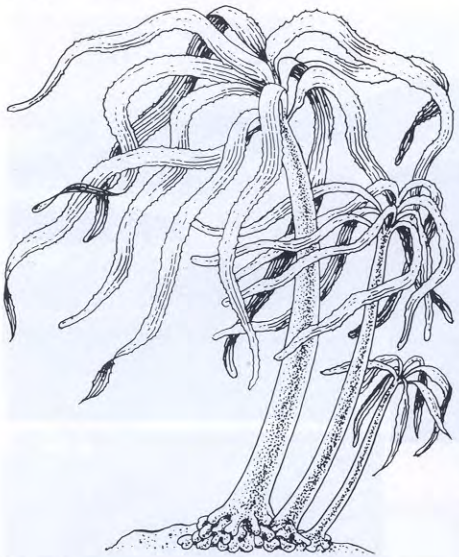
Beach immediately south of Reserve

Students exploring rocky shore at low tide

siltstone beds southwest of the fault have been pushed against 70,000 year-old terrace deposits on the fault's northeast side.

From James V. Fitzgerald Marine Reserve, return to the Coast Highway and continue south. Just past the town of Princeton, a commercial fishing and boatbuilding center, turn right at the sign for Half Moon Bay.

Sea palms clinging to offshore rocks



Sea Palms
On many rocky shores and reefs, great forests of tiny sea palms battle the tremendous forces of wind and wave. The palms, which reach only 12 inches at maturity, are actually algae that grow only where surf is continuous and high.

Sea palms maintain their hold through the flexibility of rubbery stalks and the strength of "holdfasts," or bundles of small fibers that tightly grip the rock. Sea palm stalks provide protection for animals, such as the brown-and-white-shelled limpet, that could not otherwise survive the turbulent environment.

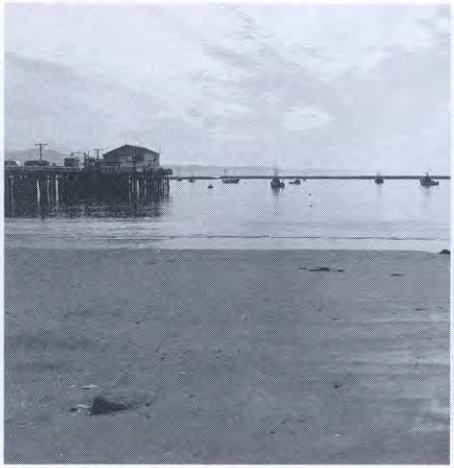
6 Half Moon Bay and Pillar Point Harbor

The turn-off at Half Moon Bay's Pillar Point Harbor provides an excellent view of beautiful Half Moon Bay. From the rocky headland of Pillar Point immediately upcoast, the Bay's shoreline gently curves southward and forms a long, sandy beach.

For more than 200 years the headland's granitic, non-erosive rock created a natural harbor. In order to provide additional wave protection for the small boats that anchor here, the Army Corps of Engineers, in 1961, completed construction of the harbor's east and west breakwaters. In 1967, the west breakwater was extended to lessen the effects of ocean waves inside the harbor.

Pillar Point Harbor is an anchorage facility as opposed to a berthing facility. In an anchorage, boats tie up to anchored buoys and passengers use a dinghy, or small row boat, to reach shore. In a berthing facility, boats are tied directly to a dock or pier. Anchorage facilities such as those at Pillar Point Harbor are used primarily by commercial fishermen.

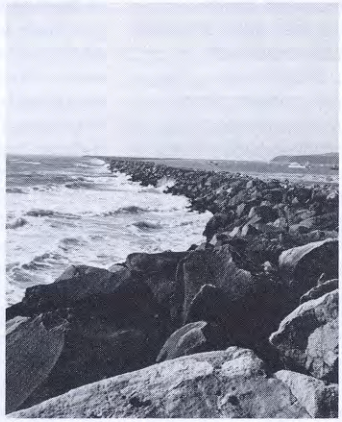
South of Half Moon Bay, the Coast Highway meanders inland. Most of the land in the area is devoted either to floriculture or agriculture. Flowers grown here include daisies, carnations and chrysanthemums. The most widely grown vegetables are artichokes, Brussels sprouts, pumpkins and broccoli. All are well adapted to the area's cool, foggy environment. Mushroom farming, sometimes called "mushroom mining" because growing areas are either in natural caves or in permanently darkened buildings, is also



Pillar Point Harbor

Flower fields and greenhouses near Half Moon Bay

Fishing boats anchored at Pillar Point Harbor



Corps of Engineers breakwater

prevalent here.

Approximately 12 miles south of Half Moon Bay, the highway crosses Tunitas Creek. Beneath the bridge over the creek are remnants of pilings from the original Ocean Shore Railroad. About 6.5 miles south of Tunitas Creek, is Pescadero Beach, our next stopping point. This beach has an impressive expanse of sand dunes.

Wave erosion at Pescadero State Beach

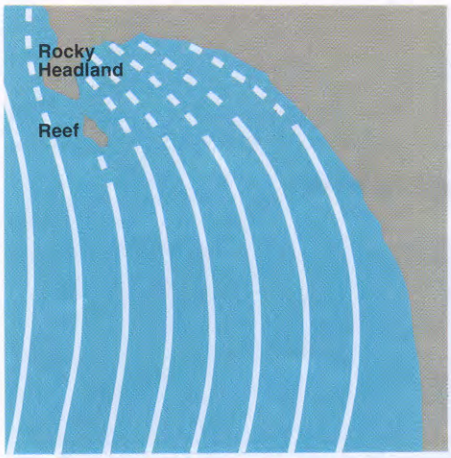
7 Pescadero State Beach and Marsh

Pescadero Beach, once a favored launching site for whaling boats, is covered with large, active dunes. Pescadero Creek flows into the ocean here, creating a fishing area for anadromous steelhead trout that migrate upstream from the ocean to spawn in fresh water. Behind the beach, the creek widens at the juncture with Bufano Creek, forming a small lagoon-like estuary. Adjacent to the water is a 210-acre protected marsh. In the hills above the marsh, large stands of eucalyptus provide roosts for the great blue herons and snowy egrets occasionally seen here.

Visitors to the marsh may also spot the owl-like marsh hawk, whose disk-shaped face acts as a sound amplifier and allows the bird's sensitive ears to hear the rustling sounds of prey hiding among the reeds.

Pebble Beach, a rocky beach at the north side of a small promontory a few miles south of Pescadero Beach, is a particularly worthwhile stop for rock collectors. Small pebbles of agate, jasper, opal and moonstone can sometimes be found among the pits and hollows of wind-sculpted sandstone formations. On the south side of the promontory, the continued expanse of carved sandstone creates an accessible tide pool area.

Immediately south of Pebble Beach is Bean Hollow State Beach, originally named *Arroyo de los Frijoles* beach. This beach actually is made up of two, nearly identical pocket beaches, with non-erodable rocky points upcoast, downcoast and at the center.



Wetlands at Pescadero and Bufano creeks

Roadside dunes partially stabilized by vegetation

Hooked Bays
Hooked bays are also called crescent or crenulate bays. They are created when waves approaching predominantly from one direction refract and diffract, or bend, around an erosion-resistant feature such as a rocky headland, and erode the less resistant downcoast shoreline.

The coast curves sharply inward immediately downcoast of the headland, then gradually straightens as the influence of wave refraction becomes less pronounced. The well-defined hooked shape mirrors the refraction pattern of the waves as they pass around the headland. The crenulate beach is typically stable, exhibiting only minor seasonal variations. Half Moon Bay, prior to the construction of the breakwaters, was a classic hooked bay.

Dune Formation
Sand dunes develop when loose dry sand is blown inland and later stabilized by vegetation. Dunes, instrumental in protecting nearshore areas from the ocean's erosive forces, can reach heights of from 30 to 50 feet along sections of the California Coast.

Dune grasses, which grow quickly once roots take hold, are known as the true dune builders. As root systems develop and become increasingly complex, larger amounts of sand are trapped to form sand masses or hillocks. In the absence of such interference, sand dunes naturally continue moving inland.

Enjoying Pescadero Beach's dune fields

Continuing south on Highway 1, also known as the Cabrillo Highway, the white tower of Pigeon Point Light Station can be seen. It was near this point on the rockbound coast that a Boston Clipper, the "Carrier Pigeon," was wrecked in 1853. The light tower, completed in 1872, was manned for more than 100 years; then an automated light was installed.

Approximately six miles south of Pigeon Point Light Station, a right turn at New Year's Road will take you to Año Nuevo State Reserve.

8 Año Nuevo State Reserve

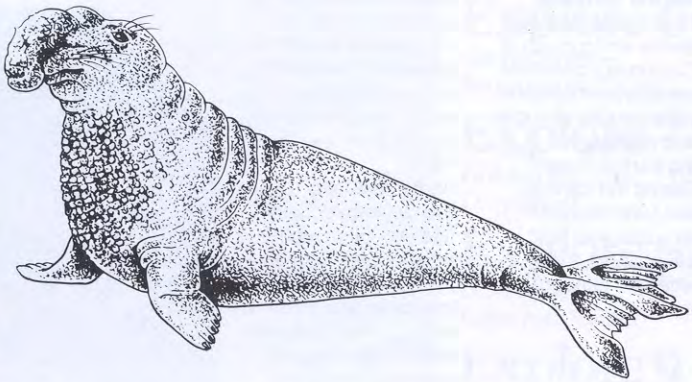
Punto del Año Nuevo, "New Year's Point," was discovered and named by Spanish explorers in January, 1603. The 700-acre reserve includes bluffs, dunes, beaches, tide pools and Año Nuevo Island. As recently as 150 years ago, the island was part of the mainland. It has since been separated from the land by wave erosion and faulting.

The reserve is best known as an important breeding ground for the endangered elephant seals which arrive here between December and March. Elephant seals were aggressively hunted along the Pacific Coast in the 1800s, and by the turn of the century only 50 were believed to remain alive. The animals were subsequently put under government protection. The first elephant seals to be sighted at Año Nuevo in this century appeared in 1955. Today the population on the island and mainland beach areas totals approximately 2,700.

Año Nuevo also provides a haven for Steller sea lions, California sea lions, and northern harbor seals. In fact, the reserve is now the largest seal and sea lion rookery south of Alaska. Most of the reserve is closed during the elephant seal breeding season, except to those on guided walking tours. Reservations for tours, conducted December 1 through March 15, can be made by calling the reserve after October 1.

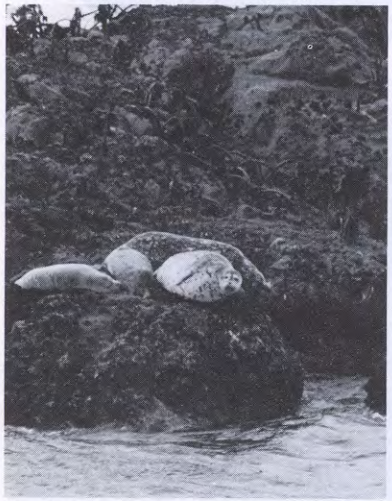
Año Nuevo is also an important geologic site. The reserve lies in the San Gregorio Fault Zone, one of the most active seismic faults in California. Five separate faults can be seen in the irregular patterns of rock layers in the

One of many beaches along Highway 1



Northern Elephant Seal
The northern elephant seal, which can weigh up to 3 tons, is named for the male's characteristic proboscis. This unusual nose, or semi-trunk, begins to form when male pups are about three years old. During aggressive behavior, the proboscis swells and becomes larger in hopes of intimidating rival males. Once a year, elephant seals habitually return to colony sites on land to breed and give birth. Newborn pups weigh up to 110 pounds and are covered with a black, furry coat that soon turns a light grey.

Male elephant seals can often be seen jealously guarding females, or harems, while younger bulls watch warily for an opportunity to fight for the role of *pasha,* or harem bull. Although apparently clumsy, the seals can move quickly by propelling themselves forward with their small front flippers. Visitors should stay well away from these often irritable though fascinating mammals.



Sea lions on rocks north of Pigeon Point

Pigeon Point Light Station

cliffs and bluffs at Año Nuevo. Two additional faults have been identified below water.

Two miles south of Año Nuevo, at the entrance to Big Basin National Park, the Coast Highway passes the Waddell Bluffs, a site of major erosion. Landslides here occasionally block the highway. One-and-a-half miles further south is the turn-off for Greyhound Rock, a popular fishing area.

Distant view of Año Nuevo Island

9 Greyhound Rock

The beach area at Greyhound Rock is a popular county reserve. On weekends, the area is often crowded with rock fishermen, surfnetters and skin divers.

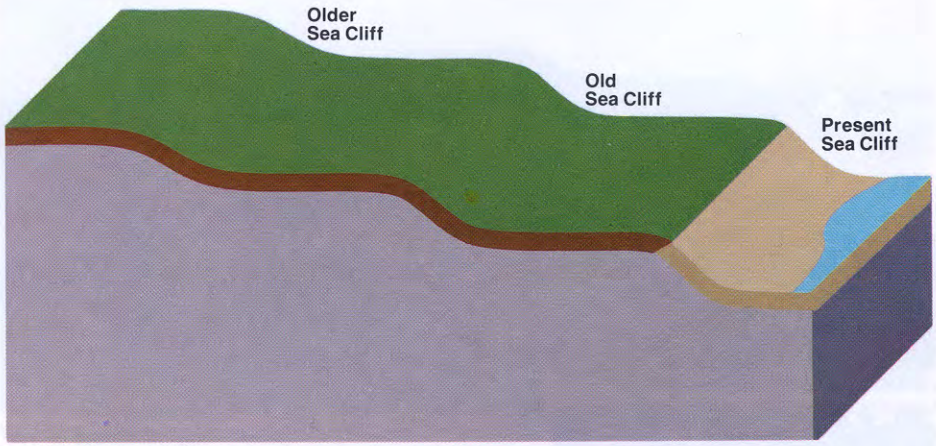
The beach lies at the foot of a high bluff and can be reached by a narrow path leading from the parking lot. Greyhound Rock itself is the smooth, grey sandstone formation that rises from the ocean in a shape resembling the hump of a whale. The rock is connected to the beach by a sand bridge called a tombolo.

About 5.5 miles south of Greyhound Rock Beach, in the one-time whaling town of Davenport, are the remnants of a half-mile-long ocean pier built in 1906. The pier lies opposite a cement plant where cement was piped from the plant through a tunnel under the road to waiting ships at the end of the pier. The pier was abandoned in the late 1940s when cement began to be shipped by truck and rail. Although the structure is now separated from the shore, the end of the tunnel can still be seen at the bottom of the cliff.

South of Davenport, the climate gradually changes due to the configuration of Monterey Bay. Summers here are warmer and foggy days fewer than on the coast immediately to the north. This mild climate typifies the downcoast areas of Santa Cruz, Monterey and Carmel, favorite Northern California summer resorts.

Marine Terraces
The marine terraces visible along much of California's coastline were formed by worldwide climatic changes and movements in the earth's crust. During the Ice Age, sea level dropped as water was held in the glaciers. Later, when air temperatures became warmer, waters from the melting glaciers slowly raised the sea level, and waves began to erode and smooth the rock of the ocean floor.

As the sea level rose, the California coastline was being uplifted and raised out of the ocean as the immense plates of the earth's crust bent and folded, uplifting and pushing the marine terraces out of the ocean.



Beach cusps south of Greyhound Rock

Tombolo
A tombolo is a naturally-formed sand or gravel bridge that connects a nearshore island or rock formation to the mainland. Tombolos are created by wave action, most notably by wave diffraction and refraction. Diffracted waves from various directions bend around the island or rock, depositing sediments between the island and the mainland. If the process continues for many years, a tombolo similar to the one at Greyhound Rock is created. Some geologists predict that a tombolo will eventually reconnect Año Nuevo Island to the mainland, which would, in effect, reverse the erosion process that originally separated the two.

Greyhound Rock tombolo

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 is publishing a series of brochures highlighting key natural and man-made 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:

South Pacific Division
630 Sansome Street
San Francisco, CA 94111
(415) 556-5630

San Francisco District
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San Francisco, CA 94105
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