COASTAL ZONE
INFORMATION CENTER

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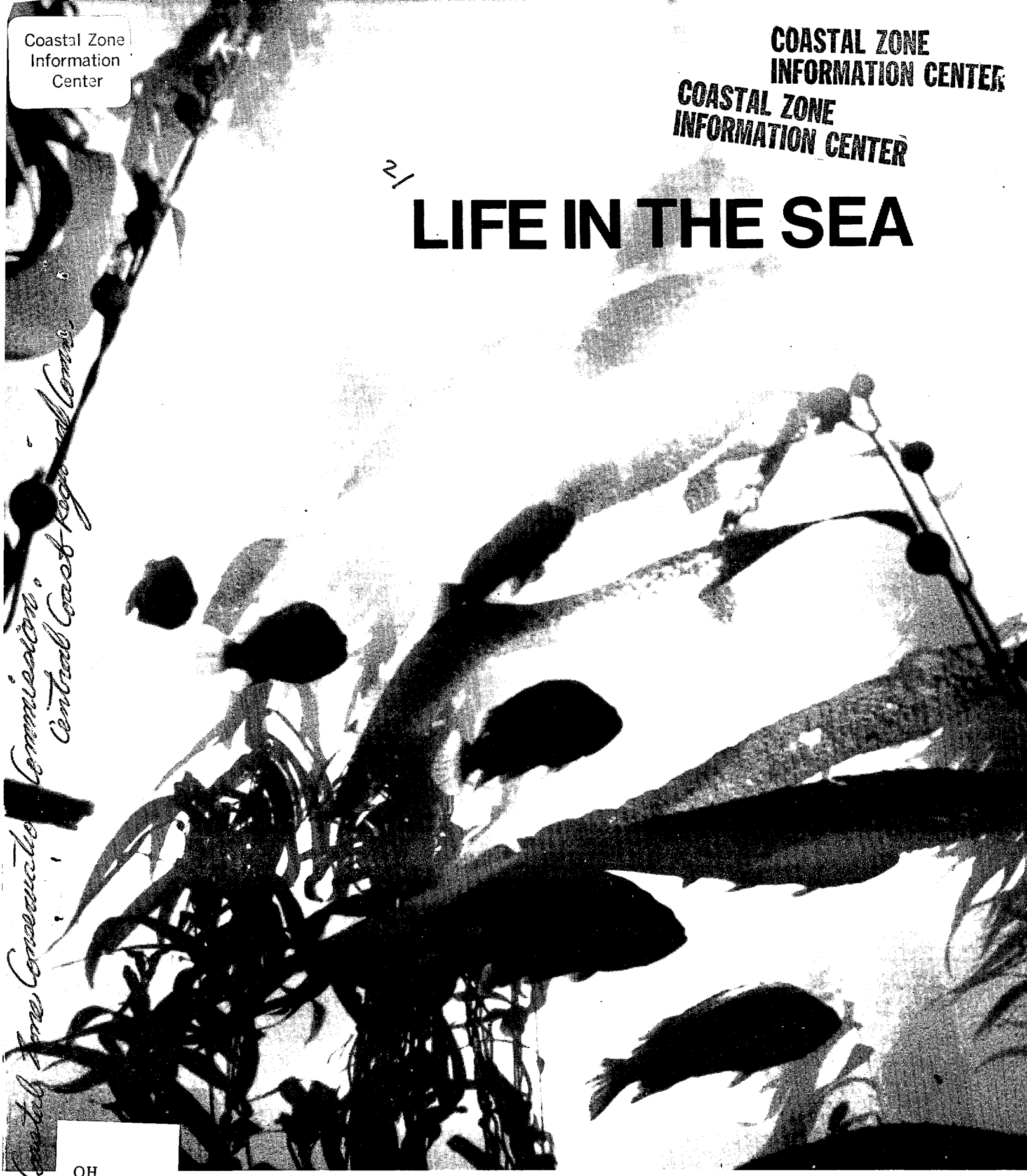
LIFE IN THE SEA



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CENTRAL COAST REGIONAL COMMISSION.

1/ CALIFORNIA COASTAL ZONE CONSERVATION COMMISSION.

LIFE IN THE SEA

Part of a Study of the California Coastal Zone

Summary of the report: "The Marine Environment", compiled by State and Regional Coastal Zone Commission staff, with extensive assistance from Dr. Thomas W. Thompson and Ms. Ruth Andresen.

The California Coastal Zone Conservation Act of 1972, (Proposition 20 at the election of November 7, 1972) created the California Coastal Zone Conservation Commission and six Regional Commissions, and directed them to prepare a comprehensive, enforceable plan for the preservation, protection, restoration, and enhancement of the coastal zone.

This is one of a series of informational reports designed to help the Central Coast Regional Commission carry out this responsibility. Using these reports, the Regional Commission will develop recommendations to the California Coastal Zone Conservation Commission on statewide policy to this Region. These recommendations, together with the recommendations of the other five Regional Commissions, will be the basic materials the State Commission will use in planning the plan for the future of the California coast.

This summary report was prepared by the Commission staff to focus on the most important Coastal planning considerations suggested by the more extensive technical report. Possible planning recommendations based on this report are listed at the end. These are only tentative, since the conclusions based on this report will need to be considered later, after other reports on different aspects of the Coastal Zone have been completed.

CENTRAL COAST REGIONAL COMMISSION

SANTA CRUZ

22 JANUARY 1974

PREFACE

This report is one of thirteen elements of the Coastal Plan covering the following subjects.

1. Marine Resources
2. Coastal Land Environment
3. Geological Hazards
4. Water and Mineral Resources
5. Energy
6. Recreation
7. Appearance and Design
8. Water Transportation
9. Land and Air Transportation
10. Power Plants and Public Utilities
11. Intensity of Development
12. Powers and Funding
13. Government Organization

This summary is abstracted from an extensive technical report covering statewide and regional issues. Copies of the technical report are available for review at the Commission office or at the following public and school libraries:

San Jose State University
Main Library
125 - 7th Street
San Jose, California 95112

Cabrillo College
Library
6500 Soquel Drive
Aptos, California

Hartnell College
Library
156 Homestead Avenue
Salinas, California

San Mateo County Library
Central Branch
25 Tower Road
Belmont, California

Santa Cruz Public Library
Main Branch
224 Church Street
Santa Cruz, California

Half Moon Bay Branch
Public Library
620 Correas Avenue
Half Moon Bay, California

University of California
Santa Cruz
Library
Santa Cruz, California

Monterey Peninsula College
Library
980 Fremont
Monterey, California

Skyline College
Library
3300 College Drive
San Bruno, California

Monterey City Library
Madison & Pacific Streets
Monterey, California

Monterey County Public Library
26 Central Avenue
Salinas, California

Pacific Grove Library
Central Avenue & Fountain Avenue
Pacific Grove, California

Emerson Branch Library
Elm Avenue & Imperial
Seaside, California

Watsonville Public Library
310 Union
Watsonville, California

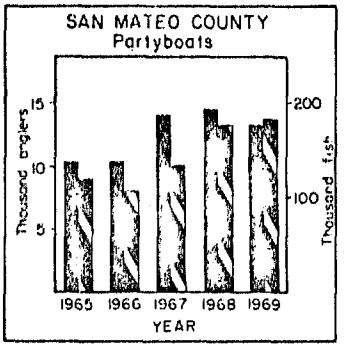
Daly City Public Library
Westlake Main Branch
275 Southgate Avenue
Daly City, California

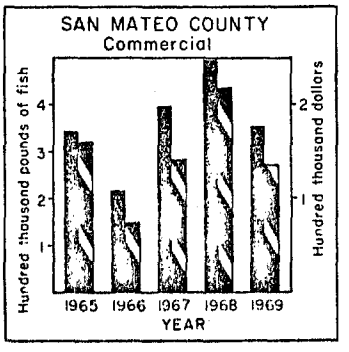
Pacifica Branch Public Library
Hilton Way & Palmetto Avenue
Pacifica, California

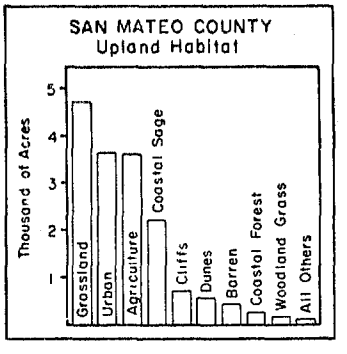
The Central Coast Regional Commission is responsible for planning the coastal region of San Mateo, Santa Cruz and Monterey Counties. Figures 1 through 3, which follow, show the coastal characteristic of this region.

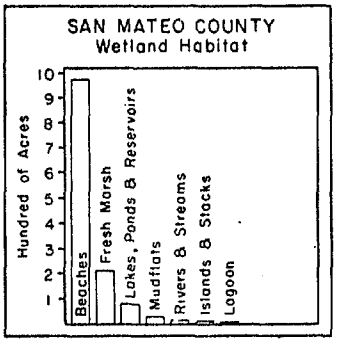
Figure 1

SAN MATEO COUNTY: COASTAL CHARACTERISTICS





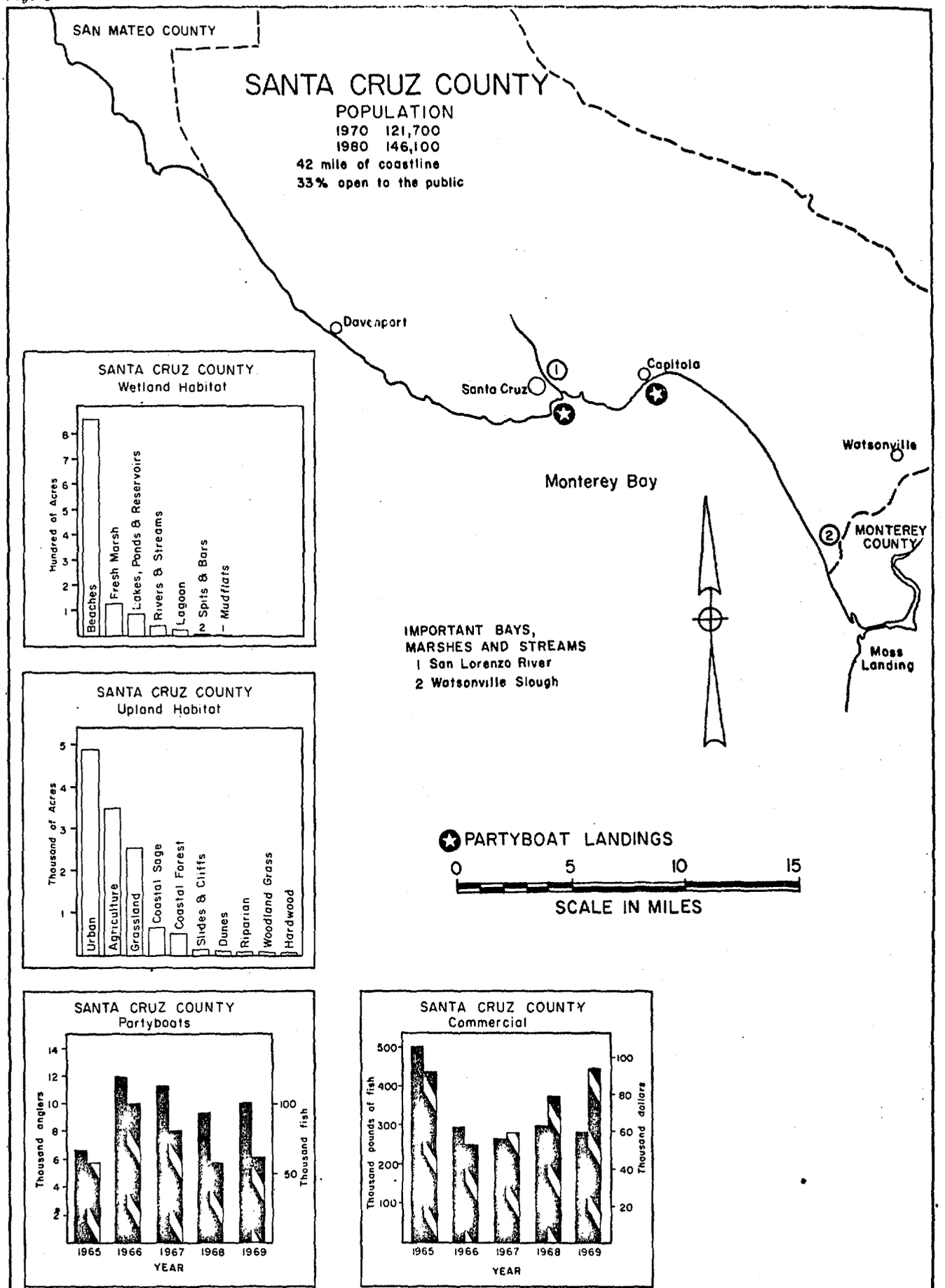




Smith, Emil J., Coastal County Fish and Wildlife Resources and Their Utilization, Department of Fish and Game, California, 1973.

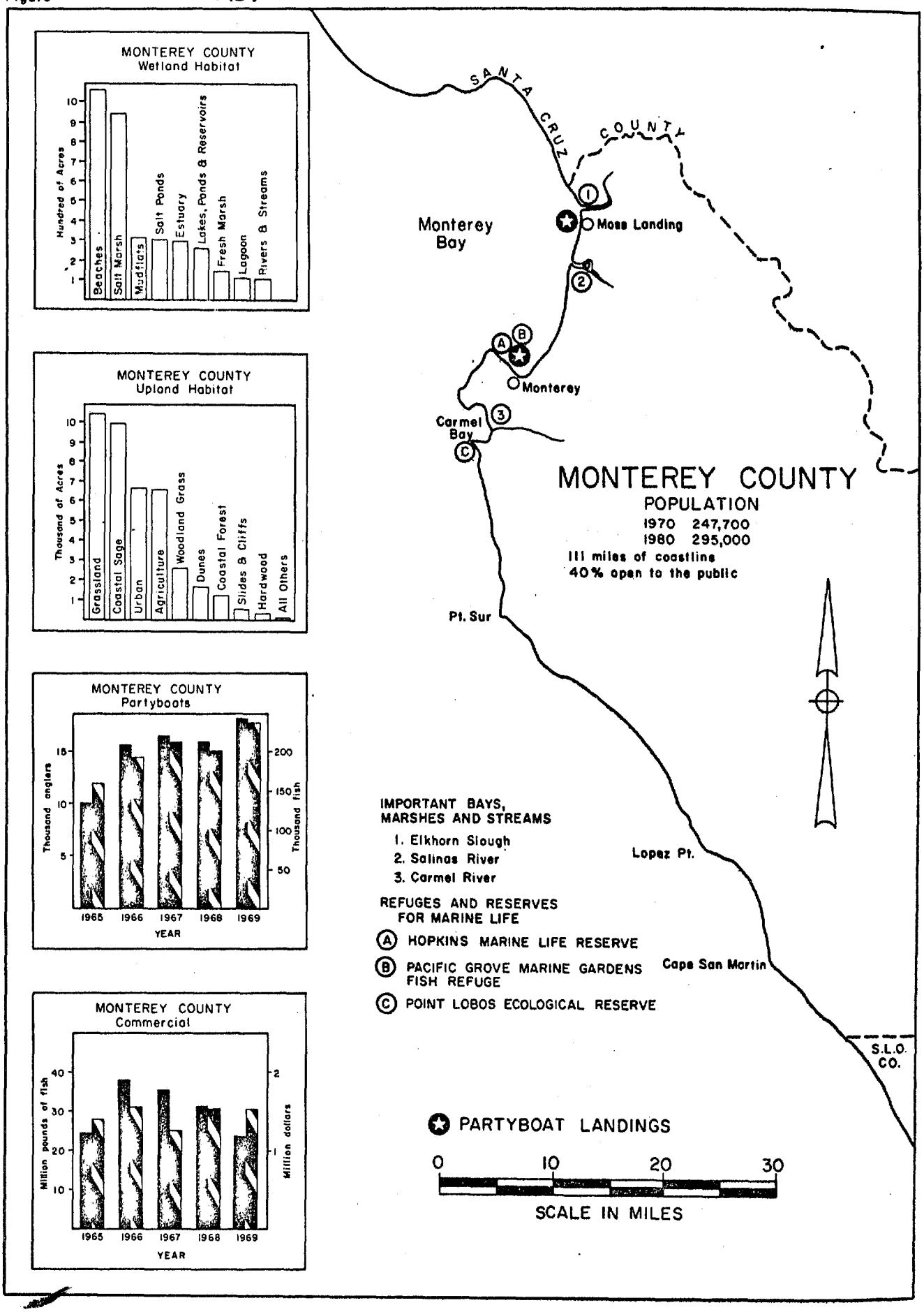
Figure

SANTA CRUZ COUNTY: COASTAL CHARACTERISTICS



Smith, Emil J., Coastal County Fish and Wildlife Resources and Their Utilization, Department of Fish and Game, California, 1973

Figure MONTEREY COUNTY: COASTAL CHARACTERISTICS



Smith, Emil J., Coastal County Fish and Wildlife Resources and Their Utilization, Department of Fish and Game, California, 1973.

Introduction

Along a thousand miles of the edge of the North American continent, the mighty Pacific Ocean caresses the land in the fury of a crashing wave and the gentleness of a silent marsh to create the unique and splendid beauty of the California coastline.

The obvious value of the sea is familiar to most Californians. Sunbathers line the beaches; children build sandcastles in the wet sand; offshore, giant ships ply the coastal waters bringing goods from around the world; and on a hot summer day the roads to the coast are crowded with inland residents pursuing the comfort of cooling sea breezes. Yet beyond these familiar values of the sea lies another aspect of the ocean which is more subtle, less obvious, but of even greater importance to mankind, it is the sea as a source of life.

Perhaps the most familiar living resources of the sea are the seafoods we consume and the fish we enjoy catching. But your omelet, your T-bone, the wax on your car, or the air you breathe tomorrow may all depend in some way on the life of the sea and its continued productivity. For example, fishmeal is an important protein source for many animal feeds so that your omelet, your fried chicken, or even your beef may depend in part on ocean life. An extract of the kelp plant may well form part of your car wax, one of the many common products that uses kelp extract. And most importantly, like all plants, marine varieties give off oxygen that is added to the earth's supply of this most necessary of all elements.

Although little of the sea is without life, the coastal waters are by far the most abundant. The coastal environment is four times as productive of life as the open ocean; 90% of the world's fisheries are in coastal waters, even though these areas atop the continental shelves make up only 10% of the ocean surface. Marine life is abundant along the California coastline because the waters are enriched with nutrients washed from the land, nourished by estuaries and wetlands that are among the most productive living systems on earth, dotted with kelp forests that contain more different kinds of plants and animals than do temperate land forests, and aided by underwater features that increase the circulation of nutrients and add to the productive area of the coastline. Unfortunately, however, with 50% of the California population living in the coastal zone, the near-shore waters also have been subject to the greatest abuse through the filling of estuaries to create more marketable real estate, the dredging of wetlands to accommodate recreational and commercial boating, the use of coastal waters as a sump for domestic sewage and industrial wastes, and the over-use of the most delicate and beautiful sections of the coastline by urbanites hungry for a communion with nature. Ironically, the most valuable elements in the marine environment are the most severely threatened by the civilization that so intimately depends on those resources.

Physical Qualities of the Sea

From the beach, the sea appears to be a generally flat surface, punctuated with a few rocks or shoals near the shore and perhaps the outline of an island on the horizon. In fact, however, the sea bottom has a more varied and rugged terrain than any found on the surface of

the continents. Extending west from the California coastline is the continental shelf, a gently sloping, submerged platform reaching outward about 40 miles to the continental slope which drops off dramatically into the deep basins of the Pacific. The rugged topography of the slope is steeper than any of the continental mountain ranges and extends downward to depths exceeding 6,000 feet. Along the California continental slope, 27 great V-shaped submarine canyons cut their way through the slope toward the shoreline. The Central Coast Region has an extensive system of submarine canyons (see Figure 4). The Monterey Submarine Canyon is among the largest of these features in the world and compares with the Grand Canyon in its dimensions (see Figure 5). The canyons act as transportation routes for nutrients from the deep sea basins up into the inshore waters; the nutrients are drawn up by the process of upwelling which occurs as the prevailing winds cause surface waters to move away from the land, allowing the deep water to flow up to replace it. This process is important not only from the fisheries standpoint, but, also, from the standpoint of providing a unique study area for the several marine research institutes located around the bay.

The richness and productivity of the California marine environment is further increased by offshore islands, which generate upwelling and contain coastal habitat of their own, and by underwater mountains and ridges that often extend upward into the "euphotic zone", the water depths penetrated by sunlight, where sea plants are able to use the light to make food through photosynthesis.

Life in the Sea

The sun is the ultimate source of energy that fuels all life processes in the sea and on the land. Only plants are able to manufacture their own food, employing photosynthesis (literally "putting together

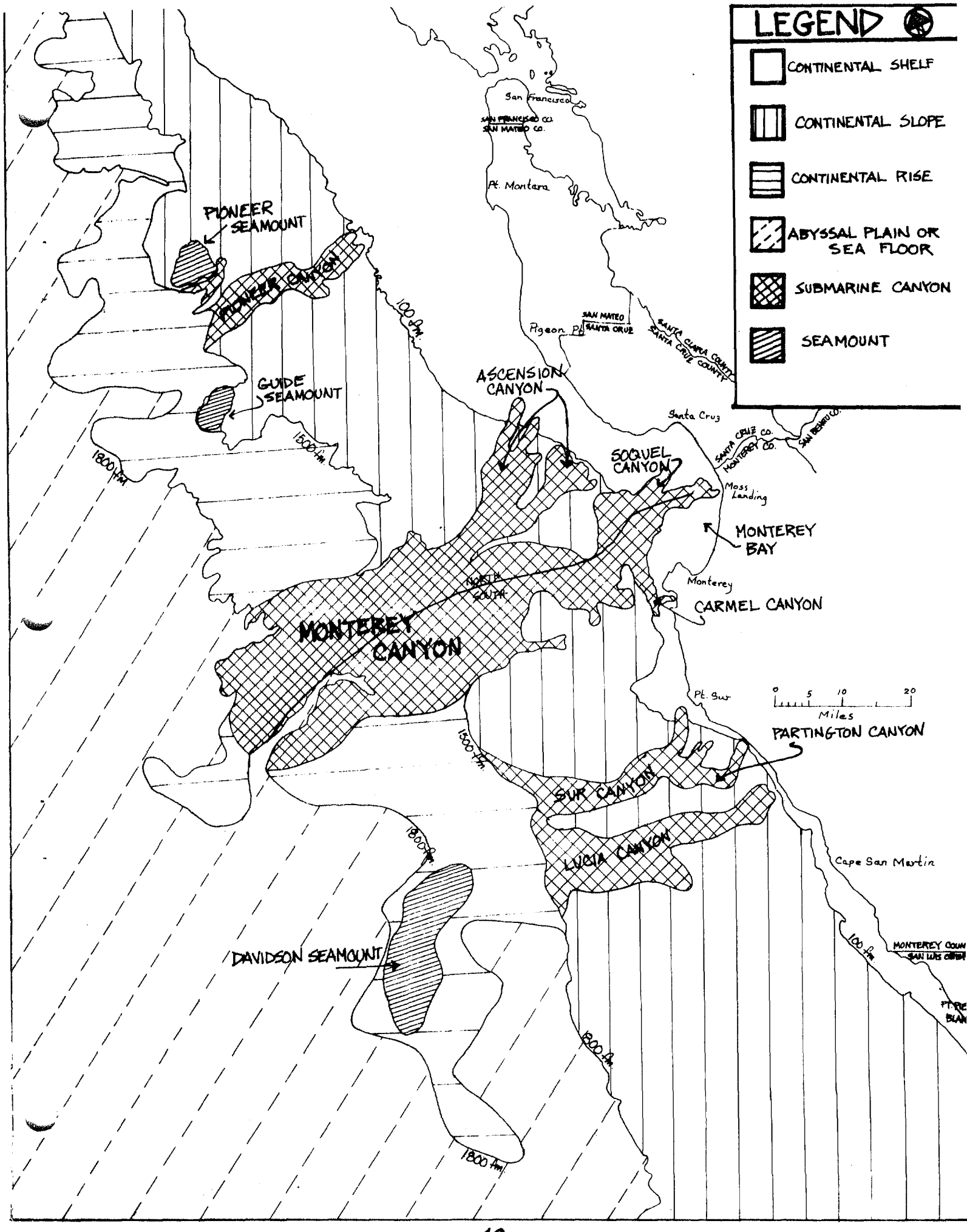
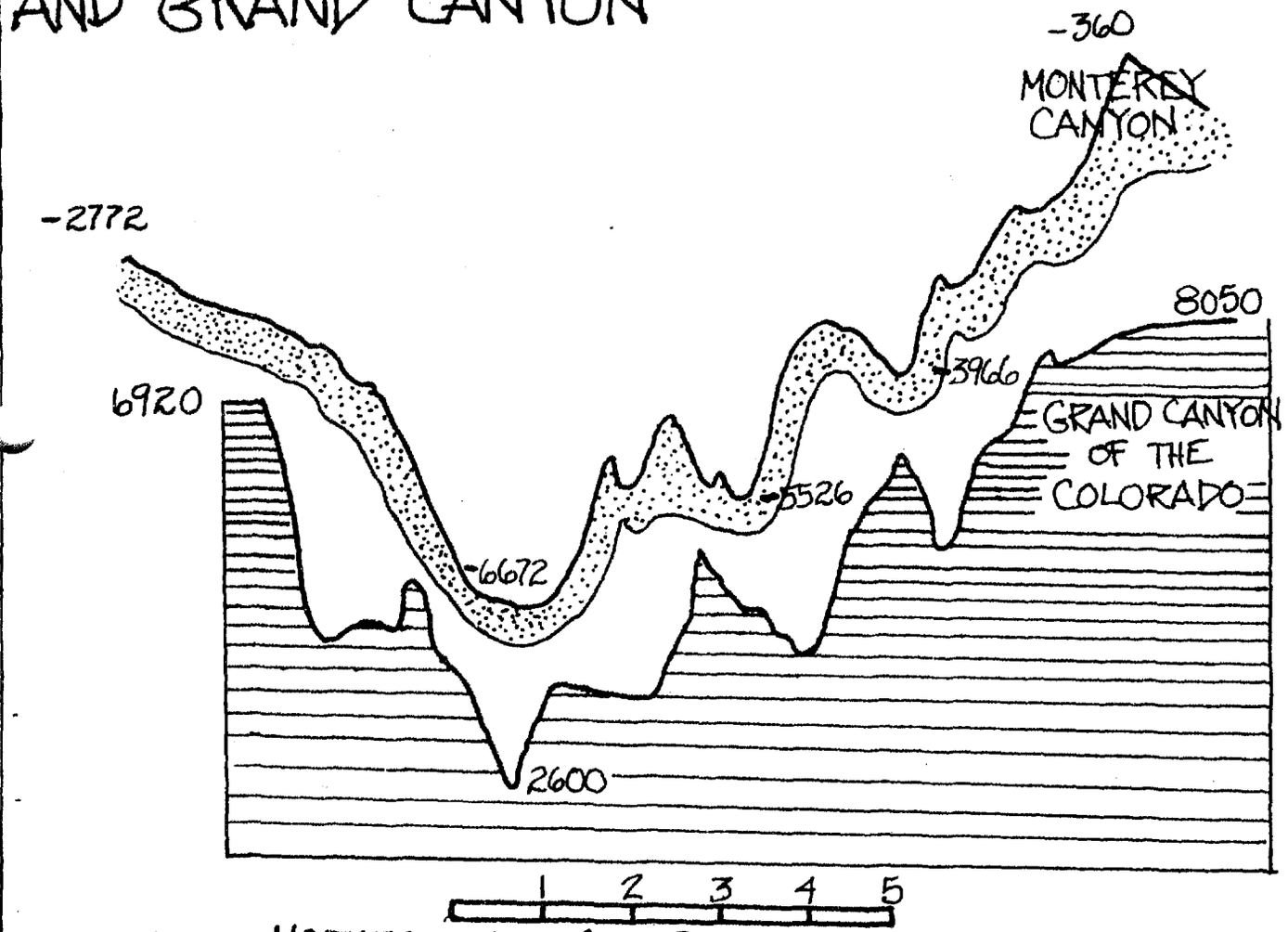

LEGEND
CONTINENTAL SHELF
CONTINENTAL SLOPE
CONTINENTAL RISE
ABYSSAL PLAIN OR SEA FLOOR
SUBMARINE CANYON
SEAMOUNT
San Francisco
SAN FRANCISCO CO.
SAN MATEO CO.
Pt. Montara
PIONEER SEAMOUNT
PIONEER CANYON
100 fm
Pigeon Pt.
SAN MATEO
SANTA CRUZ
SANTA CLARA COUNTY
SANTA CRUZ COUNTY
GUIDE SEAMOUNT
ASCENSION CANYON
1500 fm
1800 fm
Santa Cruz
SANTA CRUZ CO.
MONTEREY CO.
SAN BENITO CO.
SOQUEL CANYON
Moss Landing
MONTEREY BAY
NORTH
SOUTH
MONTEREY CANYON
Monterey
CARMEL CANYON
Pt. Sur
0 5 10 20
Miles
PARTINGTON CANYON
SUR CANYON
LUCIA CANYON
Cape San Martin
DAVIDSON SEAMOUNT
100 fm
MONTEREY COUN
SAN LUIS OBISP
1800 fm
1800 fm

FIGURE 5

COMPARATIVE PROFILES OF MONTEREY CANYON AND GRAND CANYON



HORIZONTAL SCALE IN STATUTE MILES
ELEVATIONS IN FEET
VERTICAL X 5

with light") to change carbon dioxide and water into oxygen, which is given off as a waste product, and a high energy carbohydrate compound which, in turn, can be combined with other substances to form protoplasm, the basic living compound. Two elements essential to photosynthesis are nitrogen and phosphorus, which are plentiful along the coastline because algae on tidal mudflats are capable of transforming atmospheric nitrogen into a form that can be assimilated by plants, while salt marsh plants are able to transfer phosphorus compounds from the mud into the water. With this rich supply of basic materials, the coastal marine environment can support large populations of "phytoplankton" (meaning "wandering plants"). These microscopic plants drift in the surface currents where they are consumed by the tiny "zooplankton" ("wandering animals") in the first step of the marine food chain. The zooplanton are, in essence, living vacuum cleaners that filter phytoplankton from seawater. They are necessarily far less numerous than the phytoplankton but are still far more numerous than the larger forms of marine life most familiar to man.

In the next link of the marine food chain are a wide variety of small marine animals that prey on the zooplankton. Carnivorous worms, tiny creatures shrimp-like in appearance, and fish larvae are included in this group of planktonic predators which, in turn, are the food source for creatures capable of swimming vigorously and moving independent of ocean currents (called "nekton"). Herring, sardines, and the gigantic blue whale feed on plankton throughout their entire lives, while squid consume plankton during their juvenile stages, switching to small fish as they grow older. A third type of nekton that includes sharks, tuna, and most marine mammals feed entirely on

smaller fish and squid. This last group represents the apex of the marine food chain, for its members are preyed upon only by each other, by parasites, and by man.

Thus, man's use of the living resources of the sea as a food source ultimately depends on an abundance of the tiny phytoplankton. A single fish or large marine mammal will require many tons of the microscopic plant plankton through the intervening links in the marine food chain that eventually lead to the dinner table of man.

Food and Income from the Sea

In 1970, the commercial catch landed in California totaled 703 million pounds of seafood, of which 330 million pounds of finfish and 49 million pounds of shellfish were caught in California coastal waters. Sport fishermen caught another 30 million pounds of finfish during 1970.

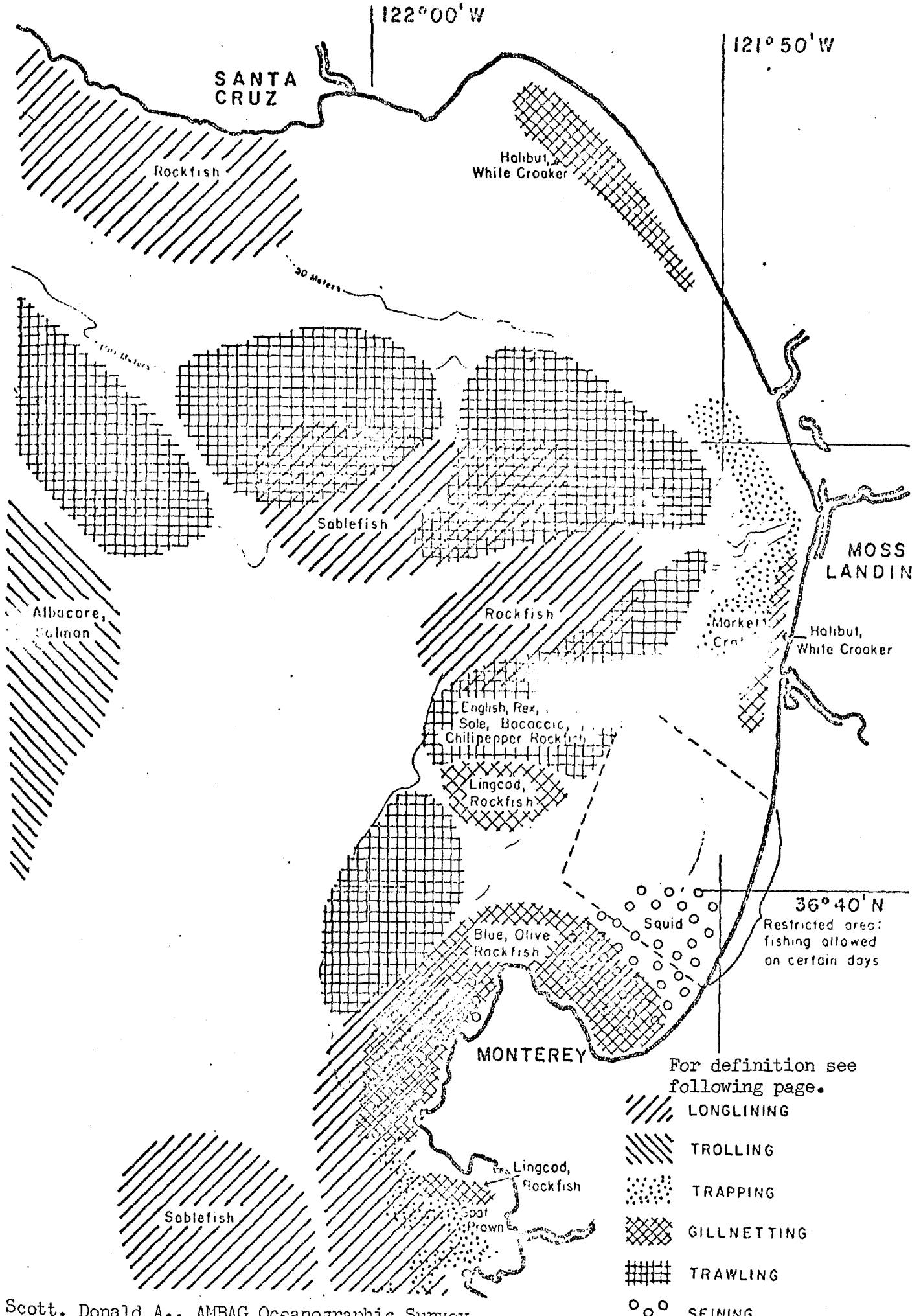
The living resources of the sea harvested by Californians include finfish, shellfish, marine mammals, and marine plants. Finfish are by far the largest component of the commercial catch with tuna, salmon, rockfish, sharks, and bass being among the popular species within this category. The term "shellfish" covers two groups of sea animals, mollusks and crustaceans. The mollusks include the familiar clams, oyster, snails, octopus, and squid. Crustaceans of commercial importance in California are crabs, shrimp, and spiny lobsters. Together, the finfish and shellfish catch had a landed value of $113 million in 1970, but this represented only part of the impact of the fishery because once caught, the fish had to be processed and marketed. In the Central Coast Region, catches valued at over $2 million were landed by commercial fishermen in 1970. These additional costs are reflected by the retail value of the catch, which came to $365 million in 1970. Additional

economic benefits are derived from foreign fisheries owned by California firms, increased prices received for poultry and meat products fed on fishmeal, fisheries research and development, and food service jobs attributable to fisheries. These benefits are substantial even if it is impossible to quantify them. Figure #6 shows the commercial fishing areas and methods in Monterey Bay.

In addition to the commercial fishermen, the marine sport fishermen make an important contribution to the California economy. In 1970, they spent over $114 million in their recreational pursuit, and these expenditures, in turn, generated another $93 million in "secondary income effects" (wages and profits to services and manufacturers catering to the sport fisherman). Figure #7 shows the sport fishing areas and methods in Monterey Bay. Also see Figures #1, 2, &3 for fishing information on a county by county basis. In the Central Coast Region, almost $7 million was generated by sport fishermen in 1970.

Marine mammals found along the California coastline include sea otters, elephant and harbor seals, California Stellar sea lions, dolphins, and whales. Over the years, hides, oil, meat, fur, bones, and gland extracts of these mammals have made an important economic contribution to California; however, the populations of marine mammals became so seriously depleted by heavy commercial exploitation that their harvest is now prohibited by federal law. Point Ano Nuevo is an important rookery for marine mammals. The California Sea Otter Preserve extends south from the Carmel River to Santa Rosa Creek in San Luis Obispo County.

Kelp dominates the commercial utilization of marine plants, with the 1972 harvest being worth about $1.63 million. "Algin," an extract from the kelp, is put to hundreds of uses in foods, medicines, cosmetics, textile products, adhesives, acoustical tile, ceramic glazes, leather finishes, and auto polishes. Several other types of algae are put to commercial use including gelidium, the source of the extract "agar" which is used in diet



Scott, Donald A., AMBAG Oceanographic Survey, Santa Barbara, California. April. 1973.

COMMERCIAL FISHERIES

DEFINITIONS

LONGLINING - This type of trolling employs branch lines off a long main line all of which bear a baited hook. They are set along the sea floor to catch bottom fish such as sablefish and rockfish in Monterey Bay, vermillion and canary rockfish in the Point Sur area.

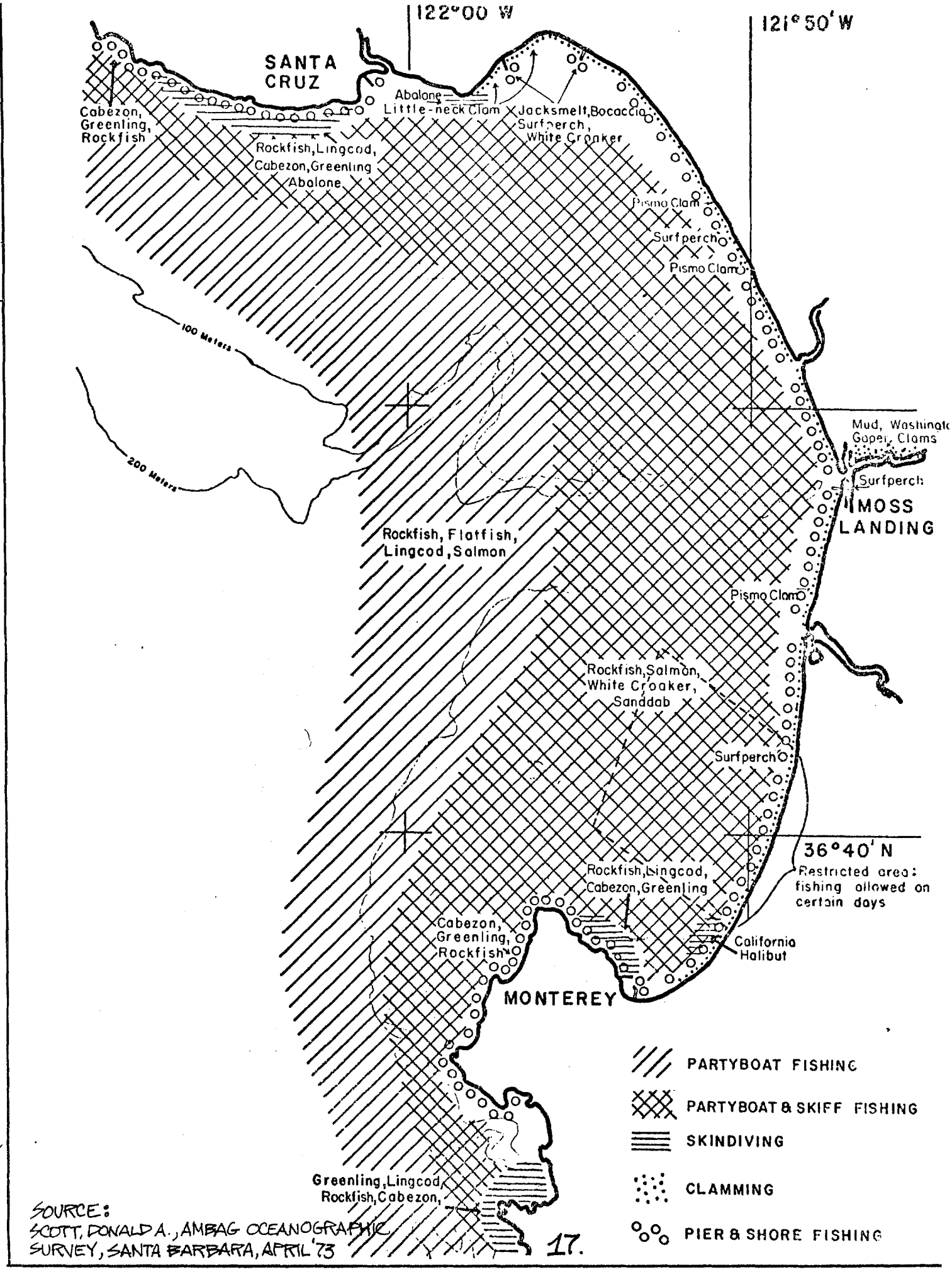
TROLL - Trolling is the process of towing a lure through the water behind a moving boat. Salmon trollers fish about 6 to 8 lines, albacore trollers have 11 or 12 lines per boat. Albacore lines are retrieved by hand, salmon lines are retrieved by mechanical means.(Ødemar 1968)

TRAP - Traps are used for market crab primarily. The trap or "pot" is baited, lowered into water 5 to 40 fathoms deep and left for one to three days. In Central California the crab fishery has shown a decline since the 1960-61 season.

GILNETTING - The gill net is designed to entangle fish in thrier meshes and so are floated in the water like a curtain. The mesehes are large enough for the fish to push its head into the net, but the gills catch if it tries to back out. Gillnetting is used for white seabass, Calif. halibut, lingcod, white croaker, and rockfish varieties.

TRAWL - Otter trawl method employs a net shaped like a flattened bag that is dragged or "trawled" across the ocean bottom. The mouth of the net is held open by divergin vanes and raised or lowered by winches. Fish taken are mostly bottomfish such as Dover sole, English sole, petrale sole, rex sole, sand sole, sanddabs, and California halibut, and rockfish such as bocaccio, chilipepper, as well as sablefish and lingcod.

Roundhall - (Seining) In roundhaul fishing the location and size of a school of fish is determined by electronic equipment. Next, the purse seine or lampara nets are laid out surrounding a school of fish in deep water. After the nets are hauled in to concentrate the fish they are scooped into the hold of the fishing vessel. The great sardine fishery was this type, however at the present time it is used for anchovy and squid.



SOURCE:
SCOTT, DONALD A., AMBAG OCEANOGRAPHIC SURVEY, SANTA BARBARA, APRIL '73

foods, jellies, and medicine, and porphyra used in Japanese foods. While Kelp is a more important crop in Southern California, it is significant in the Central Coast Region as a habitat for the endangered Sea Otter.

The total economic impact of the primary, secondary, and unquantifiable benefits of the living resources of the sea is substantial. By even the most conservative estimates, it has been determined that the harvest of marine plants and animals adds about $600 million to the California economy each year.

To increase the productivity and income from the sea, "mariculture" is being applied to several species. Mariculture is the marine equivalent of agriculture, involving the cultivation and harvest of marine organisms. The scale of operation can range from minor manipulation of an element that influences production, such as the removal of predators, to total management and controlled rearing of a species through all stages of its life cycle. Because of its relatively high costs, mariculture is presently limited to "luxury foods"; in the future, however, mariculture techniques may be applied to other species or may reduce the costs of these "luxury" foods.

Because of their sheltered waters and stable growing condition, estuaries are the favored location for mariculture operations. With a few minor exceptions, mariculture can exist harmoniously with any activity that does not cause pollution or deterioration of the marine environment. One serious exception is warm water discharges, which can increase mariculture productivity but can also seriously disrupt the habitat of native species. Five mariculture companies are licensed to operate in Monterey County, including one which uses PG&E's warm water discharge in Elkhorn Slough.

Fisheries Management Problems

At best, it is expected that the world production of protein from the sea can reach a level about 2½ times the present level. Therefore, to fulfill California's future needs, which have been estimated to be almost 2½ times the present consumption level by the year 2000, a comprehensive fisheries management program is necessary. Unfortunately, such a program does not presently exist because foreign nations, agencies of the federal government, other states, and two different departments of the State of California now share jurisdiction over several of the same water areas or species, and these multiple authorities sometimes have different policies that may not apply to all the fishermen concerned. Ideally, fisheries management should be addressed by a comprehensive international program. And California, as a major fisheries state, should play a vigorous leadership role towards achieving it.

To maintain an economically viable fishing industry in California, adequate berthing facilities should be provided for commercial fishing fleets which sometimes tend to be displaced by vessels capable of paying higher fees. No existing commercial fishing port space should be eliminated unless adequate substitute space is assured. Active commercial fishing boats should be given priority when harbors are expanded in the Central Coast Region.

Threats to the Living Resources of the Sea

With most of the California population living near the sea, and with this population continuing to rise, the coastal marine environment will continue to be subjected to several kinds of danger stemming from man's activities. These include: filling, diking, dredging, waste disposal, oil spills and excessive use for recreation and educational study and research.

The importances of Monterey Bay for commercial and sport fishing as well as for marine research has been demonstrated in a number of studies. Activities such as industrial shipping; urban, agricultural and industrial waste discharge; and oil exploration or extraction which may tend to degrade the quality of the Bay must not be allowed. Similarly, those activities already existing which may tend to degrade the quality of Monterey Bay and the coastal waters should be eliminated or mitigated to remove the threat of environmental deterioration.

1. Filling and Dredging. Of all of man's activities, the one most destructive to the marine environment is the diking and filling of a water-covered area; this entails the complete destruction of the area as a marine environment. The desire for new building areas and the need to dispose of solid wastes has led to extensive filling of estuaries (river deltas, bays, and lagoons) and wetlands (marshes and mudflats) along the coastline. These most productive of marine environments have also been dredged for ports, marinas, and navigational channels. Of the 197,000 acres of original estuarine and wetland environment, 102,000, or 52%, have been destroyed by dredging or filling.

At the turn of the century, there were 28 sizable estuary and wetland environments in southern California alone. Two-thirds of these have been dredged or filled. This loss is particularly devastating because estuaries and wetlands are essential elements in the living marine system for many reasons. Almost all sea fishes and many animal species make use of the estuaries and wetlands at some point in their life cycle either for habitat, spawning, or feeding. Moreover, estuaries and wetlands are especially rich in plant and animal life; they are shallow, allowing the sunlight that is necessary for photosynthesis to reach the bottom, and they receive an abundant supply

of nutrients from land runoff. As a result, salt marshes are among the most productive living systems and are comparable to intensively cultivated, rich tropical agriculture. Finally, phosphorus and nitrogen are made suitable for phytoplankton use by estuarine plants. Elkhorn Slough and Pescadero Marsh are the central, most valuable estuarian and wetland areas. They provide important marine and bird habitats. The following statistics show the varied beneficial uses of Elkhorn Slough:

12 duck clubs use the marsh habitat for hunting.

26,000 annual angler-days of sport fishing take place in the area.

2,500 man-days annually of clamming.

200 commercial fishing boats produce approximately $750,000 in estuarine dependent catch.

150 non-commercial boats moor at the mouth of the slough.

1,600 man-days were expended in the area for nature study, birdwatching, and photography.

The dredging of bottom material to create deeper water generates many problems. The removal of the material stirs up the bottom, creating turbidity that can limit photosynthesis in the affected waters. Additionally, dredging can recirculate oxygen-demanding or toxic materials that have accumulated in bottom muds over many years. Newly-dredged channels can change water circulation patterns in estuaries and introduce new conditions that the native species of plants and animals cannot tolerate. And dredging can completely destroy tidal mudflats and salt marshes which are the most productive parts of the estuarine system.

The disposal of the dredged material, or spoils, repeats these problems because they are often deposited back in the water at another location, creating turbidity and recirculating toxic material. In addition, the disposed spoils can smother bottom-dwelling organisms.

Not all the effects of dredging are bad, however. In addition to the obvious economic benefits for which a dredging project is undertaken in the first place, some of the dredging can be restorative, as when a silted-in lagoon mouth is dredged open or when circulation is improved in a previously stagnant area. Also, proper disposal of spoils in nearshore waters can help restore critically-needed sand to beaches downdrift from the disposal site, as will be explained in the Geology plan element. In addition, problems such as turbidity pass with completion of a project and may not be overly destructive if the project is of short duration. However, most projects occur in the partially-enclosed waters of estuaries where the amount of area affected is comparatively large and the effects greatly multiplied.

Because coastal estuaries and wetlands are so vital in the marine life system, and to the vitality of the California fishing industry, and are the best potential sites for future mariculture development, all remaining coastal wetlands and estuaries must be preserved to the maximum extent feasible. New marshes should be created wherever possible except where they would significantly reduce the open water area of an enclosed body of water or would change water circulation patterns adversely. Any further land fill and dredging operations in wetlands, estuaries, and lagoons should be restricted to the most clear public necessities, such as ports, and even then, executed in a manner least harmful to the environment.

To prevent smothering of bottom life and the clouding of the water by spoils from dredging projects, spoils should be disposed of in one of the following ways: (a) placement on dry land; (b) placement in any fills that may be determined to be in the public interest as determined by other plan elements; (c) barged or piped to sites in the ocean

where the spoils would aid in downdrift beach replenishment; or (d) disposal into naturally turbulent areas such as the head of Monterey Submarine Canyon. Ocean dumped spoils should not be placed near Kelp beds as suspended solids and pollutants reduce photosynthesis and could adversely affect this valuable habitat. Nor should dredge spoils be dumped into estuaries or wetlands causing disruption of these valuable habitats. Pending completion of improved methods of spoils handling, complete compliance with these alternatives may not be possible. In such an event the choice of the disposal site should be based upon an evaluation of which feasible method is least harmful to the marine environment.

To prevent dredging projects from releasing toxic substances that may have been embedded in the bottom materials, the bottom mud should be tested for toxicity; then spoils from any layers containing the toxic material should be carefully removed and disposed of on land in such a manner that they cannot enter the water table such as behind impervious dikes. The balance of the spoils could safely be disposed of in one of the three ways mentioned above.

2. Waste Water Disposal. "The solution to pollution is dilution" was once a reasonable idea but that was when there were fewer people and a greater amount of water that had not yet been used to dilute wastes. Even so, most wastes can be disposed of safely if discharged at levels of concentration that do not alter the functional balance of the system that receive them. This is because the vast bulk of wastes are natural materials the seas readily process. Thus, the confinement and circulation of the receiving waters are of critical importance in judging environmental impact, with more confined spaces such as bays, estuaries, and lagoons experiencing greater damage from

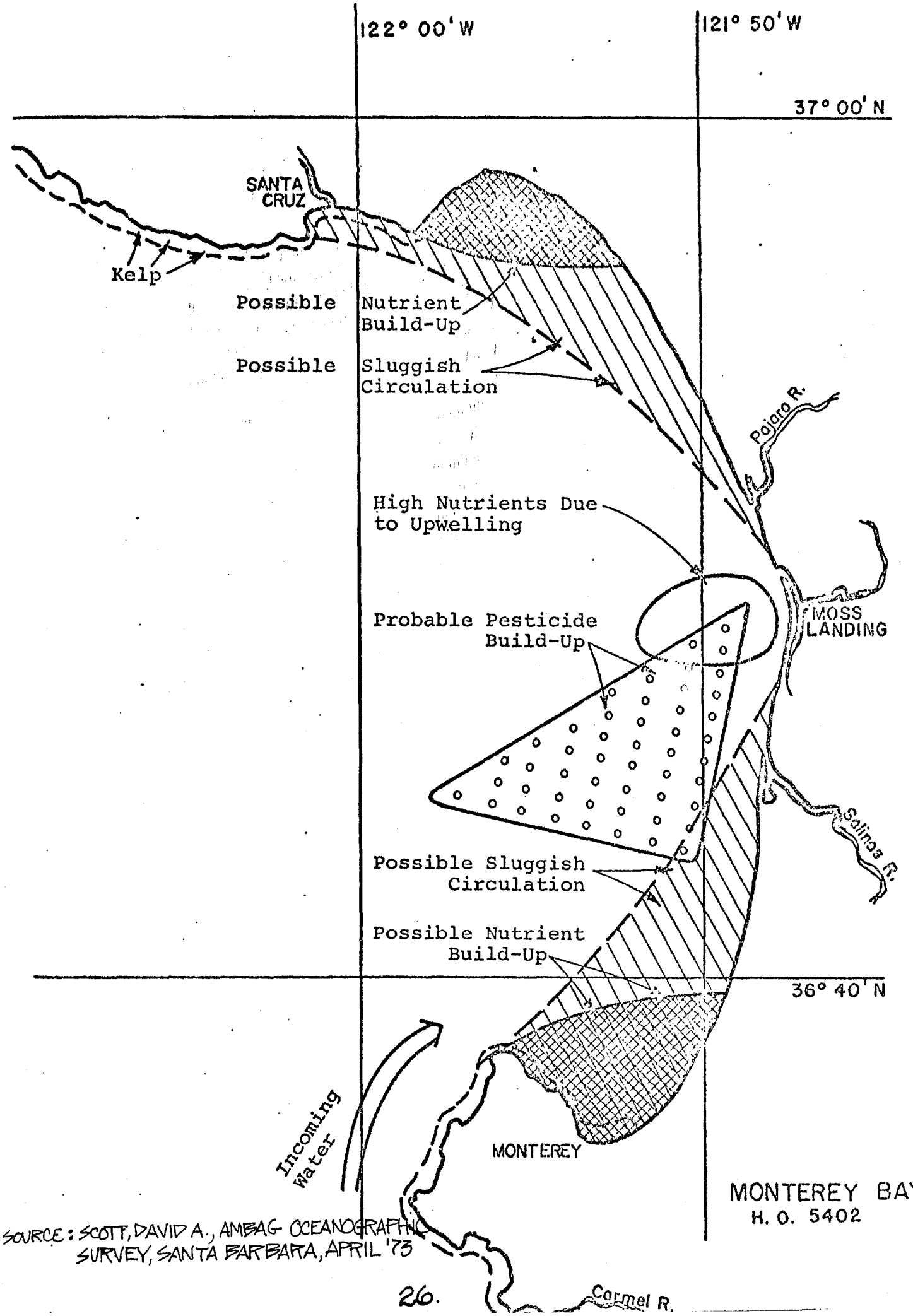
waste water disposal (even to the point of being choked or smothered) than open water such as the ocean offshore. Even so, offshore disposal of some pollutants can create damage if there is a greater concentration of waste than the ocean currents can effectively disperse. A more serious problem are poisons, which no system can tolerate.

Along the California coastline, 400 waste disposal outfalls annually dump 9.16 trillion gallons of domestic sewage into bays, estuaries, lagoons, and inshore waters. In Monterey Bay alone, there are nine sewage outfalls accounting for 8.18 billion gallons annually. Additional billions of gallons of seawater used for cooling power plants are discharged into marine waters; these waters contain no wastes but their temperature has been increased. Most sewage presently receives only primary treatment, which allows 60 to 70 percent of the organic material in the waste to be discharged for decomposition in the receiving waters. The bacteria that decompose the organic waste require oxygen for this task. The disposal of large amounts of organic material can result in such a high oxygen demand that the oxygen supply in the water will become depleted. This will cause algal blooms, fish kills, stagnation, and foul odors. This is particularly a problem in enclosed water bodies. On the other hand, if sewage is adequately treated it can be beneficial to bays, estuaries, and lagoons for it acts as a supplemental fresh water inflow. Federal law requires secondary treatment of all sewage by July, 1977, which will remove from 80 to 90 percent of the oxygen-demanding wastes.

The State Water Resources Control Board and its Regional Water Quality Control Boards have the responsibility of regulating waste water discharges in California. To help these Boards to further reduce the adverse effects of new developments in the coastal zone upon water

quality, four steps should be taken: (a) no development should be allowed if it does not meet Water Board standards for obtaining a discharge permit; (b) when the Water Board has indicated that it is considering the adoption of higher standards, projects should be approved only if they will be able to meet the higher standards if they are adopted; (c) development that would adversely affect water quality in areas of special environmental value (e.g., a wetland or estuary that could be severely damaged by erosion caused by the development or effluent from septic tanks) should not be approved unless the construction is modified to completely prevent damage to the water area, and (d) support Water Board's efforts to declare Areas of Special Biological Significance and assure their preservation. Moreover, to enhance the productivity of coastal wetlands and estuaries that depend upon fresh water inflow, statewide funding priority for upgrading sewage treatment from primary to secondary should be given to existing discharges into such bays and estuaries, rather than to improving discharges emptying directly into the ocean.

Marine organisms are adversely affected by chlorine if used in excessive amounts in treating sewage, by toxic chemicals such as DDT, and by heavy metals such as mercury, lead, copper, and zinc. Most notorious have been the pesticides such as DDT and heavy metals such as mercury. These are not only lethal, they are also persistent; that is, they remain effective for a long time. They can enter the food chain in plants, be taken up by fish and birds, and ultimately be ingested by man, with occasionally devastating effect such as the mercury poisoning tragedy in Japan in 1968. While a large environmental system such as the ocean can tolerate a certain amount of lethal material, it is now deemed mandatory that all possible efforts be made to prevent such materials from being discharged into the marine environment. Figure #8 shows pesticide and nutrient pollution problems in Monterey Bay.



SOURCE: SCOTT, DAVID A., AMBAG OCEANOGRAPHIC SURVEY, SANTA BARBARA, APRIL '73

Heated water discharged from the cooling systems of power plants and industries has both positive and negative effects on marine organisms. On the positive side, there has been some increase in the populations of some species around outfall pipes, and the warmed water is beneficial to mariculture operations because it speeds up the growth of the cultivated organisms. Unfortunately, there are also some negative effects of thermal discharges. Some species cannot tolerate the warmed water and will die off or leave to be replaced by other species that can live in the warmer water. The effect of heated water on kelp has been researched intensively and it is generally agreed that the kelp cannot tolerate higher-than-normal temperatures without some deterioration.

Many species of marine life reproduce only within certain temperature ranges, while others are stimulated to migration by temperature changes. Thus, artificially heated water can disrupt both reproduction and migration patterns. Finally, as water temperatures increase, the amount of dissolved oxygen the water can hold decreases while the life processes of marine organism require more oxygen at higher temperatures. This can result in a rapid die off of marine plants and animals under extreme conditions.

Very hot water and toxic chemicals are sometimes used to flush out the barnacles, mussels, and worms that can accumulate within an industrial cooling system. This flushing process can profoundly reduce marine life in the immediate vicinity of the outfall for a short period of time. A more general problem is the entrainment and killing of zooplankton, fish larvae, and small fish when ocean waters are drawn off for use in cooling, for desalinization of the water, or for the extraction of minerals. The extent of this "kill" is largely unknown but it can be minimized by drawing the water from deep, cold basins where few zooplankton and larvae are found.

To avoid adverse effects of using seawater for cooling in power and industrial plants a number of steps should be taken. Until more is known about the extent of damage to marine life, the most current economically feasible means of minimizing the intake of zooplankton, fish larvae, and fish into the cooling system should be utilized. Wherever possible, water used for cooling should be drawn from deep, cool basins where zooplankton and fish populations are at a minimum. High funding priority should be given to research on the effects of heated water upon the affected marine environment, and "baseline" studies of the existing marine system should be undertaken several years in advance of construction of a major cooling water discharge. Until more is known about its effects, warmed water should be discharged into the sea only at locations where strong currents are present to insure dispersal of the heated water. No new discharges into bays or estuaries should be allowed unless currents are adequate for heat dispersal, the discharge is part of an approved mariculture project, or study has been adequate to conclude no adverse effect to the enclosed water body will result. Long-term thermal discharges that would raise the water temperature in kelp beds beyond the plants' point of tolerance should not be allowed unless the discharger undertakes compensating kelp propagation measures elsewhere.

3. Oil Spills. The direct spilling of oil during pumping or transport is highly visible and can be devastating, as when the tanker Torrey Canyon went down off the English coastline or when an oil rig broke open in the Santa Barbara Channel. Yet oil enters the sea from several other sources, including the deballasting of tankers, effluents, fallout from air pollution, and natural seepage. The amount of damage from oil in the sea varies in degree and duration depending on the

type of oil, the degree to which it has been refined, and wind and wave conditions. Generally, spills are far more destructive in the sheltered waters of bays and estuaries than in the open sea. Unfortunately, some cleanup procedures taken to counteract the effects of an oil spill may be more destructive than the spill itself. Therefore, drilling, refineries and tanker terminals in bays and estuaries should be kept to a minimum unless adequate spill protection can be guaranteed. In the Central Coast Region, Moss Landing, the area most threatened by potential oil spills, is also the most biologically sensitive area.

4. Excessive Recreation and Education Use. When recreational and educational activities are concentrated to a small area or limited types of marine organisms or when they are carried out too intensively, even the most enjoyable and well-meaning pursuits can be harmful to the marine environment. For example, the intensive use of tide pools by students and commercial collectors so seriously depleted marine life in some tide pools that the taking of any organism is now prohibited except with special permission. Despite this restriction uninformed adults and tourists still take souvenirs. Moreover, the increasing number of SCUBA divers who tend to limit their diving to a few concentrated areas along the coastline can seriously deplete certain species because of the great selectivity they can practice in spearfishing. More than 70% of the diving that occurs between Point Conception and the Oregon coast is carried on between the Seaside/Monterey city limits and Point Lobos. Better access to other safe, clear water areas in the state and the encouragement of non-consumptive activities could reduce the adverse impacts of scuba diving in the Central Coast Region. The development and management of a system of underwater parks is desirable.

To preserve samples of marine and coastal habitats and their attendant fish and wildlife, some areas should be set aside as scientific and educational reserves (as recommended in the California Comprehensive Ocean Area Plan, Appendix IX). The following areas, because of their irreplaceable environmental value, are recommended to be preserved in their natural state:

James V. Fitzgerald Marine Reserve

Pescadero Creek and Marsh

Ano Nuevo Point Marine Reserve

Terrace Point Research Site

Elkhorn Slough

Pacific Grove Marine Gardens Fish Refuge

Hopkins Marine Life Refuge

Point Lobos Ecological Reserve

California Sea Otter Game Refuge

To avoid excessive recreational and educational use that could damage natural areas such as marshes, tide pools, and underwater habitats, no recreational or educational use or access that would be excessive should be allowed, and projects that would divert such demand to other natural areas that have adequate carrying capacity should be encouraged. Dessemination and enforcement of existing regulations protecting tide pools should also be encouraged. Additionally, positive approaches such as educational programs covering the beneficial use and management of these sensitive coastal areas should be instituted.

Tentative Findings and Policies to be Recommended by the Central Coast Regional Commission to the California Coastal Zone Conservation Commission, Based on the Report, LIFE IN THE SEA.

Findings

1. The living resources of the sea are of vital concern to man as they provide him with food and recreation, aid his economic well-being, and inspire and solace him.

2. The waters overlying the continental shelves of the world constitute the most valuable part of the sea. Coastal waters are four times as productive as the open ocean and even though the waters over the continental shelves comprise only 10% of the world's ocean surface, 90% of the world's fisheries are concentrated in this zone. The California coastal marine environment is one of the most productive in the world enhanced as it is by:

   a. Estuaries (Monterey Bay, Elkhorn Slough, Half Moon Bay) and wetlands (Pescadero Marsh) which are among the world's most productive living systems.

   b. Kelp beds which contain an abundant variety of life; and

   c. a rugged sea bottom which increases life productivity.

3. Estuaries (semi-enclosed bodies of water such as bays, lagoons, and river deltas which are connected to the sea and within which seawater is diluted with fresh water runoff from the land) and wetlands (water-logged lands periodically or permanently covered with shallow water such as marshes and tidal mudflats) are a vital part of the productive coastal water system. Estuaries and wetlands are rich in nutrients carried from the land by the rivers and streams which also bring fresh water to these areas. Salt marshes are one of the most productive living systems known, ranking in productivity with intensively cultivated rich tropical agriculture. Salt marsh plants transfer phosphorus compounds from the mud into the water, increasing the amoung of this nutrient available to the microscopic plants (phytoplankton) which are a basic element in the marine food chain. Tidal mudflats support the growth of a blue-green algae which transforms atmospheric nitrogen into a form that can be assimilated by other plants. And the generally shallow waters of estuaries allow sunlight to penetrate to the bottom, permitting plant growth and photosynthesis to take place. Many sea fishes and many animal species use the rich base of the estuaries and wetlands at some point in their life cycle either for habitat, spawning or feeding.

   Elkhorn Slough is the second largest estuary along the California coastline. It has been least affected by man's activities and in its relatively unspoiled state represents an extremely important resource to the coastal fisheries of California, and particularly of the Central Coast Region.

4. The sea bottom along the California coastline possesses some outstanding topographical features which aid productivity. Twenty-seven submarine canyons which cut deep into the continental shelf serve as transportation routes for nutrients being carried by upwelling (a process in which prevailing winds cause oceanic surface waters to move away from the land, drawing deep water up to replace it) from deep sea basins to inshore waters. Underwater ridges, mountains and scattered islands often extend into the sunlit zones of the water where photosynthesis takes place and create turbulence and upwelling of nutrient-rich deep water currents moving by the features.

   The Monterey Canyon is the largest and deepest submarine canyon on the West Coast. It is important in biological and geological control of the region. The seasonal upwelling supports the rich coastal fisheries while continual erosion is taking place in the canyon because of currents and seismic activity. Because it heads close to the shore and it is sufficiently deep, it has been suggested as a deepwater port.

5. Kelp beds or forests serve as sanctuaries, nurseries, habitats, and food sources for so many species that they contain more different kinds of plants and animals than a temperate land forest. The key to this rich source of life is the kelp's great "biomass" (the amount of living matter per unit area) which results in an abundance of living matter being dissolved into the surrounding sea. The Central Coast kelp beds are especially valuable because they are the primary habitat of the endangered sea otters.

6. The living resources of the sea conservatively contribute about $600 million annually to the California economy, [illegible] from processing, retailing, sport fishing, and fish[illegible]ar suppliers. The continued vitality of the fishing industry is largely dependent upon international fisheries management and the maintenance of the marine life habitat.

7. The sound management of California's coastal fisheries and the goal of maintaining harvestable species at "maximum sustainable yield" (the catch level which can support a continued heavy fishery) is difficult because:

   a. foreign nations, federal agencies, other states, and sometimes multiple California authorities share the jurisdiction of species or water areas;

   b. these several authorities often have different and sometimes conflicting policies;

   c. there is "competition" between California commercial fishermen, sport fishermen, and fishermen from other states and nations for some species;

   d. not all of these interests are subject to the same laws and regulations;

   e. marine sciences are not sufficiently exact so that undisputed "maximum sustainable yield" figures can be established. As a result, some fishermen see regulation as a punitive weapon in the competitive struggle rather than a competition guideline that all contenders can respect.

8. Mariculture (the marine equivalent of agriculture) involves the cultivation and harvest of marine organisms. Because of its relatively high costs, mariculture presently is limited to "luxury foods"; however, in the future mariculture techniques may be applied to other species or may reduce the costs of luxury foods. Estuaries with their sheltered waters and stable growing conditions are the most popular location for mariculture operations. With a few minor exceptions, mariculture can exist harmoniously with any activity that does not cause pollution or deterioration of the marine environment and can thrive in heated waters where that might be necessary. The mariculture activities should not affect tidal flows or extensively cover water areas. These operations may require the closing off of open waters once accessible to the public and thereby converting them to "private" waters. In the vicinity of Elkhorn Slough, industrial and agricultural activities adversely affect water quality. If the water quality can be improved by eliminating pollution sources, Elkhorn Slough can become a major California source of shellfish through both mariculture and natural production.

9. Estuaries and wetlands are particularly vulnerable to misuse and destruction; they have been dredged for ports and marinas, they have been subjected to sedimentation from upland erosion, they have been filled to provide more land for development, and they have been used for sumps for domestic sewage and industrial waste. Nineteen percent of California's estuaries have received moderate damage while 62 percent have been subjected to severe damage. Of the 197,000 acres of basic wetland (including marshes, bays, lagoons, sloughs, and estuaries) 102,000 acres or 52% of the original habitat has been destroyed by dredging or filling. (These figures do not include San Francisco Bay where the damages were even more extensive but which is now protected.) At the turn of the century, there were 28 sizable estuary and wetland environments in southern California alone. Two-thirds of these have been dredged or filled and the remaining one-third degraded by pollution.

Elkhorn Slough and Pescadero Marsh are the two most critical estuarian and wetland resources in the Central Coast Region.

Pescadero Marsh, the principle wetland area of the Central Coast Region, as well as the other wetlands areas within the region, are extremely important in the overall coastal environment. Accordingly, these wetlands areas should be protected to the greatest extent possible from any adverse activities that may take place in or about them. These wetlands areas will be dealt with in greater detail in the Coastal Land Element.

10. Since the turn of the century, the California kelp beds have decreased from 100 to 75 square miles. The cause of the reduction is uncertain. It may have been caused by sewage discharges which provide nutrients for increased plankton growth and reduced water clarity for sea urchins that feed on kelp or by increased water temperature resulting from natural cyclical movements of water currents or from thermal pollution.

11. Along the California coastline, 130 waste disposal outfalls annually dump 444 billion gallons of domestic and industrial sewage into bays, estuaries, lagoons, and inshore waters. Over three trillion gallons of sea water used for cooling power plants are discharged into marine waters. Water quality is regulated by the State Water Resources Control Board. Key water quality and cooling water considerations are:

a. Outfall Location. Enclosed bodies of water such as bays, lagoons, and estuaries with their limited water circulation and abundant plant and animal species are more susceptible to damage from water pollution than is the open ocean.

In the Central Coast Region, nine outfalls are located in Monterey Bay while farther north, between the Half Moon Bay area and San Francisco, seven outfalls discharge into the open ocean.

b. Oxygen Demand. Most wastes placed in the water consume oxygen as they decompose or breakdown. Many of man's wastes are natural products that the seas can breakdown and reintroduce into the life cycle. However, the discharge of large amounts of organic material in areas of poor water circulation can result in consuming so much oxygen in the water as to cause fish kills, algal blooms, stagnation and foul odors. Primary treatment of wastes permits 60 to 70 percent of the organic material to be discharged; because so much of the nations's wastes are discharged into water bodies of limited circulation, federal law now requires secondary treatment of all sewage by July, 1977 (removing 80 to 90 percent of the oxygen-demanding wastes).

c. Thermal Discharges. Based on present inconclusive research, heated water discharged from the cooling systems of power [illegible] and industries has many potential effects on the marine environment:

(1) some species that cannot tolerate the warmer water will leave or die off to be replaced by other species which can tolerate the increased heat;

(2) some native species and mariculture operations will be enhanced;

(3) reproduction and migratory patterns of some species may be disrupted;

(4) the amount of oxygen dissolved in the water may decrease in limited areas while the amount required for life processes will increase;

(5) the very hot water and toxic chemicals used for flushing fouling organisms and the cooling systems periodically reduces substantial numbers of marine life in the immediate vicinity of the intake and outfall.

In the Central Coast Region, the only thermal discharge occurs at the PG&E Power Plant at Moss Landing.

d. Toxic Chemicals and Heavy Metals. Chlorinated hydrocarbons (DDT) and polychlorinated biphenyls (PCB) as well as heavy metals (such as mercury, lead, copper and zinc) find their way into the marine environment in effluent, rainwater runoff, or air pollution fallout depending on the chemical. All have been shown to have some adverse effects on marine organisms and there is a fear that they may ultimately affect humans since they build in concentration as they move up the food chain.

The Central Coast waters receive surface runoff and pollution from an extensive urbanized and agricultural region.

e. Marine Life Entrainment. The extraction of sea water for cooling, desalinization, or mineral production draws zooplankton, fish larvae, and some small fish into the mechanical system and kills many of them.

At Moss Landing, both PG&E and Kaiser Refractory use sea water in large amounts in their operation.

f. Oil Spills. Oil enters the sea from several sources including the deballasting of tankers, accidents on ships, sewage effluents, oil drilling, fallout from air pollution, and natural seepage. It smothers some marine life, poisons others, and is aesthetically displeasing. The amount of damage from an oil spill varies in degree and duration depending on the type of oil, the degree to which it has been refined, wind and wave conditions, and the location of the spill with the most serious damage normally taking place in nearshore waters and enclosed bays and estuaries. Some clean-up procedures taken to counteract the effects of an oil spill may be more destructive than the spill itself. In the Central Coast Region, Moss Landing, the area most threatened by potential oil spills, is also the most biologically sensitive area.

12. Excessive recreational use occasionally damages some of the marine resources. Many tide pools along the California coastline have been virtually stripped of all living organisms by people collecting specimens. And in localized areas, SCUBA (self-contained underwater breating apparatus) divers can deplete some species of fish by their ability to be selective and concentrate on preferred species.

13. Dredging can adversely affect marine resources in several ways. The bottom mud is stirred up which can cause turbidity that limits photosynthesis in a small area and can recirculate oxygen-demanding or toxic materials that may have been trapped in the mud. Newly dredged channels can change water curculation patterns in estuaries and introduce new conditions which indigenous species cannot tolerate, and the dredging of tidal mudflats and salt marshes completely destroys these most productive parts of the estuarine system. Finally, disposed spoils can smother benthic organisms. However, dredging can also be beneficial; the deepening of lagoons, which are drying up restores this valuable marine environment element; and dredged spoils placed in nearshore currents can aid in the replenishment of beach sand along the coast.

Policies

1. Since coastal estuaries and wetlands are a critical element in the marine life system, are necessary to the vitality of the California fishing industry, and are the best potential sites for future mariculture development, all remaining coastal wetlands and estuaries should be preserved to the maximum extent feasible, and new marshes should be created wherever possible except where they would significantly reduce the open water area of an enclosed body of water or adversely affect water circulation.

   Elkhorn Slough is an irreplaceable resource and should be retained in its natural state. Any activities which take place in the vicinity of the slough that may alter or adversely affect the quality of this resource should be prohibited.

   The following areas are considered by the Commission to be of significant environmental importance so as to preclude any development that is adverse to their environment. The areas are:

   James V. Fitzgerald Marine Reserve
   Pescadero Creek and Marsh
   Ano Nuevo Marine Reserve and Creek
   Terrace Point Research Site and Moore Creek Lagoon
   Hopkins Marine Life Refuge
   Pacific Grove Marine Gardens Fish Refuge
   Point Lobos Ecological Reserve
   California Sea Otter Game Refuge
   Julia Pfeiffer Burns Underwater Park

   Additional areas in which any proposed development shall be carefully weighed for its public benefit are the following: San Mateo County, Montara Beach to Pillar Point, San Gregorio Beach and Creek, Pescadero Beach and Creek, Butano Creek, Moss Beach, Half Moon Bay, San Pedro Point, Frenchmen's Creek, Tunitas Creek and Beach. In Santa Cruz County, Waddell Creek and Beach, Greyhound Rock, Scott Creek, El Jarro Point, Bonny Doon Beach, Panther Beach, Laguna Creek, Majors Creek, Wilder Beach and Creek, San Lorenzo River and Beach, Schwann Lake, Corcoran Lagoon, Moran Lake, Opal Cliffs, Soquel Creek, Aptos Creek, Pajaro River mouth. In Monterey County, Monterey Bay, Moss Landing Beach, Salinas River mouth and dunes, Point Pinos to Pescadero Point, Carmel River Lagoon, San Jose Creek Beach, Malpaso Creek Beach, Soberantes Creek and Point, Garrapata Beach, Palo Colorado Creek to Rocky Creek and Beach, Bixby Creek and Beach, Little Sur River and Beach, Point Sur Beach, False Sur Beaches, Big Sur River and Beach, Pfeiffer Beaches, Partington Canyon Beach, Limekin Creek Beach.

2. To minimize destruction of marine life habitat, landfill, diking, and dredging operations in wetlands and estuaries should be prohibited unless they are necessary for maintaining water circulation and reducing sedimentation or absolutely necessary to the public welfare as established in a subsequent plan element.

3. Protection and enhancement of the productivity of the coastal wetlands and estuaries that depend upon fresh water inflow should be accomplished by the following measures:

a. highest state-wide funding priority for eliminating or upgrading to existing sewage discharges into such estuaries rather than improving discharges emptying into the ocean.

b. development in areas upstream from fresh water discharges into estuaries should be carefully controlled to avoid adverse and irretrievable damage to the wetlands areas.

c. damming or diversion of fresh water sources which provide inflow into estuaries and wetlands should not be permitted unless found to have an overriding public interest in subsequent plan element. Standards for waste water discharges into the ocean should be based on careful studies of each proposed ocean outfall location.

4. To maintain an economically viable fishing industry, adequate berthing facilities should be provided for commercial fishing fleets and no existing commercial fishing port space should be eliminated unless adequate substitute space is assured. The fishing industry has historically been a major part of the local economy, and character of the coastal region. In port or harbor expansion, priority should be given to provision of space and facilities for active commercial fishing pursuits.

5. To promote the growth and development of an economically viable fishing industry, California should continue to actively pursue working relationships for fisheries management with adjacent states and should provide vigorous leadership to efforts by the Federal government to secure adequate international fisheries controls. Local educational institutions should expand their role in disseminating technological advances in the fishing industry.

6. To avoid the loss of public access to coastal waters and the removal of natural environments, maricultural activities should be permitted only in locations where they would not decrease water areas presently accessible to and used by the general public or adversely affect natural habitats.

7. To help minimize the adverse effects upon water quality of new developments in the coastal zone, the efforts of the State Water Resources Control Board and its Regional Water Quality Control Boards should be augmented in the following ways:

a. No development should be allowed if it does not meet Water Board standards for obtaining a discharge permit.

b. When the Water Board has indicated that it is considering the adoption of higher standards, projects should be approved only if they will be able to meet the higher standards.

c. Developments that would adversely affect water quality in areas of special environmental value (e.g., a wetland or estuary that could be severely damaged by erosion caused by the development, by effluent from septic tanks, or by an oil spill from a tanker terminal, refinery or drilling operation) should not be approved unless measures are taken to minimize damage to the water area.

d. The Central Coast Commission supports State Water Resources Board's efforts to declare Areas of Special Biological Significance and to assure their preservation.

8. To avoid the adverse effects of using seawater for cooling in power and industrial plants the following should be initiated:

a. Until more is known about the extent of damage to marine life, the most current economically feasible means of minimizing the intake of zooplankton, fish larvae and fish into the cooling system should be utilized. For example, water used for cooling could be drawn from deep, cooler offshore waters where zooplankton and fish larvae populations might be at a minimum.

b. High funding priority should be given to research on the effects of both heated and cooled water upon the affected marine environment, and "baseline" studies of the existing marine system should be undertaken several years in advance of construction of a major thermal water discharge.

c. Until more is known about its effects, warmed water should be discharged into the sea only at locations where strong currents are present to insure the maximum dispersal of the heated water. No new discharge into bays or estuaries should be allowed unless currents are adequate for heat dispersal, the discharge is part of an approved mariculture project, or study has been adequate to conclude that no serious adverse effects to the enclosed water body will result.

d. Long-term thermal discharges that would raise the water temperature in kelp beds beyond the plants' point of tolerance should not be allowed unless the discharger undertakes compensating kelp propagation measures elsewhere.

9. To prevent smothering of bottom life and the clouding of the water by spoils from dredging projects, spoils should be disposed of in one of the following ways:

a. placement on dry land;

b. placement in any fills that may be determined to be in the public interest as established in a subsequent plan element;

c. if the spoils contain a high sand content, barged or piped to sites in the ocean where the suitable spoils would aid in downdrift beach replenishment;

d. disposal into naturally turbulant areas such as the head of the Monterey Submarine Canyon; or

e. placement in deep ocean areas according to the strigent criteria established by the Environmental Protection Agency.

Ocean dumped spoils should not be placed near kelp beds as suspended solids and pollutants reduce photosynthesis and could adversely affect this valuable habitat. Nor shall dredge spoils be dumped to estuaries or wetland. Accordingly, choice of disposal sites should be based upon evaluation of which feasible method is least harmful to the marine environment.

10. To prevent dredging projects from releasing unacceptable amounts of toxic substances embedded in bottom materials into coastal waters, the bottom mud should be tested for toxicity and spoils from layers containing the toxic material should be disposed of on land in such a manner that they cannot enter the water table. The balance of the spoils may be disposed of in one of the five ways provided for in Policy #8, however, where the bottom concentration of toxic materials is high, the dredging should be strongly discouraged if not absolutely necessary.

11. To avoid recreational and educational overuse that could damage natural areas such as marshes, tide pools, and underwater habitats, no recreation or education use or access that would be excessive should be allowed. Projects that would divert such demand to natural areas that have adequate carrying capacity should be encouraged.

    In environmentally suited areas, increased access should be provided for SCUBA divers so that overuse of the few existing accessible areas be reduced.

    Educational programs should be instituted to foster improved public use and management of popular tide pool areas and other areas important from the standpoint of scientific and educational pursuits.

12. To preserve samples of marine and coastal habitats and their attendant fish and wildlife, some areas should be set aside as scientific and educational reserves as recommended in the California Comprehensive Ocean Area Plan, Appendix IX and in Policy 1 above.