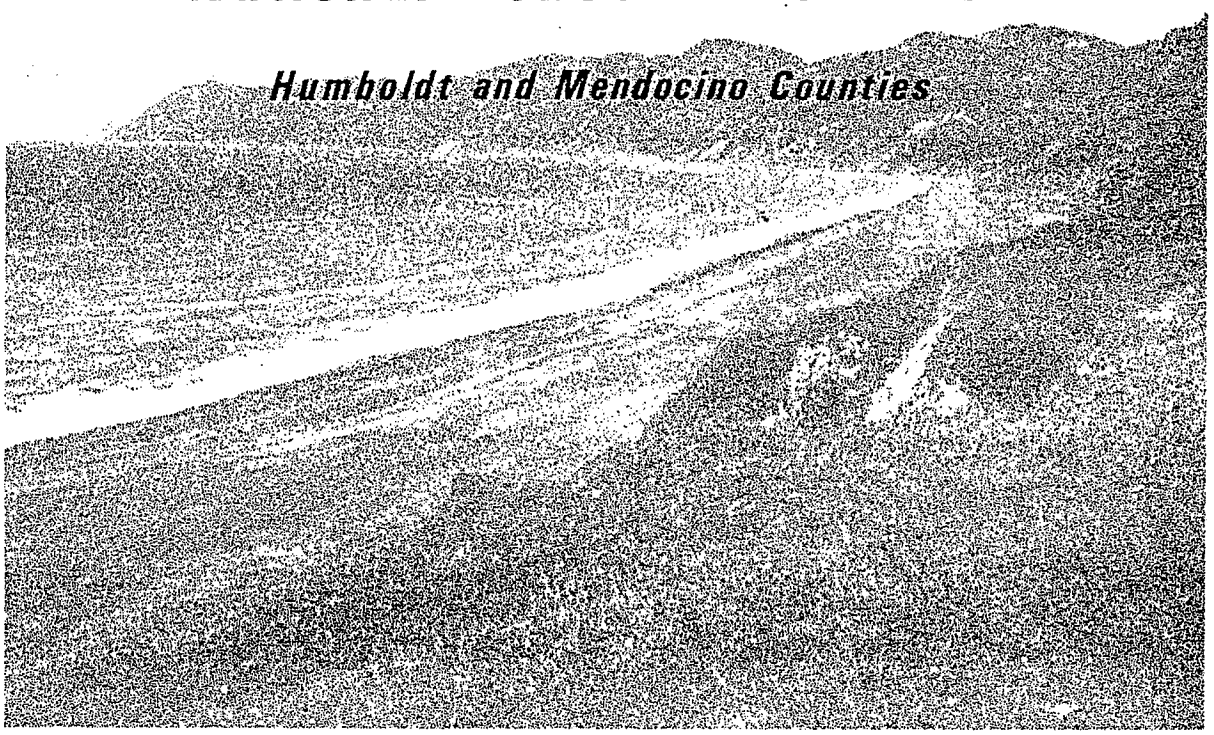
California Marine Waters
Areas of Special Biological Significance
Reconnaissance Survey Report

King Range
National Conservation Area

Humboldt and Mendocino Counties



CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

DIVISION OF PLANNING AND RESEARCH

SURVEILLANCE AND MONITORING SECTION

June 1979

WATER QUALITY MONITORING REPORT NO. 79-18

Cover Photograph:

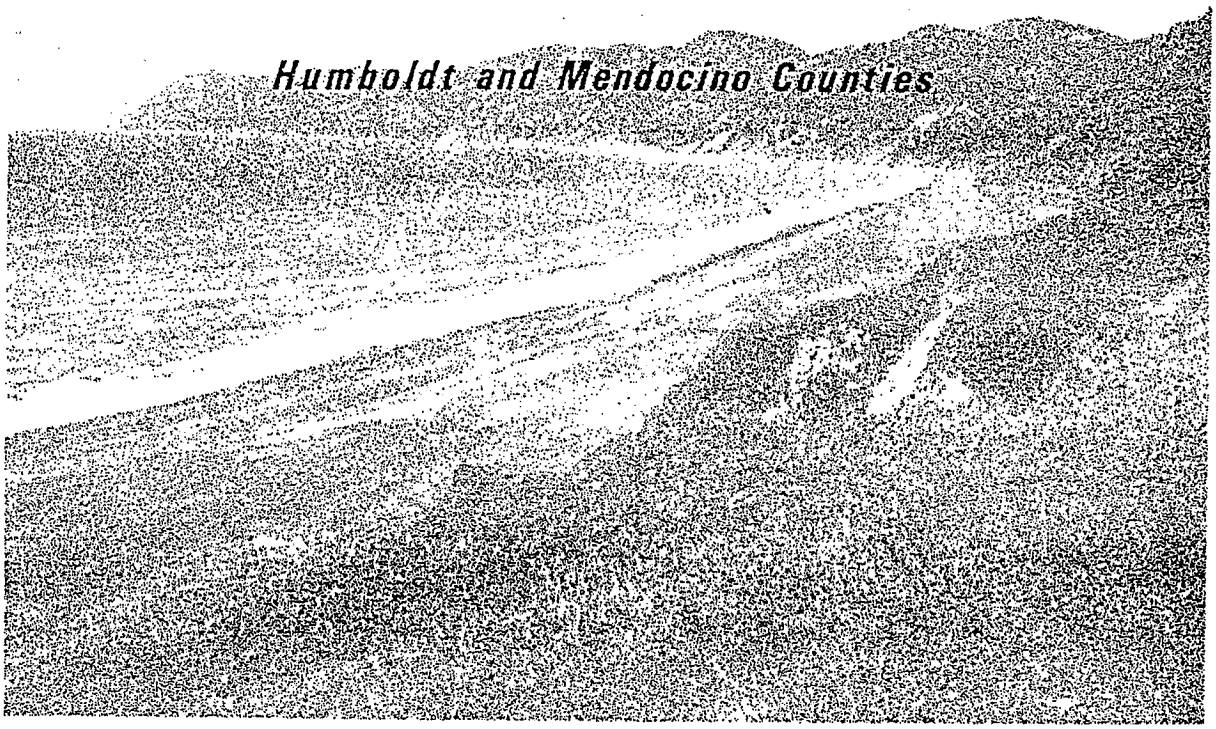
King Range
National Conservation Area
Area of Special Biological
Significance

Printed March 1980

California Marine Waters
Areas of Special Biological Significance
Reconnaissance Survey Report

King Range
National Conservation Area

Humboldt and Mendocino Counties



CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

DIVISION OF PLANNING AND RESEARCH

SURVEILLANCE AND MONITORING SECTION

June 1979

WATER QUALITY MONITORING REPORT NO. 79-18

Cover Photograph:

King Range
National Conservation Area
Area of Special Biological
Significance

Printed March 1980

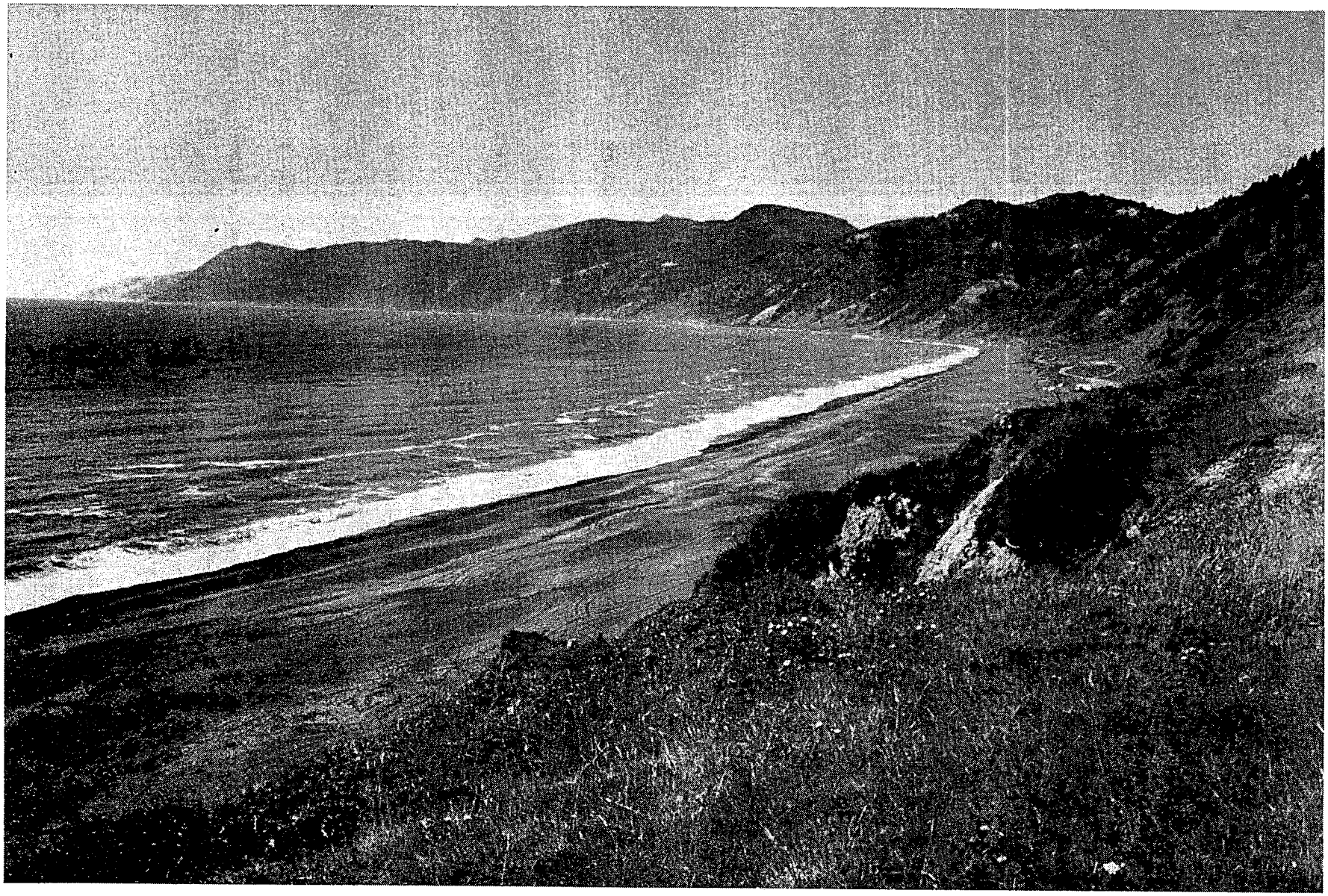
CALIFORNIA MARINE WATERS
AREAS OF SPECIAL BIOLOGICAL SIGNIFICANCE
RECONNAISSANCE SURVEY REPORT

KING RANGE NATIONAL CONSERVATION AREA

HUMBOLDT AND MENDOCINO COUNTIES

STATE WATER RESOURCES CONTROL BOARD
DIVISION OF PLANNING AND RESEARCH
SURVEILLANCE AND MONITORING SECTION

JUNE 1979
WATER QUALITY MONITORING REPORT NO. 79-18



King Range National Conservation Area, Area of Special Biological Significance

STATE WATER RESOURCES CONTROL BOARD

AREAS OF SPECIAL BIOLOGICAL SIGNIFICANCE

Designated March 21, 1974, April 18, 1974, and June 19, 1975

1. *Pygmy Forest Ecological Staircase*
2. *Del Mar Landing Ecological Reserve*
3. *Gerstle Cove*
4. *Bodega Marine Life Refuge*
5. *Kelp Beds at Saunders Reef*
6. *Kelp Beds at Trinidad Head*
7. *Kings Range National Conservation Area*
8. *Redwoods National Park*
9. *James V. Fitzgerald Marine Reserve*
10. *Farallon Island*
11. *Duxbury Reef Reserve and Extension*
12. *Point Reyes Headland Reserve and Extension*
13. *Double Point*
14. *Bird Rock*
15. *Ano Nuevo Point and Island*
16. *Point Lobos Ecological Reserve*
17. *San Miguel, Santa Rosa, and Santa Cruz Islands*
18. *Julia Pfeiffer Burns Underwater Park*
19. *Pacific Grove Marine Gardens Fish Refuge and Hopkins Marine Life Refuge*
20. *Ocean Area Surrounding the Mouth of Salmon Creek*
21. *San Nicolas Island and Begg Rock*
22. *Santa Barbara Island, Santa Barbara County and Anacapa Island*
23. *San Clemente Island*
24. *Mugu Lagoon to Latigo Point*
25. *Santa Catalina Island – Subarea One, Isthmus Cove to Catalina Head*
26. *Santa Catalina Island – Subarea Two, North End of Little Harbor to Ben Weston Point*
27. *Santa Catalina Island – Subarea Three, Farnsworth Bank Ecological Reserve*
28. *Santa Catalina Island – Subarea Four, Binnacle Rock to Jewfish Point*
29. *San Diego–La Jolla Ecological Reserve*
30. *Heisler Park Ecological Reserve*
31. *San Diego Marine Life Refuge*
32. *Newport Beach Marine Life Refuge*
33. *Irvine Coast Marine Life Refuge*
34. *Carmel Bay*

ACKNOWLEDGEMENT

This State Water Resources Control Board Report is based on a reconnaissance survey report submitted by Dr. Milton J. Boyd and Karen Sjogren. Dr. Boyd, of Humboldt State University, submitted the first part including physical, chemical and biological descriptions of the ASBS. Karen Sjogren, of the Department of Fish and Game, submitted the second half of the report which describes land and water use within the King Range ASBS.

The report by Dr. Boyd and Ms. Sjogren was prepared in fulfillment of an agreement with the California Department of Fish and Game, which has coordinated the preparation of a series of Area of Special Biological Significance Survey Reports for the Board under an Interagency Agreement.

ABSTRACT

The King Range National Conservation Area, Area of Special Biological Significance (ASBS), lies between the mouth of the Mattole River on the north, and a point near Whale Gulch to the south. Most of the coastline is in Humboldt County, with approximately 4.5 miles at the southern end in Mendocino County.

The dominant influence on the nearshore zone of the ASBS is the cool, southward flowing California current. This current is part of the general circulation pattern of the North Pacific Ocean, and shifts somewhat in relation to the shore, depending on the season.

The major source of freshwater entering the nearshore zone is the Mattole River. However, numerous small streams empty into the ocean along the shoreline. Because of the exposed coastline, wave force tends to rapidly mix freshwater with seawater in the surfzone. No estuarine plant or animal species were found anywhere within the ASBS except near the mouth of the Mattole River.

The nearshore zone of the ASBS is considered one of the most hazardous to navigation in all of California. Waves 20 to 25 feet high have been observed, even during summer months.

Six different intertidal habitat types are found within the ASBS. These are: exposed, steep sand beach; exposed mixed coarse sand-cobble beach; exposed cobble beach; exposed coarse sand beaches surrounding large boulders; semi-protected sand beach; and exposed rocky intertidal zone. With the exception of the semi-protected sand beach, all intertidal habitats are directly exposed to heavy wave pounding. The severe exposure combined with a lack of stable substrates has resulted in an intertidal biota of only modest diversity. Some representative species of this biota are: various green and red algae; California mussels; gooseneck barnacles; ochre seastars; turban snails and red abalone.

Shelter Cove Sea Park, the major municipal activity within the ASBS, was created in 1965 in anticipation of a fully developed subdivision. Thus, there is a complete water storage system including 19 reservoirs having a two million gallon capacity. There is also a sewage treatment plant and a sewer system serving most of the planned community. However, few of the lots have been developed, and the population is presently very small.

The major recreational use of the ASBS is sportfishing. This activity takes place mainly at Shelter Cove, along with camping, and offroad vehicle use.

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

FINDINGS AND CONCLUSIONS

Findings

1. The intertidal zone of the King Range National Conservation Area ASBS has been only slightly affected by human activities. Grazing and road building in the recent past have probably increased erosion from adjacent coastal watersheds, but much erosion is a direct result of active geological processes along the coast. The turbidity of nearshore waters will probably always be high because of severe wave shock along the shore as well as some natural erosion.

2. Commercial developments at Shelter Cove have resulted in significant impacts on the intertidal biota. Inadequate wastewater treatment cannot, however, be directly implicated as a causative agent impacting the intertidal biota. The treatment plant appears adequate to deal with permanent residential structures. The lack of organisms on Shelter Cove Beach may be linked to the intensive use of the beach during summer months.

3. Recreational use of the ASBS and adjacent lands will probably continue to increase in the future. Recreational users are drawn to the area because of its abundant marine resources; ironically, unregulated and unmanaged recreational use of such resources may pose the greatest threat to the marine environment here.

Conclusions

1. The ASBS is receiving adequate protection in terms of water quality, primarily because there is little human activity in or adjacent to it.

However, with increased use of the area, land uses which can degrade water quality must be regulated more closely than they are now.

2. The west slope of the King Range is extremely susceptible to erosion and uses should not be permitted (even trails) where they aggravate erosional tendencies.

3. The present sewage effluent discharge to the ASBS should cease, in order to ensure uniform enforcement of ASBS water quality requirements, to protect the rich intertidal discharge area, and to prevent the water pollution threat which the discharge may represent in the future when the plant is operating at full capacity. The effluent should be reclaimed for irrigating the adjacent golf course as an alternative to ocean discharge.

4. The best means of ensuring that water quality will remain high in the ASBS is public acquisition of undeveloped coastal lands which are now privately owned. Without public ownership, the U.S. Bureau of Land Management (BLM) will hesitate to regulate land uses which affect water quality, and will be unable to construct public facilities which are needed now and will be even more necessary when recreational use increases.

Congress should appropriate additional funds for land acquisition here immediately, before such acquisition becomes even more costly. The following priority is suggested for land acquisition:

a. Remaining undeveloped ocean front lots in Shelter Cove Sea Park west of the airstrip. These lots are adjacent to a rich, broad intertidal area which has heavy public usage, and the land should be owned by the public so that continued access is assured.

b. Additional land in the Shelter Cove area. The parking lot to be constructed here does not appear to be large enough to accommodate peak use of the area. In addition, this is a good location for picnic tables and an interpretive center, and acquired land should be used for these purposes also. BLM should have a staff member at the interpretive center at least on summer weekends. The center should list relevant DF&G regulations, good conservation practices, and inform the public about the biological communities which occur in the intertidal zone and on the bluffs.

c. Land near the parking lot at Telegraph Creek, sufficient for restroom construction. A trailhead should also be constructed here, showing the location and distances of creeks and prominent land marks to the north.

d. Undeveloped subdivision land north of Telegraph Creek.

e. Coastal land used for sheep grazing at Spanish Flat.

f. Coastal land used for sheep grazing near Punta Gorda. In the past, BLM's priorities have seemed to be based on the existence of a willing seller, and/or land which cost the least or which the owner was willing to exchange for BLM land outside KRNCA. This is understandable, considering the low ceiling which was placed on expenditures for outright acquisition. Calculation of additional funds needed for acquiring coastal lands should assume these lands must be bought; speculators or subdivision owners would probably not want to exchange their property for public lands which are inland.

The continued "no development" policy of the regional coastal commission is necessary for public acquisition of these lands. If property owners know they cannot build on their lots, they will probably be willing to sell to BLM. If they can build, they probably will, and BLM cannot acquire such land by condemnation.

5. The State Lands Commission should cooperate with BLM so that lands and the intertidal zone between Punta Gorda and Gitchell Creek can be closed to offroad vehicles (ORV). Because of the isolated nature of the coast here, it is not feasible for BLM to regulate the use of ORV's; since they are potentially disruptive to the environment, depending on their use, they should not be allowed where use cannot be regulated. Where ORV's will continue to be allowed, they should be regulated, with manpower and equipment made available to do so.

Only hikers should be allowed access to the coast between Punta Gorda and Telegraph Creek. When trails open up new portions of the coast

to backpackers, BLM should monitor use and the impact on beach areas in particular.

6. The heavy use of Shelter Cove by commercial fishermen would seem to justify expenditure of public funds for improvements beyond those which are being proposed. Replacement of the wharf would allow fishermen to go ashore more easily; the jetty should be substantial enough to prevent boats from dragging anchor, a real safety hazard when the cove is crowded. Improving the harbor will not increase its use, which occurs anyway because of the cove's location and proximity to good fishing grounds. However, improvements will better serve the heavy use which is already there.

Accommodations for sport fishermen here should include better facilities for fish cleaning, to be constructed with public funds.

7. To a large extent, adherence to the protective Department of Fish and Game regulations must be self-imposed. The closest DF&G office is sixty miles south of this area, and because of its isolation, the constant presence of a marine warden is not possible. Therefore, regulations should be prominently posted at Shelter Cove and the importance of compliance impressed upon visitors to the area. Local residents should be encouraged to inform DF&G of any violation of regulations.

INTRODUCTION

The California State Water Resources Control Board, under its Resolution No. 74-28, designated certain Areas of Special Biological Significance (ASBS) in the adoption of water quality control plans for the control of wastes discharged to ocean waters. The ASBS are intended to afford special protection to marine life through prohibition of waste discharges within these areas. The concept of "special biological significance" recognizes that certain biological communities, because of their value or fragility, deserve very special protection that consists of preservation and maintenance of natural water quality conditions to practicable extents (from State Water Resources Control Board's and California Regional Water Quality Control Boards' Administrative Procedures, September 24, 1970, Section XI. Miscellaneous--Revision 7, September 1, 1972).

Specifically, the following restrictions apply to ASBS in the implementation of this policy.

1. Discharge of elevated temperature wastes in a manner that would alter natural water quality conditions is prohibited.

2. Discharge of discrete point source sewage or industrial process wastes in a manner that would alter natural water quality conditions is prohibited.

3. Discharge of wastes from nonpoint sources, including but not limited to storm water runoff, silt and urban runoff, will be controlled to the extent practicable. In control programs for wastes from nonpoint sources, Regional Boards will give high priority to areas tributary to ASBS.

4. The Ocean Plan, and hence the designation of Areas of Special Billogical Significance, is not applicable to vessel wastes, the control of dredging, or the disposal of dredging spoil.

In order for the State Water Resources Control Board to evaluate the status of protection of King Range National Conservation Area (KRNCA) ASBS, a reconnaissance survey integrating existing information and additional field study was performed by Dr. Milton J. Boyd of Humboldt State University, and Karen Sjogren of the Department of Fish and Game. The survey report was one of a series prepared for the State Board under the direction of the California Department of Fish and Game and provided the information compiled in this document.

Much of the coastline in the KRNCA is extremely remote and virtually inaccessible because of the lack of roads. Coastal areas both north and south of Shelter Cove can be reached only on foot or with four-wheel drive vehicles. It was felt that such an area might provide valuable baseline data to the scientific community because of the essentially undisturbed character of the nearshore coastal zone (K. Sjogren, California Department of Fish and Game, personal communication).

ORGANIZATION OF SURVEY

The entire coastline of the King Range National Conservation Area was surveyed from August 1977-June 1978. Some previous data and specimen collections were also utilized. Investigations of the rocky intertidal biota were primarily qualitative. Transects were laid out perpendicular to the wave line and abundance measures assigned in five categories (abundant, common, occasional, sparse, rare). On sand or cobble beaches, 0.1 m^2 samples were taken to a depth of 20 cm and washed through 1.0 mm screens. All organisms retained on the screen were identified to species level. A photographic record of the shoreline was also completed. All sampling surveys were conducted during low tide periods.

PHYSICAL AND CHEMICAL DESCRIPTION

Location and Size

The King Range National Conservation Area (KRNCA), Area of Special Biological Significance (ASBS), lies between the mouth of the Mattole River to the north (latitude 40°17'45" North, longitude 124°52'37" West) and a point near Whale Gulch to the south (latitude 39°52'37" North, longitude 123°58'34" West). Most of the coastline is in Humboldt County, with approximately 4.5 miles (7.2 km) at the southern end of the Area in Mendocino County (Figures 1-12). Two towns of small size are near the KRNCA: Garberville, 18 miles (29 km) east of the coastline at Point Delgada, and Petrolia, 5.5 miles (8.8 km) from the mouth of the Mattole River.

The coastline is impassible at several points during high tides, but can be negotiated at almost all points during low tides. Except for an all-weather road to the Shelter Cove development on Point Delgada, travel along the coastline is by foot or four-wheel drive vehicle. From the mouth of the Mattole River to the southern border, 30.2 miles (48.3 km) of coastline (exclusive of offshore rocks) lies within the King Range National Conservation Area. The official boundary designation, as described in the State Water Resources Control Board's Areas of Special Biological Significance (1976) is as follows:

> "From Point 1 at the intersection of the mean high tide line and the north boundary of Section 36, T2S, R3W, HB&M; thence southerly on a meander line following the mean high tide line to the intersection of the mean high tide line with the south boundary of Section 4, T24N, R19W, MDB&M; thence due west to the 100-foot isobath or to 1,000 feet offshore, whichever is the greater distance; thence northerly following a meander line determined by a distance of 1,000 feet offshore or by the 100-foot isobath, whichever is farthest from shore, to a point due west of Point 1; thence due east to Point 1."

Nearshore Waters

The dominant influence on the nearshore zone is the cool, southward flowing California Current. This current, part of the general circula-

Reference: USGS Petrolia CA Scale 1:24,000

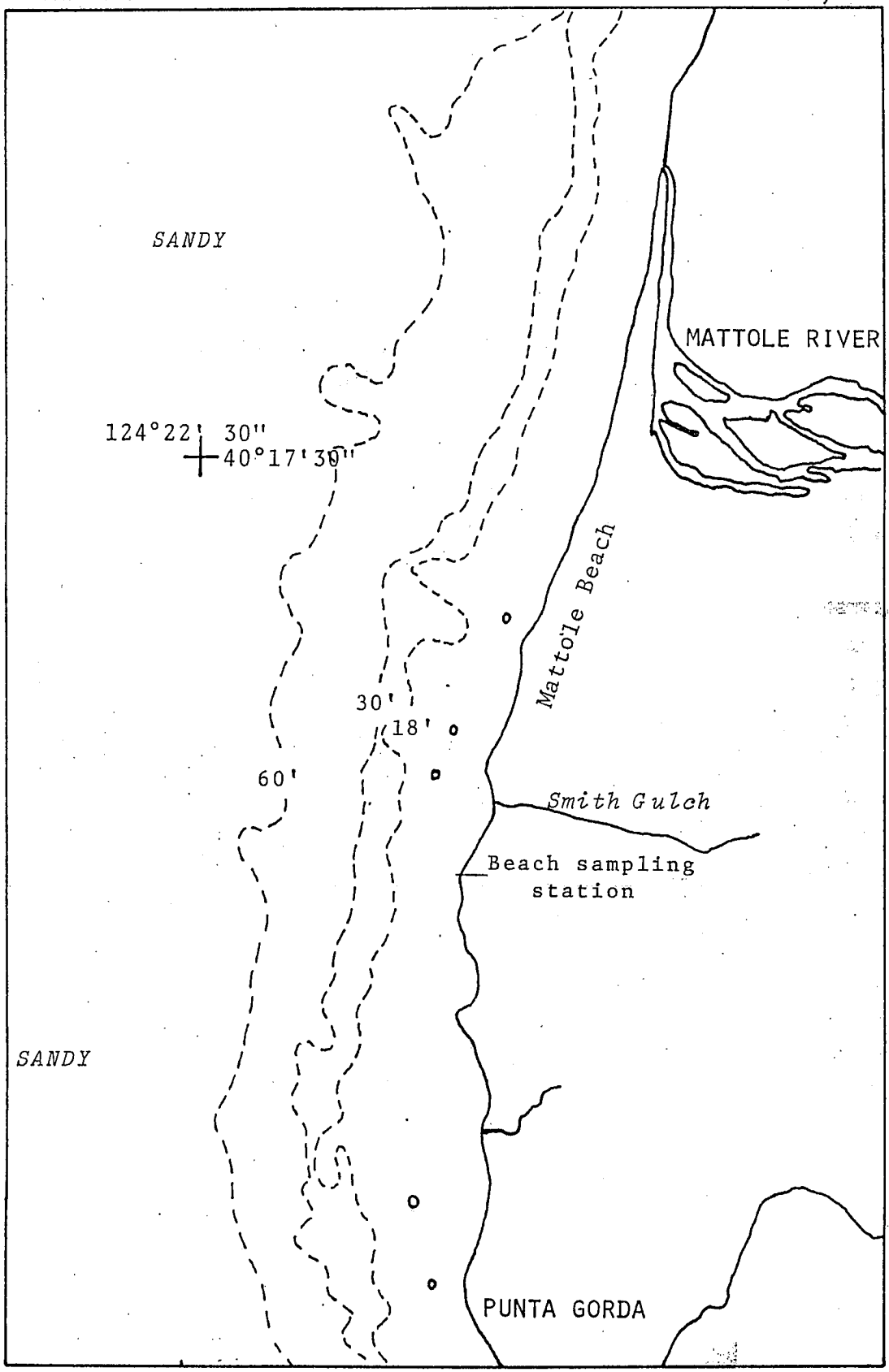


Figure 1.

Reference: USGS Petrolia CA & Cocskie Creek CA Scale 1:24,000

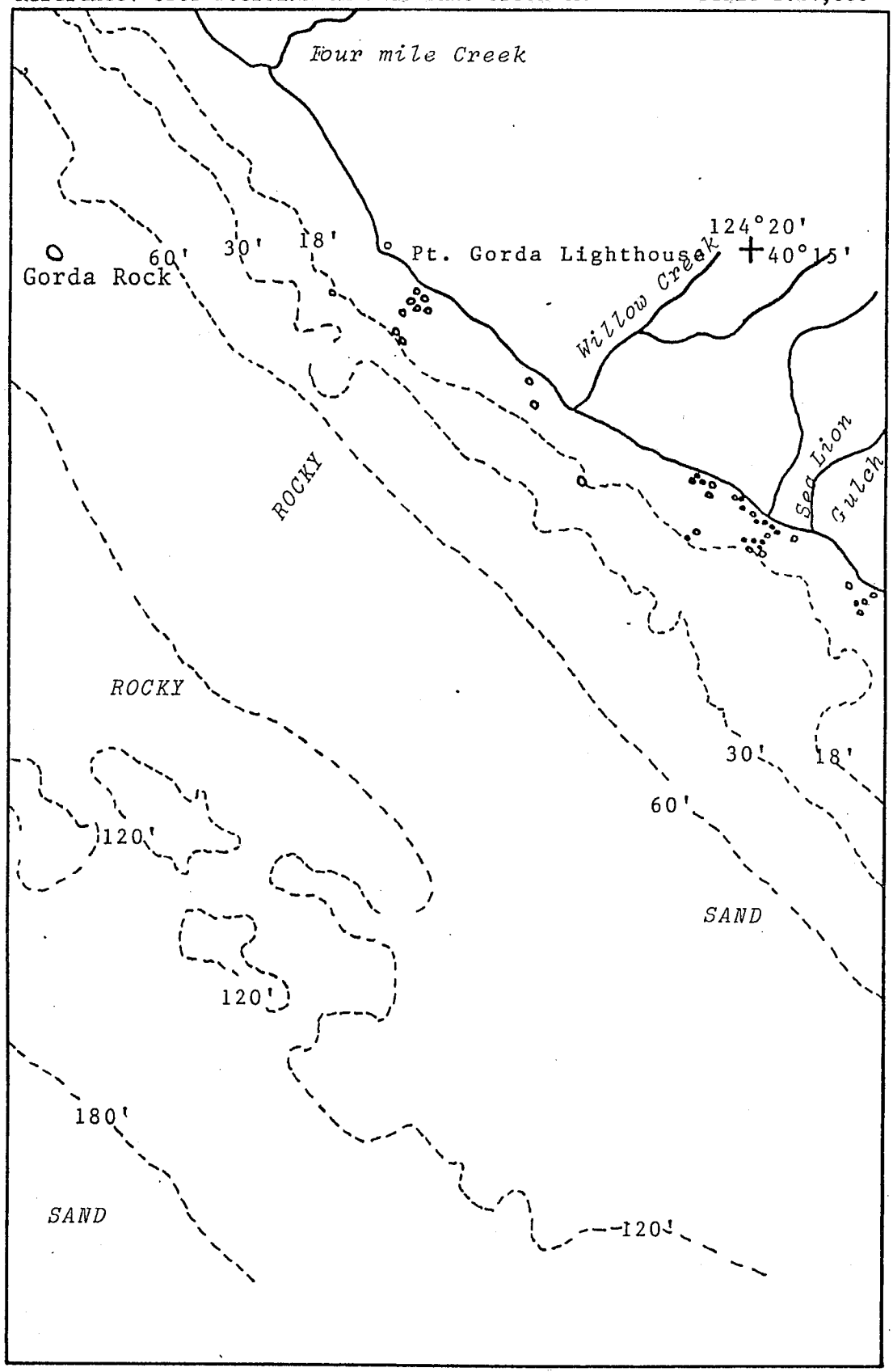


Figure 2.

Reference: USGS Cooskie Creek CA Scale 1:24,000

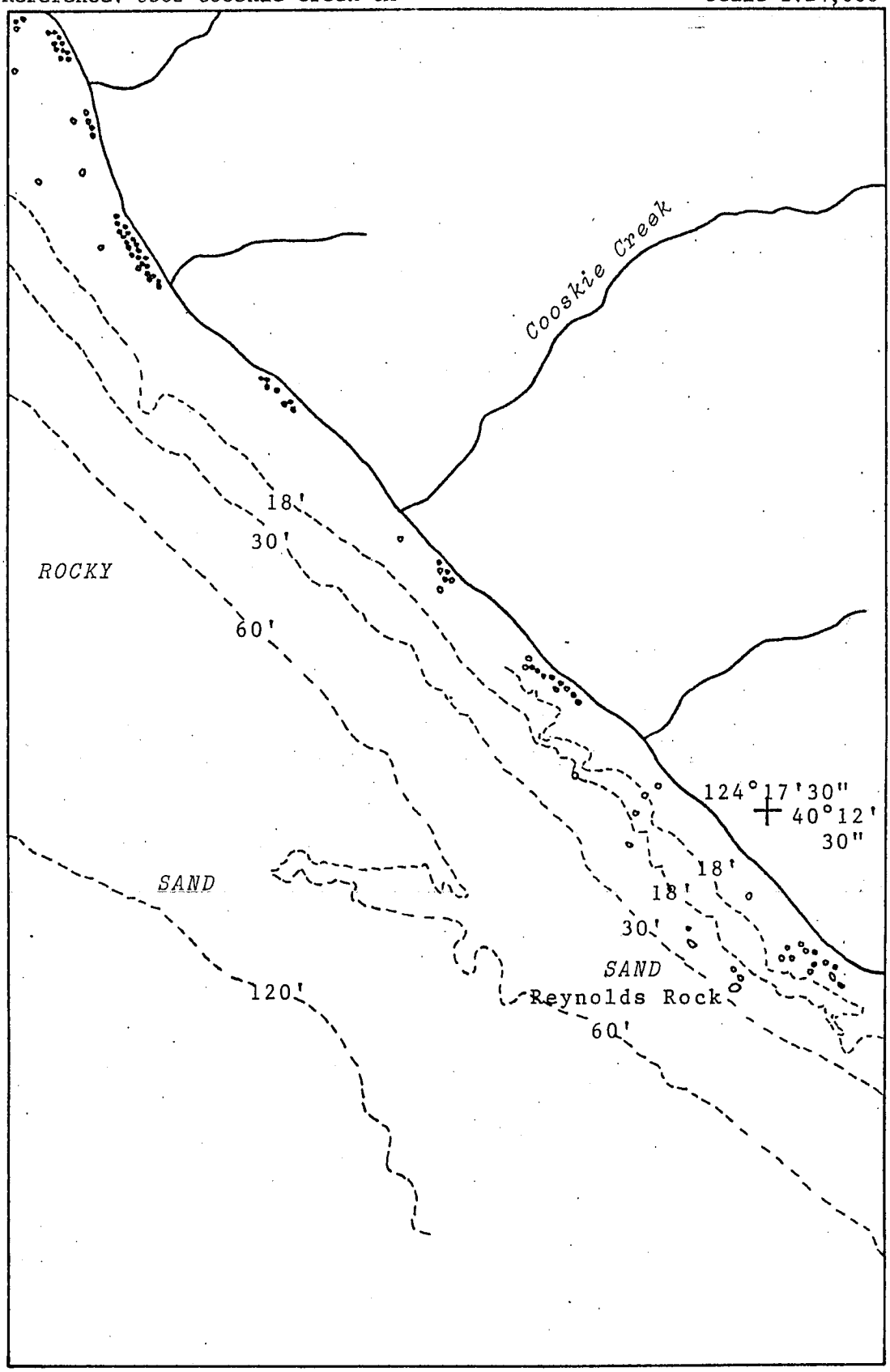


Figure 3.

Reference: USGS Cooskie Creek CA Scale 1:24,000

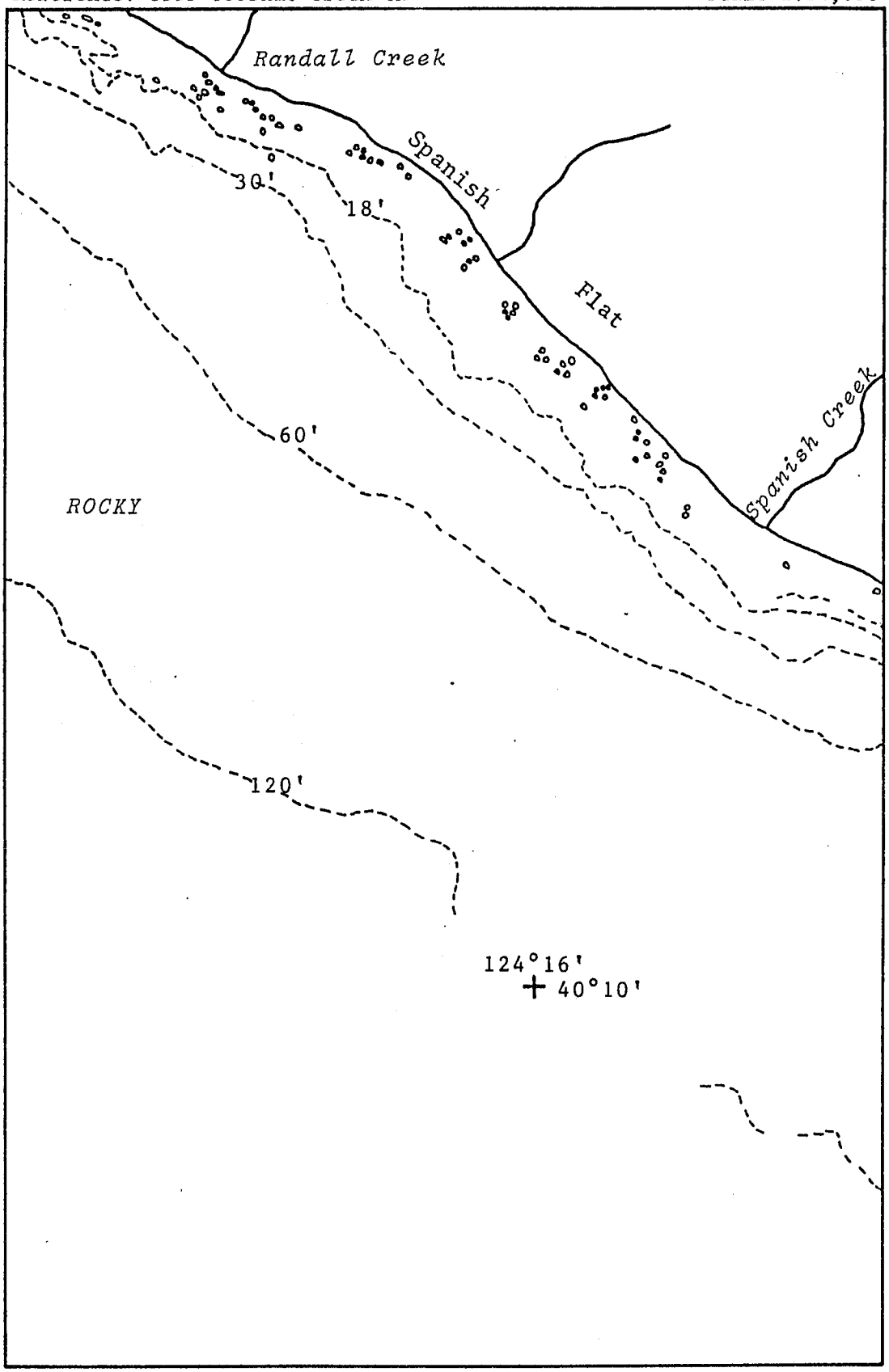


Figure 4.

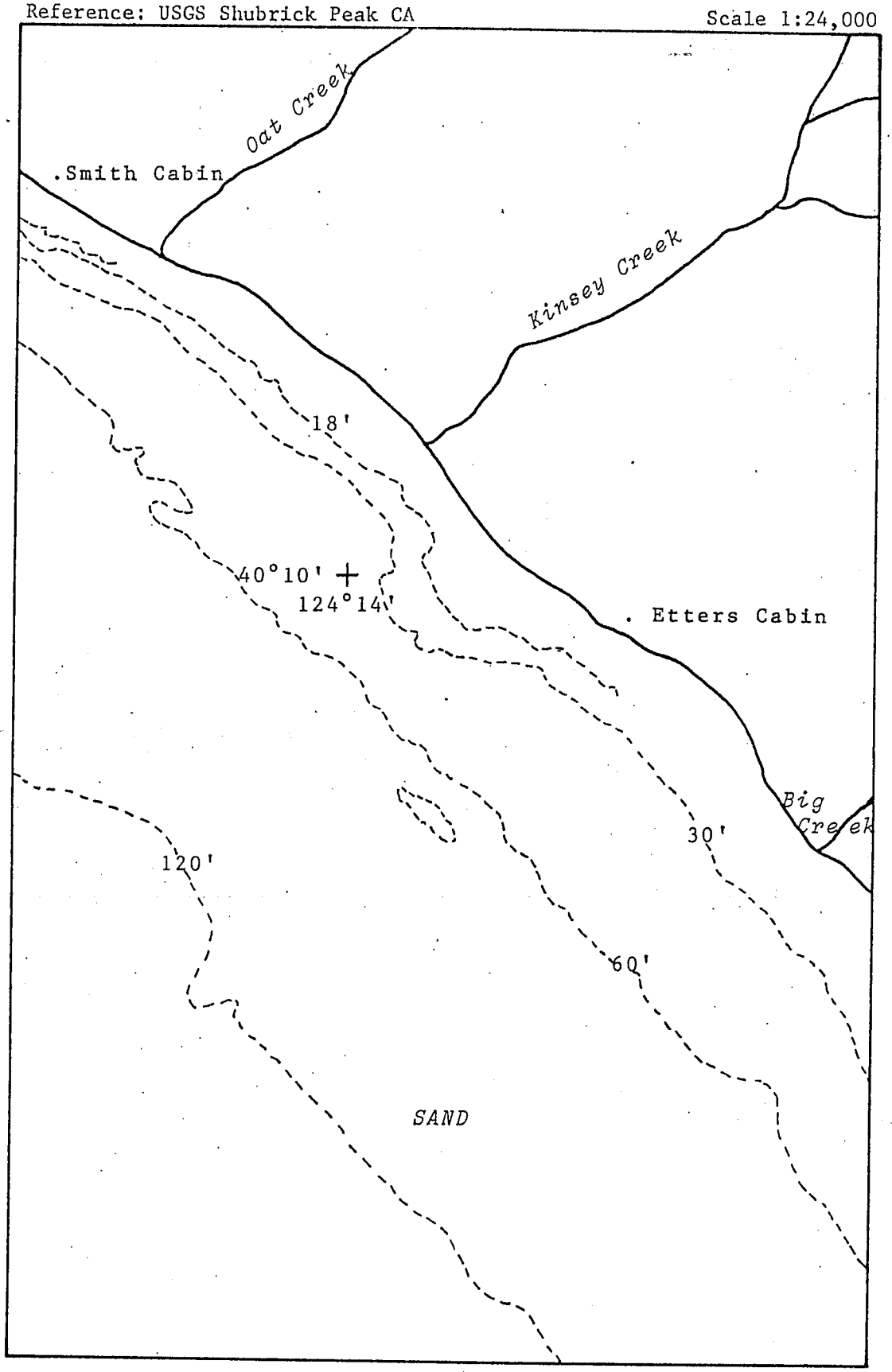

Reference: USGS Shubrick Peak CA
Scale 1:24,000
Oat Creek
.Smith Cabin
Kinsey Creek
18'
40°10'
124°14'
. Etters Cabin
Big Creek
30'
120'
60'
SAND

Figure 5.

Reference: USGS Shubrick Peak CA Scale 1:24,000

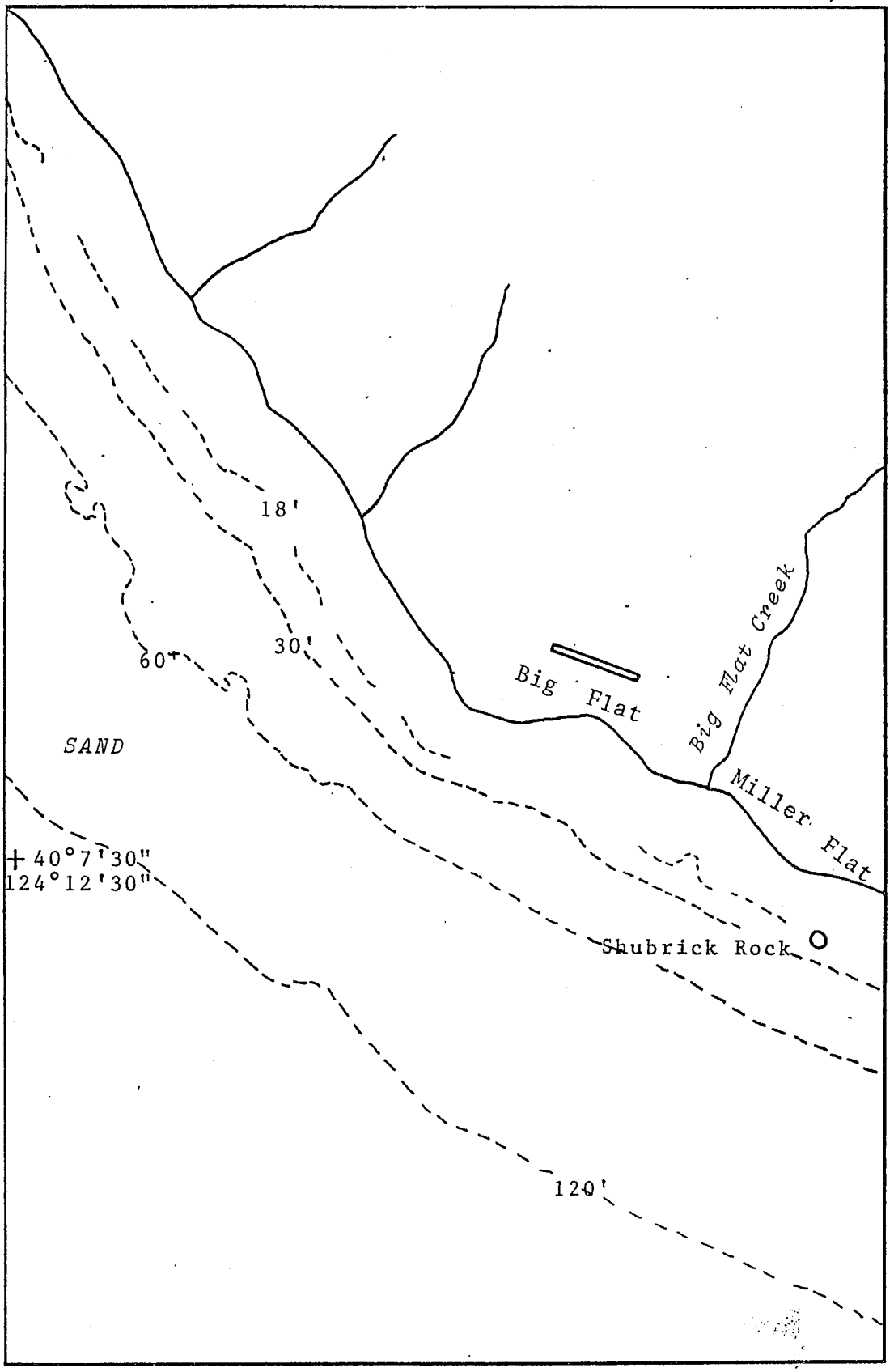


Figure 6.

Reference: Shubrick Peak CA

Scale 1:24,000

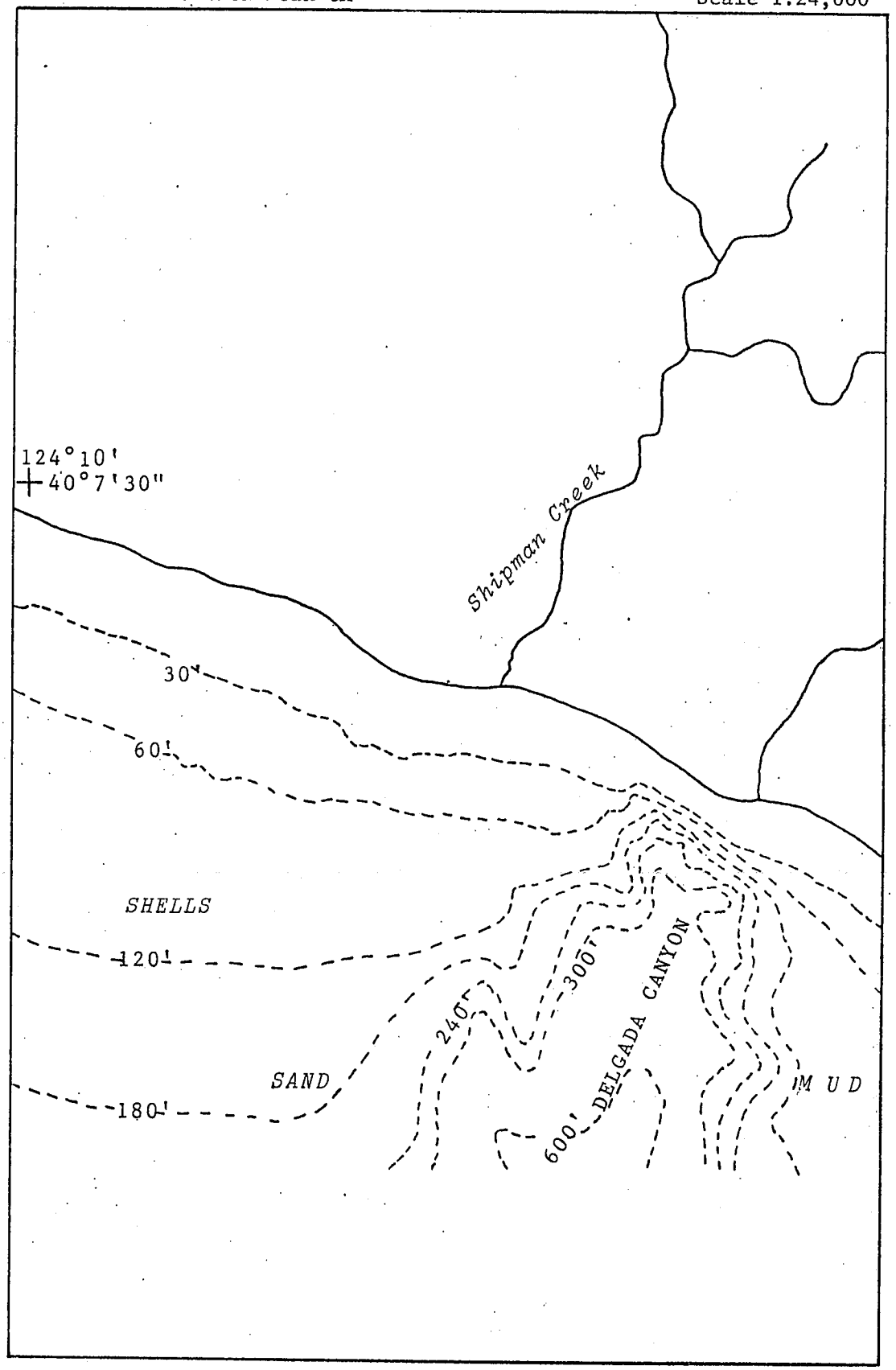


Figure 7.

Reference: USGS Shelter Cove CA Scale 1:24,000

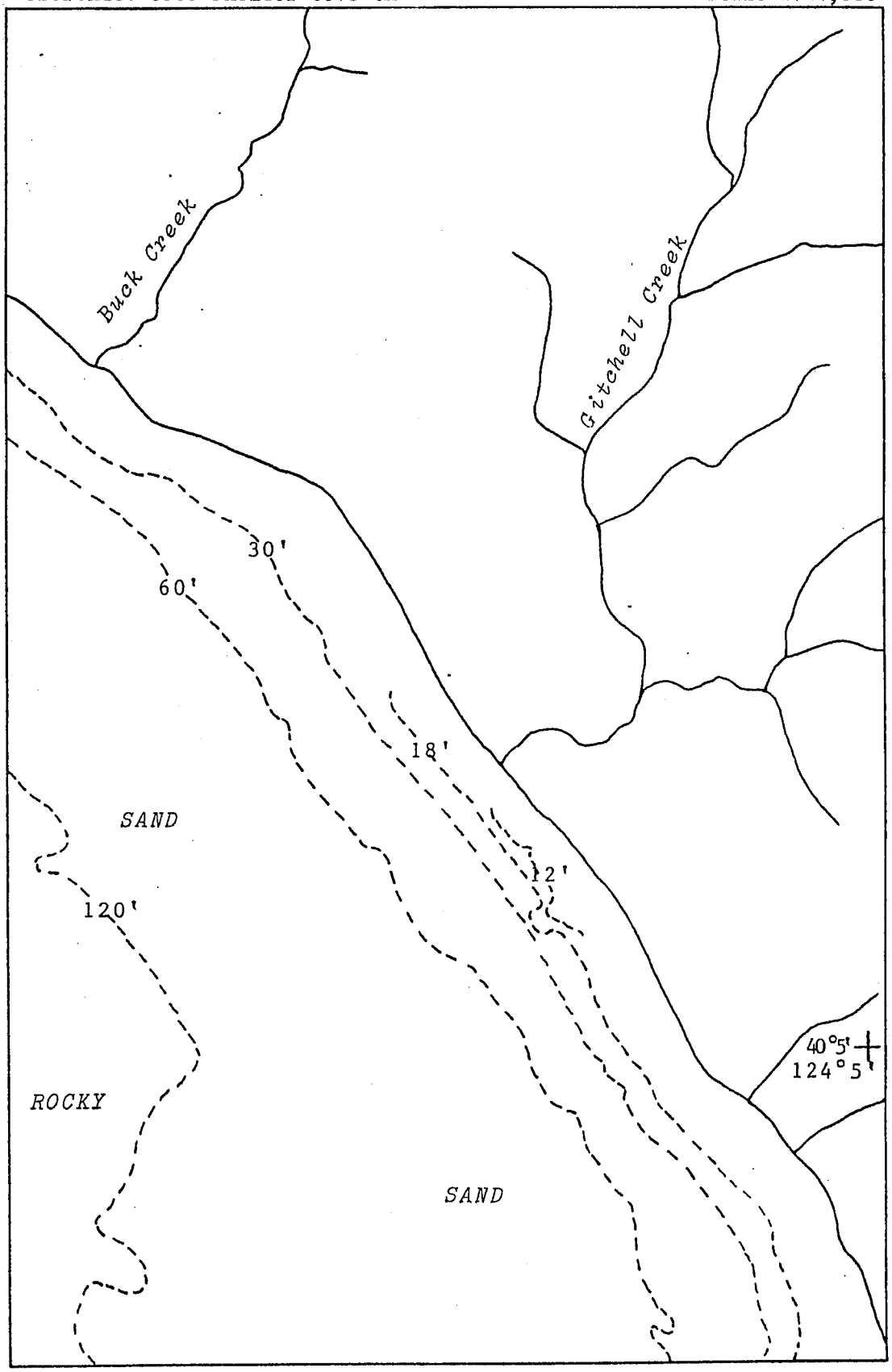


Figure 8.

Reference: USGS Shelter Cove CA Scale 1:24,000

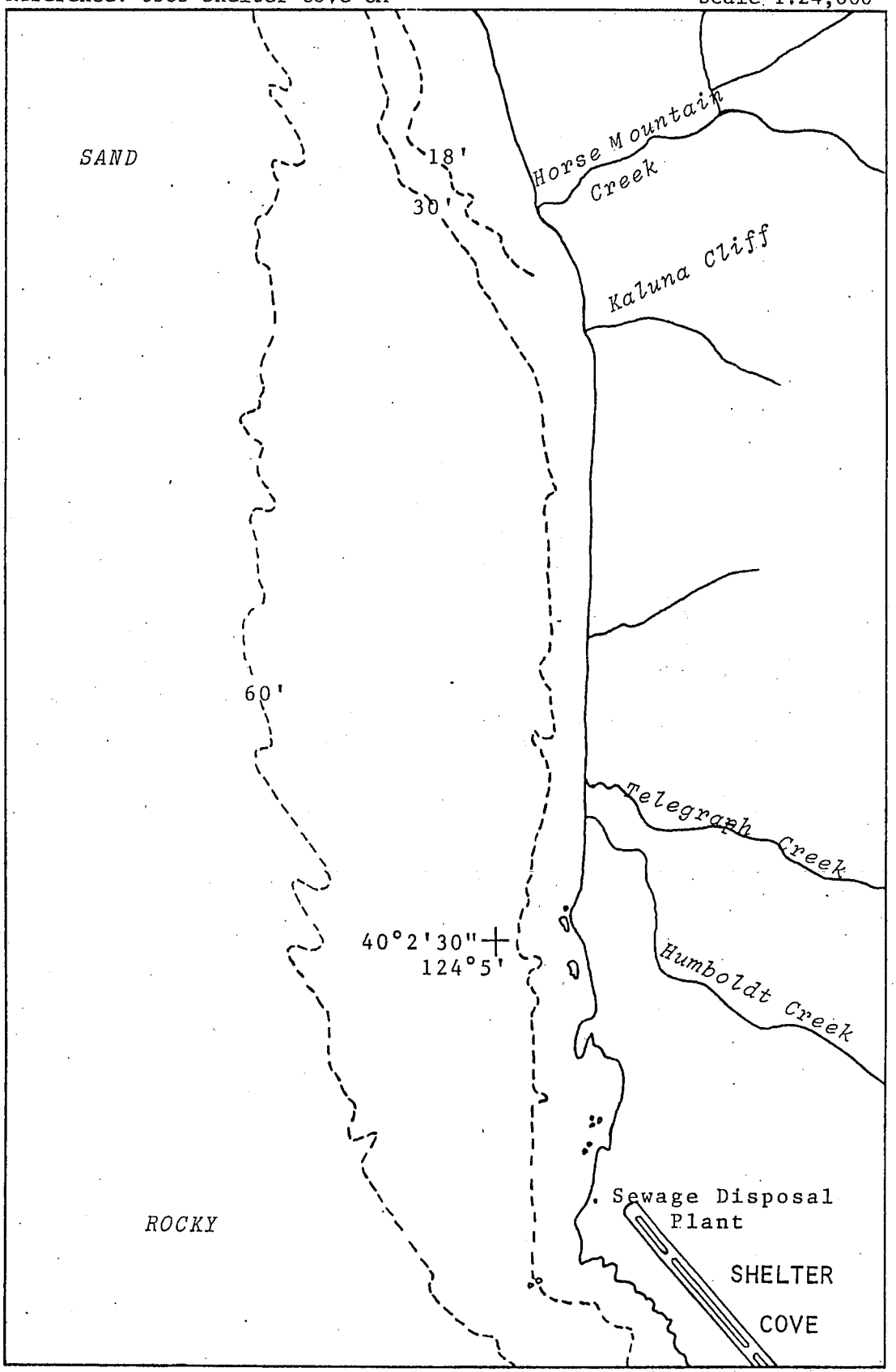


Figure 9.

Reference: USGS Shelter Cove CA Scale 1:24,000

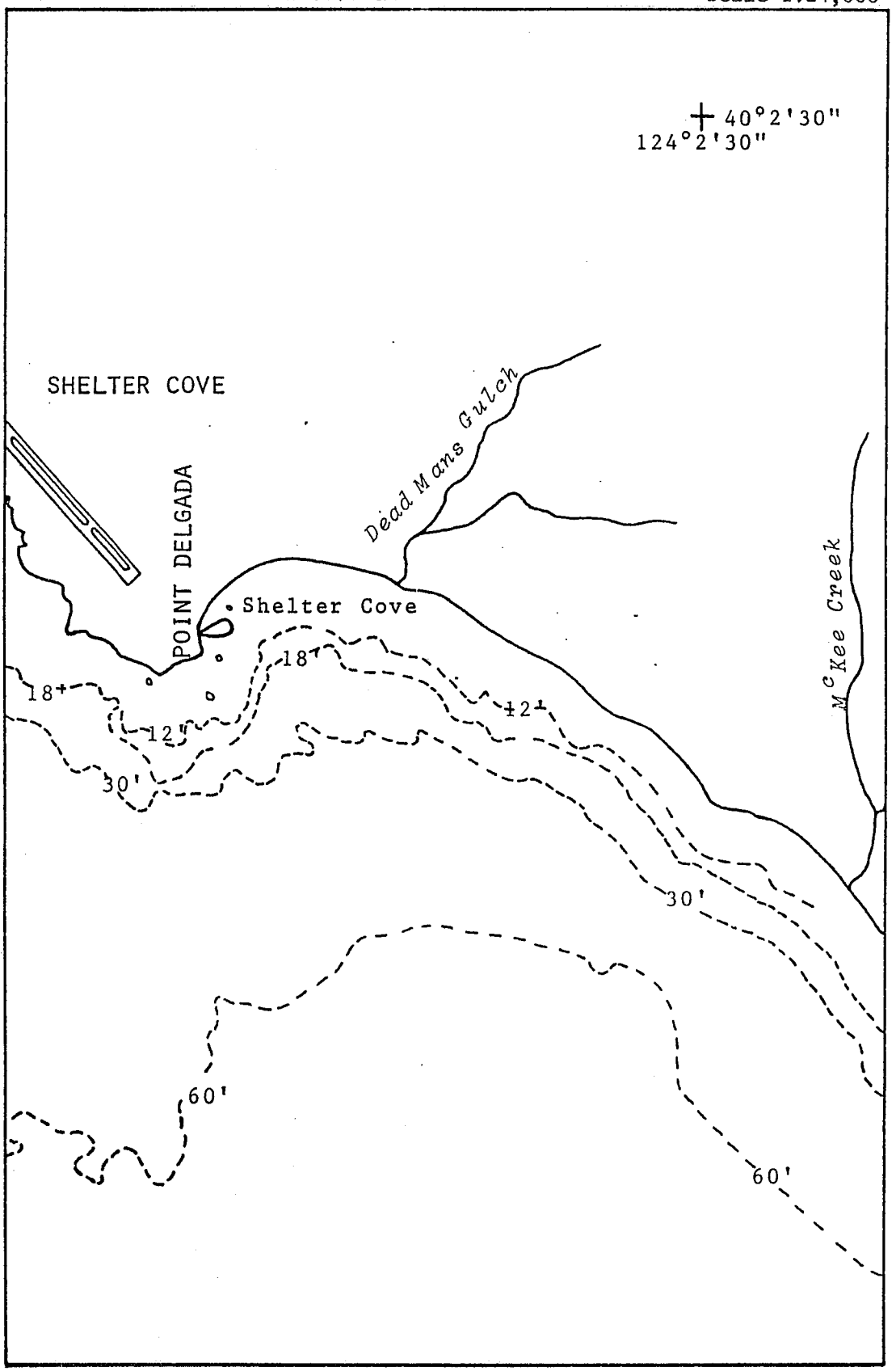


Figure 10.

Reference: USGS Shelter Cove CA & Bear Harbor CA Scale 1:24,000

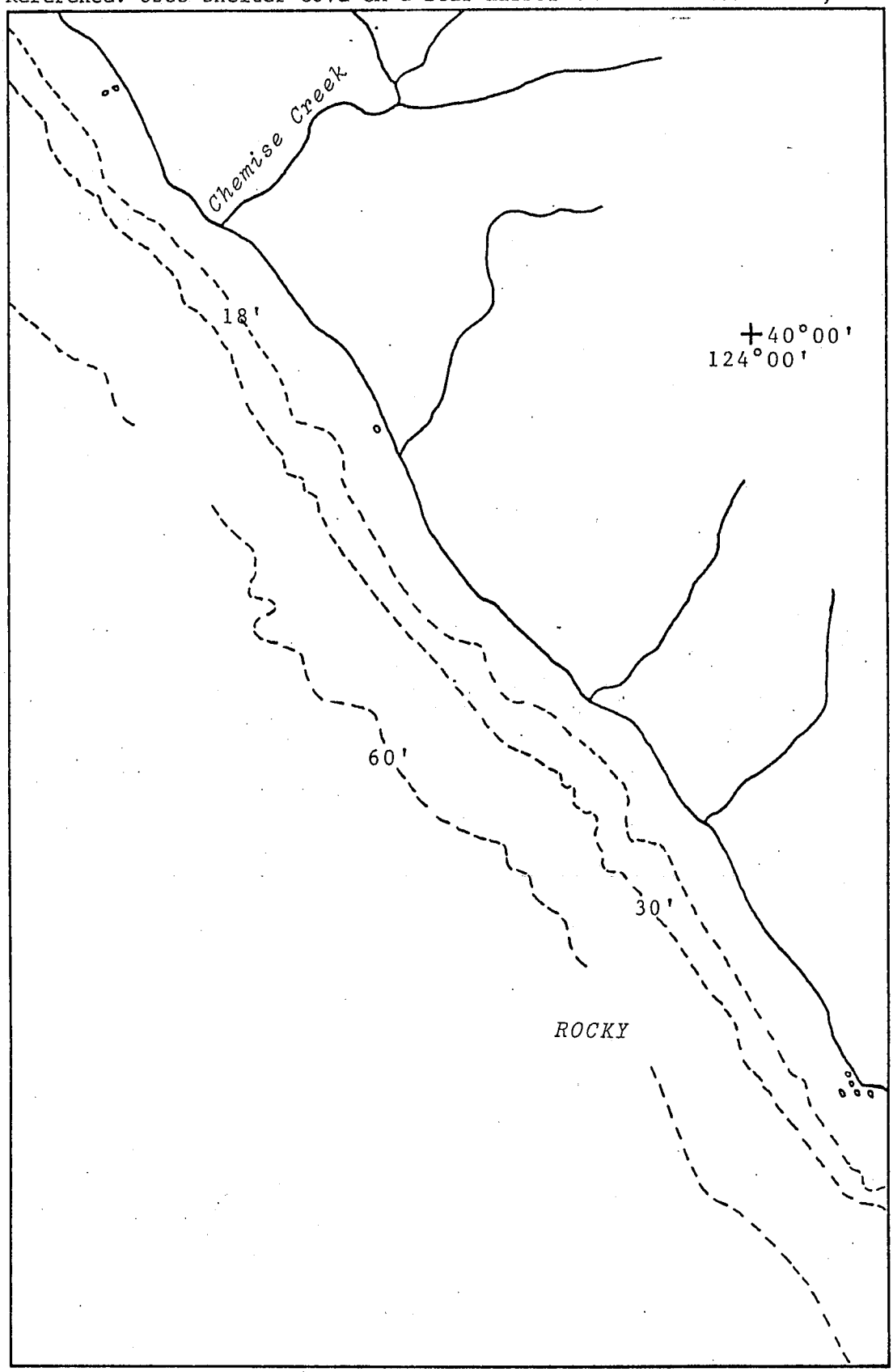


Figure 11.

Reference: USGS Bear Harbor CA Scale 1:24,000

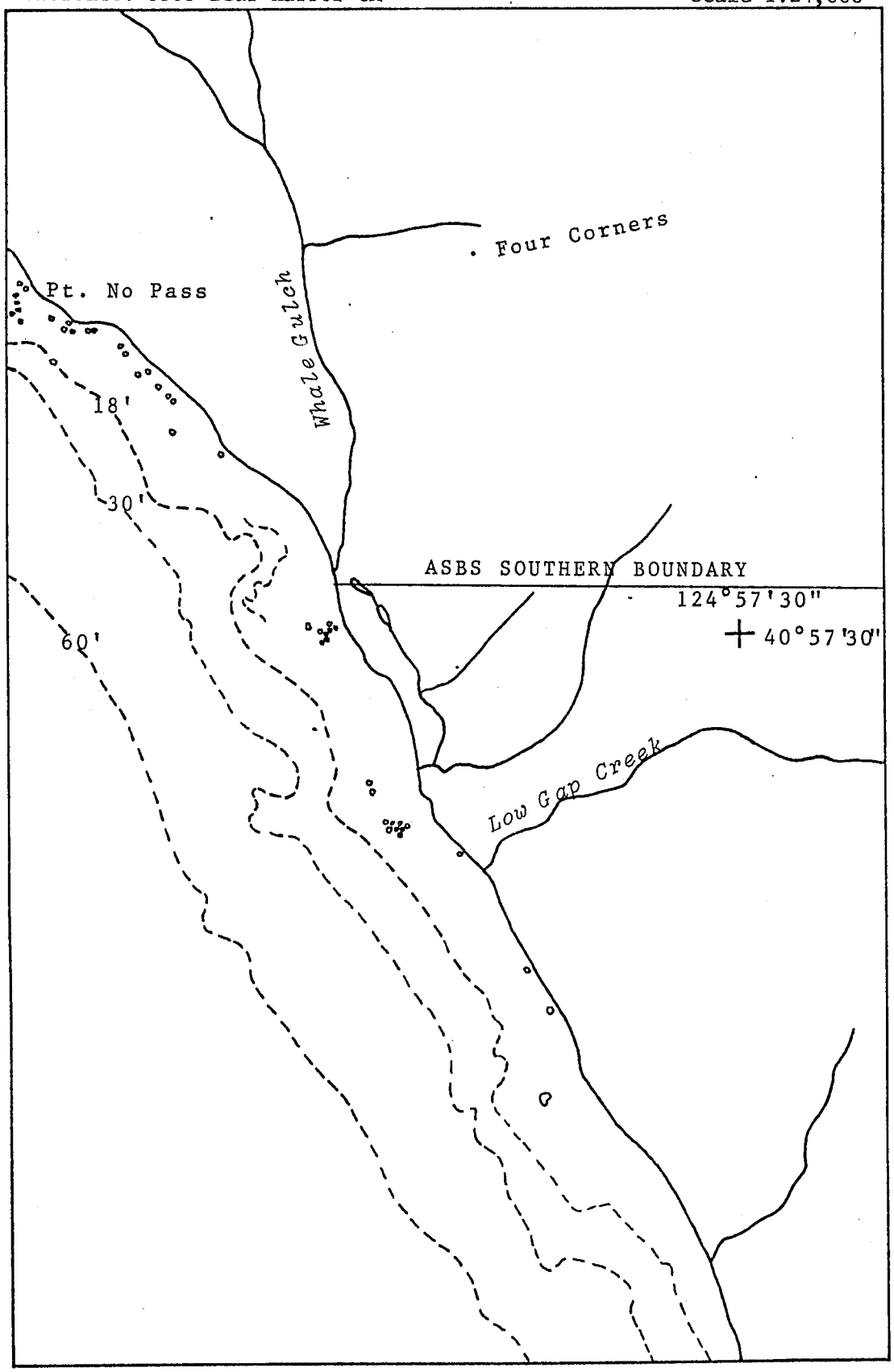


Figure 12.

tion pattern of the North Pacific Ocean, shifts somewhat in relation to the shore, dependent on the season. An "oceanic season" prevails from approximately July to November each year, when the California current is closest to the shoreline. During winter months (November to February), an inshore, northward flowing warm current, the Davidson Current, is present along the entire California coast to some point beyond Cape Mendocino, just north of the KRNCA. From approximately March to July, an "upwelling season" prevails in the nearshore waters in response to winds from the northwest. Upwelling is particularly intense just south of Cape Mendocino, greatly influencing the nearshore environment of the KRNCA (Figures 13-15).

No measurements of nearshore water temperatures or salinity have been taken on a regular basis in the ASBS. It seems likely that winter water temperatures are approximately 48°-50°F (9°-10°C), with annual high water temperatures around 55°-58°F (13°-14.5°C), based on water temperatures taken at Eureka and Trinidad to the north.

The major source of freshwater entering the nearshore zone is the Mattole River, although numerous small streams empty into the ocean along the shoreline of the ASBS. Considering the coastline is fully exposed to the effects of winter waves, it seems unlikely that freshwater significantly dilutes seawater within the nearshore zone. Wave force would tend to rapidly mix freshwater with seawater in the surf zone. No estuarine plant or animal species were found anywhere within the ASBS except near the mouth of the Mattole River. Surface water salinities probably do not fall below 28-30 parts per thousand except in the immediate vicinity of the Mattole River mouth.

The submarine topography off the coastline is complex and varied. Tidally emergent rocks are common within a quarter of a mile (400 m) of the shore, usually surrounded by coarse sand bottoms. The continental shelf (200 m depth) is apparently quite near the shoreline, within 4-5 miles (6.5-8.0 km), at several points. Three submarine canyons approach the shore along the coast: the Delgada Canyon just north of Point Delgada, the Spanish Canyon off Spanish Flat, and the Mattole Canyon just north

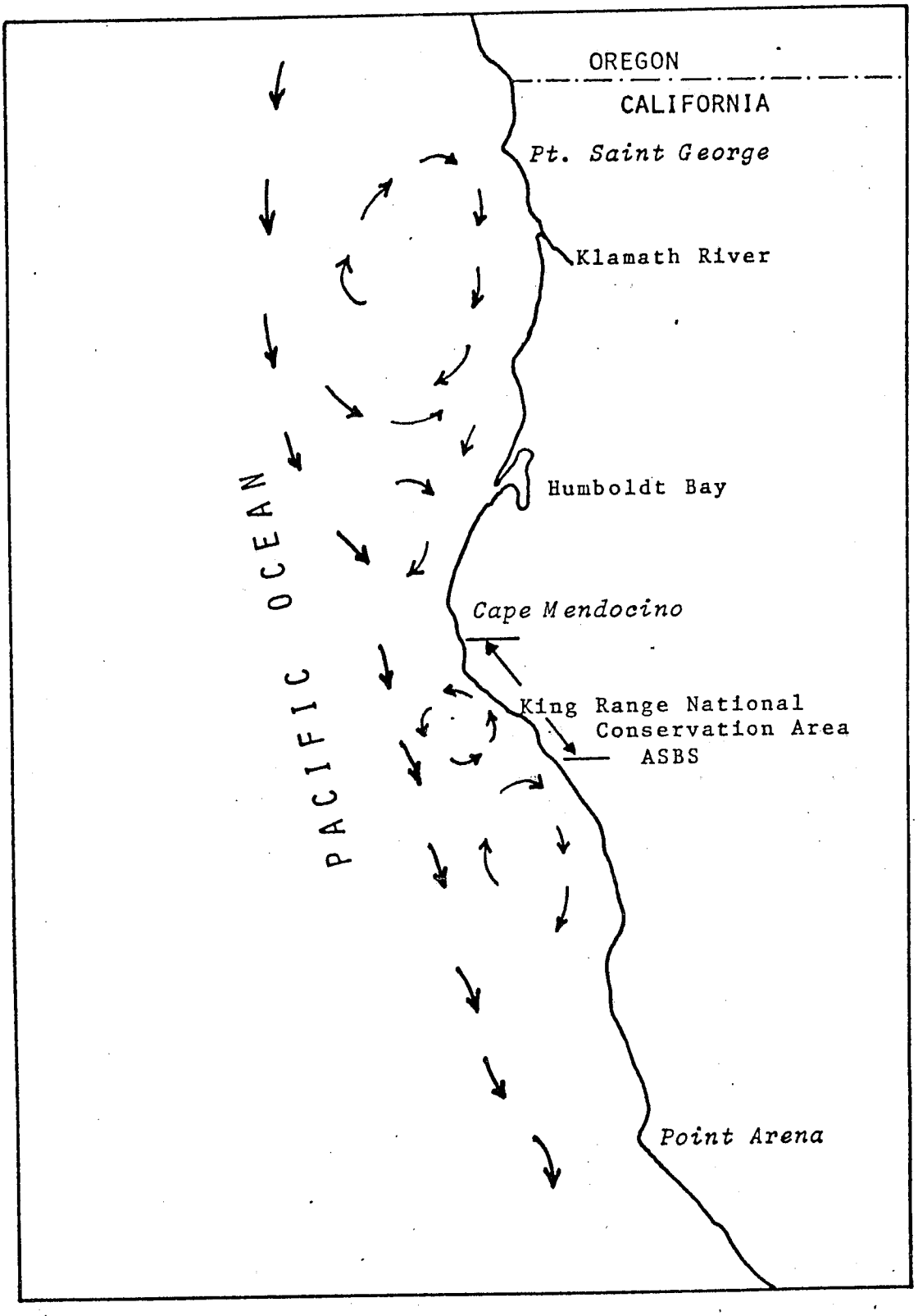


Figure 13. Current pattern typical of the "Oceanic Season" (July-November) off the northern California coast.

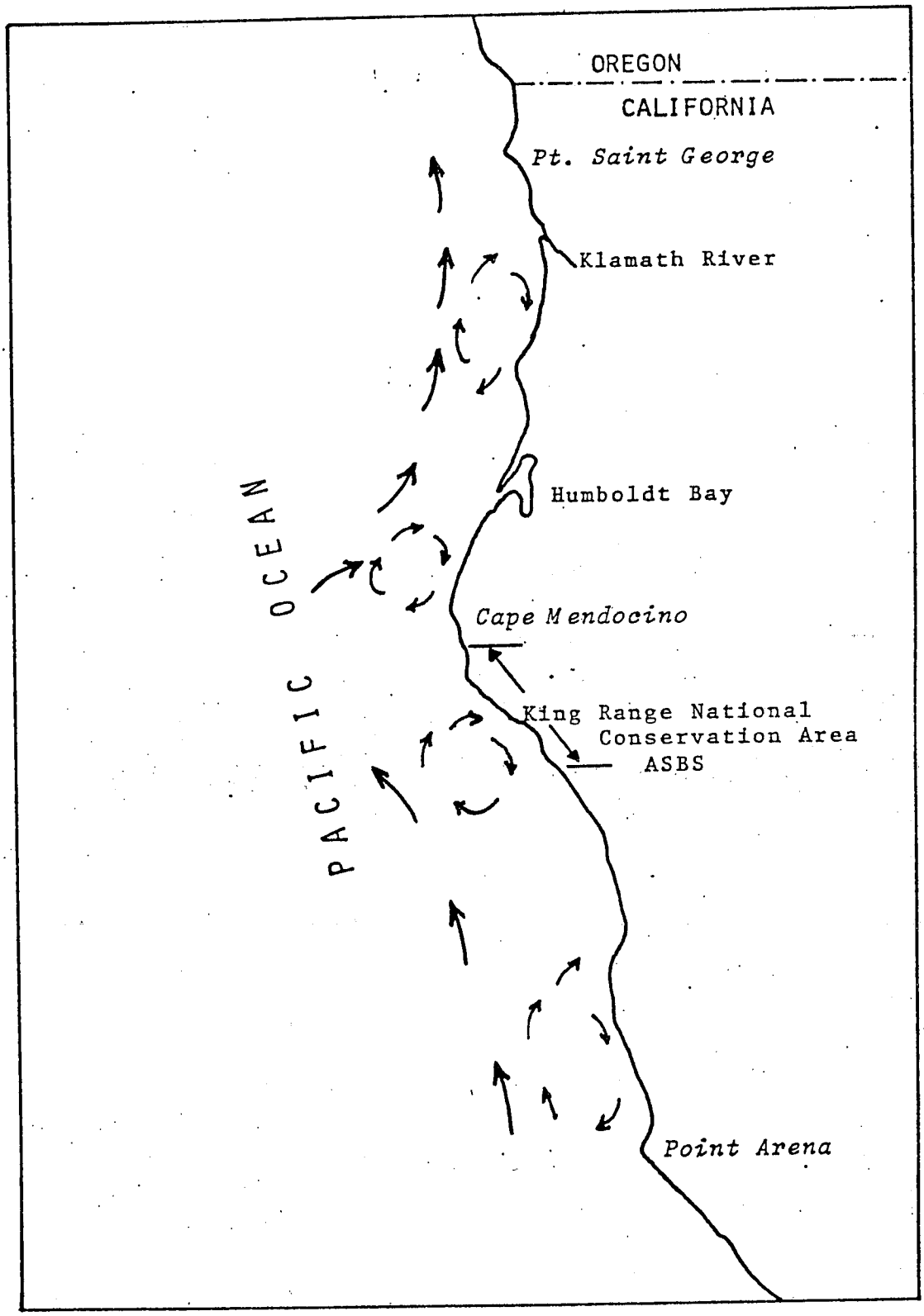


Figure 14. Current pattern typical of the "Davidson Current" season (November-February) off the northern California coast.

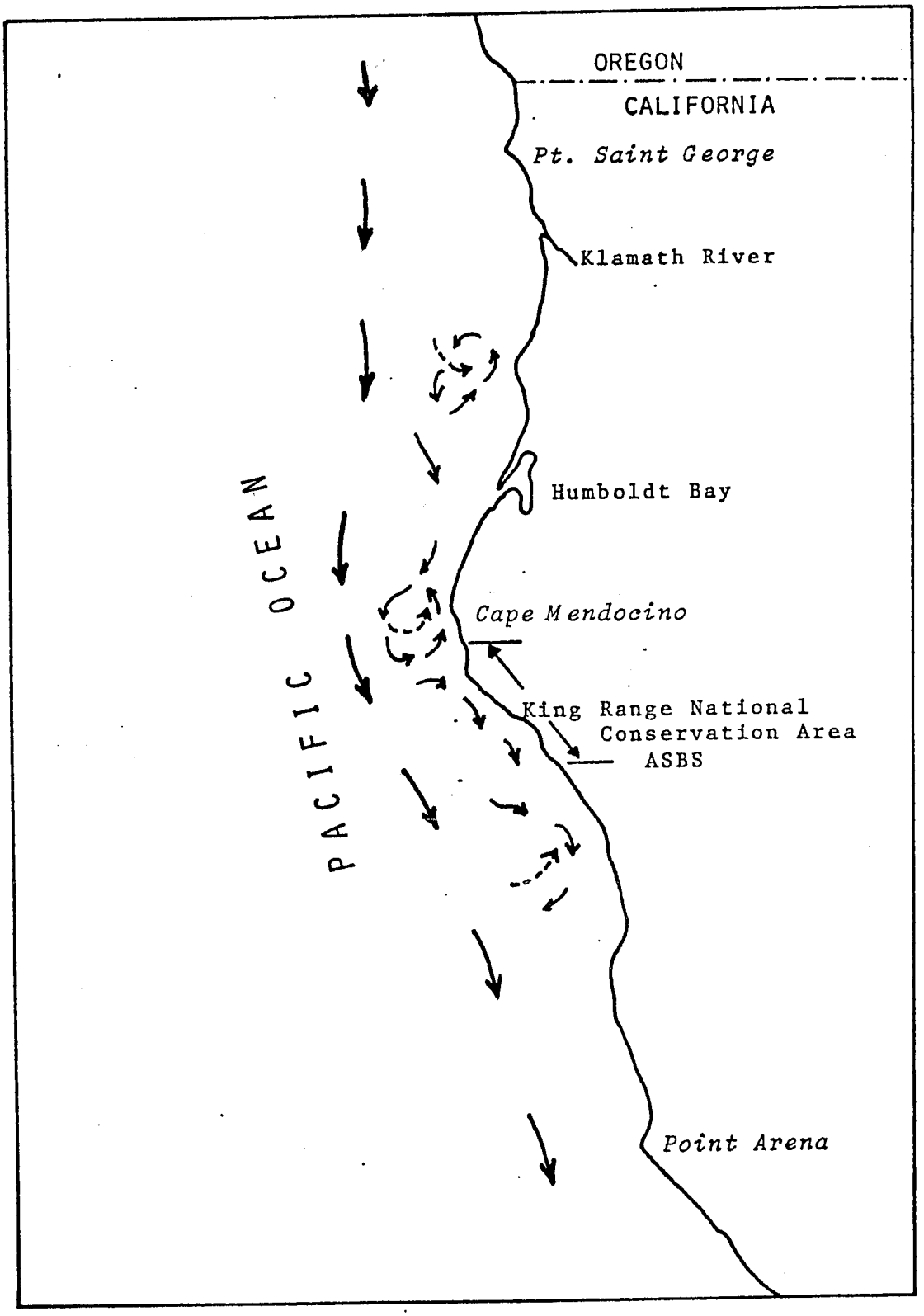


Figure 15. Current pattern typical of the upwelling season (February-July) off the northern California coast. Dashed arrows indicate intense upwelling.

of Punta Gorda. Erosion along the coastline, with transport of fine sediments into the nearshore zone, is a natural consequence of the active geological history of the coastline. Natural erosion processes have been greatly accelerated in the past fifty years by logging, grazing, and road building activities; however, the turbidity of nearshore waters is high at every season of the year. During the past five years, water visibility has not been observed to exceed five feet (1.9 km) within the ASBS. During the upwelling season (March-July), nearshore waters are frequently light to dark green in color, suggesting nutrient enrichment from upwelled waters. The coastline is considered dangerous for diving because of currents, heavy surf, and poor visibility (DeMartini, personal communication).

The nearshore zone of the ASBS is considered one of the most hazardous to navigation in all of California. Waves 20-25 feet (6-7.5 m) in height have been observed at Point Delgada and Punta Gorda, even during summer months. Many ships have been lost along the coast since the late 1800's because of the hazardous, unpredictable sea conditions, and because the coast lacks suitable protected anchorages. Only a small area southeast of Pt. Delgada (Shelter Cove) offers protection from northwesterly storms, and even there the anchorage is considered unsafe because of exposure to southwesterly winds and waves.

Topographic and Geophysical Characteristics

It is rare along the California coast to see high coastal mountains plunging steeply into the sea, but this is the case in the King Range National Conservation Area. A high ridge runs parallel to the coast through the entire area, and elevations along the coastal ridge vary from 2,596 feet (787 m) at Chemise Mountain, near the southern border, to 4,087 feet (1,238 m) at Kings Peak, and 2,350 feet (712 m) at Oat Hill near the northern border. The slopes of this ridge drop precipitously into the intertidal zone along the coastline, and are cut by numerous small streams. The entire coastline is undergoing active uplifting as the Eastern Pacific Plate is moving under the Continental Plate.

Only three areas of relatively flat ground are found along the coast: Shelter Cove, where the adjacent ridge line drops to gently rolling hills about 1/2 mile (0.8 km) from the coast, Big Flat, an alluvial fan at the mouth of Big Flat Creek; and Spanish Flat, a narrow terrace extending for 2 miles (3.2 km) from Randall Creek to Spanish Creek. Slopes bordering the coast average grades of 50-60%, and approach 90% in some drainages (e.g. Cooskie Creek, Spanish Creek, and Kaluna Cliff). Huge rock slides and talus slopes fall directly into the intertidal zone at several points.

The nature of subtidal substrates off the coast is very poorly known. Within the surf-zone and just outside it, tidally emergent rocks of Franciscan sedimentary composition are common, usually surrounded by coarse sands (the predominant material of adjacent intertidal beaches). Only two subtidal reef systems are known, one extending southward from Pt. Delgada to approximately 1.2 miles (1.9 km) from shore, the other surrounding Gorda Rock, 1 mile (1.6 km) west of the Point Gorda Lighthouse.

North of Pt. Delgada, sand and cobble beaches are the predominant intertidal habitat. Grain size varies from coarse sands to cobbles 1-2 inches (2.5-5 cm) in diameter. At some points, massive boulders have fallen into the intertidal zone near Sea Lion Gulch, at Shipman Creek, and Buck Creek. These large boulders show little evidence of weathering by marine waters, suggesting their recent arrival following erosion from the bases of the coastal mountains. The beach to the east of Pt. Delgada is composed of medium to fine grained sands, apparently eroded from the coastal bluffs bordering the beach. The coast curves southeasterly for 1 mile (1.6 km) from this beach and terminates at a small promontory known locally as "Point No Pass". From this point to the southern border of the KRNCA, cobble, coarse grain sands, and poorly weathered large boulders, particularly at the mouth of Chemise Creek, are intermixed.

Flat, shelf-like intertidal rock formations are absent along the coast except at two points. The first, about 1.1 miles (1.8 km) north of Punta Gorda, is a sedimentary (probably Franciscan) formation extending into the intertidal zone for approximately 40 yards (38 m) perpendic-

ular to the sand beach. The second, at Pt. Delgada, is a well developed series of bench formations (clearly Franciscan) extending 80-90 yards (70-80 m) from the coastal bluffs to a drop-off into the subtidal zone. The intertidal rock formations at Pt. Delgada are extensive, with evidence of weathering by surge channels and wave action. Boulders 0.5-2 meters in diameter are scattered through the intertidal zone and have fine to medium grain sands around their bases. The stable substrate and modest protection from predominantly northwest waves have resulted in the establishment of a geologically amenable intertidal habitat.

Faulting, shearing, and folding of intertidal rocks are common along the entire coastline. Even the most geologically intact structures, such as sandstone, show evidence of fractures. The main fault in the area, the Point Delgada Fault, is apparently a main branch of the San Andreas Fault, or may be the main fault itself. At Shelter Cove, several surface breaks opened during the 1906 earthquake. Nowhere are the effects of local seismicity on intertidal substrates more evident than at the huge Kaluna Slide, just north of Shelter Cove. Fractured, broken rock extends from Kaluna Cliff directly into the intertidal zone. The main break of the Point Delgada Fault is exposed near the top of the cliff; movement along the fault apparently triggered the slide in 1906.

Although the occurrence of minor faults along the coast has not been investigated, it seems clear that numerous faults cut across the coastal slopes. Barren areas, devoid of vegetation, are common along the coastline. These barren areas probably do not support appreciable vegetation because land slides accompanying earthquakes are a frequent occurrence. About one mile (1.6 km) south of the mouth of Cooskie Creek, a massive slide extends from the intertidal zone to approximately one mile inland. Although the date of the slide is unknown, the presence of uprooted trees in the slide debris and still-living Douglas Firs overhanging the upper cliffs suggest that the slide occurred within very recent times. It can be anticipated that local geological events and subsequent massive erosion will continue to have a major effect on the character of the KRNCA intertidal zone and nearshore waters.

The geological nature of the KRNCA is poorly known; it appears that two distinct and different complexes are found within the area. King Range has been mapped as part of the California Coast Range Geological Province, which elsewhere in northern California is mainly composed of rocks in the ubiquitous Franciscan formation, along with various metavolcanic intrusives or metamorphic rocks. Throughout the King Range, however, greenstones and cherts characteristic of the Franciscan formation are lacking for the most part. Only at Shelter Cove is the classic Franciscan assemblage of late Jurassic to late Cretaceous deposits encountered. Metavolcanic intrusives, sometimes evident as pillow structures (indicating their origin underwater) are also found at Shelter Cove in the coastal bluffs. Geological structures in the rest of the King Range appear to be Jurassic to Cretaceous and Cenozoic sedimentary rocks. These overlying rocks show evidences of intermittent and persistent crustal deformation. Numerous folds, thrust faults, reverse faults, and strike-slip faults apparently developed during the Tertiary period (beginning about 60 million years ago) and have continued to develop into present times because of tectonic processes. The San Andreas Fault meets the Mendocino Fracture Zone just north of the KRNCA; severe seismic hazard will continue to exist along this section of the coast.

Climate

The climate of the KRNCA can be loosely characterized as the Mediterranean type, with cool, wet winters and dry, mildly hot summers. The complex topography of the coastline makes it difficult to predict rainfall or temperatures at any given point; during the summers some stretches of the coast may be blanketed with thick fog, while areas a few miles south or north are in brilliant sunshine. Rainfall and temperature records have been kept at only one location within the Area, Shelter Cove. Monthly average rainfall and air temperature from 1973-77 are presented in Table 1. The rainfall at Shelter Cove was about 60% greater than the rainfall at Eureka, 48 miles (77.2 km) to the north, during the same period. Slightly inland, rainfall is considerably higher than along the coast. At Honeydew, just northeast of the KRNCA, the average annual rainfall is approximately 110 inches (279 cm), making it one of the wettest places in the continental U.S.

Table 1. Average monthly precipitation and air temperature at Shelter Cove, California, 1973-1977, inclusive (data from National Weather Service Office, Eureka, CA).

Month	Average Air Temperature	Average Rainfall
January	51.6°F (11.0°C)	7.20 in (18.39 cm)
February	50.6°F (10.4°C)	9.62 in (24.43 cm)
March	48.9°F (9.5°C)	9.66 in (24.54 cm)
April	51.4°F (10.9°C)	3.50 in (8.89 cm)
May	54.9°F (12.8°C)	1.53 in (3.89 cm)
June	59.3°F (15.3°C)	0.29 in (0.74 cm)
July	59.8°F (15.6°C)	0.08 in (0.20 cm)
August	59.1°F (15.2°C)	1.22 in (3.10 cm)
September	59.0°F (15.1°C)	2.39 in (6.07 cm)
October	58.4°F (14.8°C)	4.96 in (12.60 cm)
November	53.5°F (12.0°C)	9.67 in (24.56 cm)
December	51.6°F (11.0°C)	8.53 in (21.67 cm)

average rainfall 1973-77: 58.94 in (149.71 cm)

The coolest months of the year are from December through March, with the warmest months from June to September. The mean annual variation in temperature is about 10°F (5.6°C). Shelter Cove is consistently warmer than Eureka; mean monthly temperatures are about 2-4°F (1-2.5°C) above those recorded at Eureka. In the 1973-77 period, the highest temperature recorded at Shelter Cove was 89°F (32°C); the lowest was 30°F (-1.1°C). Freezing or frost along the coast is extremely uncommon.

The wind pattern along this section of the coast is not well known; wind direction and duration are not recorded at Shelter Cove. General data compiled from sea buoys and shore stations in the 45° - 49° north latitude, 125° west longitude area indicate that wind is generally from the north or northwest. During winter months, winds associated with storms are from the south to southwest. As is true for much of the northern California coastline, winds in the nearshore zone can pose significant hazards to navigation, both by generating wind driven waves, and by blowing vessels off their moorings. The lack of protection from the south and southwest at Shelter Cove limits the mooring of vessels there to the summer months.

BIOLOGICAL DESCRIPTION

Intertidal Biota

Six different intertidal habitat types can be recognized within the KRNCA (Table 2). With the exception of the semi-protected sand beach at Shelter Cove, all intertidal habitats are directly exposed to heavy wave pounding. The severe exposure along most of the coast, combined with a lack of stable substrates, have resulted in the development of an intertidal biota of only modest diversity. In the immediate vicinity of Pt. Delgada, however, a series of intertidal benches extend 100-200 yards (90-180 m) from coastal bluffs to the low intertidal zone and a highly diverse group of intertidal plants and animals can be seen there.

Exposed, Steep Sand Beaches: Exposed sand beaches within the KRNCA (see Table 2) are steep and dominated by a coarse sand fraction. The summer months are generally accompanied by sand accretion on most beaches in northern California, but this did not appear to occur on beaches of the KRNCA. Two explanations seem plausible: 1) the summer of 1977 followed a winter with very little rainfall; sand for the building of the beach may not have been transported into the nearshore zone; or 2) heavy wave action on the beaches is so constant that little accretion can take place. The second explanation seems more probable than the first because semi-protected beaches in northern Humboldt County (particularly Clam Beach) did show evidence of accretion during the summer of 1977.

Fifty samples were taken across the intertidal zone of exposed beaches in July and August, 1977. Only three species of animals were encountered: beach hoppers, Orchestoidea columbiana and O. californiana, and the ubiquitous low sand beach-surf zone mysid Archaeomysis maculata. These are the most hardy members of the northern California sand beach fauna and their presence tends to support the characterization of beaches in the KRNCA as physically rigorous, biologically sparse habitats.

Algal wrack was infrequently encountered on these exposed beaches, suggesting that subtidal rock habitats suitable for the growth of algae are absent from the nearshore benthos.

Table 2

Intertidal Habitats in the King Range
National Conservation Area

1. Exposed, steep sand beaches (8.5 miles)

   -Mattole River mouth to Punta Gorda
   -Kinsey Creek to Miller Flat
   -Black sand beach immediately north of Point Delgada

2. Exposed mixed coarse sand-cobble beaches (11.5 miles)

   -Miller Flat to Kaluna cliff
   -from Chemise Creek south to KRNCA border

3. Exposed cobble beach (4.0 miles)

   -Sea Lion Gulch to Spanish Flat
   -Surrounding most creek mouths as they empty into the ocean

4. Exposed coarse sand beaches surrounding large boulders (3.5 miles)

   -Pt. Gorda Lighthouse to Sea Lion Gulch
   -Chemise Creek north to Pt. No Pass

5. Semi-protected sand beach (0.5 miles)

   -Shelter Cove Beach

6. Exposed rocky intertidal (2.0 miles)

   -Pt. Delgada

Exposed Mixed Coarse Sand-Cobble Beaches: In areas where erosion of coastal cliffs is actively occurring (Table 2), cobbles are intermixed with coarse sands. These habitats resemble sand beaches in the appearance of the steep seaward slope, often terminating to landward at a cliff base. At high tide, the beach may be completely covered, with waves beating directly on the cliff base. Suitable habitats for even beach hoppers, Orchestoidea spp. are lacking. The only animals encountered were mysids, Archaeomysis maculata, in the swash zone. Occasionally, drift algae was thrown up on these beaches, but was usually transported away quickly by daily high tides. Only a few kelp flies were found associated with the drift algae.

Exposed Cobble Beaches: Found near large slide areas and frequently adjacent to creeks as they empty into the ocean, cobble beaches are an almost sterile intertidal habitat. As one stands at the high tide line, each wave as it rushes up the beach and recedes can be heard to move cobbles back and forth. The ceaseless motion of the beach material precludes attachment by either plants or animals. At low tides, the water drains rapidly away from the beach, leaving behind a zone of hot, dry rocks. Only a few mysids were collected from the swash zone on these beaches. If the cobbles are in the lee of a small point and thus protected from constant, direct wave action, two annual species of algae are occasionally encountered on the upper beach: sea lettuce, Ulva sp., and the red laver, Porphyra perforata. Plants are generally small and in scattered clumps, suggesting that the cobbles do not remain stable long enough for any significant growth to occur.

Exposed Coarse Sand Beaches Surrounding Large Boulders: At two locations within the KRNCA, boulders generally larger than one meter in diameter are found surrounded by coarse sands. The rocks are of the Franciscan formation and may be fairly well weathered, as at the mouth of Four Mile Creek, just north of the Point Gorda Lighthouse, and north of Chemise Creek, or they may still have sharp edges and surfaces indicative of recent arrival from a coastal landslide; just south of the mouth of Chemise Creek, for example. Around the bases of larger boulders, a relatively sterile, smooth zone, varying in height, is usually seen.

The sterile band is the result of severe sand abrasion on the rock surface, caused by wave action. If the surrounding sand level is below the band for a few weeks, there may be settlement by acorn barnacles, Balanus glandula, sea lettuce, and red laver. This is not common along the shore of the KRNCA, however, because wave movement of the sand generally continues throughout the year. Low boulders, projecting 1-1 1/2 feet (30-45 cm) above the sand, frequently have completely barren surfaces that are absolutely smooth. Sand abrasion on these rocks is so severe and continous that no organisms have an opportunity to settle and grow.

Above the zone of sand abrasion, only the most hardy intertidal invertebrates attach and grow. The biota is typically dominated by annual species with relatively short growing seasons: Turkish towel, Gigartina spp., iridescent seaweed, Iridaea spp., green rope, Spongomorpha coalita, and neptunes quill, Alaria marginata or by species with well developed adaptations for adhering to the rocks in the face of heavy wave pounding: acorn barnacles; California mussels, Mytilus californianus, gooseneck barnacles, Pollicipes polymerus; Notoacmaea persona, and N. fenestra. The distribution of plants and animals (Figure 16) is somewhat wider intertidally than under more protected conditions where potential competitors may also attach and grow. As is true in so many physically rigorous habitats, animals and plants possessing the necessary adaptations for life on exposed rocks have fairly abundant populations. The California mussel-gooseneck barnacle beds were particularly well developed, and the chief predator of these animals, the ochre sea-star, Pisaster ochraceous, was much less abundant than at Pt. Delgada. Several sea stars were washed up on the beach, apparently following dislodgement from rocky substrates. It is uncommon to observe sea-stars thrown up on a beach elsewhere in northern California except after severe winter storms. The common occurrence of sea-star dislodgement along this coast is mute evidence of the pounding power of waves striking the coastline of the King Range ASBS.

Just above the barren zone of low intertidal rocks, a few species of algae capable of withstanding considerable wave shock were usually seen: feather boa kelp, Egregia menziesii; neptune's quill, and split

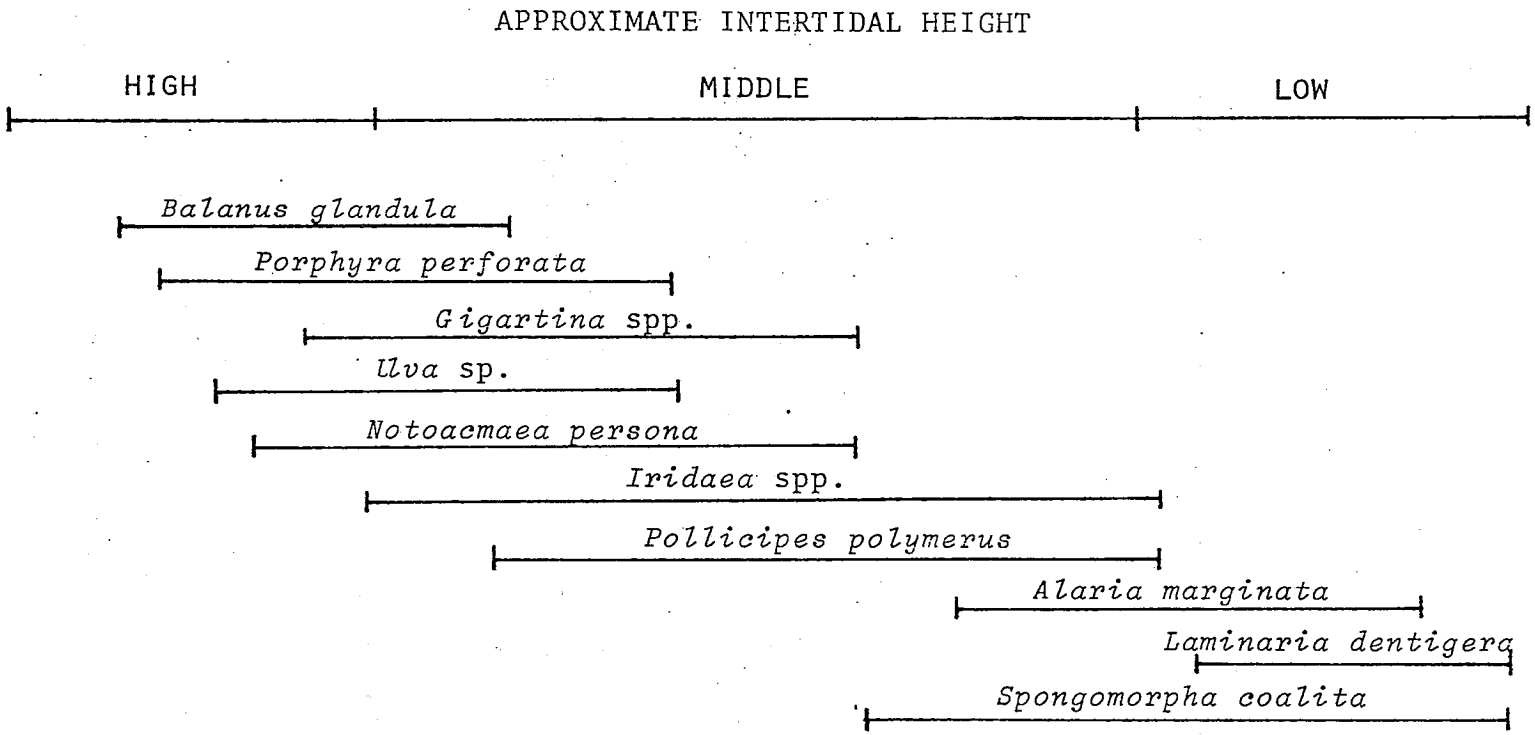


Figure 16. Distribution of intertidal organisms on boulders surrounded by coarse sand.

whip kelp, Laminaria dentigera. On the rock surface itself, the black chiton, Katharina tunicata, was often abundant. A few small patches of coralline algae may occur just above the barren zone, but apparently do not flourish on the rocks because of periodic sand abrasion or burial.

In summary, only the most hardy plants and animals are found on large rocks surrounded by coarse sands. Wave pounding appears to be severe at all times of the year in these habitats. Only those species possessing well developed means of attachment, or species with rather short (annual or less) life cycles, survive.

Semi-exposed Sand Beach at Shelter Cove: Semi-protected sand beaches in northern California generally have a more diverse fauna than exposed beaches. Twenty-five species, mainly crustaceans and polychaete worms, have been found on semi-protected beaches in northern Humboldt County and Del Norte County. The semi-protected character of the beach at Shelter Cove, and the predominance of fine to medium grain sands on the beach, suggested that a fair number of species would be encountered on this beach.

A series of transect samples and qualitative surveys were conducted on the Shelter Cove Beach in August, 1977, with disappointing results. Beach populations are usually at maximum abundance during this period of the year, but only a very few animals were encountered. Algal wrack on the upper beach contained a few sand-hoppers, animals that are usually abundant in similar habitats. In 12 mid-beach 0.10 m^2 samples only two small crustacean amphipods, Eohaustorius washingtonianus were found. Even on the low beach, in the swash zone, only mysids were encountered. It is difficult to explain why so few animals were found. Factors which may be significant in preventing the establishment of a diverse fauna include 1) the distance of this beach from other similar beaches where motile larval forms are produced for dispersal to new, like habitats; 2) seasonal events (i.e. heavy winter waves from the south and southwest) which may strip the beach of fine sands each year, thereby wiping out beach populations; or 3) human use of the beach (particularly boat launching) which may render the beach unsuitable for the establishment

of animal populations. Further investigation of these possible explanations was not possible, but the questions warrant further attention, particularly in light of the fact that the absence of beach organisms may provide important clues to the water quality of this heavily utilized portion of the KRNCA coastline.

Exposed Rocky Intertidal at Pt. Delgada: In terms of biological diversity, Pt. Delgada is the jewel of the King Range National Conservation Area intertidal zone. Almost every plant and animal species found elsewhere along the coast can be found at Pt. Delgada, along with many species found only in this rather small area. Because of public access to the Shelter Cove development, however, the intertidal populations at Pt. Delgada are at greatest risk from human collecting activities. Red abalone, Haliotis rufescens, were once abundant in the intertidal zone, but most sport collectors of this species must now resort to free diving in order to secure animals of legal size. Juvenile abalones (less than legal size) are still abundant under boulders in the Pt. Delgada intertidal zone, however. During summer months, many seasonal visitors to Shelter Cove visit the intertidal zone at low tides, with unknown effects on the populations there. It is common, however, to observe individuals collecting sea-stars, urchins, marine snails, various bivalves, and even algae, probably as souvenirs of their visit to this lush intertidal habitat.

Topographically, Pt. Delgada is bounded to landward by coastal bluffs about 60 feet (18 m) above mean sea level. Directly south of the point, the intertidal zone is a mixed area of intertidal benches, boulders, and sand which has filled in the hollows and crevices of horizontal rocky substrates. The intertidal zone is 100-200 yards (90-180 m) wide and is protected from predominantly northwest waves. Proceeding northwest along the coast, intertidal bench formations increase in elevation by about 4-8 feet (1-2 m) and are dissected by surge channels 3-6 feet (0.9-1.8 m) wide. Boulders are concentrated in the bottoms of surge channels, with very little sand accumulation because of wave surging. A series of pocket coves, with low rock benches surrounded by sand, are interspersed with the higher benches for about 1/2 mile northwest of Pt. Delgada.

The elevation of intertidal benches continues to increase gradually until, ultimately, they become continuous with the coastal bluffs just south of the Shelter Cove sewage treatment plant. The intertidal zone from this point north is fully exposed to pounding waves. The benches are separated from the bluffs by wide surge channels which cannot be crossed. Surfaces are predominantly vertical and continue northward until a black sand beach 1 1/2 miles (2.4 km) from Pt. Delgada is encountered. It appears that, geologically, the reef extending southward from Pt. Delgada is part of the same formation, and that the hard Franciscan sandstones lie parallel to the coastal bluffs, gradually increasing in elevation. The intertidal zone at Pt. Delgada is gently sloping, and somewhat protected from direct wave forces, and becomes increasingly steep and fully exposed to wave action toward the northern end of the promontory.

Biologically, the littoral zone at the southern tip of Pt. Delgada is the richest rocky intertidal habitat of the Shelter Cove area. The benches and rocks are covered by a variety of plants and animals, with different species on rock undersides and in the surrounding sands. Some of the more dominant and distinctive organisms (Figure 17) are limpets, Collisella spp. and barnacles, B. glandula, and Chthamalus dalli of the upper intertidal zone, intermixed with littorine snails, Littorina scutulata and algae, mainly Pelvetiopsis limitata. In mid-intertidal areas, the black turban snails, Tegula funebralis, and occasionally the brown, T. brunnea, are very abundant, intermixed with several algal species, including Gigartina spp., Fucus distichus, and Iridaea spp. At about mid-tide level, clumps of gooseneck barnacles and California mussels begin to dominate rock surfaces. The red alga Endocladia muricata grows both on and between clumps of mussels. Just below the barnacle-mussel zone, great masses of foliose red and brown algae cover almost every surface. In among the algae, the large gumboot chiton, Cryptochiton stelleri seems to be more abundant (1-2 per m^2) than anywhere else along the northern California coast. Green rope algae, Spongomorpha coalita cover the bottoms of many channels which wind through the middle and low intertidal zones. Large, shallow pools are found at about the 0.0 tide level and have enormous populations of sea urchins, mostly Strongylo-

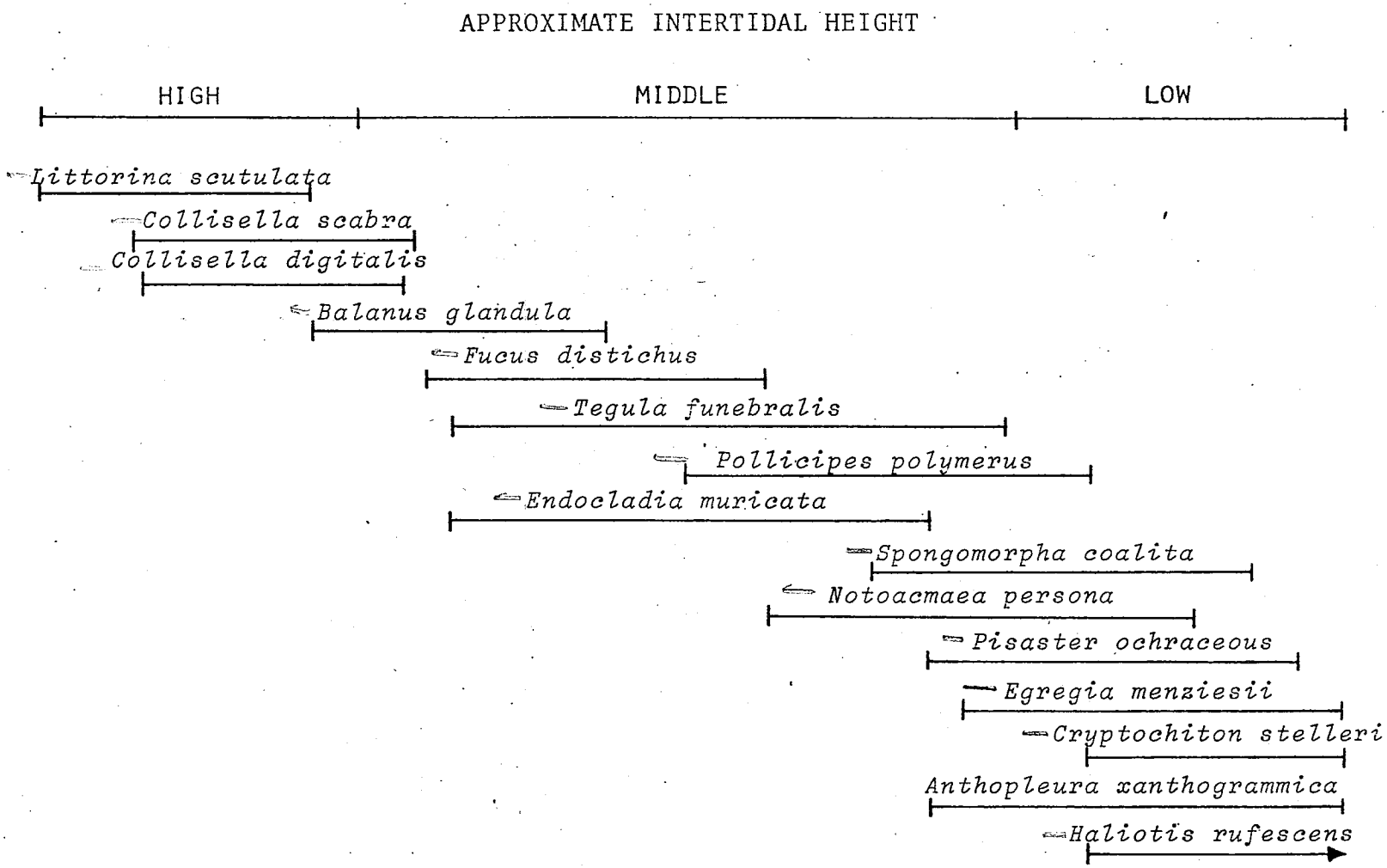


Figure 17. Distribution of dominant intertidal organisms near the southern tip of Point Delgada.

centrotus purpuratus and a few S. franciscanus. Only corraline algae are found on rocks in these pools because of the grazing activities of the urchins. Turning over a small boulder reveals yet another group of organisms. Under the boulder, small procelain crabs, Petrolisthes cinctipes and Pachycheles rudis, cluster for protection during low tides. On the bottom of the rock itself, colonies of sponges, bryozoans, and solitary anemones can be found. Among these small colonies, it is not unusual to see 3-4 juvenile red abalones. Several species of tube-dwelling worms also can be found attached to the rock under-surface. Digging in the sand around boulders, the rock cockle, Protothaca staminea, the basket cockle, Clinocardium nuttallii, and more polychaete worms can be found. Several species of sea-stars, including P. ochraceus, Leptasterias spp., Evasterias troschelii, and Pycnopodia helianthoides, are attached to rocks or are in the intertidal pools. A close examination of crevices in the low intertidal will reveal still more polychaetes and a few reddish sea-cucumbers, Cucumaria miniata. In short, there is, in the vicinity of Pt. Delgada, an extremely diverse assemblage of plants and animals; some are attached to the rocks, others are found deep in crevices, some are found only on the undersides of rocks, others only burrowing in the sand surrounding boulders or benches.

About 1/4 mile (400 m) north of Pt. Delgada, benches of slightly higher elevation project from the base of the coastal bluffs. High in the intertidal zone, only a few plants and animals are seen (Figure 18): snails, both L. scutulata and L. planaxis; a few limpets, C. digitalis and C. scabra; and some hardy green algae in crevices, mostly Cladophora columbiana. Pools at mid-tide level on the top of the benches usually have abundant populations of hermit crabs, Pagurus spp. both around and in them. Other shore crabs, Pachygrapsus crassipes and Hemigrapsus nudus, are in crevices around the periphery of the pool. Attached to the walls of the pool are the anemones Anthopluera xanthogrammica, coralline algae, and sometimes the "dead man's fingers" alga, Codium fragile. A few urchins may also be in the pools, but their most abundant populations are seen in the bottoms of the surge channels.

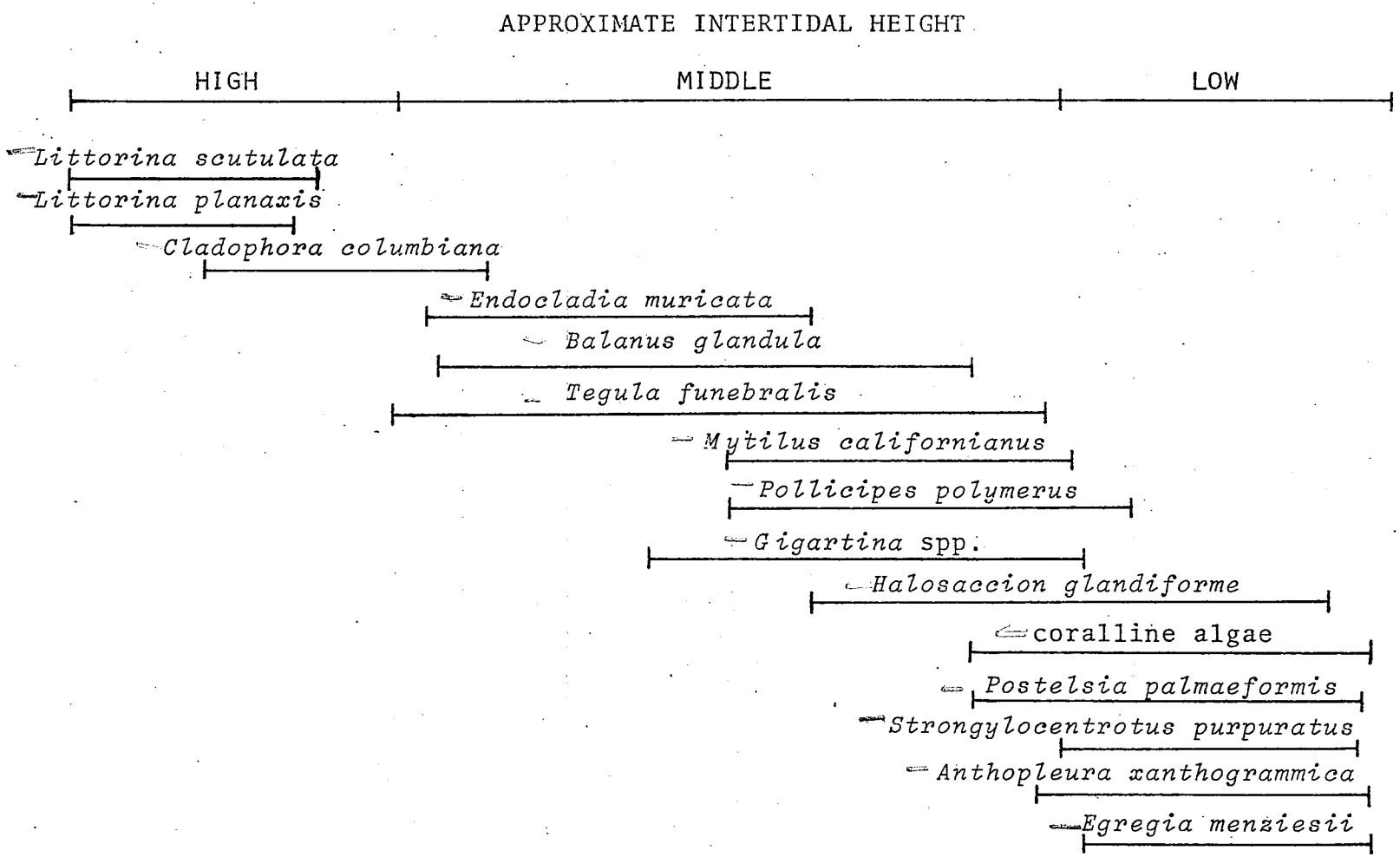


Figure 18. Distribution of intertidal organisms on the intertidal benches just north of Point Delgada.

Continuing seaward on the bench, the best developed intertidal mussel beds in Humboldt County occur at about mid-tide level. The beds continue, interrupted only by a few bare patches, out to the drop-off into subtidal areas. The seaward margin of the beds is fringed by several algae capable of withstanding severe wave shock, notably: sea palm, Postelsia palmaeformis; split whip algae, Laminaria dentigera and L. sinclairii; neptune's quill; and even some Pterygophora californica, which is much more common sub-tidally. These algae frequently have their holdfasts directly attached to the mussels, which are in turn attached to the underlying rock.

The most conspicuous sea-star on the beds is the ochre sea star, with smaller stars scattered among the mussels, mostly Leptasterias hexactis. Populations of the small "tar-spot" cucumber, Cucumaria curata, are also common nestled among the mussels.

Northward, the sides of the intertidal benches become more vertical, with the exposed tops covered by well developed mussel beds. Wave pounding becomes severe, with some elimination of more delicate plant and animal species. The sides of the benches are dominated by coralline algae and hardy, well attached species of Lessoniopsis littoralis, Pollicipes polymerus, split whip spp., and feather boa.

In summary, the intertidal benches at Shelter Cove are unique in Humboldt and Del Norte counties because of the variety of exposures to wave action seen from Pt. Delgada northward for about one mile (1.6 km). Intertidal substrates appear to be moderately protected just south of the point, and fully exposed just west of the north end of the landing strip. The intertidal zone is very well developed, having present a great variety of intertidal microhabitats, from high intertidal hypo-and hypersaline pools to well developed low intertidal underrock crevices.

During the spring of 1977 and 1978, intertidal fish at Shelter Cove were collected and identified. A total of 14 species in 13 genera and 6 families (Appendix 3) were collected. This is somewhat less than the number of species collected intertidally at other northern California locations.

Landside Vegetation

Along much of the coast of the King Range ASBS, terrestrial vegetation may be sparse or absent, particularly on some of the more unstable hillsides facing the ocean. Above the high tide line on exposed sand beaches, there is usually the development of a Coastal Strand community, particularly from the mouth of the Mattole River to Punta Gorda. On hillsides, a Northern Coastal Scrub community is intermixed at lower elevations with a Coastal Prairie community as found at Spanish Flat, Big Flat, Miller Flat, and Shelter Cove. Ridge tops overlooking the ocean are generally a mixture of the Coastal Prairie community and the North Coast Coniferous Forest community, which may approach the coast in creek ravines and deep swales on seaward facing hillsides. Much of the coastal vegetation has been greatly modified by human activities. Individuals with grazing rights in the KRNCA frequently burn grassy areas to ensure continual regeneration of palatable species of annual grasses. In areas of heavy grazing (Gib Flat, Spanish Flat) a number of introduced species have become established, probably following attempts to improve forage for sheep. Logging has been a principal industry throughout the area for some years, with associated activities (e.g. road building) having major effects in triggering increased erosion from coastal hills.

Unique Components

As far as is known, no marine species are unique to the coast of the KRNCA. Designation as an Area of Special Biological Significance was based on the high degree of isolation historically afforded this section of the coastline. Most of the coastal area is fully exposed to wave impact and, as a result, only the hardiest intertidal species can flourish in the littoral zone. At one location, Shelter Cove, a highly diverse intertidal biota is encountered, subjected in varying degrees to the forces of wave shock. The mussel beds and associated intertidal habitats are more extensive and better developed than at any other location in Humboldt and Del Norte counties. It is also at this location that impacts associated with human activities are most severe.

Since Pt. Delgada is the most northerly headland with well developed intertidal habitats, south of Cape Mendocino, it might be anticipated that some southern species might reach their northern limits close to the KRNCA. Although no new range extensions were noted as part of this study, the most northerly intertidal bed of bladder kelp, Macrocystis integrifolia in California is located just south of the KRNCA at Bear Harbor. This species has also been found as drift at Shelter Cove. A more detailed and long term study of the Shelter Cove area might show periodic colonization or establishment of southern (i.e. central California) species.

LAND AND WATER USE DESCRIPTION

Marine Resource Harvesting

Commercial Fishing: There is a considerable amount of commercial fishing within the ASBS. Commercial fishing activity is at a peak in early summer, when both salmon and Dungeness crab are being taken here.

The Dungeness crab is probably the most important commercial species which occurs in the ASBS. This fishery has largely been confined to northern California in the past decade, with an average of 94 percent of the catch being taken north of Pt. Arena. The Dungeness crab has additional importance to the commercial fisherman because it is one of the few species which can be taken during the winter months. The fishery thus provides needed income particularly when summer fisheries have been poor.

Crab boats work within the ASBS primarily between the latter part of March and June. The fishermen follow the nearshore movement of the crabs during these months, and crab pots may be set in water as shallow as 6-7 fathoms. Pots are set along the entire length of the ASBS, although some areas are utilized more heavily than others.

At the present time it is impossible to estimate what percentage of the total northern California catch is from within the ASBS. It is estimated that 20% of the northern California catch is "local", i.e., from the area of Ten Mile Beach north to Punta Gorda. The ASBS occupies about 44% of this coastal stretch. If fishing effort and success were equally spaced, 9% of the northern California catch would be from within the ASBS, or just offshore from it. Although catch statistics are lacking, the ASBS does contain Dungeness crab populations of considerable importance to the commercial fishery.

The commercial salmon fleet generates quite a bit of activity during the summer months, particularly in the Shelter Cove area. Although salmon of commercial size occur within the 100 foot isobath, most commer-

cial fishing is in deeper water. Although the commercial salmon fleet does not fish the ASBS heavily, it generates other uses of the ASBS and adjacent land. Most of the boats using the Shelter Cove harbor during the summer months are salmon trollers. Boats from the entire west coast use the harbor for anchorage when there is a good run of salmon in the vicinity. The less steep coastal streams intersecting the ASBS provide spawning habitat for silver salmon, so the area also contributes to the commercial fishery in that sense.

The sand-bottom, nearshore areas north of Pt. Delgada probably contain nursery grounds for commercially valuable species of flatfish. Commercial fishing by drag boats is not allowed within three miles of the coast, in part to protect the younger, sublegal sized flatfish which inhabit shallower water. Nevertheless, drag boats do work in waters offshore from the ASBS. The nursery grounds within the ASBS probably contribute to the fishery when the younger fish mature and move offshore.

Sportfishing: Most of the sportfishing here is done from skiffs. It has been estimated that half the effort is for salmon, and the other half for bottom fish such as lingcod, cabezon, greenling, rockcod, petrale sole, and sanddabs. Although sport boats range from Shelter Cove as far south as Bear Harbor, most of them remain in the vicinity of Pt. Delgada. Anglers also fish a sanddab bed which runs south 1/4-1/2 mile from the sewage outfall (see "Point Sources"). Thus, at least in this area, the sportsmen have a greater impact on the marine resources of the ASBS than do commercial fishermen.

Mineral Mining: Mineral activities are presently not conducted within the ASBS, or within KRNCA. The only known mineral production here in the past was for manganese, which was mined at Queen Peak in 1958-59. The owner of the coastal land just north of the Punta Gorda lighthouse has recently leased out that land for oil and gas exploration.

The U.S. Geological Survey has stated that the King Range area is "without value for minerals covered by leasing laws" and a 1962 Bureau of Land Management (BLM) inventory concluded that King Range "has very low potential for mineral production" (BLM, 1974 Management Plan).

BLM was apparently concerned about the potential for environmental degradation that mining could cause in King Range, and it developed strict regulations, with regard to mechanical mining in particular, as part of the 1974 Management Plan. On land adjacent to the ASBS, mining is not allowed except between Telegraph Creek and Point No Pass.

Surf fishing is done along the Shelter Cove beach south to Point No Pass. Redtail surfperch is the species most commonly caught; rubberlip and rainbow surfperch also are present.

A run of surfsmelt occurs once or twice a year at Shelter Cove. These are sought by fishermen who use A-frame nets at the surf line to net the smelt. Probably a few steelhead are taken from the mouths of coastal streams which drain into the ASBS; however, most steelhead fishing in the area is done at the mouth of the Mattole River, two miles north of the ASBS boundary.

Because of lack of access, the intertidal populations of red abalone remained abundant here after they had disappeared from other portions of the California coast. Now, the relative abundance of abalone probably brings as many sportsmen into the area as does good salmon fishing. The broad, flat intertidal reef at Pt. Delgada is an additional attraction as it allows relatively safe and easy abalone collection.

Abalone are taken primarily from Pt. Delgada, but also at Punta Gorda, the reef south of Buck Creek, and off Big Flat. Access to these latter areas is by private road or dune buggy, so the effort is much less than at Pt. Delgada.

Mussels are harvested at Pt. Delgada, primarily by the local residents. One bed which is utilized is just south of the sewage outfall mentioned earlier.

A few octopi and monkey face eels are also taken from the Pt. Delgada area.

Municipal Activity

A major portion (2,640 acres) of Pt. Delgada is occupied by Shelter Cove Sea Park, a subdivision consisting primarily of retirement or second homes.

The subdivision was created in 1965, and most public services were constructed between 1965-1970. These were sized or designed in anticipation of a fully developed subdivision. Thus, the water storage system has 19 reservoirs and a two million gallon capacity. The sewage treatment plant has a 200,000 gpd capacity, and the sewer system was intended to serve 2,463 of the lots, with the rest being on septic tanks. Shelter Cove has its own utility system, with lines near the ocean built underground. Roads have been constructed to serve most of the subdivision, including the hillside east of Pt. Delgada where there currently are no homes.

The zoning ordinance for Shelter Cove Sea Park allows limited commercial, as well as single and multi-family residential development. At present, commercial development consists of a small motel, restaurant, and guest house.

Shelter Cove Sea Park has ocean frontage lots from Telegraph Creek to almost the north end of Shelter Cove, a total distance of about two miles. When the land was subdivided in 1965, it aroused public concern over private development of coastal land, and contributed towards passage of the Coastal Zone Act in 1972. Now, development here is regulated by the North Coast Regional Commission, and permits must be obtained from them for building construction within 1000 yards of mean high tide.

Apart from Shelter Cove Sea Park, there are very few residences adjacent to the ASBS. There are perhaps two residences on the west slope in the Whale Gulch area, and about 50 residents in that vicinity. Residences for the sheep ranches bordering the northern portion of the ASBS are inland, near the Mattole River. BLM estimates that the total population within KRNCA is about 185.

Agribusiness and Silviculture

Silviculture: Logging activity was once extensive within KRNCA. BLM estimated that the initial harvest was 9 million board feet. Tanbark oak was logged extensively between 1900-1930.

Although most of the logging was confined to the east slopes of the King Range, the 1974 BLM Management Plan states: "Some logging has occurred on the ocean side of the range. The visual scarring and apparent slow revegetation of these areas has left some clearly visible openings in the vegetative cover ... readily seen ... from some beach areas."

Noting that "natural healing" of disturbed areas "does not usually take place", BLM imposed a moratorium on logging public lands in KRNCA in 1965. In addition, BLM prevented logging of private lands on the west slope by denying access across public lands.

In the 1974 Management Plan, BLM reiterates its policy against logging the west slope: "Only a portion of the Area, basically the east slope of the range in zones 6 and 7, is planned for commercial timber production ... the rather heavily forested but precipitous and erosive west slope ... has been excluded from such development after evaluating the need to protect other resource values."

At present, BLM is to prohibit logging of public or private lands on the west slope, and there is no known logging activity here.

Agriculture and Dairying: Agricultural activity adjacent to the ASBS is practically nil, consisting of a few vegetable gardens in the Whale Gulch area. There is some dairying activity in the Mattole River Valley, and near the river mouth (about two miles north of the ASBS). There are also a few apple orchards in the Mattole Valley.

The 1974 Management Plan for KRNCA states "Agricultural use and potential is low due to rough topography and soil conditions".

Grazing: A total of about 5 miles of coastal land is grazed by sheep. BLM indicated that fencing which separates private and public lands is inadequate, and that sheep may be trespassing onto and grazing public lands in the vicinity of private lands. The 1974 Management Plan calls for restricting the number of sheep allowed to graze on coastal lands in order to allow revegetation to occur; it recommends that grazing be limited to the months from June-October, to allow deer adequate browse during critical periods. Fencing off beach areas used for recreation is also recommended. Coastal lands where grazing is allowed will be limited to (1) area outside the Punta Gorda lighthouse, (2) between Reynolds Rock and Frazer (Kensey) Creek, and (3) Big Flat Area.

Although the 1974 Management Plan is to "cover all lands within the Area, regardless of ownership, BLM has not implemented those provisions which deal with privately owned lands used for grazing. Their efforts have been directed towards acquiring these lands; once acquired, grazing can be regulated along the lines of the management plan. Acquisition of private lands in KRNCA effectively ceased a year and a half ago, when all funds legislated for this purpose had been committed. BLM has been unable to approach the sheep ranch owners to find out if they would be willing to sell, because of lack of funds. Thus, it appears that sheep grazing adjacent to the ASBS will remain unregulated.

Governmental Designated Open Space

Much of the King Range land has historically been owned by the federal government, and leased out for timber production, grazing, or mining. In 1929, King Range lands which were then in public ownership were withdrawn from sale or disposition to private parties.

In the 1960's, legislation was first proposed which would designate King Range as a "conservation area", thereby mandating federal management and protection of the area's natural resources. Public Law 91-476 was passed in 1970, which directed the Department of the Interior to:

1. Establish King Range National Conservation Area, within described boundaries;

2. Consolidate public lands within the conservation area, through purchase or exchange for federal lands outside the boundaries;

3. Conduct an inventory of natural resources within the proposed boundaries, and, based on the inventory, develop a management plan which will indicate recommended primary and secondary uses for subareas.

The Bureau of Land Management was the federal agency which carried out the directive of public law 91-476. After all requirements had been met, King Range National Conservation Area was designated on September 21, 1974.

The north - south boundaries for the conservation area were, at the time of designation, Punta Gorda and just south of the mouth of Whale Gulch Creek. BLM nominated the nearshore waters adjacent to KRNCA as an Area of Special Biological Significance in 1973. When KRNCA ASBS was designated in March, 1974, its boundaries were contiguous with those of the conservation area. However, the northern boundary of KRNCA was subsequently moved from Punta Gorda to the mouth of the Mattole River; the northern boundary of the ASBS remains at Punta Gorda, and the seaward boundary is 1000 feet offshore, or the 100 foot isobath, whichever is the farthest from shore.

The designation of King Range as a "conservation area" does not guarantee the preservation or protection of its natural resources. Rather, the law directs BLM to manage KRNCA "under the principles of multiple use and the sustained yield of renewable natural resources". This general statement places few limitations on allowable land uses, and leaves the critical decision-making to BLM itself. In addition, BLM is not allowed to condemn "any private lands (within KRNCA) which, on the date of the act, were utilized for residential, agricultural, or commercial purposes so long as such usage is compatible with the purposes

of the act". Thus, the continued existence of Shelter Cove Sea Park (Residential) or coastal sheep ranches is assured, unless the owners want to sell their land to BLM.

The entire King Range National Conservation Area is within the planning area of the Coastal Zone Commission, and permits are required from the regional commission for all buildings on lands to approximately 3,000 feet inland.

Recreational Uses

The major recreational use of the ASBS is sportfishing, described previously. This activity, and other recreational pursuits, occur primarily in the Shelter Cove area. Although sportfishing is the major attraction at Shelter Cove, the area is also frequented by campers who simply want to enjoy the scenic beauty here, or get away from the inland heat. A number of small businesses at Shelter Cove are supported by recreational users.

Generally speaking, the Shelter Cove area extends from Telegraph Creek to Point No Pass. Point No Pass prevents beach strollers from proceeding further, and use of the beach south of there is sparse. A few backpackers hike down Chemise Mountain trail to the beach and camp in the few areas not inundated at high tide.

North of Shelter Cove, the area between Telegraph Creek and Gitchell Creek (Black Sand Beach) is used heavily by dune buggy enthusiasts. During the summer of 1977, BLM counted an average of 20 to 25 "offroad vehicles" here on holiday weekends, and about a half-dozen on other weekends.

During development of the 1974 Management Plan, BLM reported that offroad vehicle (ORV) use of the beaches was "the sharpest issue of public controversy". The Management Plan recommends closure of the beach north of Gitchell Creek to offroad vehicles; although use is not as heavy here.

ORV's cause considerable damage to creek vegetation and may be traversing over unexamined archaeological sites. Closure of the beach requires cooperation from the State Lands Commission, which has jurisdiction over the intertidal portion of the beach. If concurrence by this State agency is gained, the closure will be established and encoforced by BLM and local law enforcement agencies.

Black Sand Beach is also visited by beach strollers and a few bathers, as well as the dune buggy enthusiasts. The only public facilities there are trash cans, and the parking lot itself. The lack of public restrooms at that site is probably resulting in water quality degradation in Telegraph Creek and the beach areas. BLM has stated that in order for restrooms to be built there, additional private land south of the creek must be acquired. The owner of the land, Shelter Cove Sea Park, is apparently unwilling to sell; at any rate, BLM does not have funds available for land acquisition at the present time. Recreational use of this area will probably increase, as there is vehicle access and Black Sand Beach is one of the few publicly owned California beaches where offroad vehicle use is allowed.

The principal recreational use of the area between Gitchell Creek and Punta Gorda, particularly at Spanish Flat, is hunting. Again, this usage is small, primarily because the only vehicle access is via a private road. While deer are the main species sought, several other game species are found here - quail, blue grouse, gray squirrel, rabbit, dove and band-tailed pigeon.

The abandoned lighthouse at Punta Gorda is of historical interest; BLM recently restored it, although the area is still not fenced off from grazing areas as recommended in the management plan. The beach area from the Mattole River south to Punta Gorda is also open to offroad vehicles, somewhat increasing access to the lighthouse. BLM has constructed a parking lot just south of the Mattole River, and the 2-3 mile walk from here to the lighthouse (along a public easement) is a fairly popular day hike. During the summer of 1977, BLM counted 30-35 cars parked at the mouth of the Mattole on weekends; this is some indication of recreational use of the lighthouse area.

In 1973, BLM estimated 56,400 visitor use days within King Range National Conservation Area. Assuming almost all usage of the area is in the five-month summer period, this represents an average of less than 400 visitors/day. At that time, BLM estimated a 20% maximum growth rate per year in visitation. If such growth occurred, 1977 visitation averaged about 800/day.

The impact of such low recreational use on the ASBS would seem minimal. However, one must consider that most recreational use of the ASBS is confined to the Shelter Cove area, and that much of it involves the sport take of marine resources. In this area at least, local sources indicated recreational use has caused considerable alteration and possibly disturbance of the intertidal aspect of the ASBS.

Scientific Uses

The ASBS has apparently not been the object of any significant scientific investigations. Probably this is due to the fact that the area is for the most part inaccessible by vehicle, and because diving conditions are poor. Marine resources in the ASBS have not been surveyed by the Department of Fish and Game. The Department's information on the area is obtained from catch block data supplied by commercial fishermen in logs or on sales receipts.

In 1973, as part of their inventory of natural resources in KRNCA, BLM conducted a survey of the intertidal zone of the ASBS. No benthic sampling of beach areas was done, and most of the collected specimens were from Pt. Delgada. A species list of marine algae, invertebrates, birds and mammals was compiled from the survey; algae were identified by Humboldt State University personnel.

The extensive intertidal reef at Pt. Delgada is used for field trips by marine biology classes at Humboldt State University, and possibly other colleges and universities in northern California.

Transportation Corridors

The ASBS is located adjacent to coastline which is extremely isolated and difficult to reach by any form of transportation. More than any other factor, lack of access to the area has kept the nearshore waters in a relatively pristine state. As access increases, protection for marine resources here should likewise increase or the pristine qualities of the ASBS could be lost.

Boat Access: Boat access to the shore adjacent to the ASBS is possible only at Shelter Cove; the rest of the coast is too unprotected to allow landing or anchoring.

Airplane Access: The weather and terrain adjacent to Shelter Cove make it a relatively unsafe area for air traffic (there have been 11 aviation accidents near Shelter Cove since 1958). Nevertheless, small planes were the second transportation mode for which access was developed at Shelter Cove. In 1949 an airstrip was constructed at the western edge of Pt. Delgada. The airstrip is owned and maintained by Humboldt County. No expansion or improvements are planned for the airstrip in the near future.

Motor Vehicle Access: The only public motor vehicle access to the King Range coast is the highway from Garberville west to Shelter Cove. This 30-mile, two-lane roadway climbs the steep grade east of the crest, then descends to Shelter Cove with sharp turns and spectacular views. Shelter Cove can also be reached from the south by a one lane dirt road which is an extension of Highway 1. The road is used principally by logging trucks and it is passable by four wheel drive vehicles in good weather only.

There are two private roads to the coast adjacent to the ASBS, both negotiable by four wheel drive vehicles only. The Smith-Etter road originates at Honeydew and reaches the coast about a mile south of Spanish Flat. The second private road originates five miles south of Petrolia, passes south along Cooskie Ridge and Spanish Ridge, and also reaches the coast near Spanish Flat.

There is vehicle access to the coast just south of the Mattole River mouth, about two miles north of the ASBS boundary. From here, a trail leads south on a public easement across private property to the Punta Gorda lighthouse.

The entire stretch of beach from Telegraph Creek to Punta Gorda is traversed by offroad vehicles, which are used for transportation as well as recreational purposes here.

Pedestrian Access: The 25-mile stretch of beach which borders the middle portion of the ASBS is best reached at either end - from Telegraph Creek to the south, and from the mouth of the Mattole River to the north. Between these two points, the beach permits passage on foot.

South of Shelter Cove, five miles of coastline are enclosed at the south and north ends by two rocky cliffs which jut into the intertidal area. Both labeled "Point No Pass" on maps, they prevent pedestrian access from the beach areas to the south or north. Because of the lack of beach access, and the proximity of two campgrounds, the area was given high priority for construction and maintenance of a trail over the range and to the coast.

The resulting Chemise Mountain trail is 4 1/2 miles in length, with the last three miles of trail descending 2,500 feet to the beach. The last half mile or so of trail is a series of tight switchbacks down a steep, bare gravelly slope. This part of the trail, although reinforced with wire mesh and steel rod, is easily washed out by winter rains. The trail is used by both day hikers and backpackers, who are able to camp on the beach in the few areas not inundated at high tide.

ACTUAL OR POTENTIAL POLLUTION THREATS

Point Sources

Municipal Discharge: A small secondary treatment plant discharges into the intertidal portion of the ASBS at the northwest end of Pt. Delgada. Completed in 1967, the plant was designed primarily to handle sewage from the new subdivision at Shelter Cove, Shelter Cove Sea Park. The land developers anticipated a much greater rate of growth than has occurred, so the plant's design capacity of 200,000 gallons/day has not been approached at the present time.

The plant receives sewage from 39 residences, the trailer park, and one motel. Since use of the trailer park facilities is highly seasonal, sewage flow into the plant should be highest during the summer. Maximum dry weather flow can be estimated at 29,000 gal/day, when all residences, motel and trailer units are occupied.

As early as 1964, a proposal was made to use reclaimed effluent from this plant to irrigate the adjacent golf course. The reclamation plan remains an extremely feasible and inexpensive alternative to the ocean discharge, and one which the district would willingly undertake. However, the district has repeatedly bogged down on performing the infiltration studies which the district engineer states are "imperative for any rational conclusions and design", and which are required by both the Regional Board and the State Department of Health before the project can proceed. Until the problem of infiltration is dealt with adequately, the treatment plant effluent will continue to be discharged to the ASBS.

Probably, this point source is not a serious source of water pollution. From the small amount of testing which has been done on the discharge, the coliform count, suspended solids, and biochemical oxygen demand values are low. The discharge has the appearance of freshwater, probably due to the high degree of infiltration. The discharge does not represent a public health hazard, as there is no human activity in the

wave-swept cliff area adjacent to the outfall. The 1977 State Department of Health survey indicated the toxin level in mussels here was < 40 ug/100 grams, well below safe consumption levels.

Offshore Oil Development: There is no oil development or mineral mining offshore from the ASBS. The EIR for the 1974 Management Plan states that there is "some undetermined potential for oil and gas, as well as deposits of phosphate, manganese nodules and, near river mouths, potential placer gold".

Vessel Discharges: Shelter Cove is the only good-sized anchorage for small craft between Ft. Bragg (60 miles south) and Eureka (70 miles north). Because of its strategic location, it is used not only by the local fishing fleet but also as a harbor of refuge by boats traveling along the coast. Shelter Cove lies under the south face of Pt. Delgada, and affords fair shelter in northwest weather, but is exposed and dangerous with south or west winds. Therefore, the cove is used as an anchorage primarily during the late spring and summer, when northwest weather prevails. During the summer it is not uncommon for over a hundred boats to anchor here at night, with home ports ranging from San Diego to Seattle.

The 1977 Coast Pilot states that "occasionally a swell runs in the cove". There is usually some swell in the cove at night, which, along with the soft bottom, makes for an insecure anchorage. For this reason, and for lack of docking facilities or extensive amenities onshore, visiting fishermen usually remain on their boats. About 20 of the local commercial skiffs are hauled out of the cove every night during the salmon season.

When transient boat use of the Shelter Cove anchorage is high, a great deal of raw sewage is discharged into the cove. With an unimproved anchorage, this is unavoidable. Commercial fishing boats this size (25 to 65 ft.) do not usually have holding tanks for sanitary waste. The fishermen generally remain on their boats for good reason, and besides there are no public facilities presently at Shelter Cove. Probably some bilge water is discharged into the cove also, although standard practice is to pump bilges before coming into anchor.

Vessel discharges may not be a significant source of water pollution in the cove. There is a great deal of water transport in and out of the cove daily, and boats are usually anchored here only at night. However, use of the harbor does create a source of water pollution, and arises from a situation similar to that for recreational land use here: The construction of public services and facilities has lagged far behind increased use of the area.

Non-Point Sources

Agricultural: Agricultural practices probably cause some degradation of water quality in coastal streams flowing into the ASBS. Grazing lands are not fenced off from creeks, and include, or are adjacent to, the watersheds of: Fourmile Creek, Sea Lion Gulch, Cooskie Creek, Randall Creek, Spanish Creek, and several unnamed, smaller creeks. The number of sheep grazing these areas is not known; therefore it is impossible to assess their impact on the water quality in the ASBS. Probably, grazing has little or no effect on water quality in the ASBS, because of the high degree of water circulation in the nearshore waters here.

Oil Spills and Seeps: No oil seeps are known to occur within the ASBS. However, natural seepages along the Mattole River (2 miles north) were discovered as early as 1860, and the State's first commercial oil well was constructed near Petrolia, 11 miles north of the ASBS. The Petrolia fields are no longer productive.

The possibility of an oil spill occurring within or adjacent to the ASBS is slight. Oil tankers and freighters travel about 20 miles offshore along this part of the coast, for several reasons:

(1) to avoid navigational hazards and bad weather inshore;
(2) to avoid fishing boats and gear (crab pots) inshore; and
(3) to minimize travel time and distance between ports.

With the importation of Alaskan oil to California refineries, tanker traffic will increase adjacent to the ASBS. There are no deep water ports proposed for northern California locations, so tankers will probably con-

tinue to remain several miles offshore. In that event, the possibility of any oil spill affecting the ASBS would be lessened.

Land Development: Land development here does not contribute to any non-point sources of water pollution.

Harbor Development: Shelter Cove is essentially an unimproved anchorage, with little protection from bad weather beyond that provided by Pt. Delgada. There are no wharfs, docks, or boat ramps in Shelter Cove. Skiffs are launched by a 1 1/2 ton mobile lift. With harbor improvements scheduled for completion in 1978, the launching procedure will be somewhat modified. The road down to the cove will be paved, and a turnout constructed on the beach. Vehicles and trailers will be parked on the bluff above the cove. The parking lot will be located on BLM land just north of the restaurant, and will accommodate 25 cars and 12 boat trailers.

Although boat fuel is available, services are primarily for skiffs that can be brought up on land. The pumps are located some distance from the water, and tank storage capacity is small. The fuel dock is not a source of water pollution to the ASBS.

Although sportfishing activity is considerable at Shelter Cove, the facilities provided for fish filleting are inadequate. Located at the southwest end of Pt. Delgada, they consist of two wooden tables, with overhead faucets. Carcasses and entrails are disposed of in a dugout pit. The disposal pit creates a public health nuisance and is foul smelling.

Solid Waste Disposal: The sanitary landfill for the Shelter Cove area is located at least a mile inland and is not a source of water pollution to the ASBS. Sewage sludge is not disposed of here at the present time; all sludge is continually recirculated back to the headworks of the treatment plant.

SPECIAL WATER QUALITY REQUIREMENTS

No unique components are identified within the ASBS; therefore, there are no special water quality requirements along this section of the coastline.

ANNOTATED BIBLIOGRAPHY

Abbott, I. A. and Hollenberg, G. J. 1976. Marine algae of California. Stanford Univ. Press, Stanford. xii + 827 pp.

The standard work for identification of marine algae on the California coast.

Boyd, M. J. and DeMartini, J. D. 1977. Intertidal and subtidal biota of Redwood National Park. Technical report to the National Park Service, Contract No. CX 8480-4-0665. 162 pp.

Describes intertidal and subtidal habitats along the coast of Humboldt and Del Norte Counties and includes quantitative seasonal studies of intertidal populations.

Bureau of Land Management. U.S. Department of the Interior. 1974. Proposed management program, King Range National Conservation Area. BLM California State office. 107 pp.

Bureau of Land Management, U.S. Department of the Interior. September, 1974. King Range National Conservation Area Management Program. 80 pp.

Assessment of natural resources, including potential for recreational use; existing use and facilities. Management plan for land acquisition includes costs, time schedule, and map showing lands proposed for acquisition. Primary and secondary uses for subzones recommended, with control measures for various activities (logging, mining, etc.). Much of the 1974 plans has not been implemented.

Curray, J. R. and Nason, R. D. 1967. San Andreas fault north of Point Arena, California. Geol. Soc. Amer. Bulletin 78: 413-418.

Postulates that the Point Delgada Fault is the last landfall of the San Andreas Fault before intersecting the Mendocino Fracture zone.

Machi, M. 1977. A dream fulfilled... Shelter Cove Sun No. 1, pp. 9-10.

Describes several aspects of the early history of Shelter Cove.

Moring, J. R. 1972. A checklist of intertidal fish species collected in the vicinity of Trinidad Head, California. California Fish and Game 58: 315-320.

Munz, P. A. 1968. A California flora (with Supplement). University of California Press. Berkeley. 1905 pp.

The standard work for identification of terrestrial plant species in California.

National Oceanic and Atmospheric Administration. U.S. Department of Commerce. 1977. Climatological data: California. Vol. 81, No. 1-3.

Monthly weather data for northern California stations, with an annual summary.

Pape, R. F. 1971. Geology of the Shelter Cove area, Humboldt County, California. Senior thesis, Department of Geology, Humboldt State College. 44 pp.

Pirie, D. M., Murphy, M. J., and Edmisten, J. R. 1975. California nearshore surface currents. Shore and Beach 43 (2):23-34.

Discusses importance of Cape Mendocino in current patterns and northern California upwelling.

Ricketts, E. F., Calvin J., and Hedgpeth, J. W. 1968. Between Pacific Tides. Stanford University Press. Stanford. xiv + 614 pp.

Smith, R. I., and Carlton, J. T. 1975. Light's Manual: Intertidal invertebrates of the central California coast. University of California Press. Berkeley. xviii + 716 pp.

The standard work for the identification of invertebrates in central California. The Shelter Cove intertidal zone appears very similar in species composition to the intertidal zone of Bodega Head.

Appendix 1

Intertidal Invertebrates of the King Range
National Conservation Area

Phylum Porifera

Class Demospongiae

Cliona celata Grant, 1826
Haliclona spp.
Mycale macginitiei de Laubenfels, 1930
Ophlitaspongia pennata (Lambe, 1895)

Phylum Cnidaria

Class Hydrozoa

Abietinaria sp.
Aglaophenia sp.
Eudendrium californicum Torrey, 1902
Hydractinia spp.
Obelia geniculata (Linnaeus, 1767)
Tubularia marina (Torrey, 1902)

Class Anthozoa

Anthopleura artemisia (Pickering in Dana, 1848)
Anthopleura elegantissima (Brandt, 1835)
Anthopleura xanthogrammica (Brandt, 1835)
Balanophyllia elegans Verrill, 1864
Corynactis californica Carlgren, 1936
Epiactis prolifera Verrill, 1869
Tealia crassicornis (Muller, 1776)

Phylum Nemertea

Amphiporus imparispinosus Griffin, 1898
Paranemertes peregrina Coe, 1901

Phylum Annelida

Class Polychaeta

Nereis vexillosa Grube, 1851
Arctonoe vittata (Grube, 1855)
Halosydna brevisetosa Kinberg, 1855
Serpula vermicularis Linnaeus, 1767
Eupolymnia crescentis Chamberlin, 1919
Neoamphitrite robusta (Johnson, 1901)

Phylum Mollusca

Class Polyplacophora

Chaetopleura gemma Dall, 1879
Cryptochiton stelleri (Middendorff, 1846)
Cyanoplax dentiens (Gould, 1846)
Lepidozona mertensii (Middendorff, 1846)
Katharina tunicata (Wood, 1815)
Mopalia ciliata (Sowerby, 1840)
Mopalia hindsii (Reeve, 1847)
Mopalia lignosa (Gould, 1846)
Mopalia mucosa (Gould, 1846)
Tonicella lineata (Wood, 1815)

Class Gastropoda

Subclass Prosobranchia

Acmaea mitra Rathke, 1833
Amphissa versicolor Dall, 1871
Bittium eschrichtii (Middendorff, 1849)
Calliostoma ligatum (Gould, 1849)
Ceratostoma foliatum (Gmelin, 1791)
Collisella digitalis (Rathke, 1833)
Collisella pelta (Rathke, 1833)
Collisella scabra (Gould, 1846)
Collisella strigatella (Carpenter, 1864)
Diodora aspera (Rathke, 1833)
Haliotis kamtschatkana Jonas, 1845
Haliotis rufescens Swainson, 1822
Lacuna porrecta Carpenter, 1864
Lamellaria sp.
Littorina scutulata Gould, 1849
Littorina planaxis Philippi, 1847
Notoacmaea persona (Rathke, 1833)
Notoacmaea scutum (Rathke, 1833)
Nucella canaliculata (Duclos, 1832)
Nucella emarginata (Deshayes, 1839)
Nucella lamellosa (Gmelin, 1791)
Ocenebra lurida (Middendorff, 1848)
Searlesia dira (Reeve, 1846)
Tegula funebralis (A. Adams, 1855)
Tegula brunnea (Philippi, 1848)

Subclass Opisthobranchia

Antiopella barbarensis (Cooper, 1863)
Archidoris montereyensis (Cooper, 1862)
Dendronotus frondosus (Ascanius, 1774)
Diaulula sandiegensis (Cooper, 1862)
Dirona albolineata Cockerell and Eliot, 1905
Dirona picta Mac Farland in Cockerell and Eliot, 1905
Hermissenda crassicornis (Eschscholtz, 1831)
Onchidella borealis Dall, 1871
Rostanga pulchra Mac Farland, 1905

Class Bivalvia

Clinocardium nuttallii (Conrad, 1837)
Hinnites giganteus (Gray, 1825)
Kellia laperousii (Deshayes, 1839)
Mytilus californianus Conrad, 1837
Pododesmus cepio (Gray, 1850)
Protothaca staminea (Conrad, 1837)

Class Cephalopoda

Octopus dofleini Pickford, 1964
Octopus sp.

Phylum Bryozoa

Bugula californica Robertson, 1905
Caulibugula ciliata (Robertson, 1905)
Crisia occidentalis Trask, 1857
Eurystomella bilabiata (Hincks, 1884)
Filicrisia franciscana (Robertson, 1910)
Flustrellidra corniculata (Smith, 1871)
Heteropora pacifica Borg, 1933
Triticella elongata (Osburn, 1912)

Phylum Arthropoda

Class Crustacea

Subclass Cirripedia

Balanus cariosus (Pallas, 1788)
Balanus crenatus Bruguiere, 1789
Balanus glandula Darwin, 1854
Balanus nubilis Darwin, 1854
Chthamalus dalli Pilsbry, 1916
Pollicipes polymerus Sowerby, 1833

Subclass Malacostraca

Order Amphipoda

Orchestoidea columbiana Bousfield, 1958

Order Isopoda

Gnorimosphaeroma oregonensis (Dana, 1854-1855)
Idotea wosnesenskii (Brandt, 1851)

Order Mysidacea

Archaeomysis maculata (Holmes, 1894)

Order Decapoda

Cancer antennarius Stimpson, 1856
Cancer magister Dana, 1852
Crangon stylirostris Lockington, 1877
Cryptolithodes sitchensis Brandt, 1853
Hapalogaster mertensii Brandt, 1850
Hemigrapsus nudus (Dana, 1851)
Hemigrapsus oregonensis (Dana, 1851)

Order Decapoda (continued)

Pachycheles pubescens Holmes, 1900
Pagurus granosimanus (Stimpson, 1859)
Pagurus hirsutiusculus (Dana, 1851)
Pagurus samuelis (Stimpson, 1857)
Petrolisthes cinctipes (Randall, 1839)
Pugettia producta (Randall, 1839)
Pugettia richii Dana, 1851
Scyra acutifrons Dana, 1851

Phylum Echinodermata

Class Asteroidea

Dermasterias imbricata (Grube, 1857)
Evasterias troschelii (Stimpson, 1862)
Henricia leviuscula (Stimpson, 1857)
Leptasterias pusilla (Fisher, 1930)
Leptasterias hexactis (Stimpson, 1862)
Pisaster ochraceus (Brandt, 1835)
Patiria miniata (Brandt, 1835)
Pycnopodia helianthoides (Brandt, 1835)

Class Holothuroidea

Cucumaria miniata Brandt, 1835
Cucumaria curata Cowles, 1907
Eupentacta quinquesemita (Selenka, 1867)

Class Echinoidea

Strongylocentrotus purpuratus (Stimpson, 1857)

Class Ophiuroidea

Ophiopholis aculeata (Linnaeus, 1767)

Phylum Chordata

Class Ascidiacea

Clavelina huntsmani Van Name, 1931
Perophora annectens Ritter, 1893
Styela montereyensis (Dall, 1872)

Appendix 2

Intertidal Plants of the King Range
National Conservation Area

Rhodophyta:

Endocladia muricata (Postels & Ruprecht, 1840) J. Agardh, 1847
Odonthalia floccosa (Esper, 1802) Falkenberg, 1901
Rhodomela larix (Turner, 1819) C. Agardh, 1822
Microcladia borealis Ruprecht, 1851
Plocamium cartilagineum (Linnaeus, 1753) Dixon, 1967
Prionitis lanceolata (Harv.) Harvey, 1853
Iridaea cordata var. *splendens* (S&G, 1937) Abbott, 1971
Iridaea heterocarpa Postels & Ruprecht, 1840
Iridaea flaccida (Setchell & Gardner, 1937) Silva, 1957
Iridaea lineare (Setchell and Gardner, 1937) Kylin, 1941
Farlowia mollis (Harvey & Bailey, 1851) Farlow & Setchell, 1901
Ptilota filicina J. Agardh, 1876
Gigartina agardhii Setchell & Gardner, 1933
Gigartina canaliculatum Harvey, 1841
Gigartina papillata (C. Agardh, 1821) J. Agardh, 1846
Constantinea simplex Setchell, 1901
Dilsea californica (J. Agardh, 1876) Kuntze, 1891
Schizymenia pacifica (Kylin, 1925) Kylin, 1932
Gymnogongrus linearis (C. Agardh, 1822) J. Agardh, 1851
Corallina vancouveriensis Yendo, 1902
Callithamnion pikeanum Harvey, 1853
Laurencia spectabilis Postels & Ruprecht, 1840
Porphyra smithii Hollenberg and Abbott, 1968
Polysiphonia hendryi Gardner, 1927
Botryoglossum farlowianum (J. Agardh) DeToni, 1900
Callophyllis sp.
Calliarthron tuberculosum (Postels and Ruprecht, 1840) Dawson, 1964
Pterosiphonia bipinnata (Postels and Ruprecht, 1840) Falkenberg, 1901
Smithora naiadum (Anderson, 1892) Hollenberg, 1959
Bossiella orbigniana (Decaisne, 1842) Silva, 1957
Clathromorphum parcum (Setchell and Foslie, 1907) Adey, 1970
Gastroclonium coulteri (Harvey, 1853) Kylin, 1931
Halosaccion glandiforme (Gmelin, 1768) Ruprecht, 1851

Phaeophyta:

Fucus distichus Linnaeus, 1767
Pelvetiopsis limitata Gardner, 1924
Leathesia nana Setchell & Gardner, 1924
Leathesia difformis (Linnaeus, 1755) Areschoug, 1847
Postelsia palmaeformis Ruprecht, 1852
Egregia menziesii (Turner, 1808) Areschoug, 1876
Lessoniopsis littoralis (Tilden, 1900) Reinke, 1903
Hedophyllum sessile (C. Agardh, 1824) Setchell, 1901
Macrocystis integrifolia Bory 1826
Costaria costata (C. Agardh, 1817) Saunders, 1895

Phaeophyta (continued)

Ralfsia sp.
Analipus japonicus (Harvey, 1857) Wynne, 1971
Laminaria dentigera Kjellman, 1889
Laminaria sinclairii (Harvey, 1846) Farlow, Anderson & Eaton, 1878
Alaria marginata Postels & Ruprecht, 1840
Pterygophora californica Ruprecht, 1852
Cystoseira osmundacea (Turner, 1809) C. Agarch, 1820
Desmarestia latifrons Kutzing, 1859
Desmarestia ligulata (Lightfoot, 1777) Lamouroux, 1813, var. *ligulata*
Ectocarpus acutus var. *haplogloiae* Doty, 1947

Chlorophyta:

Spongomorpha coalita (Ruprecht, 1851) Collins, 1909
Enteromorpha linza (Linnaeus, 1753) J. Agardh, 1883
Ulva sp.
Cladophora columbiana Collins, 1903
Codium fragile (Suringar, 1867) Hariot, 1889
Codium setchellii Gardner, 1919

Spermatophyta

Phyllospadix scouleri

Appendix 3

Intertidal Fish at Point Delgada, King Range National Conservation Area ASBS

Family Cottidae

Hemilepidotus spinosus (Brown Irishlord)
Clinocottus globiceps (Mosshead sculpin)
Oligocottus snyderi (Fluffy sculpin)
Oligocottus maculosus (Tidepool sculpin)
Scorpaenichthys marmoratus (Cabezon)
Artedius notospilotus (Bonyhead sculpin)

Family Clinidae

Gibbonsia metzi (Striped kelpfish)

Family Gobiesocidae

Gobiesox maeandricus (Northern clingfish)

Family Hexagrammidae

Hexagrammos decagrammus (Kelp greenling)
Hexagrammos superciliosus (Rock greenling)

Family Pholididae

Apodichthys flavidus (Penpoint gunnel)
Xererpes fucorum (Rockweed gunnel)

Family Stichaeidae

Xiphister atropurpureus (Black prickleback)
Anoplarchus purpurescens (High cockscomb)

STATE WATER RESOURCES CONTROL BOARD

P. O. Box 100, Sacramento, CA 95801

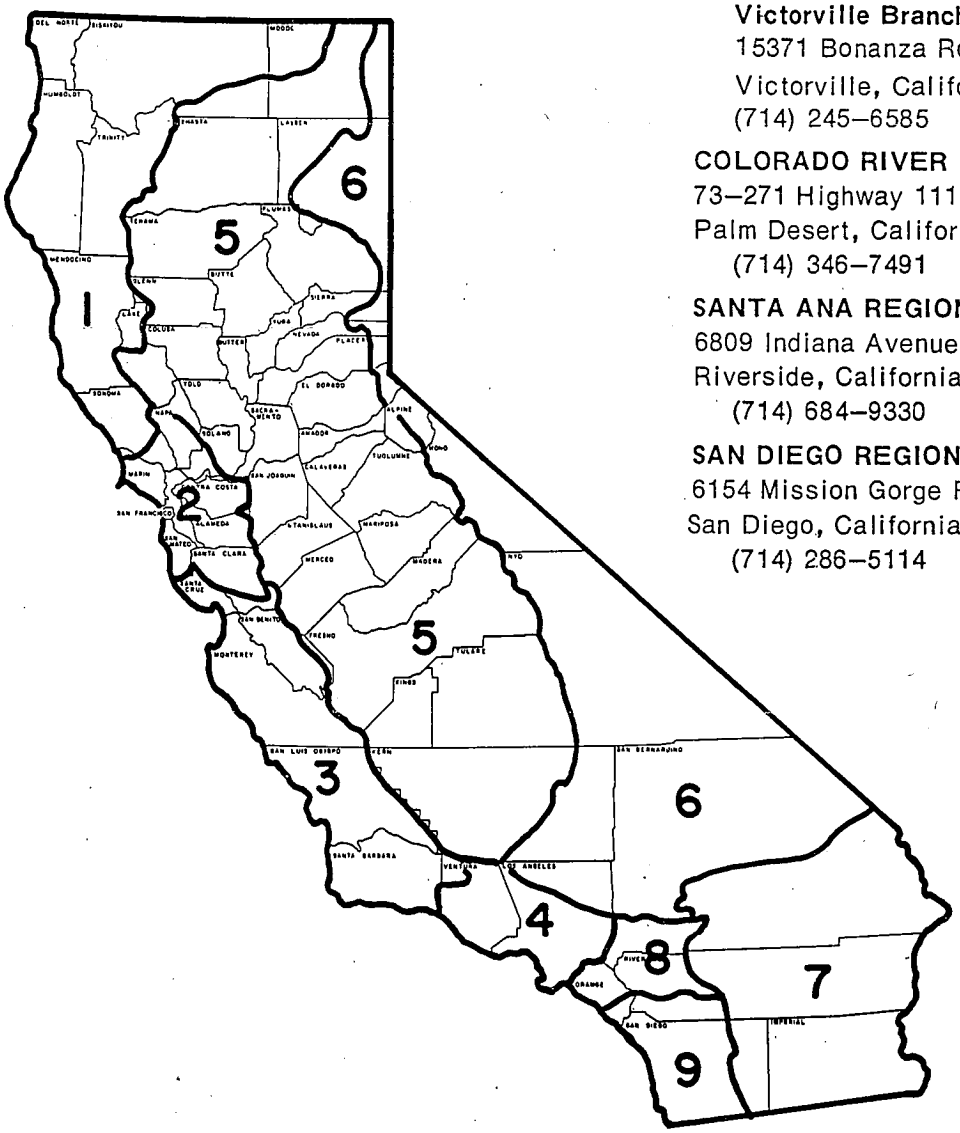
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARDS

NORTH COAST REGION (1)
1000 Coddingtown Center
Santa Rosa, California 95401
(707) 545–2620

SAN FRANCISCO BAY REGION (2)
1111 Jackson Street, Room 6040
Oakland, California 94607
(415) 464–1255

CENTRAL COAST REGION (3)
1122–A Laurel Lane
San Luis Obispo, California 93401
(805) 549–3147

LOS ANGELES REGION (4)
107 South Broadway, Room 4027
Los Angeles, California 90012
(213) 620–4460



CENTRAL VALLEY REGION (5)
3201 S Street
Sacramento, California 95816
(916) 445–0270

Fresno Branch Office
3374 East Shields Avenue
Fresno, California 93726
(209) 488–5116

Redding Branch Office
1815 Sacramento Street
Redding, California 96001
(916) 442–6376

LAHONTAN REGION (6)
2092 Lake Tahoe Boulevard
P. O. Box 14367
South Lake Tahoe, California 95702
(916) 544–3481

Victorville Branch Office
15371 Bonanza Road
Victorville, California 92392
(714) 245–6585

COLORADO RIVER BASIN REGION (7)
73–271 Highway 111, Suite 21
Palm Desert, California 92260
(714) 346–7491

SANTA ANA REGION (8)
6809 Indiana Avenue
Riverside, California 92506
(714) 684–9330

SAN DIEGO REGION (9)
6154 Mission Gorge Road, Suite 205
San Diego, California 92120
(714) 286–5114

STATE WATER RESOURCES CONTROL BOARD

P. O. Box 100, Sacramento, CA 95801

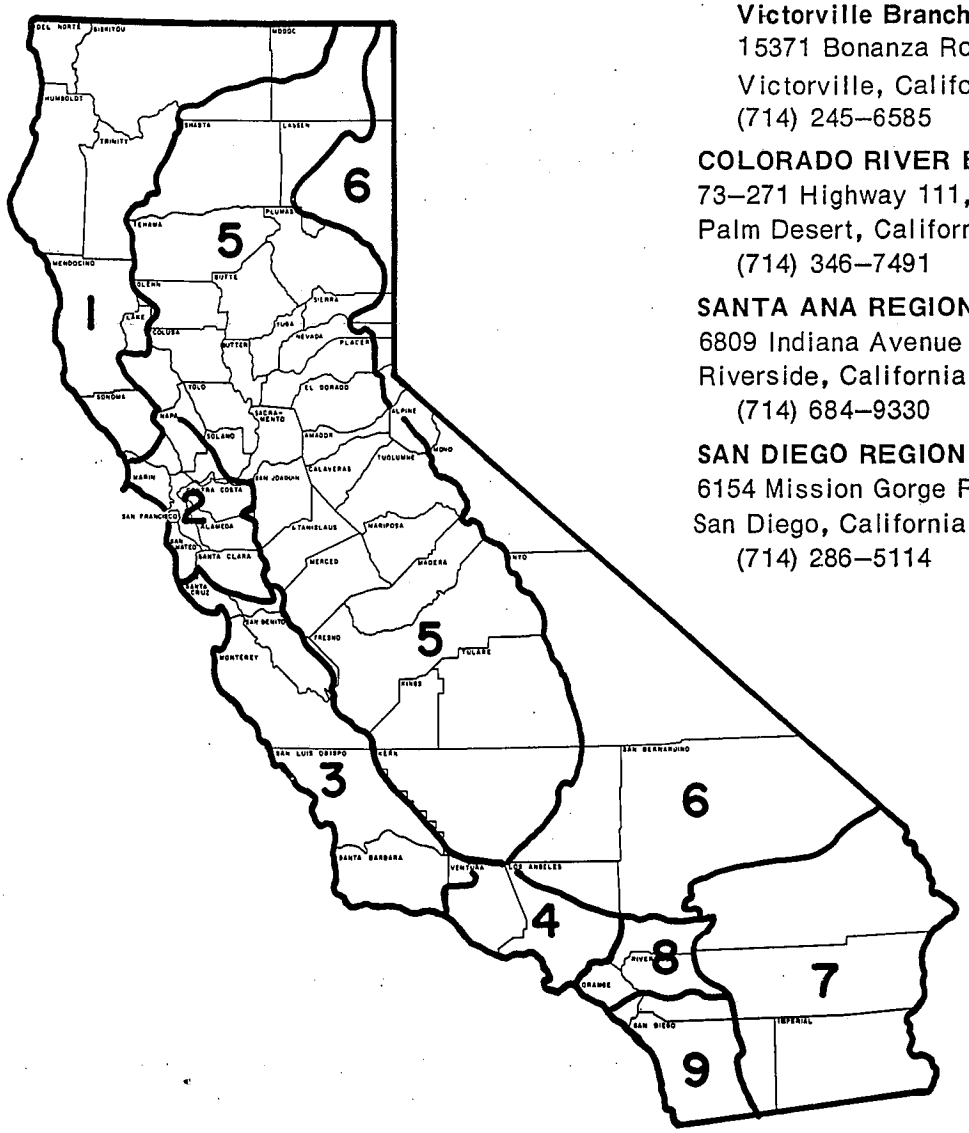
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARDS

NORTH COAST REGION (1)
1000 Coddingtown Center
Santa Rosa, California 95401
(707) 545–2620

SAN FRANCISCO BAY REGION (2)
1111 Jackson Street, Room 6040
Oakland, California 94607
(415) 464–1255

CENTRAL COAST REGION (3)
1122–A Laurel Lane
San Luis Obispo, California 93401
(805) 549–3147

LOS ANGELES REGION (4)
107 South Broadway, Room 4027
Los Angeles, California 90012
(213) 620–4460



CENTRAL VALLEY REGION (5)
3201 S Street
Sacramento, California 95816
(916) 445–0270

Fresno Branch Office
3374 East Shields Avenue
Fresno, California 93726
(209) 488–5116

Redding Branch Office
1815 Sacramento Street
Redding, California 96001
(916) 442–6376

LAHONTAN REGION (6)
2092 Lake Tahoe Boulevard
P. O. Box 14367
South Lake Tahoe, California 95702
(916) 544–3481

Victorville Branch Office
15371 Bonanza Road
Victorville, California 92392
(714) 245–6585

COLORADO RIVER BASIN REGION (7)
73–271 Highway 111, Suite 21
Palm Desert, California 92260
(714) 346–7491

SANTA ANA REGION (8)
6809 Indiana Avenue
Riverside, California 92506
(714) 684–9330

SAN DIEGO REGION (9)
6154 Mission Gorge Road, Suite 205
San Diego, California 92120
(714) 286–5114