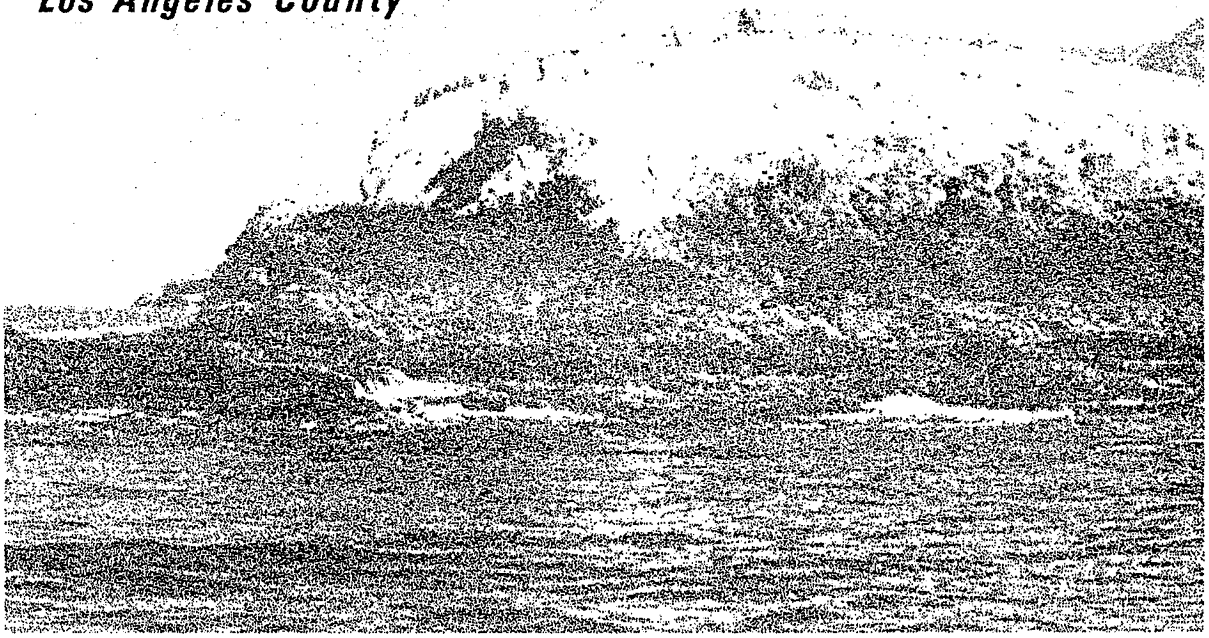
California Marine Waters
Areas of Special Biological Significance
Reconnaissance Survey Report

Santa Catalina Island

Subareas One-Four

Los Angeles County



CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

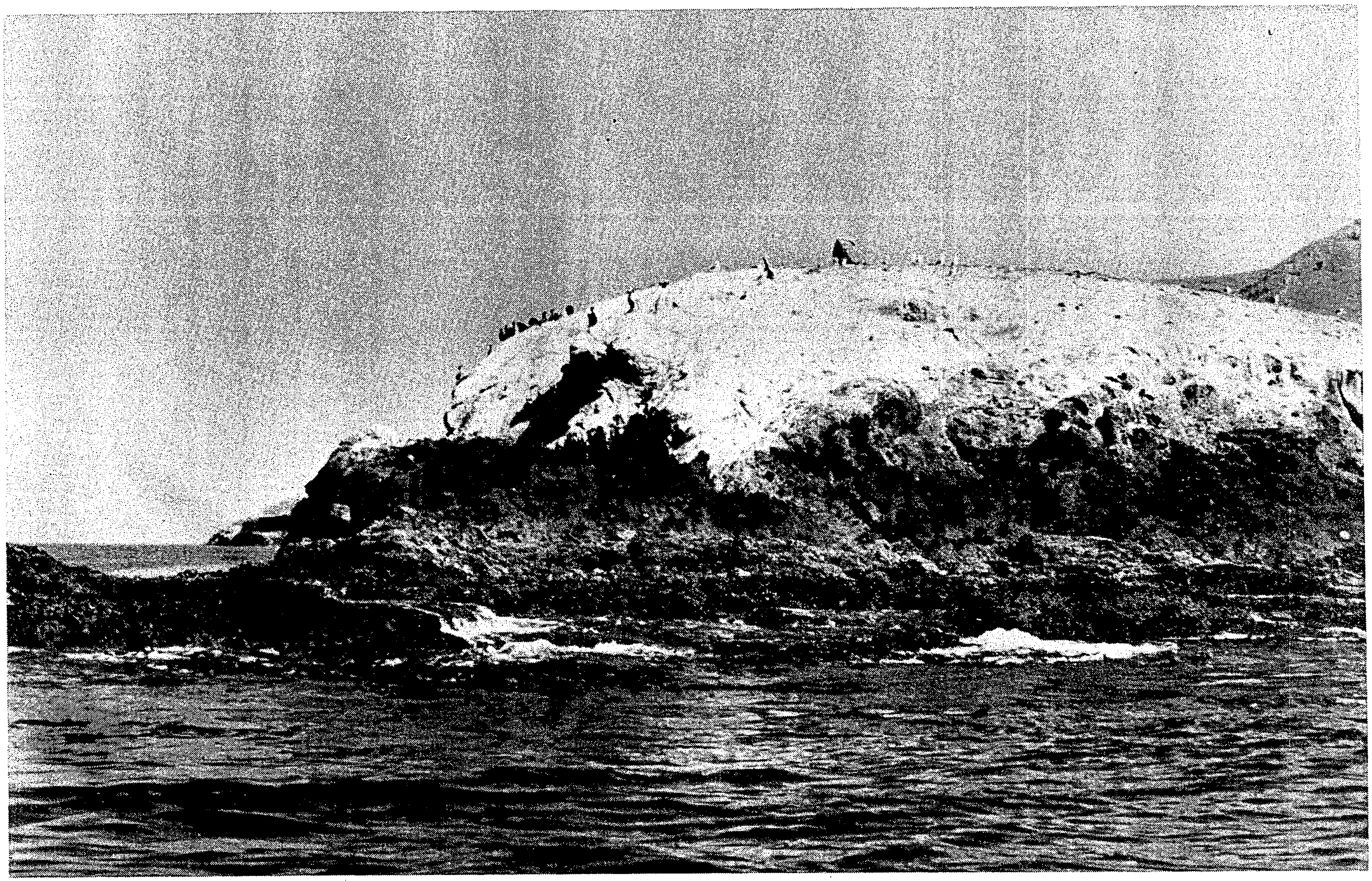
DIVISION OF PLANNING AND RESEARCH

SURVEILLANCE AND MONITORING SECTION

April 1979

WATER QUALITY MONITORING REPORT NO. 79-6

Cover Photograph:
West End at Santa Catalina Island - Subarea I Area of Special Biological Significance



Santa Catalina Island -
Subarea I ASBS

CALIFORNIA MARINE WATERS
AREAS OF SPECIAL BIOLOGICAL SIGNIFICANCE

RECONNAISSANCE SURVEY REPORT

SANTA CATALINA ISLAND-SUBAREA I
LOS ANGELES COUNTY

STATE WATER RESOURCES CONTROL BOARD

DIVISION OF PLANNING AND RESEARCH

SURVEILLANCE AND MONITORING SECTION

APRIL, 1979

WATER QUALITY MONITORING REPORT NO. 79-6

ACKNOWLEDGEMENT

This State Water Resources Control Board Report is based on a reconnaissance survey report submitted by Jane E. Dykzeul and Robert R. Given, PhD, of the Catalina Marine Science Center, University of Southern California. The latter report 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

Santa Catalina Island - Subarea I Area of Special Biological Significance (ASBS) is located on the western end of Santa Catalina Island at 33°27'N LAT; 118°33'W LONG. The area is approximately 22 miles southwest of the Palos Verdes Peninsula mainland and is part of Los Angeles County. The ASBS encompasses about 11,650 acres of nearshore water adjoining approximately 17 miles of the shoreline along the west end of the Island.

Land adjacent to the ASBS is extremely rugged, consisting primarily of mountains with steep drop-offs to the ocean which are cut frequently by narrow ravines and wide valleys. The major exposed rock is Catalina schist, which contributes to the landslides common to the steep areas. The land area is vegetated by a Coastal Sage Scrub community, dominated by prickly pear and cactus. Subtidal areas are largely sand and mud rimmed by boulder-covered slopes. The intertidal area consists about equally of solid rock walls and boulders.

Santa Catalina Island is swept by the southward-flowing California Current but subjected on a localized basis to the Southern California Counter-Current. Surface water temperatures range from 11°C in the winter to 20°C in the fall. The climate of the Island is characterized as Mediterranean with warm, dry summers and cooler, relatively dry winters.

The marine biota consist of a wide variety of subtidal and intertidal benthic species as well as fishes and other pelagic organisms.

The subtidal area supports a large number of sand dwelling organisms, such as tube worms, sand dollars, eel grass, and sea cucumbers. The subtidal rock walls and boulder areas support attached marine organisms, such as giant kelp, gorgonians, sponges, tunicates and sea stars as well as a variety of finfishes. The sparse intertidal habitat is used by the typical attached biota such as mussels, barnacles, sea palms, abalone, and anemone. Marine organisms of special importance include the scythe-

marked butterfly fish, *Chaetodon falcifer*, and the sea cucumber, *Holothuria zacae*.

The ocean area in and adjacent to the ASBS is heavily used for commercial fishing of market squid, jack mackerel, and anchovy. Sport fishermen and divers also make heavy use of the area.

Largely due to the remote location of Santa Catalina and the sparse human habitation, water quality problems in the ASBS are minimal. However, heavy seasonal boating use in some protected anchorages in the ASBS may be causing water quality problems.

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FINDINGS AND CONCLUSIONS

1. Water circulation in the windward nearshore area of Santa Catalina Island's west end (Subarea I) is poorly understood. Studies are needed to define the circulation pattern in order to improve predictive capabilities for potential pollution problems, such as offshore oil spills.

2. Wastewater disposal in the inhabited land areas adjacent to the ASBS is accomplished by spray application on land, leach fields and pit privies. These methods have no apparent adverse impact on the waters of the ASBS.

3. Boat mooring in protected areas of the ASBS may pose a short-term water quality threat to the ASBS. Special studies may be necessary to assess the potential problem, and control measures may be necessary if a water quality problem is identified.

4. The estuary at Catalina Harbor, which is outside the ASBS boundary is unique to the Channel Islands and should be considered for some level of special protection.

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. To date, thirty-four coastal and offshore island sites have been designated ASBS. 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 Biological 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 the Santa Catalina Island ASBS, a reconnaissance survey integrating existing information and additional field study was performed by Jane E. Dykzeul and Robert R. Given, PhD, of the Catalina Marine Center, University of So. California. 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.

Santa Catalina Island - Subarea I, from Isthmus Cove to Catalina Head, was included in this designation for the following reasons: 1) it has a diversity of habitat and biological assemblages; 2) it is possibly a transitional zone between subtidal areas containing predominantly northern and southern species; and 3) due to the proximity of the University of Southern California's Catalina Marine Science Center (CMSC), many scientific studies have yielded valuable information about the area. This report addresses the physical, chemical and biological characteristics of the Subarea I ASBS, as well as land and water uses, water pollution threats, and special water quality requirements. Separate, but less comprehensive, reports have been prepared for Santa Catalina Island - Subareas II, III and IV and are included in this volume.

ORGANIZATION OF SURVEY

This survey utilized existing available information in addition to that obtained by field studies. Additional information was obtained from published literature, books, annual reports, student projects, diving notes and personal interviews with persons knowledgeable about the area. Representative habitat types were chosen for field research, and the University of Southern California's Catalina Marine Science Center (CMSC), located at Big Fisherman Cove, was used as the base of operations. Biologist-divers, chosen for their knowledge of the biota, were utilized throughout the length of the survey to maintain consistency in data collection. Each area was surveyed from 100-foot (30m) depths to as shallow as surge and surf conditions would allow, with a minimum of two scuba dives per site. Relative abundances of the flora and fauna were listed according to depth and, where necessary, unidentified organisms were returned to the laboratory for identification.

Sediment and replicate biological cores were taken to a depth of 10 cm in soft bottoms, using hand-held 8 cm diameter coring tubes. Biological cores were fixed in formalin, then sieved to 2mm for macrofauna. The organisms were sorted and sent to experts for identification. Residue of greater than 0.5 mm size was retained and preserved in 70% isopropanol. Sediment cores were dried for future analysis.

The subtidal geology was surveyed by Dr. David Hadley, and involved a series of scuba dives and subsequent laboratory analyses.

PHYSICAL AND CHEMICAL DESCRIPTION

Location and Size

Santa Catalina Island is located at 33° 22' N Lat, 118° 25' W long and lies 20 miles offshore of the Palos Verdes Penninsula (Figures 1 and 2). The Island is 22 miles (35.4 km) long, 8 miles (12.9 km) across at its widest point and is oriented in a general NW - SE direction.

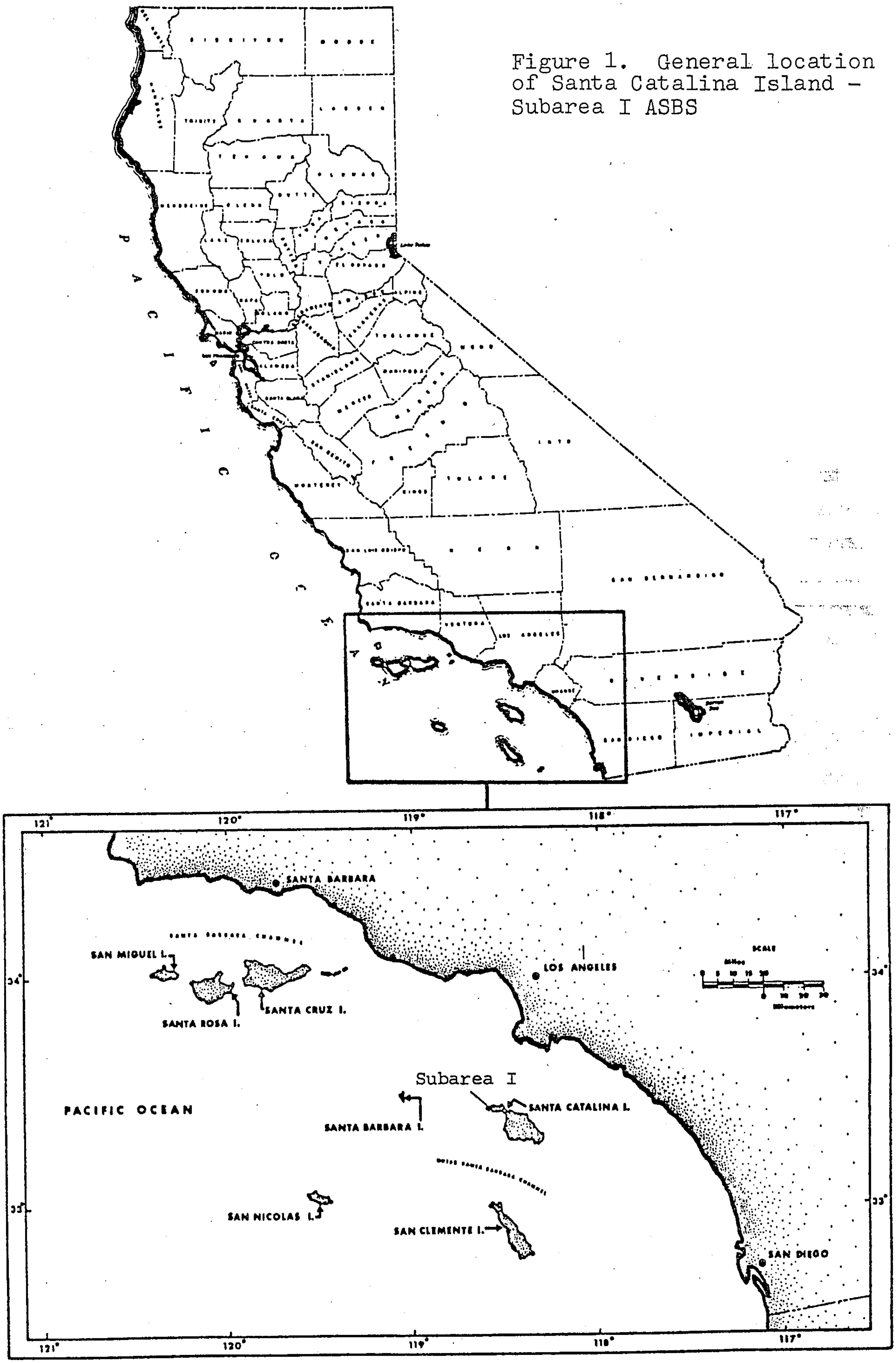
The Santa Catalina Subarea I Area of Special Biological Significance is located at the western end of the Island (33° 27' N Lat, 118° 33' W long) (Figures 2 and 4). It includes most of the area west of Two Harbors (known locally as the Isthmus). The shoreline bordering the ASBS is 17.0 miles (27.4 km) in length. The seaward boundary of the ASBS is one mile offshore, and the enclosed water surface is about 11,650 acres (4718 ha). Whereas the official ASBS land side boundary ends at the mean high tide line, the study area for this survey extended 0.5 miles inland.

The official boundary description of Santa Catalina Island - Subarea I ASBS is as follows:

> From Point 1 determined by the intersection of the mean high tide line and a line extending due west from USGS Triangulation Station "Channel" on Blue Cavern Point: thence due north to the 300-foot isobath or to one nautical mile offshore, whichever distance is greater; thence northerly and westerly, following the 300-foot isobath or maintaining a distance of one nautical mile offshore, whichever is the greater distance, around the northwestern tip of the island and then southerly and easterly, maintaining the distance offshore described above, to a point due south of USGS Triangulation Station "Cone" on Catalina Head; thence due north to the intersection of the mean high tide line and a line extending due south from USGS Triangulation Station "Cone", thence returning around the northwestern tip of the Island following the mean high tide line to Point 1.

Santa Catalina Island is part of Los Angeles County. Avalon, the only city on the Island, is 13 miles (20.9 km) straight-line distance from the study area (26 miles by road) (Figure 2). There is a community located between Catalina Harbor and Isthmus Cove, known as Two Harbors. Approximately 100 permanent residents of Two Harbors maintain the local recreational facility utilized by vacationers, the area's primary industry.

Figure 1. General location of Santa Catalina Island - Subarea I ASBS



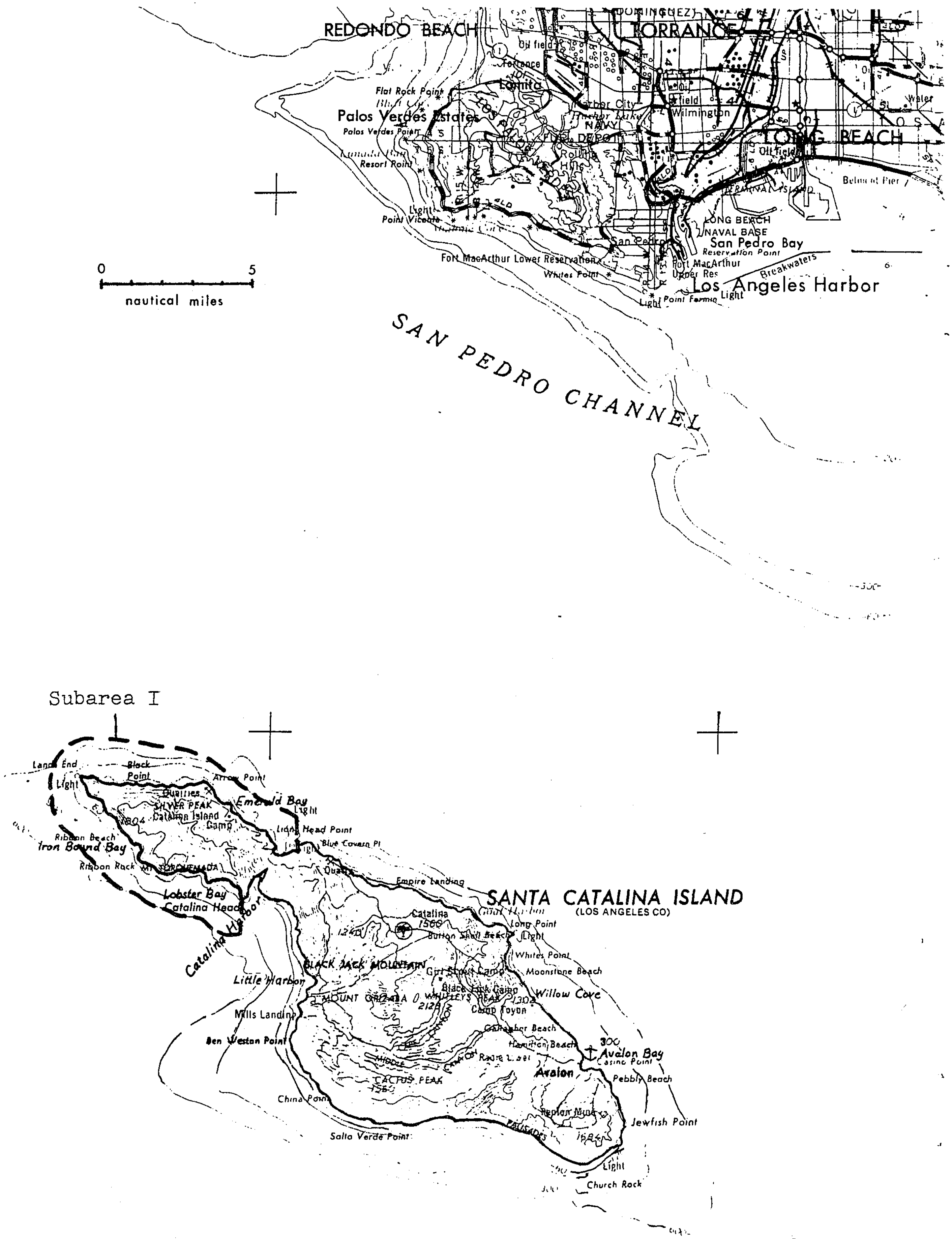


Figure 2. Location of Santa Catalina Island - Subarea I ASBS

Nearshore Waters

Submarine Topography: Santa Catalina Island borders the San Pedro Basin on the north and Catalina Basin on the south. The Island is rimmed by a shelf extending to a water depth of 450 feet (140 m) approximately one mile offshore on the southern side and two miles on the northern side. The shelf is narrowest off Arrow Point (Figure 3). It has no prominent features and gradually rises to a nearshore physiography of steep boulder slopes and cliffs; these usually begin at a subtidal depth of approximately 100 feet (30 m).

There are submerged reefs located off Emerald Bay, Starlight Beach, Howland's Landing and Isthmus Cove. Offshore rock formations which break the surface include Whale Rock, Eagle Rock, Indian Rock, Ship Rock and Bird Rock (Figure 4).

Currents: Subarea I on Santa Catalina Island is located in the Southern California Bight. The Bight has been described as "an open embayment of the Pacific Ocean bounded on the north by Point Conception, on the west by the California Current and extending southward to Cape Colnett, Baja Califonia." (Jones, 1971). The Southern California Coastal Water Research Project (SCCWRP) has extensively studied the oceanographic features of the Bight, and most of the following information has been extracted from their reports.

There are basically three major forces which determine the current regime in this area: 1) geostrophic currents created by differing water densities interacting with gravity and with Coriolis forces; 2) wind stress movement across the sea surface; and 3) local tides.

The principal geostrophic current in this area is the California Current, which flows southward along the west coast of North America. This current flows south from Point Conception to Baja California, creating the "open embayment" described above. In the Bight, a large north-flowing gyre is created east of the California Current and is known as the Southern California Countercurrent (Jones, 1971) (Figure 6). This gyre exists year-round in the Bight, and when northwesterly winds die in winter months it rounds Point Conception and becomes the Davidson Current (Wooster, 1970).

Santa Catalina Island is surrounded by the Southern California Countercurrent. Seasonal changes in current patterns and temperature

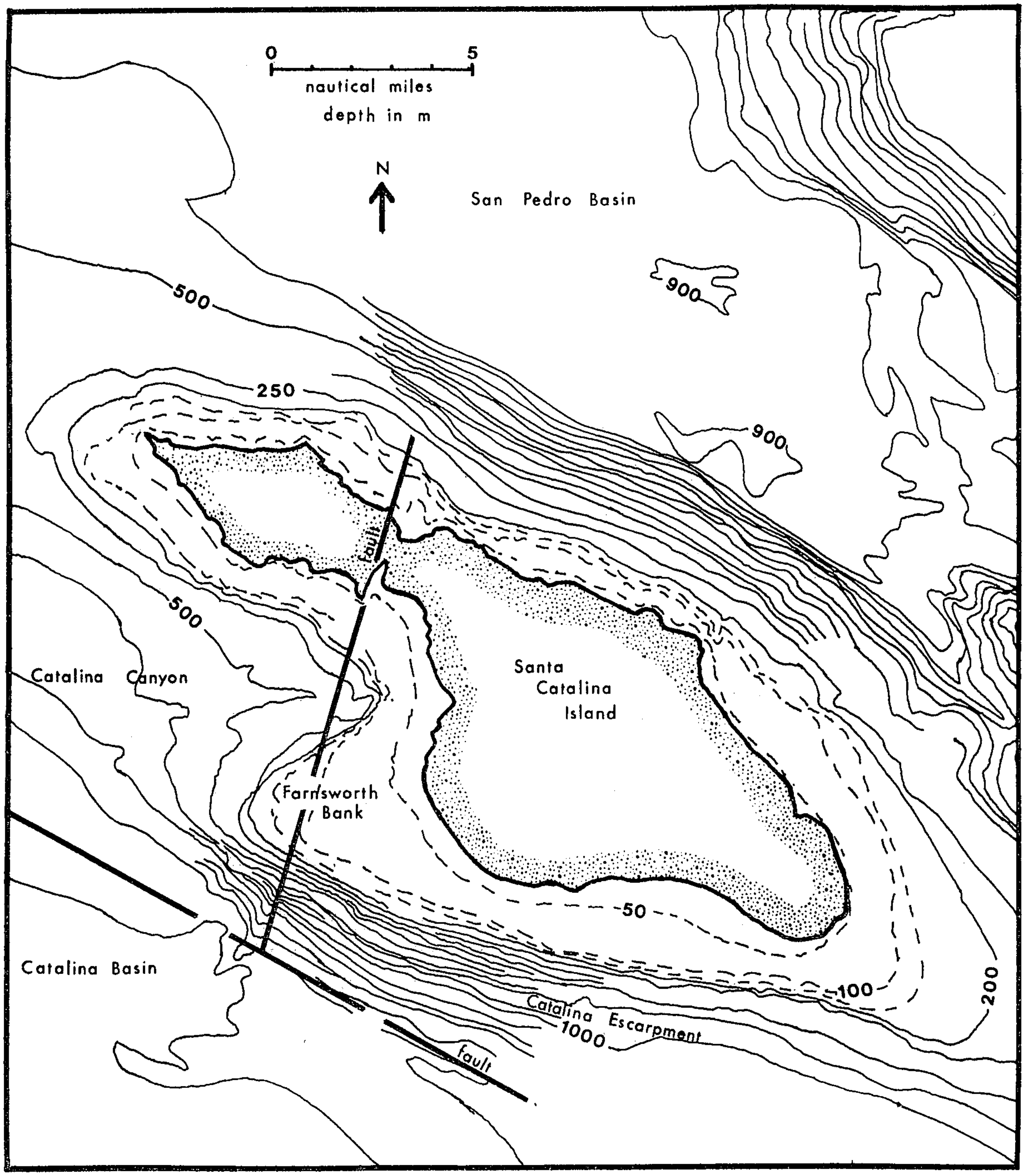


Figure 3. Submarine Topography Surrounding Santa Catalina Island (from Association of Engineering Geologists, 1967)

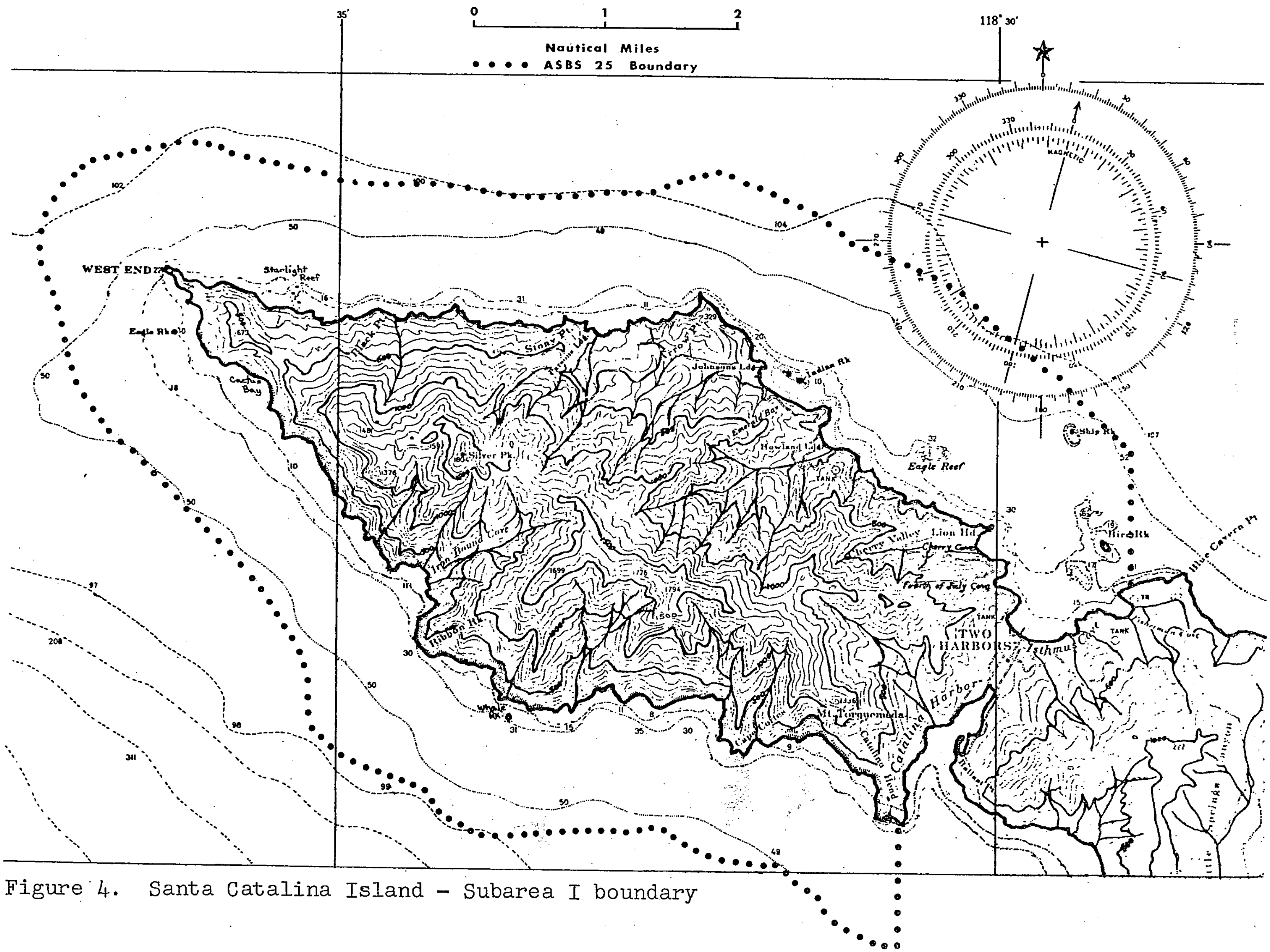


Figure 4. Santa Catalina Island - Subarea I boundary

isoclines are diagrammed in Figure 5. Ocean waters flow northwest along the southwest side of the island and seem to flow southeast along the northeast side. Little is known about the southeasterly-flowing currents. Temperature and salinity indicate that the waters found on either side of the island are very similar, suggesting that this same water mass may set up a kind of local gyre and circulate around the island.

A 10-meter drogue study was conducted by the California Cooperative Oceanic Fisheries Investigation (CalCOFI) in October, 1958, in an area southeast of Catalina Island (Schwartzlose, 1972). This study indicated the presence of a number of small gyres in the waters off Catalina (Figure 7).

Very little is known about the current patterns within this ASBS. CMSC has studied currents in Isthmus Cove. Those studies indicated that water movement is due primarily to wind stress and tidal currents. Water moves from southeast to northwest as the tide flows in and in the opposite direction as the tide flows out. This flow pattern can be confused at the surface by northwest winds. Drift cards released in the Isthmus area in April 1976 and 1977 were recovered along the mainland coast, primarily south of the release point. This is probably due to the predominant northwesterly wind and indicates the importance of wind stress in this area (Pieper, pers. comm.). These data also concur with results of a study conducted by Tibby in the spring and summer of 1937.

Upwelling is thought to occur in the ASBS but is not documented. Westerly winds blowing down northeast-facing canyons may cause upwelling from Arrow Point to Blue Cavern Point. It is likely that significant upwelling occurs at the extreme west end of the Island, possibly being at least partly responsible for the tremendous biomass of plankton found there. However, the actual causes of this probable upwelling are not known (Pieper, pers. comm.).

The prevailing direction of swell in the Southern California Bight is from the west. Consequently, intertidal areas on the southwest (windward) side of this ASBS are exposed to the most wave action. The swell bends around the west end and strikes north-facing beaches on the leeward side at an angle, reducing wave energy. Northeast-facing habitats on the leeward shore are the most protected. Only during northeast wind conditions (Santa Ana's) are these areas exposed to wave action.

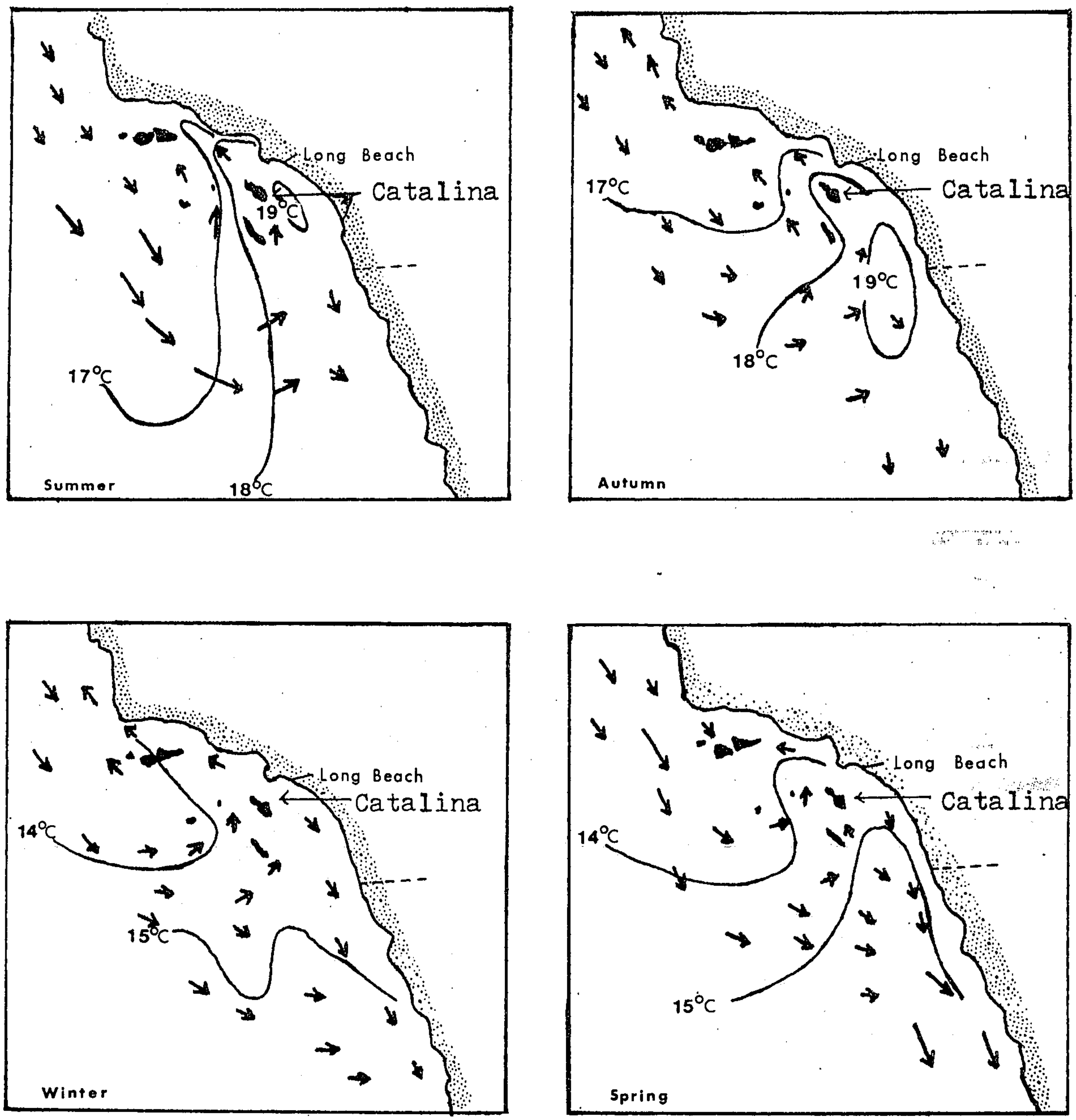


Figure 5. Average Geostrophic Surface Flow and Surface Isotherms in the Southern California Bight (Jones, 1971)

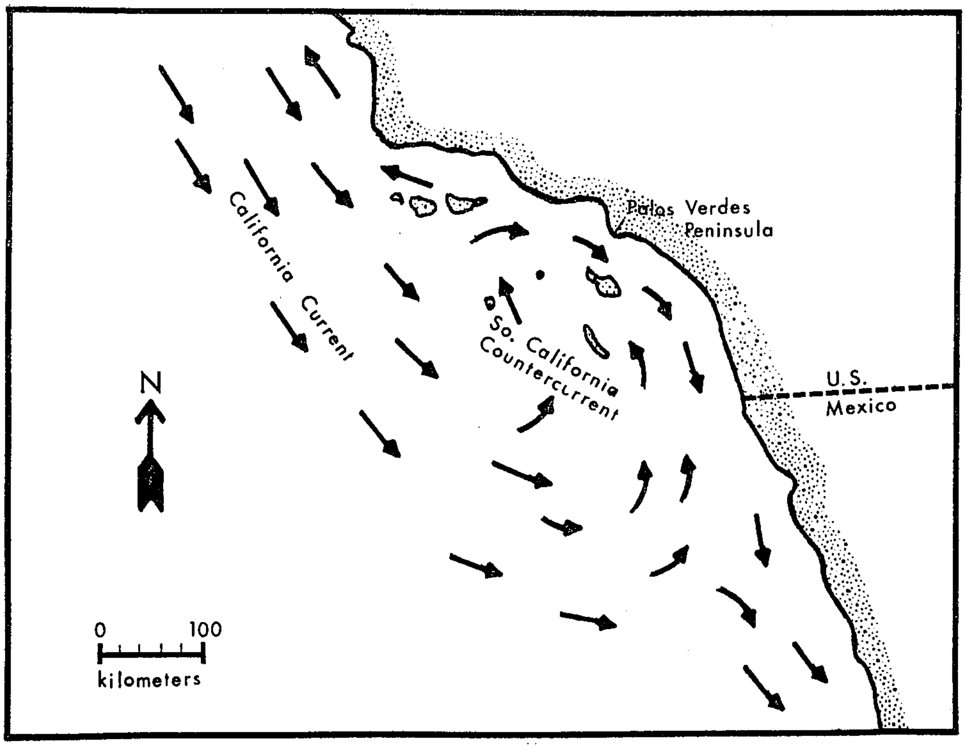


Figure 6. Surface Circulation (0 - 100m) in the Southern California Bight (Jones, 1971)

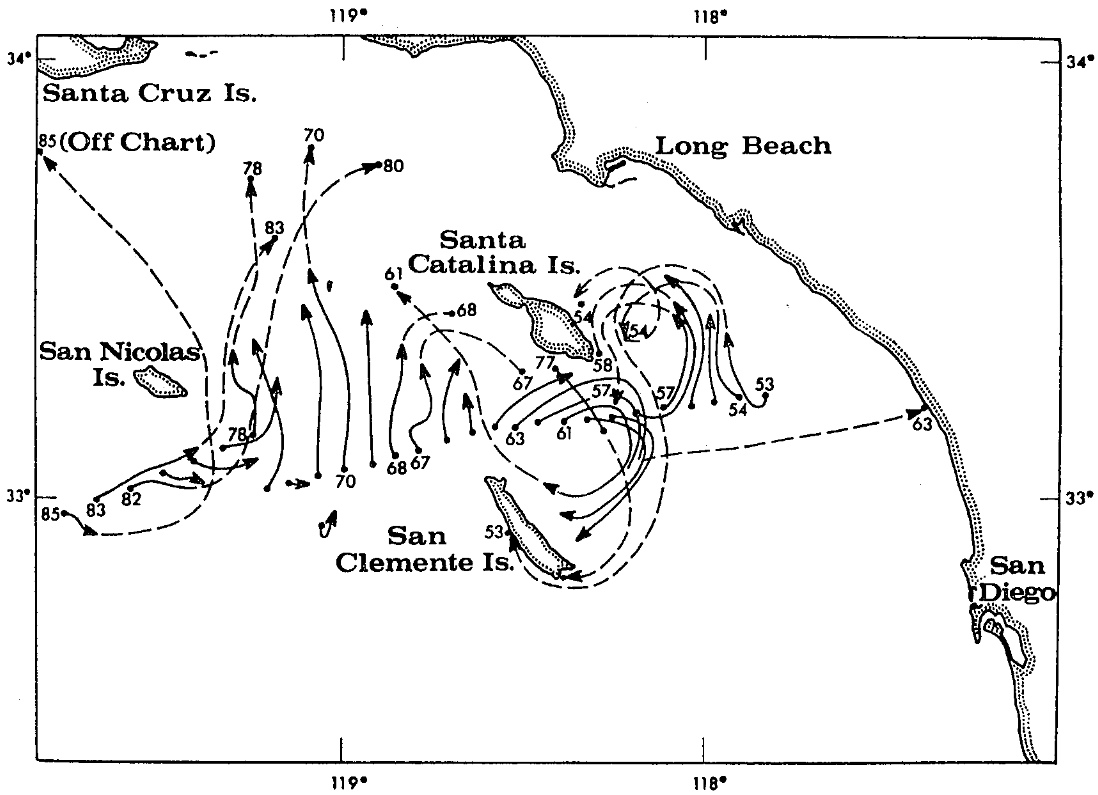


Figure 7. Drogue Measurements off Southern California in October, 1958 (Schwartzlose, 1972)

Tides at Catalina are mixed semidiurnal with a maximum range of nine feet (3 m). The range is from approximately + 7.1 feet to - 1.7 feet MLLW (NOAA, 1977). The normal fluctuation is between four and five feet (1.2m and 1.5m).

Water Quality: Water clarity and temperature data (surface and twenty meter depths) have been taken approximately daily by personnel at CMSC since 1970. The sampling station is located near Bird Rock, Isthmus Cove, on the leeward side of the Island (Figure 26). Figures 8 and 9 present the monthly mean values for clarity and water temperature for the past eight years. Though this station is located close to shore, the clarity is not indicative of those areas subjected to extensive landside runoff. During the winter of 1977-78, heavy rains and subsequent runoff resulted in poor clarity in the nearshore waters. Clarity is usually greatest between October and January --(about 25 m) and poorest between April and July (about 8 m) when plankton blooms occur.

Surface water temperatures at the CMSC sampling station range from 11°C in winter to 20°C in September and October. The water temperature along the windward side of the ASBS averaged 19.5°C at the surface during this survey, September - October 1977. A thermocline occurred between 60 to 80-foot (24 m) depths, with the lower temperatures averaging 17.8°C.

Locally, but outside the ASBS boundary, SCCWRP has taken standard water quality measurements at stations near the mainland, within the Bight (Pub. TR - 104). Salinity and temperature data (Table 1) were collected between 1950 and 1959 by the California Cooperative Fisheries Investigations (CalCOFI) at their station #90.37, located southeast of Santa Catalina Island (Figure 10).

Water quality in the ASBS has been assessed in studies involving analyses of biological material for the presence of pollutants. Drs. Rudolf K. Zahn and Gertud Zahn-Daimler of the Physiologisch-Chemisches Institut der Johannes Gutenberg, Universitat Mainz, found no significant levels of pollutants in the sponge *Tethya aurantia* collected on the leeward side of the ASBS.

Sherwood and Mearns (1975) investigated fin erosion in the dover sole, *Microstomus pacificus*, for SCCWRP and the Los Angeles County

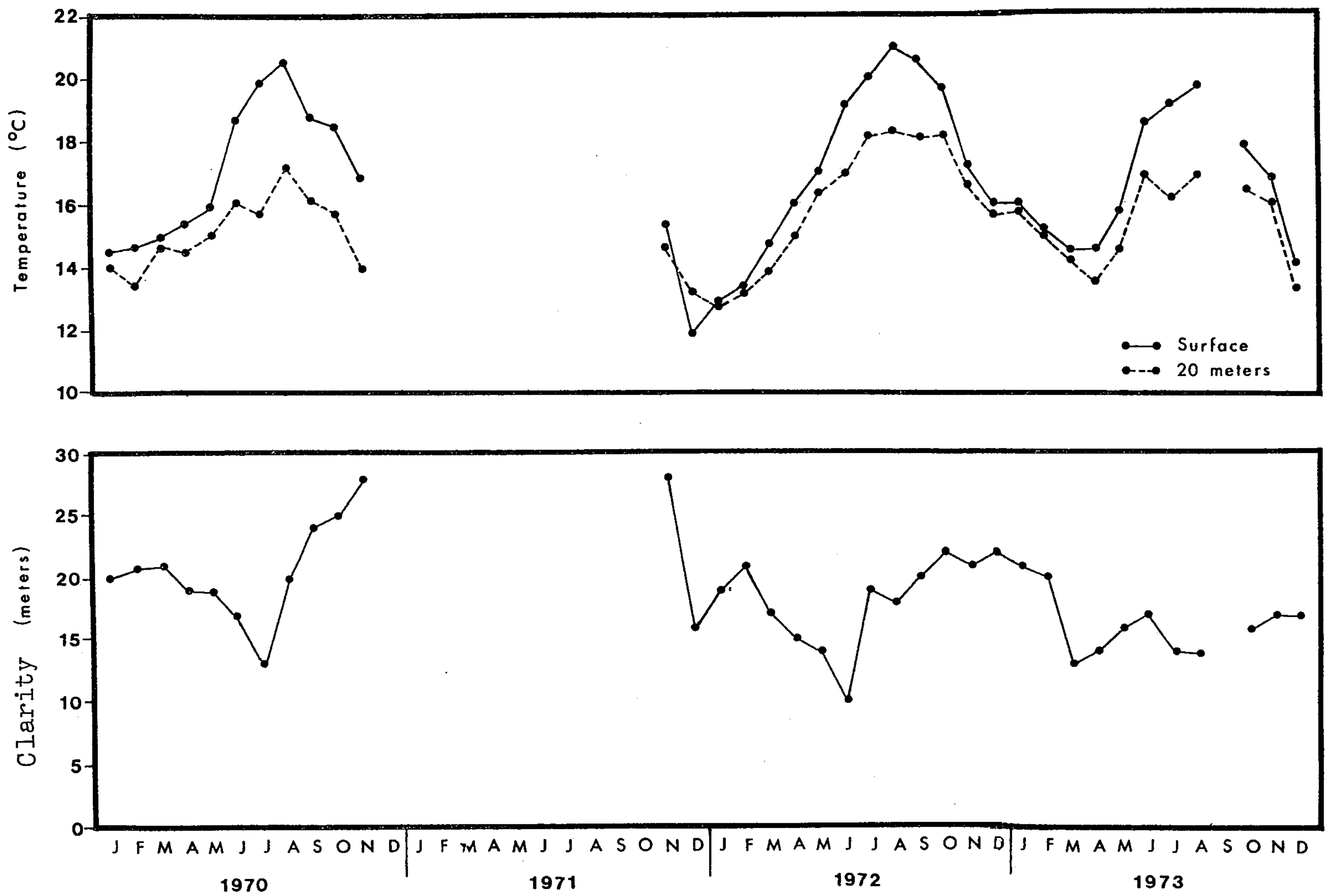


Figure 8. Mean Monthly Water Clarity and Temperature Measurements taken by CMSC, 1970-73, at Isthmus Cove

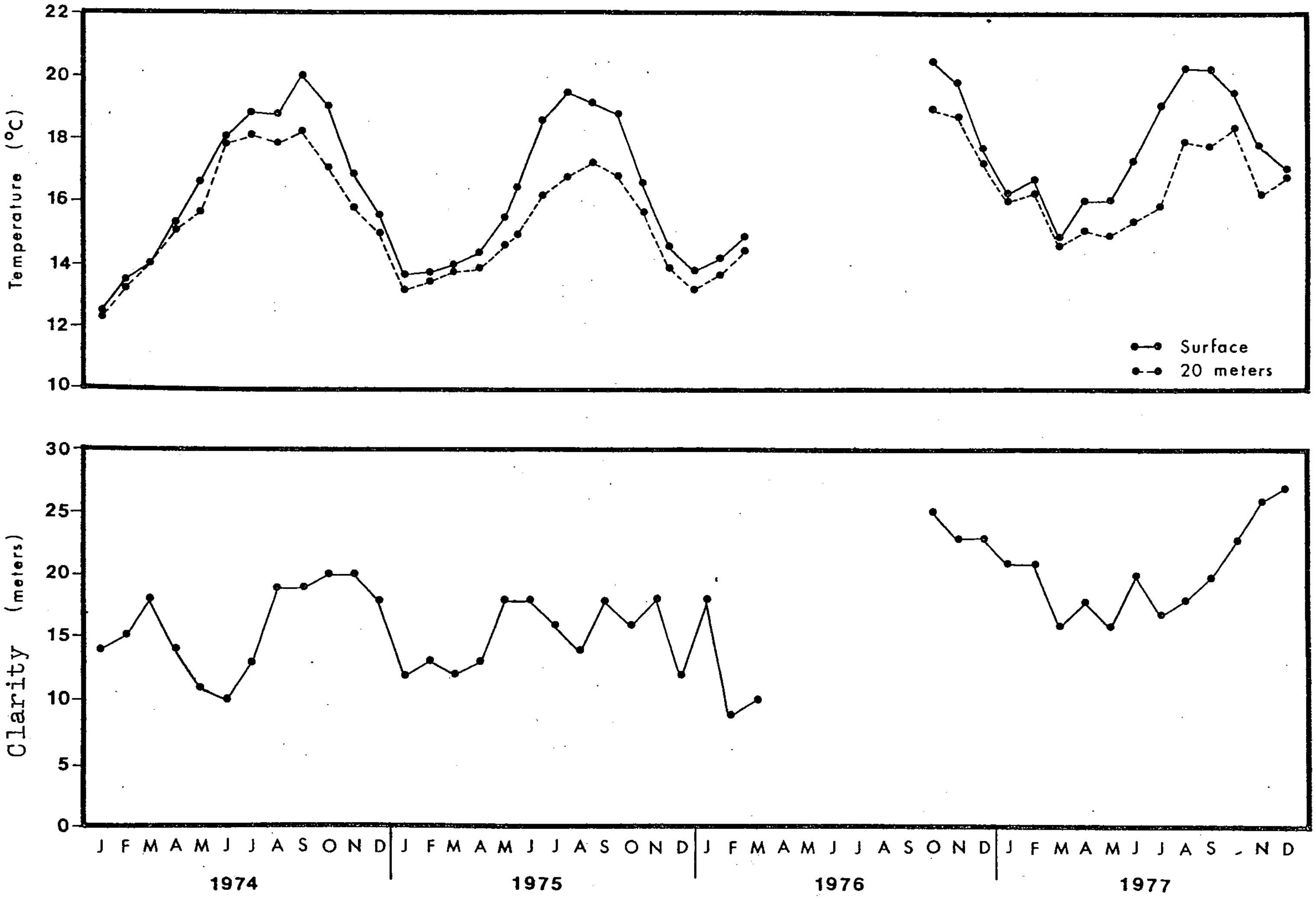


Figure 9. Mean Monthly Water Clarity and Temperature Measurements taken by CMSC, 1974-77, at Isthmus Cove

Table 1. Mean Monthly Water Temperature and Salinity Data CalCOFI Sampling Site # 90.37, 1950 - 59 (10 m depth)

Month	Temperature °C	Salinity o/oo
January	14.35	33.38
February	14.13	33.42
March	14.10	33.42
April	14.73	33.45
May	15.55	33.49
June	16.87	33.56
July	18.19	33.57
August	19.33	33.54
September	19.87	33.58
October	18.14	33.54
November	17.04	33.59
December	15.88	33.52

Table 2. Average trace element concentrations (mg/dry kg) in liver tissue from Dover sole, Microstomos pacificus, taken from Palos Verdes Peninsula outfall region and from a control station in the ASBS, 1970 - 1972.

(after deGoeij, 1974)

Trace element	Sediments (Palos Verdes)	Dover sole livers outfall	Dover sole livers Control *
Silver	3.0	5.9	7.3
Arsenic	15	4.3	10.0
Cadmium	160	0.63	1.9
Copper	23	6.6	7.3
Mercury	85	0.36	0.36
Antimony	13	0.010	0.012
Selenium	14	2.1	4.0
Zinc	17	86	89

Table 3. Average trace metal concentrations (mg/dry kg) in tissue from mussel, Mytilus californianus, from the Palos Verdes Peninsula region and from Bird Rock, Catalina Island, 1971.

(from Alexander and Young, 1976)

Trace metal	Bird Rock	Palos Verdes
Lead	12	18
Copper	21	69
Chromium	27 **	14
Silver	30	33
Zinc	100 **	75
Nickel	6	12

* authors gave no explanation for higher values at control station, but stated that no "natural" values have been determined and that these values are actually similar enough to each other to render the differences insignificant

** authors did not explain higher concentrations at Catalina, but some explanations have been offered that the type of rock at Catalina, from which the soil eventually derives, is higher in these elements. As above, there has been no "natural" level determined, and the differences between them fall within a range of insignificance

Table 4. **Levels of DDT found in fish from Palos Verdes** Peninsula and Catalina Island, 1971-1972, Los Angeles County Sanitation District (from 1973 report)

Species	Palos Verdes	Catalina	Ratio PV/Catalina
Black cod	5.1	-	-
Calico bass	6.1	0.14	44
Dover sole	19.3	0.11	175
Green-striped rockfish	14.0	0.29	48
Misc. rockfish	4.4	0.36	12
Pacific sanddab	2.7	0.4	7
Rex sole	6.4	0.55	12
Slender sole	5.4	0.41	13
Rubberlip perch	4.6	0.22	21
Black perch	18.5	0.11	168
Misc. Invertebrates	1.0	-	-
Stichopus sp.	21.0	-	-
Pleurobranchia	0.64	-	-
Mytilus californianus	4.1	0.07	59
Sediment - mg/kg dry wt.	150.0	0 - 0.5	100-500

Table 5. Sediment Quality Data (from Chen and Lu 1974.)

	Catalina	Palos Verdes
DDT	0.0133 ppm	1.332 ppm
DDE	0.0123 ppm	0.8635 ppm
DDD	0.001 ppm	0.2960 ppm
Total Volatile Substances	4.34%	3.11%
Total Organic Carbon	0.253%	0.302%
Total Phosphorus	418 ppm	1,575 ppm
Oil and Grease in Sediment	2,480 ppm	1,060 ppm
Organic Nitrogen	448 ppm	160 ppm
Kjeldahl Nitrogen	448 ppm	160 ppm
Immediate Oxygen Demand	76 ppm	259 ppm
Chemical Oxygen Demand	1.51×10^4 ppm	2.64×10^4 ppm

METALS	mg / kg dry weight	
Zinc	31.68	75.74
Nickel	41.60	37.59
Mercury	0.089	0.160
Lead	78.01	6,129
Copper	11.35	17.08
Iron	1,110.0	16,640
Chromium	26.48	48.16
Cadmium	2.11	3.57
Arsenic	2.27	6.82

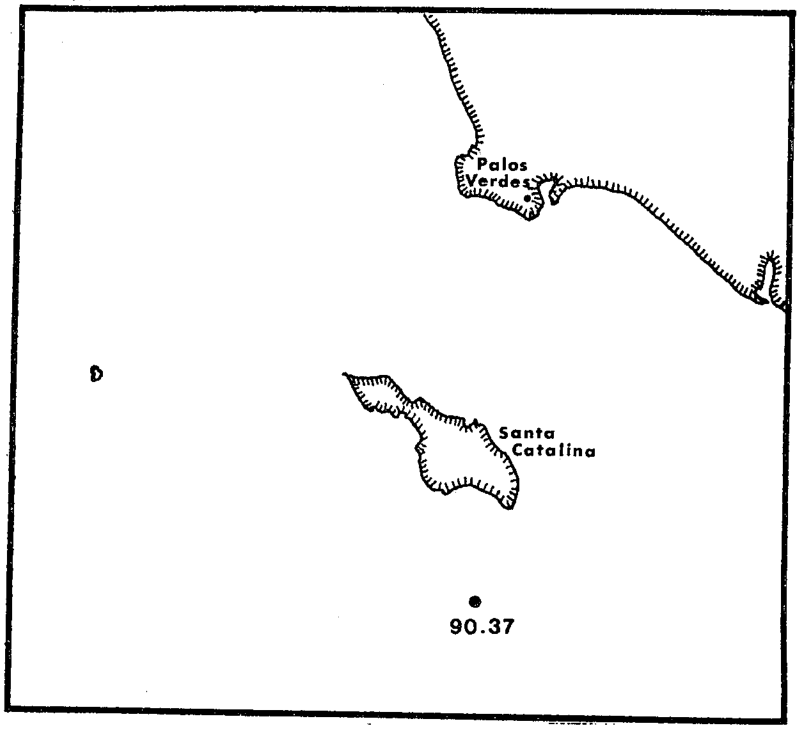


Figure 10. Approximate Location of CalCoFI Sampling Station #90.37

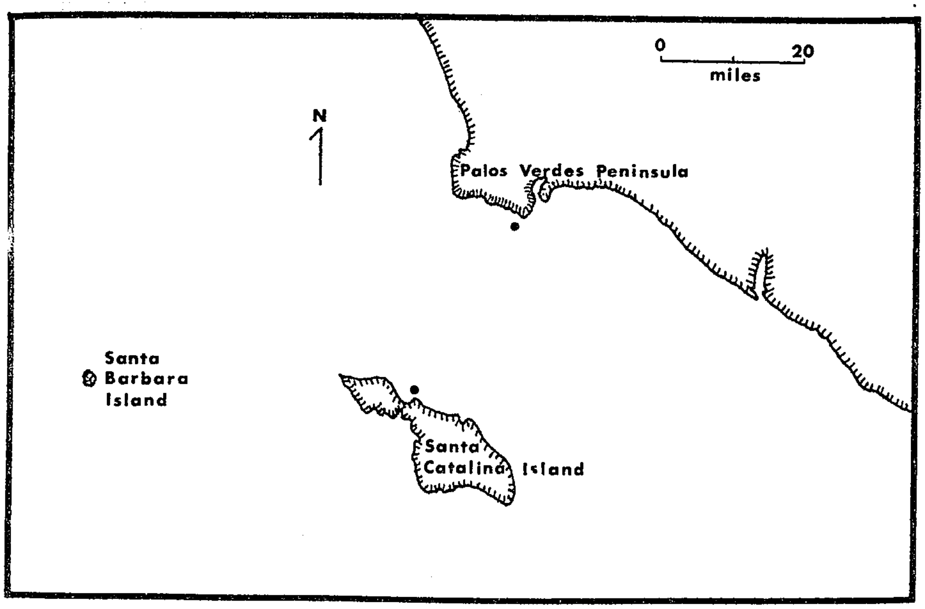


Figure 11. Sediment Quality Sampling Stations for Chen & Lu Study (1974)

Sanitation District in the vicinity of the Los Angeles County sewer outfall at White's Point, with control stations near the Catalina ASBS (Figure 27). Dover sole from the ASBS were found to have no fin disease. Liver tissues from these fishes were analyzed for trace element concentrations as well (deGoeij, 1974). Table 2 compares the metals concentrations found in fish from the ASBS and from the Los Angeles outfall area.

DDT levels were measured in fish caught in trawls by the Los Angeles County Sanitation District in 1973. Table 4 compares levels in fish from White's Point with controls at the Catalina West End, where DDT levels were found to be significantly lower.

During the summer of 1971, SCCWRP studied trace metal concentrations in the mussel Mytilus californianus at 17 sites within the Bight, 11 along the mainland coast and six adjacent to the Channel Islands, including one at Bird Rock (Figure 26). Table 3 compares levels of trace metals found in the soft tissues of the mussel Mytilus from Bird Rock and from the Palos Verdes Peninsula. In general, the highest metal concentrations were measured in the digestive glands. The data indicate that the distribution of lead is related to diffuse inputs, while the distribution of copper, chromium and silver are related more to urban point sources. No distinct pattern was observed for nickel or zinc (Alexander and Young, 1976).

The soft tissues from these mussels were also analyzed for DDT (Young and McDermott, 1976). Mussels from Bird Rock contained 0.31 mg/dry kg DDT, while mussels from Palos Verdes contained about 180 mg/dry kg DDT. Mussels from the other mainland study sites contained levels ranging from 0.17 to 3.0 mg/dry kg.

Beginning in July, 1977, the State Water Resources Control Board has maintained a mussel, Mytilus californianus, collection station in the ASBS at Arrow Point. These samples are analyzed for trace metals, selected organics, and petroleum hydrocarbon contaminants. Results of these monitoring activities are available from the State Board and will be published in annual reports.

Straughan tested the sand infauna from the intertidal regions of Isthmus Cove beach and Catalina Harbor mudflat for oil during the Bureau of Land Management's baseline study in the Southern California Bight

(1975-77). During this study, oil was observed only twice, once on Isthmus Cove beach and once at the Catalina Harbor mudflat. The cause of the oil was not determined (Straughan, pers. comm.).

Chen and Lu (1974) tested the sediment quality in the San Pedro Basin between Los Angeles - Long Beach Harbors and Santa Catalina Island for the Bureau of Land Management. They tested for trace metals, pesticides, PCB and organic materials. Table 5 compares the levels of these constituents at the sampling station located off Catalina's Blue Cavern Point with those found off the Palos Verdes Peninsula (Figure 11).

Geophysical Characteristic

Historical Seismicity: Southern California and the offshore Channel Islands lie in a seismically active area. The following statement from the Association of Engineering Geologists (1967) describes the possible influence of earthquakes on Santa Catalina:

> In summary, Catalina Island is within the seismically active area of Southern California and has probably been affected by earthquake shocks with the same frequency as that experienced on the nearby mainland. During historic time, however, the shocks felt in the Catalina Island area have apparently been less severe. The forces which have brought the formation of the major faults in the region are still active and therefore earthquake movements along them will continue throughout the mainland and offshore areas in the future.
>
> C. F. Richter (1959) indicates that the maximum probable earthquake shock that could be experienced on Catalina Island is an intensity of VII. This estimate is based upon the seismicity of the region as well as the type of bedrock underlying the area. (Page 6).

According to Dr. Robert Hart, there are no mapped active faults located on Santa Catalina west of the Isthmus. This fact in itself does not rule out the possibility of seismic activity on and adjacent to the ASBS, however. In order to more thoroughly evaluate that possibility, the California Institute of Technology Seismological Laboratory's catalog of Southern California earthquakes was reviewed. This record is a detailed compilation of seismic activity in the region for the past 45 years. Of the some 50,000 seismic events listed in the Caltech catalog, only two earthquakes, both of magnitude 2.3, were found to have epicenters near the west end of Catalina (Figure 12). These events occurred on July 19, 1952 and May 9, 1969. However, it is important to realize that all locations prior to about 1973 should be considered preliminary and requiring relocation with modern techniques, particularly for events such as these two which are near the outer edge of the Caltech seismic network. Until 1973, and especially prior to 1961, location methods for earthquake epicenters were somewhat primitive. Therefore, the two events of interest were relocated using present-day algorithms on the Seismological Laboratory's NOVA computer system. This procedure resulted in a substantial change in location for both earthquakes (Figures 12). Both epicenters shifted to the north toward the center of the San Pedro Channel. Since the northern half of the Channel has a relatively high background level of small magnitude seismicity, the revised locations can be accepted with confidence. Based upon past seismicity and upon the lack of geologically recent faults in the area of interest, it is unlikely that seismic activity represents a significant factor in the environment of the ASBS.

Adjacent Land Mass: The major exposed rock on Catalina Island is Catalina schist, a low-grade layered metamorphic rock. Landslides commonly occur where it forms steep slopes (Association of Engineering Geologists, 1967). The Isthmus area is geologically very active, as indicated by frequent landslides (Figure 13).

The land adjacent to the ASBS is extremely rugged, consisting primarily of mountains with steep drop-offs to the ocean. The area is frequently intersected by narrow ravines (Catalina Head to West End) and by relatively wide stream valleys (West End to Blue Cavern Point). The highest peak adjacent to the ASBS is Silver Peak, reaching an elevation of 1,804 feet (Figure 4). The Isthmus is the land area with the lowest elevation (less than 20 feet) and also has the narrowest width of any portion of the island (0.25 miles).

According to the Association of Engineering Geologists (1967, page 20), geologic faults on the island are characterized as follows:

> Much of the Island is believed to be bound in the offshore areas (both north and south) by subparallel northwesterly-trending faults. On the south the Catalina Escarpment (a steep 2,000' submarine slope) is believed to have formed as a result of fault movement. On the north, the submarine slope is gentle and has been formed by small normal movements along a series of subparallel normal faults. Many of the larger faults transecting the island have northwesterly trends but faults of the other orientations, normal as well as thrust types, are also present. Complex fault

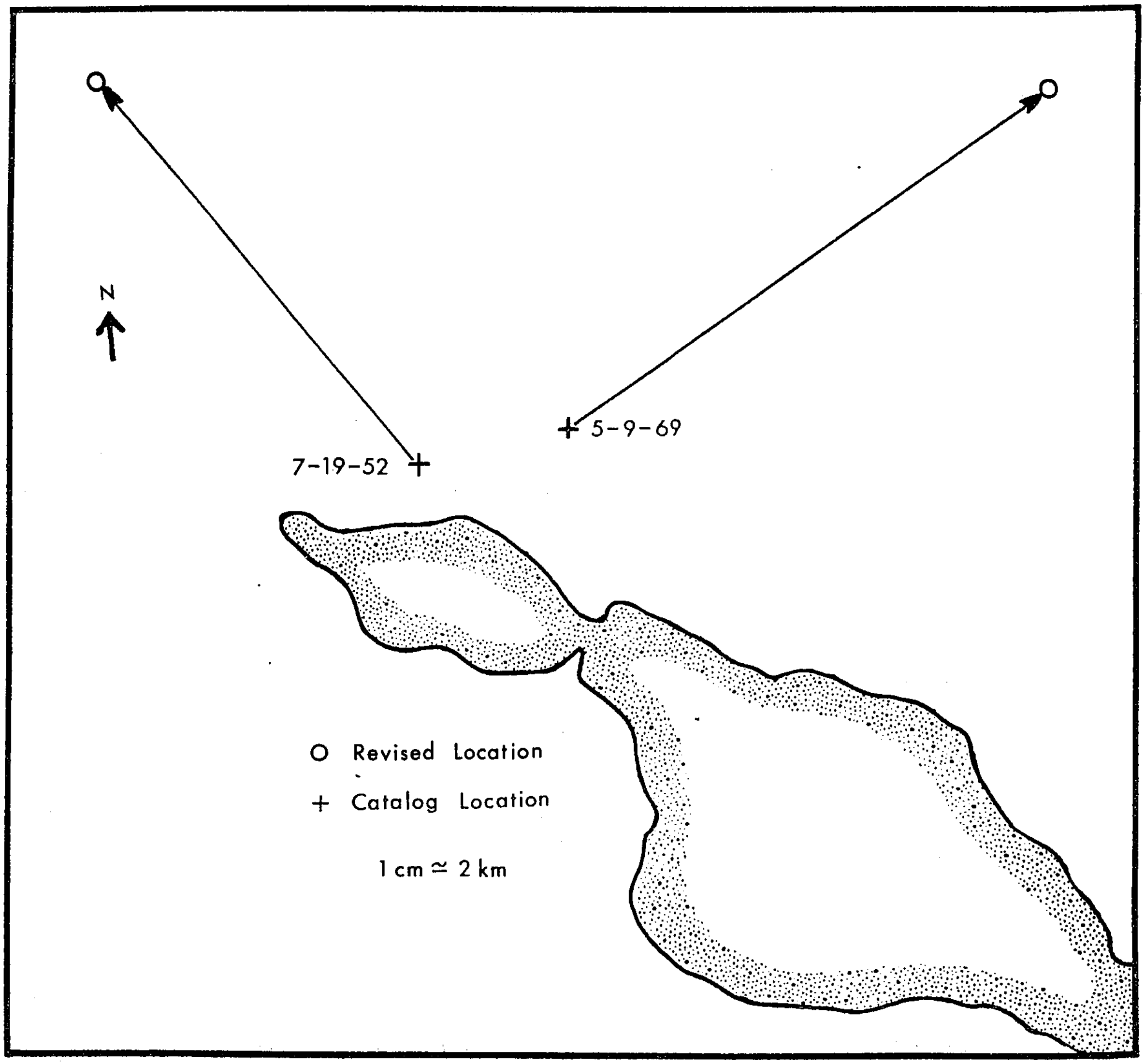


Figure 12. Catalogue Location and Revised Location of Earthquake Epicenters near the ASBS (drawn by Dr. Robert Hart)

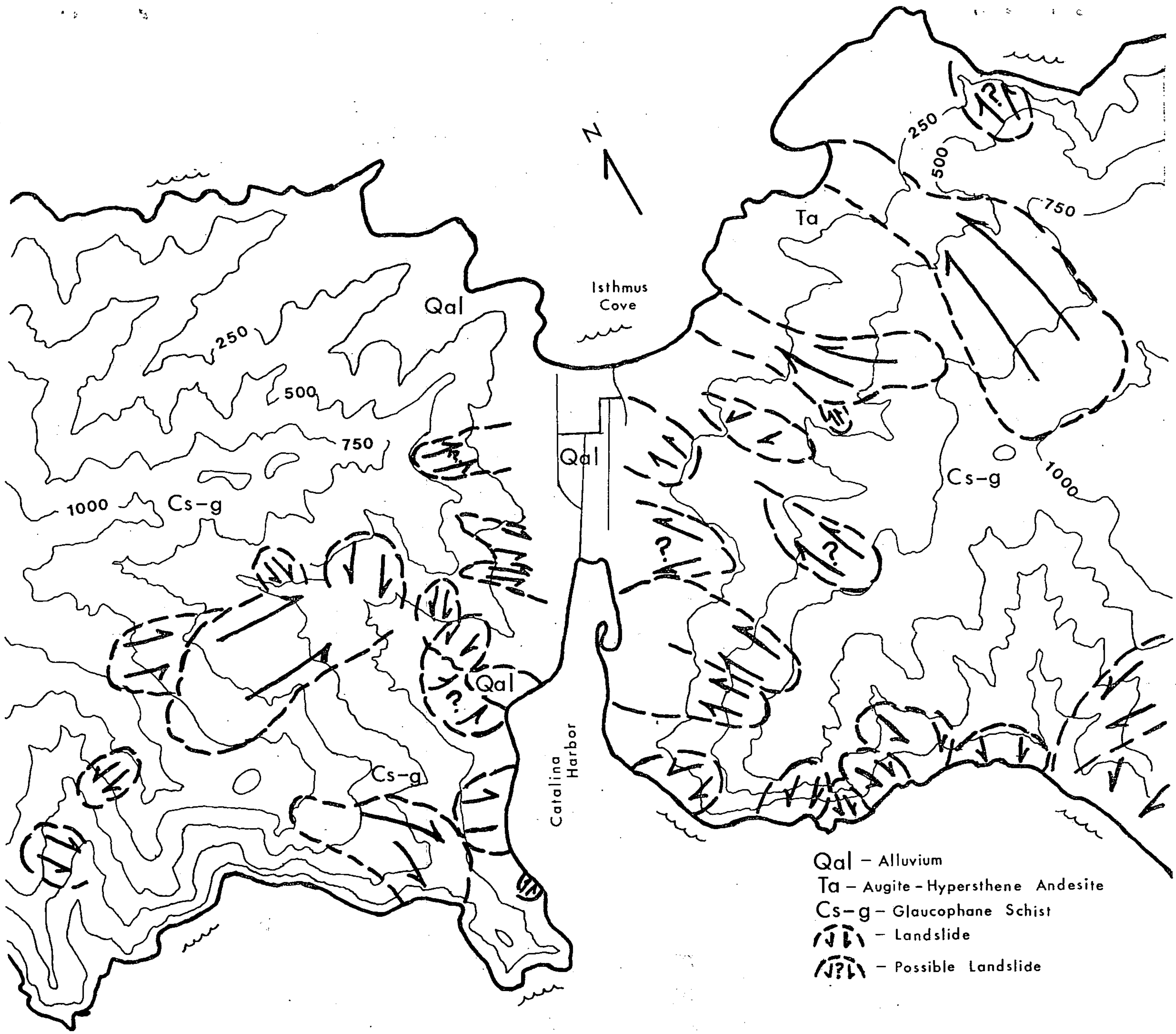


Figure 13. Generalized Geologic Map of Two Harbors, Santa Catalina Island

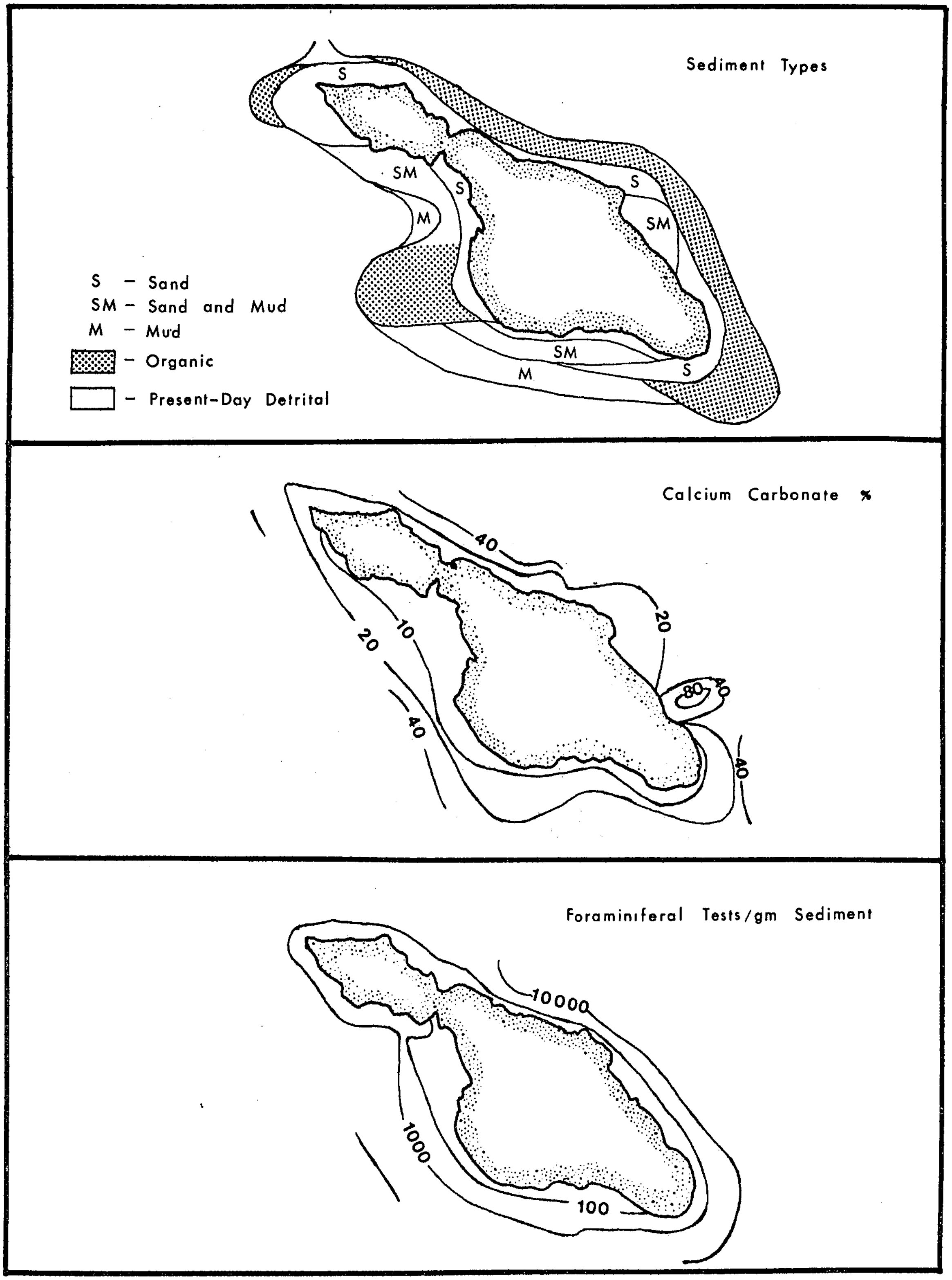


Figure 14. Sediment Composition of the Shelf around Santa Catalina Island (Emery, 1960)

zones of one-quarter mile or more in width, such as exists both inland and seaward of Parson's Landing, apparently exist on other parts of the Island.

Subtidal Substrate: Sand and mud comprise the majority of the subtidal substrate from the outer boundary of the ASBS to within approximately 500 yards (457 m) offshore (Figure 14). Nearshore, the main subtidal substrates in the ASBS are boulder slopes and sandy slopes, with a few rocky reefs. Cliffs are rare.

In general, the subtidal area of the ASBS is rimmed with boulder slopes to a depth of 50 - 100 feet (30 m). Boulder size varies with depth. Shallow sloped areas often have a narrow band of medium-sized boulders (1 m diameter) interspersed with coarse sand closer to shore. Cactus Bay exemplifies this type of substrate. Larger boulders (4 - 8 m diameter), also interspersed with sand, are found from 10 to 50-foot (15 m) depths. With increased depth, the number and size of boulders decreases, and the percentage of sand increases. In most areas surveyed, sand comprised nearly 100% of the substrate beyond 100-foot (30 m) depths.

Sandy substrate is rare in water shallower than 40 feet (12 m) between Catalina Head and Arrow Point, with the exception of Starlight Beach and Parson's Landing. However, from Arrow Point to Blue Cavern Point there are many coves, such as Emerald Bay, Howland's Landing, and Isthmus Cove, with sandy subtidal substrate. These coves are enclosed by rock outcroppings and boulders extending to a depth of approximately 40 feet (12 m).

There are three types of nearshore sediments: 1) Lithic sediment composed of rock particles; 2) organic sediment composed of biological fragments such as shells and sea urchin tests; and 3) calcareous sediment composed of $CaCO_3$, primarily from corralline algae.

Areas with heavy runoff, such as Parson's Landing and Cactus Bay, have lithic sediments, usually grading from coarse to fine sands as depth increases. Catalina Head and West End areas, which have large populations of mollusks and relatively heavy wave action, have organic sediments. Sediments found in some of the coves from Emerald Bay to Big Fisherman Cove contain a large percentage of calcareous debris. Table 6 lists the sediment types found at the ASBS survey sites. Further descriptions can be found in the Appendices.

Table 6. Sediment composition of the Santa Catalina Island - Subarea I ASBS Survey Sites

Site #	Site Location Depth	Color	% Lithic	% Organic	% $CaCO_3$
1	Lobster Point				
	80'	buff-gray	60	40	
2	Sandy Cove				
	100'	gray	80-85	15-20	
	30'	gray to gray-green	90	10	
4	Cactus Bay				
	80'	brownish-gray	90	10	
	40'	gray	95-97	3-5	
6	*Mola mola* Cove				
	100'	buff-gray	5-10	90-95	
7	Starlight Reef				
	80'	buff-gray		50	50
8	Black Point				
	100'	gray	55	45	
9	Parson's Landing				
	100'	gray	30-40	60-70	
	30'	brownish-gray	95	5	
	10'	brownish-gray	95	5	
	Intertidal	yellowish-brown	100	(50% pebbles of quartz, feldspar and schist.)	
11	Emerald Bay				
	20'	yellowish-gray		40	60
	Indian Rock Reef				
	40'	buff to yellowish gray		60-70	30-40
12	Howland's Landing				
	40'	brownish gray	95	5	
	Big Geiger				
	30'	gray	85	15	
	Little Geiger				
	30'	gray	85	15	

Table 6. Continued

Site #	Site Location depth	Color	% Lithic	% Organic	% $CaCO_3$
	Cherry Cove 35'	yellowish-gray	20-30		70-80
	4th of July Cove 40'	yellowish-gray	20-30		70-80
	Isthmus west 30'	gray	60-70		30-40
	Isthmus east 30'	gray	95-97	3-5	
	Big Fisherman Cove 30'	gray		15-20	80-85

Intertidal Substrate: The intertidal area of the ASBS is not extensive. The shoreline is extremely rugged, with the main landmass rising steeply out of the ocean. Consequently, intertidal habitats are quite restricted in vertical range. The southwest (windward) side of the island is exposed to wave action and, in certain areas, minimal intertidal areas exist (for example, Catalina Head). However, the leeward side does not benefit from wave activity, and the combination of steep slopes and low wave action results in poor intertidal habitats. Relatively good intertidal habitat, characterized by gently sloping solid substrate, can be found only at Ship Rock, Bird Rock and Big Fisherman Cove Point.

Approximately 40 percent of the ASBS intertidal area consists of solid rock walls, and about 45 percent consists of various-sized boulders. The majority of these habitats are extremely steep in profile. The remaining 15 percent of the intertidal area consists of sandy or cobbly beaches. Virtually no beaches exist from Catalina Head to the West End, with the exception of Sandy Beach. Between Catalina Head and Arrow Point, most of the intertidal habitat is occupied by boulders. Many small coves and sandy beaches occur along the northeast (leeward) coast from Arrow Point to Blue Cavern Point, although cliffs and boulder areas predominate in this region also (Figures 15 - 18).

Climate

Santa Catalina Island has a Mediterranean climate characterized by warm, sunny, and dry summer months and relatively little rainfall during cooler months. Skies are generally clear; however, fog does occur during the cooler months. The mountainous land mass often limits the fog to the windward side of the island. The Isthmus is a break in this terrain and permits fog and wind to reach the leeward side.

The average daily temperature ranges from the high 70's (°F) in late summer and the low 50's (°F) in winter. Rainfall occurs primarily between October and April; average annual precipitation is 11.4 inches, based on data from 1945 through 1967. The northeast side of Catalina experiences greater rainfall than the southwest side. The northeast-facing slopes (toward the mainland) are protected from the drying effects of the prevailing westerly winds and hot afternoon sun.

Table 7 lists the mean monthly air temperatures and precipitation, 1944 - 1967, from the U.S. National Weather Station located at the Catalina Airport. Rainfall figures for the Isthmus area from 1968 to early 1978 are presented in Tables 8 and 9.

Prevailing winds are from the west-northwest. However, during the summer and early fall, warm drying Santa Ana winds occasionally blow from the mainland (Thorne, 1967).

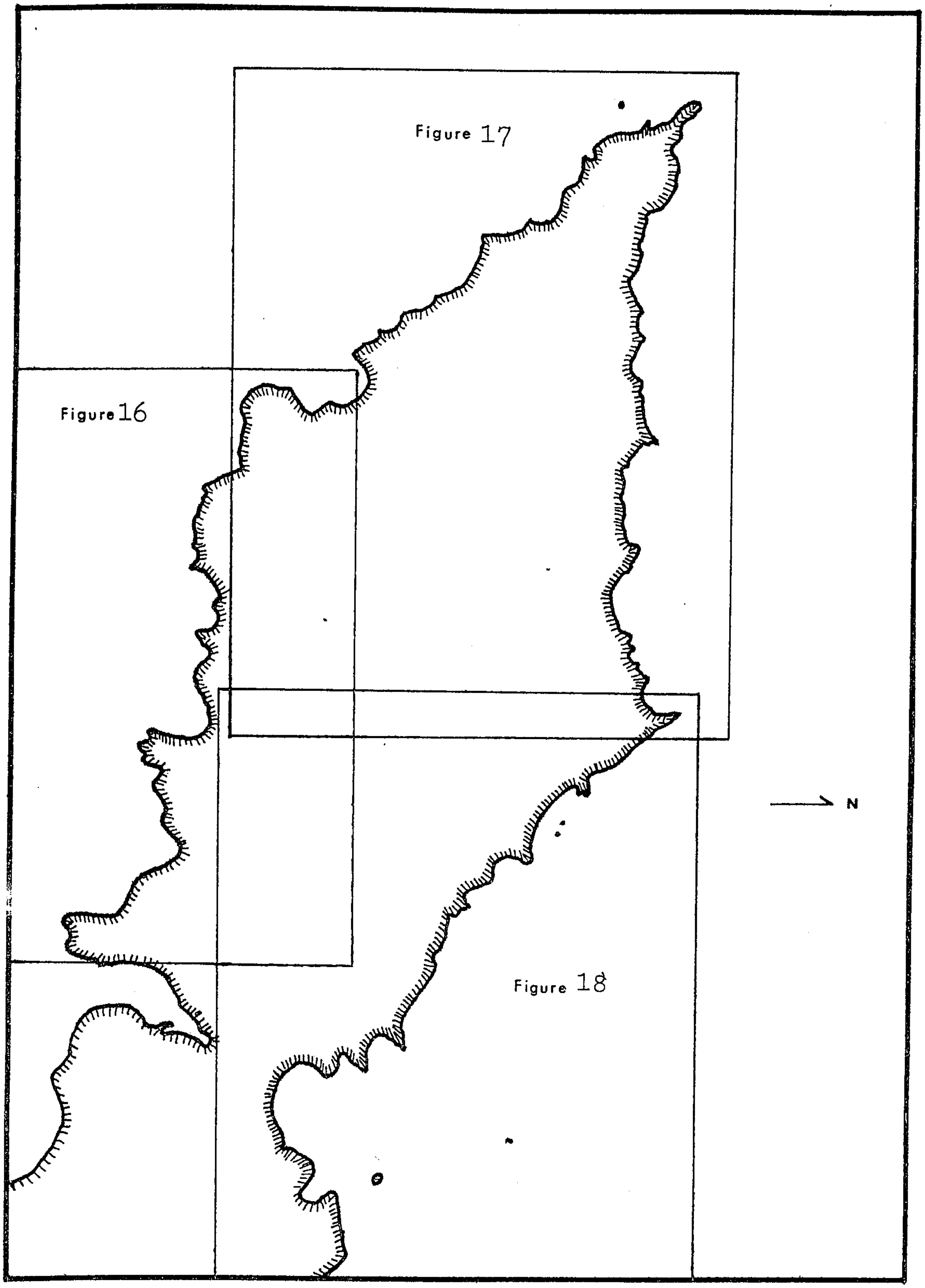


Figure 15. Location of Figures 16, 17, 18
in relation to SCI - Subarea I ASBS

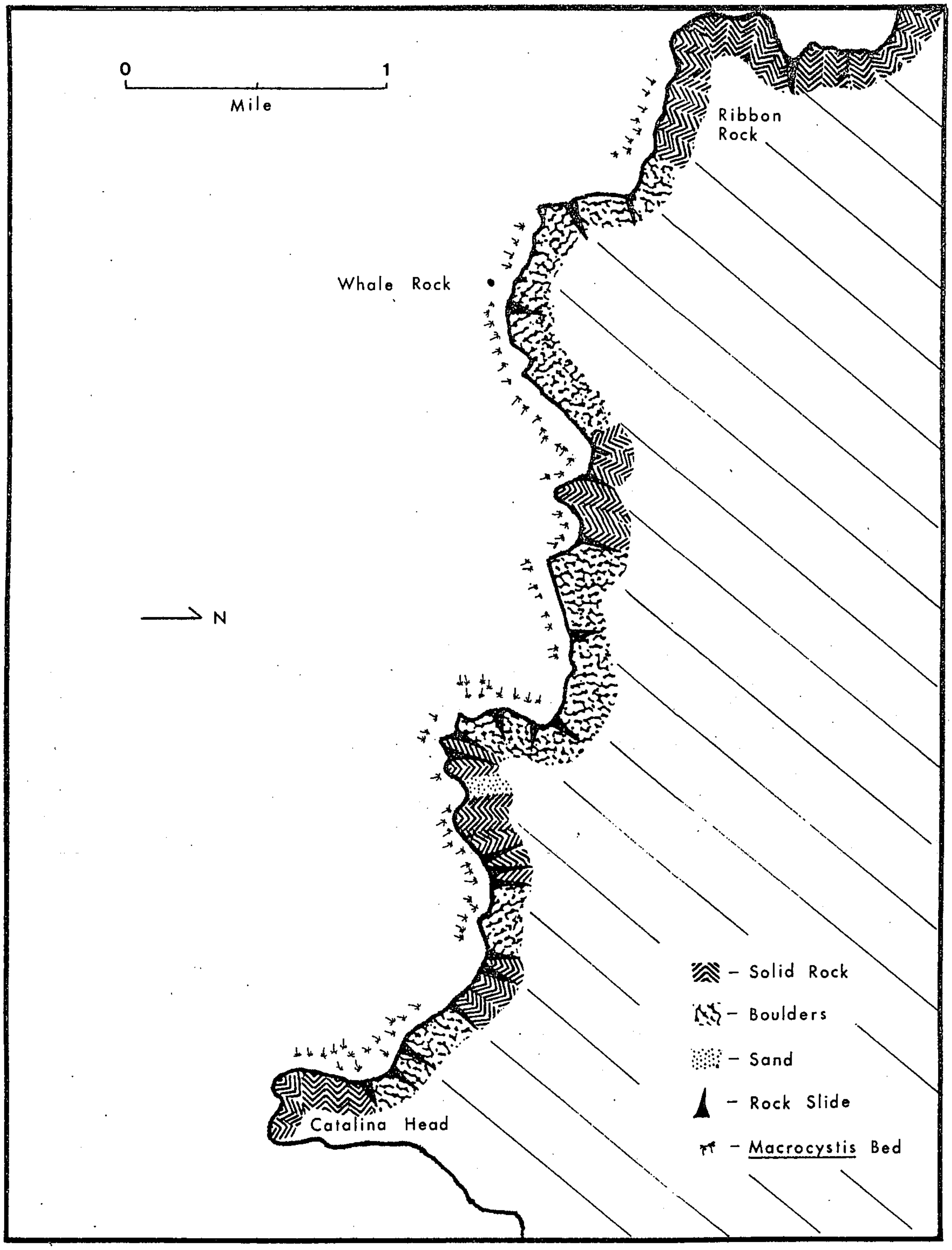


Figure 16. Intertidal substrate and giant kelp, *Macrocystis*, bed locations from Catalina Head to Ribbon Rock

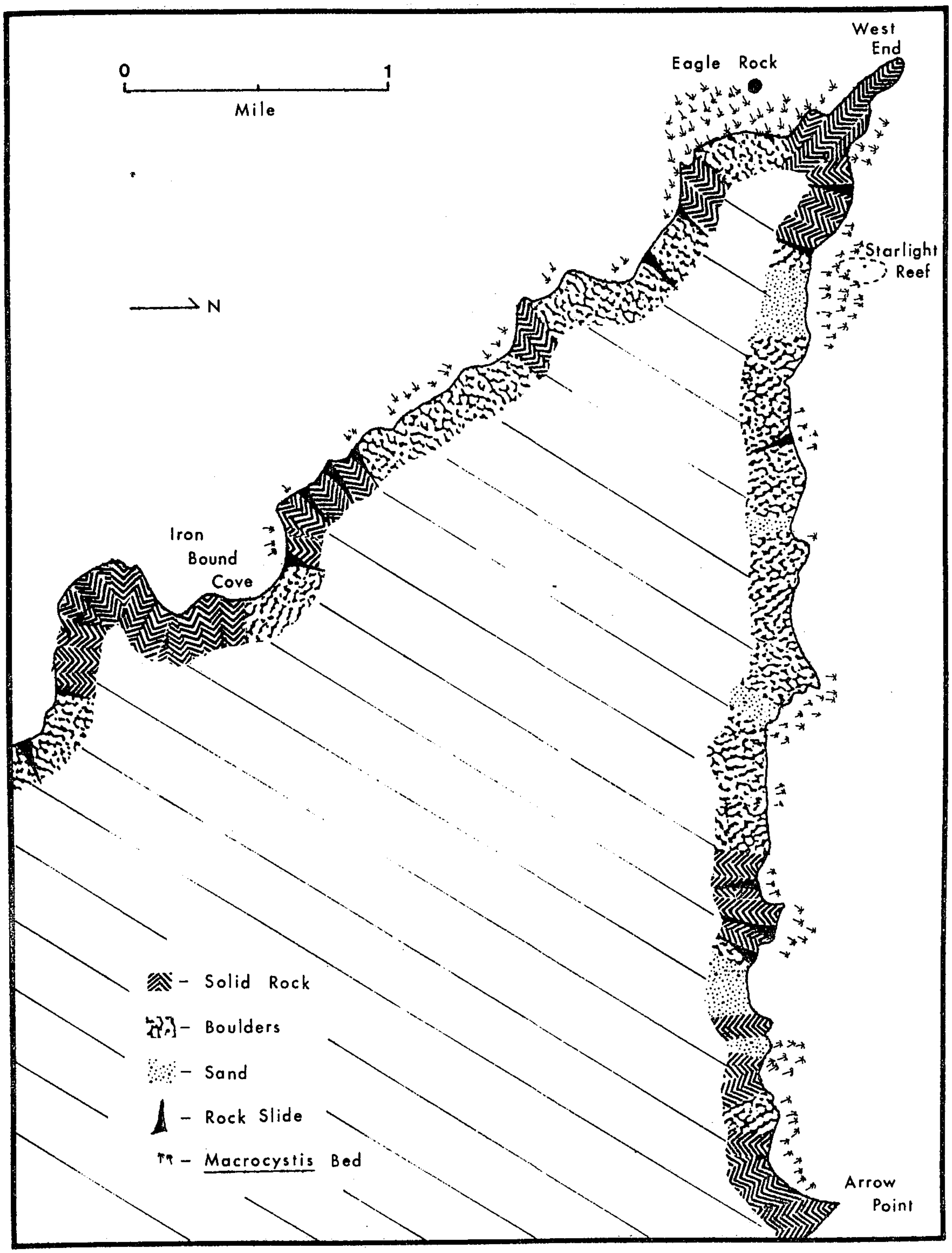


Figure 17. Intertidal substrate and giant kelp, *Macrocystis*, bed locations from Iron Bound Cove to Arrow Point

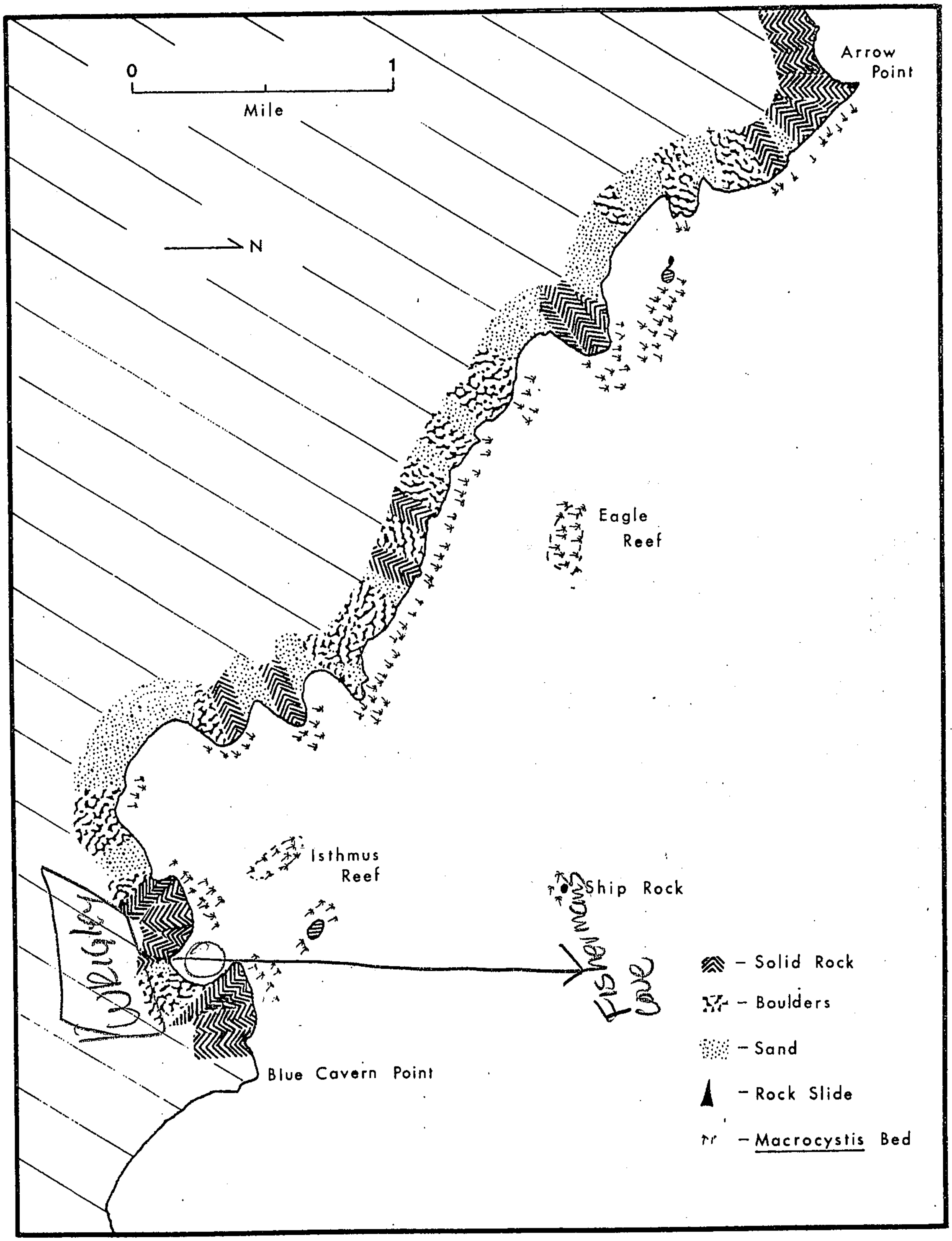


Figure 18. Intertidal substrate and giant kelp, *Macrocystis*, bed locations from Arrow Point to Blue Cavern Point

Table 7. Average monthly temperatures and precipitation for Santa Catalina Island, Catalina Airport, California. U.S. National Weather Bureau (1944-1952 and 1964-1967; Bureau closed June 1953 to December 1962).

	Air Temperature (°F)			Precipitation (inches)
	mean	max.	min.	mean
January	52.9	58.3	47.4	1.63
February	54.3	60.4	48.2	1.17
March	52.9	59.0	46.8	1.91
April	56.2	62.8	49.5	1.10
May	58.4	65.4	51.4	0.11
June	60.7	67.7	53.6	0.11
July	69.4	78.4	60.3	T
August	70.6	79.4	61.7	0.01
September	69.8	77.8	61.7	0.21
October	65.9	73.4	58.4	0.19
November	59.4	65.4	53.4	2.21
December	54.5	59.8	49.2	2.75
Annual	60.4	67.3	53.5	11.40

Table 8. Average Monthly Precipitation at Two Harbors, Santa Catalina Island (1968 - 1977). From Santa Catalina Island Conservancy Records.

	Precipitation (inches)
January	1.15
February	1.24
March	1.11
April	0.52
May	0.21
June	0.07
July	0.0
August	0.0
September	0.37
October	0.09
November	1.04
December	1.44
Total	7.24

Table 9. Yearly Precipitation at Two Harbors, Santa Catalina Island; 1969 to March 12, 1978

	Precipitation (inches)
1969	11.98
1970	9.30
1971	6.52
1972	4.0
1973	9.86
1974	10.04
1975	5.58
1976	9.34
1977	5.80
1978 (to March 12)	17.85

BIOLOGICAL DESCRIPTION

Subtidal Biota

Within the ASBS, substrate type and topographical features are largely responsible for the creation of distinct subtidal habitats. Habitat types include sand, sand interspersed with small boulders, vertical walls, and large and medium boulder slopes. Algae is an additional habitat type which can be utilized by fauna and epiphytic algae. For example, the giant kelp, Macrocystis pyrifera, growing on boulders at 20-to 60-foot (18 m) depths, creates a forest habitat for many fishes and invertebrates.

Sand is found at the seaward edge of most rocky subtidal areas, as well as at Sandy Cove (Figure 19), Parson's Landing, and all the coves on the leeward coast of the ASBS. Boulder slopes exist subtidally at Cactus Bay, Mola mola Cove and Black Point. Catalina Head and the north-facing side of Bird Rock are examples of vertical rock wall habitats.

Biotic assemblages found within particular subtidal habitats in the ASBS are discussed in the following pages and listed in the Appendices.

Sand Substrate Biota: Sand is the major substrate within the boundaries of the ASBS. However, most sand bottom areas occur at depths beyond the reach of scuba divers (greater than 100 feet). In the summer of 1977, a new submersible, TAURUS, being tested off Blue Cavern Point (Figure 26), was used to observe sandy areas to depths of 1,000 feet below sea level. These surveys found the large anomuran crab, Paralithoides tanneri, to be relatively abundant, but except for a few unidentified holothurians and rockfish, very little else was noted.

Four categories of organisms live in nearshore sandy substrate habitats: 1) anchored, 2) mobile, 3) epiphytic, and 4) infaunal. Pelagophycus sp., the large bulb or elk kelp, is an example of the first type of inhabitant and is found attached to the substrate at 50- to 100-foot (30 m) depths. Within the ASBS, it is known to occur at the mouth of Big Fisherman Cove, in Isthmus Cove, and at Black Point. Large beds of eel grass, Zostera marina, are found in 20- to 40-foot (12 m) depths

Figure 19. ASBS Survey Study Site Locations

1. Lobster Point
2. Sandy Cove
3. Iron Bound Cove
4. Cactus Bay
5. Eagle Rock Kelp Bed
6. *Mola mola* Cove
7. Starlight Reef
8. Black Point
9. Parson's Landing
10. Arrow Point
11. Emerald Bay/Indian Rock
12. Howland's Landing
13. Big Geiger Cove
14. Little Geiger Cove
15. Cherry Cove
16. Fourth of July Cove
17. Isthmus Cove
18. Big Fisherman Cove wrigly
19. Isthmus Reef
20. Bird Rock
21. Ship Rock
22. Eagle Rock
23. Habitat Reef

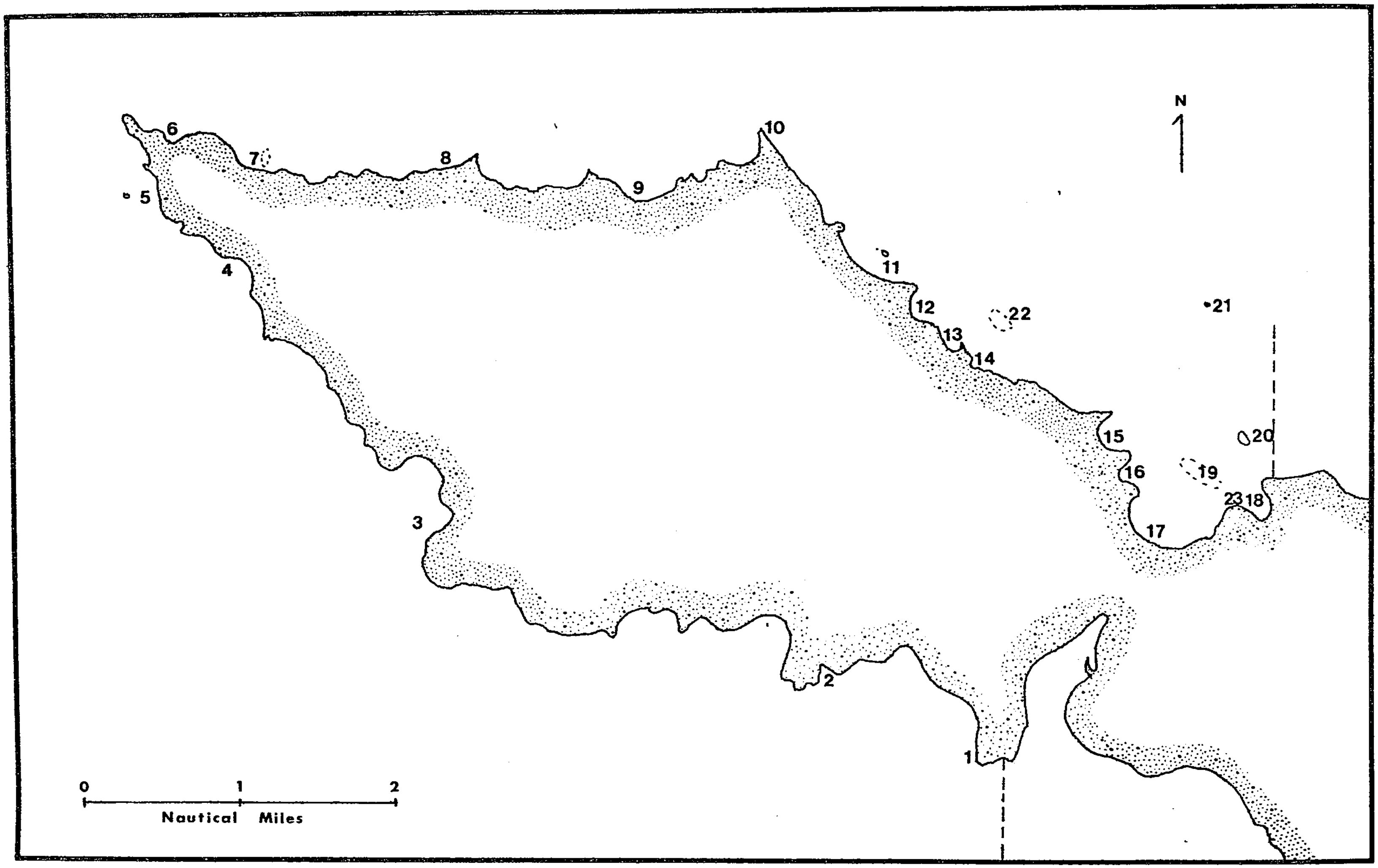


Figure 19. Cont. ASBS Survey Study Site Locations

in sandy areas at Little Geiger Cove and Big Geiger Cove.

A large bed of the sand dollar, Dendraster excentricus, occurs west of Arrow Point (Figure 26). These and other organisms bury themselves in the substrate, remaining partially exposed to feed and change location as necessary.

Mobile organisms found within the ASBS sandy subtidal zone include the extremely common, detritus-feeding sea cucumber Parastichopus parvimensis, the predatory sea star, Astropecten brasiliensis, and the bat ray, Miliobatis californica.

Some highly visible infaunal macroinvertebrates include the large, tube-dwelling polychaetes Chaetopterus variopedatus and Diopatra ornata. Emerson (1975), researching the reproductive and developmental biology of Diopatra, found these polychaetes near the outer edges of kelp beds and in other areas of organic debris accumulation, at depths of 60 to 90 feet (20 to 30 m). In some areas of the ASBS, the density of these worms can be as high as 500 individuals per square meter.

The tubes of these large polychaetes, which sometimes extend up to five centimeters above the sea floor, often provide a substrate for small red algae and for the larger brown algae such as Zonaria farlowii, Dictyopteris undulata and Pachydictyon coriaceum.

The phoronoid worm Phoronopsis californica, the sea pens Stylatula elongata and Acanthoptilum spp., and several species of cerianthid anemones are other sessile invertebrates visible in sandy subtidal portions of the ASBS.

There is considerable species diversity in the sandy subtidal macrofaunal community. One hundred species of polychaete worms were identified from cores taken during survey dives. Spiochaetopterus costarum, Lumbrineris latreilli, Owenia collaris and Allia sp. were the species found in greatest abundance. Numerous Schistomeringos longicornis and Lumbrineris zonata were found in the sands of north-facing coves. The remainder of the macrofaunal organisms are primarily small bivalve mollusks and crustaceans. The clam Phacoides approximatus and the gammarid amphipods Ampelisca cristata and Photis sp. were most abundant.

Vertical Rock Walls Biota: The algal community found on vertical rock walls is subjected to heavy surge and surf action at the shallower depths. The red algae such as *Laurencia spectabilis*, *Gelidium robustum*, and *Sciadophycus stellatus* are usually found in this habitat along with the brown sea palm, *Eisenia arborea*. The giant kelp, *Macrocystis pyrifera*, may occur on horizontal reefs but is sparse in heavy surge regions. Large, broad-bladed brown algae such as *Agarum fimbriatum* and *Laminaria farlowii* predominate at deeper depths (50 to 80 feet).

Bird Rock has very little algae on its north-facing wall. Low levels of light and a large community of herbivorous sea urchins could be the cause of this phenomenon. However, an abundance of microscopic red algae was found here and at Catalina Head, growing on the shells of the attached bivalves *Chama pellucida* and *Himmites multirugosus*.

Subtidal faunal assemblages can be grouped into two general associations according to depth. The *Chama pellucida* - *Pisaster giganteus* assemblage occurs between 15- and 50-foot (15 m) depths, the lower boundary being indistinct as *Chama* abundance gradually becomes less with increasing depth. The sea star *Pisaster giganteus* is *Chama's* primary predator (Vance, 1978), and reaches its maximum density within this zone (approximately $0.1/m^2$). A host of invertebrates is found associated with *Chama* beds, including the strawberry anemone, *Corynactis californica*, the corals *Coenocyathus bowersi* and *Paracyathus stearnsi*, the tubed polychaete *Spirobranchus spinosus*, the rock scallop, *Hinnites multirugosus*, the gastropods *Megathura crenulata* and *Serpulorbis squamigerus*, the sea urchins *Centrostephanus coronatus* and *Strongylocentrotus franciscanus*, the sea cucumbers *Parastichopus parvimensis* and *Cacumaria salma*, and the tunicate *Trididemnum opacum*.

The second major grouping found between 50- and 80-foot (24 m) depths includes the two common gorgonians *Muricea fruiticosa* and *M. californica*. A third gorgonian *Lophogorgia chilensis*, is common at Bird Rock but is rare or absent from Catalina Head. Many sessil tunicate and sponge species grow on or near the base of these gorgonians, perhaps gaining some protection thereby. These include the sponges *Haliclona permollis* and *Vergongia aurea*, and the turnicate *Trididemnum opacum*. The corals *Coenocyathus bowersi*, *Paracyathus stearnsi* and *Astrangia lajollaensis* can be found in the region also. Much rock surface is covered by encrusting bryozoans such as *Rhynchozoon rostratum* and *Parasmittina californica*.

Subtidal Boulder Habitat Biota: Boulder habitats are much more three-dimensional than either soft substrates or solid rock walls. In addition to surface substrate, there is much under-rock area utilized by a whole community of organisms. Boulders in the ASBS range between 3 and 33 feet (1-10 m) in diameter, with sand often interspersed between the smaller ones. In fact, the majority of subtidal reefs are of this sort. Extensive forests of the giant kelp, *Macrocystis pyrifera*, often grow attached to boulder reefs. Figures 16, 17 and 18 show the locations of the major kelp beds found in the ASBS.

Shallow boulder reefs (10- to 15-foot depths) support several species of common, large algae including *Eisenia arborea*, *Polcamium* sp., *Pterocladia capillacea*, and *Cystoseira neglecta*. The marine flowering plant surfgrass, *Phyllospadix torreyi*, is found on reefs exposed to heavy wave action. In slightly deeper water (20- to 40-foot depths), *Macrocystis pyrifera*, becomes abundant. Extensive kelp forests have a reduced understory algal community. Otherwise, *Cystoseira neglecta*, *Dictyota flabellata*, and *Pachydictyon coriaceum* are locally common. The red algae *Gelidium nudifrons*, *G. purpurascens*, and *G. robustum* are also locally abundant. *Plocamium coccineum* and *Sargassum muticum* occur extensively in some boulder areas seasonally. Deeper boulder reefs (greater than 50-foot depths) support primarily *Laminaria farlowii*, *Agarum fimbriatum*, and occassionally *Cystoseira neglecta* and *Eisenia arborea*.

The fauna of boulder reefs can be conveniently grouped into three categories: 1) those sessile on rock surfaces; 2) those mobile over the rock surface; and 3) those dwelling under rocks. One major difference between boulder reefs and solid rock wall habitats is the reduced abundance of the attached clam, *Chama pellucida*, on the boulder reefs. Concomitant with this reduction is a lower density of the predatory sea star, *Pisaster giganteus*. Boulder areas often have large populations of the sea urchins *Strongylocentrotus franciscanus* and *Centrostephanus coronatus* (the latter being restricted to holes during the daylight hours). In addition, the large keyhole limpet, *Megathura crenulata*, is commonly found on boulder reefs. Large mobile predators are a common component of the subtidal boulder community and include the octopus, *Octopus bimaculatus*; the lobster *Panulirus interruptus*; the seastar *Pisaster giganteus*; and the whelk *Kelletia kelletii*. In addition to urchin and limpet grazers, pink and green abalone Haliotis corrugata and H. fulgens are common herbivores.

Attached fauna include the gorgonians Muricea californica and M. fruticosa in deeper water. The sponges Tethya aurantia and Verongia aurea are locally common. Abundant bryozoans include Bugula neritina, Diaperoecia californica, Hippodiplosia insculpta and Phidolopora pacifica. The tunicates Eutherdmania claviformis, Pyura haustor and Trididemnum opacum are locally abundant.

The encrusting corraline algae, Lithothamnium giganteum, is common throughout the ASBS from 0 to 100-foot (30 m) depths. Shallow-water rock substrate is often covered primarily by low-growing algae, especially in gently sloping boulder reef areas. This is true of most of the ASBS except from the West End to Ribbon Rock. Here the boulders are relatively clean of low-growing algae, although they support large beds of Macrocystis. The low light levels, due to the thick kelp beds, and the large sea urchin population, may be responsible for the reduced algal cover here.

Under-rock habitats support a diverse fauna. Attached to the under surfaces of rocks are several sponges, including Hymanamphiastra cyanocrypta. The polychaete Chaetopterus variopedatus is often found there, as is the terebellid polychaete Neoamphitrite robusta. Several brittle stars, including Ophioderma panamensis and Ophiothrix spiculata, utilize this habitat. Strongylocentrotus purpuratus is also found there, as are the juveniles of both other urchin species. The predatory sea star, Astrometis sertulifera, is most often found under boulders.

Fish Communities: Many diverse habitats are utilized by fishes in the shallow waters off Santa Catalina Island. Surfgrass beds, sandy/shelly debris bottoms, low algae/rocky rubble, and giant kelp beds are the major inshore habitats present, each with a distinct fish species composition. Between 1974 and 1976, several hundred scuba dives were made in shallow water (less than 60-foot depths) between Lion Head and Blue Cavern Point (including Bird Rock and Ship Rock), within the ASBS. The following discussion is based on diver observations made during this time period, and considers only those species which were common in this study area.

The surfgrass beds off Bird Rock are a haven for small benthic fishes. Within these beds, spotted kelpfish, Gibbonsia elegans, pipefish, Syngnathus spp. and juvenile California scorpionfish, Scorpaena guttata, are the dominant species. Reef finspot, Paraclinus integripinnis, mussel blenny, Hypsoblennius jenkinsii, cabezon, Scorpaenichthys marmoratus, and corraline sculpin, Artedius corallinus, are also present but in fewer numbers. Just outside the deeper margins of these beds, opaleye, Girella nigricans, rock wrasse, Halichoeres semicinctus, kelp bass, Paralabrax clathratus, sheephead, Pimelometopon pulchrum, and señorita, Oxyjulis californica, are common; while kelp perch, Brachyistius frenatus, shiner perch, Cymatogaster aggregata, halfmoon, Medialuna californiensis, and black surfperch, Embiotoca jacksoni, occasionally frequent the area. Topsmelt, Atherinops affinis and occasionally blacksmith, Chromis punctipinnis are abundant in the upper water column.

In shallow sandy/shelly debris bottom habitats with seasonal fluctuations of small benthic algae, rock wrasse and sheephead are the most abundant fish, followed by small to medium-sized kelp bass. Present in fewer numbers are C-O turbot, Pleuronichthys coenosus, lavender sculpin, Leiocottus hirundo, and bat ray, Myliobatis californica. Blackeye goby, Coryphopterus nicholsii, occurs in areas with small rocks or other structures for shelter. The upper water column is often dominated by large schools of blacksmith and topsmelt.

The low algae/rocky rubble habitat lying inshore of the giant kelp beds is dominated by large schools of opaleye. Schools of juvinile opaleye are more common in the intertidal or shallow subtidal zones, whereas adults are found in deeper waters and often range into other habitats. Rock wrasse, kelp bass, sheepheads and spotted kelpfish are present in fewer numbers, while black surfperch, señorita, kelp perch, California scorpionfish, giant kelpfish, Heterostichus rostratus, and juvenile garibaldi, Hypsypops rubicundus, are observed here frequently. Wooly sculpin, Clinocottus analis, is only observed in the intertidal and very shallow subtidal regions. During certain times of the day, large schools of blacksmith and topsmelt are in the upper water column. Schools of reproductively active shiner perch are common during the fall.

The kelp beds are the most structurally complex of the ASBS subtidal habitats, and the diversity of fishes there is proportionately greater. These beds are divided vertically into a benthic zone and a middle-to-canopy zone. The most abundant benthic fishes are sheephead, rock wrasse, kelp bass, and señorita. Garibaldi, black perch, California scorpionfish, opaleye, kelp perch and pile perch, damalichtys vaca. Among the smaller benthic fishes, blue-banded goby Lythrypnus dalli, Coryphopterus nicholsii, island kelpfish, Alloclinus holderi, and spotted kelpfish are the most abundant, with zebra goby, Lythrypnus zebra, common in some areas. Benthic fish seen infrequently here include giant kelpfish, kelp rockfish, Sebastes atrovirens, treefish, S. serriceps, California moray, Gymnothorax mordax, horn shark, Hetrodontus francisci, and swell shark, Cephaloscyllium ventriosum.

In the middle-to-canopy zone, señorita, kelp perch and blacksmith are dominant. Kelp bass, and halfmoon occur in fewer numbers, followed by giant kelp fish, kelp rockfish, and in some areas, juvenile olive rockfish, Sebastes serranoides. First-year juvinile kelp bass, señorita, giant kelp fish, kelp rockfish and treefish are most prevalent in the middle-to-canopy zone.

Ship Rock has three basic habitats: 1) a giant kelp bed fringing the rock, bounded by 2) steeply sloping boulder regions, surrounded by 3) a deep, sandy bottom. Blacksmith is the dominant kelp bed fish, and the population here is larger than in any other area. Previously-mentioned kelp bed fishes are also present at Ship Rock, and in similar numbers. In the shallower areas of the surrounding boulder region, convict fish, Oxylebius pictus, are commonly seen. The population size of swell shark is greatest at Ship Rock, and individuals are abundant at all depths in the boulder regions. Pacific angel shark, Squatina californica, can be seen in deep sandy bottom areas.

At Bird Rock, convict fish are present in lower numbers than at Ship Rock, but numbers of all other kelp bed fishes are similar.

Pelagic fishes, such as yellowtail, Seriola dorsalis, jack mackerel, Trachurus symmetricus, California barracuda, Sphyraena argentea, and common mola, Mola mola are occasionally abundant in the upper water column surrounding both Ship Rock and Bird Rock.

At night, the distribution of fishes changes dramatically. Sheepheads, garibaldi, blacksmith and opaleye seek shelter among the rocks and within rocky crevices. Kelp bass retreat among the low algae and rocks while convict fish bury themselves in the sandy/shelly debris. All of the remaining diurnally active fishes remain in essentially the same areas at night but become inactive. Kelp rock fish can be observed actively feeding in the middle-to-canopy zone of the kelp beds, while the California moray forages among the rocks. Queenfish, Seriphus politus, walleye surfperch, Hyperprosopon argenteum, and the olive rock fish presumably move in from deeper water. Top smelt are common in the upper water column outside the kelp beds. On the sandy/shelly debris bottoms, sargo, Anisotremus davidsoni, can be observed at night, although it is also seen occasionally in this habitat during the day.

Intertidal Biota

Intertidal habitats are sparse at Catalina Island. Ship Rock and Bird Rock contain the only relatively extensive intertidal communities found within the ASBS. These offshore rocks have broad bases and rise from below sea level up to 50 or more feet (15 m) above sea level with approaching angles of approximately 45° from the vertical.

The highest rocky intertidal zone is inhabited by the periwinkle Littorina planaxis. In the ASBS, these individuals are usually small in size, never attaining the 10-15 mm size of northern California specimens. The congeneric L. scutulata is much rarer than L. planaxis. The isopod rock louse, Ligia occidentalis, is also found here.

The limpets Collisella scabra and C. digitalis share high intertidal areas with the giant owl limpet, Lottia gigantea. L. gigantea is not equally distributed over all rock types on Bird Rock but is usually restricted to basalt or other smooth surfaces. The barnacles Balanus glandula, Chthamalus fissus and Tetraclita squamosa occur within a broad vertical range in the upper intertidal zone. Below this, Mytilus californianus, can be found in scattered clumps, attaining its densest populations on exposed western ends at Bird Rock and Ship Rock. Interspersed with M. californianus is the gooseneck barnacle, Pollicipes polymerus, again being most abundant in exposed areas of the substrate. A host of invertebrates is associated with the Mytilus beds, one of the more important being the predatory sea star, Pisaster ochraceus.

Small numbers of the aggregate anemone, Anthopleura elegantissima, can be found on Bird Rock and Indian Rock, and in somewhat more abundance on the north- and west-facing sides of Ship Rock. Tegula funebralis can occasionally be found, although populations are not large. The lined shore crab, Pachygrapsus crassipes, is also encountered occasionally. The black abalone, Haliotis cracherodii, is locally abundant in crevices washed by wave surge.

The Mytilus californianus zone (0 - 10-foot depth) grades into a zone dominated by the southern sea palm, Eisenia arborea, and the surf grass, Phyllospadiz torreyi, on the south side of Bird Rock. Elsewhere, M. californianus continues into subtidal areas to approximately -5 feet (e.g., Bird Rock, north wall). Chama pellucida, occasionally seen in intertidal areas, is most aboudant just below the Mytilus zone.

A band of the feather boa kelp, Egregia laevigata, is commonly found fringing the ASBS intertidal zone. Other algae common to this zone include the erect coralline Corallina officinalis, the red alga Geldium purpurascens, and the brown algae Pelvetia fastigiata and Hesperophycus harveyanus.

Sea Birds

According to Dr. George Hunt, there are nine species of sea birds found around Santa Catalina Island, and their population density in the ASBS is low. A Bureau of Land Management study of the Southern California Bight has recorded abundance information for these species but it is unpublished at present. The seasonal abundance of sea birds in nearshore waters varies with the onshore movement of squid during the winter spawning season. In the winter of 1975 an average of 5,501 birds were sighted per survey, as opposed to 382 birds in the spring, 235 in the summer and 322 in the fall (Hunt, pers. comm.).

Offshore rocks are one of the major habitats utilized by nesting sea birds on the Channel Islands. Due to the general paucity of offshore rocks around the ASBS, few breeding species are found.

Historical data indicate that Brandt's cormorants, Phalacrocorax penicillatus, bred on Ship Rock and Bird Rock around 1900. At the present time, however, only western gulls, Larus occidentalis, are nesting on Catalina Island. Of the approximately 10,000 pairs of breeding western gulls in the Southern California Bight, only 30 pairs are found nesting at Bird Rock.

Terrestrial Biology

A continuous mountain ridge runs along the west end of Santa Catalina Island in the northwest-southeast direction, with Silver Peak (elev. 1,804) the highest peak in the range. All runoff from these slopes drains directly into the ASBS.

The southern or windward side of the west end falls sharply from the ridge to the ocean, with grades of up to 60°. Erosion from wind and rain prevent topsoil from accumulating, except in a few ravine bottoms where groves of trees and shrubs are found. The northern or leeward side of the island descends gradually from the ridge, with more extensive drainages, plateaus and small canyons. The plant communities on the north side of the slope are varied, with denser vegetation contributing to soil buildup and preventing excessive erosion.

The low annual rainfall (12 inches) on Catalina, together with both the nature of the soil and the abundant rock outcrops, creates a semi-arid environment, supporting relatively sparse, desert-like plant communities.

Most watersheds draining into the ASBS are small and cover short distances, especially near the West End along the windward side of the island. The majority of these are covered by what is best termed the Coastal Sage Scrub community, heavily dominated by the prickly pear cactus, Opuntia littoralis. There are a few watersheds with a scant Scrub Oak Woodland community and occasional small groves of the endemic Catalina Ironwood. Overgrazing by feral goats has reduced 10 to 40 percent of these watershed areas, and virtually all the ridge tops, to bare dirt.

On the north side of the ridge there are more extensive watersheds: 1) from Stoney Point to the West End; 2) above Emerald Bay; and 3) behind Parson's Landing (the largest). These are covered principally with Scrub Oak Woodland and Coastal Grassland communities.

The plant communities on lands adjacent to the ASBS are not complete representations of the same communities on the California mainland. There is a paucity of plant species on Catalina compared to the mainland as the result of the poor dispersability of many plants over water. There are four different plant communities on the west end of Catalina: Coastal Sage Scrub; Southern or Scrub Oak Woodland; a mix of Coastal Prarie/Valley Grassland; and Chaparral. The dominant species in each community commonly occur in fewer numbers than in the mainland counterpart community; the relative abundance of dominant species also differs.

Of these four plant communities found near the ASBS, the Coastal Sage Scrub community is best represented and can be found in most areas on slopes, ridges and flats, on dry, clayey or rocky soil. Prickly pear, Opuntia littoralis, and California sagebrush, Artemesia californica are the main plants in this community (a complete listing of the species found in this and other plant communities adjacent to the ASBS can be found in the Appendix). Prickly pear can cover up to 80 percent of the steeper slopes, resulting in a rather open-type association with shrubs and cactus growing to a height of one to three feet. The Coastal Sage Scrub community is often intergraded with the grassland community.

Immediately adjacent to the ASBS there is a mixture of the Coastal Prairie community and the Valley Grassland community. Avena barbata and Bromus mollis characterize this type of community, which is found on rolling hills and ridges with thin, but good soil.

The Southern or Scrub Oak Woodland community is dominated by the most common tree on Catalina, the scrub oak, Quercus dumosa. This tree, 5 to 20 feet (6 m) in height, can comprise up to 98 percent of a dense woodland, or it can grow in sparse numbers in open stands with grasses and understory annuals.

The Chaparral community, characterized by chamise, Adenostoma fasciculatum, Quercus dumosa, and toyon, Heteromeles arbutifolia, is found among numerous rocky outcroppings on north-facing gradual slopes. These shrubs and trees, ranging from 3 to 8 feet high, seldom grow in dense clumps, but are found more often in open stands.

The watershed west of Lobster Point and south of Mt. Torquemada drains into Lobster Bay, with slopes of approximately 50°. The watershed community consists of 60 percent prickly pear, 10 percent sagebrush, 20 percent bare dirt, and a few scattered scrub oak, lemonadeberry, Rhus integrifolia, grasses and other annuals Avena barbata, A. fatua, Eremocarpus setigerus, and perennials, Selaginella bigelovii, Mimulus puniceus, Rhus laurina, Dudleya spp.

The slopes above Cape Cortes west to Whale Rock are 40 - 50°, and are covered by 40 percent bare dirt of thin and rocky soil, 55 percent prickly pear, and 10 percent assorted shrubs and low trees, most of which are found in the higher ravine bottoms.

From Whale Rock west to Ribbon Rock a moderately-developed Scrub Oak Woodland community occurs on the northwest-facing slopes, and a near blanket of cactus on the southeast-facing slopes. Ribbon Rock itself is a large outcrop of loose rocks with minimal vegetation, with slopes of about 20° below the ridge becoming 60° above the intertidal. The northwest-facing slopes consist of 50 percent scrub oak, 30 percent shrubs and 20 percent dirt. The southeast-facing slopes contain 80 percent prickly pear, 5 percent shrubs, and 15 percent dirt.

To the southeast, Silver Peak drops from an elevation of 1,804 feet (550 m) into Iron Bound Bay, Spring Landing and Star Bay. The 40 - 60° slopes here contain 60 percent prickly pear, 10 percent scrub oak, and a few Catalina Ironwood, Lyonothamnus floribundus floribundus, primarily on northwest-facing slopes and in canyon bottoms, and 30 percent bare dirt and rocks.

The westernmost land on the southern side of Catalina, from Cactus Bay to West End, lies below West Point at 673-foot (205 m) elevation, and consists of a series of steep, rocky slopes with scant soil or vegetation. Slope coverage consists of 40 percent prickly pear, 5 percent shrubs and 55 percent exposed rock and dirt. This type of terrain continues around West End for several hundred yards along the north side of the Island.

Immediately east of West End, above Starlight Beach, is a low-growing and well-developed scrub oak forest, extending east to Stony Point. The gradual slopes directly north of Silver Peak are broad and flat, with no deep canyons running through them. The upper third of the slopes, above 1,000 feet (305 m) are 60 - 90 percent bare dirt and rock, with severe erosion directly below the ridge. Below 1,000 feet the area is covered by 40 percent lemonadeberry, 10 percent shrubs and 10 percent open areas of grasses or dirt.

Parson's Landing is at the base of a rather desolate plateau of exposed dirt and spotty vegetation, above which is a moderate scrub oak forest. The flat expanse is approximately 85 percent rock and dirt, covered in the spring by grasses, and 15 percent scattered scrub oak and shrubs such as, Rhus integrifolia, Foeniculum vulgare and Eremocarpus setigerus. The forest behind this area is predominantly scrub oak, with occasional Heteromeles arbutifolia, Sambucus mexicana, Adenostoma fasciculatum, and other shrubs.

From Arrow Point southeast to Howland's Landing are two drainages separated by a ridge running down into Emerald Bay. The northern drainage into Emerald Bay is covered by an extensive Coastal Prairie/Valley Grassland community, with 70 percent grasses such as Avena barbata, A. fatua, Bromus mollis, Poa scabrella, Elymus condensatus and others, 15 percent prickly pear and 15 percent scrub oak and other shrubs. The upper reaches of this watershed and the drainage above Howland's Landing are primarily bare dirt. The southern drainage canyon, in which Howland's Landing is located, is fairly deep and flat in its lower half, with characteristic riparian vegetation of 40 percent grasses, 40 percent toyon, Catalina cherry, Prunus ilicifolia lyonii, elderberry, Sambucus mexicana, scrub oak and 20 percent open dirt and dry water courses. The upper half thins out to shrubs and grassland.

East of Howland's Landing to Fourth of July Cove the land topography consists of steep slopes and several short and deep canyons. Over 50 percent of this land drains into Cherry Valley, the deepest and longest of these canyons. Cherry Valley has a broad, flat foot with bare dirt and several species of halophytes closest to shore, with a thick grove of Catalina cherry behind this. The upper portion of Cherry Valley exhibits classic north-south exposure vegetation, with prickly pear and other Coastal Sage Scrub cliff community species on the south-facing slope. The north-facing slope contains a unique forest of chamise mixed with occasional toyon, mountain mahogany, Cercocarpus betuloides var. blancheae, California lilac, Ceanothus arboreus, manzanita, Arctostaphylos catalinae and wild coffee, Rhamnus pirifolia. There is also an understory of annual grasses, and two large, healthy groves of Catalina Ironwood. The smaller canyons and cliff areas are covered with an incomplete thick cover, at places impenetrable, but more often open. The vegetation cover here consists of about 40 percent chamise, 20 percent scrub oak, 20 percent a mix of lemonadeberry, toyon and wild coffee, 15 percent other shrubs and herbs, and 5 percent open grassland and dirt.

Isthmus Cove and Little Fisherman Cove comprise a long, narrow sandy beach. The small drainages behind these beaches are covered by 75 percent grassland and 25 percent riparian vegetation such as scrub oak, toyon, and Encelia californica. Big Fisherman Cove, site of the Catalina Marine Science Center, has a similar watershed, but more exposed rocky areas. This watershed is covered by 60 percent grassland, 10 percent shrubs and trees in the bottom of the drainages, and 30 percent bare dirt and rocky outcrops.

Unique Components

Catalina Island is subjected to both north- and south-flowing components of the Southern California Countercurrent. While little is actually known about the nearshore biological implications of this water mass, there is some evidence to suggest that these two components converge at the extreme western tip of the Island (West End or Land's End), and that this area therefore supports some representatives of both southern and northern biotas. Land's End is an area of extremely heavy water action during most of the year and, therefore, has not been well-studied.

General observations on the terrain and biological assemblages, coupled with some specific sightings of exotic species, seem to substantiate the existence of rather unique assemblages. However, the only uncommon occurrence which has actually been documented is for the scythe-marked butterflyfish, Chaetodon falcifer, sighted nearshore at Eagle Rock in December, 1976 (Los Angeles County Museum Note), and also possibly sighted near CMSC and Blue Cavern Point. A southern gastropod species, tiger cowry, a southern slate-pencil sea urchin, and several species of sea turtles have also been reported here, but these reports have not been confirmed.

Recently a small population of the sea cucumber Holothuria zacae "forma iota" was found off Ship Rock. This species is common off Mexico and Cedros Island, but has never been reported from anywhere else north of the Mexican border. Biologists at CMSC are monitoring The Ship Rock population, and are in the process of publishing notes on the northern extension of *H. zacae's* range.

LAND AND WATER USE DESCRIPTIONS

Marine Resource Harvesting

Commercial Fishing: The California State Department of Fish and Game has divided oceanic waters off the California coast into fishing "blocks", to enable the Department to record pertinent information on commercial and sport landings. Santa Catalina Island - Subarea I ASBS lies primarily within block #762, with a small section in #761 (Figure 20). The following information was provided by the Department of Fish and Game.

The squid fishery is of primary importance in block #762, accounting for 56 percent of the total commercial squid landings in California between 1964 and 1974 (Figure 21). Market squid, Loligo opalescens, are fished in nearshore waters (0 - 500-foot depths) where they aggregate to spawn from mid-December into March. Commercial fishermen are permitted to use night lighting to attract the squid, and to catch them with purse seines, lampara nets and brails. In 1974, catch block #762 yielded 4.8 percent of the total California catch and 13.7 percent of the squid landed at Los Angeles (Table 10).

Jack Mackerel, Trachurus symmetricus, are next in importance from block 762, accounting for 40 percent of the commercial catch in California between 1964 and 1974. Northern anchovy, Engraulis mordax, comprised 10 percent of the total catch during this time period, while Pacific bonito, Sarda chiliensis, comprised 3 percent. The remaining 4 percent of the total catch is included in Table 11.

The nearshore waters of the ASBS, from West End to Blue Cavern Point, are off limits to commercial lobster and abalone fishing. These two fisheries comprised 0.1 percent and 0.9 percent of the catch from 1964 to 1974 respectively.

Although Table 10 indicates that the block #762 sea urchin catch from 1973 - 1974 comprised a large percentage of the Los Angeles landing, sea urchins are no longer being fished in this area.

Kelp Harvesting: Giant kelp, Macrocystis pyrifera, and Gelidium, spp. are the principal species of algae harvested commercially in Southern

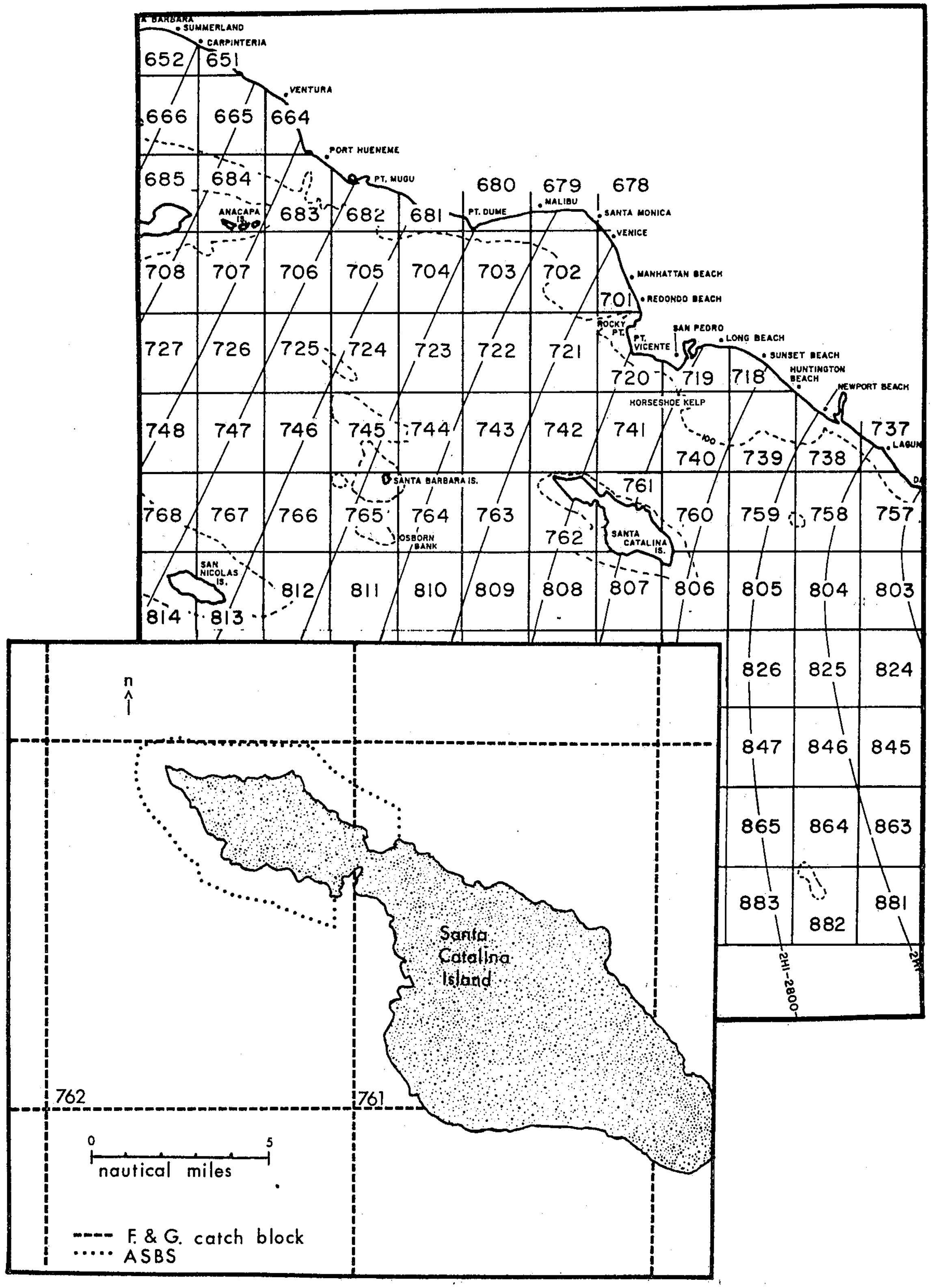


Figure 20. Location of the ASBS in Relation to California Department of Fish and Game Catch Blocks

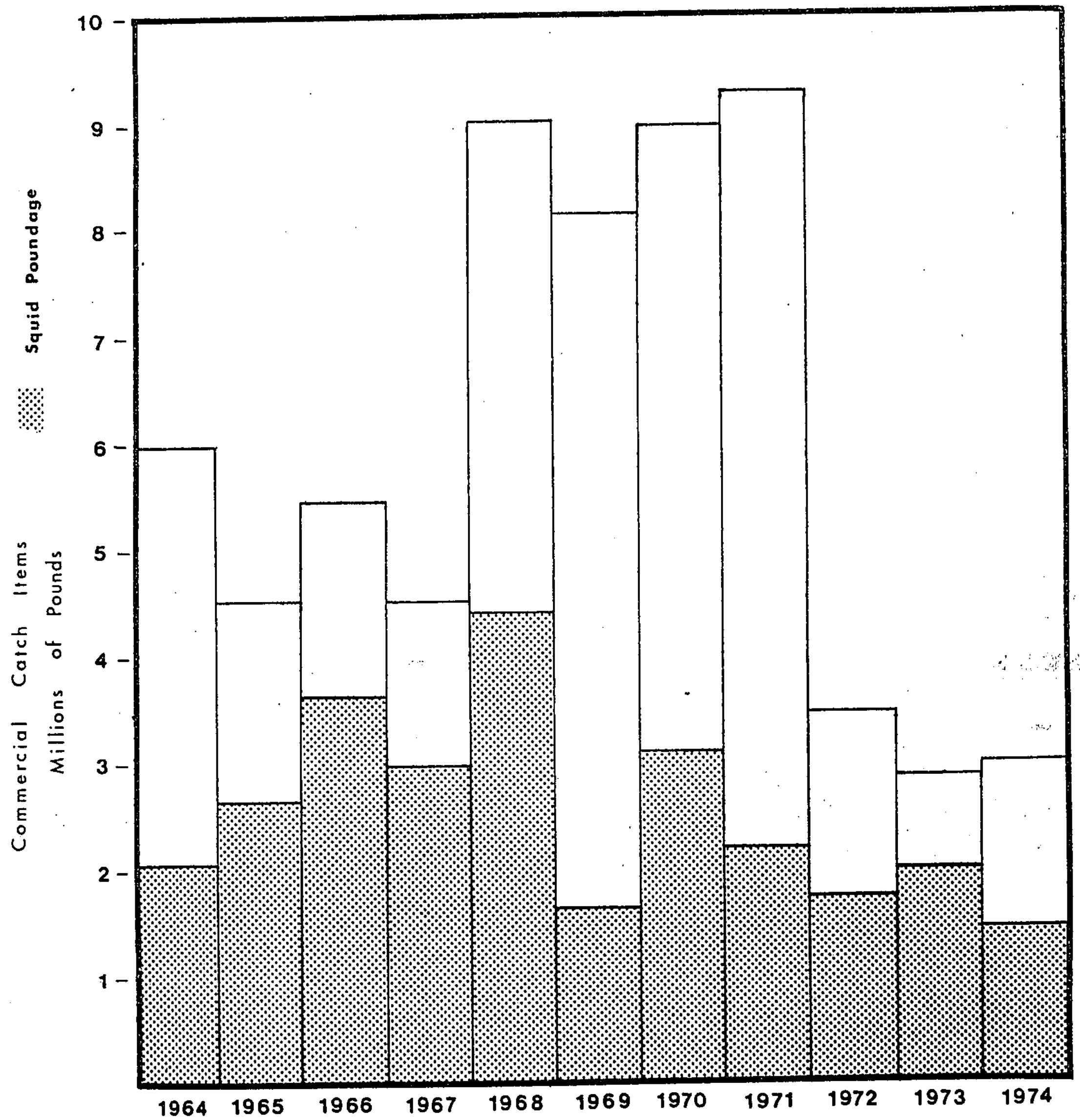


Figure 21. Market Squid Landings in Block #762 in Relation to Total Commercial Landings in California, 1964-1974

Table 10. Major Species Landed from Catch Block # 762 in 1974; Percentages of Los Angeles and California Commercial Landings

	lbs	% Los Angeles Landings *	% California Landings
FISH			
Yellowtail	261	1.3	0.3
Jack Mackerel	1,072,650	4.3	4.2
Swordfish	2,672	0.7	0.4
Northern Anchovy	703,880	0.1	0.1
California Sheephead	40	2.4	1.1
Shark	2,158	2.4	0.5
California Halibut	140	0.2	0.0
Rockfish	1,736	0.4	0.0
Sculpin	378	1.8	0.0
White Sea Bass	3,573	2.6	1.2
Opaleye	243	2.6	2.5
Halfmoon	558	23.6	7.0
Surfperch	1,309	5.3	0.9
INVERTEBRATES			
Black Abalone	6,619	2.0	0.6
Green Abalone	4,136	4.1	3.4
Pink Abalone	5,761	2.8	1.3
White Abalone	225	2.0	0.2
Squid	1,396,895	13.7	4.8
Sea Urchin	13,757	19.3	0.2
California Spiny Lobster	4,416	5.6	2.3

* Los Angeles Landing figures include items shipped into Los Angeles ports, caught in other area.

(from unpublished computer printouts,
California Department of Fish & Game)

Table 11. Average Commercial Landing of Fish and Invertebrates from Catch Blocks #761 and #762, 1964-1974

	761 $\bar{x}$ lbs/year	762 $\bar{x}$ lbs/year
FISH		
Pacific Bonito	21,372	165,848
Bluefin Tuna	466	6,316
Albacore		298
Yellowtail	80	489
Pacific Mackerel	37,784	118,964
Jack Mackerel	183,191	2,366,944
Pacific Butterfish	309	206
Swordfish	8,422	6,076
Pacific Sardine	3,688	6,236
Northern Anchovy	137,023	617,584
California Barracuda	21	124
California Sheephead	3	89
Shark (misc.)	196	2,477
Bonito Shark	2	22
Leopard Shark	6	38
Common Thresher	1	8
Soupfin Shark		23
Blue Shark		1
Smelt (misc.)	1,632	1,360
Sablefish		1,152
Lingcod		3
California Halibut	2	1,490
Sanddab	9	8
Rockfish (misc.)	715	3,162
Sculpin (misc.)	164	525
Cabezon	1	
Giant Sea Bass	11	354
White Sea Bass	419	3,037
White Croaker	1,531	1,846
Flying Fish	10,266	2,727
Opaleye	373	231
Halfmoon	103	1,561
Blacksmith		4,474
Surfperch (misc.)	154	469
Ocean Whitefish		2

Continued

Table 11. continued.

	$\bar{x}$ lbs/year 761	$\bar{x}$ lbs/year 762
INVERTEBRATES		
Molluscs		
Black Abalone	642	1,291
Green Abalone	2,362	12,046
Pink Abalone	1,594	38,951
White Abalone		195
Market Squid	2,363,111	2,535,871
Crustaceans		
Rock Crab		112
California Spiney Lobster	1,281	7,646
Echinoderms		
Sea Urchin		9,279 *
$\bar{x}$ total lbs	2,803,430	5,914,292

* 1973-1974 only

(from unpublished computer printout, California Department of Fish & Game)

California. Both species are found in the ASBS but are in lower abundance and are less accessible than along the mainland coast. Therefore, although one company did attempt to harvest in the area, there is presently no commercial kelp harvesting within the ASBS (Pinkas, pers. comm.).

Sport Fishing: The nearshore waters off Catalina are heavily used by sport fishermen and divers. The ASBS is only 20 nautical miles from the Los Angeles metropolitan area and offers the mainland populace the opportunity to pursue these activities.

Between 1965 and 1976, on the average, 250 party boats utilized the waters off the west end of Catalina (DF&G catch block #762) yearly for fishing. (Figure 22), with the summer months receiving the heaviest traffic (Figure 23). Pacific bonito, kelp bass and halfmoon are the species most often caught. Table 12 lists all species taken and their mean weight for the years 1965 - 1976. Over that time period, approximately 1.5 fish were caught per angler hour (Figure 24).

Diving is also a popular sport here. Sixteen percent of all Southern California diving activity from party boats occurs in block #762. Table 13 lists the mean number and species of fish and invertebrates taken by sport divers in catch block #762 from 1971 to 1976. Table 14 compares diver utilization of the west end of Catalina with that of the entire Southern California area between 1971 and 1976.

The warm waters and good visibility in the ASBS attract divers year-round, but primarily in the late summer and early fall. Besides fishing, underwater photography is a popular activity of the sport diver, due to the excellent water clarity and interesting marine life.

Municipal Activities and Designated Open Space

The history of the ownership of Santa Catalina Island is well-documented and need not be detailed here. In 1542 Cabrillo claimed the island for Spain. Later, after Mexico declared its independence, Catalina was ruled by a series of appointed governors. Thomas M. Robbins received it as a land grant in 1846, after which it changed hands a number of times. In 1892 the Banning family bought Catalina, and shortly thereafter formed the Santa Catalina Island Company, intending to operate the island as a resort. In 1919 the Bannings sold controlling interest in the Santa Catalina Island Company to William Wrigley, and from then

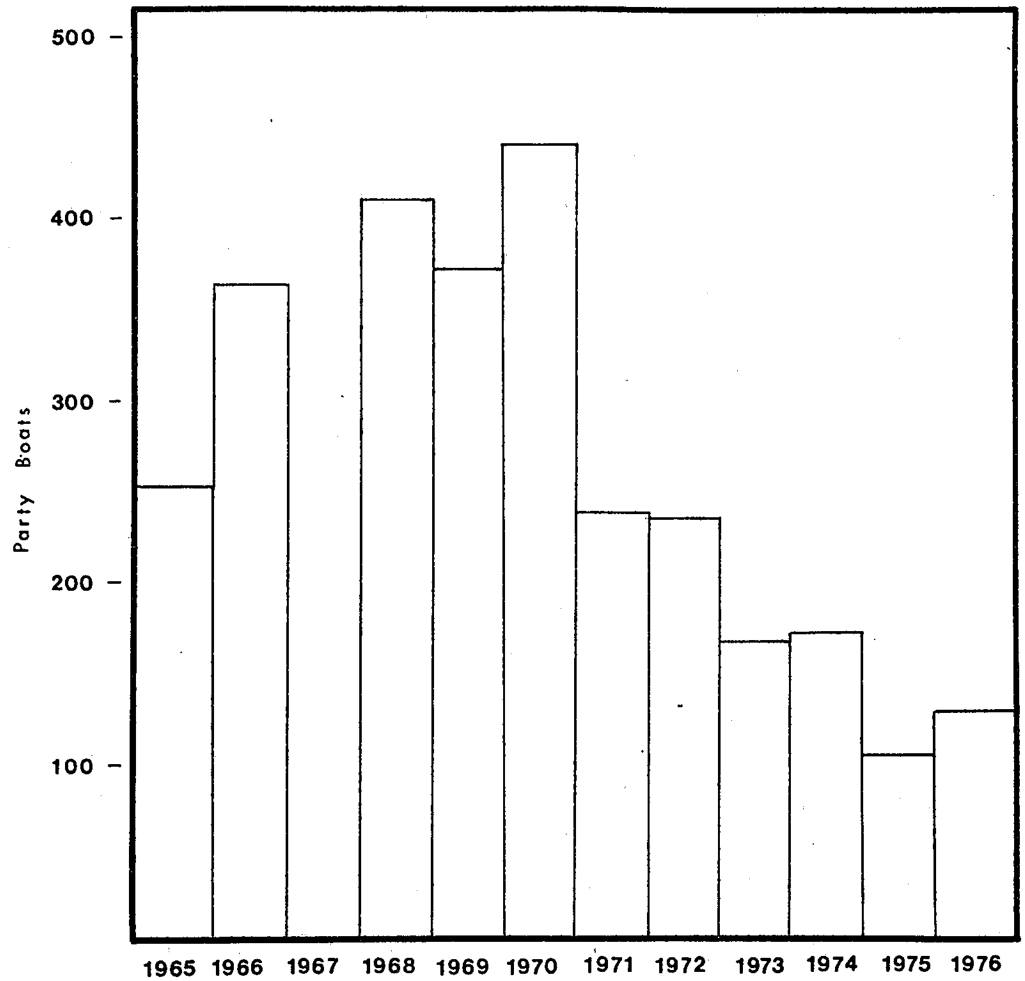


Figure 22. Yearly Party Boat Activity in Block #762, 1965-1976 (unpublished data, California Department of Fish & Game)

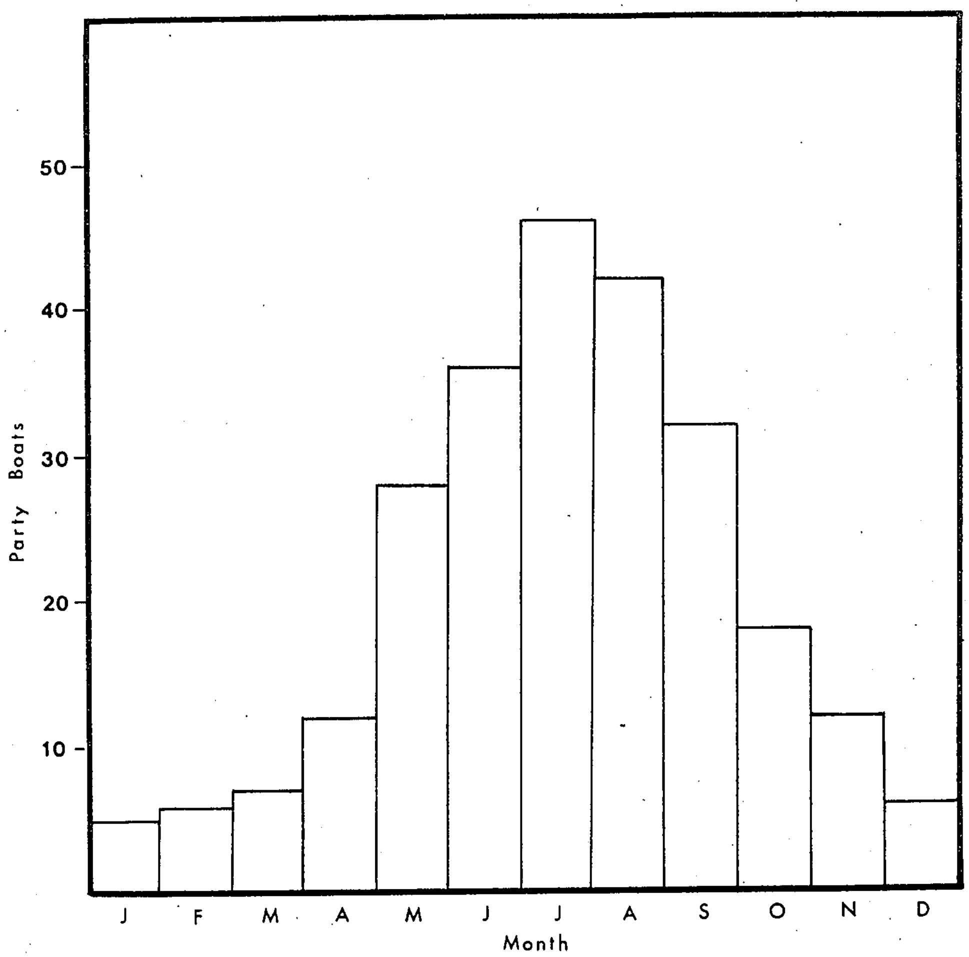


Figure 23. Mean Monthly Sport and/or Party Boat Activity in Block #762, 1965-1976 (from unpublished data, California Department of Fish and Game)

Table 12. Mean Party Boat Landings, 1965-1976, Catch Block #761 and #762

FISH	761 $\bar{x}$ lbs/year	762 $\bar{x}$ lbs/year
Pacific Bonito	21,042	7,298
Bluefin Tuna	13	10
Albacore	12	2
Yellowtail	760	634
Pacific Mackerel	6,703	1,049
Jack Mackerel	84	37
California Barracuda	981	770
California Sheephead	3,720	2,756
Blue Shark	5	
Lingcod	25	25
California Halibut	475	586
Sanddab	148	128
Flounder	350	116
Rockfish	6,587	12,781
Sculpin	1,580	727
Cabezon	11	5
Kelp Bass	69,987	27,890
Giant Sea Bass	7	1
White Sea Bass	195	105
Yellowfin Croaker	72	17
White Croaker	20	
Opaleye	475	246
Halfmoon	40,473	25,488
Sargo	635	190
Ocean Whitefish	179	269
Total	154,539	81,130

(from unpublished computer printout,
California Department of Fish & Game)

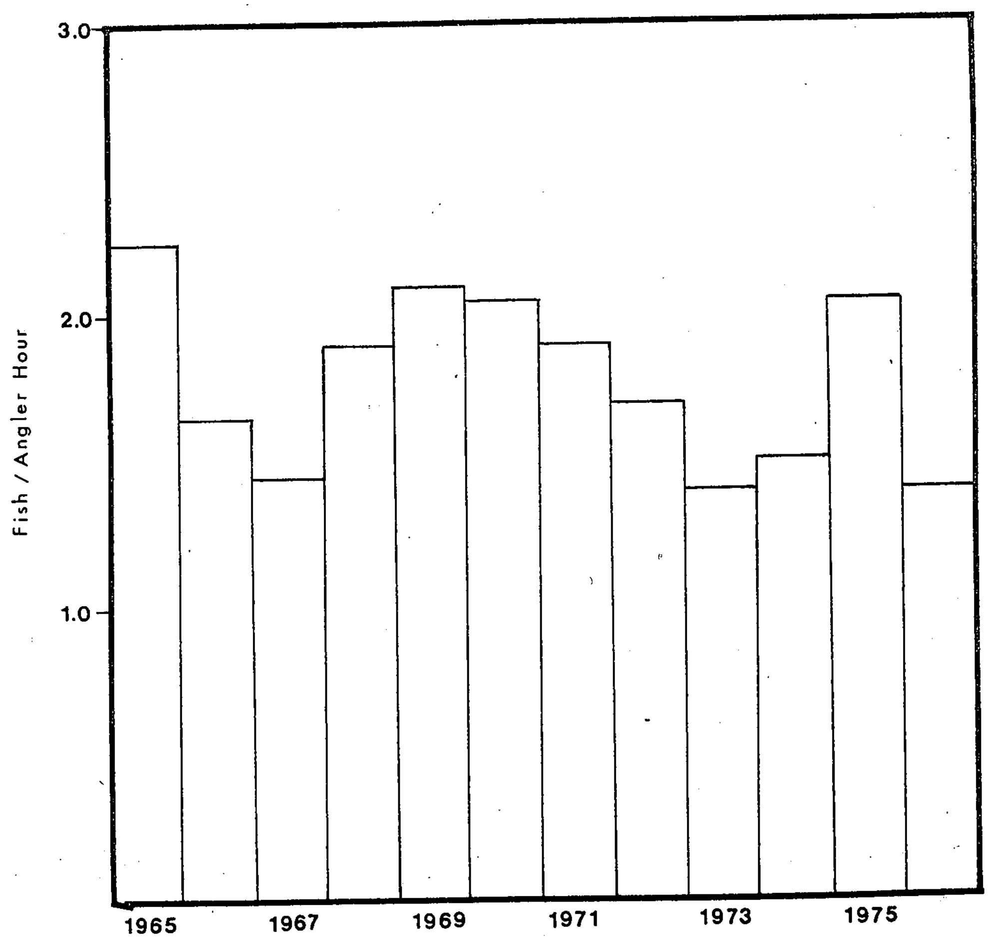


Figure 24. Number of Fish Caught per Angler-hour in Block #762, 1965-1976 (unpublished data, California Department of Fish and Game)

Table 13. Average Number and Species of Fish and Invertebrates Taken by Sport Divers from Catch Block #762, 1971-1976.

	$\bar{x}$ / year
FISH	
California Sheephead	634
California Halibut	30
Sanddab	1
Flounder	5
Sculpin	47
Rockfish	40
Cabezon	3
Kelp Bass	400
White Sea Bass	0.2
California Moray	0.2
Opaleye	23
Halfmoon	64
Black Surfperch	2
Rubberlip Serfperch	0.5
INVERTEBRATES	
Abalone (misc.)	2,981
Black Abalone	116
Green Abalone	1,329
Pink Abalone	653
White Abalone	75
Red Abalone	1
Rock Scallop	815
Sea Urchin	200 *
California Spiney Lobster	177

* Total number taken in 1973.

(from unpublished computer printout, California Department of Fish & Game)

Table 14. Diving Activity in California State Department of Fish and Game Catch Block #762 compared with that in all of Southern California (mean values 1971-1976).

Mean Number of:	Catch Block #762	Southern California	% Southern California total in block #762
Fish	7,431	74,930	9.9
Boat Trips	178	1,282	13.9
Divers	4,520	30,070	15.0
Diver Hours	23,296	144,315	16.0
Fish/Diver	1.7	2.5	
Fish/ Diver Hour	0.33	0.46	

(from unpublished computer printout, California Department of Fish & Game)

until 1975 the control of the Company, and the island, remained with the Wrigley family.

In 1972 the Santa Catalina Island Conservancy (a non-profit foundation) was formed, dedicated to preservation of the unique natural features of Catalina. Beginning with the acquisition of a 600-acre (243 ha) easement at Mt. Blackjack, the Conservancy now controls 41,135 acres (16,654 ha) (approximately 86%) of the open-space land. Final transfer of the lands was accomplished in early 1975, when the stockholders in the Santa Catalina Island Company turned over all their Class A common stock to the Santa Catalina Island Conservancy, which in turn redeemed the Company for land and other assets.

Meanwhile, pressures to develop the island were being pitted against a desire to preserve its natural beauties and unique features. In 1974 the Santa Catalina Island Company entered into a 50-year open-sapce easement with Los Angeles County, restricting development in the public interest on 41,000 of the 42,135 acres (17,509 ha) which the Conservancy would eventually own. With this agreement to restrict development resulting in a reduction of county taxes, Los Angeles County acquired specific access rights, subject to reasonable restrictions concerning the needs of the land. Whereas the tax assessment had previously been based on "highest and best" commercial use, tax rates are now based on the land's use as an open space area for public education and recreation. The Department of Parks and Recreation is the administrative unit, acting for Los Angeles County, working with the Conservancy in the development of land use programs. The Conservancy's policy is that "All property owned and operated by the Conservancy will be open to the general public, subject to reasonable restrictions concerning the needs of the land, with the primary interest of the foundation being in preserving the natural areas." Figure 25 delineates lands owned by the Conservancy and Santa Catalina Island Company, as well as those forming the open space easement.

Between 1965 and 1970 the Santa Catalina Island Company deeded a total of 13.5 acres (5.5 ha) of land in Big Fisherman Cove to the University of Southern California, to support the building and later expansion of the Catalina Marine Science Center. Another 40 acres in the Big Fisherman Cove area is under long-term lease to USC by the Santa Catalina Island Company.

The Catalina Cove and Camp agency (administered by Mr. Douglas Bombard) leases the Two Harbors area from the Santa Catalina Island Company, and operates it as a landside recreational support facility for the large yacht anchorages at Isthmus Cove and Catalina Harbor. In 1959 a master plan was drawn up by the Bechtel Corporation for the development of a large recreation and research-oriented community at Two Harbors. This plan was abandoned due to the lack of "buildable" land at the Isthmus proper (see section on Landslides), coupled with the restrictions placed on private developers by the newly-formed Coastal Commission.

Except for the Catalina Marine Science Center, which maintains a more-or-less capacity enrollment throughout the year (50-60 people), the population on Catalina varies drastically with the tourist seasons. The "summer" runs roughly from Memorial Day in May through Labor Day in September. During that time, the City of Avalon, as well as the other recreation areas and summer camps on the island, are generally filled to capacity. During the remaining "winter" months, the population of Avalon drops to a fairly constant level of permanent residents while the other areas retain a minimum number of more-or-less permanent, maintenance-type personnel.

	Permanent	Summer
AVALON	1,500	up to 8,000/day
TWO HARBORS	c. 100	c. 1,500/day
CMSC	50 - 60	-----

Agribusiness

Lands adjacent to the ASBS are not used for grazing cattle or sheep. A large population of feral goats, Capra hirca, does utilize this area and has grazed the foliage to the point of causing extensive erosion. Terrestrial populations, as well as intertidal and subtidal communities, can be adversely affected by the resulting sediment load, especially during heavy rains.

The feral goat population of the entire island has been estimated at between five and ten thousand, a majority of this population inhabits the west end.

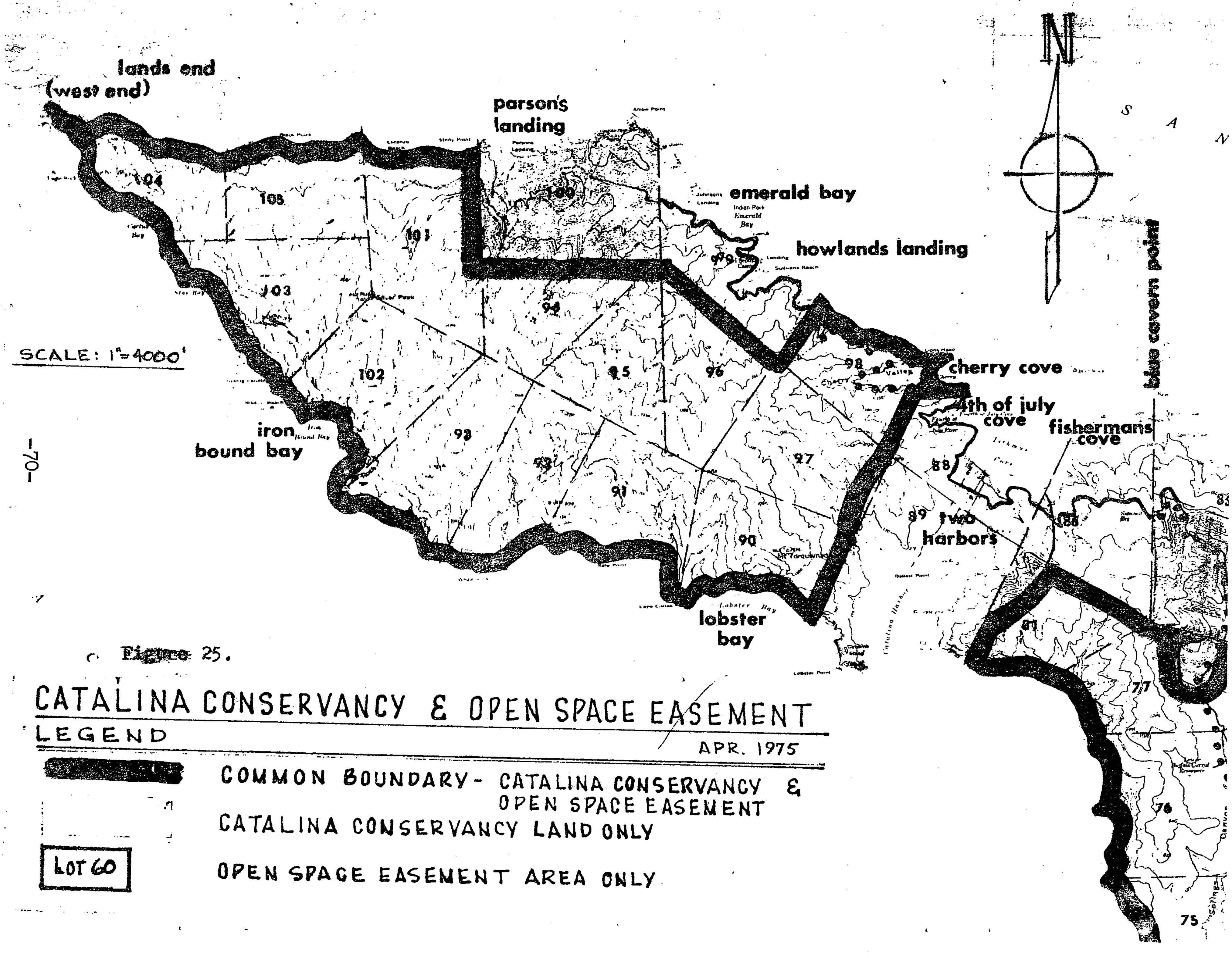


Figure 25.

CATALINA CONSERVANCY & OPEN SPACE EASEMENT

LEGEND

APR. 1975

COMMON BOUNDARY - CATALINA CONSERVANCY & OPEN SPACE EASEMENT

CATALINA CONSERVANCY LAND ONLY

LOT 60 OPEN SPACE EASEMENT AREA ONLY

Both the Santa Catalina Island Company and the Santa Catalina Island Conservancy have attempted to limit the numbers of goats. Each year goat hunting is organized and seems to have some role in controlling the population (see section on Recreational Uses). The recent drought has also played a part in population control.

To a lesser degree, wild pigs and buffalo also use the West End area. (Propst, pers. comm.)

Mineral Mining

Mineral mining has occurred in the past on Catalina Island. In 1830 the first discovery of gold was made by Captain George Yount, in a quartz outcropping somewhere near Cherry Cove. In 1863 there was a "gold rush" to Catalina, but Captain Yount's gold vein was never relocated.

Silver, lead and zinc were mined on Mt. Blackjack from 1923 to 1927, but due to a low market price, mining operations were discontinued. There has been no commercial mining on lands adjacent to the ASBS.

The Bureau of Land Management has recently leased portions of the outer continental shelf off southern California to oil companies for exploration and drilling. No oil company bid on the tracts between Santa Barbara Island and Santa Catalina Island, probably because the great water depths in this area (over 500 m) make drilling operations infeasible at this time. In other tracts, to the southwest of the ASBS, exploratory drilling has commenced; however, no oil has been found.

Recreational Uses

Catalina Island is a vacation land, and nearly all of its 76 square miles (120,099 ha) of land are protected and open for hiking, camping and backpacking.

Camping is restricted to specified campgrounds. Adjacent to the ASBS, Little Fisherman Cove contains a campground maintained by the Catalina Cove and Camp Agency. In 1976, 12,000 to 15,000 campers utilized this facility. The area at Parson's Landing has recently been leased to a private group for establishment of a semi-primitive campground. The other coves along the leeward side of the ASBS maintain private recreational facilities, such as the Yacht Club at Fourth of July Cove and the Boy's Camp at Howland's Landing.

The short distance from the mainland makes Santa Catalina a popular destination for boaters. There are 225 moorings in Isthmus Harbor, 26 at Fourth of July Cove, 99 at Cherry Cove, one at Little Geiger Cove, 40 at Howland's Landing, 96 at Emerald Bay and two at Parson's Landing. There are also excellent anchorages in most coves on the leeward side of the ASBS. During the summer months, all moorings are in continuous use, and on weekends most of the anchorage areas are also full (Bombard, pers. comm.).

As has been previously mentioned in the section on sport fishing, the waters of the ASBS are heavily used by hook-and-line fishermen and by recreational divers.

Hunters use the island's recreational facilities during some of the winter months. A controlled number of deer, feralgoat, and pig hunters are allowed to hunt in certain areas, under the auspices of trained guides. There are campgrounds on lands adjacent to the ASBS, on the hilltop above Howland's Landing and at Emerald Bay, to support this hunting operation.

Scientific Study Uses

The University of Southern California maintains a marine laboratory (Catalina Marine Science Center) at Big Fisherman Cove near the Isthmus. Courses in oceanography and marine biology are conducted during the spring and summer months. In addition to academic courses, basic scuba diving and research diving techniques are taught at CMSC.

The laboratory is also used by other universities and colleges. The University of California at Los Angeles is currently using the facilities for teaching and research. Table 15 lists some representative types of research projects being conducted, indicating the scope of field work in the area. Additionally, the Appendix contains abstracts of ongoing research being conducted by USC and UCLA students and researchers. A master list of species occurring at Catalina Island, accompanied by a complete file of transparencies for identification purposes, is currently being compiled at CMSC.

Table 15. Catalina Marine Science Center Research Projects--1970-1977

Mapping and biological survey of a site for an undersea laboratory at Santa Catalina Island

Gross behavioral characteristics of selected marine organisms in the presence of an oily substance

Studies on the bluebanded goby (*Lythrypnus dalli*)

A new method of determining diver performance underwater

Biology of *Sargassum* in Big Fisherman Cove

Feeding behavior of the pink abalone (*Haliotis corrugata*)

Distribution of two gastropods in a southern California reef habitat

The dependence of fish species diversity on environmental complexity

Suspension feeding on different sizes of plankton

The distribution of grazing invertebrates on marine subtidal rocky outcroppings

The importance of size in the food preferences and responses to light, gravity and surge in the snail *Norrisia norrisii*

Interspecific territoriality and agressive behavior of the California inshore pomacentrid -- *Hypsypops rubicundus* (garibaldi)

A study of the distribution, abundance, diet and possible anti-predator mechanisms in the giant keyhole limpet (*Megathura crenulata*)

Morphological variations in the southern sea palm (*Eisenia arborea*)

Post-commercial-harvesting populations of *Strongylocentrotus franciscanus* at Catalina Harbor

Vertical distribution and crown coloration in *Spirobranchus spinosus* (Polychaeta; Serpulidae)

A survey of the elk kelp, *Pelagophycus porra*, adjacent to Habitat Reef, Big Fisherman Cove

Effects of DDT on photosynthesis in the green alga *Ulva* sp.

An electrophysiological study of food-finding and feeding in the California sea hare, *Aplysia californica*

Even the laboratory studies are somewhat field-oriented. Nearly all of the researchers and many of the students are certified scuba divers. In 1977, CMSC-certified divers made a total of 5,199 scientific dives off Catalina Island, the majority being within the ASBS boundaries.

The ASBS has been utilized as a control area in several non-university studies. The California State Department of Fish and Game is currently comparing the interactions of sportfish in a kelp habitat along the Palos Verdes Peninsula with a control area at Lion Head, in the ASBS (Figure 26) (Wilson, pers. comm.). The Los Angeles County Sanitation District, in cooperation with the Southern California Coastal Water Research Project, used control stations on the windward side of the west end in a study of diseased fin fish (Haydock, pers. comm.). The species list from these trawl stations gives an indication of the fishes occurring in that area (Table 16 and Figure 27).

The Bureau of Land Management, conducting baseline surveys in 1975 - 1977 prior to planned oil drilling activities, sampled the sandy intertidal macrofauna from Isthmus Cove and Catalina Harbor Beach (Table 17). They also collected deep water macrofauna from between Santa Barbara Island and Santa Catalina Island; however, this deep water biota is not considered representative of the macrofauna of the ASBS (Jones, pers. comm.). The Bureau of Land Management has also surveyed the rocky intertidal zone of Big Fisherman Cove Point, but only a portion of those data are available at this time.

The Southern California Coastal Water Research Project (SCCWRP) has conducted several studies in the ASBS, primarily concerning water quality. Their data have been summarized in the water quality section of this report.

The California Cooperative Oceanic Fisheries Investigation (CalCOFI) in conjunction with the State Department of Fish and Game, is conducting a research project to determine the total pelagic and bathypelagic fisheries resources available in the California Current System. Studies began in 1950 and, with refined sampling techniques, are still being carried out using sonar and midwater trawls in data collection. The sampling stations are located 2 to 50 nautical miles west of the ASBS. Data from this study are contained in CalCOFI Reports #1 - 26, with #27 currently in press.

Figure 26. Locations of Scientific Studies and Areas of Interest within the ASBS

1. Approximate locations of natural oil seeps (from Emery, 1960)
2. Submersible TAURUS dive location
3. Vance, 1978 study site
4. California Department of Fish and Game - Lion Head Station
5. SCCWRP mussel collection site - Bird Rock
6. BLM infaunal collecting site - Catalina Harbor mudflat
7. BLM infaunal collecting site - Isthmus Cove Beach
8. BLM rocky intertidal collecting site - Big Fisherman Cove
9. CMSC water temperature and transparency sampling site
10. CMSC seawater system discharge
11. Location of sand dollar (Dendraster excentricus) bed

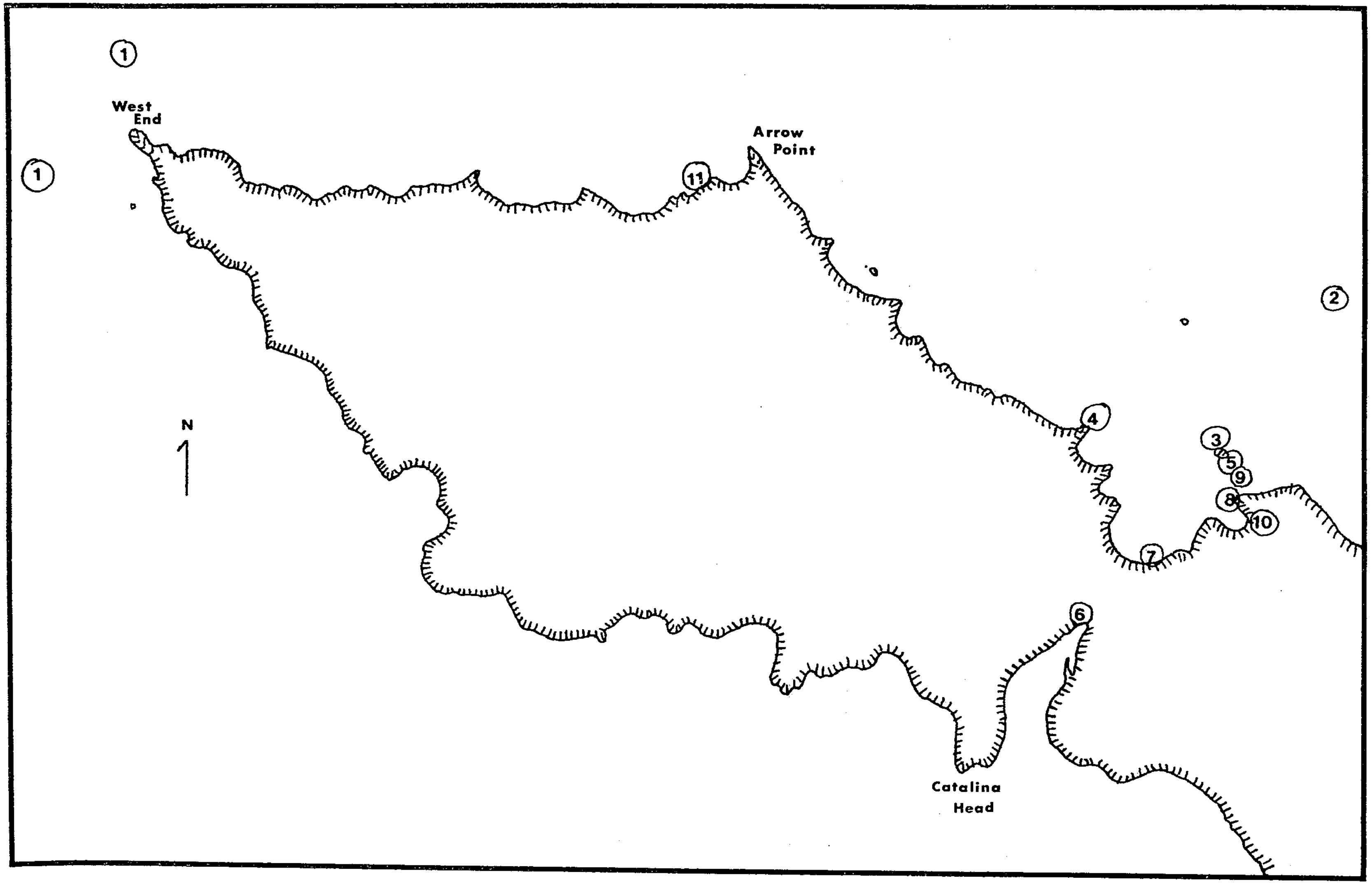


Figure 26. Cont. Locations of Scientific Studies and Areas of Interest within the ASBS.

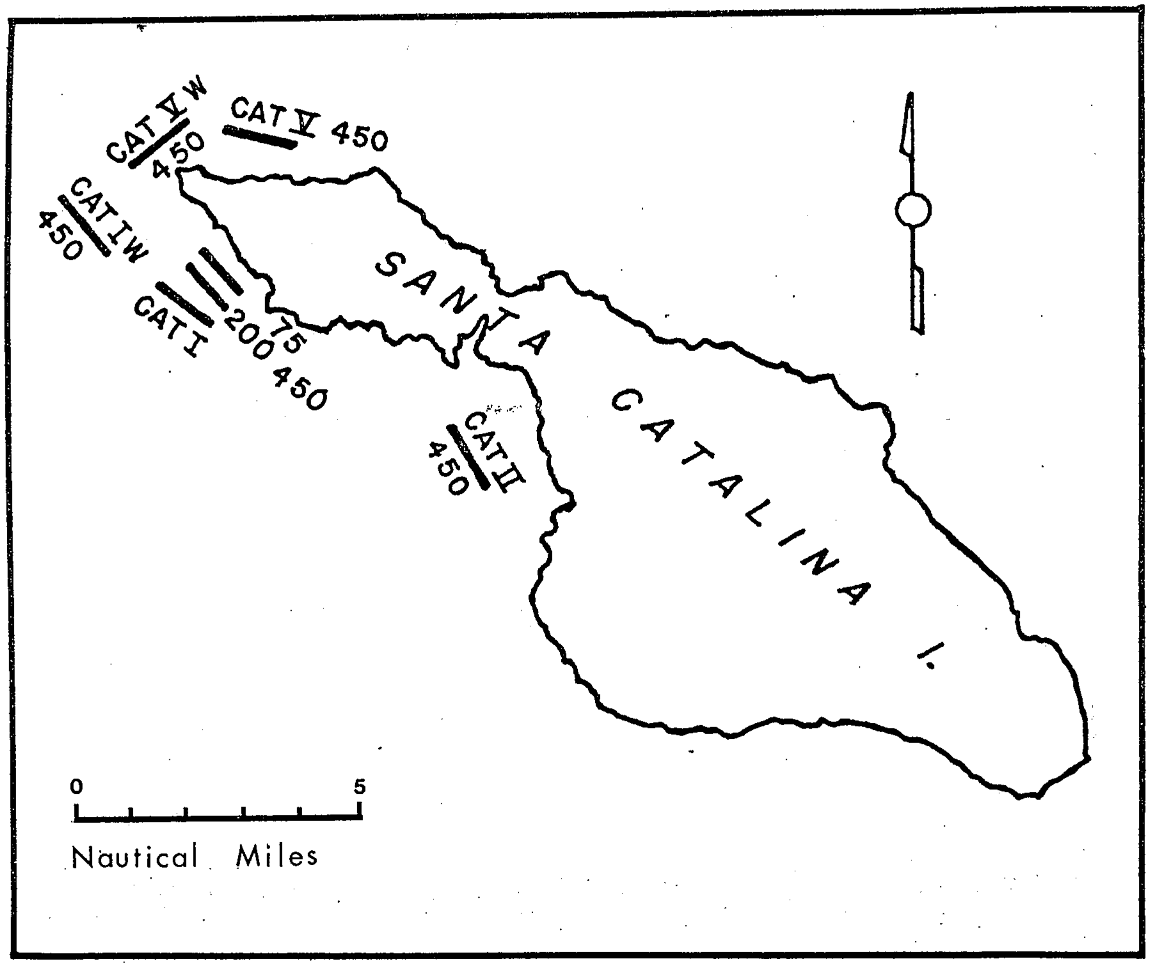


Figure 27. LACoSD and SCCWRP Otter Trawl Stations in the Vicinity of the ASBS. (from Los Angeles County Sanitation District Semi-annual EIS Reports to the Los Angeles Regional Water Quality Control Board, 1974-1976)

Table 16. Fish Caught in Trawls off Catalina Island by Los Angeles County Sanitation District and Southern California Coastal Research Project (20-40 meter depth), 1974-1976.

Squatina californica	Pacific angel shark
Torpedo californica	Pacific electric ray
Hydrolagus colliei	Ratfish
Argentina sialis	Pacific argentine
Lepidogobius lepidus	Bay goby
Lycodopsos pacifica	Blackbelly eelpout
Paralabrax clathratus	Kelp bass
Oxyjulis californica	Seniorita
Zalembius rosaceus	Pink surfperch
Brachyistius frenata	Kelp surfperch
Cymatogaster gracilis	Island surfperch
Sebastes elongatus	Greenstriped rockfish
S. goodei	Chilipepper
S. levis	Cowcod
S. miniatus	Vermilion rockfish
S. paucispinis	Bocaccio
S. saxicola	Stripetail rockfish
S. jordani	Shortbelly rockfish
S. rubrivinctus	Flag rockfish
S. chlorostictus	Greenspotted rockfish
Chitonotus pugetensis	Roughback sculpin
Scorpaena guttata	Sculpin
Icelinus filamentosus	Threadfin sculpin
Radulinus asprellus	Slim sculpin
Zaniolepis frenata	Shortspine combfish
Z. latipinnis	Longspine combfish
Citharichthys sordidus	Pacific sanddab
C. stigmaeus	Speckled sanddab
C. xanthostigma	Longfin sanddab
Hippoglossina stomata	Bigmouth sole
Xystreurys liolepis	Fantail sole
Glyptocephalus zachirus	Rex sole
Lyopsetta exilis	Slender sole
Microstomus pacificus	Dover sole
Parophrys vetulus	English sole
Paralichthys californicus	California halibut
Pleuronighthys coenosus	C-O turbot
P. decurrens	Curlfin turbot
P. verticalis	Hornyhead turbot

(from Los Angeles County Sanitation District Semi-annual EIS Reports to the Los Angeles Regional Water Quality Control Board, 1974 - 1976)

Table 17. Macrofaunal species found on Catalina Island sandy beaches, Isthmus Cove and Catalina Harbor. (B.L.M. study 1975-1977 unpublished)

Species	Catalina Harbor	Isthmus
VERMES		
Amphinomidae	X	
Boccardia hamata	X	
B. proboscidea	X	
B. sp.	X	
Capitella capitata	X	
Capitellidae	X	
Cirratulidae	X	
Eteone dilatae	X	
E. pacifica	X	
Exogone lourei	X	
Eunicidae	X	
Fabricia sp.	X	
Glycera tenuis	X	
Glyceridae	X	X
Haploscoloplos elongatus	X	
Hemipodus borealis	X	X
Lumbrineridae	X	
Lumbrineris sp. A	X	
L. sp. B	X	
L. zonata	X	
Malmgrenia sp	X	
Marphysa sanguinea	X	
Mediomastus sp.	X	
Megalomma pigmentum	X	
Neanthis acuminata	X	
Nematoda	X	
Nemertean sp.	X	
Nemertean sp. A	X	
Nemertean sp. B	X	
Nemertean sp. C	X	
Nemertean sp. D	X	
Nephyts caecoides	X	
Nephtyidae	X	
Nereidae	X	
Nerinides sp.	X	
N. acuta	X	
Nothria stigmatis	X	
Notomastus magnus	X	
N. precocis	X	
N. tenuis	X	
N. lineatus	X	
Onuphidae	X	
Orbiniidae	X	
Oligochaeta	X	

VERMES Continued	CATALINA HARBOR	ISTHMUS
Paraonides platybranchia	X	
Pareurythoe californica	X	
Pherusa capulata	X	
Phyllodocidae	X	
Polydora socialis	X	
Polyopthalmus pictus	X	
Prionospio nr. malmgréni	X	
P. sp.	X	
Pseudomalacoceros maculata	X	
Pseudopolydora paucibranchiata	X	
Scoloplos acmeceps	X	
Scyphoproctus oculatas	X	
Spio filicornis	X	
Spionidae	X	
Terebellidae	X	
Tharyx	X	
COELENTERATA		
Anthozoa?	X	
PISCES		
Clevelandia ios	X	
Gobiidae	X	
Ilypnus gilberti	X	
Leuresthes tenuis (eggs)	X	X
Quietala y-cauda	X	
CRUSTACEA		
Exosphaeroma inornata		X
Allomiscus perconvexus	X	X
Ampithoe pollex	X	
A mpithoe sp.	X	
Anatanais sp.	X	
Betaeus harrimani	X	
Callianassa Californiensis	X	
C. juvenile	X	
C. longimana	X	
Callianassa sp.	X	
Cancer anthonyi	X	
Corophium acherusicum	X	
Corophium sp.	X	
Cyathura munda?	X	
Exocirolana chiltoni	X	X
Hemigrapsus oregonensis	X	
Heterophoxus c.f. oculatus	X	
Idotea c.f. rufescens	X	
Leptochelia dubia	X	
Orchestia georgiana	X	
Orchestoidea benedicti	X	
O. corniculata	X	X
O. juvenile	X	X
Paraphoxus c.f. calcaratus	X	
Paranthura elegans	X	
Proharpinia sp.	X	
Pugettia dalli	X	
Tylos punctatus	X	

	CATALINA HARBOR	ISTHMUS
MOLLUSCA		
Acteocina culcitella	X	
A. incluta	X	
Caecum californicum	X	
Chione undatella	X	
Cryptomya californica	X	
Cumingia californica	X	
Leporimetis obesa	X	
Littorina sculata	X	
Macoma nasuta	X	
Nassarius tegula	X	
Norrisia norrisii	X	
Olivella biplicata	X	
Parvilucina tenuisculpta	X	
Pelecypoda sp.	X	
Protothaca staminea	X	
Tagelus californianus	X	
Tegula eiseni	X	
Transennella tantilla	X	
INSECTA/ARACHNIDA		
Amara sp.	X	
Amphidosa nigropilosa	X	
Anthomyiidae	X	
Cafius lithocharinus	X	
Chilopoda	X	
Coelopa sp. larvae		X
Cyclorrhapha larvae	X	
Cyclorrhapha pupae	X	
Dalichopodidae larvae	X	
Epantius obscurus	X	
Eumolpinae	X	
Forficula auricularia	X	
Gnaphosa maritima	X	
Gnaphosa sp.	X	
Hadrotes crassus	X	
Histeridae larvae	X	
Ichneumoninae	X	
Myrmeliontidae	X	
Oedemeridae (Copidita sp.? larvae)	X	
Staphylinidae	X	
Staphylinidae larvae	X	
Staphylinidae pupae	X	
Tenebrionidae larvae	X	

Archaeological Investigations

The first recorded archaeological investigations of the Santa Catalina Indian inhabitants took place in the 1870's and have continued sporadically ever since. Our knowledge of the early Indians is based mainly on those studies, since very few of the Indians were actually removed to the mainland and those that were became widely scattered before they could be questioned by trained ethnographers. Those archaeological studies, backed by radiocarbon dating, indicate that Catalina has been occupied by humans for at least 4,000 years.

It has been estimated that there are about 2,000 activity sites on Catalina, of which 920 have been mapped and described. There seems to have been three major population centers, supporting a total of 1,000 to 1,500 Indians. The largest village was at the Isthmus (Two Harbors) with other major sites at Avalon and Little Harbor. The sites range from more or less permanent villages to temporary shellfish-gathering locations and soapstone quarries.

In the 1950's, the University of California at Los Angeles developed a systematic research program which continued into the 1970's. They also did some work at the Starlight Beach site and conducted short-term survey-type "digs" at Emerald Bay and a few other locations.

All of the major activity sites, including the Isthmus, have been found on the leeward side of the island, probably because of its protection from the winds and the physiography. The gentler slopes and the drainage areas near the various coves are much more conducive to habitation than the harsh, steep cliffs of the windward side.

Transportation Corridors

Santa Catalina Island lies between the two main shipping corridors to Los Angeles Harbor (Figure 28). Both approaches are quite distant (at least 13 miles) from the ASBS, and therefore the threat of serious impact from oil spills seems minimal. However, the magnitude of the spill, as well as sea and weather conditions and dominant current flow at the time of the spill could heavily influence potential impact.

Catalina Cruises operates medium-sized passenger boats which transport visitors to Catalina on a regular basis. There are daily trips year-round to Avalon, but only weekend stops at the Isthmus during the winter. Summer schedules include daily trips to the Two Harbors area. Air transportation by seaplane or helicopter is available on a year-round basis, usually providing two trips per day to the Isthmus. All supplies comming to the Island arrive by barge, either at Avalon or the Isthmus, and are transported to their destinations by truck.

Residents of the Isthmus utilize one main road (Figure 29), consisting of 1) a slurry-topped section between Big Fisherman Cove and Two Harbors, 2) a well-traveled dirt road from Two Harbors to Emerald Bay, and 3) a four-wheel drive dirt road through the interior, from Emerald Bay back to Two Harbors. The road from Two Harbors to Avalon is dirt for about the first seven miles, then a combination of dirt and slurry for the remaining 19 miles.

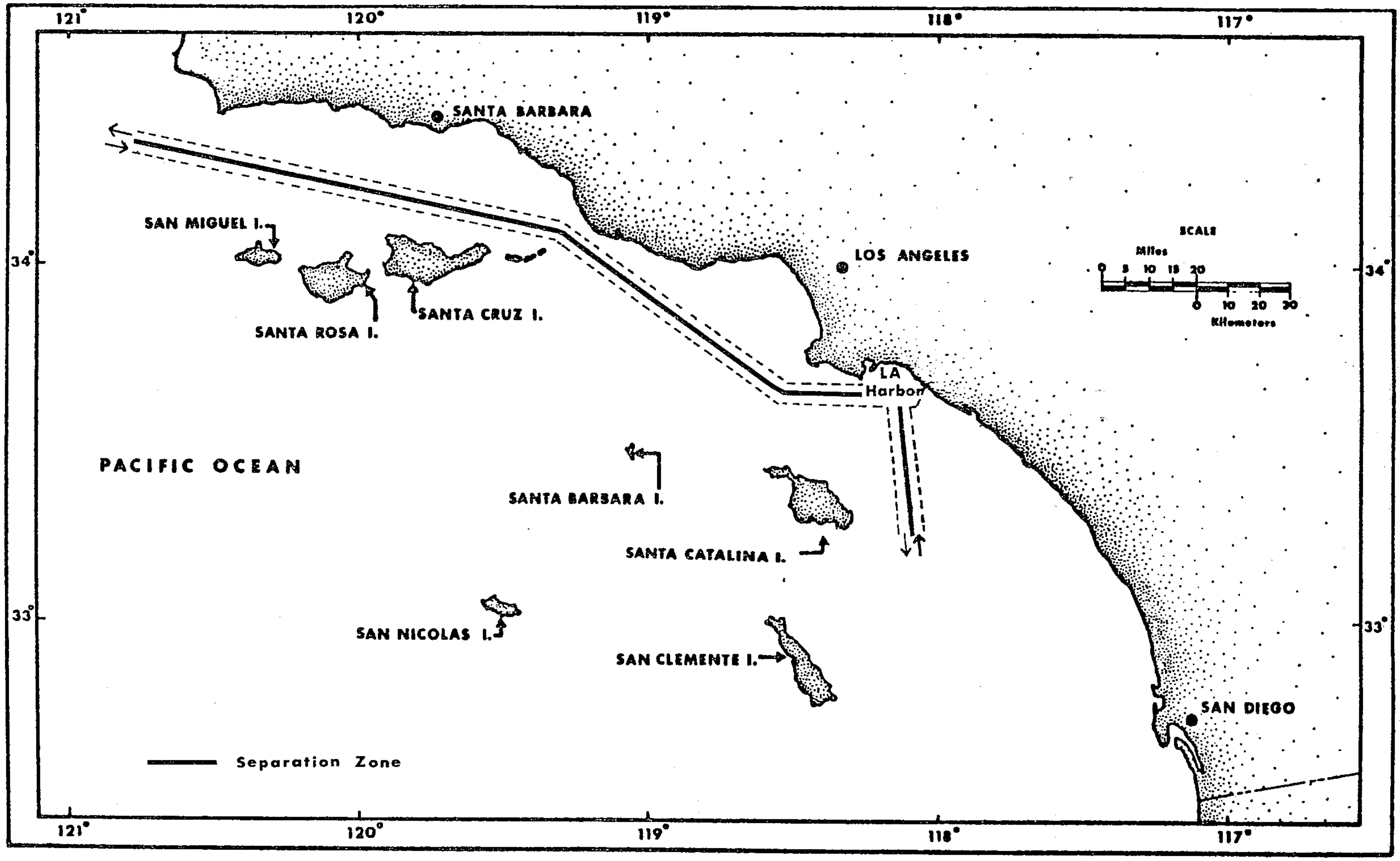


Figure 28. Freighter Transportation Corridors in the Southern California Bight

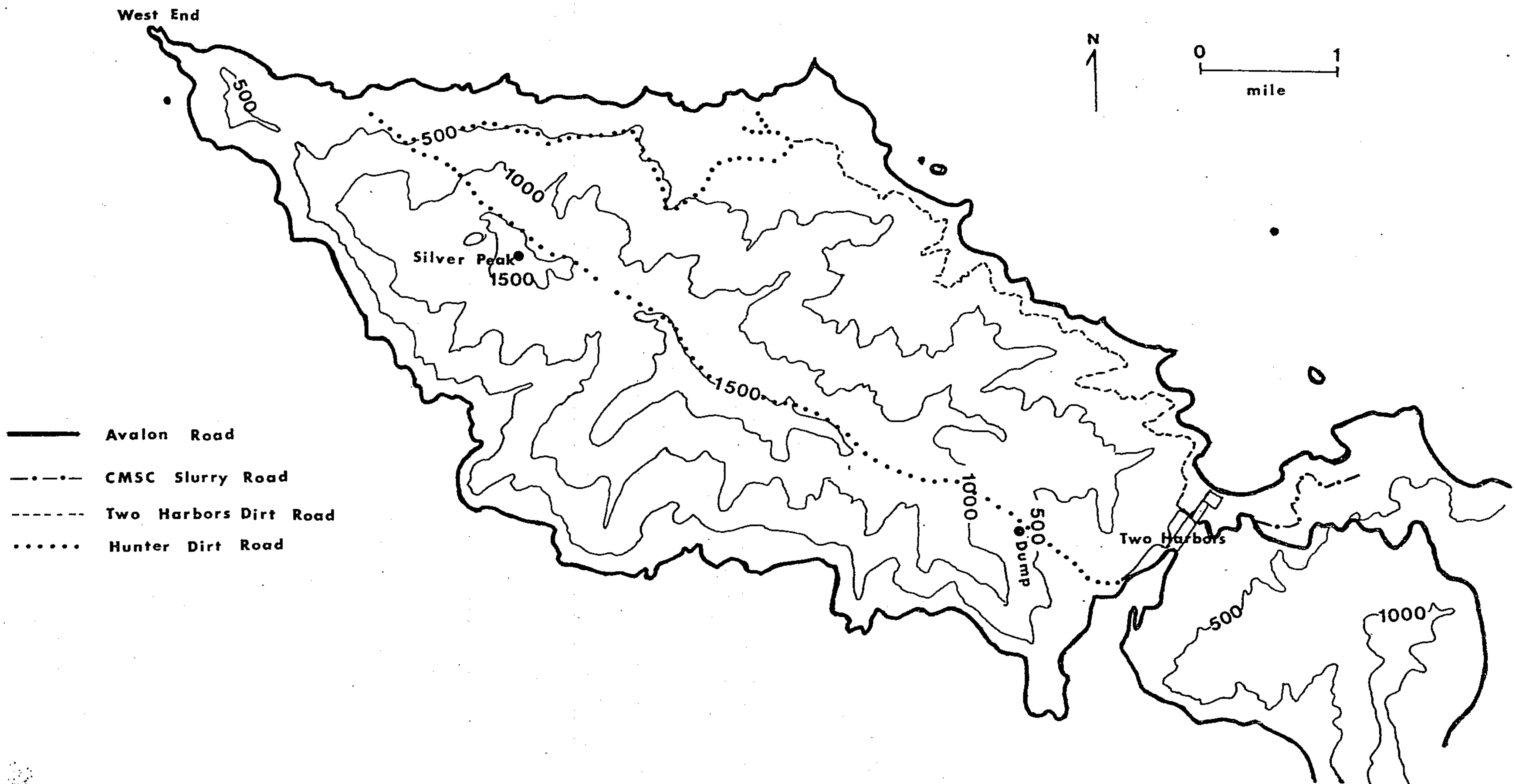


Figure 29. Roads Adjacent to Santa Catalina Island - Subarea I ASBS

ACTUAL OR POTENTIAL POLLUTION THREATS

Point Sources

No point sources of industrial waste are discharged into the ASBS. The two domestic sewage treatment facilities do not appear to constitute a water quality threat. Sewage treatment facilities serving the main areas of habitation are detailed below and illustrated in Figure 30.

TWO HARBORS - prior to 1966, raw sewage was discharged into Isthmus Cove through a short subsurface outfall. In 1966, a treatment plant was built and has been operating continuously ever since. Sewage treatment consists of an activated sludge digestion process, with extended aeration and provision for chlorination. The holding pond has a ten-day capacity under current flows, and the effluent is ultimately sprayed onto a hillside in a fenced area (Figure 31). Capacity of the system is 37,500 gallons per day (GPD). The treatment plant effluent is monitored weekly for temperature, residual chlorine, pH and settleable solids and less frequently for other constituents. There is no documentation of non-compliance with the RWQCB requirements for operation or monitoring, either at this plant or at the USC facility described below.

CATALINA MARINE SCIENCE CENTER - The waste water treatment plant for CMSC went into operation in late 1967 and has essentially the same treatment methods and monitoring requirements as the Two Harbors plant (Figure 32). The capacity of the CMSC plant is 15,000 GPD. The plant is owned by the Santa Catalina Island Company and operated and monitored by the same personnel responsible for the Two Harbors facility.

In June 1966, the Los Angeles County Health Department set the following criteria for the CMSC installation, and it is assumed that these and other criteria were all complied with:

1. That the plant shall be capable of producing an effluent which will meet the requirements of Section 7900, California Administrative Code.

2. That only well-stablized and disinfected effluent will be used for spray irrigation.

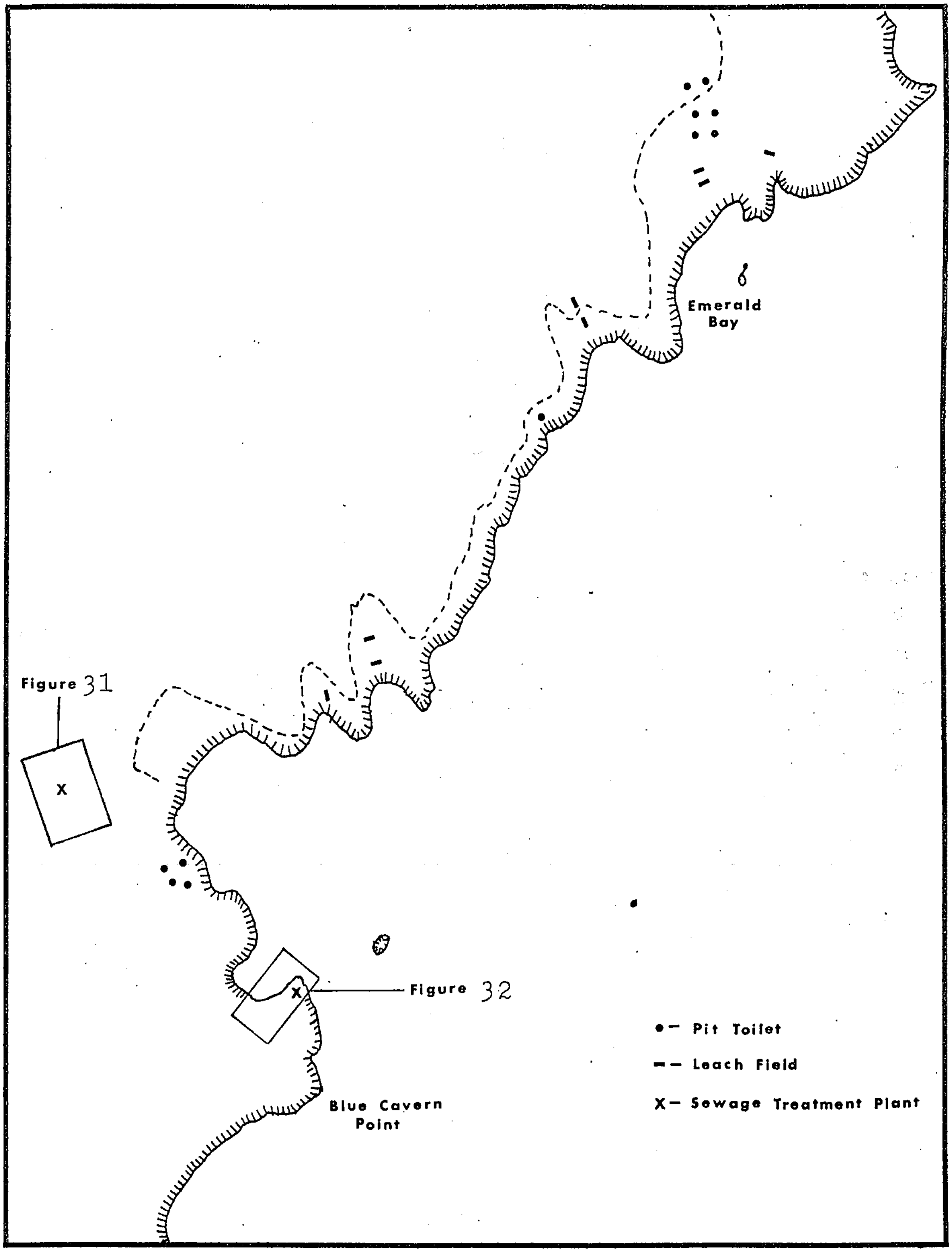


Figure 30. Sanitary Facilities Adjacent to Santa Catalina - Subarea I ASBS

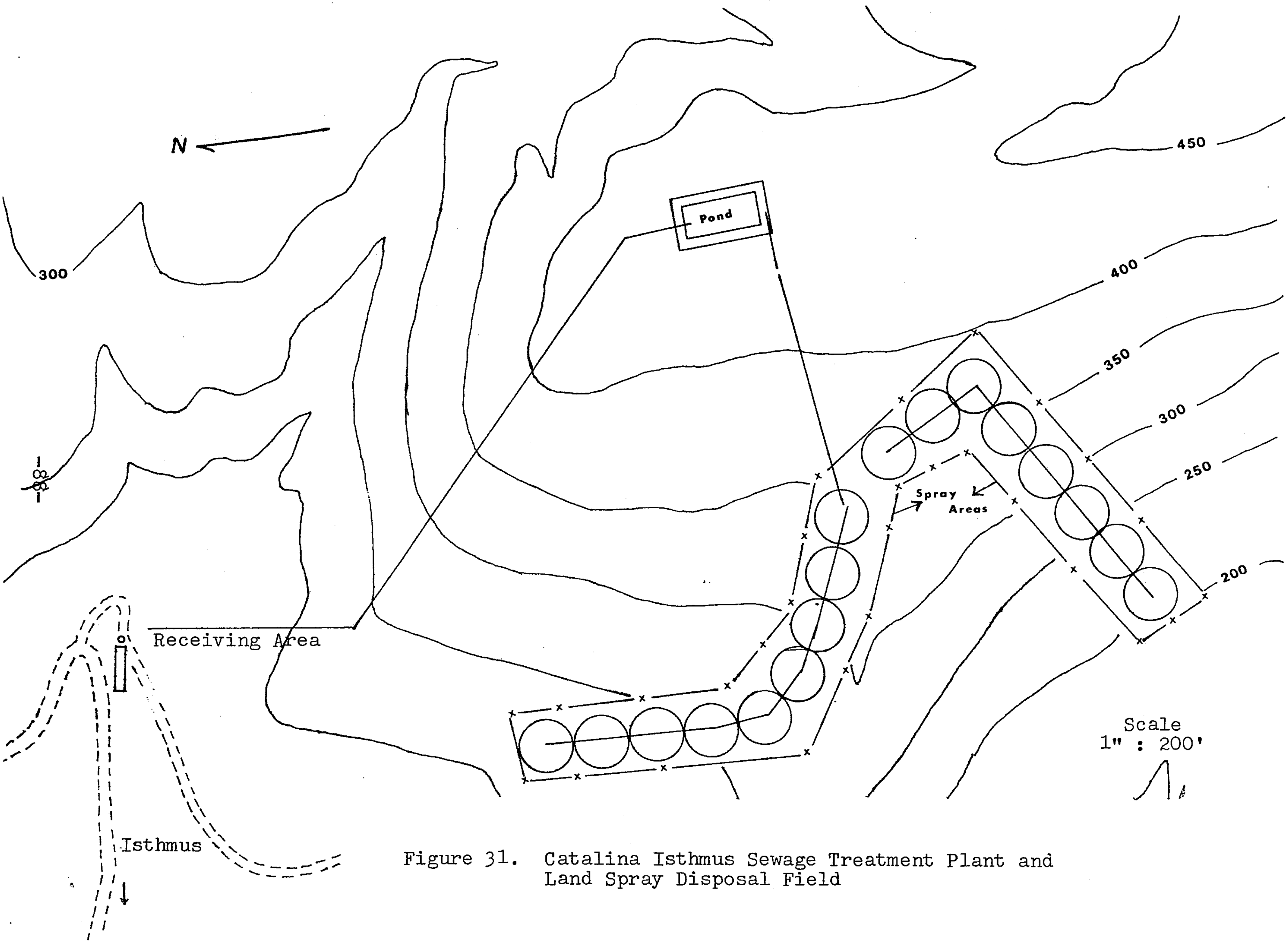


Figure 31. Catalina Isthmus Sewage Treatment Plant and Land Spray Disposal Field

3. That the effluent shall at all times be confined to the property that is under the control of the discharger.

4. That the discharger provide for additional spray area if such area is needed in the future.

5. That the plant, pond and spray area be fenced so as to effectively exclude unauthorized persons.

6. That suitable warning signs will be provided on the fence surrounding the spray area indicating that reclaimed water is being used.

OTHER INHABITED AREAS WITHIN THE ASBS - The various coves and camping areas adjacent to the ASBS utilize leach fields and/or pit toilets, the locations of which are detailed in Figure 30. Use of these areas tends to be seasonal (see Municipal Activities). No documentation is available as to the effect of these sanitary facilities on the adjacent marine environment, but general observations do not suggest any adverse biological impact.

BOATS - Regulations for boat waste disposal are currently changing from holding tank requirements to include utilization of approved chemical treatment devices. Personal observations (R. Given) in many of the boat anchoring and mooring areas during the past ten years seem to indicate no lasting effect of holding tank discharge on the marine benthos. During the heavy-use seasons, paper and other flushed materials may occasionally be seen under the moored or anchored boats, but surveys in those same areas a month or so after the season ends show none of this material remaining.

There is little possibility of boat use increasing in this ASBS because essentially all of the safe moorings and anchorages are already used to capacity. Thus the potential for long term water quality impact from this source can be considered static and probably of minimal concern. However, further investigation of this potential problem may be warranted.

CATALINA MARINE SCIENCE CENTER SEAWATER SYSTEM - In addition to the sewage treatment plant already described, the Center also operates a flow-through seawater system designed to supply the laboratory building with seawater for purposes of keeping animals and plants alive. The intake structure is located near the laboratory, at 25-foot (8 m) depths. The water is pumped over a hill to a 15,000-gallon tank. From there it

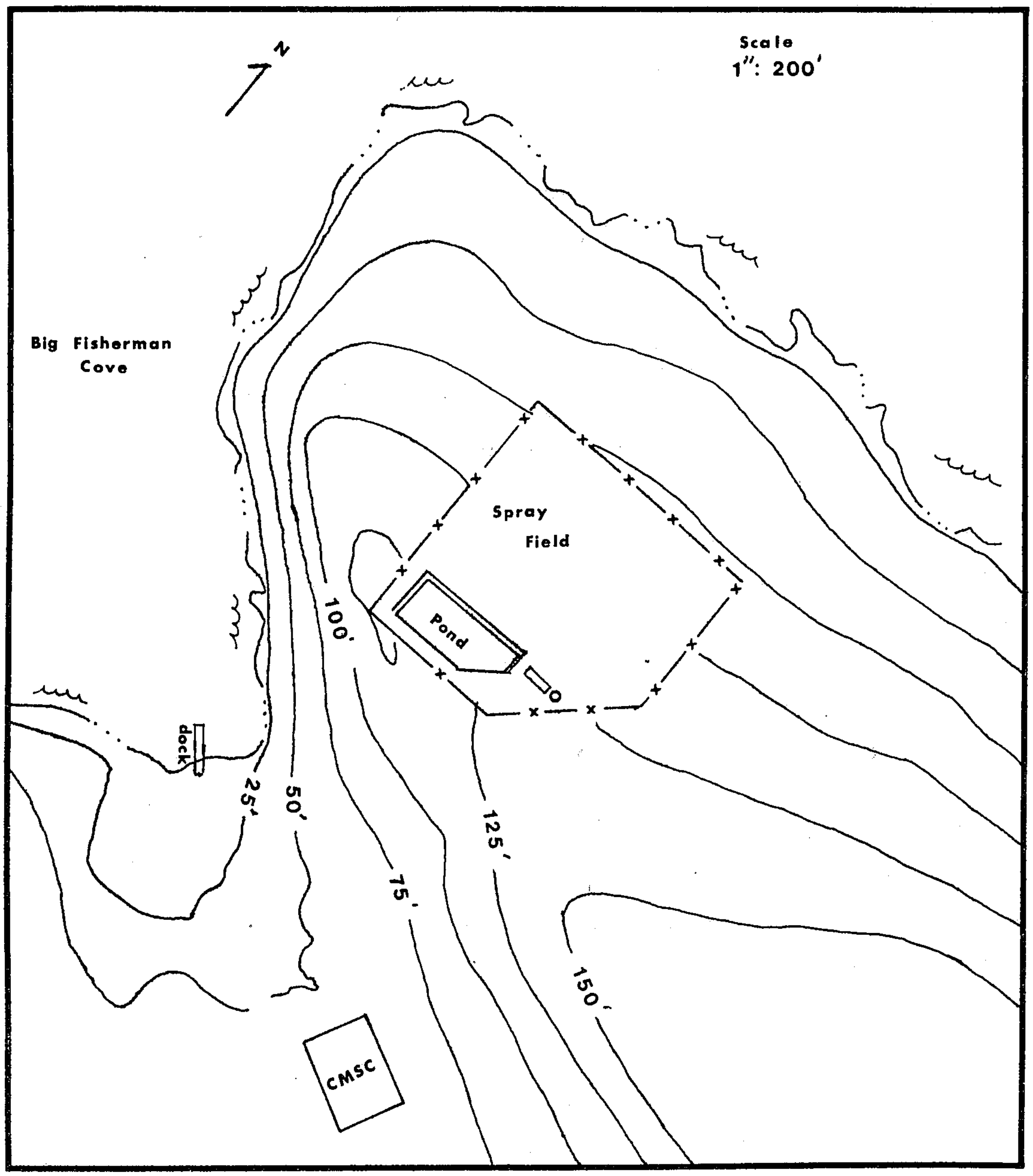


Figure 32. Catalina Marine Science Center Sewage Treatment Plant and Land Spray Disposal Field

flows by gravity to the laboratory building, circulates through the acquarium system, and is discharged at a rate of about 40 GPM to the north side of Big Fisherman Cove. The seawater is not heated, cooled, or filtered, being used strictly for maintenance of living organisms. Total flow during normal operations is about 45,000 GPD.

Monitoring requirements for the seawater discharge are detailed in the Water Quality section. As was stated previously, tests on all of the parameters monitored fell well within the limits allowed by the RWQCB, and most values show little deviation from those of ambient seawater.

OFFSHORE OIL DEVELOPMENT AND TRANSPORT - Transportation of petroleum products in the vicinity of the ASBS, as well as ongoing efforts to develop oil production in tracts west-southwest of the ASBS, offer some risk of oil spillage and pollution in the ASBS. The distance between these activities and the ASBS mitigate the apparent severity of the potential problem; however, uncertainties in the surface water current patterns, sea state, weather conditions and magnitude of spill require that this potential problem be considered.

Non-Point Sources of Pollution

Overgrazing by feral goats causes severe erosion on the steep slopes which drain into the ASBS. During periods of heavy rainfall, runoff has a high sediment load which may damage intertidal and subtidal communities. However, the authors were unable to document the effect of such runoff after the heavy winter storms of 1977-78.

Two natural oil seeps have been reported off the West End (Figure 26) (Emery, 1960). Straughan tested for oil in the BLM study but never found evidence of these oil seeps. It has been suggested that the apparent seeps actually emanate from shipwrecks (Straughan, pers. comm.).

CMSC has plans for improving their harbor facility at Big Fisherman Cove (Figure 33). Harbor development will include a new pier and docking facilities, a heliport, and enlargement of the paved waterfront apron. The heliport will be used for emergency situations involving the decompression chamber which operates there. Moffatt and Nichol have studied water circulation patterns in the area and have recommended the best design for the facility.

All solid wastes in the Two Harbors area, including that from CMSC, are transported to a land disposal site (Figure 29) and burned (Bombard, pers. comm.).

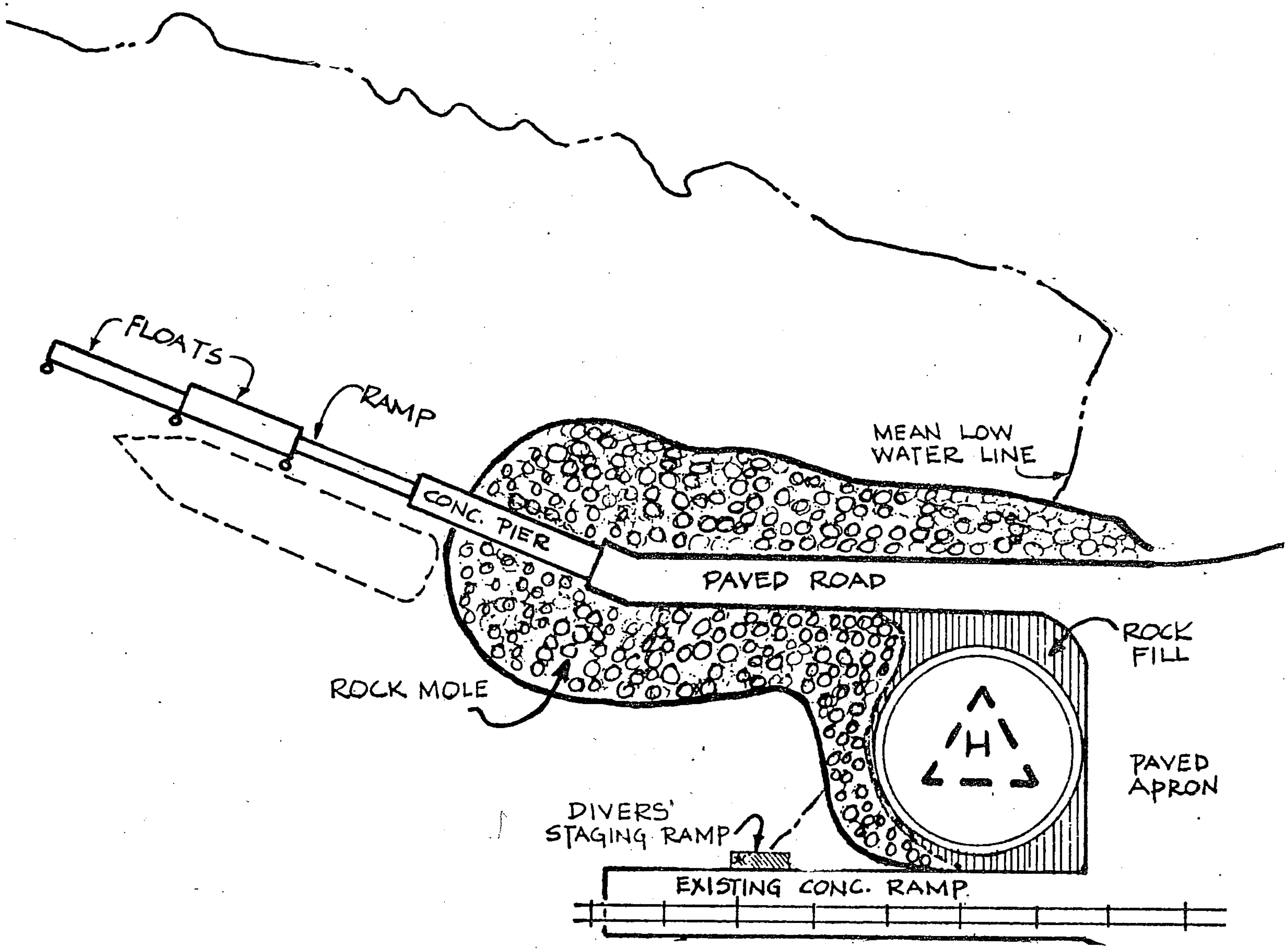


Figure 33. Catalina Marine Science Center
Proposed Harbor Facility Improvements

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APPENDIX I

GEOLOGICAL INVESTIGATIONS

1. Sediment Descriptions at Study Sites 1 - 18

2. Detailed Illustrations of Representative Geological Features at Study Sites 1, 2, 4, 6, 7, 11 and 18

SEDIMENT DESCRIPTIONS

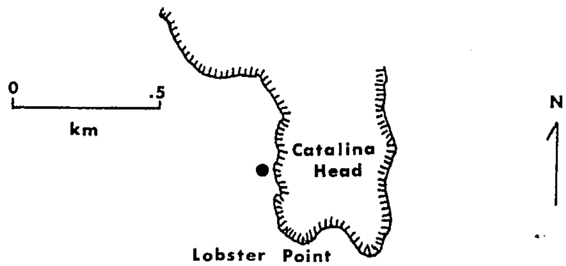
Study Site #	Location and description
1	LOBSTER POINT 80' Buff-gray, very poorly sorted, very angular to subrounded lithic and organic (shells) fragments. Particle size ranges from medium pebbles to coarse silt. Lithic 60% Shell 40%
2	SANDY COVE 100' Gray, friable to unconsolidated, medium to fine silty matrix of lithic and calcareous detritus. 1-3% shell fragments, smaller than 3mm. Lithic matrix 80 - 85% Organic detritus 15 - 20%
	SANDY COVE 30' Gray to graygreen, poorly sorted, unconsolidated, subangular to rounded lithic and calcareous medium pebbles to fine silt. Lithic (Catalina shist) 90% Shell fragments 10%
4	CACTUS BAY 80' Brownish-gray, unconsolidated, well sorted, very fine lithic sand with some organic debris (shell fragments 1 - 10 mm, worm tubes, bits of algae). Lithic sand 90% Organic debris 10%
	CACTUS BAY 40' Gray, unconsolidated, well sorted, very fine lithic sand. Lithic sand 95-97% Shell fragments 3- 5%
6	MOLA MOLA COVE 100' Buff to gray, poorly sorted, angular, unconsolidated, shell and other organic debris and Catalina shist fragments Shist (1-10 mm) 5 - 10% Organic detritus 90 - 95%
7	STARLIGHT REEF 80' Buff to gray, unconsolidated, angular calcareous debris (shells, spines, algae formed concretions) particle size 0.1 to 5 mm.
8	BLACK POINT 100' Gray, friable to unconsolidated, subangular wacke. Lithic granules 2 - 3% Coarse to fine silt 40 - 50% Shell fragments (0.05 to 5 mm) 45%

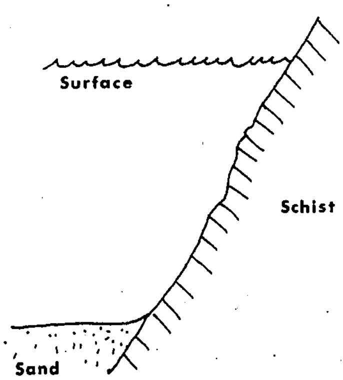
Study Site #	Location and description
9	PARSON'S LANDING 100' Gray, friable to unconsolidated, poorly sorted subangular lithic and calcareous fragments. Particle size grades from medium silt to small pebbles. Lithic 30 - 40% Shell fragments and other flora debris 60 - 70%
	PARSON'S LANDING 30' and 10' Brownish gray, slightly indurated, slightly ferruginous, very well sorted fine silt. Lithic 95% Shell fragments 5%
	PARSON'S LANDING INTERTIDAL Poorly sorted, angular, lithic (Catalina shist) medium pebbles to very fine sand, unconsolidated. Very fine sand is yellowish-brown, pebbles of quartz, feldspar and shist.
11	EMERALD BAY 20' Yellowish-gray, unconsolidated calcareous rounded floral debris with coarse to fine grains of angular lithic and organic fragments. Calcareous debris 60% (1-3 mm) Matrix 40%
	INDIAN ROCK REEF 40' Buff to yellowish-gray, unconsolidated, poorly sorted, angular to subrounded calcareous debris composed of both flora (maximum size is 3 - 4 mm, 30 - 40%) and fauna (maximum size is 10 mm, 60 - 70%) particles.
12	HOWLAND'S LANDING 40' Brownish gray, slightly indurated, slightly ferruginous, very well sorted fine silt. Lithic 95% Shell fragments 5%
13	BIG GEIGER COVE 30' Gray, moderately well sorted, unconsolidated, subrounded, medium silt to fine sand that is composed of lithic and organic grains. Lithic 85% Organic (shell fragments, tubes) 15%
14	LITTLE GEIGER COVE 30' Gray, moderately well sorted, unconsolidated subrounded, medium silt to fine sand that is composed of lithic and organic grains. Lithic 85% Organic (shell fragments, tubes) 15%
15	CHERRY COVE 35' Yellowish gray, friable to unconsolidated, calcareous rounded floral debris with lithic and organic matrix.

(continued)

Study Site #	Location and description
15	CHERRY COVE 35' Yellowish gray, friable to unconsolidated, calcareous rounded floral debris with lithic and organic matrix. Calcareous debris 70 - 80% (1 - 3 mm) Matrix 20 - 30%
16	4TH OF JULY COVE 40' Yellowish gray, friable to unconsolidated calcareous rounded floral debris with lithic and organic matrix. Calcareous debris 70 - 80% (1 - 3 mm) Matrix 20 - 30%
17	ISTHMUS COVE (WEST) 30' Gray, friable to unconsolidated, calcareous rounded floral debris with fine sand to coarse silt. Matrix of lithic and organic fragments. Calcareous debris 30 - 40% Matrix 60 - 70%
	ISTHMUS COVE (EAST) 30' Gray, moderately well sorted, friable lithic silt with 3 - 5% coarse to very coarse, subangular to subrounded rock fragments. Few well preserved, unbroken shell (3 - 5 mm) and worm tubes (?), organic content 3 - 5%
18	BIG FISHERMAN COVE 30' Gray, friable to unconsolidated, medium to fine silty matrix of lithic and calcareous detritus. 1 - 3% shell fragments, smaller than 3 mm. Lithic matrix 80 - 85% Organic detritus 15 - 20%

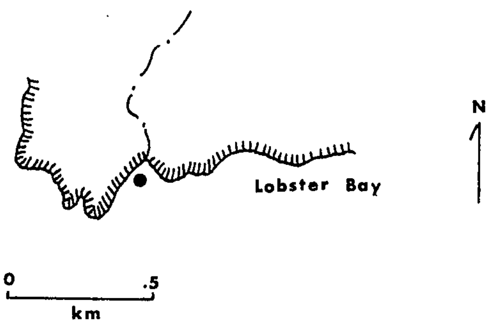
Study Site # 1 -- Lobster Point

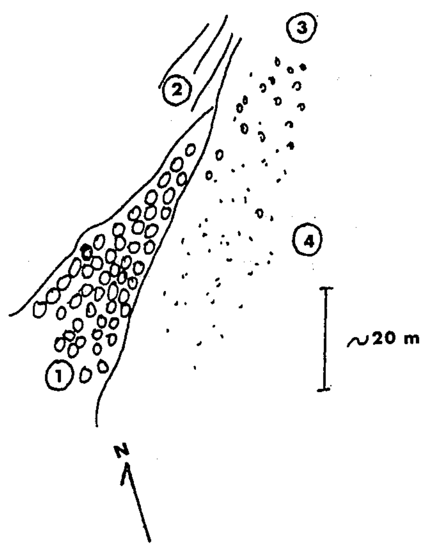




Cliff, average slope 50 - 60°, cut by several vertical channels that serve to funnel the surge. Composed of Catalina schist; foliation dips into wall (N60E, 30N) forming small ledges (.1 to 1 m), sheer walls (1 to 5 m) and overhangs. Depth of the sand - rock contact is about 70 feet.

Study Site #2 -- Sandy Cove





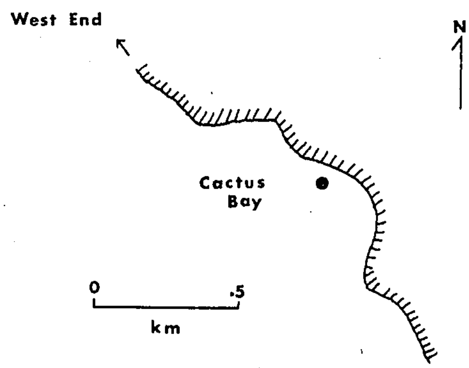
1. Talus slope, boulders up to 2 m in diameter, composed of Catalina schist.

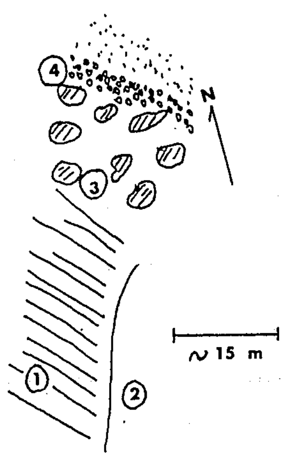
2. Outcrop of Catalina schist, foliation dips about 60° south and forms ledges and small overhangs that are spaced about 10 cm apart; forms a vertical wall about 8 m high.

3. Depth - 25 feet; bottom is covered with pebbles and cobbles, some as large as 10 cm. Some rocks (quartzites and schists) appear very fresh, probably recently washed in by the stream.

4. Sands and cobbles are detritus washed in by the stream, forming a small delta; grades from coarse (10 cm) to fine sands.

Study Site #4 -- Cactus Bay



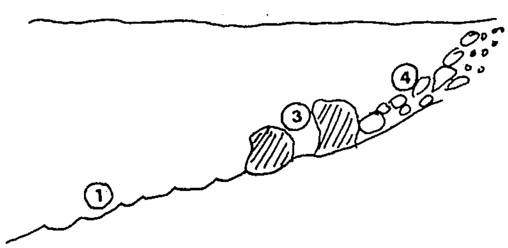


1. Depth - 40 feet; ripple marks with 1.5 m wavelength, formed with coarse sand (95% lithic) and some broken shells. Sand: quartz and lithic fragments (Catalina schist)

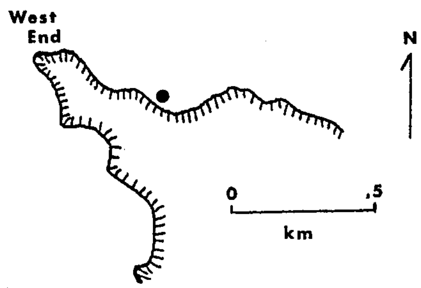
2. Fine-grained silt, no large ripple marks

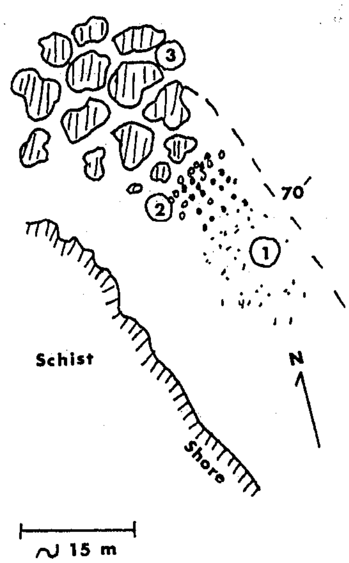
3. Depth - 35 feet; base of talus slope, boulders are 1 - 10 m apart, 3 - 4 m in diameter, sitting on coarse sand.

4. Depth - 30 feet; jumbled talus, blocks to .1 - 2 meters diameter.



Study Site #6 -- Mola Mola Cove



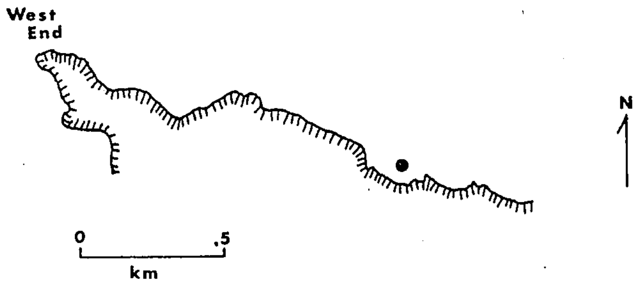


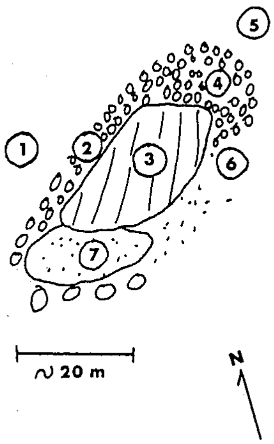
1. Depth - 55 feet; blocky talus sloping about 20°; rocks up to 1 m diameter; below, about 70-foot depth is the contact between talus and a gently sloping sandy bottom.

2. Depth - 35 feet; slope is uniformly covered with pebbles (1-4 cm), slopes about 20°; some very fresh-looking rock suggests recent transport.

3. Very large boulders of Catalina schist (5 - 10 m), joints about 1 m apart, possibly some basement outcrops of schist (difficult to distinguish if basement or large blocks); slopes about 60 - 70°, some sand between larger blocks, many overhangs and caves.

Study Site #7 -- Starlight Reef





1. Sandy bottom talus interface at about 75 feet.

2. Talus blocks of Catalina schist, 1-2 m in diameter.

3. Catalina schist outcrop.

4. Talus; blocks 2 - 4 m, talus slopes about 30°.

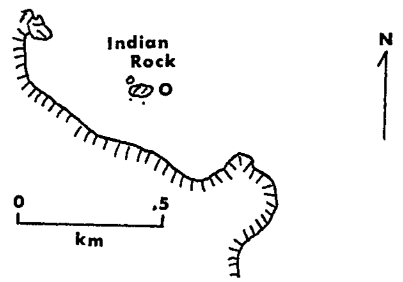
5. Depth - 60 feet; sand and scattered blocks 1 - 3 meters in diameter.

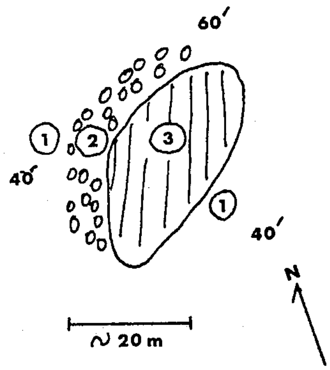
6. Depth - 40 feet; gently sloping (5-10°); talus blocks .5 - 1 m, a few large (1 - 3 m) blocks; occasional sandy patch 1 - 2 m across.

7. Sandbar, about 5 m by 20 m.

This "reef" is a basement high of Catalina schist, surrounded by debris apparently shed by the outcrop. Topography is steepest on the north-west side and the north end.

Study Site #11 -- Emerald Bay



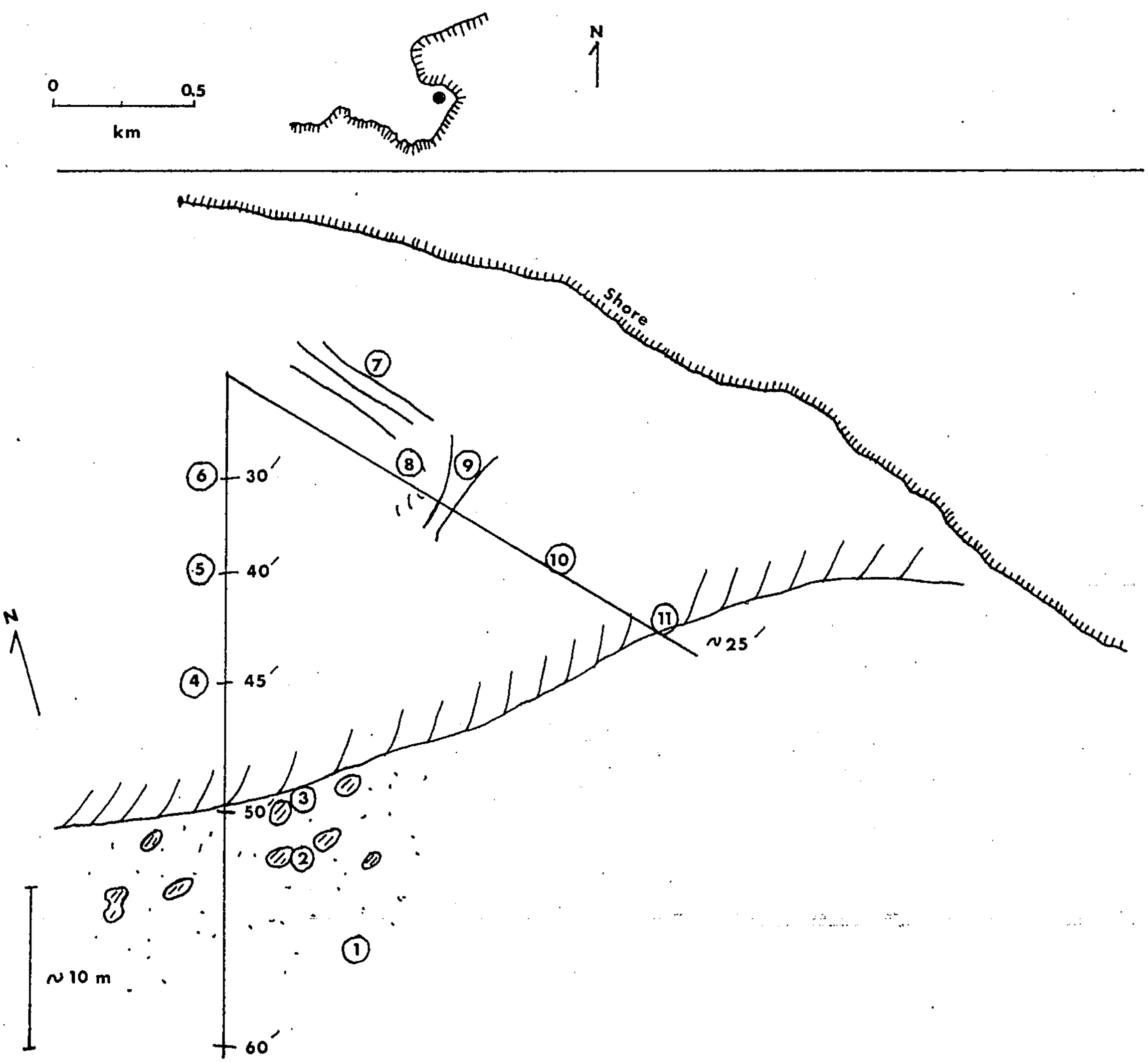


1. Gently sloping (about 5°) bottom; soil is about 95% $CaCO_3$ from algae, 5% broken shells.

2. Talus, blocks 1 - 2 meters in diameter.

3. Depth - 35 feet; outcrop of Catalina schist; appears to be a lower grade of metamorphism than at sites 2 - 6; rock is easily broken and is deeply weathered; foliation planes well-developed and dip north; foliation forms ledges and overhangs on the scale of .1 - 1 meter.

Study Site # 18 -- Big Fisherman Cove



1. Sand, coarse (1 - 2 mm) with 50% $CaCO_3$.

2. Andesite boulders about 1 meter across and 2 - 3 meters apart.

3. Andesite-basement outcrop - contact with sand; scattered, broken vesicular andesite boulders (1 meter in diameter).

4. Multiple ledges about 1 meter high (non-vesicular andesite).

5. Coarse (1 - 2 cm) andesitic debris flow with shell fragments.

Study Site #18 (continued)

6. Boulders (about 1 meter in diameter); rapid increase in slope; benches approximately parallel to shore, 3 - 4 meters high.

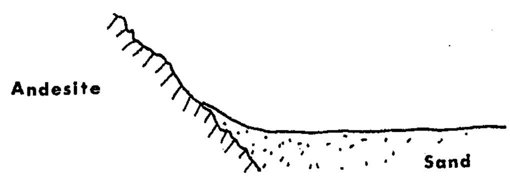
7. Very steep walls of andesite, 1 - 2 meter ledges.

8. Jointed andesitic ledges about .5 meters apart; non-vesicular; fractures strike north-south.

9. "Channel", strikes N30E, full of 20 cm boulders, slopes about 20°.

10. Cliffs (3 - 5 meters high) and benches, covered with boulders about .3 meters in diameter; immediately to the northeast is a wall, 10 meters high, composed of andesite.

11.



APPENDIX 2

A TAXONOMIC LISTING OF TERRESTRIAL PLANTS FOUND IN ASBS #25

A Taxonomic Listing of the Major Plants in the Four Representative Plant Communities found in the ASBS, with their Community Associations

Community Key: CSS = Coastal Sage Scrub
CP = Coastal Prairie
SOW = Scrub Oak Woodland
C = Chaparral

DIVISION - LEPIDOPHYTA

Class - Lycopodinae

Order - Selaginellales

Family - Selaginellaceae

Selaginella bigelovii (spike moss) (CSS)

DIVISION - ANTHOPHYTA

Class - Dicotyledoneae

Family - Asteraceae

Achillea millefolium (yarrow) (CP)
Artemisia californica (California sagebrush) (CSS)
Baccharis pilularis subsp. *consanguinea* (coyote bush)(C)
Encelia californica (CSS)
Eriophyllum confertiflorum var. *confertiflorum* (CSS)
Haplopappus venetus subsp. *furfuraceus* (CSS, C)
Hemizonia fasciculata (tar weed) (CP)
Hemizonia clementina (tar weed) (CP)
Microseris heterocarpa (C)

Family - Brassicaceae

Brassica spp. (wild mustard) (CP)

Family - Cactaceae

Opuntia littoralis (prickly pear) (CSS)

Family - Caprifoliaceae

Sambucus mexicana (elderberry) (SOW)

Family - Crossosomataceae

Crossosoma californicum (wild apple) (SOW, C)

Family - Cucurbitaceae

Marah macrocarpus (wild cucumber) (CSS, SOW, C)

Family - Ericaceae

Arctostaphylos catalinae (manzanita) (C)

Xylococcus bicolor (SOW)

Family - Fabaceae

Lotus argophyllus subsp. _ornithopus_ (silvery clover) (CSS)

Lotus hamatus (CSS)

Lotus scoparius subsp. _scoparius_ (deerbrush) (CSS)

Lupinus spp. (lupine) (CP)

Family - Fagaceae

Quercus dumosa (scrub oak) (SOW, C)

Family - Hydrophyllaceae

Eriodictyon traskiae (yerba santa) (SOW)

Family - Lamiaceae

Marrubium vulgare (horehound) (CP)

Salvia mellifera (black sage) (SOW, CSS)

Family - Nyctaginaceae

Mirabilis laevis (four-o'clock) (CSS, CP)

Family - Polygonaceae

Eriogonum giganteum subsp. _giganteum_ (St. Catherine's Lace) (CSS)

Family - Primulaceae

<u>Dodecatheon</u> <u>clevelandii</u> subsp. <u>insulare</u> (shooting star) (CP)

Family - Rhamnaceae

<u>Ceanothus</u> <u>arboreus</u> (California - lilac) (C)

<u>Rhamnus</u> <u>pirifolia</u> (wild coffee) (SOW, C)

Family - Rosaceae

<u>Adenostoma</u> <u>fasciculatum</u> (chamise) (C)

<u>Cercocarpus</u> <u>betuloides</u> var. <u>blancheae</u> (mountain mahogany) (C)

<u>Heteromeles</u> <u>arbutifolia</u> (toyon) (CSS, C)

<u>Prunus</u> <u>ilicifolia</u> subsp. <u>lyonii</u> (Catalina cherry) (SOW,C)

Family - Scrophulariaceae

<u>Mimulus</u> <u>puniceus</u> (sticky monkey flower) (CSS)

Family - Solanaceae

<u>Lycium</u> <u>californicum</u> (box thorn) (CSS)

Family - Anacardiaceae

<u>Rhus</u> <u>integrifolia</u> (lemonadeberry) (CSS, SOW)

<u>Rhus</u> <u>laurina</u> (laurel sumac) (CSS, SOW)

Class - Monocotyledoneae

Family - Poaceae

<u>Avena</u> <u>barbata</u> (wild oat) (CP)

<u>Avena</u> <u>fatua</u> (wild oat) (CP)

<u>Brachypodium</u> <u>distachyon</u> (CP)

<u>Bromus</u> <u>mollis</u> (CP)

<u>Bromus</u> <u>rubens</u> (foxtail) (CP)

<u>Distichlis</u> <u>spicata</u> var. <u>stolonifera</u> (salt grass) (CP)

<u>Elymus</u> <u>condensatus</u> (ryegrass) (CP)

<u>Festuca</u> <u>pacifica</u> (CP)

Family - Poaceae (cont.)

Lamarckia aurea (goldentop) (CP)

Poa scabrella (Malpais bluegrass) (CP)

Family - Liliaceae

Dichellostemma pulchellum (bluedick) (CP)

These are the more conspicuous plants found in the ASBS during the course of this study. The major taxonomic scheme was from Munz (1968); the trivial and common names from Thorne (1967).

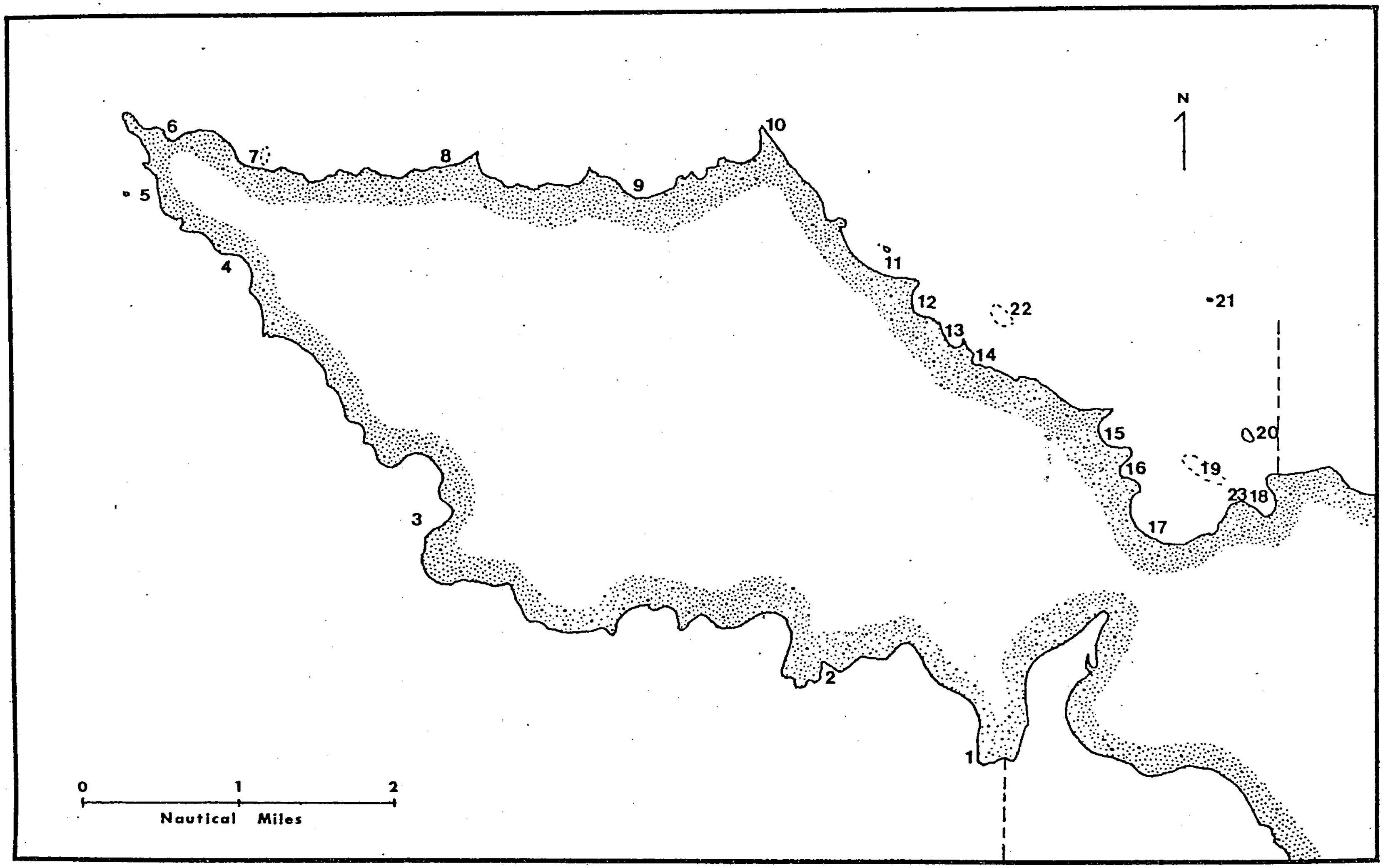
APPENDIX 3

MASTER SPECIES LIST

Locations of ASBS Study Sites

1. Lobster Point
2. Sandy Cove
3. Iron Bound Bay
4. Cactus Bay
5. Eagle Rock
6. Mola Mola Cove
7. Starlight Reef
8. Black Point
9. Parson's Landing
10. Arrow Point
11. Emerald Bay/ Indian Rock Reef
12. Howland's Landing
13. Big Geiger Cove
14. Little Geiger Cove
15. Cherry Cove
16. Fourth of July Cove
17. Isthmus Cove
18. Big Fisherman Cove
19. Isthmus Reef
20. Bird Rock
21. Ship Rock
22. Eagle Reef
23. Habitat Reef

Note: Sites # 15 through # 23 were not actually sampled during this Survey, but lie within the major study area for CMSC and have been well-documented for the past 10 years. Data from these areas have been used generally throughout the report, although not specifically as to site.



LOCATIONS OF ASBS STUDY SITES

Explanation of Entries and Symbols

All marine organisms observed, collected or otherwise considered in this survey of the ASBS are included in the Master Species List. Appropriate taxonomic categories separate major groups.

Ecological data are compiled into a "formula" (with no mathematical implications), to present data in the following sequence:

DEPTH (or depth ranges) (in feet) in which observations/ collecions were made. The symbol " i " indicates intertidal.

SUBSTRATE

R = rock
S = sand
M = mud
P = pelagic
K = kelp

RELATIVE ABUNDANCE If noted, categories are:

r = rare (seen occasionally)
c = common
a = abundant

If not noted, notation of presence (p) will be used.

If actual counts were made, as with infaunal organisms from cores, the numbers or ranges will be given. Infaunal (cored) invertebrates will be further identified in the List with the symbol (I) following the species name.

SURVEY SITES Numbered sites at which the organism was noted, referred to Site list and location map

Example: if several specimens of the gammarid amphipod Ampelisca cristata were taken in cores from Sites #6 (50'), #7(45') and #4(30'), with a number of females being gravid, the entry would be as follows:

Gammaridea

Ampelisca cristata (I)

30 - 50: S : 3-5 : 4,6,7

Most females gravid

APPENDIX 3a
MARINE ALGAE

ALGAE RECORDED AT ASBS STUDY SITES

Phylum RHODOPHYTA (red algae)

Acrosorium uncinatum

* 20 - 80: R : r-c : 2,6,8,9,11

Bossiella orbigniana

i - 100: R : c,p : 2,3,4,6,9

Botryocladia pseudodichotoma

5 - 60: R : r,p : 1,3,4,8

Botryoglossum farlowianum

20 - 40: R : p : 5

Calliarthron sp.

i - 40: R : p : 3,9

Callophyllis violacea

80 - 100: R : r : 8

Carpopeltis bushiae

i - 60: R : c-a: 1,2,4, 6 - 9, 11

Chondria sp.

20 - 30: R : r,p : 8, 12 - 14

Corallina officinalis

20 - 40: R : p : 18

Corallina vancouveriensis

i, 40 - 100: R : r-a : 8,9

Corallina sp.

i - 100: R : a,p : 1,2,4,5,6,7,9,11

Cryptopleura crispa

20: R : p : 6

Endocladia sp.

i: R : p : 9

Phylum RHODOPHYTA (cont.)

<u>Plocamium</u> sp.

i - 80: R : r-a,p : 2, 4 - 9, 12

<u>Polysiphonia</u> sp.

20 - 80: R : p : 4,9

<u>Prionitis</u> <u>cornea</u>

i - 40: R : r,p : 4,5

<u>Pterocladia</u> <u>capillacea</u>

i - 100: a,p : 2,4, 6 - 9, 12, 18

<u>Rhodoglossum</u> <u>affine</u>

i - 60: R : p : 2,3,6,8,9

<u>Rhodymenia</u> <u>californica</u>

i - 100: R : r,p : 1, 2,4,6,8,9,11

<u>Rhodymenia</u> <u>pacifica</u>

i - 60: R : p : 1,2,4,8,9

<u>Sciadophycus</u> <u>stellatus</u>

20 - 40: R : p : 1,6,7

* symbols and sequences used in the "ecological formula" are detailed in the introductory remarks preceding the Master Species List.

Phylum RHODOPHYTA (cont.)

Gelidium coulteri

i: R : p : 9

Gelidium nudifrons

i - 100: R : r-a,p : 1 - 4, 6,9

Gelidium purpurascens

i - 80: R : r : 1 - 4, 6 - 9, 11

Gelidium robustum

i - 80: R : r-a, p : 1,2,4, 6 - 9

Gigartina canaliculata

i: R : p : 6,9,14

Gigartina leptorhynchos

i: R : p : 6,8,9

Gigartina spinosa

i - 80: R : r,p : 1 - 6, 8,9, 12

Laurencia pacifica

i - 40: R : p : 1,6,8,9

Laurencia spectabilis

i: R : r-a : 6,8,9

Liagora sp.

i: R : p : 8,14

Lithothamnium sp.

20 - 100: R : r-a : 2,5,8,9,11,12,13,18

Lithothrix aspergillum

5 - 80: R : r,p : 3,4 6 - 9, 18

Plocamium cartilagineum

i - 80: R : r,p : 1,4,6,7

Plocamium coccineum

40,80: R : r : 8,9

Phylum CHLOROPHYTA (green algae)

<u>Chaetomorpha</u> <u>spiralis</u>

* i - 40: R : r,p : 2,4, 6 - 9

<u>Cladophora</u> <u>graminea</u>

i - 40: R : r,p : 2,6,8,9,11

<u>Cladophora</u> <u>microcladioides</u>

40: R : p : 9

<u>Codium</u> <u>cuneatum</u>

i - 60: R : r-a,p : 1,2,4 - 9, 11, 12

<u>Codium</u> <u>fragile</u>

i - 80: R : r,p : 2,6,8,9,12,14,18

<u>Codium</u> <u>hubbsi</u>

20 - 60: R : r,p : 1,6,7,8,11

<u>Codium</u> <u>setchellii</u>

i - 40: R : r,p : 5,6

<u>Derbesia</u> <u>marina</u>

20 - 40: R : r,p : 1,6.8,9

<u>Derbesia</u> <u>marina</u> ("Halicystis ovalis" stage)

20 - 40: R : p : 2,9

<u>Enteromorpha</u> sp.

i: R : p : 9

<u>Ulva</u> sp.

i, 40: R : p : 9, 18

<u>Urospora</u> <u>penicilliformis</u>

20 - 40: R : p : 18

* symbols and sequences used in the "ecological formula" are detailed in the introductory remarks preceding the Master Species List.

Phylum PHAEOPHYTA (brown algae)

Acinetospora nicholsoniae

* 10 - 60: R : a (seasonal), p : 18

Agarum fimbriatum

40 - 100: R : r-a,p : 1,2, 6 - 9

Colpomenia sinuosa

20 - 60: R : r-c,p : 2,4,7 - 9, 12 - 14

Cystoseira neglecta

5 - 30, 60 - 80: R : p : 3,9

Cystoseira osmundacea

5 - 30, 40 - 100: R : p : 2,3

Cystoseira sp.

20 - 100: R : r-a,p : 1, 4 - 9, 11, 12

Dictyopteris undulata

20 - 100: R : c-a, p : 1,2, 4 - 7, 11, 18

Dictyopteris sp.

20 - 100: R : r-a, p : 1,2,8,9, 12, 13, 14

Dictyota flabellata

20: R : r : 6

Dictyota sp.

20 - 80: R : r,p : 2,4,8, 11, 14, 18

Dictyota/Pachydictyon

20 - 100: R : r-a,p : 2,4,5,8,9, 14

Egregia menziesii

i - 80: R : a,p : 1,2, 5 - 9

Eisenia arborea

i - 100: R : r-a, p : 1 - 9, 11, 14, 18

Halidrys dioica

i - 20: R : a,p : 4, 7 - 9, 14

Phylum PHAEOPHYTA (cont.)

Haliptylon gracile

i - 80: R : r,p : 3 - 9

Hesperophycus harveyanus

i: R : p : 18

Laminaria farlowii

i - 100: R : r-c, p : 1, 2 - 11

Macrocystis pyrifera

5 - 100: R : r-a, p : 1 - 15, 18

Pachydictyon coriaceum

i - 60: R : r,p : 1, 2, 4 - 8, 11

Pelagophycus porra

80 - 100: r-a, p : 6,8

Pelvetia fastigiata

i: R : p : 9, 14, 18

Sargassum muticum

20 - 80: R : r-a, p : 1, 2, 4, 5, 7, 8, 9, 11, 12, 13, 18

Sargassum palmeri

20: R : p : 9

Sargassum sp.

80: R : p : 2

Tinocladia crassa

40: R : p : 9

Zonaria farlowii

i - 100: R : r-a,p : 2, 5 - 9, 11 - 13, 18

ANGIOSPERMAE (marine flowering plants)

Phyllospadix torreyi (surfgrass)

i - 40: R : a, p : 2,3,4,8,9,

ANGIOSPERMAE (cont.)

Zostera marina (eelgrass)

30: SM : p : 13

* symbols and sequences used in the "ecological formula" are detailed in the introductory remarks preceding the Master Species List.

APPENDIX 3b
MARINE INVERTEBRATES

MASTER LIST OF INVERTEBRATE SPECIES NOTED DURING THE ASBS SITE SURVEY

(includes epibiota and infauna)

Phylum PORIFERA (Sponges)

Astylinifer arndti

* 20 - 40: R : p : 9

Haliclona permollis

20 - 40: R : p : 2,5,6

Hymenamphiastra cyanocrypta

20 - 60: R : p : 2,4,6,8

Tethya aurantia

40 - 100: R : r,c,p : 1,5,7,8,9, 11

Verongia aurea

20 - 40: R : p : 2, 4 - 6, 9

Phylum COELENTERATA (Anemones, corals, sea pens, gorgonians, etc.)

Class Hydrozoa (hydroids)

Aglaophenia sp.

i - 40: R : p : 2,6,9

campanularids, unid.

20 -40: R : p : 9

Eudendrium sp.

10 - 25: R : p : 10

Hydractinia echinata

20 - 100: R and shells : p : 6,9

Lytocarpus nuttingi

20 - 40: R : p : 9

Obelia sp.

10 - 25: R : p : 10

* symbols and sequences used in the "ecological formula" are detailed in the introductory remarks preceding the Master Species List.

Phylum COELENTERATA

Class Hydrozoa (cont.)

Obelia sp.

10 - 25: R : p : 10

Sertularella sp.

i - 100: R and algae: p : 6,8,9

Sertularia sp.

20 - 60: R and algae: p : 2,9

Sphaerocoryne sp.

10 - 25: R and algae: p : 10

Class Anthozoa (anemones, corals, sea pens, etc.)

Acanthoptilum sp. (sea pen)

140: M : p : 10

Anthopleura elegantissima (aggregating anemone)

i - 40: R : p : 1,2, 4 - 6

Astrangia lajollaensis (stony coral)

20 - 40: R : p : 6,9, 10

Balanophyllia elegans (stony coral)

20 - 40: R : p : 7, 11

Ca 'osoma arenaria (anemone) (I)

100: S : 1 : 8

cerianthid anemones, unid. (burrowing anemones)

20 - 100: S, M: p : 1,8,9, 11, 13

Coenocyathus bowersi (colonial stony coral)

20 - 100: R : r,p : 1,2,6,8, 10

Corynactis californica (jewel anemone)

20 - 40: R : a,p : 1,2,7, 10, 11

Haliplanella sp. (anemone)

20 - 40: R : p : 9

Phylum COELENTERATA

Class Anthozoa (cont.)

Lophogorgia _chilensis_ (whip gorgonian)

20 - 100: R : p : 7 - 10

Muricea _californica_ (sea fan)

20 - 100: R : c-a, p : 1,2, 4 - 11, 14

Muricea _fruticosa_ (sea fan)

20 - 100: R : c-a, p : 1,2,4,6 - 9, 11

Pachycerianthus sp. (burrowing anemone)

40 - 140: S, M : p : 2,9, 10

Paracyathus _stearnsi_ (solitary stony coral)

20 - 100: R : r,p : 1,6,9, 10

Parazoanthus _lucificum_ (zoanthid)

20 - 40: R : p : 9

Ptilosarcus sp. (sea pen)

140: M : p : 10

Stylatula spp. (sea pen)

140: M : p : 10

Tealia sp. (anemone)

i - 40: R : p : 8,9

Phylum PLATYHELMINTHES (tapeworms, flatworms, etc.)

Class Turbellaria

Order - Polycladida (free-living flatworm)

polyclad, unidentified (I)

100: S : 1 : 8

Phylum ANNELIDA (segmented worms)

Class Polychaeta

Family Acrocirridae

Macrochaeta sp. (I)

10 - 40: S : 1 - 4: 15 - 17

Family Ampharetidae

Amphisamytha (?) *bioculata* (I)

80 - 100: S : 1 : 9

Family Amphinomidae

Pareurythoe californica (I)

10 40: S : 1-3 : 16, 17

Family Arabellidae

fragment, unidentifiable (I)

80 - 100: S : 1 : 8

Family Capitellidae

Capitella capitata (I)

10 - 40: S : 1 : 2

Mediomastus californiensis (I)

10 - 40: S : 1 - 4: 11, 12, 15 - 17

Scyphoproctus ocularis (I)

10 - 40: S : 2 : 11

Family Chaetopteridae

Chaetopterus variopedatus (I)

10 - 40: S : 1, 5: 12, 14

Chaetopterus variopedatus

20 - 140: S, M: a,p : 8 - 10, 12, 13, 15

Mesochaetopterus taylori (I)

10 - 40: S : 1 : 9
80 - 100: S : 1 : 14

Class Polychaeta (cont.)

Family Chaetopteridae (cont.)

<u>Spiochaetopterus costarum</u> (I)

10 - 40: S : 1 - 42 : 2, 9, 11 - 14, 17, 18
80 - 100: S : 1 - 22 : 1,4,6,7,8,9

<u>Spiochaetopterus</u> sp.

60 - 100, 140: S : p : 6, 10

Family Cirratulidae

<u>Caulleriella bioculata</u> (I)

80 - 100: S : 1 : 8

<u>Chaetozone setosa</u> (I)

80 - 100: S : 1 - 4: 1, 8, 9

<u>Tharyx,</u> unidentifiable (I)

10 - 40: S : 1 - 4: 2,8, 13, 15 - 18
80 - 100: S : 1 - 2: 6,7

cirratulid, unidentifiable (I)

80 - 100: S : 1 : 9

Family Dorvilleidae

<u>Protodorvillea gracilis</u> (I)

80 - 100: S : 1 : 1

<u>Schistomeringos longicornis</u> (I)

10 - 40: S : 1 - 3: 13, 15 - 17

Family Flabelligeridae

<u>Pherusa capulata</u> (I)

10 - 40: S : 1 : 17

flabelligerid, unidentifiable (I)

10 - 40: S : 1 : 2

Class Polychaeta (cont.)

Family Glyceridae

Glycera americana (I)

10 - 40: S : 1 : 15

Glycera capitata (I)

10 - 40: S : 2 : 11
80 - 100: S : 6 : 6

Glycera oxycephala (I)

80 - 100: S : 1 : 2,4

Hemipodus borealis (I)

10 - 40: S : 1 : 11

Family Hesionidae

Gyptis arenicolus glabrus (I)

80 - 100: S : 1 : 4

Heteropodarke heteromorpha (I)

10 - 40: S : 1 : 2

Micropodarke dubia (I)

80 - 100: S : 1 - 10: 2,7,8

Ophiodromus pugettensis (I)

10 - 40: S : 1 : 15

Family Lacydoniidae

Lacydonia nr. _miranda_ (I)

10 - 40: S : 1 : 11, 15
80 - 100: S : 2 : 7

Family Lumbrineridae

Driloneris nuda (I)

80 - 100: S : 1 : 7

Lumbrineris sp. (I)

10 - 40: S : 1 : 2, 17

Class Polychaeta (cont.)

Family Lumbrineridae (cont.)

Lumbrineris bicirrata (I)

80 - 100: S : 1 : 8

Lumbrineris erecta (I)

10 - 40: S : 4 : 14

Lumbrineris latreilli (I)

10 - 40: S : 1 - 12 : 11, 13 - 17
80 - 100: S : 1 - 27 : 1,2,4, 7 - 9

Lumbrineris pallida (I)

10 - 40: S : 2 - 8: 11, 16, 17

Lumbrineris zonata (I)

10 - 40: S : 1 : 11, 14 - 18

Family Maldanidae

Axiothella rubrocincta (I)

10 - 40: S : 1 - 2: 2, 16, 17

Axiothella sp. (I)

10 - 40: S : 2 : 2

Euclymeninae, unid. (I)

10 - 40: S : 1 - 4: 2, 13 - 18

Praxillella affinis pacifica (I)

10 - 40: S : 1 - 2: 15, 17, 18

Praxillella maculata (I)

80 - 100: S : 1 : 2

Family Nephtyidae

Aglaophamus sp. (I)

10 - 40: S : 1 - 2: 13, 17

Class Polychaeta (cont.)

Family Nereidae

<u>Ceratonereis</u> nr. <u>paucidentata</u> (I)

10 - 40: S : 1 : 13, 17, 18

<u>Nicon</u> sp. (I)

80 - 100: S : 1 : 7

Family Onuphidae

<u>Diopatra</u> <u>ornata</u>

20 - 100, 140: S, M: p : 4,7,8, 10

<u>Nothria</u> <u>elegans</u> (I)

80: S : 1 : 1

<u>Nothria</u> <u>stigmatus</u> <u>intermedia</u> (I)

10 - 40: S : 2 : 2
80 - 100: S : 2 : 7

<u>Onuphis</u> (?) <u>nebulosa</u> (I)

10 - 40: S : 1 : 4

Family Opheliidae

<u>Polyophthalmus</u> <u>pictus</u> (I)

10 - 40: S : 1 : 2, 14

Family Orbiniidae

<u>Naineris</u> <u>dendritica</u> (I)

80 - 100: S : 1 : 6

<u>Phylo</u> <u>felix</u> (I)

10 - 40: S : 1 : 17, 18

<u>Scoloplos</u> <u>acmeceps</u> (I)

10 - 40: S : 1 : 13, 17

<u>Scoloplos</u> nr. <u>acmeceps</u> (I)

10 - 40: S : 1 : 13

Class Polychaeta (cont.)

Family Orbiniidae (cont.)

Scoloplos nr. *armiger* (I)

10 - 40: S : 1 : 4, 14

Scoloplos sp.

10 - 40: S : 2, 3: 16, 17

Family Oweniidae

Owenia collaris (I)

10 - 40: S : 1 - 8: 2, 8, 11 - 14, 16, 17
80 - 100: S : 2 - 11: 1,2,4,6,9

Family Paraonidae

Acesta nr. *cerruttii* (I)

10 - 40: S : 1 : 17

Allia nr. *quadrilobata* (I)

10 - 40: S : 1 - 4: 9, 12, 16
80 - 100: S : 1 - 2: 1, 6 - 8

Allia sp. (I)

10 - 40: S : 1 - 12: 11, 13 - 17

Cirrophorus sp. (I)

10 - 40: S : 1 : 16
80 - 100: S : 1 : 1

Paraonides sp. (I)

10 - 40: S : 18 : 9
80 - 100: S : 1 : 2,6

Tauberia gracilis (I)

10 - 40: S : 1 : 12

Tauberia oculata (I)

10 - 40: S : 1 : 12

Class Polychaeta (cont.)

Family Phyllodocidae

<u>Anaitides</u> sp. (I)

10 - 40: S : 1 : 2

<u>Eumida longicornuta</u> (I)

10 - 40: S : 1 : 9

<u>Hesionura</u> sp. (I)

10 - 40: S : 2 : 11
80 - 100: S : 1 : 7

<u>Phyllodoce hartmanae</u> (I)

10 - 40: S : 2 : 9

<u>Steggoa californiensis</u> (I)

10 - 40: S : 1 : 17

Family Pisionidae

<u>Pisione remota</u> (I)

10 - 40: S : 2,6 : 11, 15
80 - 100: S : 3 : 7

Family Pilargidae

<u>Synelmis albini</u> (I)

10 - 40: S : 2 : 11

Family Poecilochaetidae

<u>Poecilochaetus johnsoni</u> (I)

10 - 40: S : 1 : 17

Family Polynoidae

<u>Harmothoe</u> nr. <u>scriptoria</u> (I)

80 - 100: S : 2 : 6

Family Questidae

fragment, unid. (I)

10 - 40: S : 7 : 11

Class Polychaeta

Family Sabellidae

<u>Chone</u> <u>albocincta</u> (I)

10 - 40: S : 1 - 2 : 11, 15, 17

<u>Megalomma</u> <u>pigmentum</u> (I)

10 - 40: S : 1 - 3: 11, 16, 17

<u>Potamethus</u> sp. (I)

10 - 40: S : 2, 13: 2, 16
80 - 100: S : 1, 3: 1, 7

Family Serpulidae

<u>Spirobranchus</u> <u>spinosus</u>

20 - 100: R : c,p : 1, 2, 5 - 10, 12, 18

<u>Spirorbis</u> sp

20 - 50: R and algae: p : 5,6, 10

Family Sigalionidae

<u>Sthenelanella</u> <u>uniformis</u> (I)

10 - 40: S : 1 - 3: 11, 13, 15, 17

fragment, unid. (I)

80 - 100: S : 1 : 8

Family Spionidae

<u>Aonides</u> sp. (I)

80 - 100: S : 1 : 6

<u>Dispio</u> <u>uncinata</u> (I)

10 - 40: S : 1 - 8: 4,8, 14

<u>Malacoceros</u> sp. (I)

80 - 100: S : 1 : 6, 8, 9

<u>Minuspio</u> <u>cirrifera</u> (I)

10 - 40: S : 2 - 13, 55: 2,9, 11 - 18
80 - 100: S : 1 - 2: 6,7,9

Class Polychaeta (cont.)

Family Spionidae (cont.)

Paraprionospio pinnata (I)

10 - 40: S : 1 : 12

Polydora citrona (I)

10 - 40: S : 1 : 11

Polydora socialis (I)

80 - 100: S : 1 : 6

Polydora sp. (I)

80 - 100: S : 42 : 4

Prionospio steenstrupi (I)

10 - 40: S : 1 : 2

Prionospio sp. (I)

80 - 100: S : 1 : 4

Scolelepis nr. acuta (I)

10 - 40: S : 3, 65: 4, 9

Scolelepis sp. (I)

10 - 40: S : 1 - 3: 2, 12 - 14, 17, 18

Spiophanes missionensis (I)

80 - 100: S : 1 : 1, 8, 9

Spionidae, unid.

20 - 40: R and algae: p : 9

Spionidae, unid. (new genus) (I)

10 - 40: S : 2 : 11

Family Syllidae

Exogone lourei (I)

10 - 40: S : 1 - 4: 11, 13, 14, 16 - 18

Class Polychaeta (cont.)

Family Syllidae (cont.)

Exogone molesta (I)

10 - 40: S : 1 - 2: 11, 14, 18
80 - 100: S : 1 : 1

Exogone sp. (I)

10 - 40: S : 4 : 9

Odontosyllis phosphorea (I)

10 - 40: S : 1, 2: 9, 14

Sphaerosyllis californiensis (I)

10 - 40: S : 1 - 8 : 11, 15 - 17

Syllides longicirrata (I)

10 - 40: S : 16 : 9

Typosyllis adamanteus (I)

80 - 100: S : 1 : 6,7

Typosyllis nr. _heterochaeta_ (I)

80 - 100: S : 1 : 7

Family Terebellidae

Amaeana occidentalis (I)

10 - 40: S : 1 - 3: 12, 17, 18

Loimia sp. (I)

80 - 100: S : 1 : 4, 6

Loimia medusa (I)

80 - 100: S : 2 : 8

Pista alata (I)

10 - 40: S : 1 : 16, 17
80 - 100: S : 1 : 6

Pista disjuncta (I)

10 - 40: S : 1 : 15 - 17

Class Polychaeta (cont.)

Family Terebellidae (cont.)

Streblosoma crassibranchia (I)

80 - 100: S : 1 : 2

terebellids, unid.

20 - 40: R : p : 9

Phylum ARTHROPODA, Subphylum Mandibulata

Class Crustacea

Subclass - Ostracoda

Cylindroleberididae, unid. (I)

80 - 100: S : 1 : 6, 7

Rutiderma sp. (I)

100: S : 1 : 8

Vargula americana (I)

100: S : 1 : 6

Subclass - Cirripedia (barnacles)

Chthamalus fissus

i : R : p : 9, 18

Balanus tintinnabulum

i - 20: R : p : 6, 9

Balanus trigonus

i - 20: R : p : 6, 9

Pollicipes polymerus (goose barnacle)

i : R : p : 10, 20

Tetraclita squamosa elegans

i : R : p : 18

Tetraclita squamosa rubescens

i : R : p : 18

Class Crustacea (cont.)

Subclass - Malacostraca

Series - Leptostraca

Nebalia sp. (I)

100: S : 1 : 8

Series - Eumalacostraca

Superorder - Peracarida

Order - Cumacea

cumacean, unid. fragment (I)

30: S : 1 : 9

Order - Isopoda

Colanthura sp. (I)

30: S : 1 : 2 : 11

Gnorimosphaeroma sp. (I)

100: S : 1 : 9

Janiridae, unid.

30: S : 1 - 8: 15, 16, 18

Paraselloidea, unid. (I)

100: S : 2 : 2

Order Amphipoda

Suborder - Gammaridea

Ampelisca cristata (I)

30: S : 1, 18: 9, 11
100: S : 1 : 6

Aoridae, unid. (I) (females only)

80: S : 3 : 7

Heterophlias seclusus (I)

30: S : 1 : 11

Suborder - Gammaridea (cont.)

Isaeidae, unid. (I) (females only)

30: S : 1 : 2

<u>Paraphoxus</u> <u>stenodes</u> (I)

30: S : 1 : 13

<u>Photis</u> sp. (I)

10 - 30: S : 13 : 9
100: S : 1 : 2,6,8

<u>Syrrhoe</u> sp. (I)

30: S : 1 : 15

<u>Westwoodilla</u> <u>caecula</u> (I)

100: S : 1 : 8

Suborder - Caprellidea

<u>Caprella</u> sp. A (I)

10 - 30: S : 1 - 2: 9, 11, 15

<u>Caprella</u> sp. B (I)

30: S : 1 : 11, 15

Superorder - Eucarida

Order - Decapoda

<u>Cancer</u> (?) <u>anthonyi</u> (I)

100: S : 1 : 6, 8

<u>Clythocerus</u> <u>planus</u> (I)

100: S : 1 : 2

<u>Crangon</u> <u>munitellus</u> (I)

100: S : 1 : 6, 8

<u>Cycloxanthops</u> <u>novemdentatus</u>

20 - 40: R : p : 5, 9

hermit crab, unid.

20 - 40; 100: R : p : 9, 10

Order - Decapoda (cont.)

Lepidopa californica (I)

30: S : 1 : 14

Lophopanopeus sp. (I)

100: S : 1 : 2

Lysmata californica

i: R : p : 6

megalops, unid. (I)

100: S : 1 : 2

Panulirus interruptus (spiny lobster)

i - 60: R, S: p : 2, 4, 5, 7, 8, 9, 11

Paguristes ulreyi (I)

100: S : 1 : 6

Pagurus granosimanus (I)

100: S : 1 : 2

Pagurus (?) *setosus* (I)

90: S : 1 : 1

Podochela sp. (I)

100: S : 1 : 6

Polyonyx quadriungulatus (I)

30: S : 2 : 14

Portunus xantusii (I)

30: S : 1 : 16
100: S : 1 : 2

Pugettia dalli (I)

30: S : 1 : 11

Subphylum - Chelicerata

Class - Pycnogonida (sea spiders)

<u>Phoxichilidium</u> sp. (I)

30 - 40: S : 5 : 2, 11
90 - 100: S : 1 - 2 : 1, 6, 8

pycnogonid, unid. (I)

30: S : 1 : 15

Phylum MOLLUSCA

Class - Amphineura (chitons)

<u>Cyanoplax dentiens</u> (I)

90: S : 1 : 1

Class - Cephalopoda (octopus, squid)

<u>Octopus bimaculatus</u>

i - 40: R : r, p: 1, 2, 6, 8, 9, 11

Class - Pelecypoda (clams)

<u>Americardium biangulata</u>

i, 120: S : p : 9, 10

<u>Chama pellucida</u>

20 - 100: R : p : 1, 2, 4 - 9, 20

<u>Hinnites multirugosus</u> (rock scallop)

i - 80: R : p : 1, 2, 6 - 9, 11, 14

<u>Hinnites multirugosus</u> (I)

80: S : 1 juv. : 4

<u>Ischadium demissum</u> (I)

40: S : 1 : 16

<u>Laevicardium</u> sp. (I)

10 - 40: S : 1 : 12, 15, 17
90: S : 1 : 1

<u>Mytilus californianus</u>

i - 20: 1, 6, 9

Class - Pelecypoda (cont.)

Periploma sp. (I)

30: S : 2 : 18

Phacoides approximatus (I)

10 - 40: S : 1 - 27: 2, 11 - 18
80 - 100: S : 3 - 7: 2, 8, 9

Pitar sp. (I)

30: S : 1 : 11

Pododesmus cepio

20: R : p : 10

Solen rosaceus

30: S : p : 18

Solen rosaceus (I)

30: S : 1 : 11

Tagelus californianus

30: S : p : 18

Tellina sp. (I)

10 - 40: S : 1 : 13, 18

Transennella sp.

100: S : 3 : 2

Class - Gastropoda (snails)

Acmaea sp. (limpet

i: R : p : 9

Aplysia californica

60 - 100: R, S: p : 6

Astraea gibberosa

30: R : p : 13

Class - Gastropoda (cont.)

<u>Astraea</u> <u>undosa</u>

20 - 100: R : r, p: 1,2,4,5,8,9, 12

<u>Bursa</u> <u>californica</u>

100 - 120: S, M: p : 9, 10

<u>Caecum</u> <u>californicum</u> (I)

10 - 40: S : 2 : 16

<u>Caecum</u> <u>crebricinctum</u> (I)

10 - 40: S : 1 - 2 : 11, 15 - 17
80 - 100: S : 4, 14: 1, 7

<u>Chelidonura</u> <u>inermis</u>

20 - 40: R : p : 9

<u>Collisella</u> sp.

i: R : p : 9

<u>Conus</u> <u>californicus</u>

20 - 120: R, S : p : 8 - 12

<u>Crepipatella</u> <u>lingulata</u>

20: R : p : 10

<u>Cypraea</u> <u>spadicea</u>

- 60: R : p : 8

<u>Dendrodoris</u> <u>albopunctata</u>

20: R : p : 10

<u>Fissurella</u> <u>volcano</u> (I)

100: S : 1 : 6

<u>Flabellinopsis</u> <u>iodinea</u>

20 - 40: R : p : 2, 7, 9, 14

<u>Fusinus</u> <u>kobelti</u>

20 - 40: R : p : 9

Class - Gastropoda (cont.)

Haliotis corrugata (pink abalone)

20 - 100: R : p : 4, 6, 7, 9, 11, 12

Haliotis cracherodii (black abalone)

i : R : p : 8, 9

Haliotis fulgens (green abalone)

20 - 40: R : p : 2, 4, 6, 8, 9, 12

Haliotis sorenseni (white abalone)

60 - 100: R : p : 2, 6

Kelletia kelletii

20 - 120: R, S : p : 1, 2, 4, 6, 10, 11

Littorina planaxis

i: R : p : 9, 14

Littorina scutulata

i : R : p : 14

Maxwellia gemma

20 - 40: R : p : 9

Megasurcula carpenteriana

120: S : p : 10

Megasurcula stearnsiana

120: S : p : 10

Megathura crenulata (keyhole limpet)

20 - 100: R : r, p: 1, 2, 4 - 9, 11, 12, 14

Norrisia norrisii

i - 50: algae : p : 2, 8, 9, 10, 12

Ocenebra sp.

40: R : p : 9

Olivella biplicata

20: S : p : 18

Class - Gastropoda (cont.)

Polycera atra

20: R : p : 10

Serpulorbis squamigerus

20 - 100: R : r,p: 1, 2, 6, 7, 9, 12

Tegula aureotincta

20 - 40: R : p : 5, 9, 12, 14

Tegula eiseni

20 - 40: R : p : 5, 9, 13

Triopha carpenteri

20 - 50: R : p : 9, 0

Tylodina fungina

i - 40: R : p : 2, 6, 8, 9

Phylum ENTOPROCTA

Barentsia sp.

20: R : p : 10

Phylum BRYOZOA

Aetea sp.

0 - 60: R and algae: p : 2, 8, 9, 10

Bugula neritina

20 - 100: R : p : 2, 4, 6 - 11

Cellaria mandibulata

20 - 100: R : p : 6, 8, 9

Diaperoecia californica

20 - 100: R : p : 2,5, 6, 8, 9

Fenestrulina malusii

60 - 100: R : p : 6, 8

Phylum BRYOZOA (cont.)

Hippodiplosia insculpta

20 - 100: R : p : 6, 10

Hippothoa hyalina

20 - 40: R : p : 2, 9

Lichenopora novae-zelandiae

20 - 100: R and algae : p : 2, 6, 8, 9

Membranipora sp.

20 - 100: R and algae: p : 2, 8, 9, 10

Parasmittina californica

20 - 100: R : p : 2, 6, 8, 9

Pherusella brevituba

20 - 40: algae: p : 2, 9

Phidolopora pacifica

20 - 40: R : p : 2, 9, 10

Rhynchozoon rostratum

20, 60 - 100: R : p: 2, 6

Scrupocellaria bertholetti

20 - 40: R and algae: p : 8, 9

Thalamoporella californica

20 - 60: R and algae: p : 2, 8

Tricellaria occidentalis

20 - 40: R : p : 2, 9

Watersipora sp.

20 - 60: R : p : 8, 9

Phylum BRACHIOPODA

Glottidia sp. (I)

80: S : l : 4

Phylum PHORONIDA

Phoronis vancouverensis

15: R : p : 20

Phoronopsis californica

20 - 100: M : p : 4, 8, 10, 13, 18

Phylum SIPUNCULIDA

Golfingia sp. (I)

20 - 40: S : 2 - 9: 11, 16 - 18

Phylum ECHINODERMATA

Class - Asteroidea (starfish)

Astrometis sertulifera

60 - 100: R : p : 6, 7

Astropecten brasiliensis

40 - 80: S : a, c: 2, 4

Henricia leviuscula

20 - 100: R : p : 8, 10

Linckia columbiae

20 - 100: R : r,c: 1,2,6, 10

Patiria miniata

20 - 100: R : c,p : 1, 2, 10, 18

Pisaster giganteus

20 - 100: R : c,p : 1, 2, 4 - 12, 18

Pisaster ochraceus

i, 20 - 40: R : p : 1, 9

Class - Holothuroidea (sea cucumbers)

Cucumaria salma

20 - 40: R : r, p: 1, 2, 9, ,0, 11

Parastichopus parvimensis

20 - 100: R, S: c, p : 1, 2, 5 - 14, 18

Phylum ECHINODERMATA (cont.)

Class - Echinoidea (sea urchins and sand dollars)

<u>Centrostephanus</u> <u>coronatus</u>

20 - 100: R : c,p : 1, 4, 6, 9, 11, 12, ,4

<u>Dendraster</u> sp. (sand dollar) (I) (juv)

20 - 40: S : 3 : 11

<u>Lovenia</u> <u>cordiformis</u>

80: S : 1 : 4

<u>Lytechinus</u> <u>pictus</u>

100: S : p : 2, 9

<u>Lytechinus</u> <u>pictus</u> (I)

80 - 100: S : 1 - 3 : 2, 8, 18

<u>Strongylocentrotus</u> <u>franciscanus</u>

20 - 80: R : c,p: 1, 2, 4 - 9, 11, 12, 14

<u>Strongylocentrotus</u> <u>purpuratus</u>

i - 80: R : r,p : 1, 2, 4, 6, 8, 9

<u>Strongylocentrotus</u> sp. (I) (Juv)

20 - 40: S : 1, 6: 2, 11, 15, 16
80: S : 1 : 7

Class - Ophiuroidea (brittle stars)

<u>Amphipholis</u> sp. (I)

20 - 40: S : 1 - 8: 2, 11, 15, 16
100: S : 2,3 : 6, 8

<u>Ophioderma</u> <u>panamensis</u>

20 - 40: R : p : 5

<u>Ophiopteris</u> sp. (I)

30: S : 1 : 11

<u>Ophiothrix</u> <u>spiculata</u>

20 - 40: R and algae : p : 5, 6

Class - Ophiuroidea (cont.)

ophiuroid, unid. juv. (I)

30: S : 1 : 9, 17

Phylum CHORDATA

Subphylum - Urochordata (sea squirts)

<u>Clavelina</u> <u>huntsmani</u>

20: R : p : 10

<u>Euherdmania</u> <u>claviformis</u>

20 - 40: R : p : 9, 10

<u>Metandrocarpa</u> <u>taylori</u>

20 - 100: R : p : 2, 6, 8, 9, 10

<u>Trididemnum</u> <u>opacum</u>

20 - 100: R and algae: p : 1, 2, 4, 6, 8, 9, 14

Subphylum - Cephalochordata (lancelets)

<u>Branchiostoma</u> <u>californiense</u>

80: S : 1 : 7

APPENDIX 3c

FISHES

LIST OF FISHES RECORDED FROM SANTA CATALINA ISLAND ASBS

BY THE

CATALINA MARINE SCIENCE CENTER

Family, scientific and common names, and format after Miller and Lea (1972)

* = species also noted at ASBS Study Sites and treated in following section

Heterodontidae

* *Heterodontus francisci* — horn shark

Squalidae

Squalus acanthias — spiny dogfish

Squatinidae

* *Squatina californica* — pacific angel shark

Scyliorhinidae

Cephaloscyllium ventriosum — swell shark

Carcharhinidae

Triakis semifasciata — leopard shark

Mustelus californicus — gray smoothhound

Mustelus henlei — brown smoothhound

Prionace glauca — blue shark

Torpedinidae

Torpedo californica — pacific electric ray

Platyrhinidae

**Platyrhinoidis triseriata* — thornback

Rhinobatidae

* *Rhinobatos productus* — shovelnose guitarfish

Myliobatididae

* *Myliobatis californica* — bat ray

Dasyatididae

Urolophus halleri — round stingray

Chimaeridae	
Hydrolagus colliei	ratfish
Muraenidae	
* *Gymnothorax mordax*	California moray
Engraulididae	
Engraulis mordax	northern anchovy
Batrachoididae	
Porichthys notatus	plainfin midshipman
Gobiesocidae	
Gobiesox rhessodon	California clingfish
Gobiesox maeandricus	northern clingfish
Rimicola muscarum	kelp clingfish
Exocoetidae	
Cypselurus californicus	California flyingfish
Atherinidae	
Leuresthes tenuis	California grunion
* *Atherinops affinis*	topsmelt
Antennariidae	
Antennarius avalonis	roughjaw frogfish
Syngnathidae	
* *Syngnathus californiensis*	kelp pipefish
Syngnathus leptorhynchus	bay pipefish
Scorpaenidae	
* *Scorpaena guttata*	sculpin or spotted scorpionfish
Sebastes dallii	calico rockfish
* *Sebastes serriceps*	treefish
* *Sebastes rastrelliger*	grass rockfish
* *Sebastes atrovirens*	kelp rockfish
Sebastes mystinus	blue rockfish

Scorpaenidae (cont.)

Sebastes hopkinsi	squarespot rockfish
* *Sebastes serranoides*	olive rockfish
Sebastes constellatus	starry rockfish
Sebastes rosaceus	rosy rockfish
Sebastes umbrosus	honeycomb rockfish
Sebastes rubrivinctus	flag rockfish
Sebastes paucispinus	bocaccio

Zaniolepididae

Zaniolepis frenata	shortspine combfish

Hexagrammidae

* *Oxylebius pictus*	painted greenling
Ophiodon elongatus	lingcod

Cottidae

Scorpaenichthys marmoratus	cabezon
Icelinus filamentosum	threadfin sculpin
Orthonopias triacis	snubnose sculpin
Artedius corallinus	coralline sculpin
Artedius creaseri	roughcheek sculpin
Leiocottus hirundo	lavender sculpin
Clinocottus analis	wooly sculpin

Serranidae

Stereolepis gigas	giant sea bass
* *Paralabrax clathratus*	kelp bass
Paralabrax maculatofasciatus	spotted sand bass
Paralabrax nebulifer	barred sand bass

Branchiostegidae

* *Caulolatilus princeps*	ocean whitefish

Carangidae	
Trachurus symmetricus	jack mackerel
Seriola dorsalis	yellowtail
Pristipomatidae	
Xenistius californiensis	salema
* *Anisotremus davidsoni*	sargo
Sciaenidae	
Seriphus politus	queenfish
Cynoscion nobilis	while seabass
Umbrina roncador	yellowfin croaker
* *Cheilotrema saturnum*	black croaker
Girellidae	
* *Girella nigricans*	opaleye
Kyphosidae	
Hermosilla azurea	zebraperch
Scorpididae	
* *Medialuna californiensis*	halfmoon
Chaetodontidae	
Chaetodon falcifer	scythemarked butterflyfish
Embiot· idae	
* *Rhacochilus toxotes*	rubberlip surfperch
* *Embiotoca jacksoni*	black surfperch
Hyperprosopon argenteum	walleye surfperch
* *Cymatogaster aggregata*	shiner surfperch
* *Brachyistius frenatus*	kelp surfperch
Micrometrus minimus	dwarf surfperch
* *Damalichthys vacca*	pile surfperch
* *Phanerodon furcatus*	white surfperch

Embiotocidae (cont.)

Phanerodon atripes	sharpnose surfperch
* Embiotoca lateralis	striped surfperch

Pomacentridae

* Hypsypops rubicundus	garibaldi
* Chromis punctipinnis	blacksmith

Sphyraenidae

Sphyraena argentea	California barracuda

Labridae

* Pimelometopon pulchrum	California sheephead
* Oxyjulis californica	senorita
* Halichoeres semicinctus	rock wrasse

Bathymasteridae

Rathbunella hypoplecta	smooth ronquil

Blenniidae

Hypsoblennius gilberti	rockpool blenny
Hypsoblennius jenkinsi	mussel blenny

Clinidae

Paraclinus integripinnis	reef finspot
* Alloclinus holderi	island kelpfish
* Heterostichus rostratus	giant kelpfish
Gibbonsia metzi	striped kelpfish
* Gibbonsia elegans	spotted kelpfish
Gibbonsia erythra	scarlet kelpfish

Pholididae

Ulvicola sanctaerosae	kelp gunnel

Gobiidae

* Coryphopterus nicholsii	blackeye goby
* Lythrypnus dalli	bluebanded goby
* Lythrypnus zebra	zebra goby

Gobiidae (cont.)	
Typhlogobius californiensis	blind goby
Clevelandia ios	arrow goby
Scombridae	
Scomber japonicus	pacific mackerel
Bothidae	
Paralichthys californicus	California halibut
Xystreurys liolepis	fantail sole
Hippoglossina stomata	bigmouth sole
Citharichthys stigmaeus	speckled sanddab
Pleuronectidae	
* *Pleuronichthys ritteri*	spotted turbot
* *Pleuronichthys coenosus*	C-O turbot
Microstomus pacificus	Dover sole
Molidae	
* Mola mola	common mola

FISHES RECORDED AT ASBS STUDY SITES

Alloclinus holderi

* 20 - 60: R : p : 2,6,9

Anisotremus davidsoni

20 - 100: P : p : 2,6

Atherinops affinis

Surface, 20 - 80: P : p : 1,2,4,7,8,9,11

Brachyistius frenatus

20 - 100: K : p : 6,8,9,10

Caulolatilus princeps

80: P : p : 7

Cheilotrema saturnum

20: P : p : 3

Chromis punctipinnis

20 - 100: K, R, S : c , p : 1,2,4 - 11, 13,14,18

Coryphopterus nicholsii

20 - 100: R, S : c - a : 2,6 - 10, 18

Cymatogaster aggregata

i - 40: K : p : 8,9

Damalichthys vacca

20 - 60: K, R : c, p : 8 - 10, 13, 14

Embiotoca jacksoni

20 - 60: K, R : r, c, p : 1,2, 4 - 10, 13,14

Embiotoca lateralis

20 - 40: K : p : 4

Gibbonsia elegans

20 - 60: R, S : c : 18

Gibbonsia montereyensis

20 - 60: R : p : 8,9

Gibbonsia sp.

i - 40: R : r, p : 1,2,4,5,9

Girella nigricans

i - 60: K, R, S : r, c, p : 1,2, 4 - 10, 13,14,18

Gymnothorax mordax

20 - 100: R : r, c, p : 1, 6 - 9, 18

Halichoeres semicinctus

20 - 40: R, S : c, p : 2,5,6,9 - 11, 13,14,18

Heterodontus francisci

i - 40, 140: R, M : p : 2,4, 7 - 10

Heterostichus rostratus

i - 40: K : p : 3,5,6,8,9
noted mating at #3

Hippoglossina stomata

140: M : 2 : 10

Hypsypops rubicundus

20 - 100: K, R : r, c, p : 1,2, 4 - 11, 18

Lythrypnus dalli

20 - 100: R : c, p : 6 - 11, 18

Lythrypnus zebra

20 - 40: R : a, p : 9, 10

Medialuna californiensis

20 - 100: P : r, c, p : 1.2, 4 - 9, 11, 18

Mola mola

40 - 100: P : p : 6

Myliobatis californica

i 80: S : p : 4

Oxyjulis californica

20 - 100: P, R, S: c, p : 1,2, 4 - 11, 13,14,18

Oxylebius pictus

i - 40: R : p : 5,7,8,10,11

Paralabrax clathratus

20 - 100: K, R, S : r, c, p : 1,2,4, 6 - 15, 18

Phanerodon furcatus

20 - 40: K : p : 9

Pimelometopon pulchrum

20 - 100: P, R, S : c, p : 1,2, 4 - 14, 18

Platyrhinoidis triseriata

140: M : p : 10

Pleuronichthys coenosus

30 - 80: S : p : 4, 13, 14

Pleuronichthys ritteri

140: M : 2 : 10

Rhacochilus toxotes

20 - 40: P, R, S : c : 18

Rhinobatos productus

60 - 80: S : p : 4

Scorpaena guttata

i - 60: R : p : 2,8,9

Sebastes atrovirens

20 - 100: K, R : p : 2,6, 10, 11

Sebastes rastrelliger

20 - 40: R : p : 8,9

Sebastes serranoides

20 - 100: R : p : 6, 9

Sebastes serriceps

i - 100: R : p : 6,8, 10

Squatina _californica_

80, 140: M, S : r, c : 1, 10

Syngnathus _californiensis_

Surface: K : p : 8

* symbols and sequences used in the "ecological formula" are detailed in the introductory remarks preceding the Master Species List.

APPENDIX 3d

SEA BIRDS

LIST OF SEA BIRDS KNOWN TO OCCUR IN ASBS

Order CHARADRIIFORMES

Brachyramphus hypoleucus	Xantus murrelet
Larus californicus	California gull
Larus heermanni	Heermann's gull
Larus occidentalis	Western gull
Sterna maxima	Royal tern

Order PELECANIFORMES

Pelecanus occidentalis	Brown pelican
Phalacrocorax auritus	Double-crested cormorant
Phalacrocorax penicillatus	Brant's cormorant

APPENDIX 3e

MARINE MAMMALS

MARINE MAMMALS OBSERVED DURING ASBS SITE SURVEYS

Order PINNIPEDIA

Family Otariidae (eared seals)

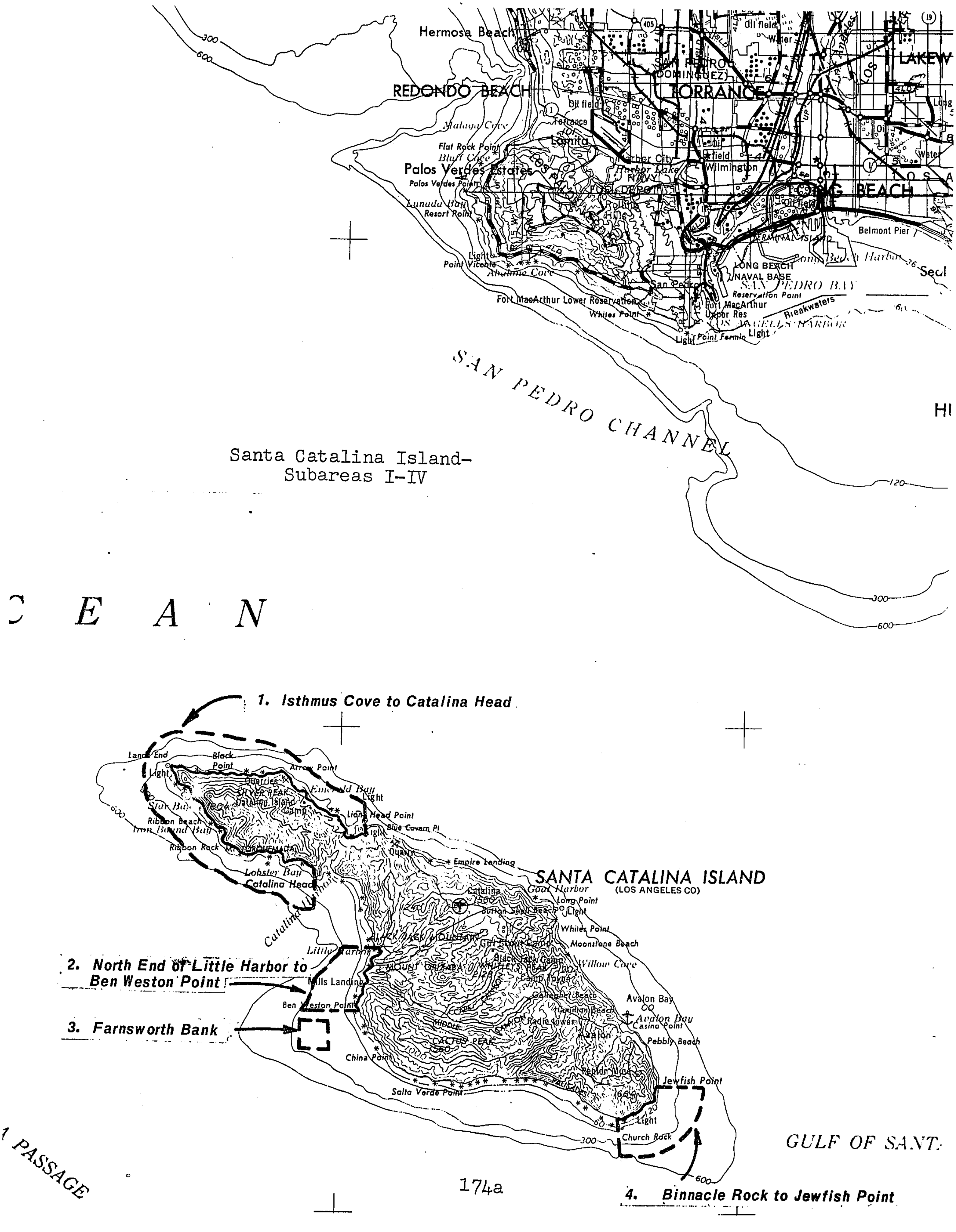
Zalophus californianus (California sea lion)

Family Phocidae (earless seals)

Phoca vitulina (Harbor seal)

Both species were seen at Site #6 (Mola Mola Cove), and Site #7 (Starlight Reef), in October, 1977.

The following ASBS summary reports on Santa Catalina Island - Subareas II, III and IV were originally prepared by Kathleen Cassow of the California Department of Fish and Game working under contract to the State Water Resources Control Board. The reports are intended to provide a brief overview of the respective ASBS by summarizing existing information. More detailed Reconnaissance Survey Reports may be prepared for these areas later and will be announed accordingly.



Santa Catalina Island-
Subareas I-IV

SUMMARY REPORT

SANTA CATALINA ISLAND-SUBAREA TWO
(NORTH END OF LITTLE HARBOR TO BEN WESTON POINT)

AREA OF SPECIAL BIOLOGICAL SIGNIFICANCE

CONCLUSIONS

The biology of the area is poorly known. Since Catalina Island is frequently used as a non-polluted site for purposes of comparison with the Southern California mainland, a future study of the area may be warranted.

INTRODUCTION

Santa Catalina Island-Subarea II was designated for its diversity of habitats, which include rocky headlands, exposed and semi-exposed pocket beaches and a submarine canyon.

PHYSICAL AND CHEMICAL DESCRIPTION

Santa Catalina Island-Subarea II is located on the south (windward) side of the island at the approximate coordinates 33°22'N. LAT, 118°29'30"W. LONG. It is four miles by boat from the Catalina Harbor, the only all weather harbor on the windward side. The ASBS includes approximately six miles of coastline from the north end of Little Harbor to Ben Weston Point. The seaward boundary follows the 300 foot isobath or a line one nautical mile offshore, whichever is more distant. Total water area is 836 hectares.

The offical boundary description for this subarea is as follows:

> From Point 1 determined by the intersection of the mean high tide line and a line extending due south from USGS Triangulation Station "White Bluff"; thence due west to the 300-foot isobath or to one nautical mile offshore, whichever distance is greater; thence southerly on a meander line following the 300-foot isobath or maintaining a distance of one nautical mile offshore, whichever distance offshore is greater, to a point due west of USGS Triangulation Station "Slip" on Ben Weston Point;

thence due east to the intersection of the mean high tide line and a line extending due west from USGS Triangulation Station "Slip"; thence northerly following the mean high tide line to Point 1.

Wind patterns in Southern California are highly variable. Summer is marked by gentle westerly winds increasing in intensity in the afternoon and decreasing in the evening. Fall winds are minor except for the hot, dry, Santa Ana winds which blow from the mainland. Storms in the fall and winter come from the southeast. Southeast winter storms are generally followed by clearing conditions and westerly and occasional Santa Ana winds. Spring brings violent storms with westerly winds which may last several days. (Fay, 1973).

During spring and summer the California Current brings northern Pacific water south past the Channel Islands towards Mexico. In late summer, surface temperatures are at a maximum, and a marked thermocline exists. At this time, a gyre is set up and water passes inshore to San Diego where it swings northwest toward Point Conception and may join the Davidson Countercurrent flowing northward along the coast.

In fall, surface waters cool and wind mixing breaks down the thermocline. In spring, surface waters are driven offshore by storms, and upwelling of cool nutrient rich waters occurs at this time. These cool surface waters also cause fogs which tend to occur in April, May, and June. (Fay, 1973).

Mean monthly temperatures (1950-1959) recorded in CALCOFI sample area 90.37 southeast of Catalina Island were lowest in February (14.10°C) and highest in September (19.87°C). (Dykzeul and Given, 1978).

The intertidal area of the ASBS include several types of habitats. Wide sandy beaches occur in four main areas including Little Harbor, Cottonwood, and Ben Weston Beach, where picnic or campground facilities have been built. Within the rocky point extensions, tidepools and surge channels are exposed at low tides. In other areas, steep cliffs and talus slopes of rubble and boulders plunge directly into the sea.

The cliffs and talus slopes continue into the subtidal. Typically the rock reefs continue to depths of 20 to 50 feet (6-15m) to a sand bottom base. The subtidal rock habitats here include surge channels, crevices, ledges, and caves. Sand bottom habitat is also found at the center of the cove at Little Habor, and mixed sand and rock also occurs in the center of other coves.

The ASBS is openly exposed to westerly winds and swell. With the exception of the protected northern end of Little Harbor, the coast of the ASBS is continuously beaten by the surf. A strong nearshore current runs along the southern portion of the area near Ben Weston Point.

BIOLOGICAL DESCRIPTION

Kelp occurs along the ASBS primarily in depths between 30 and 60 feet (9-18m). The windward side of the island, which includes the ASBS, tends to be less heavily exploited by divers and sportfisherman than the leeward side. As a result, abalone and fish are not so severely depleted here. Fulton and Gordon (1975) mention yellowtail, Seriola dorsalis, and opaleye, Girella nigricans, as occurring at Sentinel Rocks, a point south of Little Harbor.

The intertidal was surveyed at Little Harbor by Given and Lees (1967), and his species list appears in Appendix 1. A common and important species here is surf grass, Phyllospadix spp., which is found in the low intertidal and shallow subtidal. Jack Engle (CMSC, pers. comm.) has found that surf grass beds serve as nursery grounds for juvenile lobster. At San Clemente Island, surf grass beds were found to be sensitive to sewage pollution and were severely reduced around a small domestic outfall (Littler and Murray, 1975). Grunion, Leuresthes tenuis, spawn on the sandy beaches of the ASBS.

LAND AND WATER USE

The extent of kelp harvesting and commercial and sport fishing in the ASBS is not known but is assumed low because of the distance from the mainland to the windward side of the island.

There is no agribusiness or silviculture within one mile of the ASBS. However, feral goats (5,000 to 10,000) roam the island and are a local source of erosion. Two approaches to Los Angeles Harbor pass Catalina Island but are distant to the ASBS, and their potential effect is unknown (Dykzeul and Given, 1978).

The primary use of this area is recreational. A campground which receives heavy use in the summer is located at Little Harbor. Little Harbor provides a good overnight anchorage and many boats use the harbor in the summer. Pit toilets are used at the Little Harbor campground and at Ben Weston Beach. The number of campers here is controlled, and reservations are required.

ACTUAL OR POTENTIAL POLLUTION THREATS

Increased usage by campers, picnickers and boaters at Little Harbor and Ben Weston Beach detracts from the unspoiled appearance of the area. The ASBS does not appear threatened by pollution.

APPENDIX 1

Species list from the intertidal area at
Little Harbor (Given & Lees, 1967)

High Intertidal (mostly in crevices and pools)

- *Chthamalus* sp.
- *Littorina planaxis*
- *Hormomga*(sic) *adamsiana*
- *Pachygrapsus crassipes*
- Spionid polychaetes
- Chitons
- *Tegula* spp.
- (not much conspicuous algae)

Mid Intertidal

- Coralline algae (mixed)
- *Anthopleura elegantissima* (abundant)

Collisella scabra
Chthamalus sp.

Sand-Rock ecotone

Some coralline algae
Codium sp.
Anthopleura sp.
Petrospongium rugosum
Hormomga(sic) sp.
Collisella scabra
Littorina planaxis
Littorina scutulata
Stenoplax sp.

Low Intertidal

Phyllospadix torreyi (extensive beds)
Codium sp.
Cystoseira sp.
Sargassum agardhianun (shallower than *S. palmeri*)
S. palmeri
Anthopleura xanthogrammica
Cirolana harfordi
Ligia occidentalis
Pagurus samuelis
Tetraclita sp.
Collisela scabra
Aplysia californica
Astraea sp.
Haliotis cracherodii
Octopus sp.
Stenoplax sp.
Tegula sp.
Purple urchins and tunicates

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SUMMARY REPORT

SANTA CATALINA ISLAND-SUBAREA THREE
FARNSWORTH BANKS ECOLOGICAL RESERVE

AREA OF SPECIAL BIOLOGICAL SIGNIFICANCE

CONCLUSIONS

The protection afforded the purple coral, Allopora californica, by ecological reserve and ASBS status of this area is justified considering the rarity and slow growth of this beautiful hydrocoral. Human collection of the coral appears to be the only current threat to the survival of this species. Therefore, the impact of increased diver usage of the area should be carefully monitored and the reserve status strictly enforced. Study of the life history and growth rates of, Allopora californica, at Farnsworth Bank should be encouraged.

INTRODUCTION

The Santa Catalina Island - Subarea III, Area of Special Biological Significance, encompasses the Farnsworth Bank Ecological Reserve. Designation of the area as an ASBS and Ecological Reserve was intended to provide special protection of the purple coral which inhabits the area.

PHYSICAL AND CHEMICAL DESCRIPTION

The Farnsworth Bank Ecological Reserve is located 1.6 miles southeast of Ben Weston Point, Catalina Island on a bearing of 240° true at approximately 33°20'40" N. LAT, 118°31' W. LONG. (Smith and Johnson, 1974). The bank occupies an area of about 26 acres (10.5 ha) approximately 575 yards long by 200 yards wide. The official boundary description for this area is as follows:

> "Waters within the Farnsworth Bank Ecological Reserve, which are located 1.6 nautical miles southwest of Ben Weston Point, Catalina Island, on a bearing of 240° true. The Bank is composed of sheer rocky pinnacles rising from the sandy ocean floor 250 feet deep to within 50 feet of the surface. The Bank occupies an area approximately 575 yards long by 200 yards wide."

Farnsworth Bank is a rocky pinnacle rising to within 50 feet of the surface from a sandy bottom at 150 to 160 feet (44-49 m) depth. It should be noted that the ASBS description (CSWRCB, 1976) appears to be in error in stating the base of the pinnacle is at 250 feet. (See Fulton and Gordon 1975, NOAA map 18746). Farnsworth Bank is eight miles (12.8 km) south of Catalina Harbor, the only all weather harbor on the windward (south) side of the island. It is approximately 22 miles by boat from the ASBS to the nearest town, Avalon, on the leeward (north) side of the island. From Avalon it is approximately 20 miles (32 km) to the Palos Verdes Peninsula.

Farnsworth Bank is the only ASBS which is completely submerged. As it is completely exposed to the typical west swell and westerly winds, the bank is subjected to strong current and surge.

Wind patterns in Southern California are highly variable. Summer is marked by gentle westerly winds increasing in intensity in the afternoon and decreasing in the evening. Fall winds are minor except for the hot, dry, Santa Ana winds from the mainland. Storms in the fall and winter are from the southeast and are usually followed by clearing conditions and westerly and occasionally Santa Ana winds. Spring brings violent storms, accompanied by westerly winds, which may last several days. (Fay, 1973).

During spring and summer the California Current brings northern Pacific water south past the Channel Islands towards Mexico. In late summer, surface temperatures are at a maximum and a marked thermocline exists. At this time, a gyre exists in the Southern California Bight whereby water is transported inshore southward to San Diego, then swings northwest towards Point Conception, where it may join the Davidson Countercurrent flowing northward along the coast.

In the fall, surface waters cool and wind induced mixing breaks down the thermocline. In the spring, surface waters are driven offshore by storms, and upwelling of cool nutrient rich waters occurs at this time. The cooler surface waters generate fog during the months of April, May, and June. (Fay, 1973).

Mean monthly sea surface temperatures (1950-1959) recorded in CALCOFI sample area 90.37 southeast of Catalina Island were lowest in February (14.10°C) and highest in September (19.87°C). (Dykzeul and Given, 1978).

The subtidal area has numerous canyons, valleys and crevices. In addition, there are two pinnacles that rise from the sandy floor. One rises to about 50 feet below the water surface on the east side of the bank and a second rises to within 70 feet of the water surface on the west side.

BIOLOGICAL DESCRIPTION

The subtidal biota was surveyed by Wright (unpub.). The most noteworthily biological phenomonen occurring in the area is the purple coral, Allopora californica, growing in heads up to two feet in diameter. Though this species occurs occasionally elsewhere, heads this size have been documented only at Farnsworth.

The purple coral is of special interest because of its rarity and apparent fragility. Ostarello (1973) studied the life history, settlement, mortality and regeneration of the coral in Carmel Bay, California. She found the coral was relatively slow growing. One year after settling, colonies averaged 5 mm in size. Natural mortality was highest in young colonies and appeared to result primarily from competition for space with other faster growing organisms or sedimentation. Because this species cannot withstand sedimentation, it is found primarily on vertical walls in areas where surge and currents keep the rocks free of debris. However, the study was done in central California where oceanographic conditions and the size of the coral differs from conditions at Farnsworth Bank. It would be valuable to have similar information, particularily growth rates, at Farnsworth Bank, where the corals grow to such large size.

Sea palms and strawberry anemones, Corynactis californica, are typically found at the top of Farnsworth pinnacles. Bryozoans, including Diaporecia californica and Hippodiplosia insculpta, are more common on the sides of the pinnacles. Convictfish, Oxylebius pictus, are very common here. Large lobster, Panuluris interruptus, are found here and are taken by sport divers. Blue rockfish, Sebastes mystinus, otherwise uncommon at Catalina Island, are commonly found here (Smith and Gordon, 1975). One new species of sea star was discovered here. (Jack Engle, Catalina Marine Science Center, pers. comm.).

LAND AND WATER USE

The regulations pertaining to Farnsworth Bank Ecological Reserve allow harvesting of plants, all sport and commercial fishing activities, including SCUBA diving, spearfishing, swimming, and boating. However, the purple coral and geological specimens cannot be collected.

Although Farnsworth Bank is growing in popularity as a diving area, the long distance from the mainland, rough and unpredictable weather, and depths of the pinnacle limit the number of divers which visit the area. Because of the depths involved, safe bottom time is extremely limited. Despite these limits, many divers make the 3-5 hour round trip boat ride from the mainland to see this remarkable area.

ACTUAL OR POTENTIAL POLLUTION THREAT

As no agrigibusiness, silviculture, or municipalities occur near the ASBS, there is no evident threat from these sources. Catalina Island lies between the two freighter approaches to Los Angeles harbor. However, these approaches are distant from the island and no documentation is available as to their effect (Dykzeul, 1978).

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A two year (1972-1973) diving survey of Farnsworth Bank. Includes a description of substrate, flora and fauna, including species list, topographic map of the reefs and some (poor quality) movie footage.

SUMMARY REPORT

SANTA CATALINA ISLAND-SUBAREA FOUR
BINNACLE ROCK TO JEWFISH POINT

AREA OF SPECIAL BIOLOGICAL SIGNIFICANCE

CONCLUSIONS

Little is known about the biology of this area. Further study of the ASBS may be warranted in view of the value of the unspoiled and unpolluted Catalina Island as a control station for comparison with the highly stressed biota of the neighboring Los Angeles County Coast.

INTRODUCTION

The east end of Santa Catalina Island was designated an Area of Special Biological Significance because it represented the warmest water region of the Channel Islands. The physical and biological conditions present a marked contrast to the rest of the Channel Islands.

PHYSICAL AND CHEMICAL DESCRIPTION

The ASBS extends from Jewfish Point to Binnacle Rock on the east end of Santa Catalina Island. Its seaward boundary follows the 300 foot isobath or a line one nautical mile offshore, whichever is more distant. Approximate coordinates of the center of the area are 33°18'30" N. LAT and 118°18' W. LONG. The shoreline is approximately seven miles long, and the total surface water area is about 2,260 acres (904 ha). The official boundary description for this area is as follows:

> "From Point 1 determined by the intersection of the mean high tide line and a line extending due north from the highest point of Binnacle Rock; thence due south to a point one nautical mile offshore or to the 300-foot isobath, whichever distance is greater; thence easterly and northerly, maintaining a distance of one nautical mile or to the 300-foot isobath, whichever distance is greater, to a point due east of the easternmost extension of the mean high tide line at Jewfish Point; thence due west to the eastern most extension of the mean high tide line at Jewfish Point; thence southerly and westerly following the mean high tide line to Point 1."

It is approximately 5 miles (8 km) from Jewfish Point to Avalon, the nearest town. From Avalon, it is approximately 22 miles to the mainland, depending on the destination point.

Wind patterns in Southern California are highly variable. Summer is marked by gentle westerly winds increasing in intensity in the afternoon and decreasing in the evening. Fall winds are minor except for the hot, dry, Santa Ana winds from the mainland. Storms in the fall and winter come from the southeast. A southeast winter storm is usually followed by clearing conditions, westerly, and occasional Santa Ana winds. Spring brings violent storms with westerly winds which may last several days. (Fay, 1973).

During spring and summer the California Current brings north Pacific water south past the Channel Islands towards Mexico. In late summer surface temperatures are at a maximum and a marked thermocline exists. At this time, a gyre is set up and water passes inshore to San Diego where it swings northwest toward Point Conception, where it may join the Davidson Countercurrent flowing northward along the coast.

In fall, surface waters cool and wind mixing breaks down the thermocline. In spring, surface waters are driven offshore by storms, and upwelling of cool, nutrient rich waters occurs at this time. These cool surface waters also cause fogs which tend to occur in April, May, and June. (Fay, 1973).

Mean monthly temperatures (1950-1959) recorded in CALCOFI sample area 90.37 southeast of Catalina Island were lowest in February (14.10°C) and highest in September (19.87°C). (Dykzeul and Given, 1978).

This area is characterized by steep, rocky cliffs. As a result, the intertidal area is generally limited in extent and is inaccessible; occasional pocket beaches are narrow and steeply sloping and consist of sand and gravel, with scattered rubble and boulders.

Subtidally, these cliffs and talus slopes continue and deep water occurs relatively close to shore. As a result, kelp beds generally form a narrow fringe around the island; however, a more extensive kelp bed exists between Binnacle Rock and the shoreline.

The ASBS is fully exposed to south swell. Binnancle and Church Rock are the most exposed; Jewfish Point is somewhat protected. This exposure plus the strong winds at the east end of the island make near-shore waters rough, and less frequently dived than other areas around the island.

BIOLOGICAL DESCRIPTION

The biology of this area is poorly known. One transect was qualitatively surveyed by Given (1967). The only mapping available for the area is from a fathometer tracing at Binnacle Rock, which showed the typically steep drop off to deep water.

LAND AND WATER USE

Dykzeul & Given (1978) report that although giant kelp, Macrocystis pyrifera, and Gelidium spp. are harvested in Southern California, their lower abundances and relative inaccessability around Santa Catalina have discouraged harvesting.

This area is infrequently dived due to the limited underwater visibility and the surge, swell and wind. However, Fulton and Gordon (1975) report that spear fishing can be good along this portion of the island. There are no municipalities, agribusiness or silvicultue within a mile of the ASBS. However, a large population of feral goats (estimated at 5,000 to 10,000) roam the island and contribute substantially to erosion by overgrazing.

Catalina Island lies between the two approches to Los Angeles Harbor. However, these approaches are distant and their potential to affect the ASBS is unknown (Dykzeul and Given, 1978).

ACTUAL OR POTENTIAL POLLUTION THREATS

The quarry near Jewfish Point is reported to result in local siltation and the blasting causes obvious coastline alteration. No other pollution threats are evident. The remoteness, lack of access, and relatively poor weather and diving conditions make an increase in the usage of this area unlikely.

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