U.S. Army Corps
of Engineers

Explore 11

The California Coastline
Point Mugu to Point Fermin

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 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, water quality and flood control activities, harbor development and protection, and fish and wildlife conservation.

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.

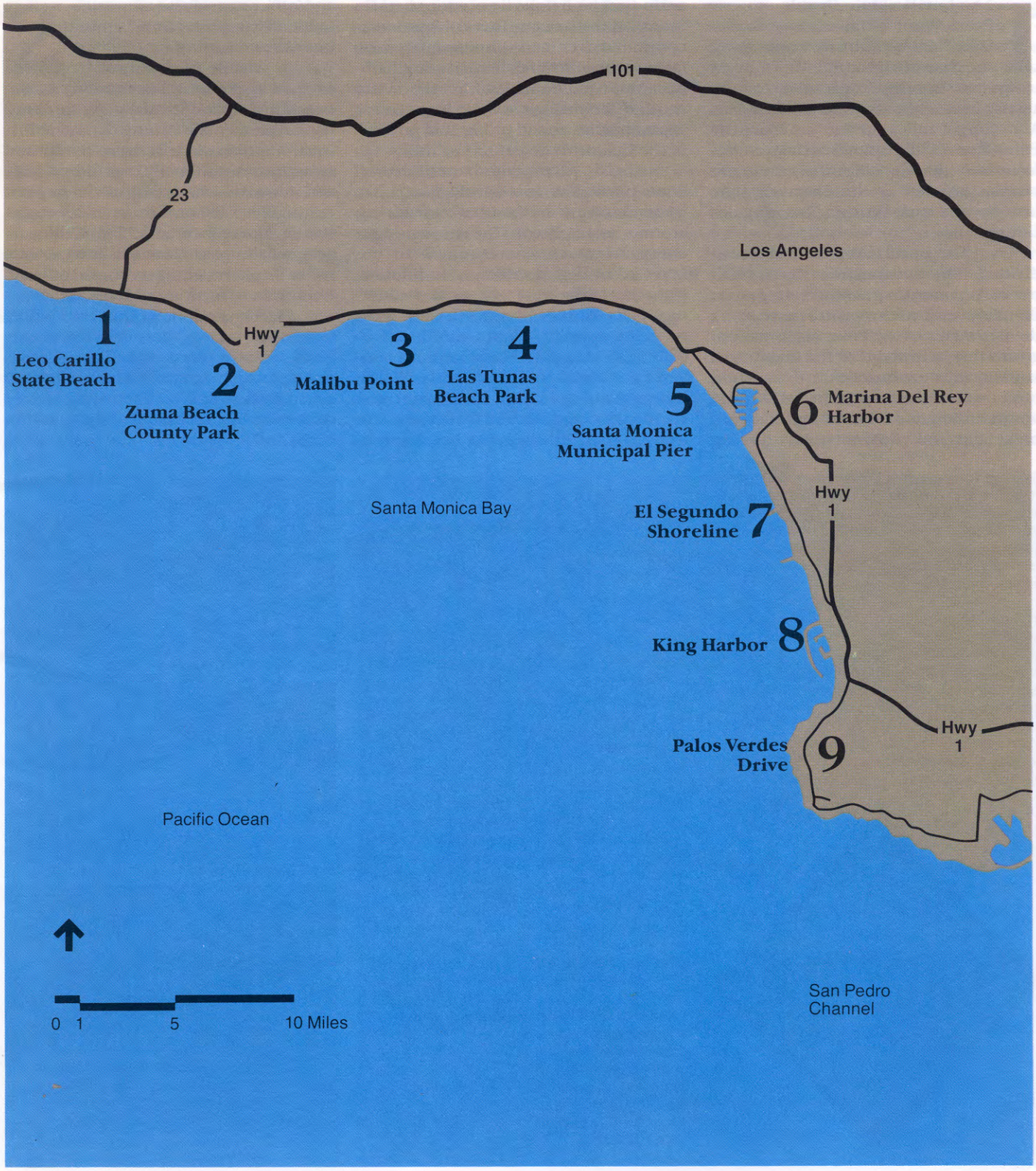
Point Mugu to Point Fermin

The coastal landscape between Point Mugu and Point Fermin is dominated by the rugged Santa Monica Mountains, the curving sweep of Santa Monica Bay and the wide, flat Los Angeles Basin. Along most of the 80-mile shoreline of this east-west trending stretch of land, the highway closely parallels the coast. Although the area is particularly recognized for its long, sandy beaches, numerous other natural coastal features are prevalent. Jutting promontories and deep coves, pocket beaches, wave-eroded cliffs and rocky tide pools add a level of diversity often not considered.

The area's natural beauty and mild climate have attracted the largest population in California. As a result of intense land use, portions of the shoreline have been filled, dredged and reshaped to allow the development of harbors, marinas, roads and a variety of coastal structures. Because these activities have greatly affected natural erosion and deposition processes, numerous efforts such as beach restoration programs and shoreline habitat preservation have been implemented to help counteract the effects of development.

Nowhere is the enjoyment of water-associated recreation more evident. Encouraged by warm, dry summers and mild winters, boating and scuba diving, surfing and swimming, sunbathing, jogging and strolling are enjoyed year-round. Ocean temperatures are moderate, ranging from the upper 50s in winter to the low 70s in summer.

Regardless of the effects of dense urbanization, the always invigorating presence of the Pacific is here for everyone to enjoy. Fresh sea breezes and the misty spray of wind-tossed waves are continual reminders of the importance of preserving the quality of ocean waters and the fragile beauty of the shoreline. The Corps of Engineers encourages your assistance in perpetuating these valued qualities.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23
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1 Leo Carillo State Beach

From Point Mugu to Leo Carillo State Beach, Highway 1 runs along the base of high arid hills; along an irregular shoreline characterized by small coves and narrow sandy beaches. About eight miles downcoast from the Point, Leo Carillo State Beach stretches for more than a mile. To reach the beach, turn left at the entrance sign, just beyond the Ventura/Los Angeles County line.

The beach area of the park is divided into two portions by a small rocky promontory known as Sequit Point. Several rocky protrusions along the perimeter of the Point act as natural groins that help stabilize the quantity of sand on adjacent beaches.

Arroyo Sequit flows to the ocean at Sequit Point. Numerous cobbles, carried downstream during periods of high flow, lie scattered at the mouth of the stream. This same process, continued over many hundreds of years, formed the alluvial delta that eventually became Sequit Point. Such accretion has created the majority of the low coastal promontories found along this portion of the California coast.

The crescent-shaped downcoast portion of Leo Carillo Beach has been formed by waves refracting around Sequit Point. The strong, high-energy wave climate common to the Leo Carillo Beach shoreline is different from that to the west where the shadowing effect of the Channel Islands protects the coastline from the full impact of Pacific storms. The Corps of Engineers maintains offshore wave gaging buoys along the coast. The height and frequency data gathered from these stations is used in designing breakwaters and other coastal structures, as well as in identifying "real time" conditions for boaters and surfers.

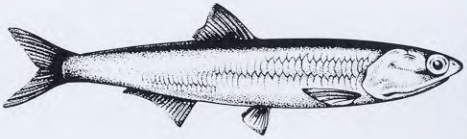
Visible offshore are large beds of giant kelp. The shadowy recesses beneath this prolific seaweed provide habitats for a wide variety of marine life, including fish such as bass, perch and cabezon. Occasionally, sea lions, seals and numerous marine birds can be seen resting on offshore rocks nearby. Between November and May, California gray whales pass close to shore as they move from breeding grounds off Baja California to feed in colder Alaskan waters. During periods of low tide, rocky tide pools along the edges of Sequit Point are easily accessible. These fragile, ecologically balanced habitats offer opportunities to study a fascinating variety of marine life, including sea anemones, crabs and periwinkles.

Caution

To fully enjoy your explorations of the California coast, it is important to be aware of its innate, and often unexpected, hazards.

In some areas, the possibility of landslides makes hiking on the cliffs particularly dangerous. Because loose materials can suddenly cascade to the water below, walking should be restricted to areas well away from cliff edges. Those walking beneath shoreline cliffs should be aware of the possibility of falling rocks.

Non-slip, protective footgear should be worn at all times while exploring tide pools or climbing rocks near the water's edge. Always watch for incoming tides, and beware of the dangers of rip currents, backwash and large waves.



Northern Anchovy

The northern anchovy is found in great abundance in California coastal waters. Typically no more than seven inches long, this slender-bodied fish has a metallic blue-green back with silvery sides and belly. In addition to being important to the diets of numerous fish, marine mammals and birds, the anchovy has great commercial importance. Considered one of the state's most valued fishery resources, it is marketed in canned, fresh and frozen form and is processed as part of a protein supplement for livestock and poultry feed. It is also used extensively as bait by the sport fishing industry.

As is the case with most forage fish, the anchovy has an extraordinarily high reproductive rate and a short life span. During maturity, a female often carries up to 20,000 eggs in various stages of development. Although major spawning generally occurs in early spring months, the anchovy has been known to spawn at various other times. Each year, approximately 65 percent of the entire population serves as forage for other species.

Campers parked near Point Mugu.

Point Mugu State Park

Sand is blown up the face of the hill by onshore winds.

2 Zuma Beach County Park

Zuma Beach County Park attracts thousands of sunbathers, swimmers and surfers during summer months. The beach is located about a mile upcoast from Point Dume at the foot of Trancas Canyon. Through this thickly vegetated ravine runs Trancas Creek, one of the numerous small arroyos that drains from the Santa Monica Mountains into the Pacific.

The beach at Trancas Creek experiences typical seasonal changes. Beach sands consist primarily of sediments eroded from nearby shoreline cliffs or carried from inland areas by coastal streams. During summer months, when flow is minimal and wave energy moderate, a sand barrier develops at the mouth of the creek. During winter, higher flows and strong storm-generated waves wash the sand offshore, forming underwater bars. The sand is again returned to the shoreline during summer months.

Because of its geographic orientation, Zuma Beach is directly exposed to ocean waves. For this reason, there is a visible seasonal variation in the width of the beach. Although such fluctuation is not typically dramatic, a major storm in the late 1950s did reduce the size of the beach by approximately 50 feet within a 24-hour period.

Point Dume, a mass of erosion-resistant volcanic rock that rises nearly 215 feet above sea level, marks the upcoast limit of Santa Monica Bay. The tip of Point Dume is believed by some to have once been an offshore island that was later connected to land by a tombolo. A tombolo formation is created as diffracted waves bend around an offshore island or rock. The bending process reduces wave energy, causing sediments carried by littoral, or nearshore, currents to drop out behind the island. Through continual deposition, the tombolo develops and the once-offshore formation is connected to the mainland.

In the vicinity of Point Dume, traces of two marine terraces, or coastal benches, can be seen. The first, nearest shore, is about 150 feet high; the second follows portions of the coast highway, rising about 250 feet above sea level. In nearby waters, numerous rocks provide resting sites for marine birds such as the cormorant and the brown pelican. Erosion-resistant rocks such as these have been left behind as more erosive portions of the coastline were washed away. At low tide, the rocky tide pools in the vicinity of Point Dume offer glimpses of a variety of hardy intertidal plant

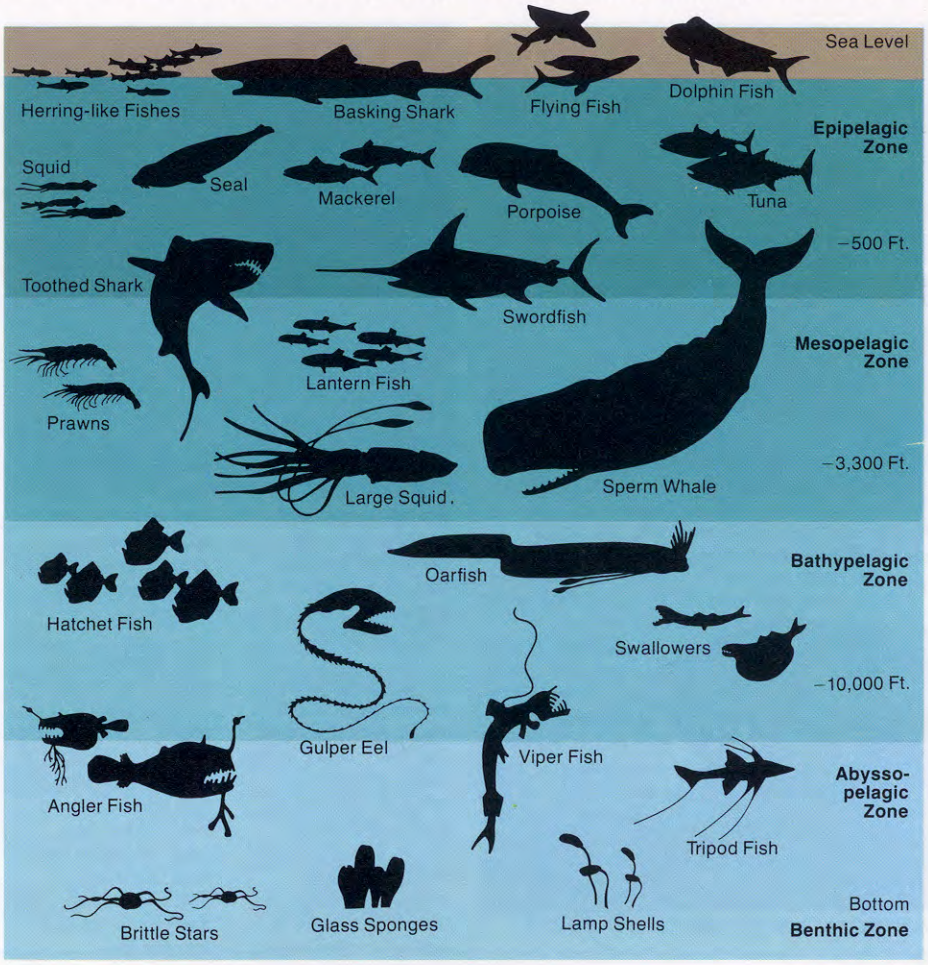
Life Zones

The sea is divided into horizontal and vertical life zones. Due to their individual characteristics, the vertically stratified zones serve as habitats for specific types of marine life. Although animals characteristic of one zone sometimes move into other zones, each stays predominantly where light, temperature, pressure, food, shelter and wave climate are most suited to its needs.

The first zone is the *epipelagic* zone. The greatest amount of life occurs in this zone because of the light penetration. Larger organisms feeding on phytoplankton and zooplankton are adapted to a greater amount of light. The specific location of this zone depends to some extent on the geographic location, since areas with high water turbidity have significantly less light. In the *mesopelagic* zone, organisms are adapted to the darkness. Some do migrate to the epipelagic zone at night to feed. Cold waters delineate the lower part of the zone.

The next zonation, called the *bathypelagic* zone, is characterized by total darkness and water temperatures down to 40°F. The *abyssopelagic* zone extends below the 40°F temperature. Relatively few animals are in this zone since food is scarce.

The *benthic*, or bottom zone, of the sea is typically occupied by scavengers that feed on decayed plant material and other organic debris that settles to the ocean floor. The type and number of animals varies considerably from the nearshore to the deep sea, from rich to barren areas and from relatively warm water to cold water.



and animal life.

Dume Cove, situated in the lee of Point Dume, is protected from northwesterly waves by the sheltering influence of the Point. The steep, nearly vertical cliffs backing the beach area offer protection from winds from the north and east. This small, scenic cove is accessible by hiking from Paradise Cove, a private recreational beach just downcoast, or by following a trail that leads downward from nearby cliffs.

The 16 miles of coastlne between Point Dume and Santa Monica is predominantly rocky and rugged. The bluffs rise as much as 3,000 feet above sea level within three to four miles of the coast, forming part of the Santa Monica Mountains. In many places along this section of the coast, specially designed rock revetments help protect the shoreline from wave erosion.

3 Malibu Point

Malibu Point extends seaward in the heart of the beautiful Malibu area, only a few miles downcoast from Point Dume. Those traveling the Pacific Coast Highway can most readily locate this small promontory by watching for Malibu Creek, which flows into Santa Monica Bay in the vicinity of the Point.

A small lagoon and floodplain are located just inland from the mouth of Malibu Creek. Although not considered a classic coastal lagoon, due to the absence of extensive marshes and mudflats, this sandy ponded area does provide a habitat for a number of marine birds. The Malibu Creek floodplain creates a visible break in the line of steeply eroded bluffs that mark this stretch of coastline.

The bluffs here consist of loosely consolidated cobbles and pebbles that are subject to major sliding—particularly during periods of heavy rain. Over the years, the slides have resulted in property losses totaling millions of dollars. A nearby geologic fault known as the Malibu Coast Fault runs east and west parallel to the coastline. The fault begins in the vicinity of Anacapa Island, cuts into the shore near Point Dume, and runs along the base of the Santa Monica Mountains to the Hollywood Hills area.

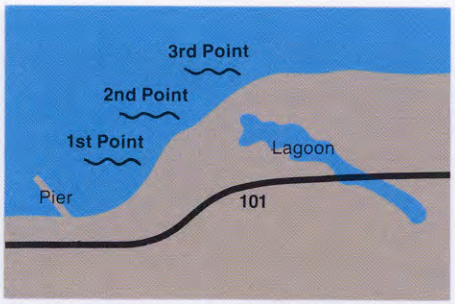
Just downcoast from Malibu Point the 700-foot Malibu Pier extends into the sea. This recreational pier, also known as Kellers Shelter Pier, is popular with local anglers and serves as a landing site for sport and commercial fishermen. From here, one can watch surfers riding Malibu's famous waves.

The anchorage area adjacent to

Cormorants, gulls, and brown pelicans enjoy Point Dume's protection on Cove Beach.

Numerous rocks provide resting places for abundant marine life.

A Paradise Cove home perched on the cliff.



Surfing at Malibu Point

During summer, Malibu Point is rated as one of the finest surfing sites along the California coast. Although normal surf usually varies between two and four feet, strong waves sometimes break at six to eight feet.

Long, right-breaking waves are created as swells refract around the Point. Three separate point breaks occur at intervals of approximately 100 yards. The first break has the greatest amount of energy, is usually the highest, and offers the most uneven ride. Although the second and third breaks occur closer to shore and have less energy, all three offer good, rideable surf. Height and speed vary with changing tidal conditions. Waves are best when swells are from the southwest.

An unwritten rule states that the surfer riding closest to the broken portion of the wave has the right of way. By following this rule and observing basic safety precautions, large numbers of surfers can enjoy the exhilaration and challenge of a favorite site.

Long, right-breaking waves are ideal for surfing.

Children race the waves on Paradise Cove's beach.

Malibu Pier extends 700 feet into the sea.

the pier is commonly referred to as an "open bight," meaning that the embayment is curved and open to the direct approach of waves. Some protection from north and westerly winds is provided by the sheltering influence of Malibu Point. The anchorage is used primarily by sport fishing boats that moor here between runs to coastal fishing grounds. Catches include kelp bass, California halibut, yellowtail and rockfish.

To the west, a shallow submerged shelf extends about half a mile offshore, marked by the bobbing canopies of giant kelp. During storm periods, high-energy waves often tear the kelp from its rocky foundation and wash large quantities onto area beaches. Within a year, the fast-growing kelp re-establishes new, full-grown beds.

4 Las Tunas Beach Park

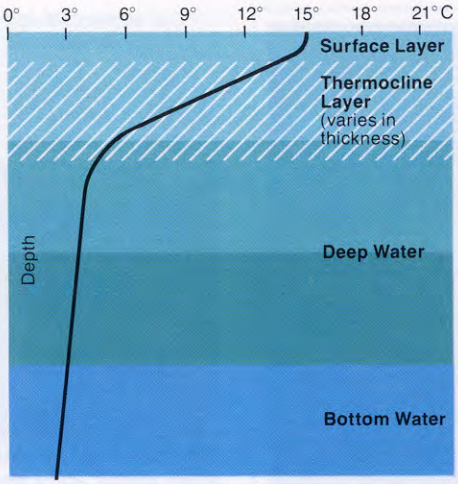
En route from Malibu Point to Las Tunas Beach Park—about five miles downcoast—note the many shoreline cliffs that have been terraced in an attempt to reduce erosion and prevent landslides. As an additional precaution, retaining walls have been built at the base of the cliffs to prevent falling rocks and soil from blocking the highway.

Along the shoreline are the remains of several steel sheet-pile groins. These structures, in various stages of deterioration, are all that remain of a 1929 beach erosion control program designed to trap sands carried by littoral currents and maintain a wide sandy beach. The dilapidated groins create a significant hazard.

The small day-use park at Las Tunas is located just upcoast from the foot of Topanga Canyon, about four miles northeast of Santa Monica. Castle Rock, the largest of the rocks scattered along the coastline in the area, marks the dividing point between Las Tunas Beach Park and Topanga Beach to the east. In contrast to the typical seasonal pattern characteristic of most California beaches, which are narrower in winter and wider in summer, Las Tunas tends to remain narrow during both winter and summer months. The narrow winter configuration is caused, as is typical, by northern hemisphere storm waves approaching from the west. The unusual narrow summer profile results from storm waves directly approaching Las Tunas Beach from the southern hemisphere. The normal daily variation in tidal range along this stretch of coastline is approximately five feet. During heavy storm periods the ex-

Thermocline
The thermocline is the layer of ocean water separating the warmer surface layer from the deeper colder zone. In this transitional area, water temperature quickly declines with increase in depth. Although the ocean typically has a relatively gentle vertical temperature gradient, a widespread, permanent thermocline does exist, and is usually deep enough to be virtually insulated from seasonal variations.

In certain climates, recognizable thermocline depths vary with the seasons. In Southern California, for example, shallow, sharply graded thermoclines are common from mid-spring through summer and mid-fall. At the beginning and end of the period, thermocline depths range from 10 to 20 feet. In late summer, depths can range up to 60 or 70 feet.



Deteriorating sheet metal groins are all that remain of a 1929 erosion control program.

A groin extends to an offshore rock.

Detritus
Thousands of plant and animal species, an endless variety of water conditions, and fascinatingly diverse habitats contribute to the ecological balance of the sea. A key ingredient in this balanced combination of processes is *detritus*. Consisting of nonliving organic materials, detritus results from the disintegration and decomposition of plant and animal life.

Much detritus is suspended in the water in minute particles. Slightly larger particles drift slowly downward like a gentle organic rain, serving as food for filter feeders of all forms and sizes. Bottom scavengers depend upon another form of detritus, the remains of larger sea creatures that drop to the ocean floor.

Broken shells also contribute to the sea's ecological composition because many shells are rich in minerals, and their eventual decomposition contributes valuable nutrients that benefit both plants and animals. Another very different example of the value of detritus is the large masses of seaweed which float to shore and contribute to the natural process of beach building. The seaweed acts as a foundation on which sand accumulates as wind-blown particles become trapped in its wet masses.

treme range can reach ten feet or more.

Will Rogers State Beach begins at the downcoast end of Topanga Beach. Adjacent to the beach Will Rogers State Historical Park marks the site of the former residence of the well-known American humorist. The three-mile-long beach fronts the beautiful residential community of Pacific Palisades. The palms, eucalyptus and various other trees and low-growing shrubs planted on the cliffs diminish erosion problems and add a pleasant aesthetic quality to the otherwise nearly barren escarpment.

5 Santa Monica Municipal Pier

The Santa Monica Municipal pier, one of Southern California's most popular shoreline recreational areas, is located near the intersection of Ocean Avenue and Main Street in Santa Monica. Built in the early 1920s, the pier is lined with restaurants, snack stands and a penny arcade. Here, exceptional views can be enjoyed of the long curving sweep of Santa Monica Bay.

Upcoast, some ten miles northwest, are the cliffs of Malibu. Nearer the pier, another bold line of cliffs, or *palisades,* extends along the shoreline. These cliffs consist of the unconsolidated sands and gravels of a wide alluvial fan washed seaward out of the Santa Monica Mountains. Situated atop the cliffs is beautiful Palisades Park. About 16 miles downcoast, the Palos Verdes Peninsula can be seen jutting seaward at the end of the bay. Nearer by, approximately four miles in the distance, is the offshore breakwater that protects the harbor entrance to Marina del Rey.

In addition to offering a variety of recreational concessions, the Santa Monica Pier provides boat rentals and launching facilities, fuel, water and boat repair services. A shuttle service runs between the pier and an anchorage area behind the detached rubblemound breakwater that extends upcoast near the end of the pier. Built in 1933, the anchorage is used primarily by sport fishermen. It provides shelter from all but the most violent winter storm waves.

It is interesting to note that in 1889, the U.S. Senate Committee of Commerce considered both Santa Monica and San Pedro as major new

Santa Monica Pier stretches 1,000 feet out from the beach.

Santa Monica Salient

Prior to the construction of the Santa Monica breakwater, the crenulate shape of the Santa Monica Bay shoreline was largely uninterrupted. With the completion of the breakwater, however, a *salient,* or outward projection of land, began to develop in the lee of the structure. The salient, which now extends for some distance seaward, has significantly changed the shoreline's natural contour.

The Santa Monica salient was created as a result of the wave-shadowing effect of the breakwater. The structure modifies approaching waves by causing them to diffract, or bend. With the resulting reduction in wave energy, suspended sediments drop out and accumulate along the shoreline. Salients in the lee of breakwaters are not uncommon. In fact, shore-parallel breakwaters such as the one at Santa Monica are often referred to as man's "salient generators."

The Pier is lined with restaurants, snack stands, and a penny arcade.

Santa Monica Beach is subject to high energy wave action.

Broad steps lead from the pier to the beach.

harbor sites for Southern California. The plan to develop a harbor at Santa Monica was confirmed in 1890, but was soon abandoned. Nine years later construction of the San Pedro Breakwater began, serving as the first step in the creation of the vast Los Angeles/Long Beach Harbor complex.

After visiting the pier and beach areas, return to the shoreline route and continue downcoast on Pacific Avenue. After about two miles, a right turn leads to the Venice Pier, another of the recreational piers so common to Southern California. Built in 1965, this 1,800-foot concrete structure is located approximately in the center of Venice Municipal Beach. A paved promenade for biking, jogging, roller skating and strolling runs along the beach.

Further downcoast, along Pacific Avenue, is the Grand Canal of Venice. This channel served as the main waterway for the network of salt water canals that ran through the area.

Masterminded and nurtured to realization by visionary entrepreneur Abbot Kinney, this "Playground of the Pacific" was dedicated in 1905 and soon became a renowned recreational mecca. Built on salt marshes and sand dunes that were part of the original Mexican land grant of Rancho La Ballona, Venice attracted as many as 75,000 people a day during summer months in the early 1900s. The city's carefree nature changed with the deterioration of the canals, the influx of oil wells and the years of the Great Depression.

6 Marina Del Rey Harbor

Marina del Rey Harbor, home port for more than 6,000 pleasure craft, is considered one of the largest small craft harbors in the world. The upcoast side of the entrance channel is located at the end of Pacific Avenue, a few blocks from the Venice Pier. This stop provides an excellent opportunity for viewing the harbor's entrance channel, jetties and offshore breakwater. Here, too, those who enjoy fine pleasure craft can admire an impressive parade of yachts and sailboats passing to and from the harbor area.

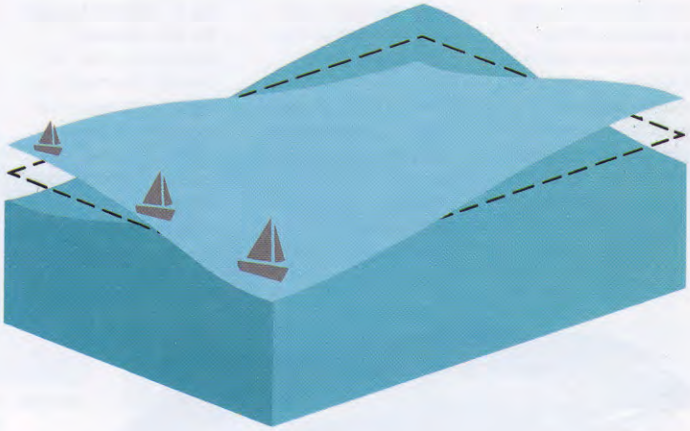
The harbor's two rubblemound entrance jetties were completed by the U.S. Army Corps of Engineers in 1958. The downcoast jetty serves a dual purpose, since it also serves as the upcoast jetty of the Ballona Creek Flood Control Channel. Dredging operations for

Seiching

Seiching, or surge, occurs when an enclosed body of water is disturbed. Such a disturbance produces slow-moving, often barely distinguishable waves that rhythmically slosh back and forth against opposite ends of the basin. The frequency with which these waves strike depends upon the size and depth of the bay, harbor or lake in which they occur. Seiching tends to follow a very regular pattern of movement, even when the body of water has an irregular shape.

A moderate level of seiching can be created by wind or the waves of boats. Seiching of greater significance often occurs in bays and harbors that are open to the sea and subject to the effects of long-period ocean waves. Sudden changes in atmospheric pressure can also create a significant level of seiching.

The amount of vertical water movement is directly proportional to the wave *period*, or the time between waves. Although seiching does not usually create a major problem, large seiches with periods of several minutes can cause extensive damage to boats, mooring lines and berths.



Vacationing at the turn of the century on the Grand Canal and Venice Beach.

Venice beach today.

Marina del Rey were completed in 1962. During that time, some 3.2 million cubic yards of sand were deposited on the beach downcoast of Ballona Creek.

A 2,330-foot rubblemound detached breakwater, designed to dissipate a maximum amount of wave energy, is located seaward from the end of the marina jetties. Plans for the construction of the breakwater were formalized following a 1962-63 winter storm that severely damaged the initial harbor facilities. By 1965, the breakwater, the revetment-lined main channel and the harbor interior were completed.

From the entrance channel viewing point, follow Via Marina and turn right on Panay Way for a close-up look at the well-designed interior of the harbor. Panay Way runs down the center of one of the Marina's six *moles,* the extensions of land built of materials dredged from the harbor during its construction. The moles are lined with concrete sea walls and rubblemound revetments to prevent the erosion that would otherwise result from harbor surge, or seiching. Off Panay Way, at the end of Basin D, is the Marina's only public beach.

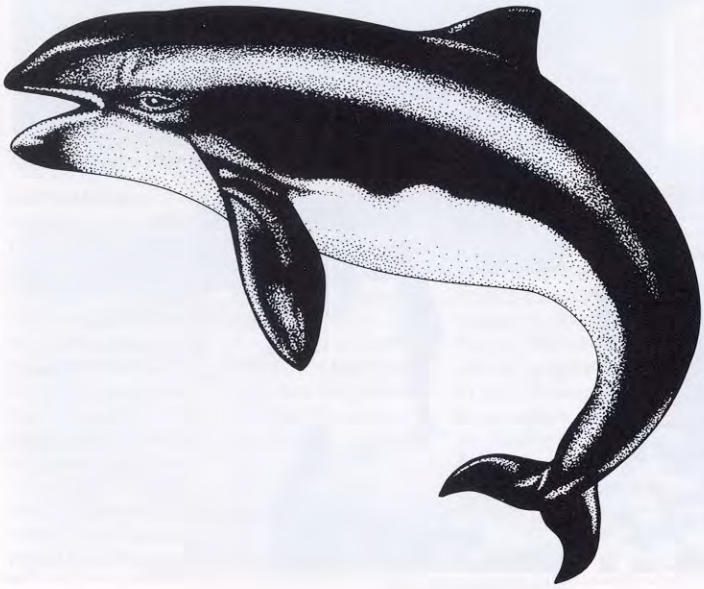
Return on Panay Way to Via Marina, turn right and continue to Admiralty Way where a right turn leads around the inland perimeter of Marina del Rey to Fiji Way. Turn left on Fiji, continue to Lincoln Boulevard and make a right; then continue to Jefferson Boulevard. Jefferson runs seaward through one of the few remaining pockets of coastal agricultural land in the Los Angeles area. At Vista del Mar, turn right to a lookout point above the Ballona Creek Flood Control Channel. The small marsh in the foreground serves as a marine nursery for a variety of small fish, including the northern anchovy, jack smelt, beach perch and striped mullet.

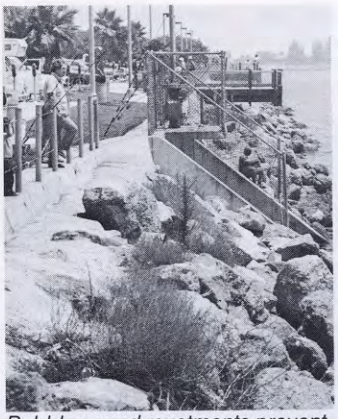
The revetment-lined Ballona Creek Flood Control Channel, built by the Works Project Administration in the 1930s, closely parallels the original stream bed of Ballona Creek. For about ten years in the early 1800s, the creek's floodplain served as the delta for the Los Angeles River. The river adopted the Ballona Creek course in 1815, when unusually high flood waters caused the river to turn westward into what is now downtown Los Angeles. In 1825, again due to high flood waters, the river returned to its earlier discharge point in Wilmington, just downcoast of the Palos Verdes Peninsula.

From the Flood Control Chan-

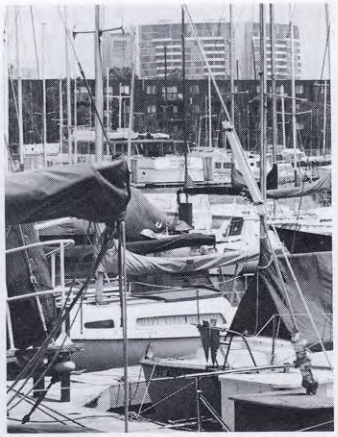
Harbor Porpoise
The harbor porpoise, a member of the tooth-whale family, is a stocky, blunt-nosed marine mammal that reaches a length of slightly more than six feet and weighs up to 160 pounds. Its color is predominantly dark gray, fading to light gray or white along the underside.

The fast and graceful harbor porpoise is a relative of the Atlantic harbor, or common, porpoise. Although most frequently found near shore, it has been reported as far as 25 miles off coast. Its diet consists primarily of fish, although it sometimes eats squid and crustaceans. Between April and June, the harbor porpoise gives birth to one or two calves, each weighing approximately ten pounds.





Rubblemound revetments prevent erosion due to boat wakes and harbor surge.



Marina del Rey is home to more than 6,000 small craft.

Sailboarding in the calm waters of Marina del Rey.

nel, follow Vista Del Mar along Isadore B. Dockweiler State Beach through the community of Playa del Rey. Here, a Corps of Engineers' beach replenishment program dredges sand from the mouth of the Marina del Rey and Ballona Creek channels and periodically pumps it onto the beach through long pipes. At other times, the dredged sands are deposited near the surface where natural ocean processes distribute the sediments on this beach and others downcoast. The rubblemound groins extending from the shoreline are a key element in stabilizing the shoreline.

A short distance inland from the lower stretch of the beach is Los Angeles International Airport. The airport is built on extensive dune fields. Between 1938 and 1962, millions of cubic yards of sand from the dunes were placed on the beach.

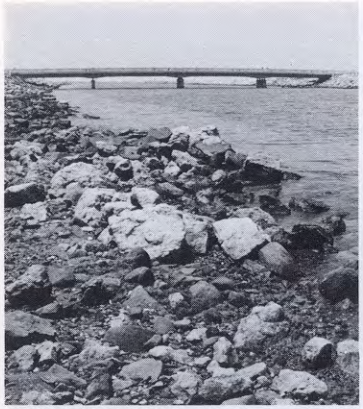
7 El Segundo Shoreline

The shoreline of the City of El Segundo, located between Playa del Rey and Manhattan Beach, is an area dominated by commercial and industrial activity. Buoy-moored tankers can often be seen offloading oil that is pumped through underwater pipes to the pier and then to nearby oil storage tanks.

The Continental Shelf gradually slopes westward to reach a depth of approximately 50 fathoms within six to ten miles from shore. The ocean floor then plunges to depths of more than a mile in some areas.

Downcoast from El Segundo are the wide and beautiful beaches of Manhattan and Hermosa Beach. To reach these popular recreational beaches, drive downcoast along the main thoroughfares, Manhattan and Hermosa Avenues, and turn right on any side street leading to the shoreline. The beaches along this section of the coast are backed by low, active dunes and a concrete sea wall, constructed to slow the inland migration of sand and stabilize the backshore area. Piers provide local fishermen many long and relaxing hours.

The sandy expanse of shoreline just downcoast from the Hermosa Beach Pier is recognized as one of many spawning grounds for the grunion, a small silvery fish that migrates ashore in great numbers between the months of March and September. The female fish deposits its eggs in the sand where they are immediately fertilized by the male. When the eggs become immersed by seawater during the succeeding spring tides, they hatch and the larvae swim to the sea.



Ballona Creek Flood Control Channel parallels the original stream bed.

Strolling, cycling, and jogging are popular on the Manhattan Beach sea wall.

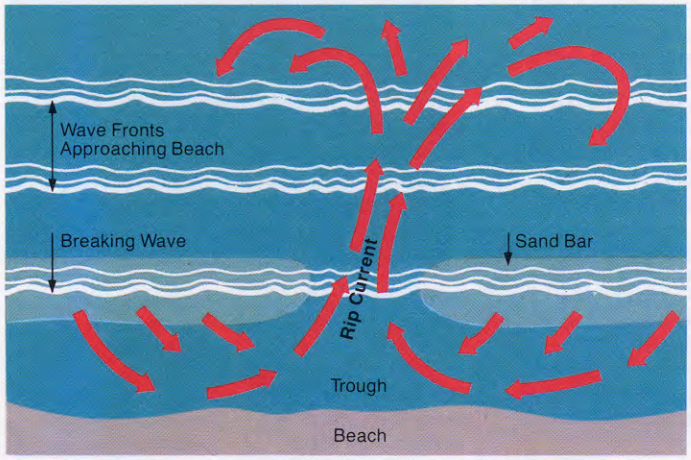
Oil tankers are a common site from the El Segundo shoreline.

Rip Currents

Rip currents are common to many areas along the shoreline and can be extremely dangerous to swimmers. By carefully observing wave patterns, it is possible to identify and avoid these fast-moving crosscurrents.

Rip currents are often visible as narrow bands of water cutting through the breaking waves. At times, their location can be identified by a large number of small, sharp waves that are similar in appearance to wind chop. The formation of a rip current begins as water accumulates on the shore side of an underwater sand bar. When a sufficient amount of water has accumulated, a seaward-flowing current forms across the lowest part of the bar. The velocity of the water flowing through the newly formed channel depends upon the width of the opening. When a channel is narrow, for example, water speed can reach four feet per second.

Rather than attempting to swim against a rip current, swimmers should move to either side and swim away from its effects.



8 King Harbor

King Harbor, formerly known as Redondo Beach Harbor, is a moderate-sized, small-craft port used primarily by pleasure boats. To visit this busy coastal marina, continue downcoast on Hermosa Avenue and turn right just inside the Redondo Beach city limits at a sign reading "King Harbor Marina." Here, in the late 1800s, a small commercial port handled lumber shipments arriving by schooner from Northern California and the Pacific Northwest.

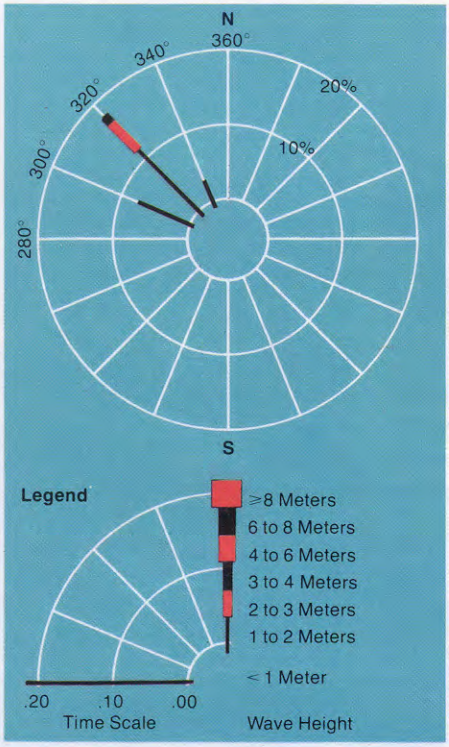
The current harbor, dedicated in 1966, is protected from the full impact of waves by a long, north breakwater that begins at the harbor's upcoast end and curves for more than 5,000 feet south to flank the entrance channel. Reconstruction of the original north breakwater, built in 1939, was completed in 1958, along with an extension of more than 2,000 feet. The south breakwater and concrete baffles at the entrances to the harbor's two largest berthing basins were also completed at that time. The baffles, structures similar in concept to breakwaters, allow some flow-through of water and help to reduce the effects of harbor surge.

After completion of the north breakwater, sand began to bypass the harbor entrance and drop into the Redondo Submarine Canyon. This underwater canyon is one of the most significant coastal features in Southern California. Cutting deeply into the Continental Shelf, it drops from a depth of about 30 feet at the harbor entrance to some 220 feet within less than 700 yards. Because the mouth of the canyon is situated near the harbor entrance, the maintenance dredging critical to most coastal harbors is unnecessary here. Some natural oil and gas seepage makes its way to the water's surface from the depths of the canyon. Bubbles of gas measuring up to six inches in diameter have been reported in the vicinity.

King Harbor's north breakwater and the submarine canyon together create a nearly complete littoral, or shoreline, barrier, resulting in the virtual depletion of natural sand supplies that would otherwise flow to downcoast beaches. To remedy the situation, the beach between King Harbor and Malaga Cove, about two-and-a-half miles downcoast, was replenished in 1968 with more than 1.4 million cubic yards of sand pumped from the nearshore ocean floor. A few years after this replenishment, a 600-foot groin was constructed a few blocks southwest of the harbor at the foot of Topaz Street.

Wave Rose

A wave rose is a graphic representation of wave energy at a given location over a period of time. A wave rose designates wave height and wave frequency from a particular direction. The information used in creating this diagramatic representation is obtained from varied sources, including hindcasting of meteorological data, coastal wave gaging stations and routine marine weather logs recorded by ships at sea. This combined information is of great value to oceanographers and engineers who must rely on accurate wave data for research and design projects.



The wave rose shown above illustrates wave heights at a particular location during a given month. It shows that waves during that period approached predominantly from the northwest. It also shows, for example, that at an approach direction of 320 degrees from true north, waves were from one to two meters high about 11 percent of the time, two to three meters high 5 percent of the time and from three to four meters high less than one percent of the time.

A 5,000 foot breakwater protects King Harbor Marina.

Recreation at Beach Basin.

Redondo Beach is another favorite with swimmers, surfers, and sunbathers.

The impervious solid-core nature of the groin makes it highly effective in trapping the sands carried by longshore currents and helping to maintain the wide sandy beach.

Another good vantage point from which to view King Harbor can be reached by returning to Hermosa Avenue, driving around the inland side of the harbor and turning right on Portofino Way. From the parking area here the entrance channel is clearly visible. The sandy public beach at the foot of Portofino Way is a favorite spot from which to watch the activity of this busy recreational harbor.

From King Harbor, return to Hermosa Avenue, make a right turn and continue downcoast on Esplanade along Santa Monica Bay toward the Palos Verdes Peninsula.

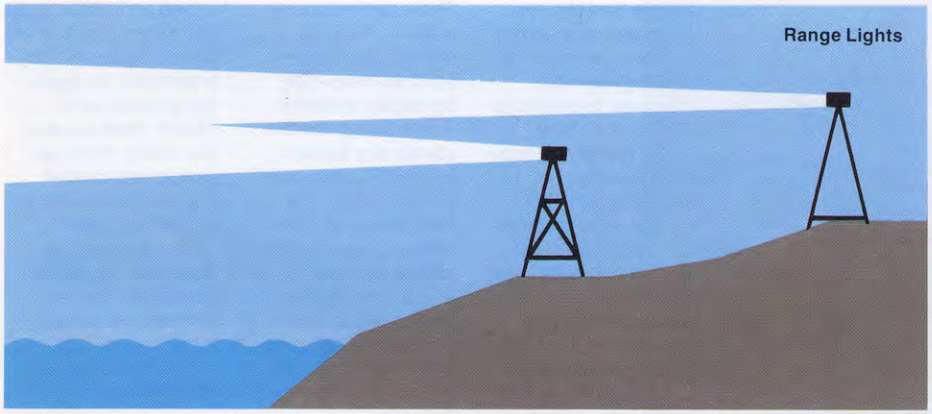
9 Palos Verdes Drive

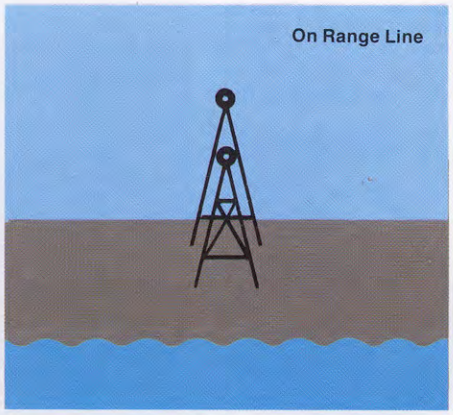
The 18-mile drive along the shoreline of the Palos Verdes Peninsula is one of great scenic beauty. Separating Santa Monica and San Pedro bays, the peninsula's highly irregular, rugged shore is bordered by vertical sea cliffs, small pocket beaches and rocky tidepools. The height and configuration of this wide coastal headland differs significantly from the predominantly low, smooth profile of Santa Monica Bay to the north.

The drive around the Palos Verdes Peninsula begins at Malaga Cove, located at the downcoast end of Torrance County Beach, about three miles from King Harbor. To reach Malaga Cove from the harbor, continue downcoast along Esplanade to Avenue I. Turn right, drive one block, then turn right again onto Catalina Avenue. Within a short distance another right on Hollywood-Palos Verdes Drive leads to the entrance of the City of Palos Verdes. Drive shoreward to Paseo del Mar to continue along the shoreline.

About a mile beyond Malaga Cove, narrow, jutting Flatrock Point offers outstanding upcoast views of the curving expanse of Santa Monica Bay. Just offshore are Flat Rock and Bit Rock, two large, wave-eroded sea stacks reminiscent of the rocky coastline of Northern California. Here, too, is the Palos Verdes Estates Shoreline Preserve, an area set aside to help ensure conservation of the shoreline's fragile environment.

From Flatrock Point follow the coastal route past Bluff Cove. A left turn on Cloyden Road and a right turn on Epping Road, on the downcoast side of the Palos Verdes High School campus,





Aids to Navigation

The term "aids to navigation" refers to any devices external to a vessel that assist the navigator in determining position, safe course or location of danger. For signals, radiobeacons, ranges and Loran are aids to navigation, as are lighthouses, beacons, buoys and lightships. The types of aids available to the mariner vary with the conditions and requirements of a particular location.

Fog signals are used under conditions of reduced visibility. Usually consisting of a series of long and short blasts, punctuated by periods of silence, each series has a specific meaning to the mariner. Fog signals can take the form of diaphones, horns, sirens, whistles or bells.

Radiobeacons are installed in lighthouses and other coastal structures as well as on lightships and buoys. Their range is relatively short, varying from 10 to 175 nautical miles. Radiobeacons operate continuously or in sequenced groups of up to six, each individually identified by a unique Morse code system.

Ranges are two structures that, when appearing to be over one another, indicate a safe course. They are often located on shore and can be either lighted or unlighted. Range lights may be white, red or green and may display various characteristics distinguishing them from surrounding lights. Because ranges appear on navigation charts they assist the navigator in determining position.

Loran, an acronym for LOng RAnge Navigation, is a sophisticated radio system based on the principle that the time of arrival of radio pulses from two synchronized transmitting stations describes a hyperbolic "line of position," or LOP. This time difference is measured by the navigator through use of a special receiver. The information is converted into geographic LOPs through the use of Loran Charts or Tables. These valuable tools indicate the mariner's exact position at the point where two calculated LOPs cross. Most recent Loran receivers are capable of automatically converting LOPs into latitude and longitude. Although satellite navigation (SATNAV) provides a more accurate navigational assistance world-wide, Loran is used extensively along the western coast of the United States because it provides continuous, accurate readings.

The maintenance of navigation aids is a federal responsibility designated at the first session of Congress in 1789. Today, the U.S. Coast Guard is responsible for most navigation aids in the United States.

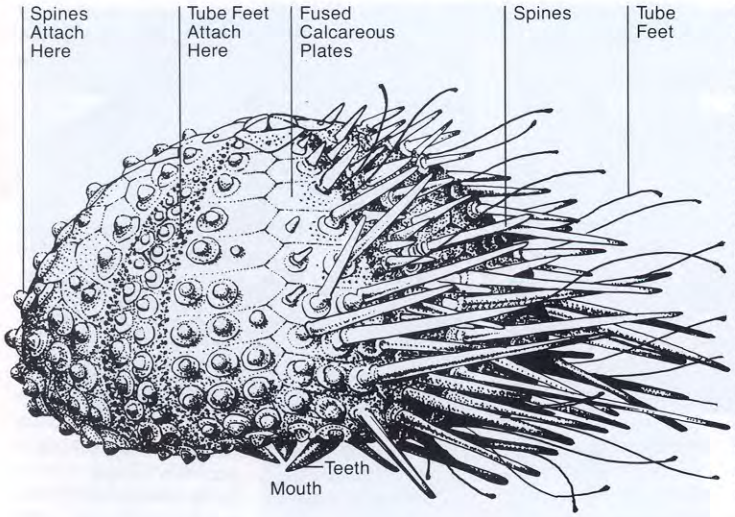
once again leads to Paseo del Mar. Turn right almost immediately on Rocky Point Road and continue downcoast along Palos Verdes Point. Note the extensive beds of giant kelp offshore. The kelp is marked by a lighted whistle buoy to warn sailors and other small-boat navigators of potential hazards.

Rocky Palos Verdes Point rises abruptly eastward toward the Palos Verdes Hills, which spread inland for about ten miles and vary in width from four to six miles. The highest hill, San Pedro, rises more than 1,500 feet above sea level. It is theorized that during much of the Pleistocene era, a time between 10,000 and two million years ago, the Palos Verdes Hills were an offshore island. Over the millenia, a series of 13 marine terraces rose out of the sea, slowly elevating the island. It is believed that the island eventually became part of the mainland through the development of a massive alluvial fan that spread across the Los Angeles Basin from the Santa Monica Mountains.

Immediately downcoast from Palos Verdes Point is Lunada Bay. Flanked to the south by Resort Point, a classic pocket beach lines its shoreline. Approximately two miles beyond the Bay is the Point Vicente Light, situated atop a 67-foot tower, about 185 feet above the Pacific. Marineland of the Pacific, an aquatic park, is located a short distance from the Point.

The Portuguese Bend area runs along the southern slopes of the Palos Verdes Peninsula, and is easily recognizable by the evidence of extensive landslide activity. The slumping of the coastal bluffs here occurs due to an overlying mass of soil that, lubricated by ground water, slides on a steeply dipping layer of bentonite. Efforts are continually being made to deter this seemingly insurmountable problem.

A short distance beyond Portugese Bend, exit from Palos Verdes Drive on 25th Street and continue into the City of San Pedro to Western Avenue. Here, turn left to drive again along Paseo del Mar. Beautiful, grassy Point Fermin Park runs along the coastline here for more than a mile. The picturesque Point Fermin Light, built in 1874, is located at the tip of the Point at the downcoast end of the park. From this scenic vantage point, the long expanse of the San Pedro Breakwater can be seen extending from Cabrillo Beach into the distance. The breakwater forms the upcoast perimeter of the Ports of Los Angeles and Long Beach, which together comprise one of the largest man-made harbor complexes in the world.



Purple Sea Urchin
The purple sea urchin is one of the most fascinating intertidal creatures found along this section of the coast. Perfectly adapted to the ever-pounding surf, this hard-shelled creature is usually found half-hidden in indentations in the rock. Although it is a matter of some controversy, the indentations seem to result from the action of the sea urchin's spines, aided by movement of the water.

Three appendages of the urchin—its spines, tube feet and pedicellariae—can be readily identified. The bristling, flexible spines and suction-cupped feet are used in locomotion. The feet also serve as a means of respiration and as a sense of touch. The urchin's pedicellariae, thin, moveable stalks armed with tiny jaws, are used to repel its enemies.

The purple sea urchin, also called a sea egg or sea porcupine, is a scavenger that primarily eats algae and tiny organisms. Its skeleton is made up of closely fitted calcareous plates which appear to form a shell. The skeleton is more accurately called a "test" because the plates are formed by connective tissues beneath the surface, rather than being created by body secretions.

Spectacular views of rugged coastline can be seen from Palos Verdes Drive.

Grassy Point Fermin Park runs along the coastline for more than a mile.

Point Fermin Light was built in 1874.

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
211 Main Street
San Francisco, CA 94105
(415) 974-0356

Los Angeles District
300 N. Los Angeles Street
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(213) 688-5320

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Explore 8
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Explore 9
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Point Conception

Explore 10
Point Conception to
Point Mugu

Explore 11
Point Mugu to
Point Fermin

Explore 12
Point Fermin to
Newport Beach

Explore 13
Newport Beach to
The Mexican Border

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