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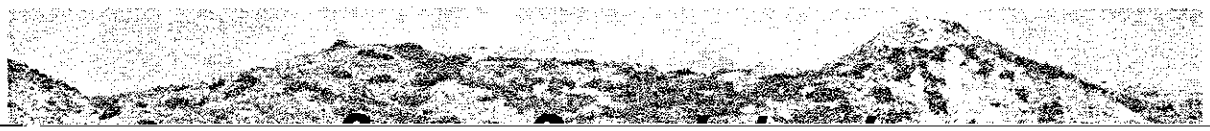
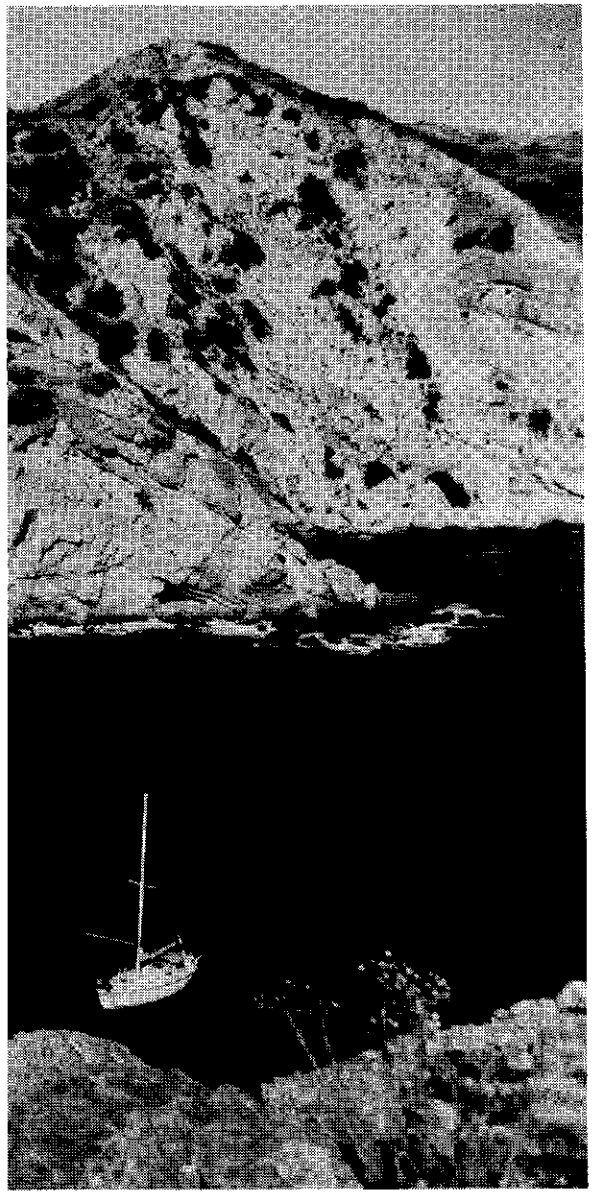
California Marine Waters

Areas of Special Biological Significance

Reconnaissance Survey Report





ificance

STATE WATER RESOURCES CONTROL BOARD

AREAS OF SPECIAL BIOLOGICAL SIGNIFICANCE

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

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

CALIFORNIA'S MARINE WATERS
AREAS OF SPECIAL BIOLOGICAL SIGNIFICANCE

RECONNAISSANCE SURVEY REPORT

SANTA CRUZ ISLAND
SANTA BARBARA COUNTY

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

APRIL, 1979
WATER QUALITY MONITORING REPORT NO. 79-8

ACKNOWLEDGEMENT

This State Water Resources Control Board Report is based on a reconnaissance survey report submitted by Dr. Bruce H. Robison of the Marine Science Institute, University of California, Santa Barbara. 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

The Santa Cruz Island Area of Special Biological Significance is bounded on the west, at Frazer Point, by longitude 119° 55' 44" W; on the east, at San Pedro Point, by 119° 31' 10" W; on the north, at West Point, by latitude 34° 04' 39" N; and on the south, at Bowen Point, by 33° 57' 33" N. The ASBS covers an area of 101,000 acres and is officially designated as:

> Waters surrounding Santa Cruz Island to a distance of one nautical mile offshore or to the 300 foot isobath whichever is the greater distance.

Port Hueneme is the nearest municipality to the ASBS and is approximately 19.2 miles from the eastern tip of Santa Cruz Island.

The California Current is the eastern boundary current of the North Pacific Gyre. Circulation in the Southern California borderland and continental shelf region is dominated by a large, counterclockwise coastal eddy. The effect of this large eddy is to recycle water originally derived from the California Current.

An interesting and significant feature of the oceanographic climate in the vicinity of Santa Cruz and Anacapa Islands is related to the wind patterns. Prevailing northwest winds dominate the Southern California region. The east-west orientation of the shore and the mountainous Channel Islands create a corridor which channels the wind patterns into a more easterly direction, resulting in a divergence over the center of the channel. This creates a wind drift of warmer surface waters towards the mainland coast and also towards the northerly edge of the Channel Islands, especially Santa Cruz. The divergence under these circumstances may oppositely affect temperature distributions on the southern (leeside) of Santa Cruz, although Anacapa Island seems to be surrounded by waters of higher temperature.

Surface seawater temperatures around the Islands generally range from 55° F (13° C) in winter to 65° F (18° C) in summer. Warmer temperatures occur on the southern, leeward, coasts and toward the mainland eastward.

Water quality within the ASBS is generally good because of the isolated location. However, oil and tar deposition from natural seeps and ship traffic is chronic. Primary productivity in the Santa Barbara Channel shows a peak bloom in the spring and a minor bloom in the summer.

Data on dominate fish, invertebrate, and algal species in the subtidal region were obtained from diving transects made at eight sites along the coast of the island. Some of the representative species of alga are: giant bladder kelp, Macrocystis pyrifera; Agarum fimbriatum; and Pterygophora californica. Representative species for fish and invertebrates are: sheephead, Pimelometopon pulchrum; black surfperch, Embiotoca jacksonii; terebellids, nudibranchs and the sea urchin, Anthopleura elegantissima.

The intertidal region is also diverse with species such as California mussel, Mytilus californianus, gooseneck barnacle, Pollicipes polymerous, turban snails, red algae, anemones and urchins. Also present in abundance are the black abalone, Haliotis cracherodii, the green abalone, H. fulgens, and sea lettuce, Ulva. At some locations around the island, the rocky intertidal zone is very rugged and receives considerable wave action. As a consequence, the intertidal biota is reduced to a few hardy species, such as Collisella and Littorina.

There are several unique components within the ASBS, as well as on the Island itself. Pelagic shrimp, Sergestes similis, occur in great abundance in the waters; the brown pelican, Pelicanus occidentalis californicus, has begun to re-occupy Santa Cruz Island; and the channel island fox, Urocyon littoralis, is found in abundance here.

The survey concludes that the greatest present destructive threat is oil pollution from offshore drilling platforms and vessel traffic. There is little predictive capability in estimating the effects of such pollution because of the scarcity of information on the area's current patterns.

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FINDINGS AND CONCLUSIONS

1. Santa Cruz Island is one of the finest remaining examples of Southern California's natural coastal environment.

2. Water quality in Santa Cruz Island ASBS appears to be generally well protected; however, offshore oil development and transportation may pose a major threat to the water quality and marine biota.

3. Purchase of Santa Cruz Island by the Nature Conservancy promises to provide even better long-term protection to the ASBS and landside area.

4. In order to assess and predict oil-related impacts to the ASBS, additional information is needed on the Island's marine biota and water movement as well as the overall effects of oil on marine biota.

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 of 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 Cruz Island ASBS, a reconnaissance survey integrating existing information and additional field study was performed by Dr. Bruce H. Robison of the University of California, Santa Barbara. 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 Cruz Island was one of four Santa Barbara Channel Islands desig-

ORGANIZATION OF SURVEY

Santa Cruz Island is the largest, most rugged and varied of Southern California's Channel Islands. The accessibility of representative study sites was a major factor in the present survey and must be a basic consideration in any future baseline and monitoring studies. Access to the Island is limited because of its distance offshore. It is accessible by boat but landing permits must be obtained in advance from the Santa Cruz Island Co. All shore-based research and survey activities are conducted through the field station operated by the Marine Science Institute at the University of California, Santa Barbara. The Island's rugged terrain and coastline make much of it inaccessible. Four-wheel-drive vehicles are necessary for land transportation to most parts of the Island. Small boats are necessary for access to those areas which cannot be reached by land.

In the present study, the eleven subregional areas were investigated by: beachwalks for adjacent land area, beach, and intertidal zone survey; SCUBA and free-diving surveys of the subtidal zone; and aerial surveys. Not all procedures were conducted in each area because of factors such as lack of a beach and because of weather and sea-state conditions. In addition to the field work, much information was obtained from discussions with researchers who are currently conducting programs at Santa Cruz. Because of the very large area covered in this survey, the Island has been divided into subregional watershed areas (Figure 1). Using detailed USGS topographical maps, major watershed areas were identified and outlined. The criteria for determining subregions and their associated watershed areas were:

1. subregions of roughly equal size.
2. shore areas representative of different combinations of microclimate, oceanic influences, terrestrial influences, and geomorphology.
3. convenience of access to each area for shoreline surveys and subtidal transects.
4. suitability as sites for future baseline and monitoring programs.

Tables 1 and 2 summarize the areal coverage and other salient features of each subregion. The nearshore components are circumscribed by boundaries drawn one mile out from major promontories, normal to the general coastline and connected by lines parallel to the general coastline (see Figure 1 and Appendix 1).

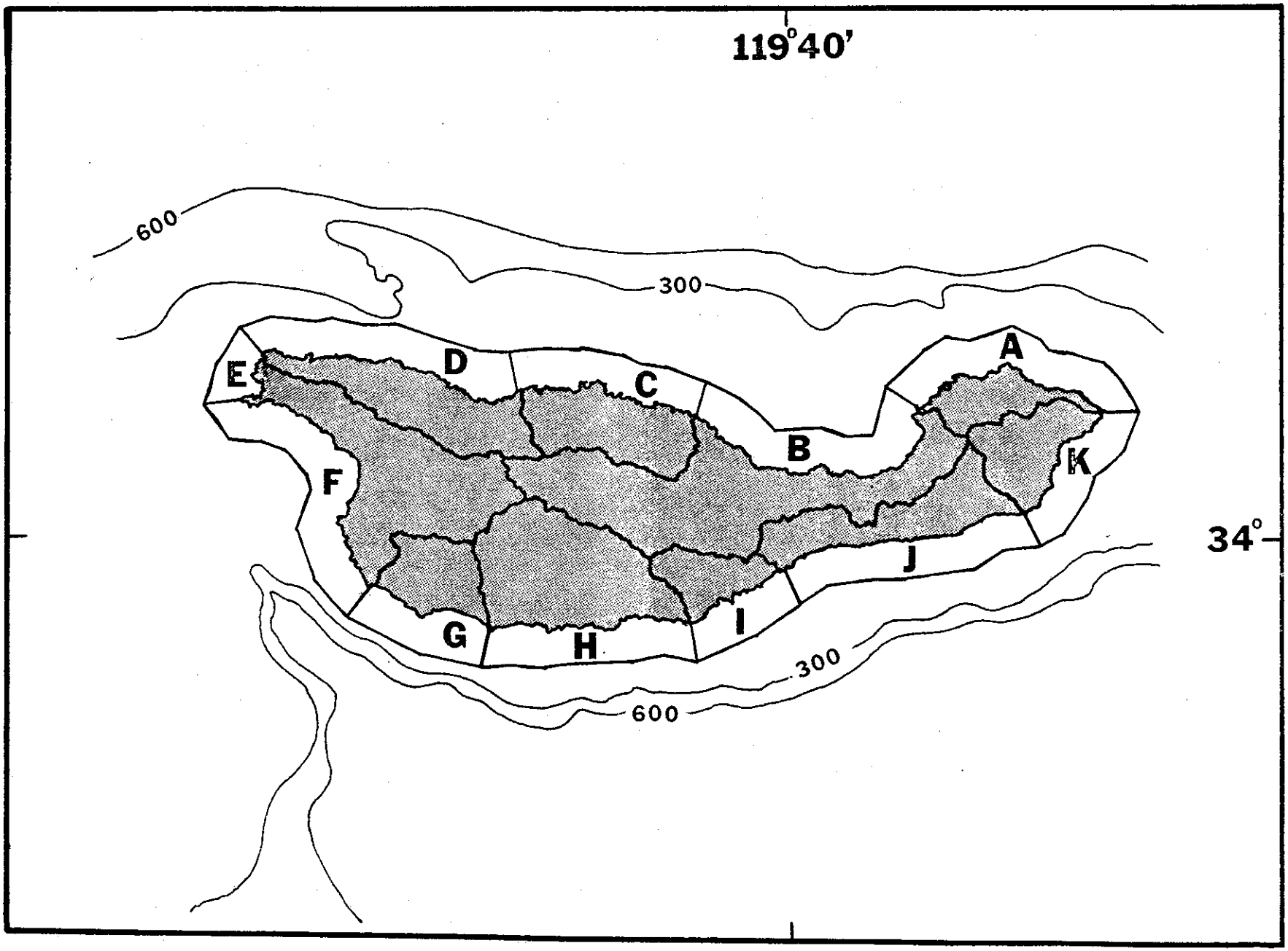

Figure 1. Subregional watershed areas.

Table 1. Proportions of watershed and nearshore areas (flat projection) of Santa Cruz Island.

Region	Regional Area(mi2)	Watershed Area Km^2	acres	Hectares	%	Nearshore Area Km^2	acres	Hectares	%	Ratio N/W
A	4.0	10.4	2569.8	1038.2	35	19.1	4719.6	1906.7	65	1.85
B	22.5	58.2	14381.2	5810.0	75	19.5	4818.5	1946.7	25	0.34
C	8.3	21.4	5287.9	2136.3	60	14.0	3459.4	1397.6	40	0.65
D	9.7	23.0	5683.3	2296.2	53	20.6	5090.3	2056.5	47	0.90
E-F	16.3	42.2	10427.6	4212.6	61	27.0	6671.7	2695.4	39	0.64
G	5.4	13.9	3434.7	1387.6	55	11.3	2792.2	1128.0	45	0.81
H	15.9	41.1	10155.8	4102.9	73	15.1	3731.2	1507.4	27	0.36
I	4.0	10.3	2545.1	1028.2	54	8.6	2125.1	858.5	46	0.85
J	8.2	21.2	5238.5	2116.4	54	18.1	4472.5	1806.9	46	0.85
K	5.6	14.6	3607.7	1457.5	57	11.2	2767.5	1118.1	43	0.76
TOTAL	99.9	256.3	63331.6	25585.9	63	164.5	40648.0	16421.8	37	$\bar{x}$=0.80

PHYSICAL AND CHEMICAL DESCRIPTION

Location and Size

Santa Cruz Island is bounded on the west, at Fraser Point, by longitude 119° 55' 44" W; to the east, at San Pedro Point, by 119° 31' 10" W; on the north, at West Point, by latitude 34° 04' 39" N; and to the south, at Bowen Point, by 33° 57' 33" N. Santa Cruz Island is 21 miles (33.6 km) long, 6 miles (9.6 km) at the widest point, and has a coastal perimeter of 69.6 miles (111.4 km).

The Santa Cruz Island ASBS covers an area of 101,000 acres (4,208 ha) and is officially designated as:

> Waters surrounding Santa Cruz Island to a distance of one nautical mile offshore or to the 300 foot isobath, whichever is the greatest distance.

The Island is part of Santa Barbara County and lies offshore: West Point, Prisoners Harbor, and San Pedro Point are 26.2, 26.6, and 27.3 statute miles (41.9, 42.5, and 43.6 km), respectively, from the City of Santa Barbara's breakwater; San Pedro Point lies 21.2 miles (33.9 km) to the southwest of the City of Ventura; San Pedro Point is 19.2 miles (30.7 km) west of the mouth of Port Hueneme Harbor, the nearest municipality (Figure 2).

San Miguel, Santa Rosa, Anacapa, and Santa Cruz Islands make up the Santa Barbara Channel Islands chain.

Nearshore Waters

Currents: The California Current is the eastern boundary current of the North Pacific Gyre; it bears cold subarctic water and flows southeasterly along the California coast, departing seaward at Point Conception because of the indentation of the Southern California coastline. Circulation in the Southern California borderland and continental shelf region is dominated by a large, counterclockwise coastal eddy. The effect of this large eddy is to recycle water originally derived from the California Current. This recirculated water is subject to coastal warming during its circuit encompassing the area off lower California. The eddy is driven by the entrainment of surface waters by the California Current as it deflects offshore. Northward flow within the Southern California Bight is seasonally enhanced by

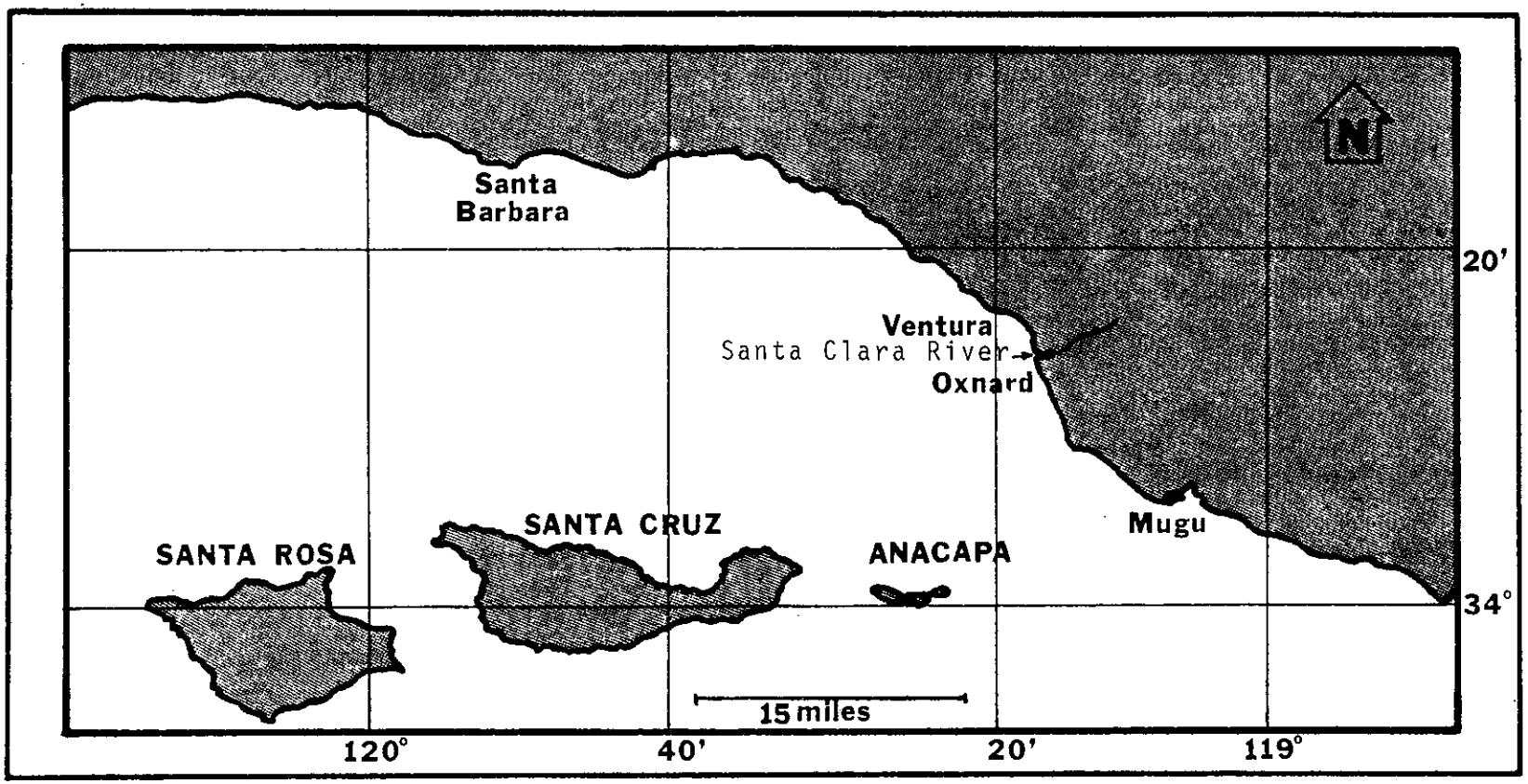

Figure 2. Location map of Santa Cruz Island.

the Davidson Current in winter. At depths below about 630 ft (191 m) equatorial water is carried north by the California undercurrent or countercurrent.

No comprehensive survey of the oceanographic climate of the nearshore waters of Santa Cruz Island is available, but a general picture can be gained from a synthesis of information from a variety of sources (Figure 3). Within the Santa Barbara Channel, there are consistent indications of a counterclockwise circulation, although the general pattern of surface circulation is variable, depending on wind direction and velocity. A weak, non-tidal flow sets east in the spring and summer and west in autumn and winter. California current water apparently enters from the west and flows easterly along the northern edge of Santa Cruz Island. Circulation is somewhat more complex in the vicinity of Anacapa Island, which is under the influence of both California Current water carried in from the west, as well as waters derived from coastal gyres to the south. Water passes through the gap between Anacapa in either direction, and this circulation is apparently strongly influenced by the set of tidal currents which average about one knot.

Little information is available for circulation of the nearshore waters of the southern fringe of Anacapa and Santa Cruz. There is no direct influence of California Current water in that region, and there is some indication

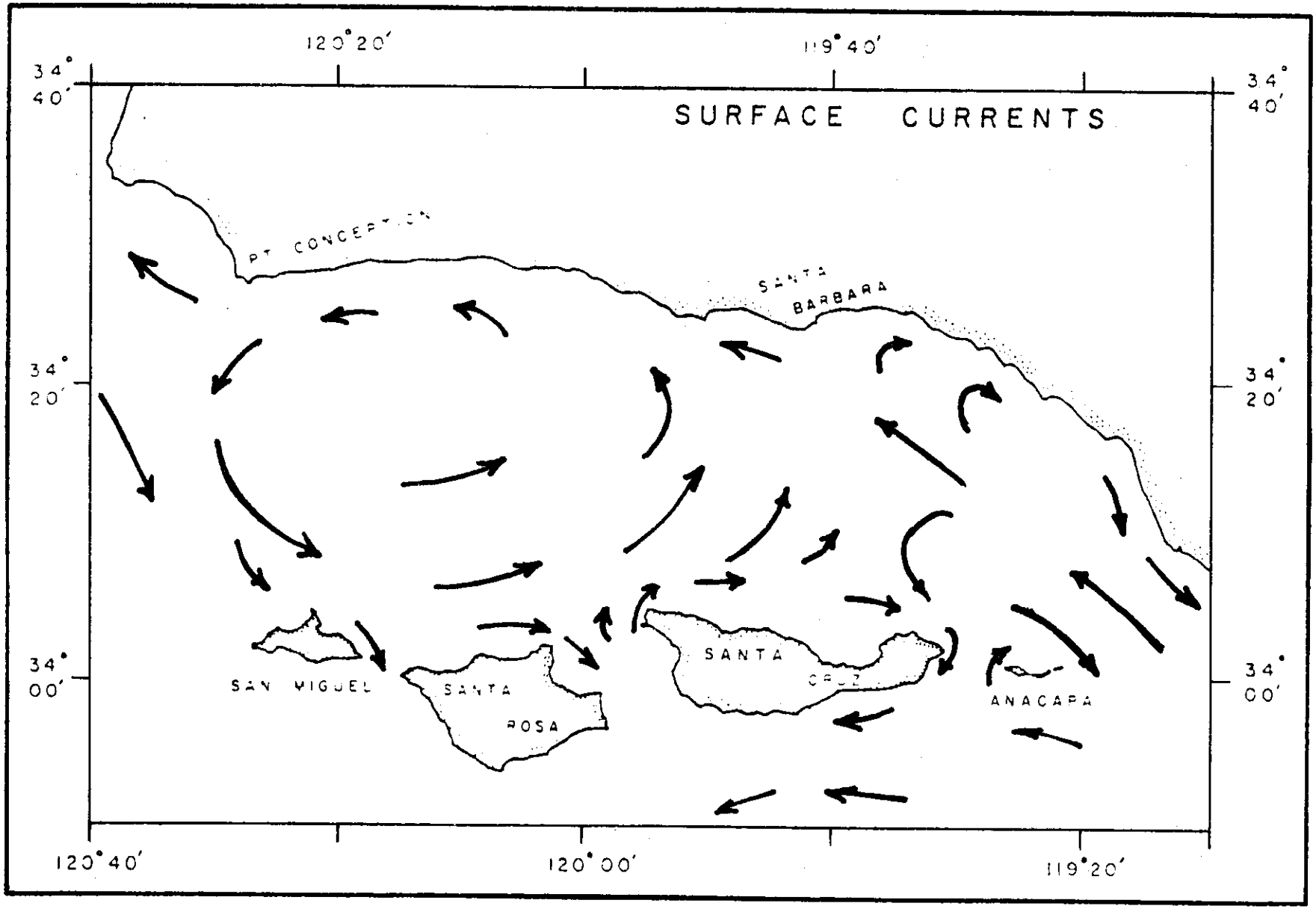

Figure 3. Surface currents around Santa Cruz Island.

Nearshore upwelling is a consistent feature along the south-facing mainland coast between Ventura and Point Conception. This upwelling is caused by the strong northwesterly winds which drive surface water offshore and bring cooler subsurface waters to the surface. Upwelling due to the same wind patterns is likely to occur along the southern coast of Santa Cruz Island where the extent of the shelf and water column temperature are similar to that of the mainland coast. The occurrence of upwelling is supported by qualitative observations of lesser water clarity and sporadic cooler water conditions on the Island's southern fringe. Unfortunately, no quantitative observations of sufficient frequency are available to document upwelling events there.

There are three apparent hydrographic seasons in the nearshore regions of the ASBS. January through April brings a wind-generated period of surface mixing; May through July is the cooler, upwelling period; and August through December is a period of stratification.

Water Column: The most extensive series of oceanographic observations which are relevant to interpretation of nearshore conditions in the ASBS study site were made between 1956 and 1960 by scientists at the University of Southern California's Allan Hancock Foundation, under sponsorship of the [then] California State Water Quality Control Board. These observations, published in 1965, extended from the mainland coast out to the 300-foot depth contour. While this zone does not encompass the nearshore waters of Santa Cruz Island, the information can be extrapolated in general terms to create an overall picture of oceanographic conditions in those waters, especially

erally range from 55° F (13° C) in winter to 65° F (18° C) in summer. Warmer temperatures occur on the southern, leeward coasts and toward the mainland eastward. In waters over the Santa Barbara Basin, surface warming and thermal stratification within the upper 250 ft (76 m) occur between June and November; mixing removes the thermocline and reduces the temperature of the water in this upper layer between January and March. South of the islands over the Santa Cruz Basin, the thermocline persists longer and the mixing period is restricted to February-March.

Salinity variations follow a similar pattern. Surface layers south of the Islands have a slightly higher salinity range (34 to 37 o/oo) than is found on the windward side (34 to 36 o/oo). Dissolved oxygen concentration is a function of mixing in the surface layers; in the Santa Cruz Basin, 60% air saturation is the lowest level usually found within the upper 250 ft (76 m); in the Santa Barbara Basin this layer may contain levels as low as 50%, and near the bottom, at 2000 ft (608 m), anoxic conditions occur.

Turbidity is a wind and current related factor and is generally higher on the north or windward side of the islands and higher downcurrent to the east. Localized turbidity is determined by wind, rain, waves, and shore type and thus is greatest off areas like Cristi Beach, Prisoners Harbor, Chinese Harbor, and Frenchy's Cove where the substrate and dynamic factors are most suited for particle suspensions. Interisland regions of the shelf are also areas of high turbidity. Larger scale turbidity patterns form downstream and thus are generally more common along the northern coasts of Santa Cruz and Anacapa. Turbidity along the southern coasts may flow westward when south winds or west gyral currents prevail.

Water quality around the Islands is generally good because of their isolated location. However, oil and tar pollution from natural seeps and ship traffic is chronic, particularly along the north coast. Primary productivity in the Santa Barbara Channel shows a peak bloom in the spring and a minor bloom in the summer. Overall, primary productivity is highest in the northeastern portion of the Channel. Upwelling along the Islands may lead to periods of locally high productivity.

Topographic and Geomorphic Characteristics

Submarine Topography: The northern tier of Southern California's Channel Islands, San Miguel, Santa Rosa, Santa Cruz, and Anacapa, comprise a

subsection of the mainland shelf that is surrounded by seafloor depths of at least 700 ft (212 m). West of the islands' shelf, off San Miguel and Santa Rosa, is the outer slope of the Southern California Bight, which grades into deep water. The northern edge of the island platform drops rather steeply into the Santa Barbara Basin (maximum depth about 2000 ft or 608 m), an elongate depression running north and west off the mainland coast between Ventura and Point Conception. The southeastern margin is bounded by the Santa Cruz Basin and the Santa Monica Basin.

The shelf along the northern coast of Santa Cruz Island falls sharply, in two stages, to the floor of the Santa Barbara Basin; within 0.75 mi (1.25 km) from shore the bottom depth reaches 165 ft (50 m), then flattens out in a 2.5 mi (4.0 km) wide ledge; it drops another 500 ft (152 m) to the basin floor within 4.25 mi (6.8 km) of the shoreline. The shelf on the southern side of the island is wider and extends deeper due to the slope of the Santa Cruz Basin: the 330 ft (100 m) isobath is 2.75 mi (4.4 km) from shore, at the upper edge of a steep drop to 800 ft (243 m) within 3 mi (4.8 km) from shore; at a distance of 5 mi (8.0 km) from the southern coast of the island, the depth is about 4000 ft (1216 m) and this grade continues downward to the bottom of the Santa Cruz Basin with a maximum depth of 6200 ft (1884 m).

Southwest of Santa Cruz Island is a deep water intrusion by the Santa Cruz Canyon. The canyon is at the head of the Santa Cruz Basin but while relatively deep water occurs off the coast between Kinton Point and Morse Point, the interisland shelf is not breached.

Benthic substrates in the nearshore area are mostly a mixture of relatively coarse sediments with substantial outcroppings of hard rock bottom. An exception is the silt and mud bottom off Chinese Harbor. Nearly all of the exposed hard bottom areas shallower than about 60 ft (18.2 m) support kelp forests, and reef locations can be determined by kelp bed surveys (Appendix 1).

Landside Geomorphology: The four Northern Channel Islands appear to be the tops of submerged mountains, most likely an extension of the coastal Santa Monica Range. The geomorphology of the region shows that it has had a history of vulcanism, uplift, and subsidence. This region is near the leading edge of the continental plate, and the area around Santa Cruz Island has a low to moderate level of seismic activity. The major fault in the area of Santa Cruz runs along the central valley. North of the fault are primarily volcanic Cenozoic rocks, while areas south of the fault are chiefly

Cenozoic sediments. Fault locations and seismic activity patterns are shown in Figure 4.

Santa Cruz has a coastline consisting largely of bluffs, cliffs, and steep rocky slopes. Wave action has formed the cliffs and has created a multitude of caves and clefts in them. Terraces have been formed in places by uplift. Sedimentation is generally most extensive on the northern and southern reaches of the shelf and is thickest to the north. Tidal flow and reversing currents flush the shallow interisland shelf areas, and sediments are generally more sparse with larger particle sizes.

Subtidal Geomorphology: Major reef locations and their extent are indicated in Appendix 1 by the dark areas representing kelp beds. Stands of giant kelp, *Macrocystis*, and other brown algae occupy nearly all of the Island's subtidal rocks. About 85% of the sediments in the Santa Barbara Basin, including the deep northern margin of Santa Cruz, originate as runoff from the Santa Clara River south of Point Conception. The remainder of the deep sediments are mostly a mixture of material of varied origin. Shallow shelf sediments are more directly influenced by the Islands themselves. South of the main Santa Cruz Island fault line, much of the exposed surface rock is sedimentary sandstone, and the subtidal sediments are often sandy with relatively small particle sizes. North of the fault line, fine sediments are more patchily distributed into shoreline pockets, and the substrate is more rocky because of the volcanic nature of the surface rock. Some site-specific details of subtidal substrate are given in the section entitled "Subtidal Biota".

Intertidal Geomorphology: For purposes of discussion, the intertidal area of Santa Cruz Island has been divided into eleven subregions, designated below as Areas A through K (Figure 1). Additional information to supplement the description that follows is presented in Table 2 and Appendix 1.

Area A - San Pedro Point to Coche Point. Most of the intertidal zone in this area is a narrow range of rocky cliff and bluff faces. Accumulations of cobble, gravel, and pebbles occur in pockets along the rocky wall. Intertidal boulders and rocky outcrops are common. The intertidal beach at Scorpion Cove consists primarily of small boulders and rocky cobble, backed and underlain by sand; on either side of the beach are steep rocky cliffs with boulders at their base. The small beach at Potato Harbor has a sandy pocket with many boulders and rocky cobble and is surrounded by steep rocky cliffs.

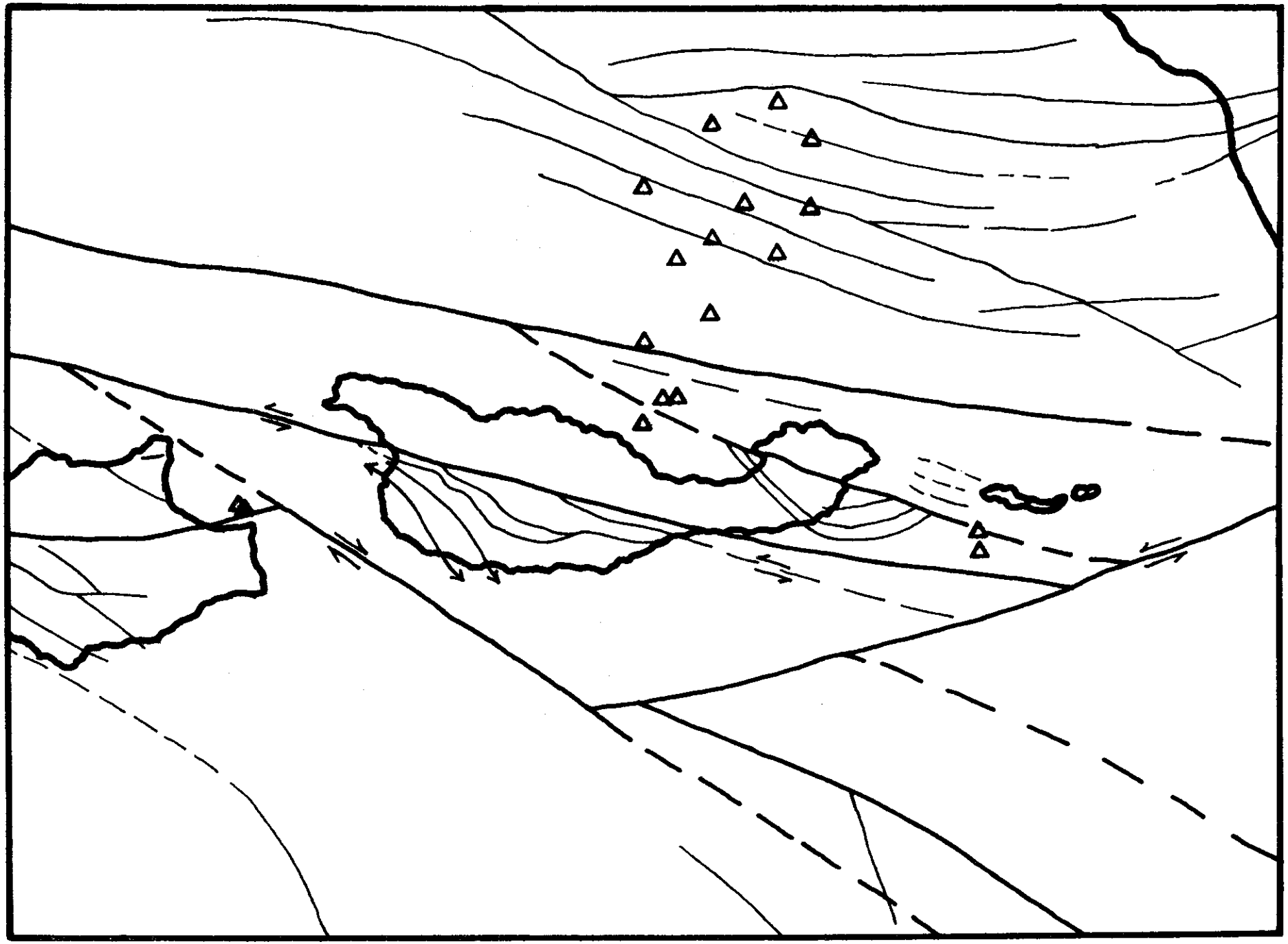

Figure 4. Fault lines and seismic loci (triangles); after Weaver, 1969.

Table 2. Proportions of sandy beach, cobble beach, cliff shore and sloping rocky shore, along the coastline of Santa Cruz Island.

Region	Sandy Beach km	Sandy Beach mi	Cobble Beach km	Cobble Beach mi	Cliff Shore km	Cliff Shore mi	Rocky Slope km	Rocky Slope mi	Total Shoreline km	Total Shoreline mi
A	0.4	0.2	0.5	0.3	10.7	6.6	0	0	11.6	7.1
%	3		4		92		0			
B	0	0	6.5	4.0	1.6	1.0	7.3	4.5	15.4	9.5
%	0		42		10		47			
C	0	0	1.0	0.6	11.7	7.3	0	0	12.7	7.9
%	0		8		92		0			
D	0	0	0	0	15.3	9.5	0	0	15.3	9.5
%	0		0		100		0			
E & F	4.8	3.0	0	0	2.7	1.7	9.9	6.1	17.4	10.8
%	28		0		15		57			
G	5.6	3.5	0	0	0	0	0.8	0.5	6.4	4.0
%	88		0		0		12			
H	2.4	1.5	0	0	6.2	3.9	1.5	0.9	10.1	6.3
%	24		0		61		15			
I	0.7	0.4	0	0	3.6	2.2	0	0	4.3	2.6
%	16		0		84		0			
J	0	0	0	0	12.2	7.6	0.1	0.1	12.3	7.7
%	0		0		99		1			
K	1.9	1.2	2.4	1.5	1.5	0.9	0.8	0.5	6.6	4.1
%	29		36		23		12			
TOTALS	15.8	9.8	10.4	6.4	65.5	40.7	20.4	12.6	112.1	69.7
%	14		9		53		18			

Area B - Coche Point to Twin Harbors. This part of the coastline acts as a scoop to the prevailing wind and current patterns; thus, its beaches are more gradual and contain many smaller sized substrate particles. Toward the western end of area B the intertidal zone resumes its rugged, rocky character. On the west of Chinese Harbor lies a steep, narrow, cobble beach with a great abundance of unbroken, "sublegal" sized abalone shells. A thick band of driftwood occupies the rear portion of the beach. There are no sand patches, but occasional small patches of tar are present. On the east, the narrow cobble beach is surmounted by immense piles of driftwood, and surf patterns are highest to the east and off the central shoreline promontory. At Prisoners Harbor, from the landing pier to the eastern promontory, there is cobble beach with sand and sand patches increasing in number to the east. In October, during the initial survey, there was a lagoon behind the beach, but after the heavy winter rains, streamflow had breached the beach and deposited a sand and silt delta beyond the cobble. This substrate grades to larger rocks and boulders at the rocky point where there are a few small tidepools. West of the pier is a short cobble and boulder beach, then sloping rock faces and boulders.

Area C - Twin Harbors to Arch Rock. This area is almost exclusively an interface between steep rocky cliffs and the sea. Boulders and offshore rock outcrops are common while sand and fine sediment beaches occur only in the narrow recessed clefts of several small harbors. This part of the shoreline is swept by strong prevailing winds and currents. Fry's Harbor is a small recession in the lee of Diablo Point. The small curved beach is bounded on the east and west by boulders and rocky slopes, and sand predominates in the western central portion.

Area D - Arch Rock to West Point. Like area C, area D is composed primarily of vertical rock faces, with caves, arches, boulder piles and offshore rocky outcrops. Cueva Valdez and the nearest cove to the west appear to have the only small particle substrates in this area. At Cueva Valdez, the base of the cove and a small runoff area adjacent to it, have depositions of sand and silt from the runoff; these beaches also have a gravel and cobble component and are bounded on both sides by rocky points and shelves. No Name Cove is located to the west of Cueva Valdez. This small notch in the shoreline has a sandy and cobble beach on its western side and sheer rock walls on the east. The beach break is bordered by two large rock outcrops.

Area E - West Point to Fraser Point. This northwest facing shoreline grades from steep cliffs on the northern end to flatter, gradually sloping rock substrate at the neck and northern shore of Fraser Point. Wenner Cove and the adjacent pocket cove have the only sand beaches in Area E. The northern shore of Fraser Point has a small pocket cobble-beach just west of Wenner Cove while the remaining intertidal zone is low and rocky with several outlying rocks.

Area F - Fraser Point to Posa Point contains the largest and broadest sand beach on the Island. The broad arc of Cristi Beach faces into the northwest wind, and its intertidal zone is free of rocky outcroppings. South of Kinton Point are alternating rocky promontories and sandy cobble beaches. North of Cristi Beach is a low, rocky intertidal area and then sandy beaches at Forney and Little Forney Coves. The outer part of Fraser Point is low and rocky with many fissures and intertidal rocks. Forney Cove like Wenner Cove on the northern side of Fraser Point, has a beach that grades from sand to pebble to cobble and then to boulder substrates toward the point (Appendix 1). Intertidal rocky areas are extensive beyond the sand margin. Little Forney Cove, just north of Forney Cove, is cobbled. The northern rocky point at Cristi Beach has many tidepools and an expansive rock shelf. Tar patches are common and the sand beach has a very gradual slope and an extensive sweep of fine sand (Appendix 1). The southern headland has a boulder-strewn and cobble-piled intertidal zone with large rocks lying just offshore; tar deposition is much less here than at the northern headland.

Area G - The Posa Point to Punta Arena coastline forms a gentle "W" with Morse Point at its center and curving sand beaches along the arms. Rocky intertidal areas are restricted primarily to Posa, Morse, and Arena Points, where rock outcrops occur and rocky shelves form the substrate.

The beaches flanking Morse Point are long, wide sandy beaches with strong slopes and no rocks. The surf is strong and rolling. Driftwood accumulates on the upper beach. Gull Island, off Punta Arena, has a large exposed rocky intertidal area with flanking sandy areas.

Area H - Punta Arena to Bowen Point is an alternating sequence of broad, rounded rock promontories and narrow sand and rubble beaches. The rocky areas are layered, and shelves form at intertidal levels with numerous, tidepools in some areas. Willows Harbor is a heavy surf area with many tidepools and a rocky shelf at the base of the western headland. There is a sandy

pocket beach, which grades to pebble and cobble regions near the margins. No driftwood or tar patches are present here, and there is an extensive rocky area around the small islets off the cove's eastern point. The sand beach to the east is bisected by an earth slide, and large black boulders in the intertidal region mark its outer extent. This eastern beach has coarser sand and a steeper slope.

Area I - Bowen Point to Blue Banks area. The shoreline in this area is a continuing alternation of rocky layers and narrow sand beaches. Coches Prietos and Albert Anchorage flank a prominent rocky headland with intertidal boulders and cobbles. In most rocky areas along this portion, wave action has eroded the slope to form an intertidal rocky shelf with an overhanging ledge. Coches Prietos is a sandy crescent beach that is wide at its center and narrowing toward the outer edges. This beach has both a moderate slope and grain size. No driftwood or tar deposits were apparent on the beach.

Area J - Blue Banks to Sandstone Point. Sloping rocky bluffs and occasional sand beaches characterize this south facing portion of the coastline. At Valley Anchorage, the intertidal zone is high and rocky, etched from the bluff face with little accumulation of boulders or large rocks. The sandy beach to the east is narrow with a few offshore, intertidal rocks.

Area K - Sandstone Point to San Pedro Point. The southern portion of this area has a continuation of the alternating sandy and rocky intertidal zones with Smugglers Cove being the largest stretch of sandy beach. North of Smugglers Cove, the cliffs become steeper and the intertidal zone is narrower and rockier, more like the northern coast of the island. Smugglers Cove lies in the middle of area K. The western headland has a cobble and boulder beach above a rocky substrate, grading to cobbles and sand toward the center. The beach widens considerably at the center where a stream bed reaches the beach; all of the beach area is littered, including driftwood, and wreckage from at least six boats; tar patches are present but sparse, and are found primarily near the eastern headland. The eastern intertidal portion grades from sand and small cobble to cobbles and dirt at the shoulder of a soil bluff.

Landside Geomorphology: The following is a description of the landside Santa Cruz Island geomorphology presented by the subregion designations (Appendix 1).

Area A - Scorpion Harbor lies at the mouth of a wide, relatively shallow, east-west oriented canyon. A descending line of hills, which form the southern margin of the canyon, terminates in steep cliffs at the shore. The northern edge of the canyon is lower and the land above is more rolling. This is the main watershed of the area but the stream flows irregularly. Potato Harbor lies at the base of tall, steep slopes which form a bowl-shaped depression in the coastline, with steep sloping walls on two sides and a nearly vertical wall opposite them.

Area B - Chinese Harbor is fed by runoff from three canyons. The easternmost watershed is the largest, and the elevation behind the beach declines from northeast to southwest. There is a fumarole in the cliff on the western side of the runoff gorge at the eastern end of the beach. Prisoners Harbor lies at the mouth of a narrow valley with a stream along its eastern margin. Bluffs above the western end of the beach have relatively low and flat tops. On the east, the cliffs are steeper and the hills are much higher.

Area C - Frys Harbor has steep walls on two sides and a gently sloping rear portion that opens from a drainage canyon. Two lines of hills run parallel to the canyon, decreasing in height toward the shore. The ridge lines above Frys Beach form a rounded depression.

Area D - No Name Cove, west of Cueva Valdez, has a vertical rock face at its southeastern side and is fed by an angled canyon between high hills. The northwestern side has slightly less elevation but forms high rocky cliffs to seaward. This is a runoff area and two additional canyons feed into the one behind Cueva Valdez.

Area E - Wenner Cove is backed by the low, flat peninsula of Fraser Point which is part of a low plain below the ridge at West Point. This area is the northwestern extent of the central valley fringe and it receives little runoff.

Area F - Cristi Beach is at the mouth of the Island's large central valley. A stream bed meets the beach near its center, and while it is seasonally dry, it represents the island's main drainage channel during rainy periods. The central vally marks the Island's major fault line, and it separates the northern volcanic rocks from the southern sedimentary rocks. The sandstone bluffs at the southern end of Cristi Beach are fossiliferous with exposed shell middens and petrified vegetation.

Area G - Morse Point is flanked by coastal hills to the west and a more gradual slope to the inland ridge on the east. Runoff follows drainage can-

yons on both sides of the point but the eastern canyon is larger and more pronounced. Directly behind the two beaches are dry, sandy hillocks.

Area H - Willows Cove lies at the terminus of a broad canyon with a high ridge dropping to steep rock cliffs on the west and a lower sloping ridge to the east. Beyond the eastern cove margin is a lesser runoff canyon and a second ridge that has collapsed seaward across the beach.

Area I - Coches Prietos is bounded on the east and west by steep rocky headlands and to the north by a gently sloping drainage canyon. Several smaller canyons feed the main canyon, and this is the primary runoff channel west of the ridge which determines the cove's eastern margin.

Area J - Valley Anchorage lies at the foot of rocky hills and ridges. Ravines which carry local runoff are steep and narrow and do not descend to beach level. There is a single rounded promontory between two of the drainage channels, but all of the beach front is bordered by near-vertical cliffs, most of them descending from high ridges.

eral southeasterly direction. Clouds and fog associated with the marine layer increase the humidity and lower the temperature. Because of its offshore location, Santa Cruz Island generally has lower temperatures than the mainland, with more fog. Hot, dry Santa Ana winds occur during winter months when a high pressure area develops inland and blows warm air seaward, but their effect is diminished over the Island.

The prevailing regional wind flow pattern is from the northwest, but in the Santa Barbara Channel, the Islands and coastal mountain range act to funnel a major portion eastward. In the lee of the northwest winds, the mainland coast of the Channel and the southern coasts of Anacapa and Santa Cruz Islands receive occasional winds from the west and southwest (Figure 5). In the Channel, west winds blow nearly every afternoon, then decrease at sundown. In the winter, southeast storms occur which impact the islands' southern coasts; Anacapa and Santa Cruz are also subject to occasional northeasters. In strong northwest weather outside the Channel, the northern shores of the Islands experience a buildup of wind, waves, and swell. This belt of rough seas is known as Windy Lane and occupies a six-mile-wide belt along the Islands.

Rainfall on Santa Cruz Island is sparse, usually occurring in the winter along with dense fog that is more persistent than on the mainland coast. Santa Cruz is within the semi-humid maritime zone which receives more than 13 inches (33 cm) of rain a year. Due to the lack of fog, the driest time of year is in the spring although the least rainfall occurs during summer. Average annual rainfall, measured over 70 years at the Stanton Ranch in Santa Cruz Island's central valley, is about 20 in (50 cm) with yearly totals ranging from 6.5 in (17 cm) to 56.2 in (142 cm).

Air temperature is closely related surrounding sea temperatures. Coastal temperatures on Santa Cruz are strongly influenced by fog and wind. Coastal temperatures usually range between a low of 35° F (2° C) and an average high of 85° F (29° C). The central valley experiences frost and has an annual temperature range between 30° F (-1° C) and 90° F (32° C).

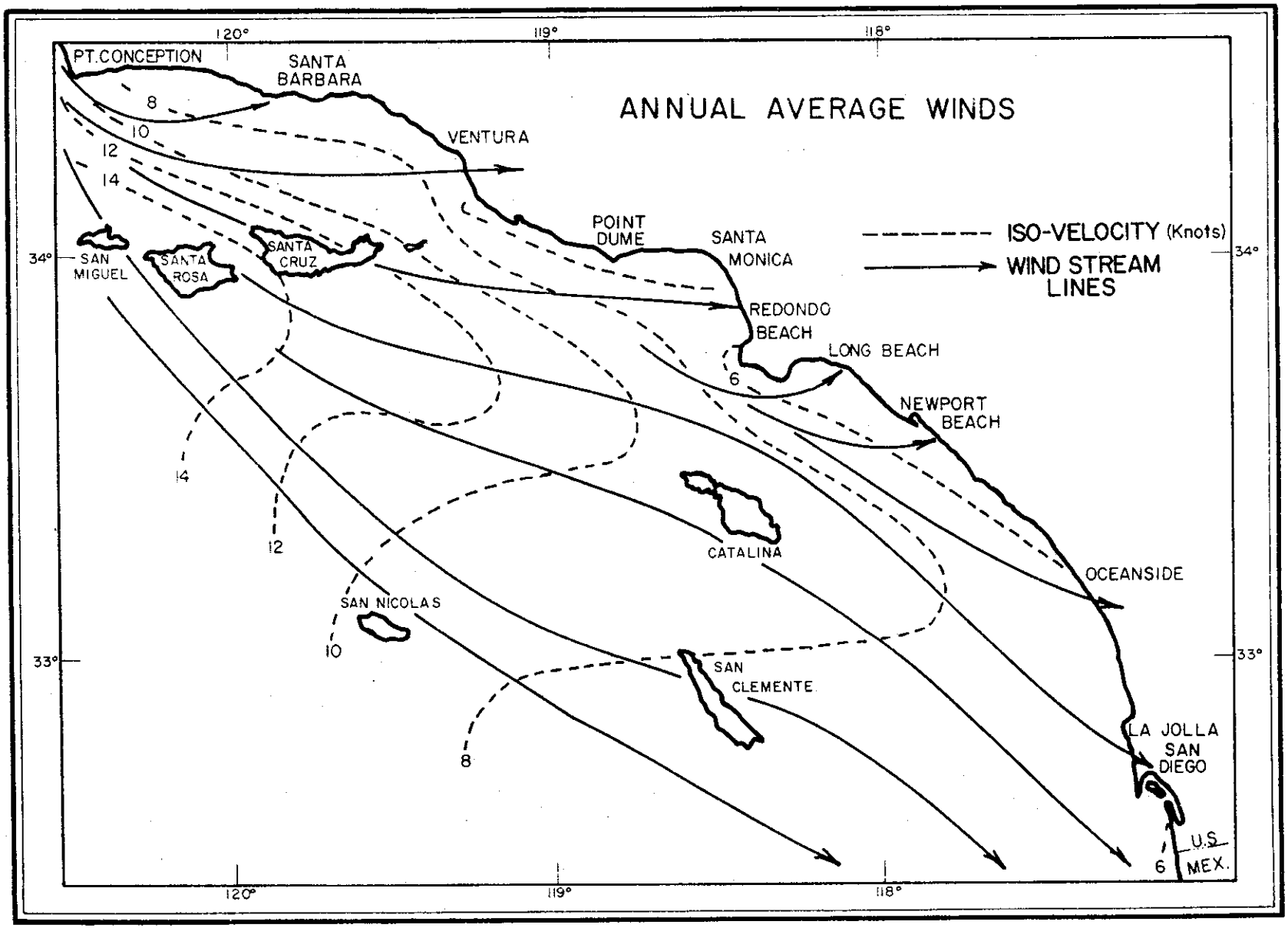

Figure 5. Wind patterns of the Channel Islands; Hancock Found.,1969.

BIOLOGICAL DESCRIPTION

Subtidal Biota

Appendix 3 contains the subtidal survey data from diving transects made at eight sites along the coast of the Island. Dominant fish and invertebrate species are listed and enumerated. The dominant subtidal algal species are listed below in order of their relative abundance at each site.

Prisoners Harbor - broad-bladed brown algae, *Laminaria farlowii*; giant bladder kelp, *Macrocystis pyrifera*; *Agarum fimbriatum*.

Frys Harbor - giant bladder kelp, *Agarum fimbriatum*; *Pterygophora californica*.

No Name Cove west of Cueva Valdez - giant bladder kelp, *Agarum fimbriatum*.

Wenner Cove - surf grass, *Phyllospadix scouleri*; feather boa kelp, *Egregia laevigata*; *Eisenia arborea*; *Codium fragile*; *Corallina* sp.

Forney Cove - feather boa kelp, giant bladder kelp.

Morse Point - giant bladder kelp, *Pterygophora californica*; bull kelp, *Nereocystis leutkeana*.

Willows Cove - giant bladder kelp, *Pterygophora californica*; feather boa kelp, *Agarum fimbriatum*.

Coches Prietos - giant bladder kelp, *Agarum fimbriatum*; *Pterygophora californica*.

Intertidal Biota

The following areas of Santa Cruz Island were surveyed for their intertidal biota.

Chinese Harbor (Area B) has a long, narrow cobble beach with occasional rocky intertidal areas. Wave action is considerable here and the resultant tumbling of the cobbles makes the intertidal zone nearly uninhabitable. Along the entire length of the beach, empty abalone shells, purple urchin tests, kelp wrack, and wrack flies were observed.

Prisoners Harbor (Area B) is a cobble and sand patch beach with rocky intertidal areas at each end of the beach. At the eastern rocky point, small tidepools contained only the sea anemone, *Anthopleura elegantissima*, snails *Tegula* spp., and patches of encrusting red algae. Boulders at the east point had only a few limpets, *Acmae* spp. and small bunches of California mussels,

Mytilus californianus, or acorn barnacles, *Balanus glandula*. The rocky intertidal zone at the western promontory is somewhat richer, including the animals listed above as well as the channeled basket shell. *Nassarius fossa-*

barnacles, turban snails, gooseneck barnacles, and rock crabs. The algae include Calliarthon sp., Bossiella sp., and Dictyopteris zonarioides, with dense giant kelp in the surf zone.

At Morse Point (Area G), the rocky substrate beyond the sand beach has many small littorines, acorn barnacles, anemones, and rockweed; the sand beach contains only the sand crab, Emerita.

At Willows Cove (Area H), the rocky intertidal areas around the western promontory and the offshore rocks are particularly rich and diverse (Figure 6). Wave action is light and tidepools are abundant in the rocky substrate. The most abundant intertidal animals include: Littorina sp., acorn barnacles, sea anemone, California mussel, gooseneck barnacle, Collisella, Limpets, Ligia, turban snails, purple urchin, the giant red urchin, S. franciscanus, ochre sea star, brown barnacle, hermit crab, the rock crab, tube worms, Phragmatopma, and abalone. The most abundant algae include: eelgrass, sea lettuce, Codium, Calliarthron, Corallina, Egregia, and rockweed.

Valley Anchorage (Area J) has a very rugged rocky intertidal zone which receives considerable wave action. As a consequence, the intertidal biota is reduced to a few hardy forms, primarily Collisella and Littorina; a few clumps of California mussel occur in rock clefts.

Smugglers Cove (Area K) has a sand and cobble beach between rocky headlands. A few tidepools occur off the western point and stream drainage produces a silty area near the center of the beach. The intertidal fauna is sparse and includes the brown barnacle, Chthamalus fissus, Littorina littoria? Acmaea, and turban snails.

Landside Vegetation

The dry and rocky character of the coastal zone on Santa Cruz Island has restricted the adjacent land vegetation to four principal habitat types.

Coastal Bluffs - Soil pockets on the steep cliffs and bluffs provide growing area for Dudleya spp. Eriogonum spp., and tickseed, Coreopsis gigantea. On the lower eastern and western portions Mesembryanthemum spp. is also found.

Coastal Strand - Sand dunes behind a few of the beaches, (Prisoners, Cristi, Morse, and Smugglers), are inhabited with low-growing sea rocket, Cakile maritima, Chamissoris cheiranthifolia, Franseria chamissonis, and several species of sand verbena, Abronia, are present.

Figure 6. Example of the diverse intertidal invertebrates at Willows Cove.

Coastal Sage Scrub - Dry sloping faces provide habitat for a number of shrubs including: Baccharis pilularis, California sagebrush, Artemisia californica, Salvia spp., and lemonadeberry, Rhus integrifolia, with occasional stands of the cactus Opuntia spp.

Coastal Canyon - The fourth type of habitat supports the coast live oak, Quercus agrifolia, in the wetter canyons. Other canyon inhabitants include Catalina ironwood, Lyonothamnus floribundus, Catalina cherry, Prunus lyonii, and summer holly, Comarostaphylis diversifolia.

Unique Components

Populations of the pelagic shrimp, Sergestes similis, occur in great abundance in the waters of the Santa Barbara Channel, over the Santa Barbara Basin. This species has potential commercial significance and may be harvested in the near future. Inshore schools of this species may occur periodically along the northern coast of the Santa Cruz Island ASBS.

The brown pelican, Pelecanus occidentalis californicus, has begun to re-occupy Santa Cruz Island, particularly the coastal rocks near Scorpion Anchorage. While the pelican technically lives on rocky areas adjoining the ASBS, it feeds on marine biota from within and around the Area. Many investigators believe that the pelican's drastic decline in the late 1960's was caused by egg-shell thinning which resulted from feeding on marine organisms contaminated with DDT and its metabolites. Measures to control DDT discharges in the Los Angeles area have resulted in reduced contamination and presumably have assisted in the recovery of the pelican population.

In addition to these marine animals, Santa Cruz Island, which is outside the ASBS, has five endemic plants and the channel island fox, Urocyon littoralis. The plants are: Rock cress, Arabis hoffmanii, shaggy-barked manzanita, Arctostaphylos tomentosa subcordata, live forever, Dudleya nesotica, gooseberry, Ribes thasherianum, and lace pod, Thysanocarpus conchuliferus.

LAND AND WATER USE DESCRIPTION

Marine Resource Harvesting

Commercial Fishing: The primary commercial fishing activities within the Santa Cruz and Anacapa Islands ASBS areas are the collection of abalone, urchins, and lobsters. Four species comprise the bulk of the abalone catch: black, *Haliotis cracherodii*, red, *H. rufescens*, pink, *H. corrugata*, and green, *H. fulgens*. The commercial catch is harvested by divers working in the middle and deep subtidal regions. Intertidal and shallow subtidal collection are prohibited, but this rule is flagrantly violated, as was observed during the survey. With the decline of abalone stocks north of Point Conception, collecting pressure on the Channel Island populations has increased. As a result, these stocks appear also to be in decline.

Sea urchin fisheries, conducted out of Santa Barbara, Ventura, and Port Hueneme are locally important within the ASBS. The purple sea urchin, *Strongy-*

These activities probably pose no substantial current threat to the ASBS biota.

Municipal and Industrial Activities

There are no municipalities or industrial activities within one mile of the Santa Cruz Island ASBS. The nearest municipality is Port Hueneme, 19.2 statute miles (30.7 km) from San Pedro Point. However, the nearest industrial activities are the offshore oil drilling platforms in the Santa Barbara Channel. A small, underwater acoustic facility is operated by General Motors at Valley Anchorage, and a U.S. Navy radar facility is located in the hills between Chinese Harbor and Prisoners Harbor. Neither facility creates any apparent disturbance within the ASBS boundaries.

Agribusiness and Silviculture

There are no logging or dairying operations within or immediately adjacent to the Santa Cruz Island ASBS. Two ranches occupy the Island; about 15% is held by the Gherini Ranch and the rest is owned by the Stanton Ranch. Aside from the olive groves behind Chinese Harbor, agricultural activity is insignificant. Grazing by cattle and about 10,000 feral sheep is extensive. This has had a very negative effect on the Island's vegetation and has caused considerable erosion. Fencing has had only limited success in containing the sheep and an eradication program is underway. The cattle are successfully controlled and grazing areas are rotated to reduce the grazing pressure and its impact.

Governmental Designated Open Space

None of the Santa Cruz Island ASBS is designated as an open space, public park, or ecological reserve. However, the University of California includes the Island in its Natural Land and Water Reserves System. While the island is privately owned, about 85% of it will eventually be owned by the Nature Conservancy if current negotiations are successfully concluded. If the Nature Conservancy does acquire this property, it will be managed to provide for limited public use, scientific research, education, and primarily for protection.

Recreational Uses

Santa Cruz is a popular boating, fishing, and diving area for day-trippers from Santa Barbara, Ventura, and Port Hueneme. Party boats of fishermen and SCUBA divers frequent the region. Landing is prohibited except by prior permission of the Santa Cruz Island Co., so that recreational use is restricted primarily to the nearshore region.

Scientific Study Uses

Numerous scientific studies are conducted on or around Santa Cruz Island, all coordinated by the UCSB Field Stations, except for offshore sampling by Southern California Coastal Water Research Project (SCCWRP) and California Cooperative Fisheries Investigation (CalCOFI).

Transportation Corridors

Figure 7 shows the Santa Barbara Channel shipping lane. No records of traffic through the area are kept, but it probably only rarely exceeds six or seven large vessels per day.

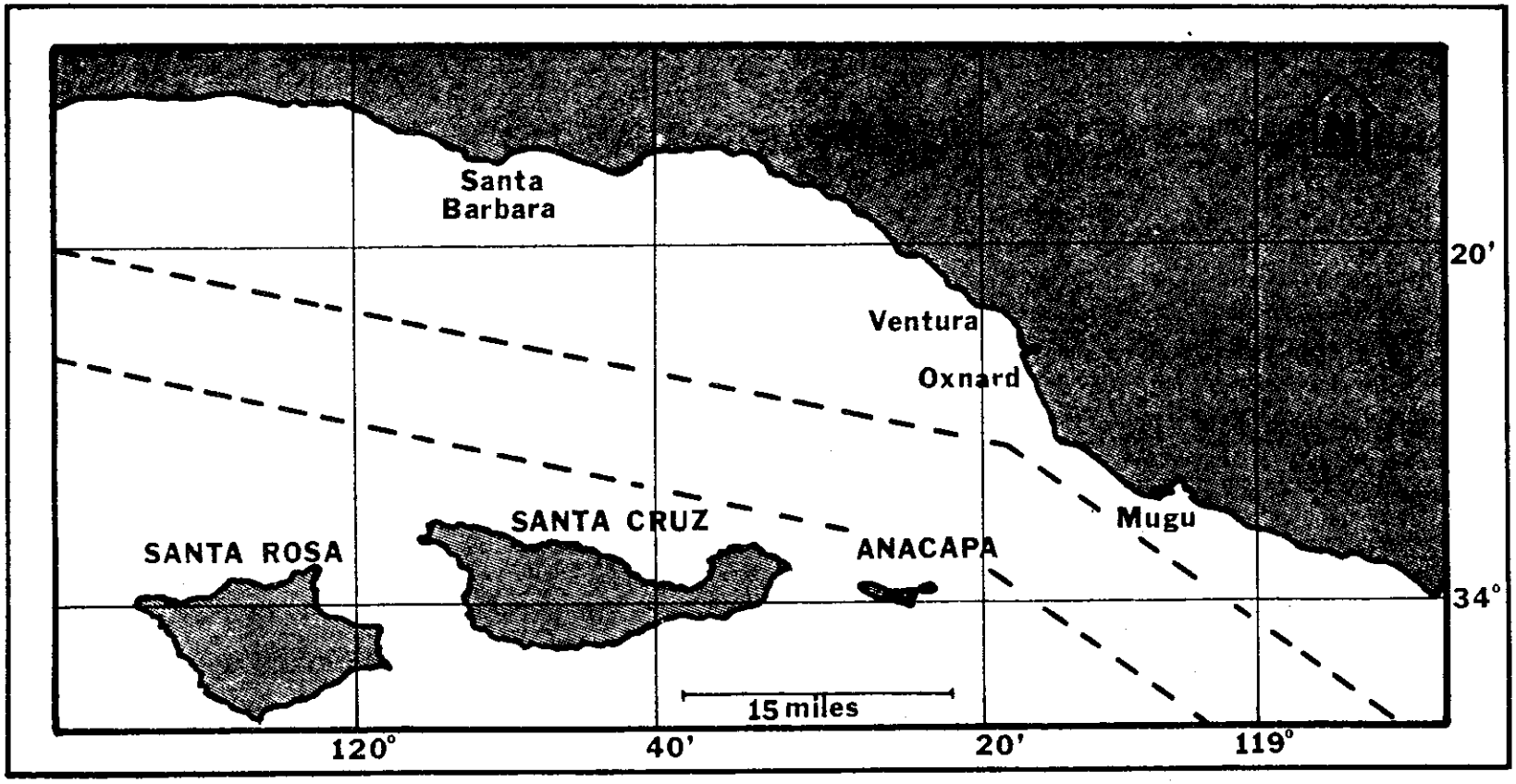

Figure 7. Santa Barbara Channel shipping lane.

ACTUAL OR POTENTIAL POLLUTION THREATS

Point Sources

Radioactive Wastes: There are no radioactive wastes within the Santa Cruz Island ASBS. However, about 25 miles to the south (at 33° 35' N, 119° 30' W in the Santa Cruz Basin) there is a radioactive waste dumpsite that was used by the Atomic Engergy Commission in the early 1950's. Approximately 2,900 55-gallon drums containing uranium and thorium wastes were dumped. This is low-level material (about 60 curies of activity). The existence of this dumpsite is not widely known, and the nature of radionuclide pollution makes it a potential threat.

Offshore Oil Development: No oil development takes place within the Santa Cruz Island ASBS boundaries. However, nearby operations in the Santa Barbara Channel and off the mainland coast undoubtedly lead to oil and tar deposition on the Island's coast. As oil slicks regularly extend downstream from the drilling platforms, prevailing weather and current patterns dictate that a portion of this petroleum will impact the Island's northern coastline. Many of the nearby offshore leases were granted before the institution of strong environmental considerations, and thus they are not constrained by the more recently adopted controls. The proposed sale of future lease sites includes areas quite close (3 miles) to the Northern Channel Islands. Development of these areas will increase the level of oil reaching the Islands. The effects of this increase cannot be predicted as yet because there has been little data available concerning the effects of the current level. It should be noted, however, that observations at Cristi Beach on Santa Cruz Island showed a striking difference between the intertidal biota at oil impacted areas and nonimpacted areas at the north point. Also, there was a general difference in biota between the north point and the less impacted south point.

Vessel Discharges: Shipping traffic through the Santa Barbara Channel, and also south of the Islands, undoubtedly leads to some pollution of their shorelines. It is common practice for large vessels to flush their bilges, sewage tanks, and oil storage tanks prior to and/or after leaving port. The Coast Guard polices this problem, but they can be effective only during the daylight periods. Expanding vessel traffic due to the increasing trans-

portation of Alaskan oil and liquified natural gas will add to this pollution problem.

Non-point Sources

Natural oil seeps are common features in the marine environment around the Northern Channel Islands. There has been no systematic survey of these seeps but several are known to directly affect the islands. Two are located between Santa Rosa Island and Santa Cruz Island, off West Point; two more occur on the shelf along the latter's northern coast; one is known to be just north of the interisland gap between Santa Cruz and Anacapa Islands; another is located north of East Anacapa. These seeps are periodic, with irregular output volumes.

SPECIAL WATER QUALITY REQUIREMENTS

A special consideration with regard to the biota of the Northern Channel Islands concerns its tolerance to oil pollution. The Santa Barbara Channel has been an area of natural oil seepage through a relatively long period of geological time. The resident biota of this region has evolved under these conditions. While the effects of current levels of oil deposition are poorly understood, it is probable that significant increases in oil spillage will seriously damage the marine biota. Therefore, every effort must be made to control oil spillage from development and transportation activities.

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Comments: Dated but useful for general background of island geology.

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Comments: Contains a nearly complete vegetation list and climate data.

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Comments: Contains detailed bottom profiles of the shelf around Anacapa Island.

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Comments: An excellent background reference with a few specifics to the ASBS.

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Comments: Discussed in text.

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Comments: Discussion of natural resources and their management, including park policies, park visitation and research.

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Comments: Articles on geology, archaeology, terrestrial and marine flora and fauna. (Includes Bartholomew, 1967. Seal and Sea Lion populations of the Calif. Islands.)

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Comments: A nearly complete general description of the island's submarine topography, geological characteristics, and sediment patterns.

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Comments: A classification and characterization of island geography with fault maps.

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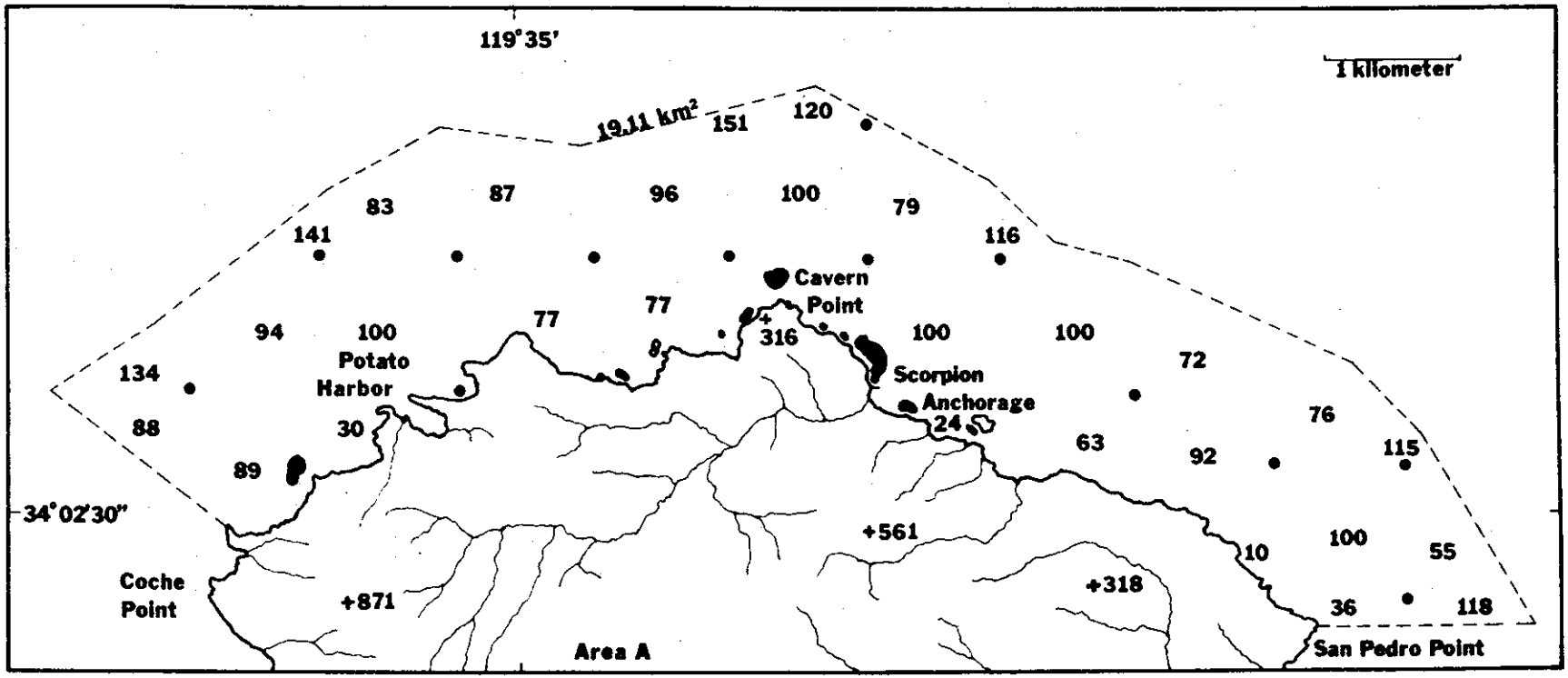
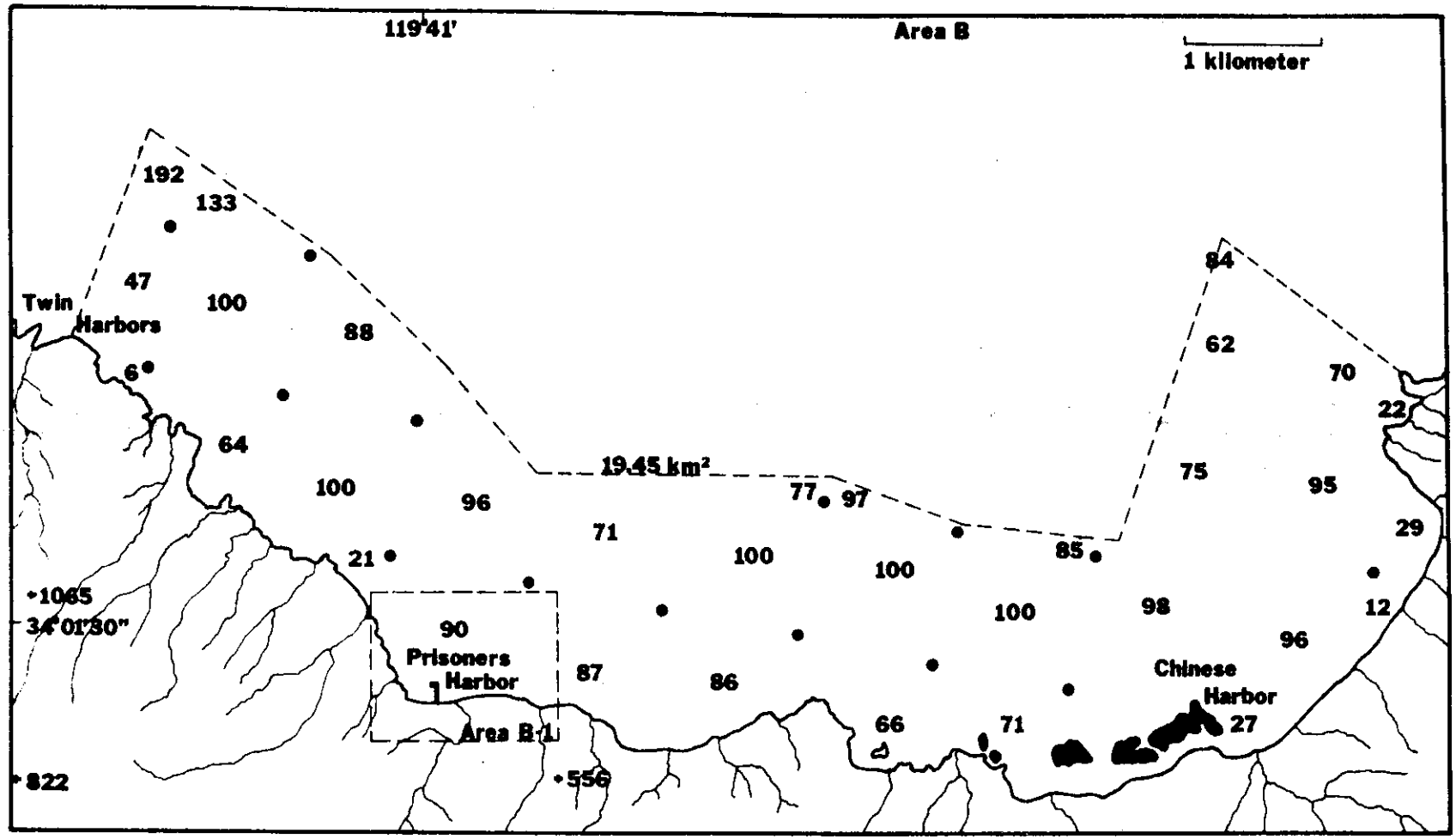
Comments: This paper is appended to the report.

APPENDIX 1

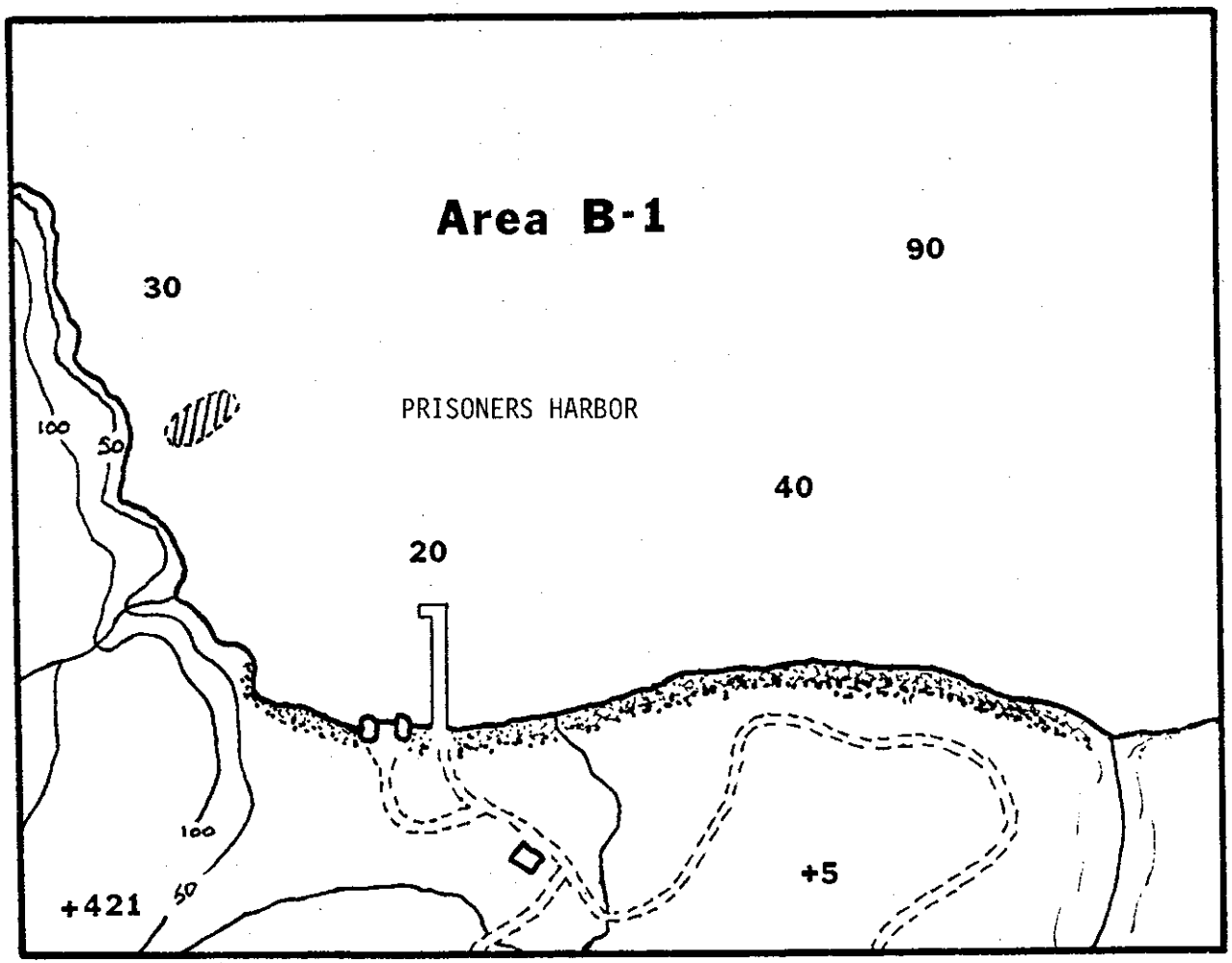
Subregional Survey Information
(Areas A-K)



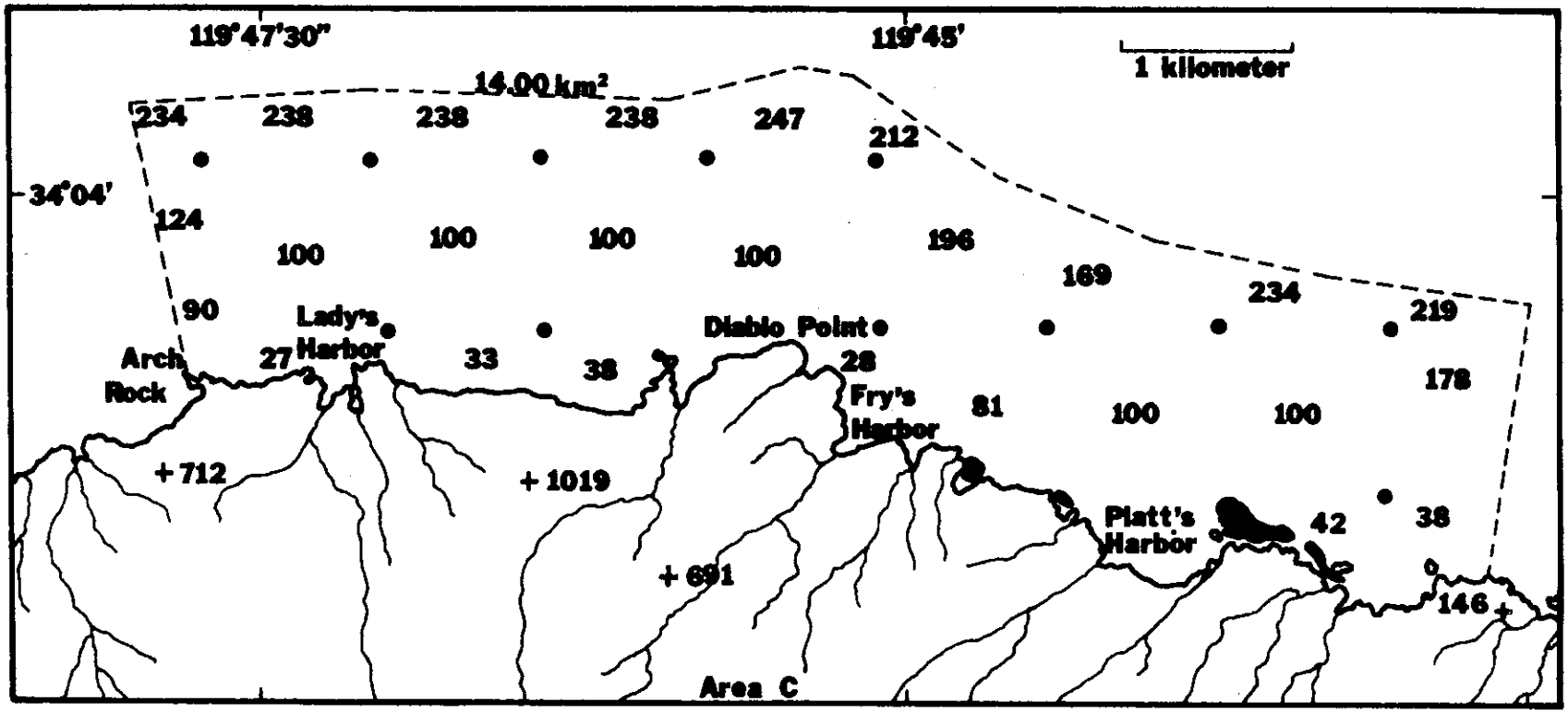
Appendix 1a. Subregional area A; heights and depths in feet. Dark areas are kelp beds. The dashed line is approximately 1 mile offshore.



Appendix 1b. Subregional area B; heights and depths in feet. Dark areas are kelp beds. The outer dashed boundary is approximately 1 mile offshore.

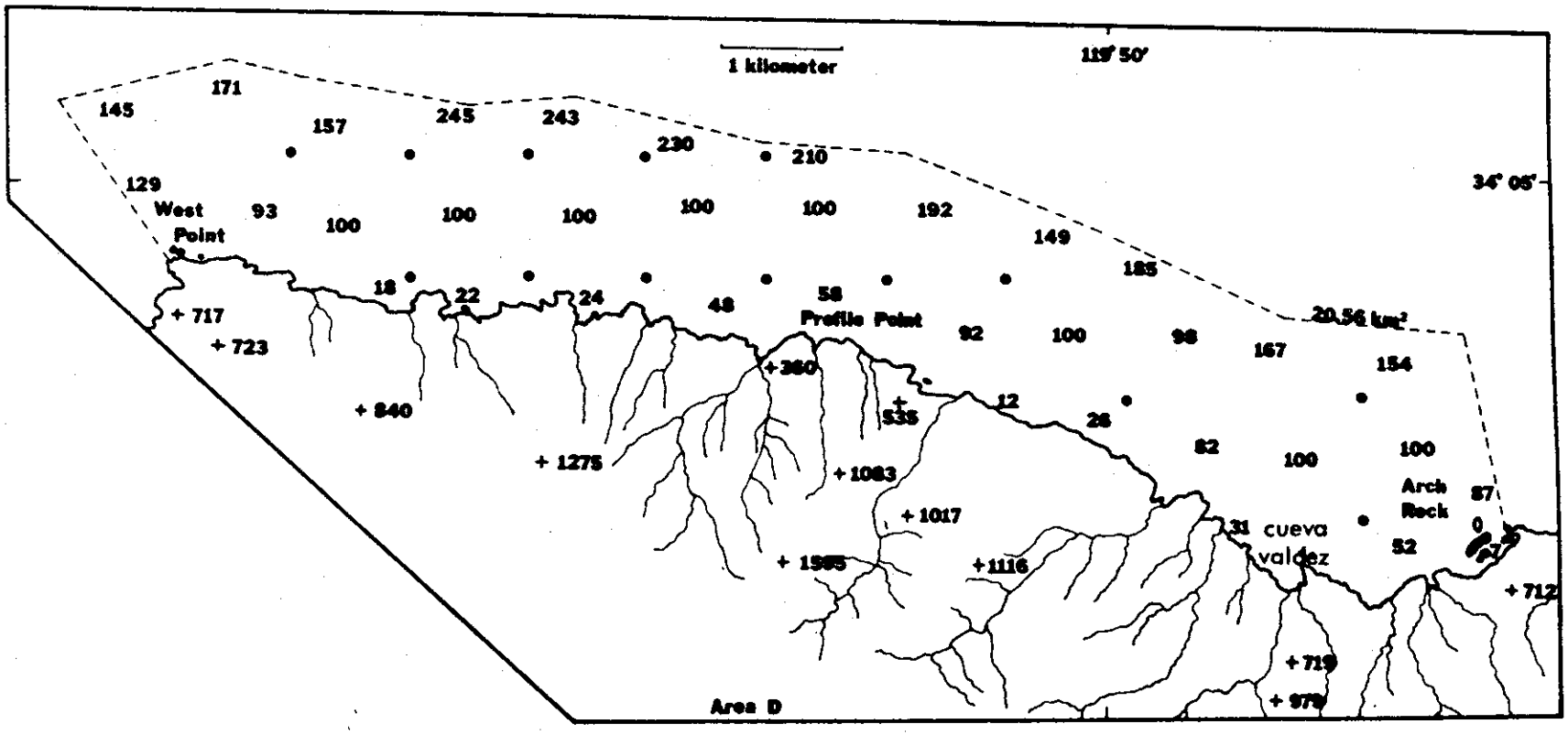


Appendix 1c. Area B-1; heights and depths in feet. The lined area is the subtidal survey.

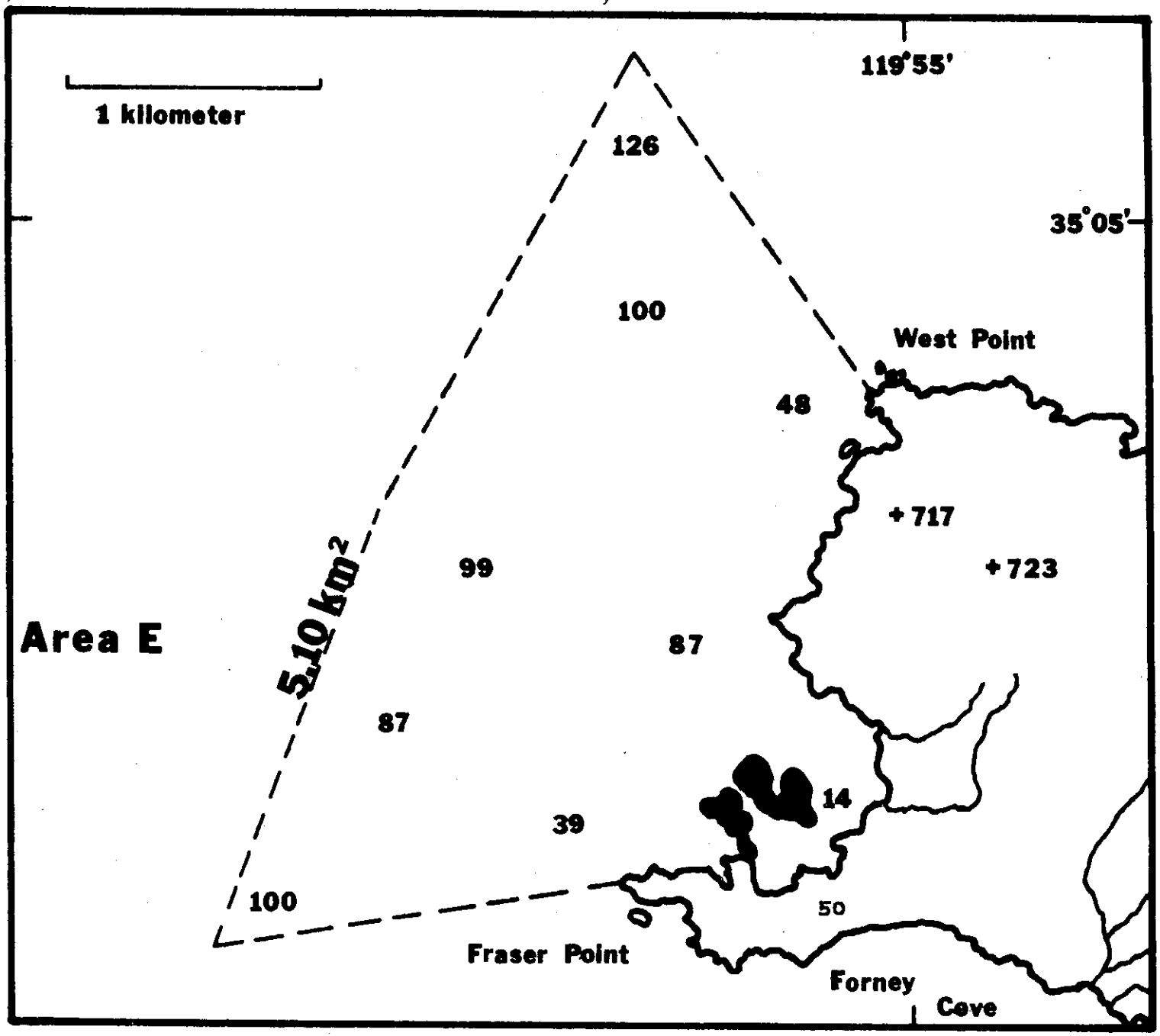


Appendix 1d. Subregional area C; heights and depths in feet.

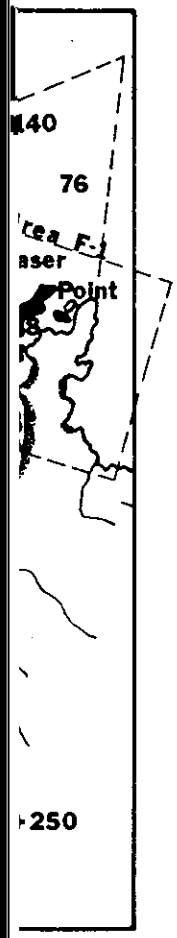
Dark areas are kelp beds. The dashed line is approximately 1 mile offshore.



Appendix 1e. Subregional area D; heights and depths in feet. Dark areas are kelp beds. The dashed line is approximately 1 mile offshore.



Appendix 1f. Subregional area E; heights and depths in feet.
Dark areas are kelp beds. The dashed line is approximately 1 mile offshore.


140
76
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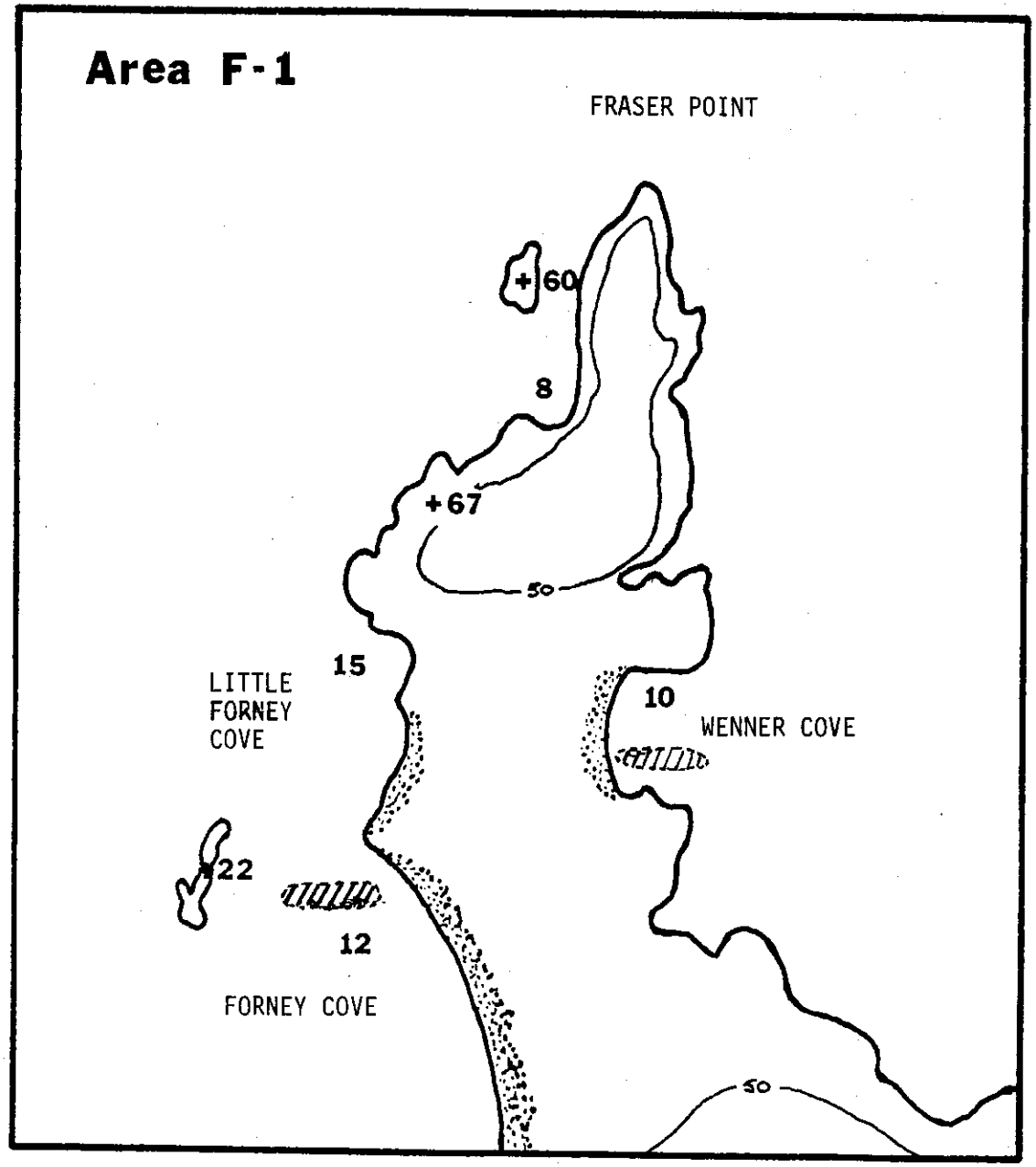
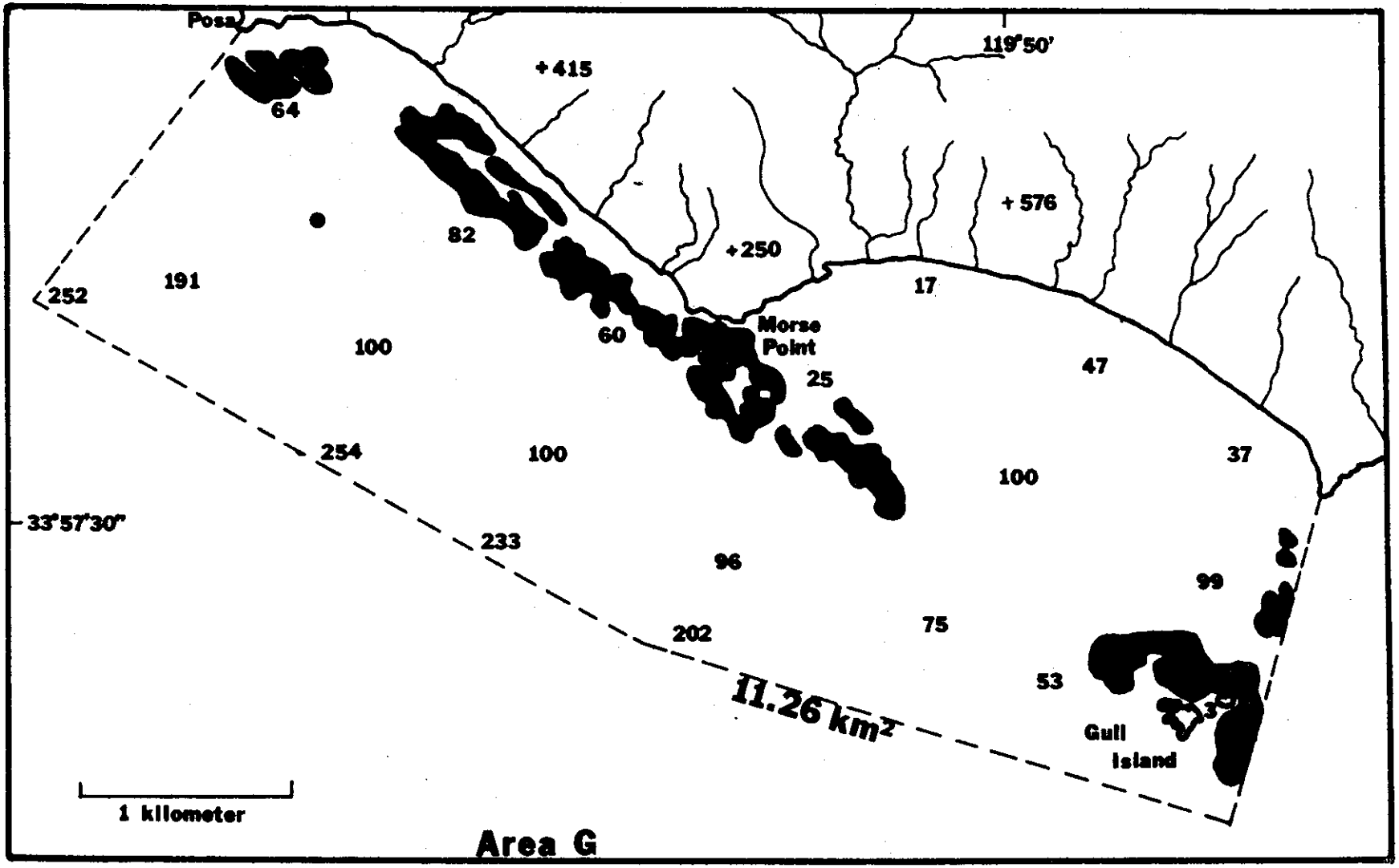
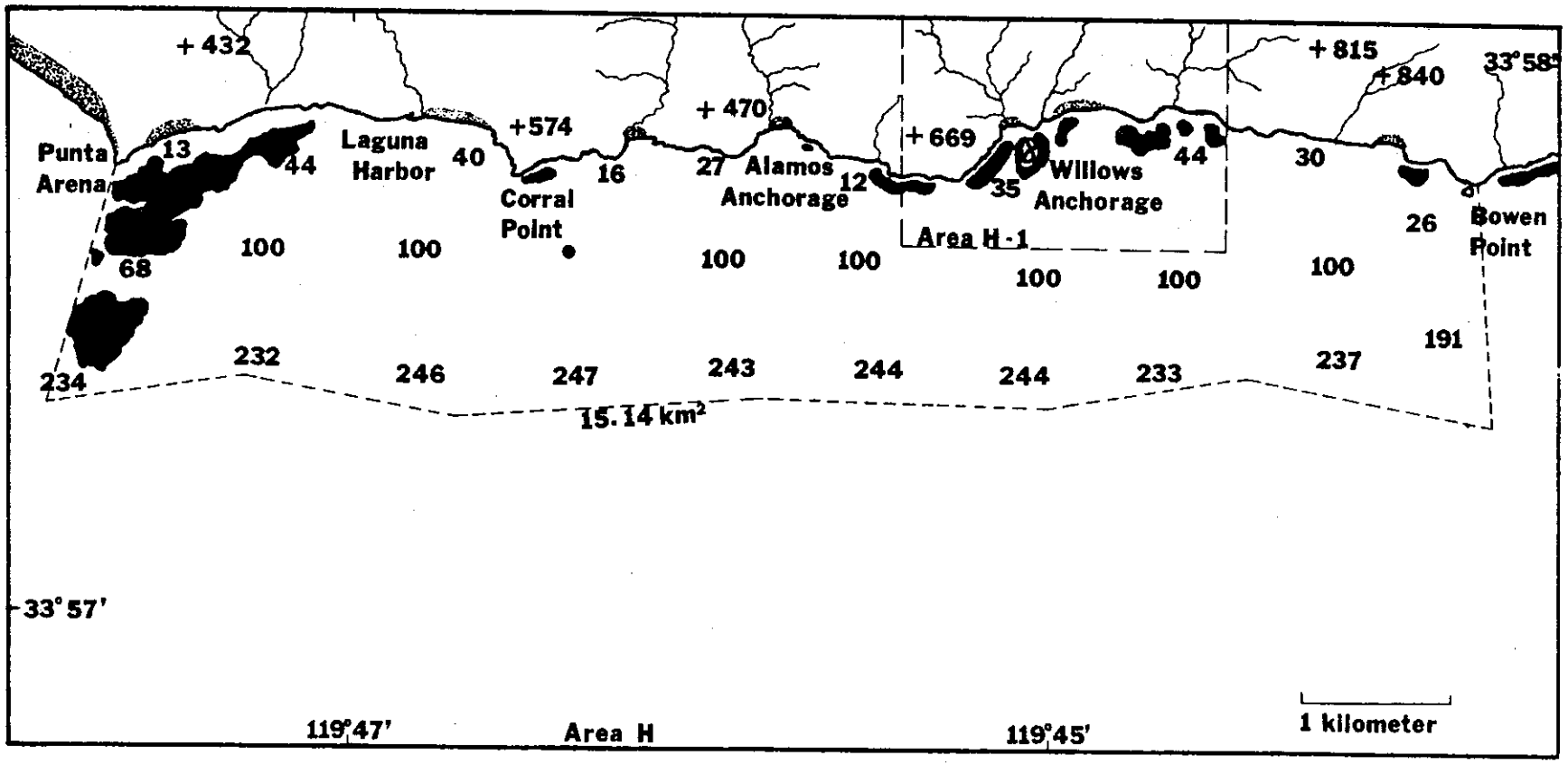
aser
Point
250



Appendix 1h. Area F-1; heights and depths in feet. The lined area is the subtidal survey.

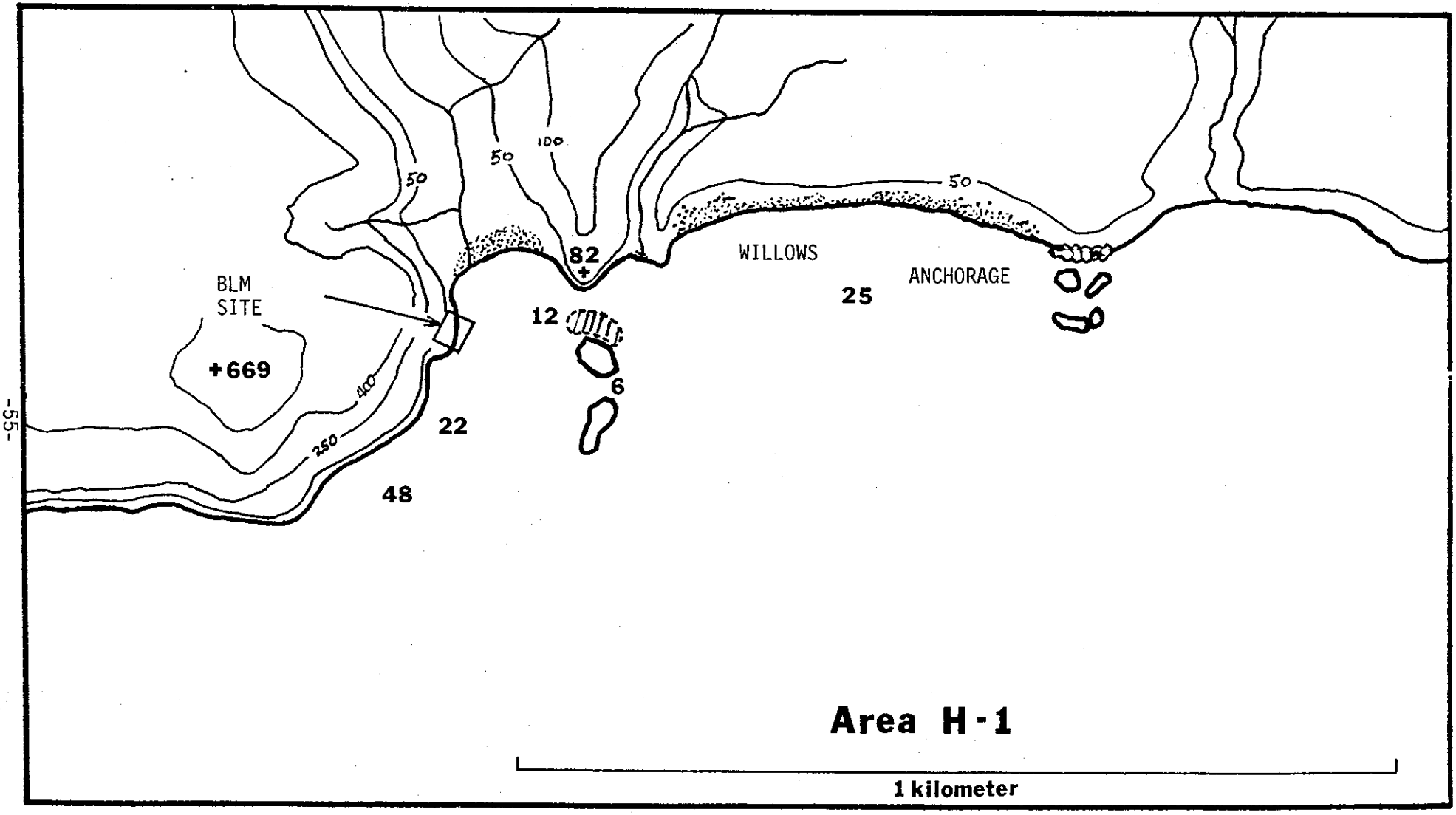


Appendix 1i. Subregional area G; heights and depths in feet. Dark areas are kelp beds. The dashed line is approximately 1 mile offshore.

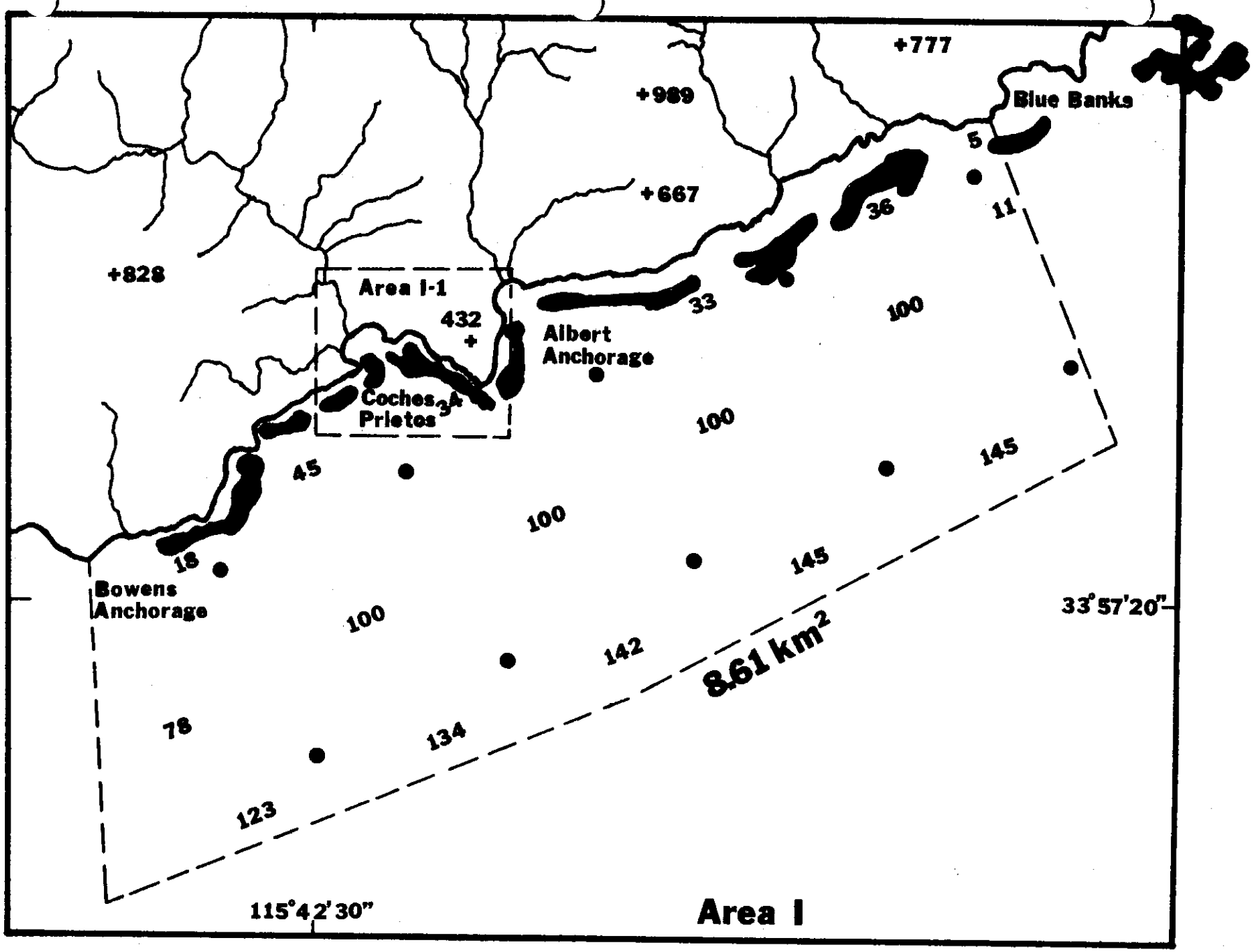


Appendix 1j. Subregional area H; heights and depths in feet.

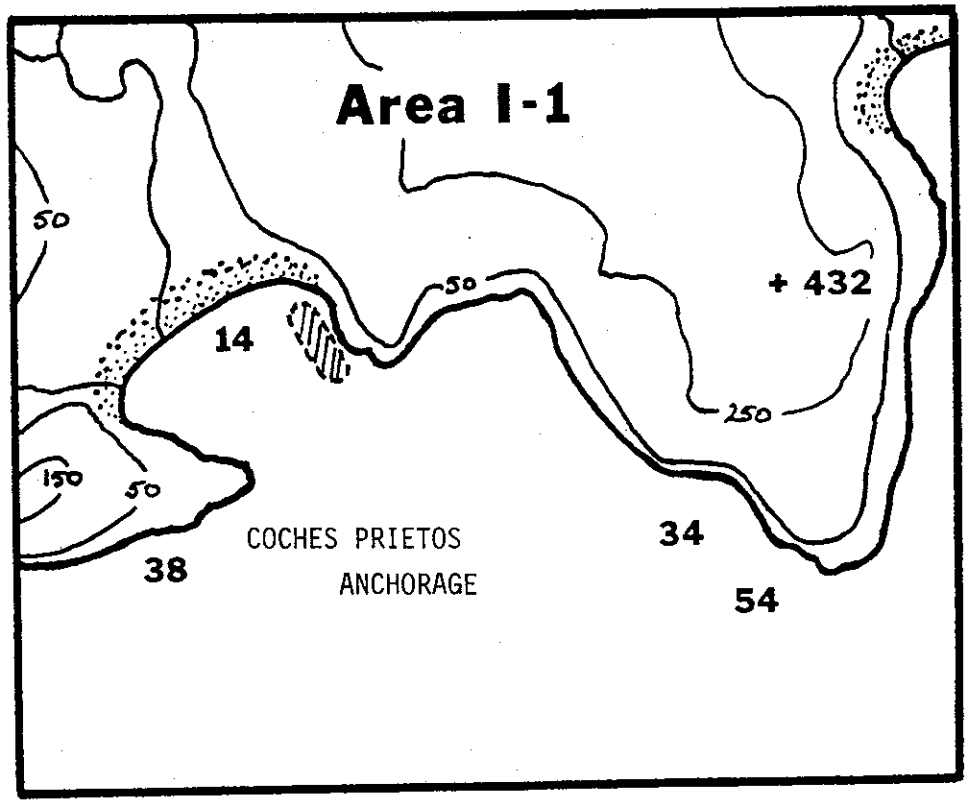
Dark areas are kelp beds. The outer dashed boundary is approximately 1 mile offshore.



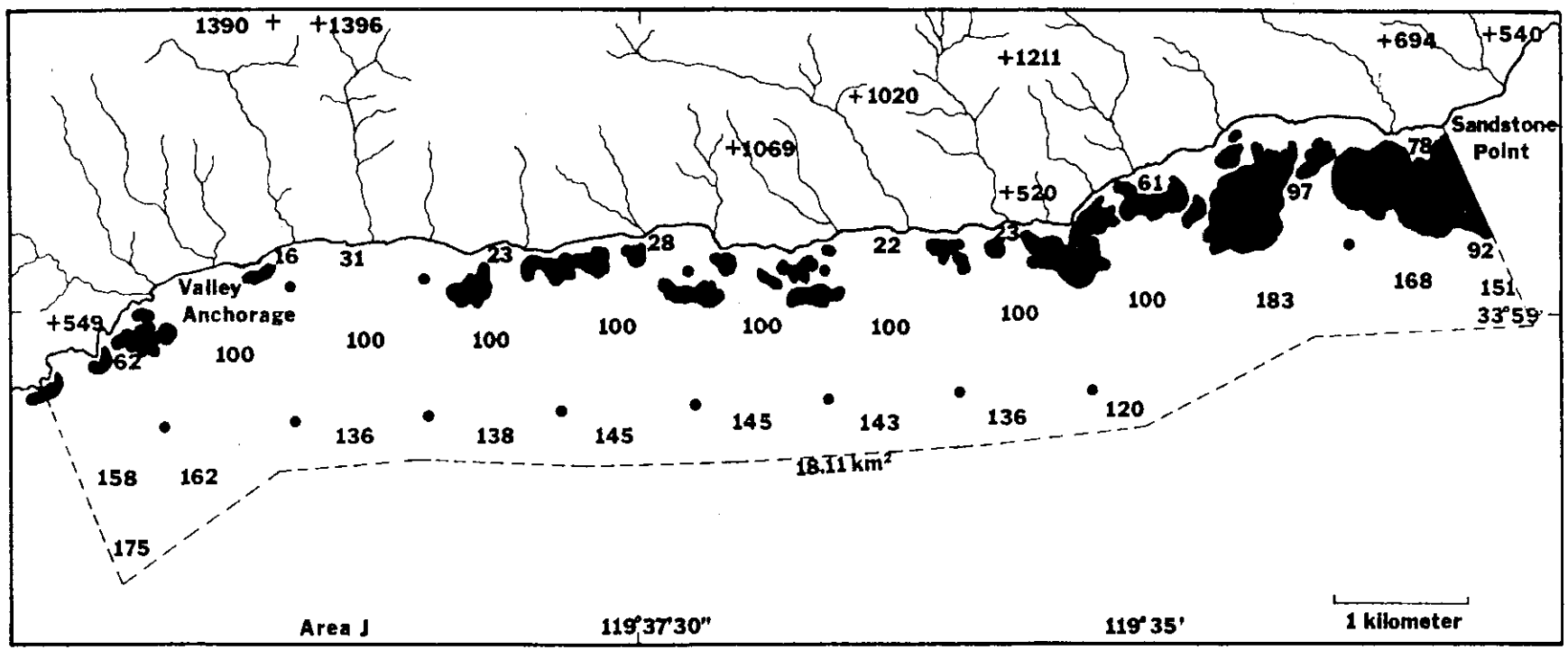
Appendix 1k. Area H-1; heights and depths in feet. The line area area is the subtidal survey.



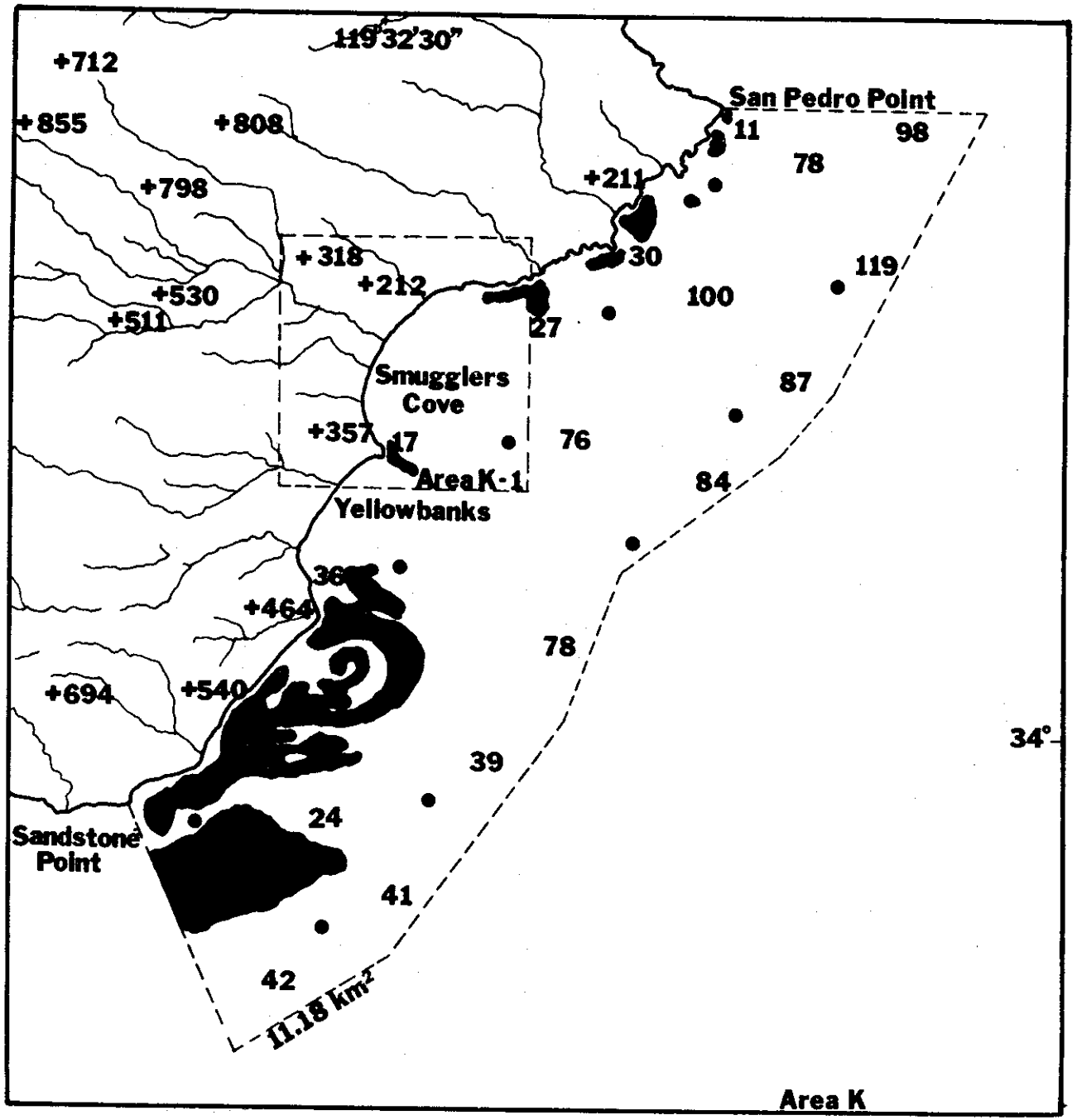
Appendix 11. Subregional area I; heights and depths in feet.
Dark areas are kelp beds. The outer boundary is about 1 mile offshore.



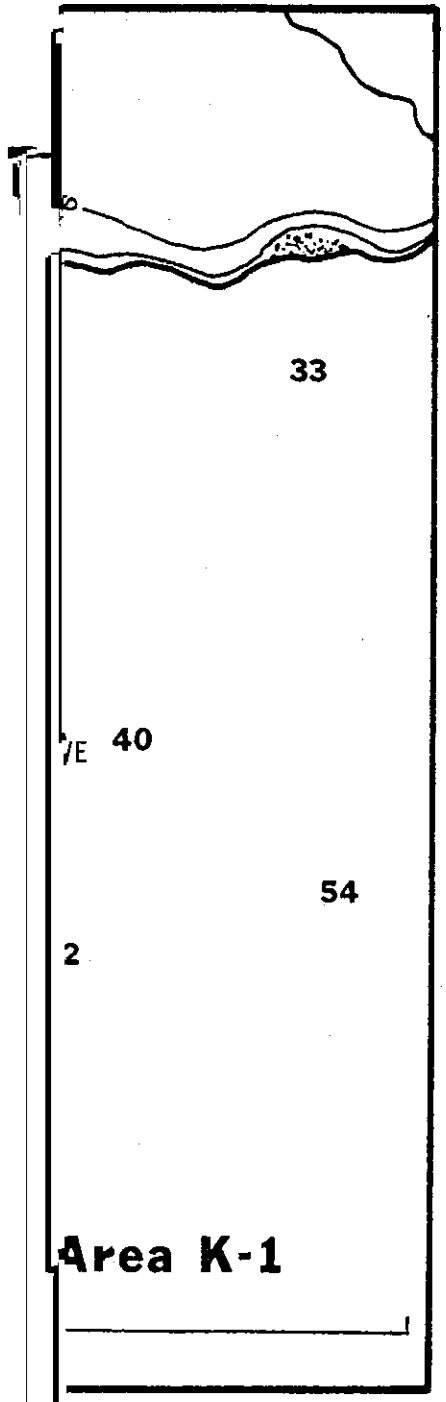
Appendix 1m. Area I-1; heights and depths in feet.
The lined area is the subtidal survey.



Appendix 1n. Subregional area J; heights and depths in feet. Dark areas are kelp beds. The dashed line is approximately 1 mile offshore.



Appendix 1 o. Subregional area K; heights and depths in feet.
Dark areas are kelp beds. The outer boundary is about 1 mile offshore.

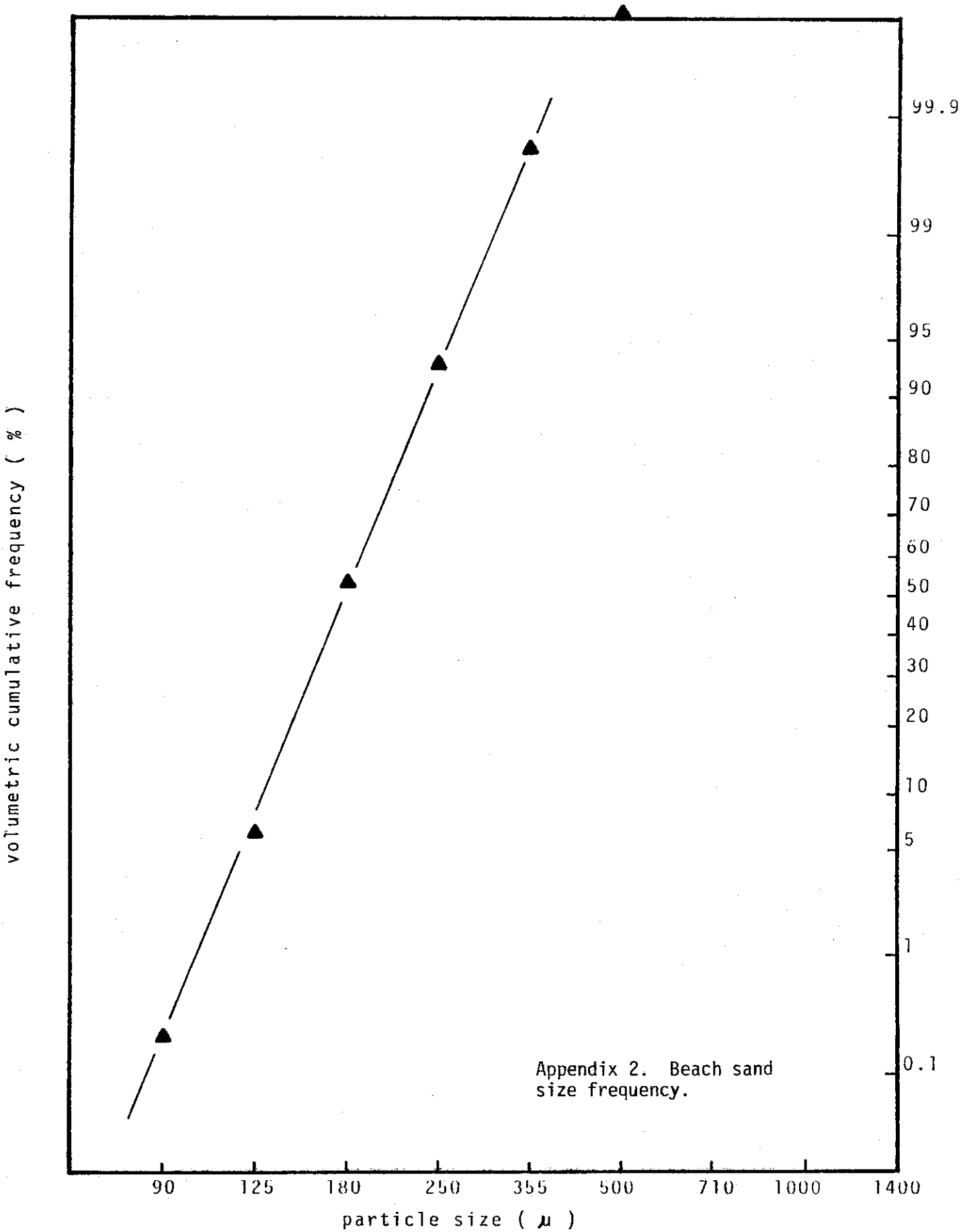


feet.

APPENDIX 2

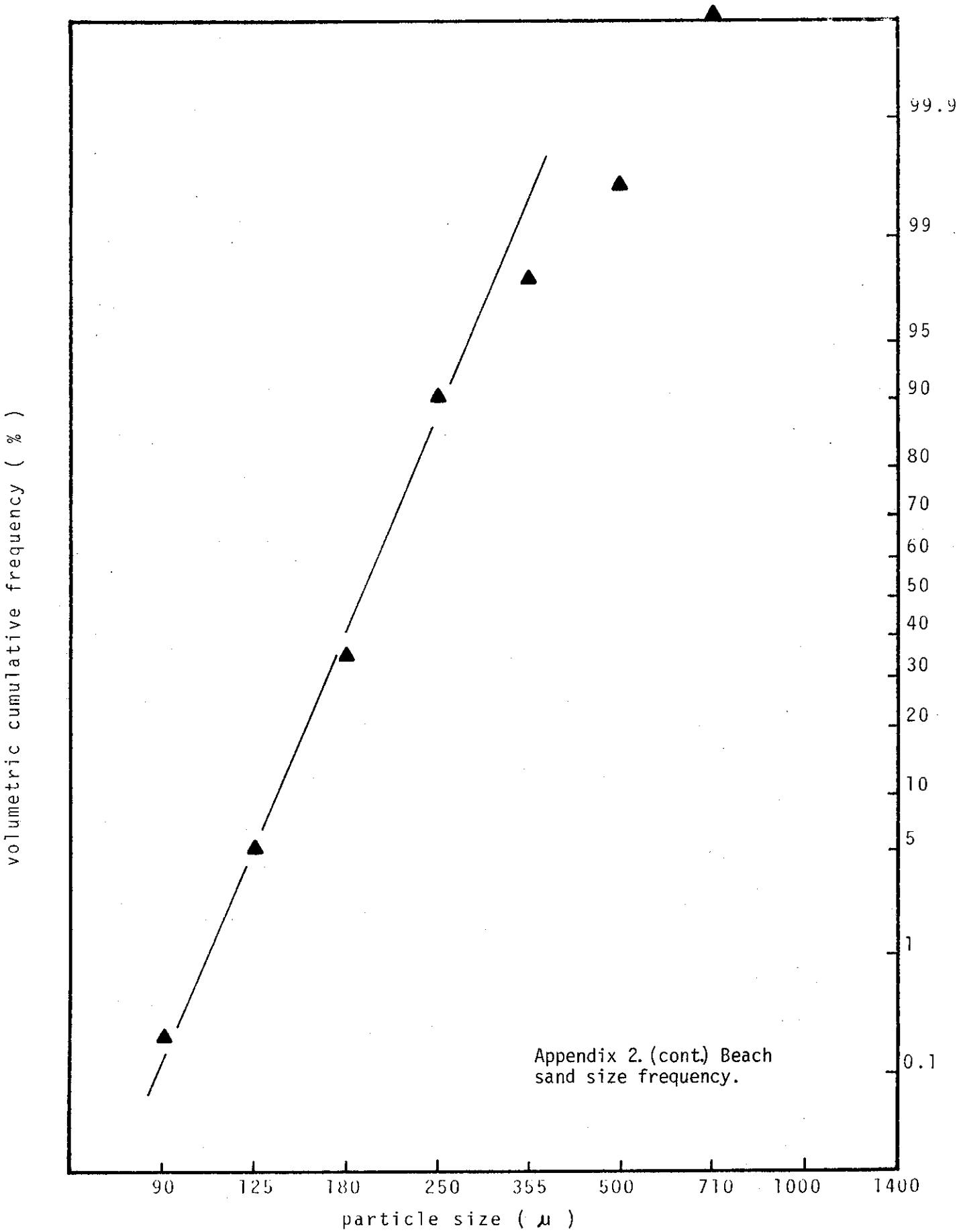
Particle Size Distribution for Beach Samples from Areas F-K

LOCATION: area F, beach at Little Forney Cove



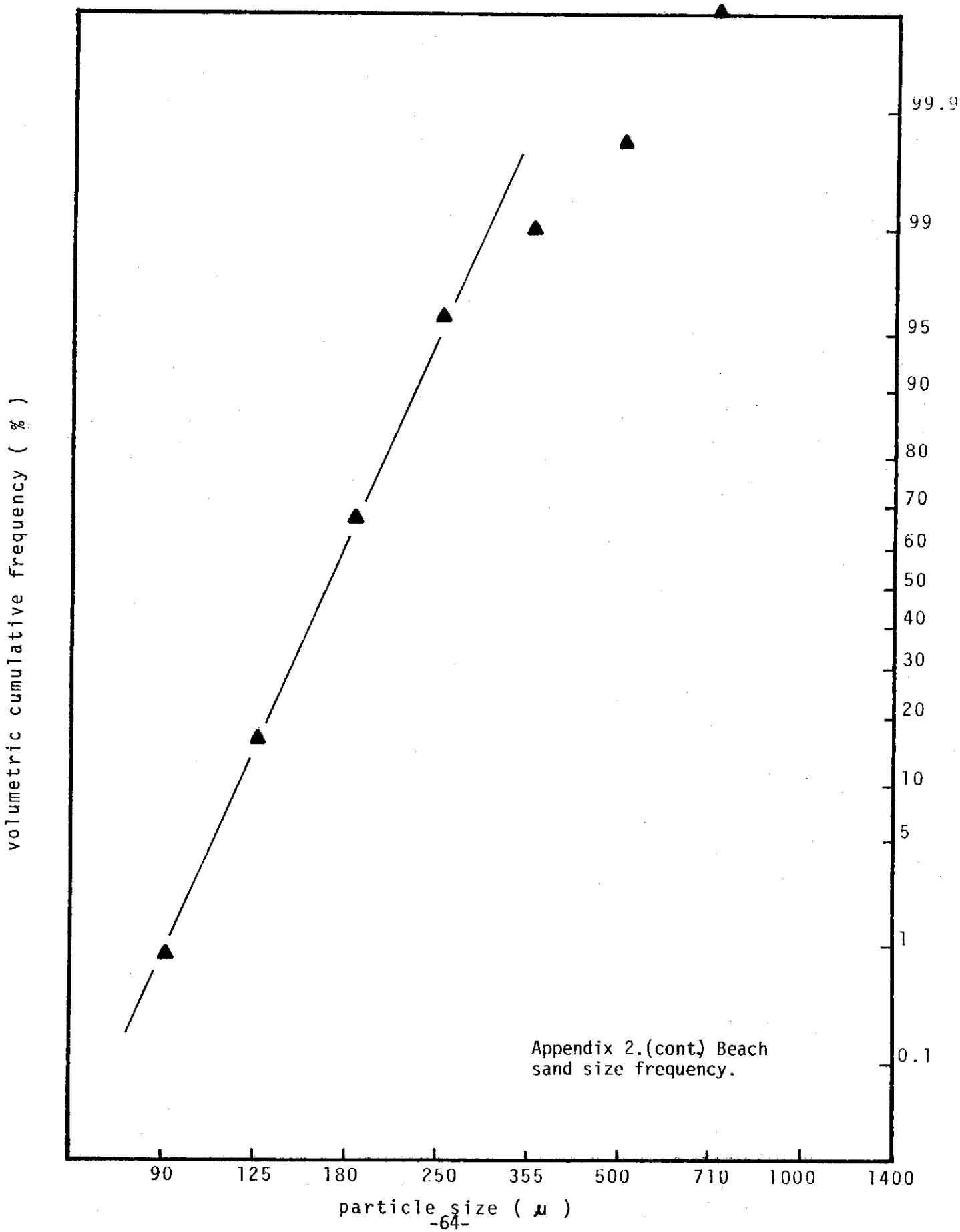
Appendix 2. Beach sand size frequency.

LOCATION: area F, Forney Cove



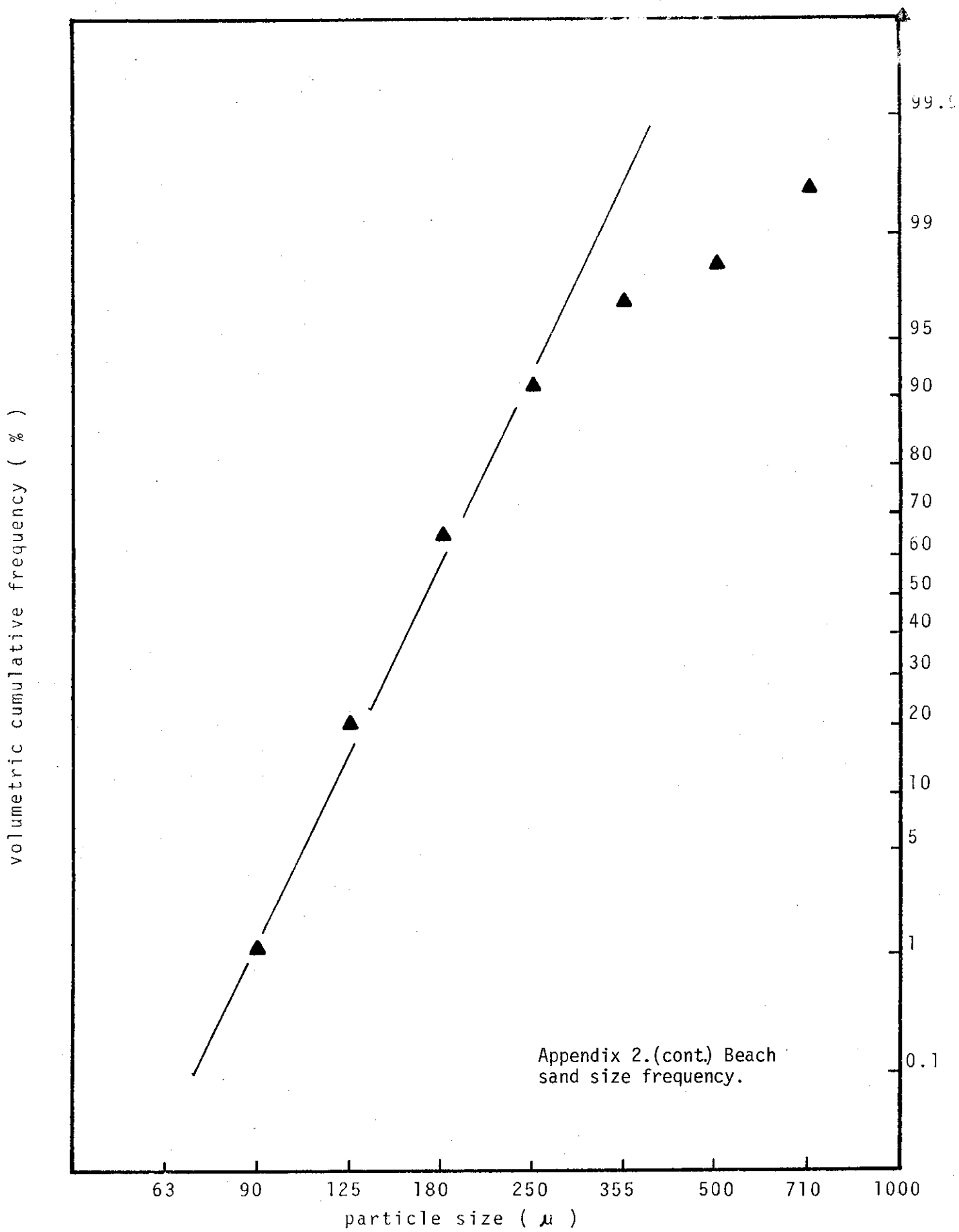
Appendix 2. (cont.) Beach sand size frequency.

LOCATION: area F, north end of Cristi Beach



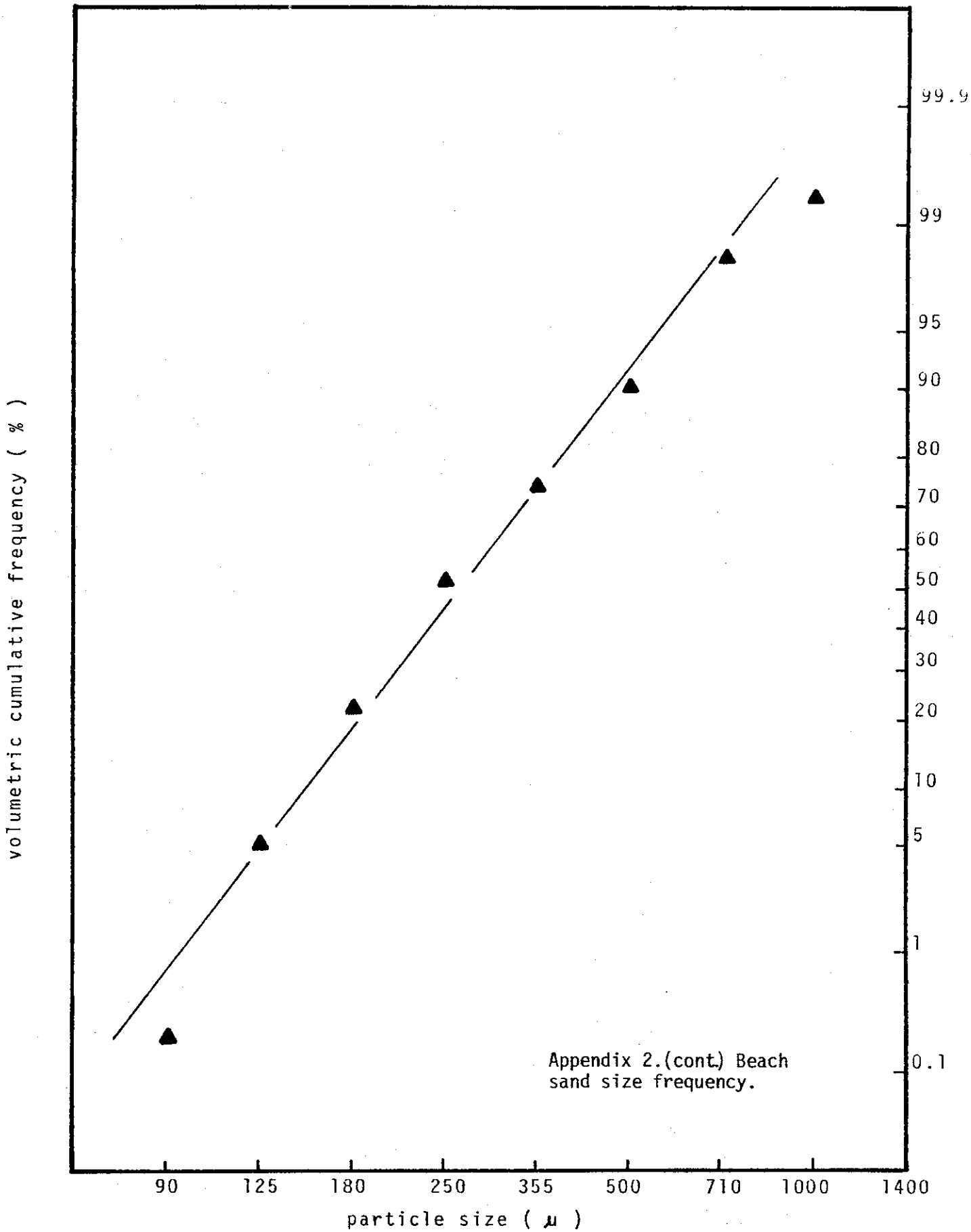
Appendix 2.(cont.) Beach sand size frequency.

LOCATION: area F, stream mouth near central Cristi Beach



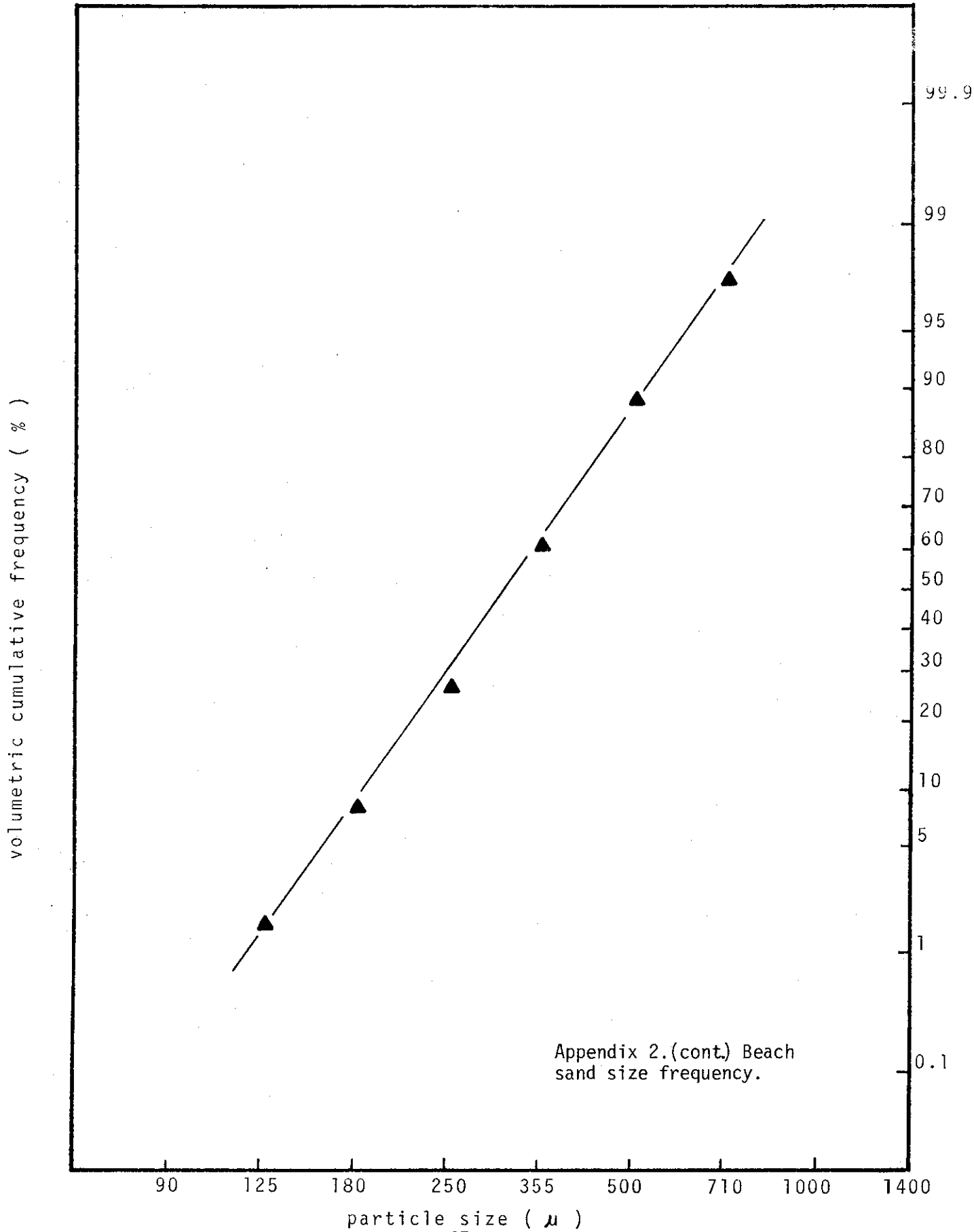
Appendix 2.(cont.) Beach sand size frequency.

LOCATION: area F, south end of Cristi Beach



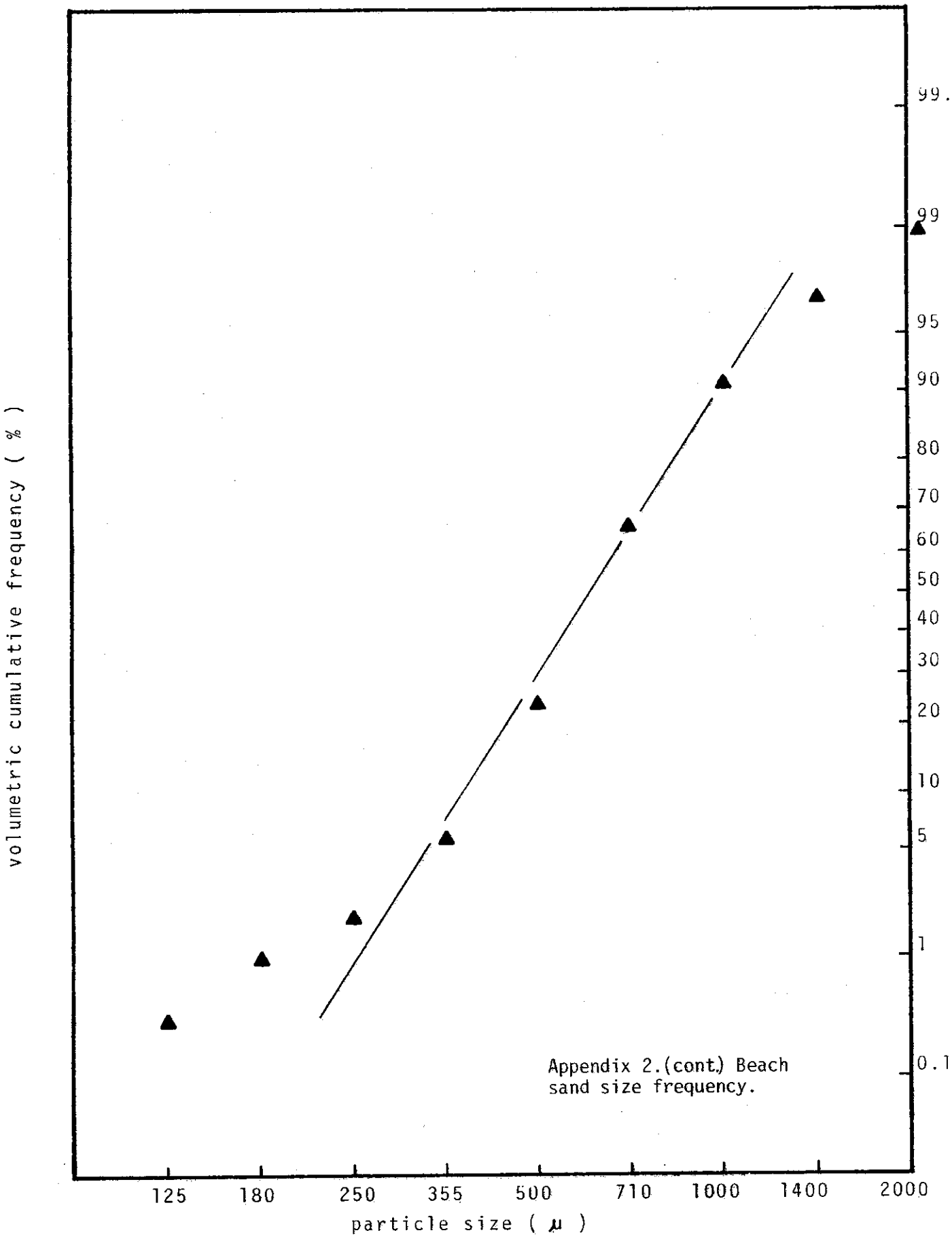
Appendix 2.(cont.) Beach sand size frequency.

LOCATION: area G, beach just west of Punta Arena



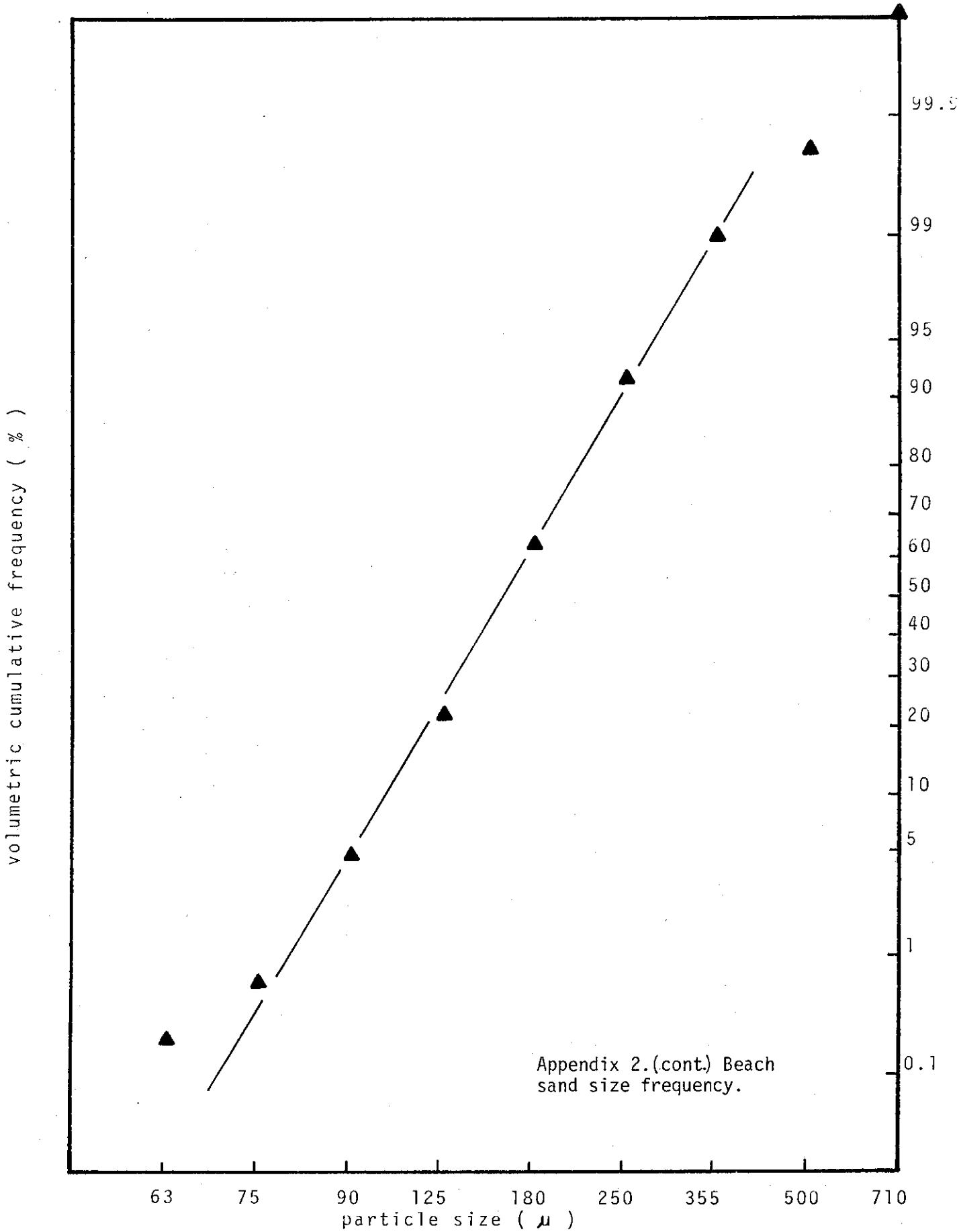
Appendix 2.(cont.) Beach sand size frequency.

LOCATION: area H, pocket beach east of Willows Cove



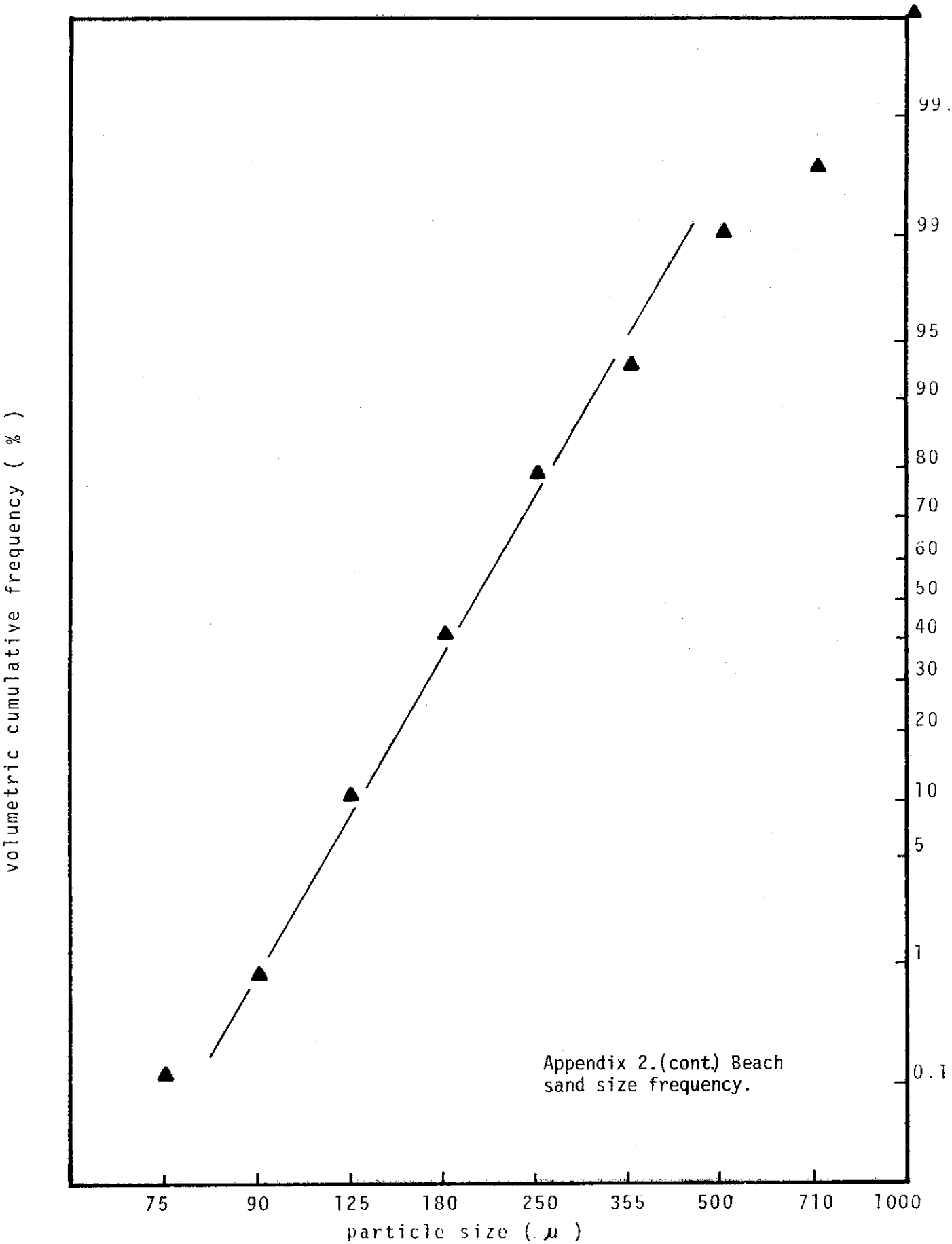
Appendix 2.(cont.) Beach sand size frequency.

LOCATION: area H, Willows Cove



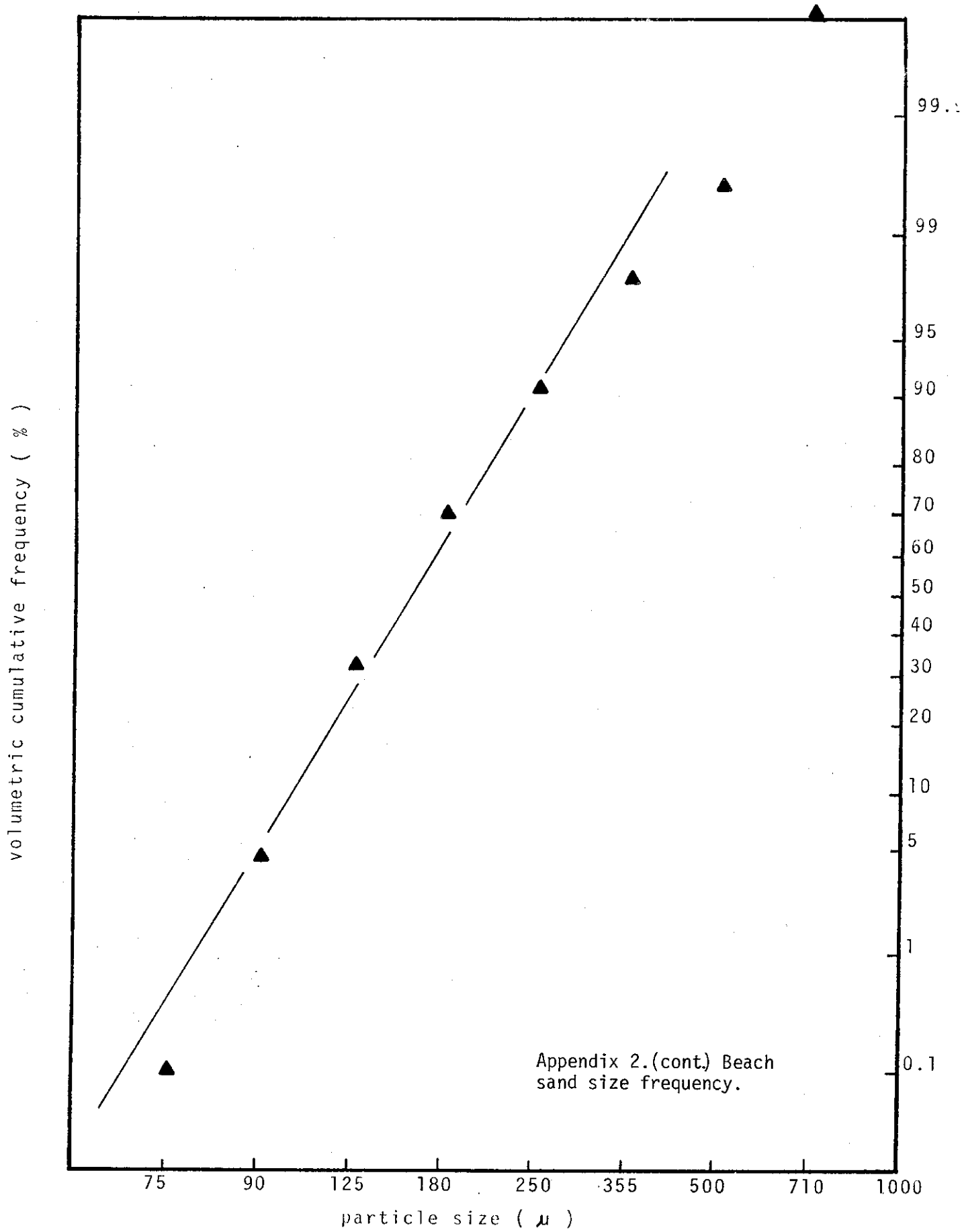
Appendix 2.(cont.) Beach sand size frequency.

LOCATION: area I, Coches Prietos



Appendix 2.(cont.) Beach sand size frequency.

LOCATION: area K, Smugglers Cove



Appendix 2.(cont.) Beach sand size frequency.

APPENDIX 3

Subtidal Transect Survey Data from Diving Transects

APPENDIX 3

SUBTIDAL TRANSECT SURVEY

Transect Location: Prisoners Harbor

Depth Range: 0-33' Visibility: 20'

LARGE CONSPICUOUS INVERTEBRATES	Abundance by Depth
CNIDARIA	
Hydractinia	
Abietinaria	
Anthopleura elegantissima	Abundunt
A. xanthogrammica	
Tealia	1
Balanophyllia paracyathus	5
Astrangia	
Corynactis	3
Pachycerianthus	Numerous
Clavularia	
Lophogorgia	5
PORIFERA	
Zygherpe	
Acarnus	
Hymenamphiastra	
Tethya	
POLYCHAETA	
Diopatra	5
Chaetopterus	17+

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Prisoners Harbor

Depth Range: 0-33' Visibility: 20'

INVERTEBRATES (CONT'D)	Abundance by Depth
MOLLUSCS (CONT'D)	
Astraea	
Serpulorbis	
Olivella	
Nudibranchs	Coryphella 2
Mytilus	
Psuedochama	
Hinnites	3
Pododesmus	
Navanax	Numerous on mud
Aplysia	1
Zonaria	
Kelletia	
ECTOPROCTS	
Membranipora	
Thalamoporella	
Hippodiplosia	Numerous on 25' bank
Phidolopora	
ECHINODERMS	
Dermasterias	
Patiria	
Pisaster giganteus	2
P. ochraceous	2
Orthasterias	
Ophiothrix	
Ophioderma	
Stichopus	13
Cucumaria	
Eupentacta	
Strongylocentrotus purpuratus	3
S. franciscanus	19
OTHER	

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Prisoners Harbor

Depth Range: 0-33' Visibility: 20'

VERTEBRATES	Abundance by Depth
SHARKS AND RAYS	
Horn shark (*Heterodontus francisci*)	
Angel shark (*Squatina californica*)	
Thornback (*Platyrhinoidis triseriata*)	
Bat ray (*Myliobatis californicus*)	1
FLATFISH	
Halibut (*Paralichthys californicus*)	1
Turbots and Soles	
Sanddabs	
ROCKFISH	
Whitebelly (*Sebastodes vexillaris*)	
Treefish (*S. serriceps*)	1
Black and yellow (*S. chrysomelas*)	6
Gopher (*S. carnatus*)	4
Grass (*S. rastrelliger*)	
Kelp (*S. atrovirens*)	30
Brown (*S. auriculatus*)	2
Blue (*S. mystinus*)	20
Olive (*S. serranoides*)	1 adult, 8 juvenile, 100 young
KELPBED "BOTTOMFISH"	

SUBTIDAL TRANSECT SURVEY

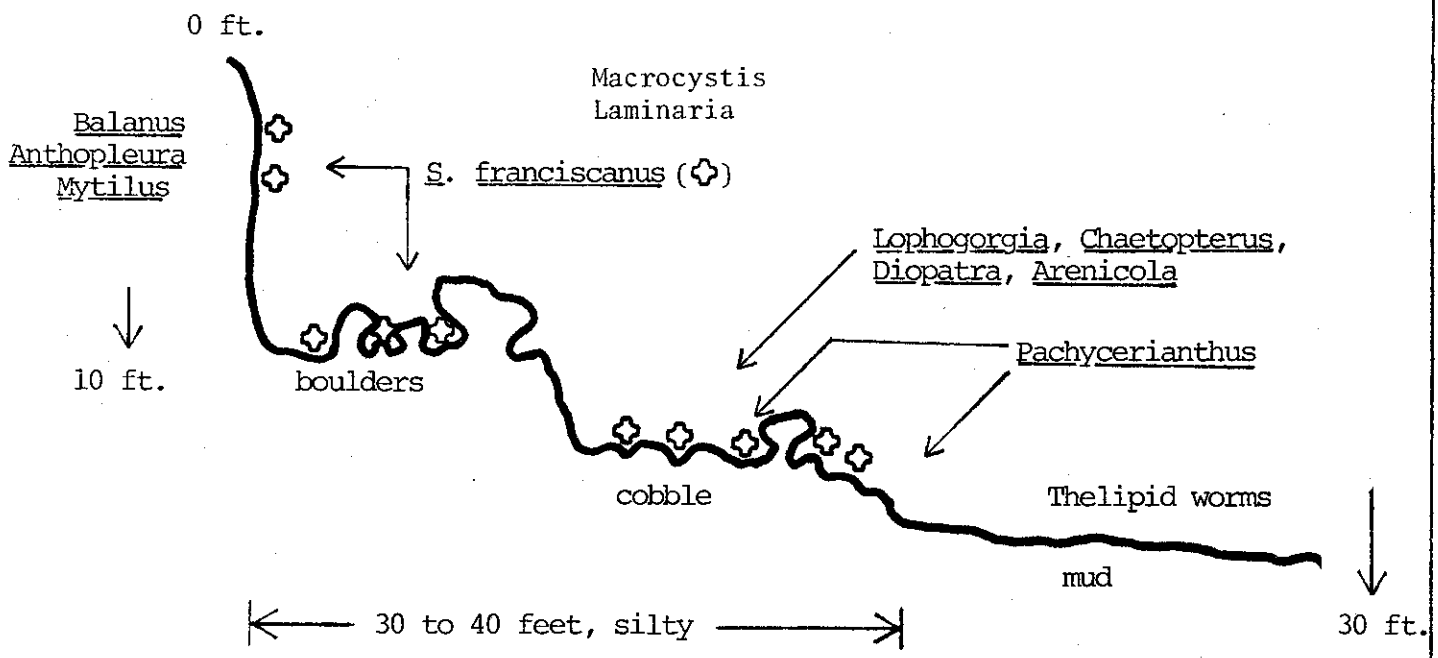
Transect Location: Prisoners Harbor

Depth Range: 0-33' Visibility: 20'

VERTEBRATES (CONT'D)	Abundance by Depth
PERCH (CONT'D)	
Island Sp. (*C. gracilis*)	
Dwarf Sp. (*Micrometrus minimus*)	
Reef Sp. (*M. aurora*)	
White Sp. (*Phanerodon furcatus*)	
KELPBED SWIMMERS AND HOVERERS	
Kelpbass (*Paralabrax clathratus*)	20
Opaleye (*Girella nigricans*)	3
Halfmoon (*Medialuna californiensis*)	2
Blacksmith (*Chromis punctipinnis*)	6
Sheephead (*Pimelometopon pulchrum*)	15
Señorita (*Oxyjulis californica*)	5

APPENDIX 3 (cont.)

SUBTIDAL PROFILE - PRISONERS HARBOR



APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Fry's Harbor

Depth Range: 0-70' Visibility: 60'+

LARGE CONSPICUOUS INVERTEBRATES	Abundance by Depth
CNIDARIA	
Hydractinia	Abundunt @ 10 & 20'
Abietinaria	
Anthopleura elegantissima	Many @ 0-10'
A. xanthogrammica	Abundunt @ 0-2'
Tealia	3@ 20',30',40'&55', 1@ 60'
Balanophyllia	Abundunt @ 20'
paracyathus	Abundunt @ 40-60'
Astrangia	
Corynactis	Abundunt @ 10-30'
Pachycerianthus	8@ 60'
Clavularia	Abundunt @ 10-55'
Lophogorgia	2@ 40', 3@ 55', 4@ 60'
PORIFERA	
Zygherpe	2@ 30'
Acarnus	1@ 20', 1@ 20'
Hymenamphiastra	1@ 55', 1@ 20'
Tethya	2@ 20', 4@ 55', 5@ 60'
POLYCHAETA	
Diopatra	Abundunt @ 55'
Chaetopterus	4@ 30', 4@ 55'
Dodecaceria	
Terebellids	Abundunt @ 60'
Eudistylia	1@ 10'
Spirorbis	Abundunt @ 20'
CRUSTACEA	
Pollicipes	
Balanus tintinnabulum	Many
Tetraclita	1@ 0-2'
Panulirus	
TUNICATES	
Styela	
Euherdmania	
trididemnum	2@ 30'
Aplidium	2@ 10'
Clavelina	
MOLLUSCS	
Haliotis cracherodii	
H. rufescens	
H. sorensoni	
H. corrugata	1@ 40', 1@ 30'
Megathura	2@ 40', 1@ 20', 3@ 10'

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Fry's Harbor

Depth Range: 0-70' Visibility: 60'+

INVERTEBRATES (CONT'D)	Abundance by Depth
MOLLUSCS (CONT'D)	
Astraea	
Serpulorbis	7@ 10'
Olivella	
Nudibranchs	Corypuella 2@ 60', 1@ 30'
Mytilus	Abundunt @ 0-2'
Psuedochama	Abundunt @ 20'
Hinnites	2@ 30', 1@ 20', 1@ 10'
Pododesmus	1@ 10'
Navanax	
Aplysia	5@ 30'
Zonaria	
Kelletia	
ECTOPROCTS	
Membranipora	
Thalamoporella	Abundunt @ 10'
Hippodiplosia	Abundunt @ 20-40'
Phidolopora	Abundunt @ 40-60'
ECHINODERMS	
Dermasterias	
[illegible]	Abundunt @ 30-60

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Fry's Harbor

Depth Range: 0-60' Visibility: 60'+

VERTEBRATES	Abundance by Depth
SHARKS AND RAYS	
Horn shark (*Heterodontus francisci*)	
Angel shark (*Squatina californica*)	2@ 60'
Thornback (*Platyrhinoidis triseriata*)	
Bat ray (*Myliobatis californicus*)	
FLATFISH	
Halibut (*Paralichthys californicus*)	
Turbots and Soles	
Sanddabs	
ROCKFISH	
Whitebelly (*Sebastodes vexillaris*)	6
Treefish (*S. serriceps*)	7
Black and yellow (*S. chrysomelas*)	14
Gopher (*S. carnatus*)	6
Grass (*S. rastrelliger*)	
Kelp (*S. atrovirens*)	Abundunt
Brown (*S. auriculatus*)	
Blue (*S. mystinus*)	Abundunt
Olive (*S. serranoides*)	2 adults, many juveniles
KELPBED "BOTTOMFISH"	
Scorpionfish (*Scorpaena guttata*)	1@ 10'
Convictfish (*Oxylebius pictus*)	Abundunt
Cabezon (*Scorpaenichthys marmoratus*)	
Garibaldi (*Hypsypops rubicunda*)	6
Blackeye goby (*Coryphopterus nicholsii*)	Abundunt
PERCH	
Rubberlip (*Rhacochilus toxotes*)	4
Black surfperch (*Embiotoca jacksoni*)	10
Rainbow Sp. (*Hypsurus caryi*)	
Striped Sp. (*Embiotoca lateralis*)	2
Kelp Sp. (*Brachyistius frenatus*)	5
Pile Sp. (*Rhacochilus vacca*)	12
Barred Sp. (*Amphistichus argenteus*)	
Calico Sp. (*A. koelzi*)	
Walleye Sp. (*Hyperprosopon argenteum*)	
Spotfin Sp. (*H. anale*)	
Silver Sp. (*H. ellipticum*)	
Shiner Sp. (*Cymatogaster aggregata*)	

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

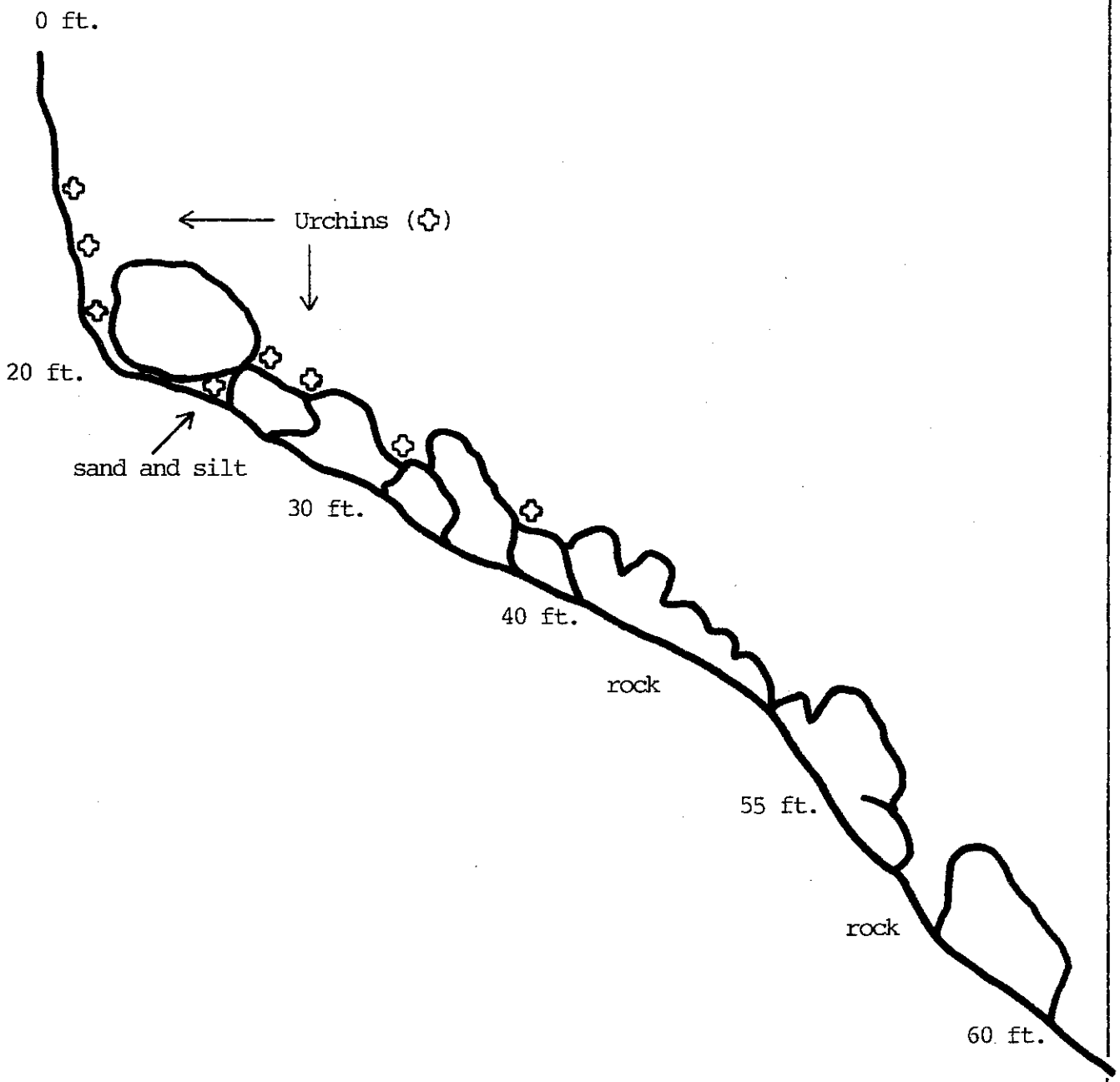
Transect Location: Fry's Harbor

Depth Range: 0-60' Visibility: 60'+

VERTEBRATES (CONT'D)	Abundance by Depth
PERCH (CONT'D)	
Island Sp. (*C. gracilis*)	
Dwarf Sp. (*Micrometrus minimus*)	
Reef Sp. (*M. aurora*)	
White Sp. (*Phanerodon furcatus*)	
KELPBED SWIMMERS AND HOVERERS	
Kelpbass (*Paralabrax clathratus*)	Abundunt
Opaleye (*Girella nigricans*)	Abundunt
Halfmoon (*Medialuna californiensis*)	1
Blacksmith (*Chromis punctipinnis*)	Abundunt
Sheephead (*Pimelometopon pulchrum*)	Abundunt
Señorita (*Oxyjulis californica*)	Abundunt

APPENDIX 3 (cont.)

SUBTIDAL PROFILE - FRYS HARBOR



APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: One cove west of Cueva Valdez

Depth Range: 0-30'

Visibility: 40+

LARGE CONSPICUOUS INVERTEBRATES	Abundance by Depth
CNIDARIA	
Hydractinia	
Abietinaria	
Anthopleura elegantissima	few @ 0-20'
A. xanthogrammica	Abundunt @ 5', 3@ 10'
Tealia	3@ 28', 2@ 22', 3@ 20', 3@ 10'
Balanophyllia paracyathus	
Astrangia	Abundunt @ 22'
Corynactis	Abundunt @ 10-20'
Pachycerianthus	2@ 30', 2@ 28'
Clavularia	Abundunt @ 22'
Lophogorgia	
PORIFERA	
Zygherpe	
Acarnus	
Hymenamphiastra	1@ 18'
Tethya	2@ 22'
POLYCHAETA	
Diopatra	12@ 30'
Chaetopterus	1@ 20'
Dodecaceria	1@ 10'
Terebellids	Abundunt @ 30'
Eudistylia	
Spirorbis	
CRUSTACEA	
Pollicipes	
Balanus tintinnabulum	
Tetraclita	Abundunt @ 0-2'
Panulirus	
TUNICATES	
Styela	
Euherdmania tridiemnum	2@ 20'
Aplidium	
Clavelina	
MOLLUSCS	
Haliotis cracherodii	1@ 5'
H. rufescens	
H. sorensoni	
H. corrugata	1@ 30', 1@ 28'
Megathura	

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: One cove west of Cueva Valdez

Depth Range: 0-30'

Visibility: 40+

INVERTEBRATES (CONT'D)	Abundance by Depth
MOLLUSCS (CONT'D)	
Astraea	
Serpulorbis	
Olivella	
Nudibranchs	
Mytilus	
Psuedochama	
Hinnites	1@ 22', 1@ 20'
Pododesmus	
Navanax	
Aplysia	1@ 28'
Zonaria	2@ 22', 1@ 20', 3@ 10', 1@ 5'
Kelletia	
ECTOPROCTS	
Membranipora	
Thalamoporella	
Hippodiplosia	Abundunt @ 20-22' on red algae
Phidolopora	
ECHINODERMS	
Dermasterias	1@ 30'
Patiria	Abundunt @ 10-30'
Pisaster giganteus	2@ 28', 2@ 20', 1@ 10', 4@ 5'
P. ochraceous	2@ 5', 4@ 1'
Orthasterias	1@ 10'
Ophiothrix	5@ 30' rare
Ophioderma	1@ 30' rare
Stichopus	2@ 30', 2@ 20', 1@ 10'
Cucumaria	2@ 30'
Eupentacta	
Strongylocentrotus purpuratus	15@ 30', 15@ 22', 2@ 5'
S. franciscanus	5@ 30', 15@ 28', 15@ 22', many at 19'
OTHER	

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: One cove west of Cueva Valdez

Depth Range: 0-30'

Visibility: 40+

VERTEBRATES	Abundance by Depth
SHARKS AND RAYS	
Horn shark (*Heterodontus francisci*)	
Angel shark (*Squatina californica*)	
Thornback (*Platyrhinoidis triseriata*)	
Bat ray (*Myliobatis californicus*)	
FLATFISH	
Halibut (*Paralichthys californicus*)	
Turbots and Soles	
Sanddabs	
ROCKFISH	
Whitebelly (*Sebastodes vexillaris*)	Many juveniles
Treefish (*S. serriceps*)	
Black and yellow (*S. chrysomelas*)	Abundunt, especially juveniles
Gopher (*S. carnatus*)	5
Grass (*S. rastrelliger*)	
Kelp (*S. atrovirens*)	5
Brown (*S. auriculatus*)	
Blue (*S. mystinus*)	Very many juveniles
Olive (*S. serranoides*)	20
KELPBED "BOTTOMFISH"	
Scorpionfish (*Scorpaena guttata*)	
Convictfish (*Oxylebius pictus*)	Abundunt
Cabezon (*Scorpaenichthys marmoratus*)	
Garibaldi (*Hypsypops rubicunda*)	
Blackeye goby (*Coryphopterus nicholsii*)	Abundunt
PERCH	
Rubberlip (*Rhacochilus toxotes*)	
Black surfperch (*Embiotoca jacksoni*)	Abundunt, especially juveniles
Rainbow Sp. (*Hypsurus caryi*)	6
Striped Sp. (*Embiotoca lateralis*)	2
Kelp Sp. (*Brachyistius frenatus*)	6
Pile Sp. (*Rhacochilus vacca*)	22
Barred Sp. (*Amphistichus argenteus*)	
Calico Sp. (*A. koelzi*)	
Walleye Sp. (*Hyperprosopon argenteum*)	
Spotfin Sp. (*H. anale*)	
Silver Sp. (*H. ellipticum*)	
Shiner Sp. (*Cymatogaster aggregata*)	10

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: One cove west of Cueva Valdez

Depth Range: 0-30'

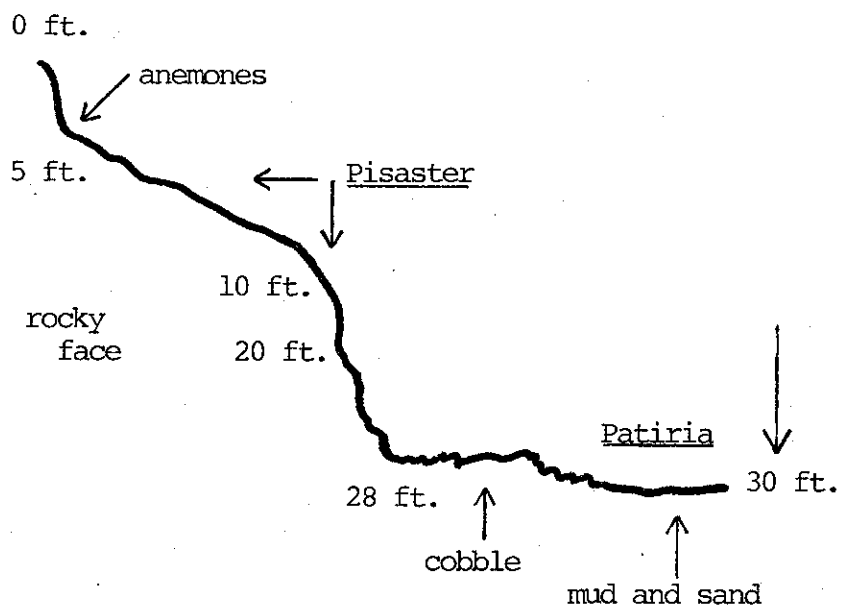
Visibility: 40+

VERTEBRATES (CONT'D)	Abundance by Depth
PERCH (CONT'D)	
Island Sp. (*C. gracilis*)	
Dwarf Sp. (*Micrometrus minimus*)	
Reef Sp. (*M. aurora*)	6
White Sp. (*Phanerodon furcatus*)	
KELPBED SWIMMERS AND HOVERERS	
Kelpbass (*Paralabrax clathratus*)	Abundunt, especially juvenile
Opaleye (*Girella nigricans*)	1
Halfmoon (*Medialuna californiensis*)	1
Blacksmith (*Chromis punctipinnis*)	Abundunt
Sheephead (*Pimelometopon pulchrum*)	1 ♂, 10 ♀
Señorita (*Oxyjulis californica*)	Abundunt

APPENDIX 3 (cont.)

SUBTIDAL PROFILE

ONE COVE WEST OF CUEVA VALDEZ



APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Wenner Cove

Depth Range: 5-30' Visibility: 40+

LARGE CONSPICUOUS INVERTEBRATES	Abundance by Depth

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Wenner Cove

Depth Range: 5-30' Visibility: 40+

INVERTEBRATES (CONT'D)	Abundance by Depth
MOLLUSCS (CONT'D)	
Astraea	
Serpulorbis	Common @ 5'
Olivella	Abundunt on sand @ 5-15'
Nudibranchs	
Mytilus	
Psuedochama	
Hinnites	
Pododesmus	
Navanax	
Aplysia	2@ 10'
Zonaria	
Kelletia	
ECTOPROCTS	
Membranipora	
Thalamoporella	
Hippodiplosia	
Phidolopora	
ECHINODERMS	
Dermasterias	
Patiria	15@ 10'
Pisaster giganteus	5@ 15'
P. ochraceous	
Orthasterias	
Ophiothrix	
Ophioderma	
Stichopus	1@ 15'
Cucumaria	
Eupentacta	
Strongylocentrotus purpuratus	Abundunt 5-30'
S. franciscanus	Abundunt @ 5-30'
OTHER	
Norissia	5@ 5'
Epiactus	15@ 30'

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Wenner Cove

Depth Range: 0-30' Visibility: 40'+

VERTEBRATES	Abundance by Depth
SHARKS AND RAYS	
Horn shark (*Heterodontus francisci*)	
Angel shark (*Squatina californica*)	
Thornback (*Platyrhinoidis triseriata*)	
Bat ray (*Myliobatis californicus*)	1
FLATFISH	
Halibut (*Paralichthys californicus*)	
Turbots and Soles	
Sanddabs	
ROCKFISH	
Whitebelly (*Sebastodes vexillaris*)	
Treefish (*S. serriceps*)	
Black and yellow (*S. chrysomelas*)	
Gopher (*S. carnatus*)	
Grass (*S. rastrelliger*)	
Kelp (*S. atrovirens*)	Abundunt
Brown (*S. auriculatus*)	
Blue (*S. mystinus*)	Abundunt
Olive (*S. serranoides*)	Abundunt
KELPBED "BOTTOMFISH"	

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

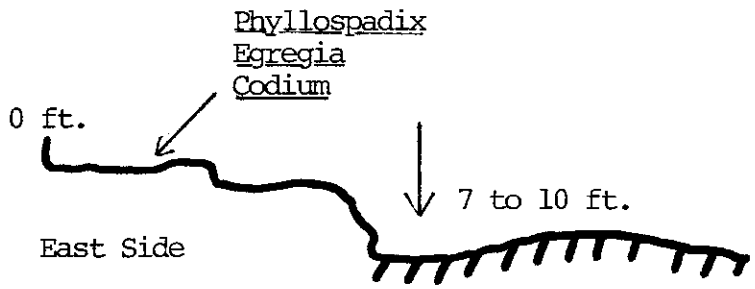
Transect Location: Wenner Cove

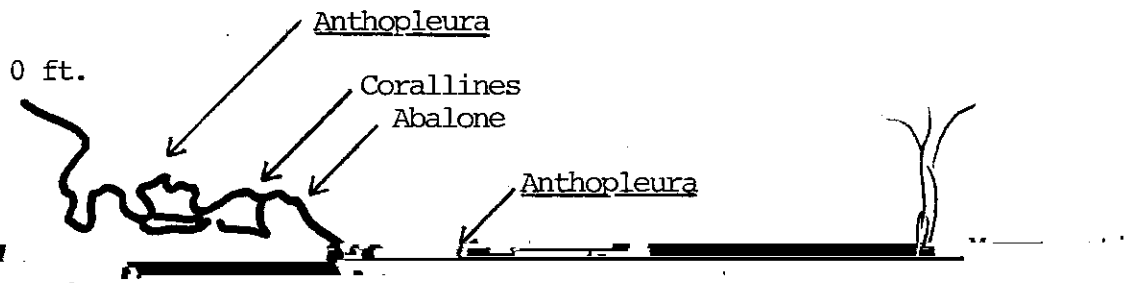
Depth Range: 0-30' Visibility: 40'+

VERTEBRATES (CONT'D)	Abundance by Depth
PERCH (CONT'D)	
Island Sp. (*C. gracilis*)	
Dwarf Sp. (*Micrometrus minimus*)	6
Reef Sp. (*M. aurora*)	Abundunt
White Sp. (*Phanerodon furcatus*)	Abundunt
KELPBED SWIMMERS AND HOVERERS	
Kelpbass (*Paralabrax clathratus*)	Abundunt
Opaleye (*Girella nigricans*)	Abundunt
Halfmoon (*Medialuna californiensis*)	8
Blacksmith (*Chromis punctipinnis*)	7 adults, abundunt juveniles
Sheephead (*Pimelometopon pulchrum*)	9
Señorita (*Oxyjulis californica*)	9

APPENDIX 3 (cont.)

SUBTIDAL PROFILE - WENNER COVE





APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Forney Cove

Depth Range: 20-30' Visibility: 30'+

INVERTEBRATES (CONT'D)	Abundance by Depth
MOLLUSCS (CONT'D)	
Astraea	
Serpulorbis	
Olivella	Abundunt on sand @ 10'
Nudibranchs	
Mytilus	
Psuedochama	
Hinnites	1@ 25', 2@ 30', 1@ 25'
Pododesmus	
Navanax	
Aplysia	7@ 25', 2@ 10'
Zonaria	1@ 30'
Kelletia	
ECTOPROCTS	
Membranipora	
Thalamoporella	
Hippodiplosia	Abundunt on red algae @ 20'
Phidolopora	
ECHINODERMS	
Dermasterias	
Patiria	25@ 20'
Pisaster giganteus	5@ 20'
P. ochraceous	
Orthasterias	
Ophiothrix	
Ophioderma	
Stichopus	3@ 20'
Cucumaria	
Eupentacta	
Strongylocentrotus purpuratus	Abundunt @ 25'
S. franciscanus	Abundunt @ 25'
OTHER	
Pagurus	3@ 15'
Renilla	3 on sand @ 15'
Phragmatopoma	Abundunt on kelp holdfast
Polymastia	common @ 25-30'
Hermissenda	1@ 25'

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Forney Cove

Depth Range: 0-30' Visibility: 30'+

VERTEBRATES	Abundance by Depth
SHARKS AND RAYS	
Horn shark (*Heterodontus francisci*)	1
Angel shark (*Squatina californica*)	2
Thornback (*Platyrhinoidis triseriata*)	2
Bat ray (*Myliobatis californicus*)	2
FLATFISH	
Halibut (*Paralichthys californicus*)	
Turbots and Soles	1
Sanddabs	2
ROCKFISH	
Whitebelly (*Sebastodes vexillaris*)	
Treefish (*S. serriceps*)	
Black and yellow (*S. chrysomelas*)	10
Gopher (*S. carnatus*)	
Grass (*S. rastrelliger*)	
Kelp (*S. atrovirens*)	Abundunt
Brown (*S. auriculatus*)	
Blue (*S. mystinus*)	Abundunt
Olive (*S. serranoides*)	Abundunt
KELPBED "BOTTOMFISH"	
Scorpionfish (*Scorpaena guttata*)	
Convictfish (*Oxylebius pictus*)	Abundunt
Cabezon (*Scorpaenichthys marmoratus*)	
Garibaldi (*Hypsypops rubicunda*)	1
Blackeye goby (*Coryphopterus nicholsii*)	7
PERCH	
Rubberlip (*Rhacochilus toxotes*)	
Black surfperch (*Embiotoca jacksoni*)	Abundunt
Rainbow Sp. (*Hypsurus caryi*)	11
Striped Sp. (*Embiotoca lateralis*)	9
Kelp Sp. (*Brachyistius frenatus*)	
Pile Sp. (*Rhacochilus vacca*)	Abundunt
Barred Sp. (*Amphistichus argenteus*)	
Calico Sp. (*A. koelzi*)	
Walleye Sp. (*Hyperprosopon argenteum*)	Abundunt, except juvenile
Spotfin Sp. (*H. anale*)	Abundunt, many juvenile
Silver Sp. (*H. ellipticum*)	
Shiner Sp. (*Cymatogaster aggregata*)	Abundunt

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

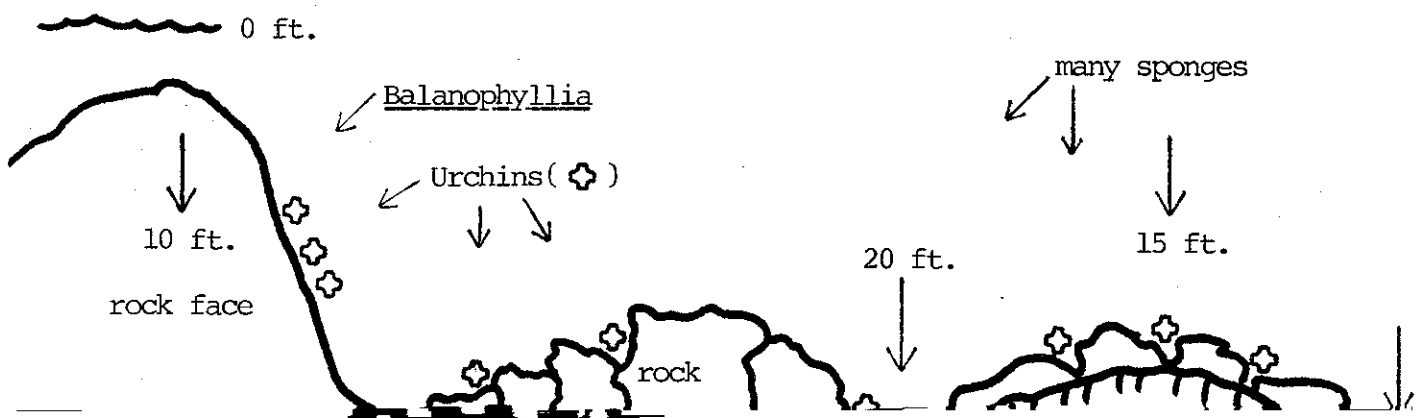
Transect Location: Forney Cove

Depth Range: 0-30' Visibility: 30'+

VERTEBRATES (CONT'D)	Abundance by Depth
PERCH (CONT'D)	
Island Sp. (*C. gracilis*)	
Dwarf Sp. (*Micrometrus minimus*)	
Reef Sp. (*M. aurora*)	9
White Sp. (*Phanerodon furcatus*)	Abundunt
KELPBED SWIMMERS AND HOVERERS	
Kelpbass (*Paralabrax clathratus*)	Abundunt
Opaleye (*Girella nigricans*)	Abundunt
Halfmoon (*Medialuna californiensis*)	12
Blacksmith (*Chromis punctipinnis*)	Abundunt
Sheephead (*Pimelometopon pulchrum*)	Abundunt ♀, 7 ♂
Señorita (*Oxyjulis californica*)	10

APPENDIX 3 (cont.)

SUBTIDAL PROFILE - FORNEY COVE



APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Morse Point

Depth Range: 0-20' Visibility: 5'

LARGE CONSPICUOUS INVERTEBRATES	Abundance by Depth
CNIDARIA	
Hydractinia	
Abietinaria	
Anthopleura elegantissima	17
A. xanthogrammica	
Tealia	
Balanophyllia	
paracyathus	
Astrangia	
Corynactis	5+
Pachycerianthus	
Clavularia	
Lophogorgia	
PORIFERA	
Zygherpe	
Acarnus	
Hymenamphiastra	
Tethya	
POLYCHAETA	
Diopatra	
Chaetopterus	
Dodecaceria	
Terebellids	
Eudistylia	1
Spirorbis	
CRUSTACEA	
Pollicipes	
Balanus tintinnabulum	
Tetraclita	
Panulirus	
TUNICATES	
Styela	1
Euherdmania	
trididemnum	
Aplidium	
Clavelina	
MOLLUSCS	
Haliotis cracherodii	
H. rufescens	11@ 15'
H. sorensoni	2@ 15'
H. corrugata	
Megathura	1

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Morse Point

Depth Range: 0-20' Visibility: 5'

INVERTEBRATES (CONT'D)	Abundance by Depth
MOLLUSCS (CONT'D)	
Astraea	
Serpulorbis	
Olivella	
Nudibranchs	
Mytilus	
Psuedochama	
Hinnites	
Pododesmus	
Navanax	
Aplysia	
Zonaria	
Kelletia	
ECTOPROCTS	
Membranipora	
Thalamoporella	
Hippodiplosia	
Phidolopora	
ECHINODERMS	
Dermasterias	
Patiria	7
Pisaster giganteus	5
P. ochraceous	
Orthasterias	
Ophiothrix	
Ophioderma	
Stichopus	2
Cucumaria	
Eupentacta	
Strongylocentrotus purpuratus	
S. franciscanus	
OTHER	
Phragmatopoma	On kelp holdfasts
Novissia	7

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Morse Point

Depth Range: 0-20' Visibility: 5'

VERTEBRATES	Abundance by Depth
SHARKS AND RAYS	
Horn shark (*Heterodontus francisci*)	1
Angel shark (*Squatina californica*)	
Thornback (*Platyrhinoidis triseriata*)	1
Bat ray (*Myliobatis californicus*)	
FLATFISH	
Halibut (*Paralichthys californicus*)	
Turbots and Soles	
Sanddabs	1
ROCKFISH	
Whitebelly (*Sebastodes vexillaris*)	
Treefish (*S. serriceps*)	
Black and yellow (*S. chrysomelas*)	
Gopher (*S. carnatus*)	
Grass (*S. rastrelliger*)	
Kelp (*S. atrovirens*)	6
Brown (*S. auriculatus*)	
Blue (*S. mystinus*)	
Olive (*S. serranoides*)	
KELPBED "BOTTOMFISH"	
Scorpionfish (*Scorpaena guttata*)	
Convictfish (*Oxylebius pictus*)	8
Cabezon (*Scorpaenichthys marmoratus*)	
Garibaldi (*Hypsypops rubicunda*)	
Blackeye goby (*Coryphopterus nicholsii*)	
PERCH	
Rubberlip (*Rhacochilus toxotes*)	
Black surfperch (*Embiotoca jacksoni*)	12
Rainbow Sp. (*Hypsurus caryi*)	
Striped Sp. (*Embiotoca lateralis*)	
Kelp Sp. (*Brachyistius frenatus*)	
Pile Sp. (*Rhacochilus vacca*)	8
Barred Sp. (*Amphistichus argenteus*)	
Calico Sp. (*A. koelzi*)	
Walleye Sp. (*Hyperprosopon argenteum*)	
Spotfin Sp. (*H. anale*)	
Silver Sp. (*H. ellipticum*)	
Shiner Sp. (*Cymatogaster aggregata*)	

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Morse Point

Depth Range: 0-20' Visibility: 5'

VERTEBRATES (CONT'D)	Abundance by Depth
PERCH (CONT'D)	
Island Sp. (*C. gracilis*)	
Dwarf Sp. (*Micrometrus minimus*)	
Reef Sp. (*M. aurora*)	
White Sp. (*Phanerodon furcatus*)	
KELPBED SWIMMERS AND HOVERERS	
Kelpbass (*Paralabrax clathratus*)	9
Opaleye (*Girella nigricans*)	
Halfmoon (*Medialuna californiensis*)	
Blacksmith (*Chromis punctipinnis*)	
Sheephead (*Pimelometopon pulchrum*)	Abundunt
Señorita (*Oxyjulis californica*)	6

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Willows Cove

Depth Range: 5-30' Visibility: 30'

LARGE CONSPICUOUS INVERTEBRATES	Abundance by Depth
CNIDARIA	
Hydractinia	
Abietinaria	
Anthopleura elegantissima	Abundunt
A. xanthogrammica	Abundunt
Tealia	
Balanophyllia	
paracyathus	
Astrangia	
Corynactis	
Pachycerianthus	
Clavularia	
Lophogorgia	
PORIFERA	
Zygherpe	
Acarnus	Few
Hymenamphiastra	
Tethya	
POLYCHAETA	
Diopatra	
Chaetopterus	
Dodecaceria	
Terebellids	
Eudistylia	
Spirorbis	Few
CRUSTACEA	
Pollicipes	
Balanus tintinnabulum	
Tetraclita	
Panulirus	Few
TUNICATES	
Styela	
Euherdmania	
trididemnum	
Aplidium	
Clavelina	
MOLLUSCS	
Haliotis cracherodii	Abundunt
H. rufescens	8
H. sorensoni	1
H. corrugata	7
Megathura	Abundunt

APPENDIX [illegible]

SUBTIDAL TRANSECT SURVEY

Transect Location: Willows Cove

Depth Range: 5-30' Visibility: 30'

INVERTEBRATES (CONT'D)	Abundance by Depth
MOLLUSCS (CONT'D)	
Astraea	1
Serpulorbis	
Olivella	Empty shells
Nudibranchs	
Mytilus	
Psuedochama	
Hinnites	
Pododesmus	
Navanax	
Aplysia	Abundunt
Zonaria	
Kelletia	1
ECTOPROCTS	
Membranipora	
Thalamoporella	
Hippodiplosia	
Phidolopora	
ECHINODERMS	
Dermasterias	
Patiria	
Pisaster giganteus	Abundunt
P. ochraceous	8
Orthasterias	1
Ophiothrix	
Ophioderma	
Stichopus	Abundunt
Cucumaria	7
Eupentacta	
Strongylocentrotus purpuratus	Abundunt
S. franciscanus	Very abundunt
OTHER	
Plumularia	4
Serpula	Abundunt
Phragmatopoma	10
Norissia	1
Octopus	2

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Willows Cove

Depth Range: 5-30' Visibility: 30'

VERTEBRATES	Abundance by Depth

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: Willows Cove

Depth Range: 5-30' Visibility: 30'

VERTEBRATES (CONT'D)	Abundance by Depth
PERCH (CONT'D)	
Island Sp. (*C. gracilis*)	2
Dwarf Sp. (*Micrometrus minimus*)	3
Reef Sp. (*M. aurora*)	Abundunt
White Sp. (*Phanerodon furcatus*)	
KELPBED SWIMMERS AND HOVERERS	
Kelpbass (*Paralabrax clathratus*)	Abundunt
Opaleye (*Girella nigricans*)	1 + abundunt juveniles
Halfmoon (*Medialuna californiensis*)	5
Blacksmith (*Chromis punctipinnis*)	Abundunt juveniles
Sheephead (*Pimelometopon pulchrum*)	1♂, abundunt juveniles
Señorita (*Oxyjulis californica*)	7, abundunt juveniles

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: East Coches

Depth Range: 0-20' Visibility: 40'

LARGE CONSPICUOUS INVERTEBRATES	Abundance by Depth
CNIDARIA	
Hydractinia	
Abietinaria	
Anthopleura elegantissima	Abundunt
A. xanthogrammica	Common
Tealia	
Balanophyllia	
paracyathus	
Astrangia	
Corynactis	
Pachycerianthus	
Clavularia	
Lophogorgia	
PORIFERA	
Zygherpe	
Acarnus	6
Hymenamphiastra	
Tethya	
POLYCHAETA	
Diopatra	1
Chaetopterus	
Dodecaceria	
Terebellids	
Eudistylia	
Spirorbis	
CRUSTACEA	
Pollicipes	3
Balanus tintinnabulum	
Tetraclita	
Panulirus	
TUNICATES	
Styela	
Euherdmania	
trididemnum	
Aplidium	
Clavelina	
MOLLUSCS	
Haliotis cracherodii	Very abundunt
H. rufescens	3
H. sorensoni	
H. corrugata	20
Megathura	15

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: East Coches

Depth Range: 0-20' Visibility: 40'

INVERTEBRATES (CONT'D)	Abundance by Depth
MOLLUSCS (CONT'D)	
Astraea	
Serpulorbis	
Olivella	
Nudibranchs	
Mytilus	Patchy
Psuedochama	
Hinnites	
Pododesmus	
Navanax	
Aplysia	
Zonaria	
Kelletia	
ECTOPROCTS	
Membranipora	Common
Thalamoporella	
Hippodiplosia	
Phidolopora	
ECHINODERMS	
Dermasterias	
Patiria	Common
Pisaster giganteus	Common
P. ochraceous	1
Orthasterias	
Ophiothrix	
Ophioderma	
Stichopus	Common
Cucumaria	
Eupentacta	
Strongylocentrotus purpuratus	Common
S. franciscanus	Common
OTHER	

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: East Coches

Depth Range: 0-20' Visibility: 40'

VERTEBRATES	Abundance by Depth
SHARKS AND RAYS	
Horn shark (*Heterodontus francisci*)	
Angel shark (*Squatina californica*)	
Thornback (*Platyrhinoidis triseriata*)	
Bat ray (*Myliobatis californicus*)	5
FLATFISH	
Halibut (*Paralichthys californicus*)	
Turbots and Soles	
Sanddabs	
ROCKFISH	
Whitebelly (*Sebastodes vexillaris*)	
Treefish (*S. serriceps*)	
Black and yellow (*S. chrysomelas*)	
Gopher (*S. carnatus*)	
Grass (*S. rastrelliger*)	11
Kelp (*S. atrovirens*)	
Brown (*S. auriculatus*)	
Blue (*S. mystinus*)	4
Olive (*S. serranoides*)	
KELPBED "BOTTOMFISH"	
Scorpionfish (*Scorpaena guttata*)	1
Convictfish (*Oxylebius pictus*)	6
Cabezon (*Scorpaenichthys marmoratus*)	1
Garibaldi (*Hypsypops rubicunda*)	
Blackeye goby (*Coryphopterus nicholsii*)	Abundunt
PERCH	
Rubberlip (*Rhacochilus toxotes*)	
Black surfperch (*Embiotoca jacksoni*)	8
Rainbow Sp. (*Hypsurus caryi*)	
Striped Sp. (*Embiotoca lateralis*)	
Kelp Sp. (*Brachyistius frenatus*)	
Pile Sp. (*Rhacochilus vacca*)	3
Barred Sp. (*Amphistichus argenteus*)	Abundunt
Calico Sp. (*A. koelzi*)	Abundunt
Walleye Sp. (*Hyperprosopon argenteum*)	3
Spotfin Sp. (*H. anale*)	
Silver Sp. (*H. ellipticum*)	
Shiner Sp. (*Cymatogaster aggregata*)	

APPENDIX 3 (cont.)

SUBTIDAL TRANSECT SURVEY

Transect Location: East Coches

Depth Range: 0-20' Visibility: 40'

VERTEBRATES (CONT'D)	Abundance by Depth
PERCH (CONT'D)	
Island Sp. (*C. gracilis*)	
Dwarf Sp. (*Micrometrus minimus*)	7
Reef Sp. (*M. aurora*)	6
White Sp. (*Phanerodon furcatus*)	
KELPBED SWIMMERS AND HOVERERS	
Kelpbass (*Paralabrax clathratus*)	Abundunt adults & juveniles
Opaleye (*Girella nigricans*)	Abundunt adults & juveniles
Halfmoon (*Medialuna californiensis*)	15
Blacksmith (*Chromis punctipinnis*)	7 juveniles
Sheephead (*Pimelometopon pulchrum*)	3
Señorita (*Oxyjulis californica*)	Abundunt adults & juveniles