

**U.S. Army Corps
of Engineers**

Explore 3

**The California Coastline
Punta Gorda to Arena Cove**



The Year of the Coast

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

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

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

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

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

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



Punta Gorda to Arena Cove

Beautiful, rugged and solitary, the rockbound coast between Punta Gorda and Arena Cove is characterized by arched rocks, majestic sea stacks, narrow inlets and small, isolated beaches. Cool temperatures prevail, with rainfall averaging from 40 to 60 inches a year. The sunny, warm days of

fall brighten the area's otherwise subdued, nearly mystical quality.

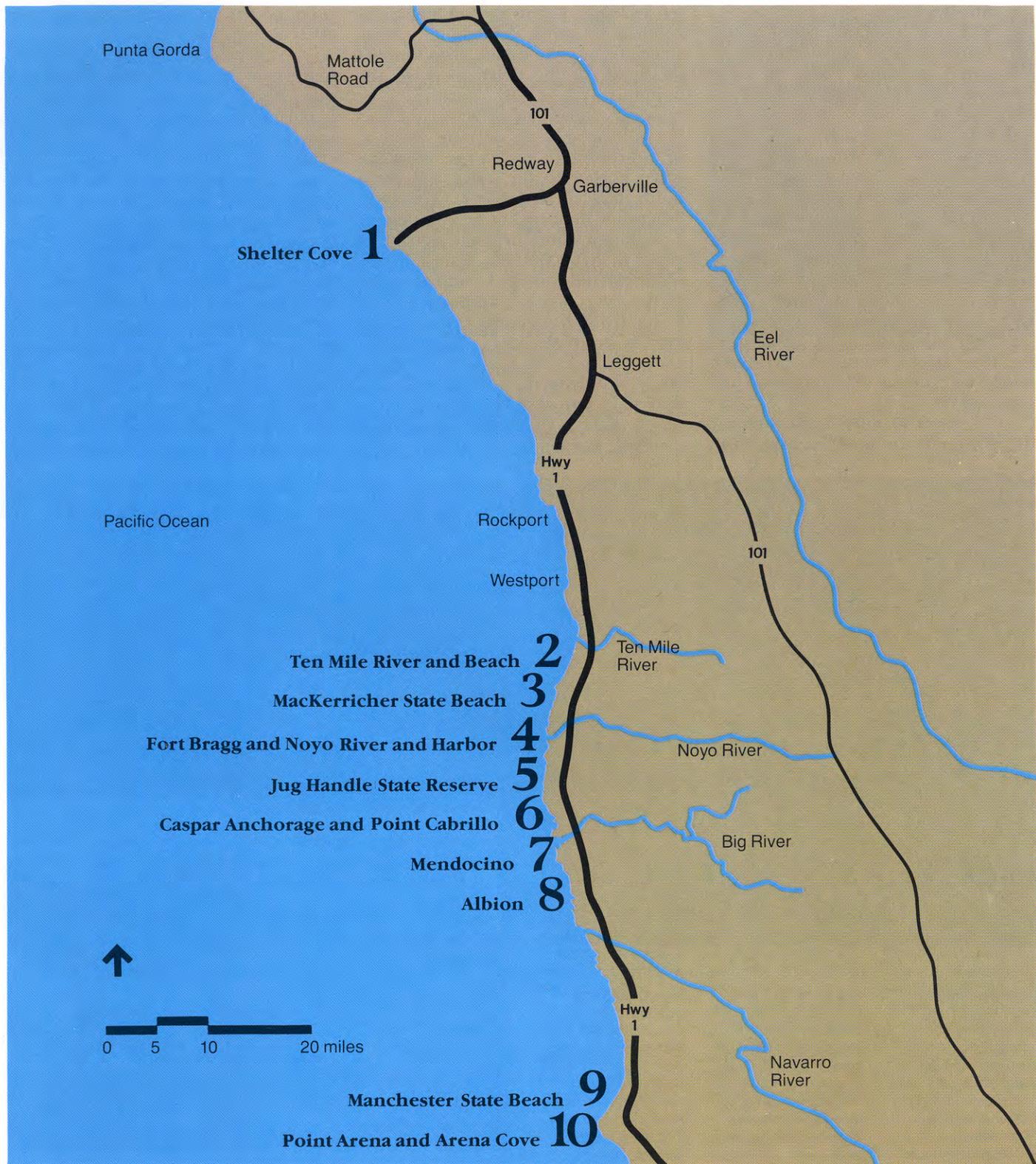
The coast here is diverse in vegetation and wildlife. Dense forests of coast redwood, oak, pine and madrone provide a habitat for blacktail deer, wild pig, bear and wild turkey. Freshwater streams and lagoons are alive with trout and bass, and nearshore ocean waters teem with king and silver salmon, steelhead trout, bottom fish, clams, abalone and mussels.

The history of man's habitation in this region begins with Indian tribes living in villages near the shoreline, where the fruits of land and sea were readily available. The arrival of entrepreneurs seeking riches from the region's natural resources began in the early 1800s. As lumbering became the predominant economic activity, the area's hills, coves and coastal streams became vibrant with activity. Depletion of the virgin timber, coupled with diminishing market demand, caused most of the mills to be abandoned by the early 1900s. The few old mill towns still scattered along the coast are the only remaining evidence of this colorful era. Today, lumbering, commercial fishing and light ranching serve as the area's

economic mainstays.

The area's geologic history is highly complex. Many coastal cliffs and coves are part of the Franciscan formation, which consists largely of ancient sea floor sediments, faulted and folded by earthquakes and tectonic activity that took place millions of years ago. This formation is named Franciscan because this same type of rock was first studied in the San Francisco area. Differences in the erodibility of the various native materials result in the region's highly rugged appearance.

Exploring this much-photographed segment of the California coastline creates a lingering sense of appreciation and wonder. We hope that you will take time to enjoy the area's many fascinating features.



1 Shelter Cove

The first point of coastal access south of Cape Mendocino is located at Shelter Cove, 40 miles downcoast from the Cape. To reach this beautiful area, follow Highway 101 south from the Eel River through spreading redwood groves and ranches. In the town of Redway, take Shelter Cove Road west for about 24 miles through the beautiful Kings Range. The narrow, paved road winds along steep mountain slopes and dips through deep valleys blanketed with coast redwood, Douglas fir, manzanita and chaparral. This scenic route is well worth the four-hour round-trip drive. Those driving recreational vehicles, however, should be cautious of steep grades and sharp curves.

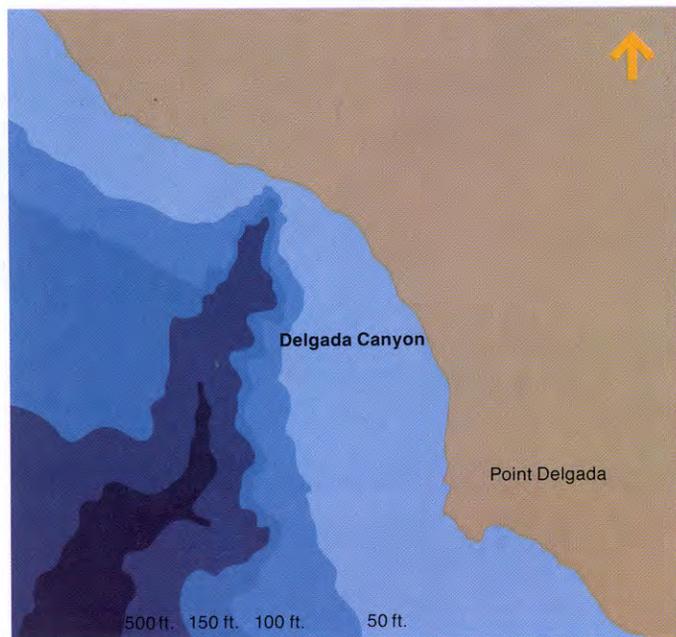
About 12 miles from Highway 101, Shelter Cove Road branches both

left and right. Follow the left branch for another 12 miles, descending a final, steep grade to the Pacific, then turn left on Upper Pacific Drive to reach the community's small harbor. The crescent-shaped bay in which the harbor is located is the only fair-weather, semi-protected anchorage between Noyo Harbor to the south and Humboldt Bay to the north. Transient fishermen often anchor here because it is sheltered from north and northwest waves by Point Delgada. A small breakwater extending from the northern side of the cove protects those launching boats from high-energy waves. Although the cove offers shelter when winds are from the northwest, it is exposed and dangerous when winds are from the southwest. In addition, *williwaws*, gusts of violent wind that move seaward, frequently blow down the

sides of the mountain, endangering boats anchored in the harbor.

Accessible tide pools can be found near the cove's breakwater at low tide. Beachcombing and fishing are popular pastimes here, and surfers often take advantage of the large breakers created by offshore rock reefs.

Another interesting site, located slightly upcoast from the harbor area, can be reached by returning along Upper Pacific Drive, crossing Shelter Cove Road and turning right on Tern Drive. Make another right turn on Dolphin Drive and follow the road downhill until you reach a small pocket beach, protected by rocky headlands flanking either end. The dark, grey-black sand, eroded from the shale cliffs backing the beach, is often covered with flat pebbles, another result of shale cliff erosion. The coarseness and highly sorted nature



Delgada Canyon

The Delgada submarine canyon extends offshore from the base of a high, steep cliff seven miles northwest of Point Delgada. As it extends seaward, canyon depths increase

at a 45-degree slope, from 40 to 200 feet, and then gradually blend into an offshore shelf at a depth of approximately 1,500 feet. The canyon head, located about midway between the mouths of Shipman Creek and

Buck Creek, was probably once connected to one of the two streams' land valleys. According to one theory, the canyon's current position is the result of a horizontal shift along the San Andreas fault line.



Anchorage at Shelter Cove



Dark sands at Shelter Cove pocket beach

of the sand here is typical of beaches with a direct northwest exposure.

Upon leaving the pocket beach, look toward Point Delgada, the flat, windswept promontory that extends about a mile from the general alignment of the coast. Imagine the fog bell that once sat on a high wooden framework at the tip of the Point. Nearby, a 960-foot wharf was built in 1885 to accommodate ships loading wool, fish and tanbark. Long before, the marine terraces of Shelter Cove served as sites for Sinkyone Indian fishing villages. Today's fishermen still catch salmon and bottom fish such as lingcod and rockfish, as the Indians did in early days.

After visiting Shelter Cove, return to Highway 101. Approximately 20 miles south, take Highway 108 near Leggett to return to the coastline. The road wanders through steep mountain-

ous terrain and second-growth forests of Douglas fir.

In the vicinity of Rockport, numerous turnouts provide excellent vistas of the rugged coastline. Westport-Union Landing State Beach, the northernmost park in Mendocino County, is a few miles south of Rockport. Shore fishing, smelt netting and diving are common activities here. For boaters, the gradually sloping, flat beach serves as a natural landing site, enhanced by a channel between the offshore rock reefs.

En route to Westport, where the first settlers arrived in the early 1860s, enjoy the much admired landscape of the Mendocino County coast with its cliffs, offshore rocks and small beaches. All of these features are examples of differential erosion, a result of waves, winds and rains battering the

coastline, slowly eroding away softer materials and leaving the more resistant cliffs and sea stacks behind.



Coast near Westport Union Landing State Beach



Coastal scene in vicinity of Shelter Cove



Rocky Mendocino County coastline



Roadside scene



Caution

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

Frequent landslides make hiking on the cliffs dangerous. Walking should be restricted to areas well away from cliff edges. Those walking be-

neath the 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 be watchful of incoming tides.

Swimmers, surfers, fishermen and boaters should be aware

of the dangerous rip currents, high waves and cold waters that are prevalent in this region. Swimmers, as well as those strolling or jogging along the shoreline, should watch for floating driftwood that can be unexpectedly tossed ashore by high-energy waves.

Because many roads

on the northern coast are isolated and rough, visitors should be certain that their vehicles are appropriate to road conditions. Pulling on and off many of the area's narrow roads can be dangerous because of the numerous logging trucks that travel here day and night.

2 Ten Mile River and Beach
 Ten Mile River, which enters the Pacific just south of Westport, supplies the sands that have built spectacular Ten Mile Beach. This long, sandy beach has one of the largest and most dramatic fields of sand dunes on the Northern California coast. The beach is privately owned and is not accessible. However, you can observe this unique beach and river area as you descend the hill toward the Ten Mile River Bridge and continue south along Highway 101.

As you cross the river, note the lush wetlands along its banks to the left. These wetlands provide important resting and feeding sites for a variety of migratory birds. This ecologically balanced environment also serves as a nursery for anadromous fish. The marshes in the vicinity of Ten Mile River are one

of California's important coastal wetland areas.

At the river mouth is a sand spit that experiences the cyclical accretion and erosion typical of summer and winter periods. During times of low river flows, the spit forms as a result of the deposition of sand carried downcoast by longshore currents. During winter, high flows break through the spit and nearly wash it away. With the return of summer, sands are redeposited and the spit takes shape once again.

Ten Mile River Beach begins at the mouth of the river and continues for about 4.5 miles south, to the upcoast end of MacKerricher State Beach. Some areas of the beach have been mined for sand intermittently since the early 1960s. The 100-foot-wide beach is backed by large, active dunes that continually migrate inland, covering what-

ever lies in their path. These impressive dune fields are created when breezes pick up loose, dry sand particles and blow them up the windward slopes of individual hillocks. The sand is deposited on the crest of the hillock and then blown to the leeward side, resulting in migration. The rate of dune movement at Ten Mile Beach varies from two to four feet a year. The dunes here tend to migrate toward the southwest as a result of predominant northwesterly winds. In some areas along the highway, visitors will see evidence of the dunes' relentless advance.

Behind the dune fields are freshwater wetland areas. Such marshy regions are common inland features when dune width and compacted sand prevent runoff from making its way to the sea. The wetness of these marshes varies, depending upon the season.



Mouth of Ten Mile River



Migrating dunes at Ten Mile Beach

Littoral Sand Loss Due to Wind

Beaches characterized by unstable sand dunes can experience a significant net littoral, or nearshore, sand loss as winds blow sand inland. Such losses will cause erosion of the shoreline unless the beach is fed by an amount of sediment equal to that being blown away. Annual sand transport due to wind can range from

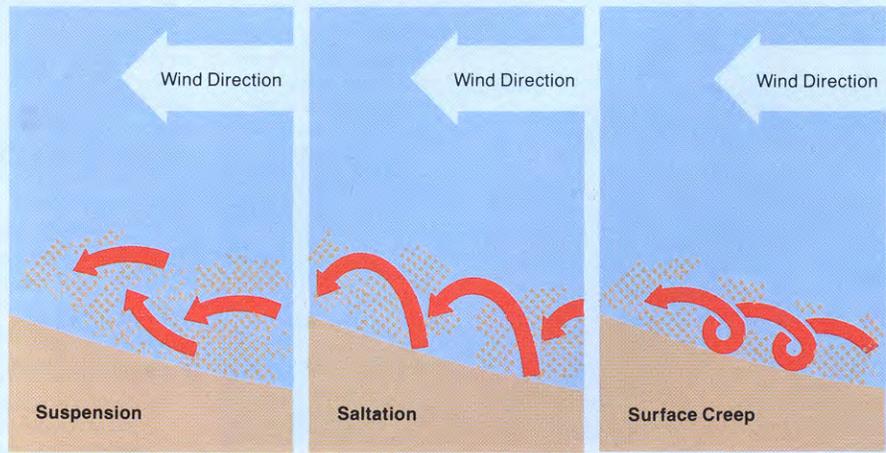
one to ten cubic yards per foot of beach front. This can result in significant reduction in the size of the beach over a period of time.

Wind-blown sand is transported by three methods. *Suspension* occurs when small grains are lifted and moved through the air. *Saltation* takes place as particles move along the surface in a series of short jumps,

and *surface creep* occurs when particles are rolled along the ground.

Determining the amount of sand loss and the rate at which it occurs is important to coastal engineers charged with a responsibility for beach maintenance. Research, conducted through regularly scheduled aerial photography, is important in determining

whether or not significant sand losses are occurring. More detailed study involving actual on-site measurement may be necessary to determine the long-term impact of wind transport on the area's sediment budget. The sediment budget is an analytical method used to identify and quantify sediment sources and to determine actual sand gain or loss in a given area.



3 MacKerricher State Beach
The entrance to MacKerricher State Beach, a 280-acre park with more than three miles of shoreline, is only a few miles south of the Ten Mile River Bridge. The park is named for the MacKerricher family, the first settlers of the nearby community of Cleone. MacKerricher State Beach has outstanding scenic and recreational opportunities. It also provides the advantage of exploring a dramatically beautiful shoreline that is inaccessible farther north.

The rocky shore of Laguna Point, extending seaward from the park's southwest corner, graphically displays the results of differential erosion. These ragged shoreline contours are sharply contrasted with the long, smooth expanse of beach to the north. Red algae grows profusely on intertidal

rocks, and bull kelp can be seen floating offshore. Hiking trails around the rim of this 30-foot-high, flat coastal terrace afford access to tide pools rich with such marine life as anemones, crabs, sea urchins and starfish. Visitors should keep in mind the fragile nature of these ecologically balanced environments and leave them undisturbed.

Many of the sandstone rocks which were formed from sand deposits along the shore have small, smoothly rounded holes. The holes, formed by wave erosion, once held small, hard pebbles, believed to have been part of an ancient stream bed. As the pebbles interacted with the water flow, the size of the cavity increased until the more resilient pebbles were washed away, leaving behind the rounded depressions in the rocks.

A wharf and lumber chute, built



Cove on upcoast side of Laguna Point



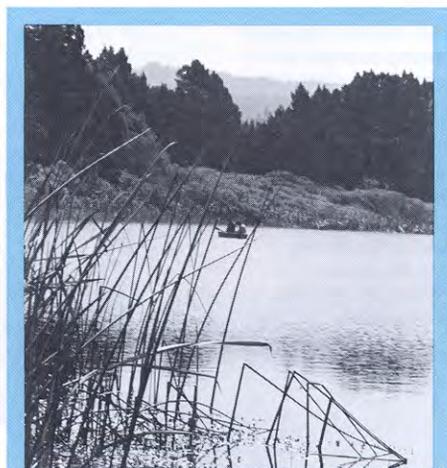
Rusty remnant of early lumbering at MacKerricher State Beach



MacKerricher's eroded sandstone rock



Rocky Laguna Point shoreline



Freshwater Marshes

Freshwater marshes, common to California coastal lowlands, account for more than 90 percent of the country's wetland acreage. Water sources for these usually shallow basins include springs, streams, natural runoff and rainfall.

Such soft-stemmed plants as cattails, reeds, waterlilies and a variety of

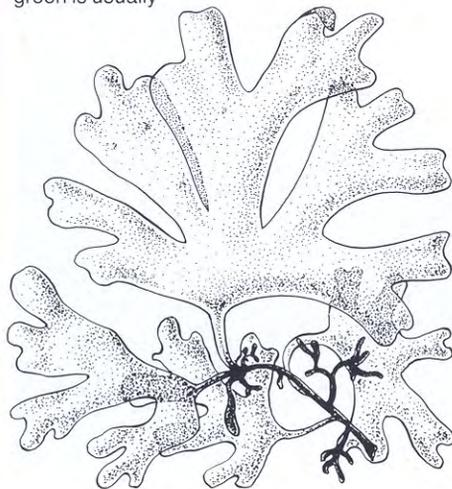
sedges and grasses are part of the complex food web innate to these rich and vibrant habitats. This strong bond of food production and consumption connects the wetland's plants and animals through a chain of interdependency. Green plants, energized by the light of the sun, serve as the primary food producers.

Red Algae

Red algae are the world's most plentiful seaweed, with more than 4,000 identified species. They grow in a variety of intertidal environments. Sizes vary from one species that is barely discernible by the human eye to another that measures 10 feet in length. Colors range from pink to reddish brown. Although red algae have green chlorophyll pigment, the green is usually

masked by other pigments.

One of the most common species found along the northern coast is the red membrane variety. Always pink or red, this multi-branched plant has fan-shaped blades and can grow to five inches in length. This alga always grows at lower tidal levels or in rocky crevices where exposure to air is limited.



in the 1880s, once extended into the waters of the small cove on the upcoast side of Laguna Point. During its use, a railroad led from the cove for more than two miles inland to the Laguna Creek lumber mill. Employing gravity, cars loaded with lumber ran downhill to the chute and then were returned to the mill by horses. The operation was abandoned in about 1904. Watch for occasional rusty rings imbedded in the rocks on the cove's downcoast side. These rings once served as anchoring points for pilings and for lumber ships. The steep-faced, dark-sanded beach here experiences high-energy waves, and rip currents are prevalent. The beach is popular with smelt fishermen.

Immediately inland of the pocket beach is picturesque Lake Cleone, a small freshwater lake fed by Laguna Creek. The cattails bordering the lake's

edges add to the area's scenic beauty and provide a habitat for red-winged blackbirds and a variety of other small marsh birds and water creatures. A tide gate at the nearcoast end of the lake is opened during periods of high creek flow, to control flooding. The gate prevents salt water from entering the lake. Lake Cleone is stocked with rainbow trout and is a popular fishing spot. A hiking trail runs around its perimeter.

When leaving MacKerricher State Beach parking lot, note that the trees change in height as you continue inland. The tree-line becomes progressively taller as the forest extends away from the sea. This natural wedge shape allows the branches of shorter trees to protect the vulnerable trunks of neighboring trees. If trunks were exposed directly to the harsh salt air, these trees would not survive.

4 Fort Bragg and Noyo River and Harbor

Fort Bragg, the largest city on the Mendocino County coast, began as a military fort built on the Noyo River in 1857. Under the command of the U.S. Army Artillery in San Francisco, the fort was established to control hostilities between the Coast Yuki Indian tribe and early settlers. In 1864, the fort was abandoned. Today the original building houses a museum on the grounds of a Fort Bragg lumber company, located west of Main Street on Redwood Avenue. The fascinating photographs and artifacts displayed here serve as nostalgic and informative reminders of the early days of the north coast lumbering industry.

Settled as a lumber town in the mid-1800s, the City of Fort Bragg has continued to be a center for lumbering

Dungeness Crab

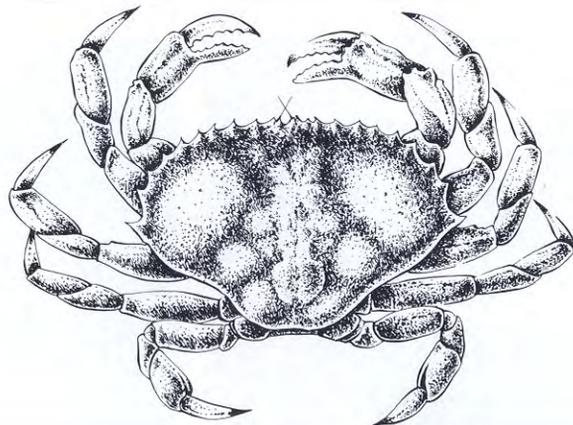
The Dungeness crab, a crustacean of great commercial importance to north coast fishermen, normally prefers sandy bottoms at depths of 50 feet or more.

Buoyed by the water, the Dungeness moves easily along the ocean bottom on the tips of three pairs of walking legs. It can move quickly when

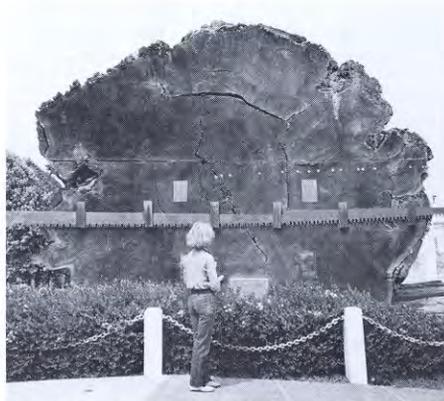
frightened or when aggressively approaching its prey. The crab feeds primarily on small fish which it tears apart with its powerful front pincers and voraciously stuffs into its tooth-lined mouth. The soft, fine hair that coats the crab's shell helps to filter water nearing the gills.

The Dungeness crab is caught with a

bowl-shaped hoop net ranging from two to three feet in diameter near the top and narrowing to about 16 inches at the bottom. These nets, usually baited with fish, are lowered along the sides of the fishing boat and quickly pulled to the surface to prevent the escape of startled occupants.



Fishing from Lake Cleone tide gate



Massive redwood log at Fort Bragg lumber museum



Fishing boat in Noyo Harbor entrance channel

operations. The original wharf, situated in a cove known as Soldier's Harbor, has long since been removed. In fact, the last time lumber left Fort Bragg by sea was in 1938. Since then, trucks and railroad cars have transported this valuable commodity.

The California Western Railroad's "Skunk" train serves as another colorful reminder of the area's past. Established as a lumber train in 1885, the "Skunk" now carries passengers and light freight between Fort Bragg and Willits much as it did in the early 1900s.

Because of its accessibility, Noyo has served as an important harbor through the years. Today it is one of Northern California's most important commercial and sports fishing centers. To explore this colorful and busy port, named for an Indian chief who once lived in the area, turn left from Main



Commercial fishing boats at Noyo

Street onto North Harbor Drive near the southern end of Fort Bragg. The road leads directly to the harbor, where there are fish processing and packing facilities, bait shops, ship building yards and charter fishing boat services. Chinook and coho salmon, as well as lingcod, black cod and rockfish are commercially offloaded here. Often, more Dungeness crabs are brought into Noyo Harbor than into any other Northern California port.

The harbor itself is a natural embayment that extends about 400 yards inland to the Noyo River mouth. This has been an anchorage area since the days when lumber was lowered from adjacent cliffs to waiting steam schooners. Because of the harbor's orientation, predominant northwesterly winds blow directly into the anchorage, creating dangerous condi-

Ocean Seasons

The ocean off the coast of California undergoes distinct periods or seasons characterized by particular current patterns. The three identifiable seasons—the Upwelling Period, the

Oceanic Period and the Davidson Period—contribute to the general circulation patterns of the Pacific Ocean. They also are related to temperature changes and nutrient concentrations in coastal water.

From February through July, the Upwelling Period is represented by the California Current, which flows south. In spring and summer, when northwest winds are prevalent, the movement of this cur-

rent, the rotation of the earth, and wind forces cause upwelling to occur. At such times, surface waters flow away from shore, and are replaced by colder, nutrient-rich bottom waters.

The Oceanic Period of the California Current takes place from July to November. This season serves as a transition period that is characterized by highly irregular eddies and currents, as well as some upwelling.

The Davidson Period, which runs November through February, is typified by a strong countercurrent called the Davidson Current. It runs northward along the coast, between the California Current and the shoreline.



tions during stormy periods. Offshore, on the upcoast side of the entrance channel, an underwater reef creates some protection by slowing the progress of waves approaching from the northwest. To provide additional protection, the Corps of Engineers constructed a 345-foot-long north jetty made of concrete and stone. To stabilize the entrance area, a north wall rubble-stone revetment and a 234-foot-long concrete south wall were also constructed. The entrance channel, which varies from 100 to 150 feet in width, is relatively shallow, with a depth of 10 feet below the mean lower low water level.

A small pocket beach on the upcoast side of the entrance channel is stabilized by a steady supply of sediments brought downstream by the Noyo River and sands eroded from adja-

cent cliffs. As with all pocket beaches, there is only a slight seasonal increase and decrease of sand. The coast at the Noyo River's entrance to the sea is part of a flat marine terrace characterized by steep shoreline cliffs. The river serves as a prime breeding ground for the anadromous fish that annually swim upstream to spawn.

Around the first bend in the river is an 8.5-acre mooring basin occupied by commercial fishing boats. This inner harbor is protected from the river's seasonal high waters by a wooden wall, or bulkhead.

Between Noyo and Point Arena to the south, the wave-cut coast is very irregular. The kelp beds that lie offshore provide important habitats for numerous fish, marine mammals and invertebrates. Flat-topped sea stacks, remnants of earlier marine terraces, are prevalent.



Glimpse of Jug Handle State Reserve shoreline



Cobbles on area beach



High-energy waves at Noyo



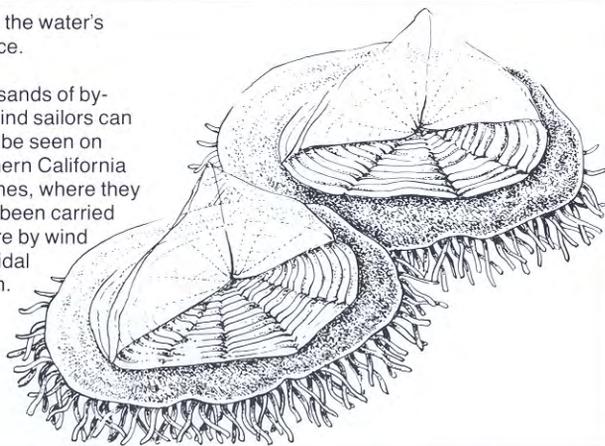
Boat building activity

By-The-Wind Sailors

By-the-wind sailors are small jellyfish which live in colonies in the open sea. These fascinating colonies are made up of thousands of individuals. Each by-the-wind sailor is about two inches long and consists primarily of a flat, bluish float. A sail-like crest that runs diagonally across the top catches the wind and carries them

along the water's surface.

Thousands of by-the-wind sailors can often be seen on Northern California beaches, where they have been carried ashore by wind and tidal action.



Noyo Harbor entrance and bridge



Navigation aids on Noyo entrance jetty

5 Jug Handle State Reserve
 Jug Handle State Reserve, a Registered National Landmark, contains a unique example of what is referred to as an ecological staircase. The reserve, located off Highway 101 a few miles south of Noyo, features a series of distinct wave-cut marine terraces that are an extraordinary example of coastal terrace development. The terraces at Jug Handle have evolved over a million years' time. Each terrace provides valuable ecological data about prehistoric and historic times. Each has its own ecosystem, with vegetation patterns that reflect climatic and soil conditions. An outstanding interpretive exhibit enhances the educational value of the reserve.

The lowest step, believed to be approximately 100,000 years old, fronts on Jug Handle Bay. The highest step,

Pygmy Forests

Pygmy Forests are common to the upper marine terraces of Jug Handle State Reserve as well as to other areas of the Mendocino County coast between the Noyo and Navarro Rivers.

These fascinating, miniature forests, first discovered here in the mid-1800s, are found

forest debris to create a highly acidic liquid. As the liquid slowly drains downward, essential soil nutrients are carried with it. Eventually the soil is completely leached of minerals. An impervious hardpan, or in flat areas subject to the accumulations of rain runoff. This eventually stagnant water combines with natural

500,000 or more years old, is in Jackson State Forest, about 2.5 miles inland. The three terraces in between are flat sequentially rising "staircase" heights. Another terrace, now offshore, may at some future time rise to become the youngest step in the staircase.

Presently, the step nearest the Pacific is covered with grasses and small plants well-adapted to harsh wind, damp air and salt spray. The second terrace also features a unique ecosystem consisting of coast redwood, Douglas fir, Bishop pine and a variety of smaller plants. These same trees, along with some of the well-known Mendocino County pygmy forests, dominate the third terrace. Normal forests and rich undergrowth also thrive on the third terrace, in areas nourished by a substrate of ancient sand dunes that have been enriched by centuries of decom-

posed forest debris to create a highly acidic liquid. As the liquid slowly drains downward, essential soil nutrients are carried with it. Eventually the soil is completely leached of minerals. An impervious hardpan, or in flat areas subject to the accumulations of rain runoff. This eventually stagnant water combines with natural

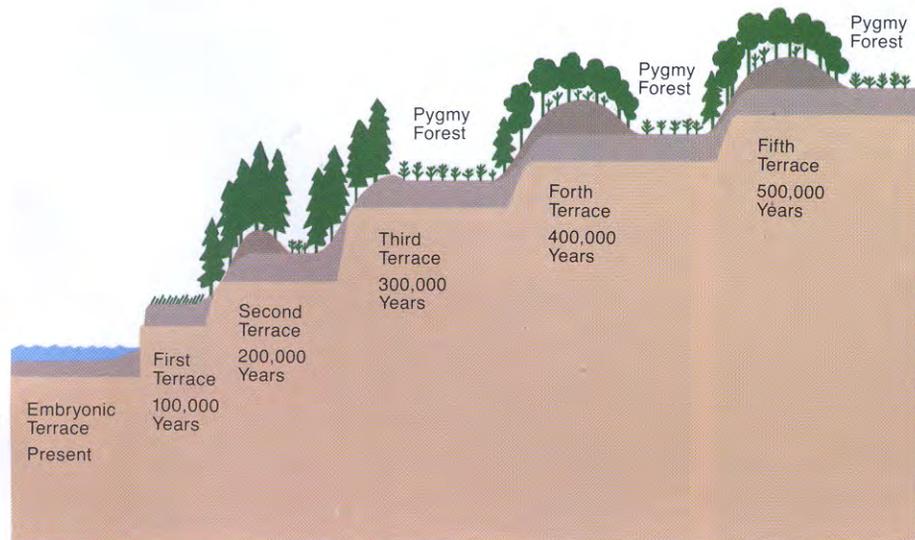
graywacke, develops due to the cumulative effects of poor drainage. The resulting restricted root growth stunts the growth of the trees. In extreme cases, a tree that would normally grow to over a hundred feet tall may attain a maximum height of two to three feet. A tree over a

hundred years old may have a trunk barely an inch thick. Dwarfed trees at Jug Handle State Reserve include Bolander and Bishop pines, cypress and manzanita. The conditions that create pygmy forests such as those in Mendocino County develop over thousands of centuries.

posing plant material. A similar soil base results in the healthy growth prevalent in portions of the fourth and fifth terraces. Here, too, however, are pygmy forests prevented from attaining normal stature by a highly impervious hardpan soil base.

Jug Handle Creek has carved its way through the marine terraces to empty into Jug Handle Bay. During summer months, a barrier beach forms at the mouth of the creek, the combined result of low creek flow and the deposition of sands carried by longshore currents. During winter, creek water breaks through the sand barrier and flows into the Bay.

The banks of Jug Handle Creek offer a rich environment for many plant and animal species. An estuarine habitat exists along its lower reaches, where tidal salt water seasonally mixes with



Former lumber mill site on Caspar Creek



Beach at Caspar Anchorage



Russian Gulch

the freshwater flow. Only vegetation well-adapted to saline soil, such as sedge and salt grass, grows in the estuarine area. Further upstream, freshwater plants including cattail, fern and willow grow in profusion. Jug Handle Beach, adjacent to the creek mouth, is a feeding site for a variety of shorebirds who wait for a fresh supply of tiny organisms brought by the incoming tide.

A short loop trail less than a mile long begins near the parking lot, follows the banks of Jug Handle Creek, then continues for a short distance downcoast before returning to the parking area.

To gain a greater appreciation of the fascinating history of the Jug Handle area, stop at the reserve's ranger station for additional information and take adequate time to explore this classic marine terrace development.

Return from Jug Handle Reserve to Highway 101. Within a short distance turn right on a road that runs parallel to the highway for a side trip to the now-quiet lumber town of Caspar. Return to the highway and continue to the next site, the historic Caspar anchorage area.



Fence lining coastal pasture land

6 Caspar Anchorage and Point Cabrillo

To visit the Caspar anchorage, once an important stopping place for lumber schooners, cross Caspar Bridge and turn right on Point Cabrillo Drive. Watch for a turnout along Caspar Creek, where a short walk leads to a cove at the mouth of the creek. Here, a scattering of old pilings is the only remaining evidence of early commercial activity.

The Caspar anchorage was often referred to as a "gunkhole" in early days. The shallowness of the water and the proliferation of mud, rocks and vegetation sometimes made navigation nearly impossible.

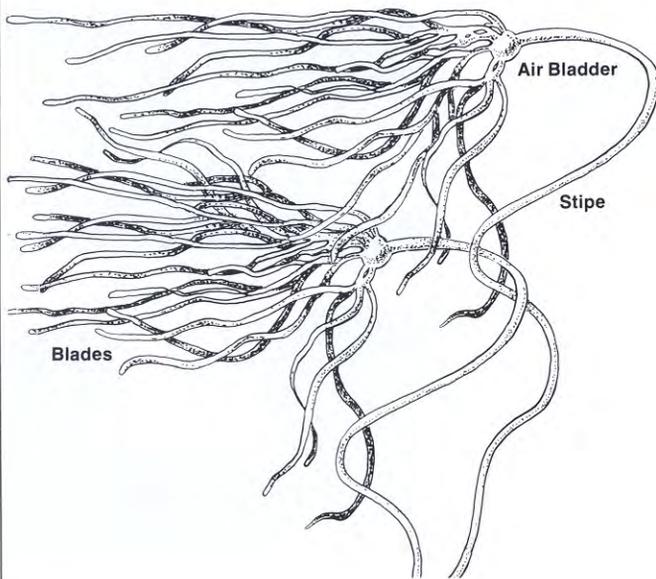
The lumber mill, built in the mid-1800s, was located on the north side of the creek mouth. With the addition of a saloon and blacksmith shop,

Bull Kelp

Bull kelp is a member of the brown algae family. Common to northern California waters, bull kelp, sometimes called sea-nymph bladder kelp, is found in depths ranging from 15 to 75 feet. Its slender stipe, or stem, can

grow to more than 250 feet long. The stipe is topped by a large, hollow air bladder as large as six inches in diameter. As many as 60 blades averaging ten feet in length hang downward from the bladder into the water. The life span of this

fast-growing giant is usually about a year. During this time, the bull kelp grows to maturity and produces the spores that create new life. It is then torn loose from its small holdfast and tossed onto coastal beaches by winter's high-energy waves.



Northern California



Southern California

Coastal Piers

Piers, so common to the Southern California shoreline, are relatively scarce along the northern reaches of the coast. This is primarily because Northern California's less industrially oriented economy and smaller populations reduce the need for their construction.

Also, the typically severe wave climate along the northern shoreline and the limited number of sheltered coastal inlets combine to make construction and maintenance difficult.

Along the southern portion of the California coast, however, piers have been built

in response to a large population and extensive industrial activity. In addition, the more gently sloping beaches and moderate wave climates typical of the southern coastline have increased the availability of sites appropriate to pier development.

this lumbering community swelled to a population of more than 1,000. In the mid-1950s, when nearby timber supplies were depleted, the mill closed.

Caspar Creek enters the sea on the upcoast side of the cove's sandy beach. During rainy seasons, the creek widens to cover the cove's entire beach area. In summer, clumps of green grasses grow on the cove's pocket beach.

From the Caspar anchorage, continue downcoast on Point Cabrillo Road. Look toward shore for a glimpse of the Point Cabrillo light station, recognized as one of the finest examples of an original California lighthouse. The facility, which sits more than 80 feet above the water, was built in 1909 by the U.S. Lighthouse Service. It was originally constructed to guide the steam-driven lumber schooners that once plied coastal waters. Today, the light sta-

tion primarily serves commercial fishing boats. The best view of the Point Cabrillo Lighthouse is from the seaward end of Heeser Drive in Mendocino.

Point Cabrillo itself is part of a flat-topped marine terrace. Seas are exceptionally rough in the vicinity of the point, due to deep offshore waters. High waves sometimes spray the top of the point's 60-foot cliffs. The higher-than-normal marine terraces here, as in many other places along this portion of the coast, are believed to be the result of a general uplifting of the earth's surface.

Between Point Cabrillo and Mendocino, three miles to the south, the coastline is typified by steep, rocky cliffs and flat, grassy marine terraces. Numerous small coves are prevalent along the highly eroded shoreline.

En route to Mendocino, at the end of Point Cabrillo Road, is the 1,120-

acre Russian Gulch State Park. The cliff-flanked indentation at the mouth of Russian Gulch Creek creates the type of small cove that early lumber schooner captains called a "doghole." Dogholes, believed to be caused primarily by wave erosion, were often the site of Mendocino County lumber ports. In stormy, foggy weather, they were difficult to spot from sea and their deep, narrow configurations created extreme navigational hazards.



Mendocino, across Mendocino Bay



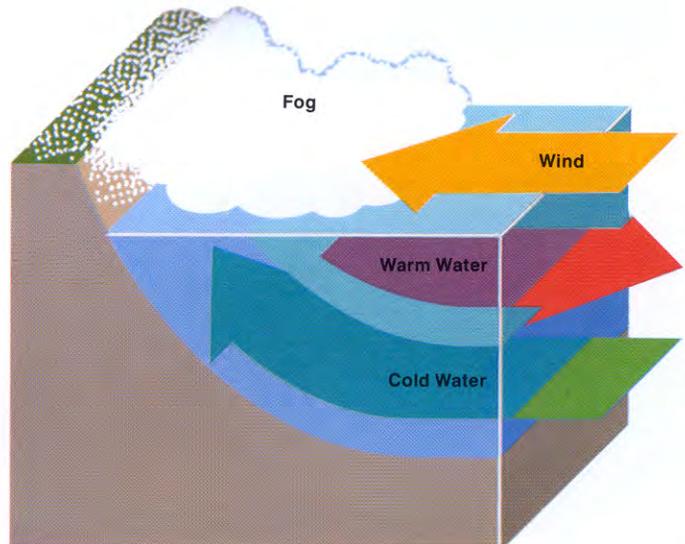
Remains of Mendocino's once-thriving lumber mill

Sea Fog

Sea fog, or *advection fog*, is particularly prevalent on the north coast during summer months. Its primary cause is an ocean process known as upwelling. Upwelling occurs when cold waters from the ocean bottom rise to replace

nearshore surface waters that have been pushed out to sea by the wind and coriolis effects. As warm, moist air passes over the cold, upwelled water, the air temperature falls below the dew point. The water vapor then condenses and becomes fog.

Because sea fog is usually dense and evenly distributed, it is highly resistant to the normally dispersing effects of strong winds and the sun's warm rays.



7 Mendocino

After taking the first exit leading to Mendocino from Highway 101, turn right on Heeser Drive to explore the headlands and to enjoy vistas of the Pacific and the much-admired Mendocino coastline. The promontories here are part of Mendocino Headlands State Park, acquired by the state in 1972. At the base of the bluff's eroded cliffs are tide pools, accessible to the public.

Continue to Main Street and park near the intersection with Heeser Drive. A pathway leads across a flat, grassy marine terrace to the edge of the cliffs south of town. Here, a structure of wooden planking serves as the only coastal remnant of Mendocino's once-thriving lumber operations. Sailing ships, and later, steam-powered schooners anchored at the base of the

cliffs, waiting to be chute-loaded.

Mendocino was once called Meiggsville, after Henry Meiggs, a settler from San Francisco who established a lumber mill here in 1852. Lumbering was dominant until the early 1920s when demand slackened. The mill closed in 1931.

Visible from the bluffs near the former lumber mill site is the mouth of the Big River, lying at the head of Mendocino Bay. Once called "Bool-Dam" by local Indians, Big River drains more than 180 square miles. Jug Handle, Caspar and Russian Gulch Creeks, as well as the Albion River, are part of the "Big River Group" of drainage basins. Coastal wetlands along Big River are recognized as some of California's most important.

A light-colored sandy beach extends along the base of the bluffs toward the river mouth. The beach is primarily

made up of sands eroded from area cliffs and brought downstream by Big River. Minerals found on this popular recreational beach include jasper, quartz, graywacke, sandstone, feldspar and small quantities of garnet.

In summer, a sand bar develops on the downcoast side of the river mouth. During winter, the bar is washed away by high river flows. When river flow is low, sands from upstream sources and incoming tides are deposited on the floor of the river bed. The position of the sands in the channel depends on the dynamic equilibrium established by freshwater flow, tidal waters and wave energy. During periods of extensive runoff, the river flushes bottom sands into the Pacific. When this occurs, a plume of freshwater sediment — made up of suspended silts and clays — extends into the sea. Some



Evidence of differential erosion along Mendocino bluffs



Driftwood-strewn beach at Van Damme State Park

Early Ship Loading and Offloading

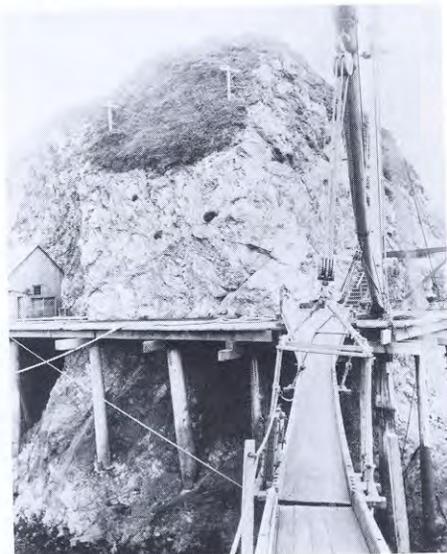
The pilings, fence posts, railroad ties and other products loaded on schooners visiting the doghole ports of the Mendocino coast were moved from shore to ship by primarily two methods—apron chute and wire chute.

The apron chute was a simple wooden slide that extended from a bluff top to ships anchored in the cove below. To stop the progress of goods speeding down the chute, an "apron" at the lower end was lifted, stopping the cargo as it neared the ship's deck.

A wire chute was merely a cable stretched between the cliff top and the ship. Materials were placed in slings and carried downward along the cable by gravity.



Wire chute



Apron chute

of the coarser materials or sands are picked up and transported by longshore currents to replenish area beaches.

Several parking areas along Highway 101 south of the Big River Bridge offer good vantage points from which to study the sculpted shoreline of Mendocino Bay. This scenic coastal area serves as a classic example of the results of differential erosion. Note the large, air-filled bladders of the bull kelp floating on the water's surface just offshore. The holdfasts of these large algae are attached to underwater reefs.

The mouth of Little River and the entrance to Van Damme State Park are a short distance south of Mendocino. During heavy northwest swells, the Little River embayment provides a safe anchorage for small boats, partially because of the protective influence of the headland immediately upcoast.

Plankton

The many microscopic plants, *phytoplankton*, and microscopic animals, *zooplankton*, that are suspended in salt and fresh water, form an integral part of the sea's complete food web. Plankton serves as a critical food source for multitudes of fish and crustaceans.

Since light promotes their growth, the

majority of ocean plankton reside within 100 feet of the water's surface. As might be expected, volume is generally greatest during periods of sunshine in the spring and summer months. Larger organisms dependent upon plankton as a food source tend to follow the more prolific areas of growth, moving back and forth with the currents.

Further protection from high energy waves is provided by the extensive rock reefs that lie offshore.



Fishing boat near Little River

Certain combinations of minerals and water temperature conditions result in extremely dense plankton growth or "bloom." The commonly known "red tide" appears as a vermilion or brownish color when billions of plankton die due to oxygen depletion or other causes. The foul-smelling red tide may contaminate fish, mollusks and crustaceans, making them toxic.

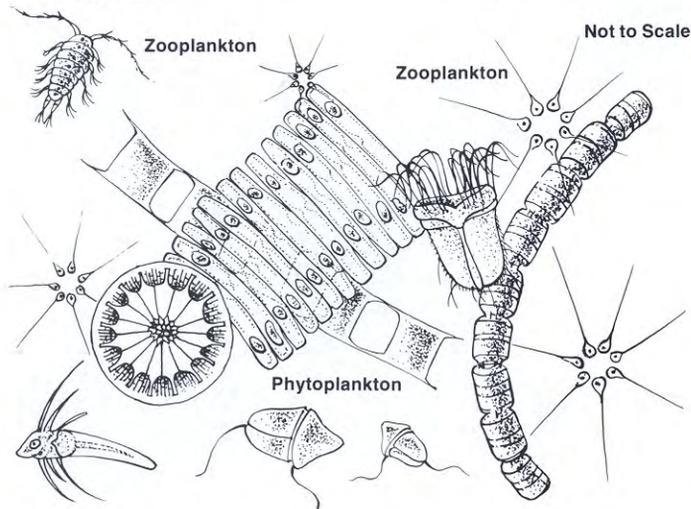
8 Albion

The town of Albion, home of one of Northern California's active fishing ports, is situated on bluffs high above the Albion River. The port itself is located near the river mouth at the head of Albion Cove, a classic Mendocino County doghole that extends about 300 yards seaward. In the center of the cove is 30-foot-high, cone-shaped Mooring Rock. The light and the fog signal on the rock serve as a guide for commercial and sports fishing boats. During periods of extreme storm activity, high-energy waves stack up and break at the river mouth, making the entrance unnavigable.

To reach Albion's port, turn left just before the Albion River Bridge and follow the road down the side of steep bluffs to the river and its flat, sandy floodplain. Several small floating piers



Early-day Albion



Albion today

provide docking facilities that can be removed during high river flow. Albion Cove, like Caspar Cove to the north, offers a protected anchorage when winds blow from the northwest.

The Albion River is relatively small and flows westward through the steep canyons of the North Coast mountain range. Dense vegetation grows along the canyon sides, including redwood, Douglas fir, red alder, willow, blackberry and a variety of low plants and shrubs.

The river and its environs provide a rich and varied ecological environment. The three miles of the river nearest shore serve as a nursery for coho salmon, surf perch, smelt and steelhead trout. Birds such as loons, herons and kingfishers search the waters for fish. Eelgrass beds, an ideal habitat for various small fish and inver-

tebrates, grow on the river bottom near the mouth of the river as well as along its banks. Several salt marshes provide important feeding and resting sites for migratory birds, and the mudflats are abundant with thousands of tiny invertebrates which nourish both birds and fish.

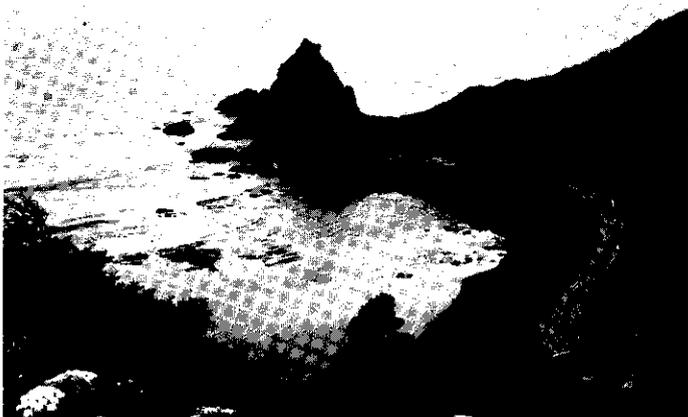
About three miles upstream there once stood a water-powered lumber mill, the first of its kind on the Northern California coast. The original mill was built by Captain William A. Richardson of San Francisco in 1853. For years, the mill served as the basis of a thriving economy, producing ties used in building a railroad in Mexico. The mill was dismantled in 1919, when the need for the ties ended.

9 Manchester State Beach
En route to Manchester State Beach, watch for occasional glimpses of Point Arena, the long, level finger of land extending offshore at the southern end of the beach. Numerous turnouts along the highway provide outstanding views of this scenic coastline. Turn left from Highway 1 at signs identifying the location of the beach. The road runs through the wide expanse of a windblown coastal floodplain where grasslands are used primarily for grazing cattle and sheep. Near the beach parking lot, note the terminus facility of the U.S. Coast Guard's Hawaiian-Far East telecommunications cable.

Due to its west-northwesterly orientation, Manchester State Beach is a wave-fronting beach, unprotected from the full impact of wind and high-energy



Mouth of Navarro River, south of Albion



Coastal scene near Elk

Western Gull

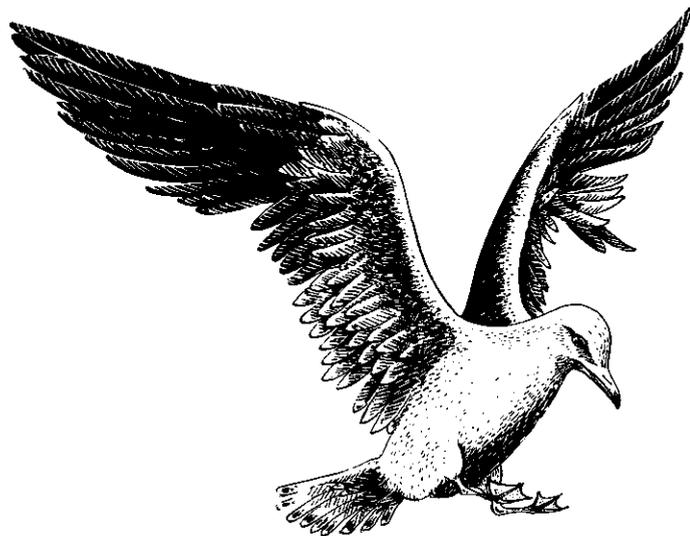
The western gull is one of the most common gulls found on the Pacific coast. Like most gulls, it is a true opportunist, taking advantage of almost any situation that offers food. They are often seen foraging for worms, clams and crustaceans left on the beach by receding tides. They also sur-

round fishing boats, watching for discards of the fisherman's catch.

The social system among western gulls is hierarchical; the oldest gulls maintain superior status because of their size and experience. They typically gather in large breeding colonies on sea rocks, sandy islands or marshlands.

Aggressive behavior is displayed towards any intruders.

The gull has an amazing flight capability, keen intelligence and remarkable digestive capacities. It can adapt to rapid weather changes, and can live on both land and sea because of its ability to drink both salt and fresh waters.



waves. This 2.5-mile-long, 65-acre beach is backed by a series of sand dunes, another result of its unprotected nature. Active, nearshore dunes are partially covered with American beach grass, while those farther inland are covered with vegetation such as sand verbena. Verbena and other growth flourish here because of the rich, moist soil content of the older dunes.

In winter, waves can be seen breaking on offshore sand bars. The bars consist of sands carried away from the beach by powerful waves. Their distance from shore depends on the energy of waves at a given point in time. Gentler waves typical of summer replenish the beach, completing the cycle.

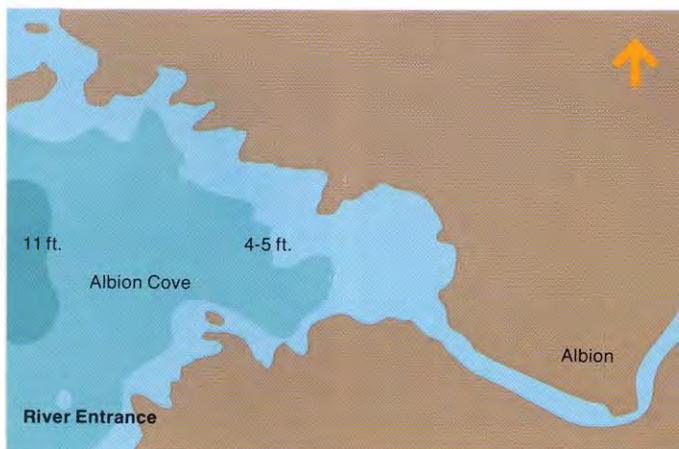
The driftwood scattered along the beach are large logs and branches that were carried downstream by rain-swollen rivers and streams, then washed



Manchester State Beach

ashore during winter storms. The driftwood acts as a device for protecting backshore areas from wind and wave erosion. The driftwood, deposited in earlier times on what is now the backshore area, is believed to have served as the catalyst for the development of the older sand dunes. Behind the dunes at Manchester are marshes and a small lagoon which act as reservoirs for accumulated rain runoff.

Camping and picnic facilities are available at Manchester State Beach. At the south end of the beach, highly eroded, uplifted sedimentary rocks create numerous accessible tide pools.



Coastal Anchorages

Few totally protected anchorages exist along the coastline from Punta Gorda to Arena Cove. In the absence of land-locked harbors, vessel operators must make use of available river entrances, embayments and coves.

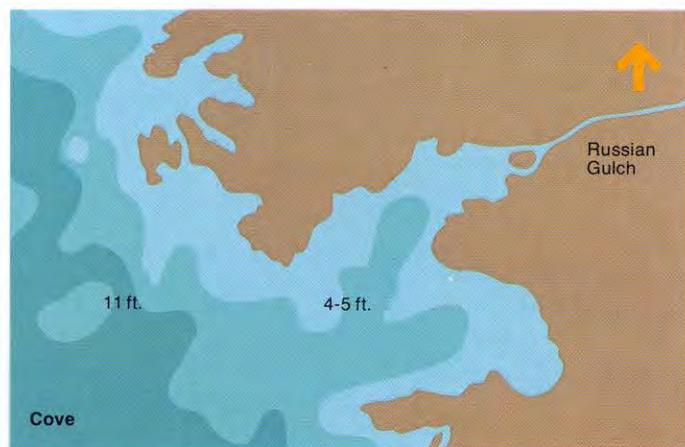
Two river mouth entrances used as all-weather, year-round mooring sites are those at Noyo and Albion. During heavy

seas, however, breaking swells and powerful surges can make navigation hazardous.

The most accessible embayments are located at Shelter Cove, Mendocino and Little River. Although Shelter Cove's crescent-shaped bay and offshore reefs provide protection from northwesterly waves, the bay is exposed when weather is from the southwest. The same is true of Men-

docino. At Little River, offshore reefs and rocks serve as natural breakwaters. In spite of this, the anchorage is not for the inexperienced seafarer.

The most common protective anchorages are deep coves such as those at Russian Gulch and Caspar. Both are narrow indentations commonly used by small-craft captains with good knowledge of local conditions.



10 Point Arena and Arena Cove

Point Arena, the most predominant point of land between Punta Gorda and Point Reyes, is made up of highly folded marine formations. The flat, windswept point consists of relatively hard rock which makes its 60-foot shoreline cliffs less erodible and more stable than most along this area of the coast. Arena Rock, a well-known navigational hazard, lies underwater about 1.5 miles north of the point. This rock, along with the extensive reefs and partially obscured offshore rocks that typify the area, has resulted in numerous maritime disasters.

In an attempt to alleviate the problem, a 115-foot light and a fog signal facility were built on Point Arena by the U.S. Lighthouse Service in 1870. The original lighthouse was destroyed in the

1906 earthquake. A reinforced concrete replacement, the first of its type to be built in the United States, became operational in 1908. By 1977, the Point Arena Light was fully automated.

To reach Arena Cove, turn right on Iverson Avenue near the southern end of the town of Point Arena at a sign reading "Coastal Access." Arena Cove is a small coastal indentation situated between two high, steep cliffs. The cove's orientation and the protection provided by the cliffs allow the pocket beach here to remain relatively stable. The beach is heavily cobbled with pebbles that have been trapped on the beach during their migration from upcoast areas. The heavily layered, crumbling cliffs consist of a conglomerate believed to have once been part of an ancient river bed. Tide pools lie at the base of the cliffs.

Because of its protected wa-

ters, the cove offers a fair-weather anchorage for small vessels. A red-roofed Coast Guard lookout tower sits on the top of the bluff on the downcoast side of the cove, and another building, originally a life-saving station built by the Coast Guard in 1903, houses a bar and restaurant. The cove's old, weathered wharf still serves transient small vessels stopping here for fuel and supplies.

From Arena Cove, return on Iverson Avenue to Point Arena. Turn right on Main Street and continue driving southward on Highway 1 toward the wide, scenic beaches of Sonoma County. South of Arena Cove the coast becomes relatively straight but retains its rugged character.

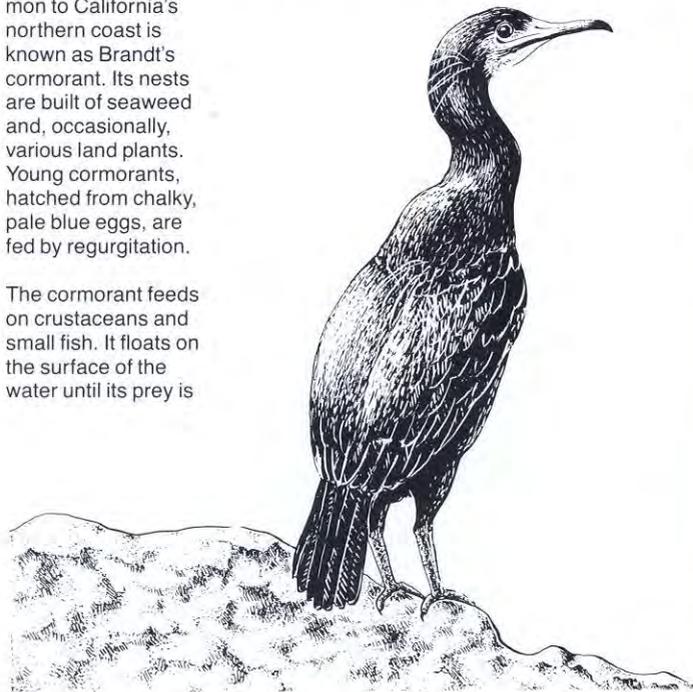
Cormorant

The dark-feathered cormorant tends to congregate in the outer areas of large bays. It breeds, however, on offshore islands and rocky shorelines. The species most common to California's northern coast is known as Brandt's cormorant. Its nests are built of seaweed and, occasionally, various land plants. Young cormorants, hatched from chalky, pale blue eggs, are fed by regurgitation.

The cormorant feeds on crustaceans and small fish. It floats on the surface of the water until its prey is

sighted. Then the bird bobs slightly upward and dives headlong into the water to reach its victim. After feeding for long periods of time, the cormorant stands immobile, with wings extended to dry.

In Japan, cormorants serve as fishermen's assistants. Rings placed on the birds' necks prevent them from swallowing their prey before the fisherman can retrieve it.



Arena Cove shoreline and pier



Cove's algae-covered rocks at low tide



Sunset on Northern California coast

The Year of the Coast

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

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

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
Los Angeles, CA 90012
(213) 688-5320

Sacramento District
650 Capitol Mall
Sacramento, CA 95814
(916) 440-2183

California Coastline
Explore Series

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Explore 9

Cape San Martin to
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

