Willard Bascom

LIFE IN THE BOTTOM

San Diego and Santa Monica Bays
Palos Verdes and Point Loma Peninsulas

There is great interest in the animals that live in the muddy shallow water bottom along the southern California coast because they are useful indicators of bottom conditions. These infauna respond to changes in feeding opportunities and surrounding chemical conditions by making adjustments in their species, their numbers, and their biomass.

The objective of this survey was to obtain enough data on the infauna and on some chemical characteristics of the bottom over a large area in a relatively short period of time so that some conclusions could be reached about the effects of man on the marine environment. The results of the survey are presented both in tables and on charts. They are as accurate as modern methods of navigation, biology, and chemistry permit. Such a data base is valuable both for assessing the present situation and for use by future scientists investigating changes with time.

This work depends largely on the Infaunal Index (a most convenient means of relating the response of animals to their food supply), on a precise method of determining the mass of animals in an area, and on the Project's 60-meter control survey of the southern California coast (which gives data on normal conditions). It was possible to make this extensive biological survey within the available time and resources because we made use of sampling and techniques developed in the past, primarily by Harold Stubbs and Jack Word of the Project (Word 1975, 1976, 1977).

SUMMARY AND CONCLUSIONS

During 1978, a special grab-sample survey was made of the muddy bottom in two large bays and off two prominent head-lands to determine the variety and quantity of animals living there. The results show the gradation of conditions ranging from areas greatly affected by the major wastewater outfalls to the natural, unchanged areas. No previous survey had extended far enough or covered sufficient area in detail to accomplish that. Although many samples have been taken over the years, the navigation often was unreliable, the space between samples was large, the equipment and methods varied from survey to survey, and the span of time between surveys was too great to permit one to make a synoptic assessment of conditions.

In this new survey, a pair of samples was taken at each of 300 stations, most of which were positioned along transects perpendicular to the shoreline at about 4-km (2.2-nautical-mile) intervals along 120 km (65 miles) of coast. The stations were located between Point Dume and Dana Point, off Point Loma, and in a grid around the Hyperion outfalls in Santa Monica Bay. The four principal measurements made at each station were Infaunal Index, bio-mass of infauna in grams per square meter, percent volatile

solids in the upper 2 cm of sediments, and biochemical oxygen demand (BOD) of the material in the upper 2 cm. For the purpose intended here, these parameters best define the benthic infauna and its living conditions in depths between 20 and 200 meters. Samples of the material and the animals have been retained in storage for possible additional analyses.

All navigation in the survey was done with LORAN-C, and all bottom samples were taken with a chain-rigged Van Veen grab. An explanation of how the measurements and analyses were made is provided later.

Table 1 contains all the data from the survey, but the charts (Figures 1 through 7) are a more convenient and effective way of presenting the findings. In them, one can see certain trends.

1. The four large outfalls have had major effects on the benthic infauna. The result is that the infaunal communities can be resolved into four generalized areas:

a. Immediately adjacent to some outfalls (within a few hundred meters of the center of discharge), there is an area where less than half the normal number of species of animals are present but where the biomass is about twice that in control areas; the number of individuals present is about the same as at controls. Although the bottom is anoxic and the odor of hydrogen sulfide can be strong, no sample from such areas was devoid of life. This zone is characterized by Infaunal Trophic Index numbers below 30, very high BOD, and volatile solids levels that are many times background.

b. Immediately outside the areas described above are larger areas of substantial change, characterized by In- faunal Index numbers that range from 30 to 60. There, the number of species is generally lower than in control areas, but the number of animals and the biomass tend to be ex- tremely large (there is up to 18 times as much mass of ani-mals per square meter as at control stations). The percent volatile solids and the BOD are likely to be twice normal. Some of this disturbance may be caused by acts of man other than wastewater discharge.

c. The regions where the Infaunal Index numbers range from 60 to 83 are of special interest. Although these regions are somewhat changed from their original conditions (as indicated by control data), the changes seem to be improvements. That is, the number of species present, the number of individuals, and the biomass are all above those in control areas. Suspension-feeding animals characteristic of normal bottoms are dominant.

d. Large areas of our local coastal waters have conditions equivalent to those measured at twenty-nine 60-meter control stations, which can be summarized as follows:

	Control Conditions	
	Average	Range
Infaunal Trophic Index	93 ± 0.9	83.1-99.6
Biomass (grams/sq meter)	70 ± 4.5	28-112
Volatile Solids (percent)	2.8 ± 0.1	1.8-3.8
Biochemical Oxygen Demand (mg/kg)	632 ± 38	266-1,017

Any conditions within the range of values given can be considered to be normal for depths of 20 to 200 meters on the southern California shelf.

Within these control-equivalent areas, there are regions where the infaunal population appears to be enhanced, possibly because of the effects of outfalls. If the Infaunal Index number is over 93 and the biomass is over 100 grams/sq meter, this can be considered evidence of enhancement.

2. This survey extended shoreward to water 10 meters (30 feet) deep, where--in most cases--we found Infaunal Index numbers above 83 but low biomass. This probably means that man's activities had little or no effect on the near-shore bottom, but we are not sure that information from that depth is reliably comparable to our control data. However, along virtually the entire coast, in depths of 20 meters where our data is valid, there is no substantial decrease below control conditions. Even minor changes begin several kilometers offshore. Much of the shores of Santa Monica Bay and the region south of Long Beach seem to be in their original condition.

3. For the same reason (inadequate control data), we are unable to comment on the meaning of the measurements at stations deeper than 200 meters, although this survey extended to 300 and, occasionally, 500 meters. The normal response of the animals living on this relatively steep slope, where sediments are naturally higher in volatile solids and biochemical oxygen demand, is not known. At some locations, outfall materials are shifted offshore to the steep slopes below 200 meters by large storms.

4. The changes in bottom conditions near outfalls parallel the depth contours and create a pattern that reveals the integrated effects of currents over the last few years; this is because the animals are affected by the fall-out of organic (food) particles that are distributed by currents that flow parallel to the contours.

5. Volatile solids measurements are a convenient way of determining the presence of excess organic materials in the bottom. For stations 20 to 200 meters in depth, a vola-tile solids value larger than about 4 percent usually is an outfall effect, although we can detect no major change in the infauna until values exceed 6 percent.

6. In areas where Infaunal Trophic Index numbers range from 30 to 60 (indicating that surface-feeding infauna prevail), Index numbers go down as BOD levels go up.

SELECTION OF STATION LOCATIONS

The area charted here covers over 1,500 sq km (600 sq miles) of sea. It was selected because it includes the parts of the southern California coastal waters that are most used and influenced by man. The outflow of harbor waters at Long Beach and San Diego is a possible source of pollutants, as are the large ships that pass through the area. There may be effects from tanker unloading facilities and industrial cooling water discharges. The shoreline structures (breakwaters, piers, jetties, and small boat harbors) probably cause local anomalies. The effects of the above are probably very small, but other factors may cause greater changes: Fishing pressure by commercial fishermen, sports divers, and party boats is intense; streams and city-street runoff after rains carry possible pollutants; and there is a continual aerial fallout on the sea surface of pesticides, lead, and perhaps other toxicants. Most importantly, each year four large municipal wastewater dischargers release about 500 million tons of wastewater that has been treated to various levels after its use by 10 million people and numerous industries. In all cases, the dilution factors for these wastewaters are very large, and it is not easy to discover if there are any significant detrimental effects on the sea or its life.

The first questions to be settled in attempting to survey such a large area were: How many samples will adequately cover the area and can they be taken and analyzed in the time available? Naturally, the answers were related to the availability of ships, people, and dollars. The original number of stations chosen seemed adequate at the planning stage, but the need for additional data points to settle un-certainties ultimately raised the number of stations to 300. A few of the stations had rocky bottoms and thus did not meet one important criterion for a grab survey station (a mud bottom that permits sampler penetration to at least 5 cm).

Past experience has shown that bottom conditions tend to be similar along contour lines. Therefore, depths of 10, 30, 60, 100, and 300 meters were selected initially; later, stations at 20, 45, and 200 meters and other depths were added to cover parts of the study area in more detail. Stations were then aligned along transects that are approximately perpendicular to the shoreline and spaced an average of about 4 km apart.

The area covered by this sampling program extends from Point Dume to Dana Point and includes Santa Monica Bay, the Palos Verdes Peninsula, San Pedro Bay, and the coast from Newport Beach to Dana Point. A second survey area, detached from this, is off Point Loma in San Diego County. The sea bottom between these two areas—off San Clemente, Camp Pendleton, and La Jolla—has natural conditions all the way. Natural conditions also prevail west of Point Dume.

Although the depth band between 10 and 300 meters was sampled, and the results are reported here, we do not believe Chat our criteria for normalcy are valid outside the 20- to 200-meter band. For that reason, the isolines only extend to those depths. In water shallower than about 20 meters, the change in the bottom to a sandy or rocky environment with substantial wave action sometimes excludes the Infaunal Index requirement that there be a mud bottom. In water deeper than 200 meters, the bottom drops rapidly away, causing changes in sediment grain size, light level, currents, and temperature; consequently, different animals live there. In this deeper water, the percent volatile solids is higher, and adequate control data (to establish what normal conditions should be) have not yet been obtained.

The location of transect lines was not entirely arbitrary. In San Pedro Bay, they were chosen so that the new stations fell close to a grid of stations surveyed 20 years ago by the University of Southern California; off Palos Verdes, the stations were arranged to coincide with some of Los Angeles County's long-term monitoring stations; and in Santa Monica Bay and off San Diego, the new stations are close to some that have been sampled by the Project in the past.

The irregularity of the coast and the existence of sub-marine canyons made extra stations necessary, and the need for more detailed data on the areas around the large out-falls required closer spacing of stations in those areas. Most of the additional stations were fitted to the topography. The density of our sampling stations off Palos Verdes is somewhat lower than around the other outfalls because this area has been so frequently surveyed in the past and the effects of the outfalls there are well known; the results from the Palos Verdes samples collected in this survey show no significant changes or variations that suggest that it would be worthwhile to sample in more detail.

The one-kilometer intervals in the sample grid around the Hyperion discharges shows the effects of those two out- falls in detail. The substantial effect of the canyon topography is evident in the results. In this area, the existing government charts were inaccurate and inadequate to explain the variations between samples, so we carefully re-mapped the shape of the bottom.

After the transect lines and sample depths were selected, the stations were then numbered accordingly; the first digits of each station number indicate the transect; the second set of numbers indicate the relative distance of the station from shore. The northwestern-most transect line near Point Dume is Line 1, and transect numbers in the two bays increase to the south to Line 24 near Dana Point. The Santa Monica Bay transects are Lines 1 through 12; San Pedro Bay/Orange County transects are Lines 13 to 24. When additional intermediate stations were required, their positions were designated by decimal fractions (for example, Station 10.5-1 is midway between transects 10 and 11). Transect lines off Palos Verdes and San Diego were numbered 1 to 10, the number being preceded by "PV" or "SD," as appropriate. If necessary in future surveys, additional stations can be added using the same numbering scheme.

REPLICATION AND THE USE OF PAST DATA

The number of grab sample replicates required to obtain statistically meaningful biological data is a long-debated subject. Various laboratories (including this one, in past years) take 3, 4, 10, or even 20 replicates. If the purpose of a survey is to determine with assurance that every species of animal living in the neighborhood of each station has been found, many replicates are useful. However, that was not our objective. In this survey, we took one sample at each station for biology and a second for chemistry; both had to meet our quality criteria. Past experience has shown that carefully taken benthic samples repeat each other with very minor variations. Once it is established that the experimental variability is small, there is little value in replication. We preferred to spend the available resources covering a much larger area. We have no doubt that, for the purpose of assessing coastal conditions, further replication is not necessary.

The Coastal Water Research Project had been sampling and studying the Southern California Bight, including the bay and headland waters sampled in this survey, for more than 8 years when we decided to make this special survey. We had examined all available information from the many scientists who had preceded us in this work. This literature search covered data from the Albatross expeditions of the 1890's as well as many more recent surveys. Much good work has been done, many valuable samples taken, and numerous analyses made by persons from the University of California, the University of Southern California, Occidental College, California State University at Long Beach, and the large municipal wastewater dischargers. In previous assessments we made use of that data whenever possible.

However, there were problems in utilizing past data: (1) The measurements extended over many years, during which natural or manmade conditions may have changed substantially, (2) the positions of stations were rarely known precisely, (3) many different types of sampling and measuring devices had been used, (4) each investigator had a different point of view or reason to do the work—each asked different questions of the sea and made different analyses of the samples obtained, (5) there are substantial recent improvements in the accuracy of methods of chemical analysis, (6) the taxonomy and biology of the local animals is now much better known, and (7) some of the measurements that we feel are essential to assessing bottom conditions were not made in the past.

We decided, therefore, to begin again and make a new survey that would be useful both now and in the future.

SAMPLING EQUIPMENT AND METHODS

The equipment and methods used for this survey have been tested by this project as well as by others over a period of years; they have been reported elsewhere, but a short review may be helpful.

Through the courtesy of the various wastewater dischargers, we were able to use their small (13- to 20-meter length) survey ships—the Marine Surveyor, Sea-S-Dee, Enchanter IV, and Monitor II. All navigation was done with LORAN-C (Model C receiver, SRD Laboratories, Middletown, Calif.), which gives sample location in the LORAN grid within about 20 meters. If necessary, positions can be converted to latitude and longitude by anyone with a LORAN-C chart. Once equipped with this precise and convenient navigational device and a high-quality echo sounder (Honda Model HE-103-C, 50 kHz), we were able to improve the charts of the sea floor, including the Santa Monica submarine canyon. In doing this, we found numerous variations from the depths given on official LORAN charts (No. 18746 and 18744). Therefore, some of the depth contours shown on the charts in this paper were revised by us and do not coincide with those on the official charts.

The principal sampling device used was a chain-rigged Van Veen grab originally developed elsewhere and revised by our group after much usage (manufactured by Kahl Scientific Co., San Diego). We find that this grab takes virtually un-disturbed 0.1-sq-meter samples of mud bottoms; mounds and tracks made by animals usually reach deck level intact, and the light surface constituents of the mud are still present. Tests made for the U.S. Environmental Protection Agency (Contract No. R801152; Word et al. 1976; Word 1977) demonstrated the superiority of this sampler to other types. It is about equivalent to a box corer for the purpose of capturing the infauna or protecting sample surfaces, and it is much more convenient to use. This grab triggers on bottom contact about 98 percent of the time in reasonably calm weather.

As previously mentioned, two grab samples were taken at each station, one for biology and the other for chemistry; water depth given by the ship's echo sounder was confirmed by means of a metering wheel on the winch.

When a biology grab is retrieved, it is placed in a rectangular plastic basin. The hinged top of the grab, which consists of a 0.5-cm screen and a rubber flap, is raised so that the surface of the sea bottom lies revealed, still covered with water. At this time, any special bottom features (including smell, texture, color, unusual animals or materials, etc.) are noted. The grab jaws are then opened so that the mud flows into the plastic basin whence it is then washed into a box with a bottom made of 1-mm screen.

The animals and other matter remaining on the screen are re- moved, preserved in plastic bags (Whirl-Pak) partly filled with a 5 percent formalin/seawater solution buffered with borax, and returned to the laboratory.

The grab sample to be used for chemical analysis was brought aboard and opened in a similar way to expose the un- disturbed bottom. Then a syringe-type corer 2.6 cm in dia- meter was used to sample the upper 2 cm of mud (usually four such small cores are taken). The chemical sampling depth of 2 cm was chosen because we wanted the results to represent present conditions. The character of the bottom changes with time, being eroded by storm waves and/or covered by new sediments. By taking only the uppermost 2 cm, one reduces the chance of measuring former conditions that may have influenced the animals living there 10 or more years ago but now are covered over.

Samples to be used for volatile solids and BOD analysis or for metals analyses are put in 120-ml presterilized plastic jars; samples to be analyzed for chlorinated hydro-carbons are put in glass jars with aluminum foil covers. All are presterilized, labeled, and refrigerated at once.

At 65 stations in Santa Monica Bay, an automatic camera that takes strobe-lighted photos with Kodachrome film at 3-minute intervals was lowered. The intense flash (25-watt- seconds in 0.12 microsecond) permits the use of Kodachrome or Ektachrome films at high f-stops. A small bag of squid was used to attract animals; although it seemed to create interest, it is rare to see a fish eating in the photographs. Usually there were fish in the first photo; they were not disturbed by the flash, and their numbers increased through- out the half hour the camera was on station. Examples of such photos have been published in the past; when this part of the survey is completed, it will be reported.

LABORATORY METHODS

The plastic bags full of animals and bottom material larger than 1 mm were delivered to our taxonomy group, whereupon the following steps were taken. The samples were rescreened under a freshwater spray that removed the formalin; the solid material was transferred to jars containing 70 percent ethanol solution. The invertebrates were sorted into seven categories and placed in glass vials (polychaetes, molluscs, crustaceans, ophiuroid fragments, ophiuroid discs, other echinoderms, and miscellaneous organisms). Debris was placed in another vial (shells of long-dead animals fall in-to the category of debris, along with small rocks, worm tubes, grass cuttings, twigs, plastic bits, fish line, aluminum foil, etc.).

Each of the seven vials was sorted for Infaunal Index animals, which were then counted. The total weight of each of the seven groups was obtained by placing the damp animals in a tared plastic tube with a screen on the bottom end. Five minutes were allowed for moisture at the bottom of the tube to be transferred to the blotter-like paper towel on which it was placed. Then the total weight of tube and animals was obtained to the nearest milligram. Total bio-mass is then the sum of all the weights of the animals collected (including their shells) less the weights of their containers. Relatively large animals, such as urchins, starfish, and fish were weighed separately; their weights are not included in the total biomass values.

After the results were logged, the vials of animals in alcohol from each site were wrapped together and stored for possible future use. These samples could be of value to some future scientist who wants information about some aspects of this survey on which we are not reporting.

The plastic bag of sediment intended for volatile solids and BOD measurements is usually frozen when it arrives in the laboratory. The sample is then homogenized, and a 5- to 10-gram subsample is placed in a tared beaker, dried for 24 hours at 105°C and weighed again, the result being the dry weight of the sample. The beaker is then placed in a muffle furnace at 550°C for 1 hour to volatilize the organic fraction and then weighed a third time. The difference between this weight and the dry weight permits the calculation of the percent volatile solids.

For the BOD measurement, a 0.5- to 2-gram sample of the homogenized sediment is weighed in a tared aluminum pan. The sample is placed in a 300-ml BOD bottle, which is then filled with oxygen-saturated seawater (at 20°C under standard conditions, it contains 8 parts per million of dissolved oxygen). One milliliter of bacterial seed solution (a culture of ocean bottom bacteria maintained on digested sludge) is added. The bottle is then sealed and stored for 5 days in the dark at 20°C with 15 seconds of agitation per day. At the end of the 5 days, dissolved oxygen is determined by the Winkler-azide method, and the amount of oxygen remaining is calculated in milligrams of oxygen per kilogram of sediment (dry weight).

For the present, the subsamples of sediment to be analyzed for metals and chlorinated hydrocarbons are stored in freezers. We do not plan to analyze these samples until there is a specific need for that data.

ACKNOWLEDGMENTS

From the beginning this survey was known as the Bascom Survey because the author wished to take full responsibility for making such a large effort using techniques that were then regarded as unorthodox by some biologists (for example, the lack of replicates, the reliance on the Infaunal Index, and the minimal bottom chemistry). Our scientific responsibility was to cover a large area with a survey that would amply cover all areas affected by man while keeping costs within budget.

As with virtually all of the Project's work, the survey was the cooperative effort of many staff members, especially Harold Stubbs and Michael Moore, who took most of the samples; Jack Word and his group of taxonomists, who sorted, counted, weighed, and identified the animals; and Henry Schafer, who did the volatile solids and BOD analysis. All of us thank the Cities of Los Angeles and San Diego, as well as the Sanitation Districts of Los Angeles and Orange Counties, which donated the shiptime to this work.

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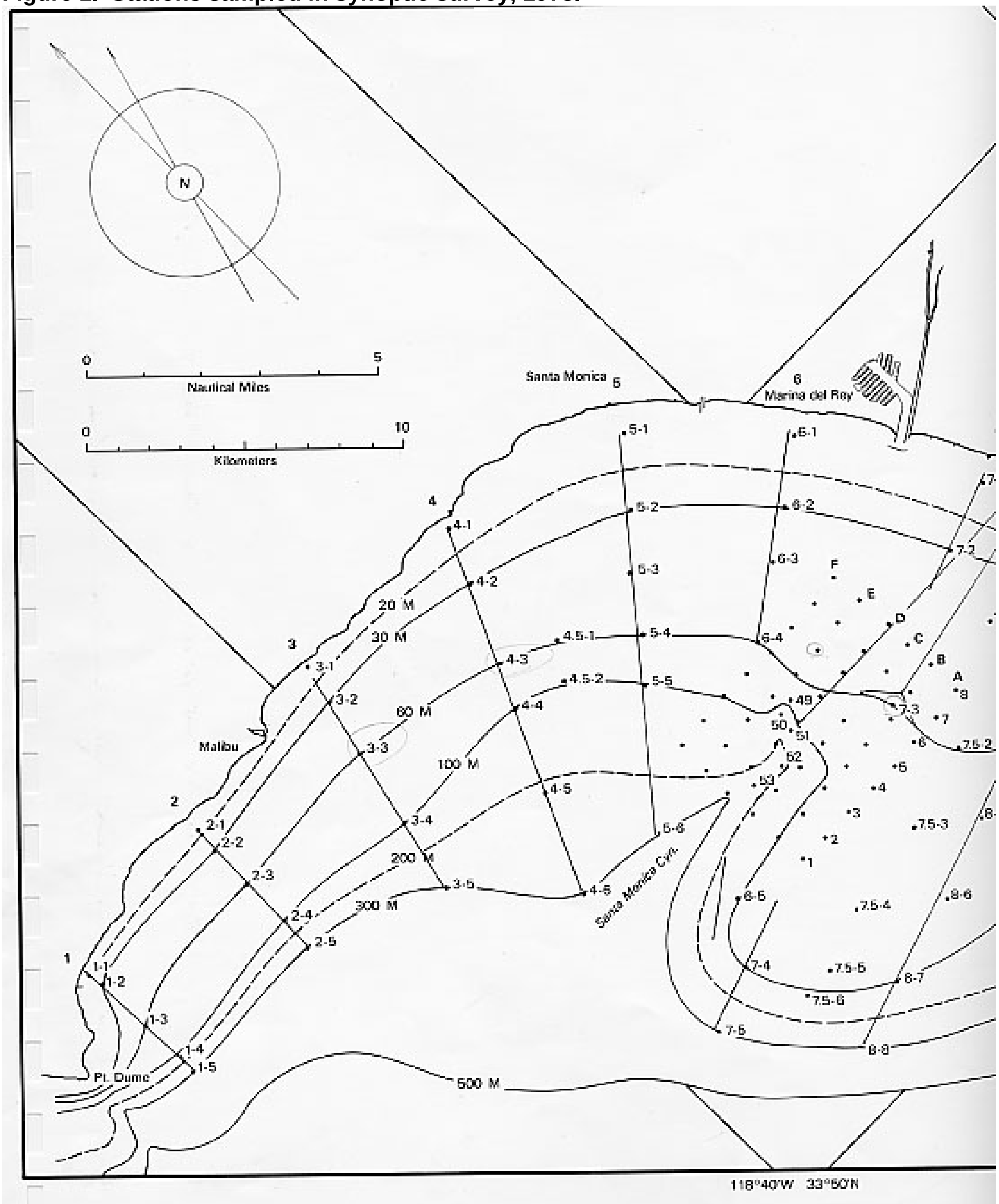
Figure 1. Stations sampled in synoptic survey, 1978.



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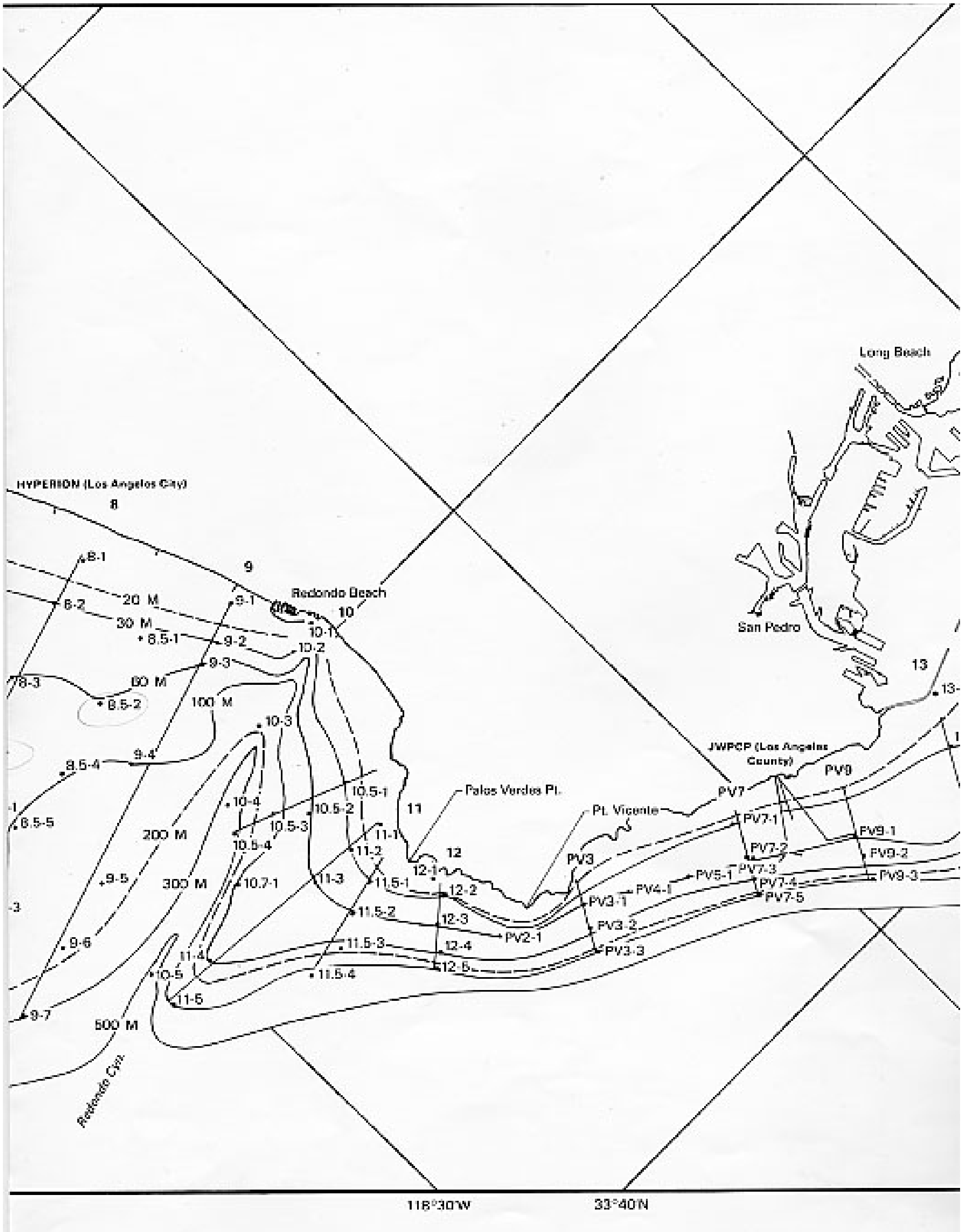

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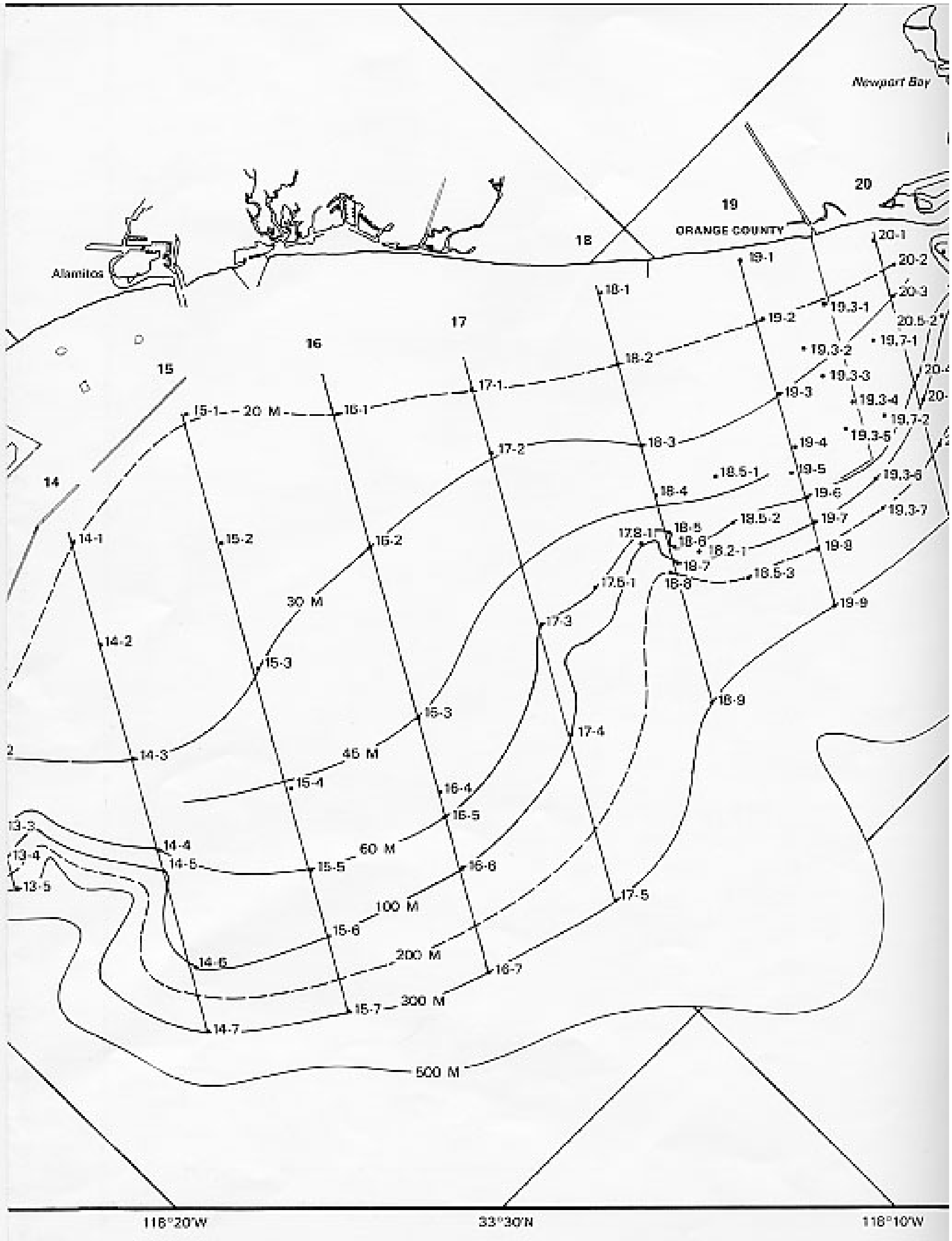

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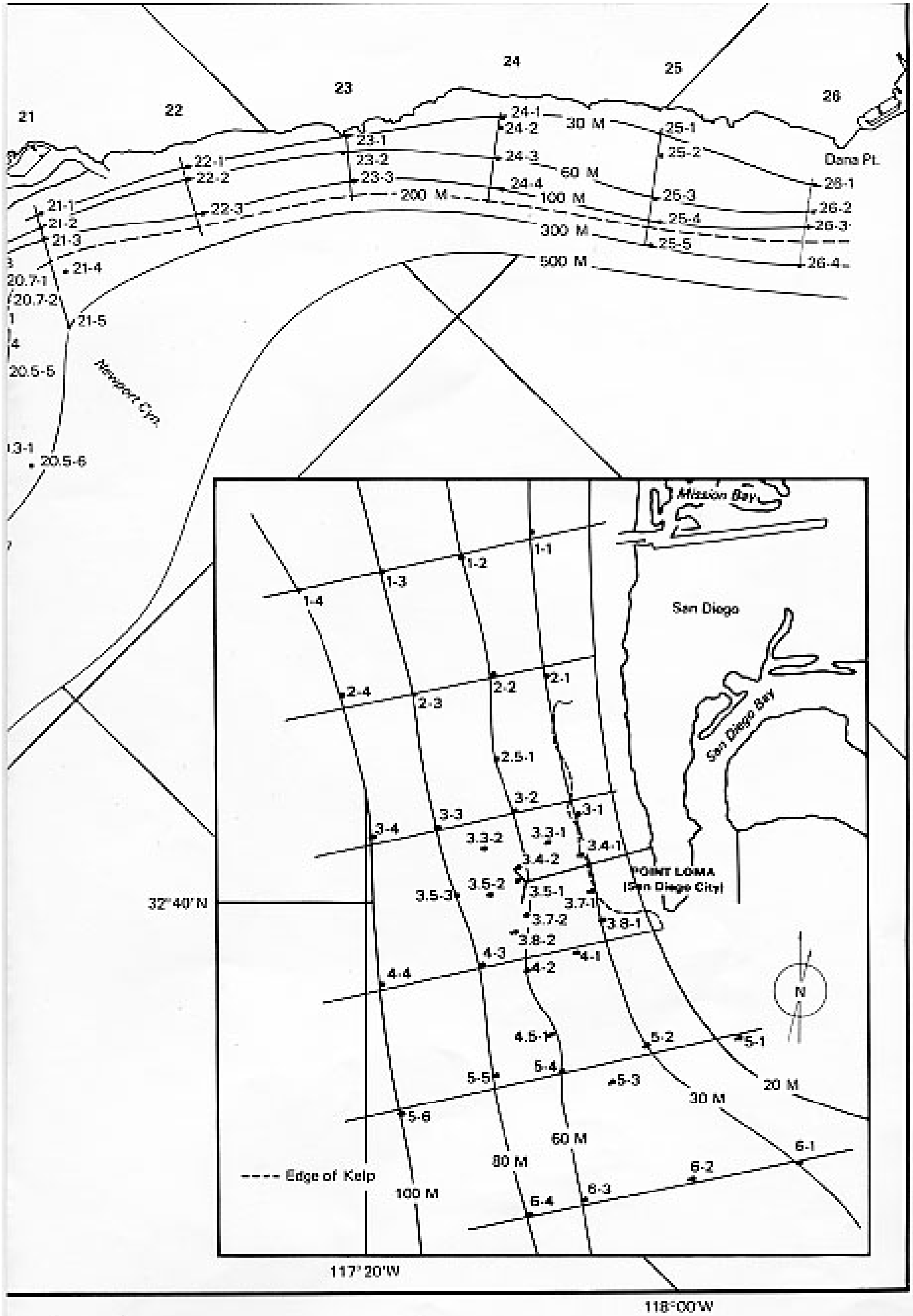
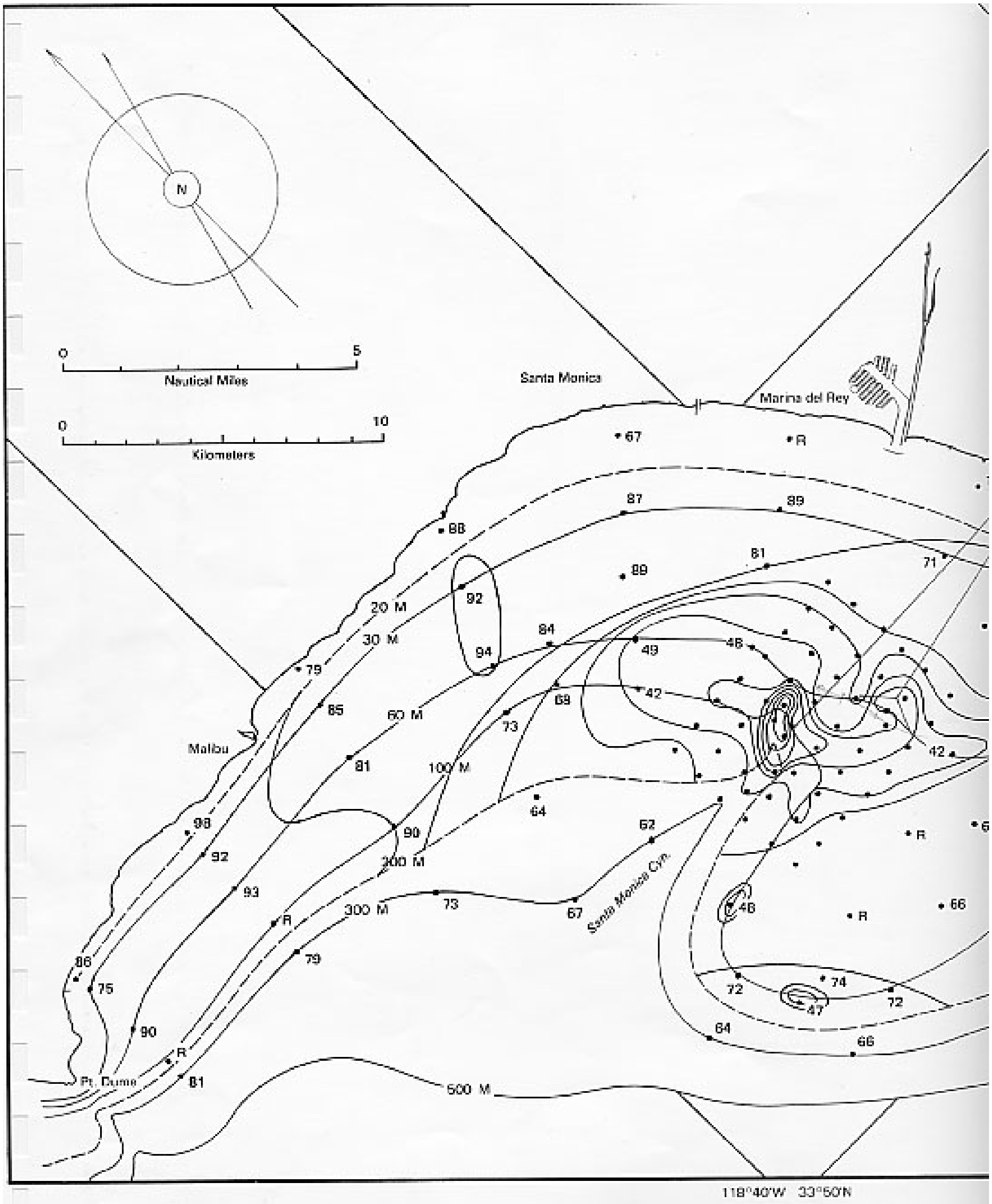


Figure 2. Infaunal Index vales, synoptic survey, 1978. Values for the grid of stations around the Hyperion outfalls are shown in Figure 4. "R" means rocky bottom.



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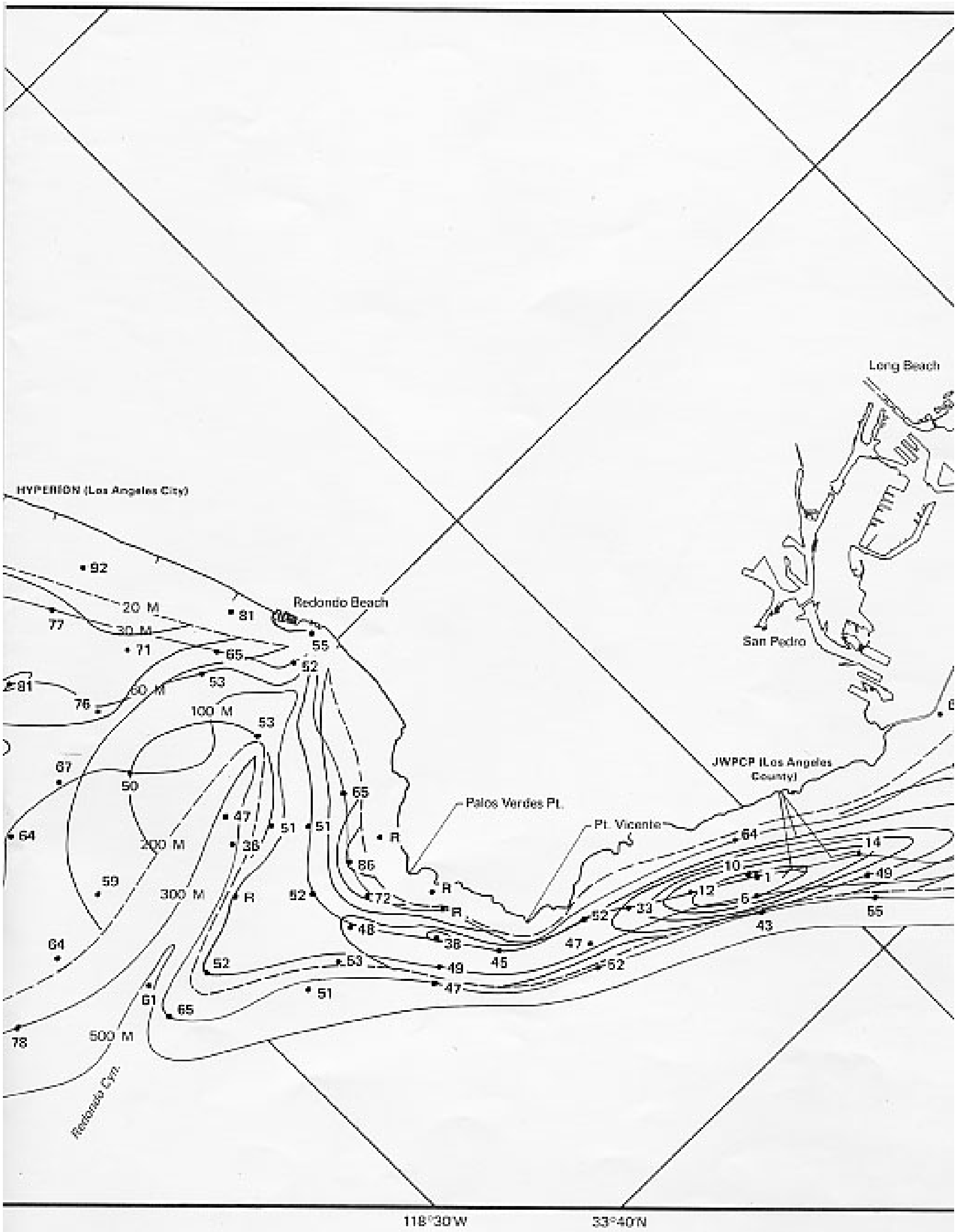

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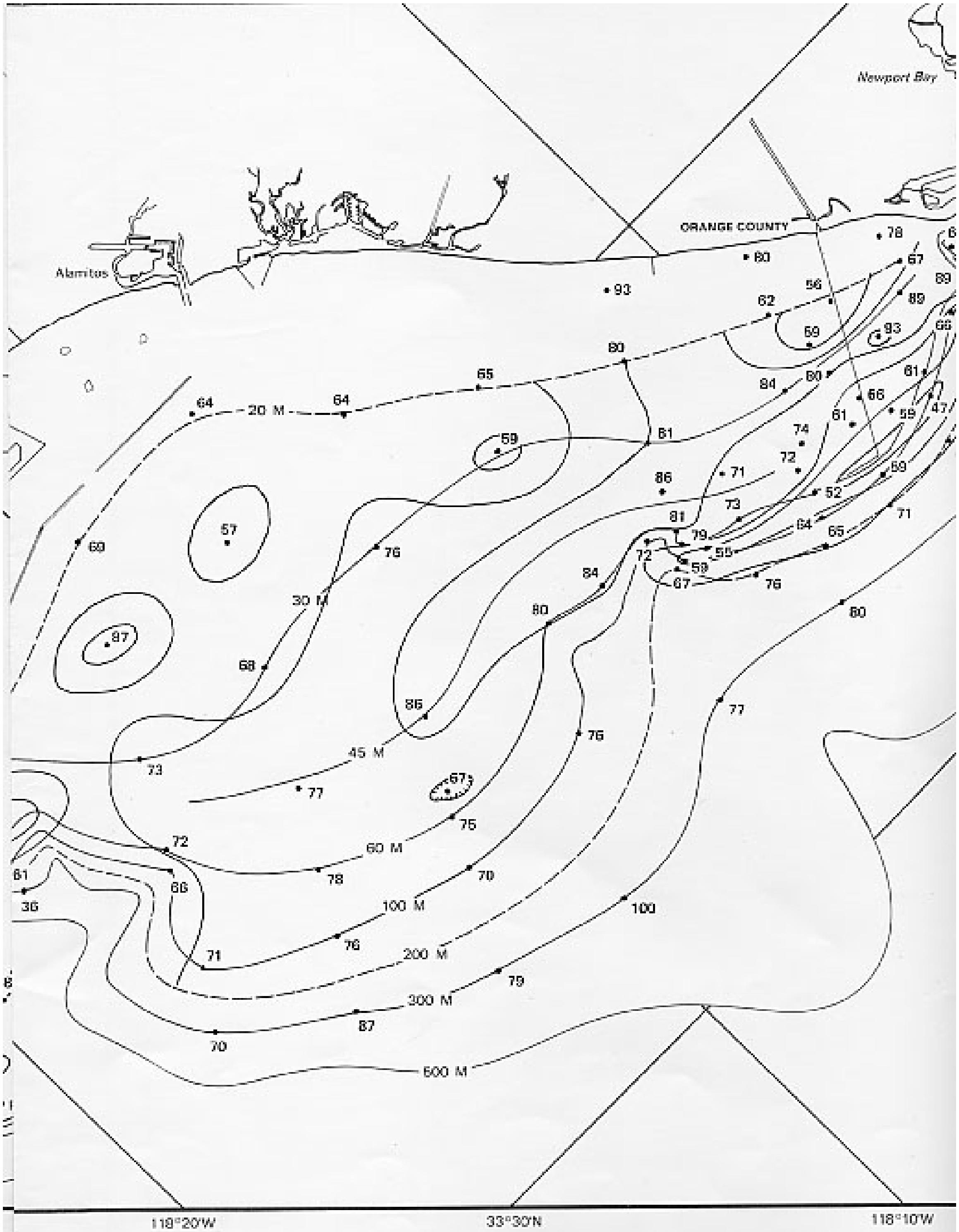

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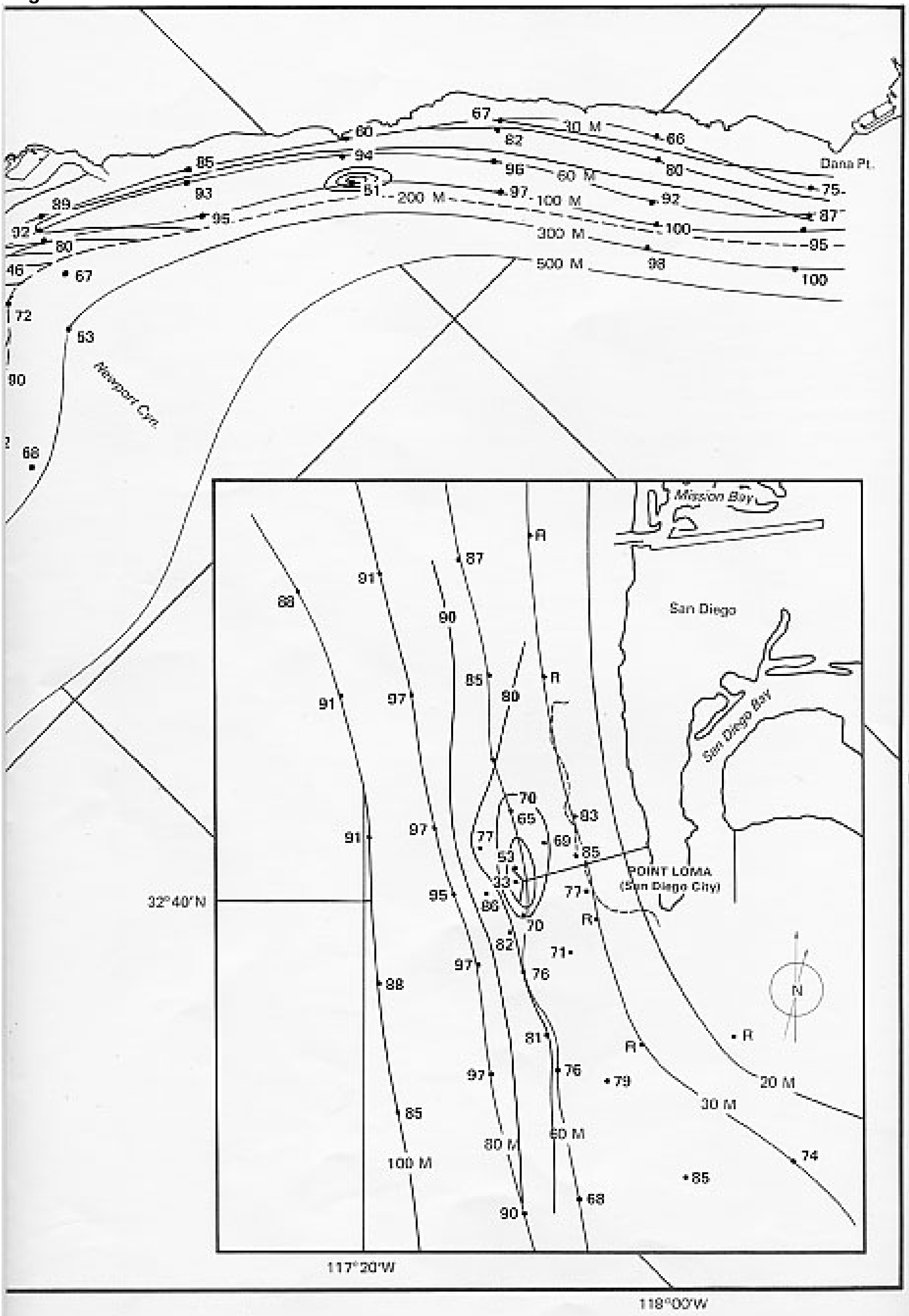
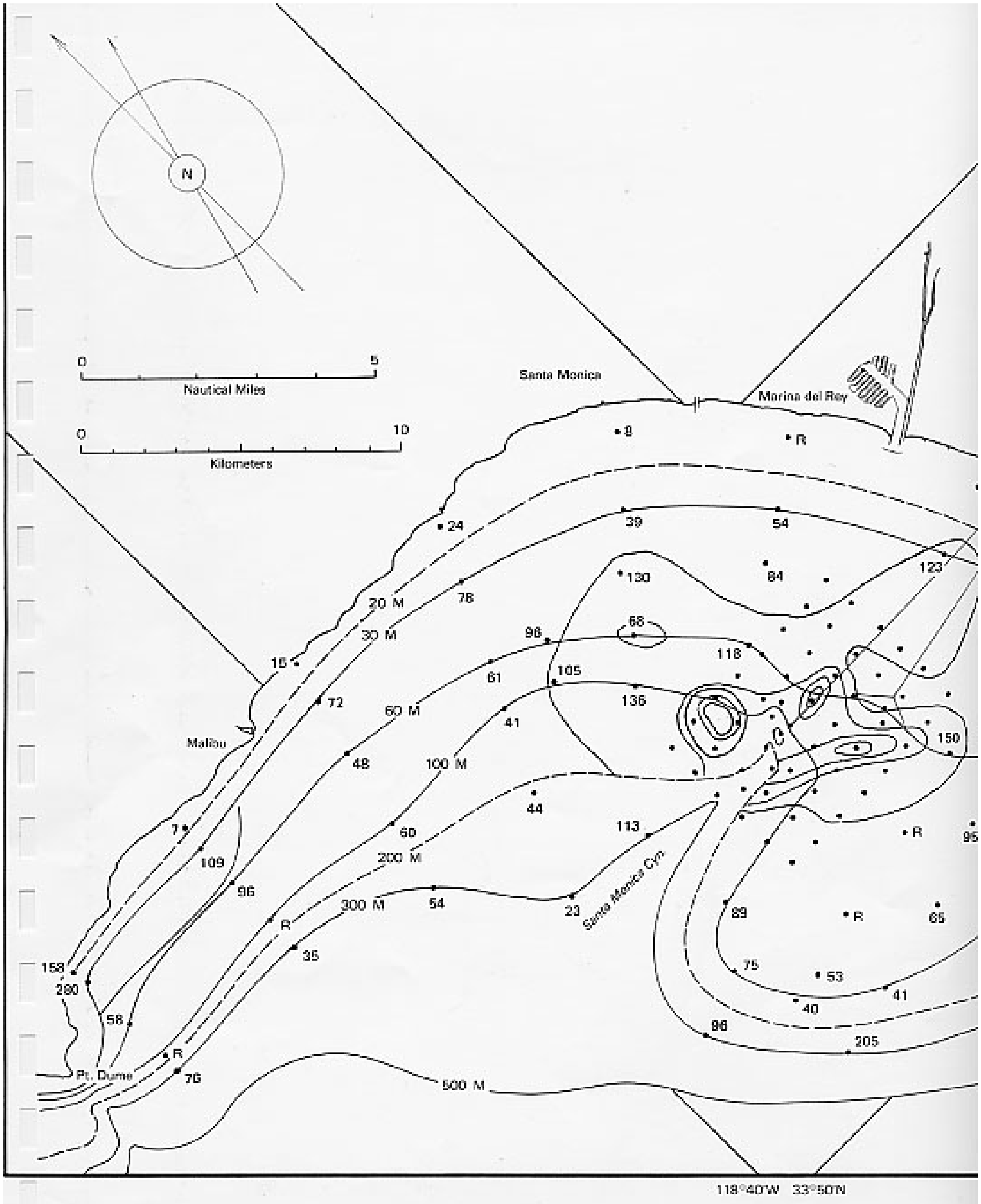


Figure 3. Infaunal biomass (grams/sq meter), synoptic survey, 1978. Values for the grid of stations around the Hyperion outfalls are shown in Figure 5. "R" means rocky bottom.



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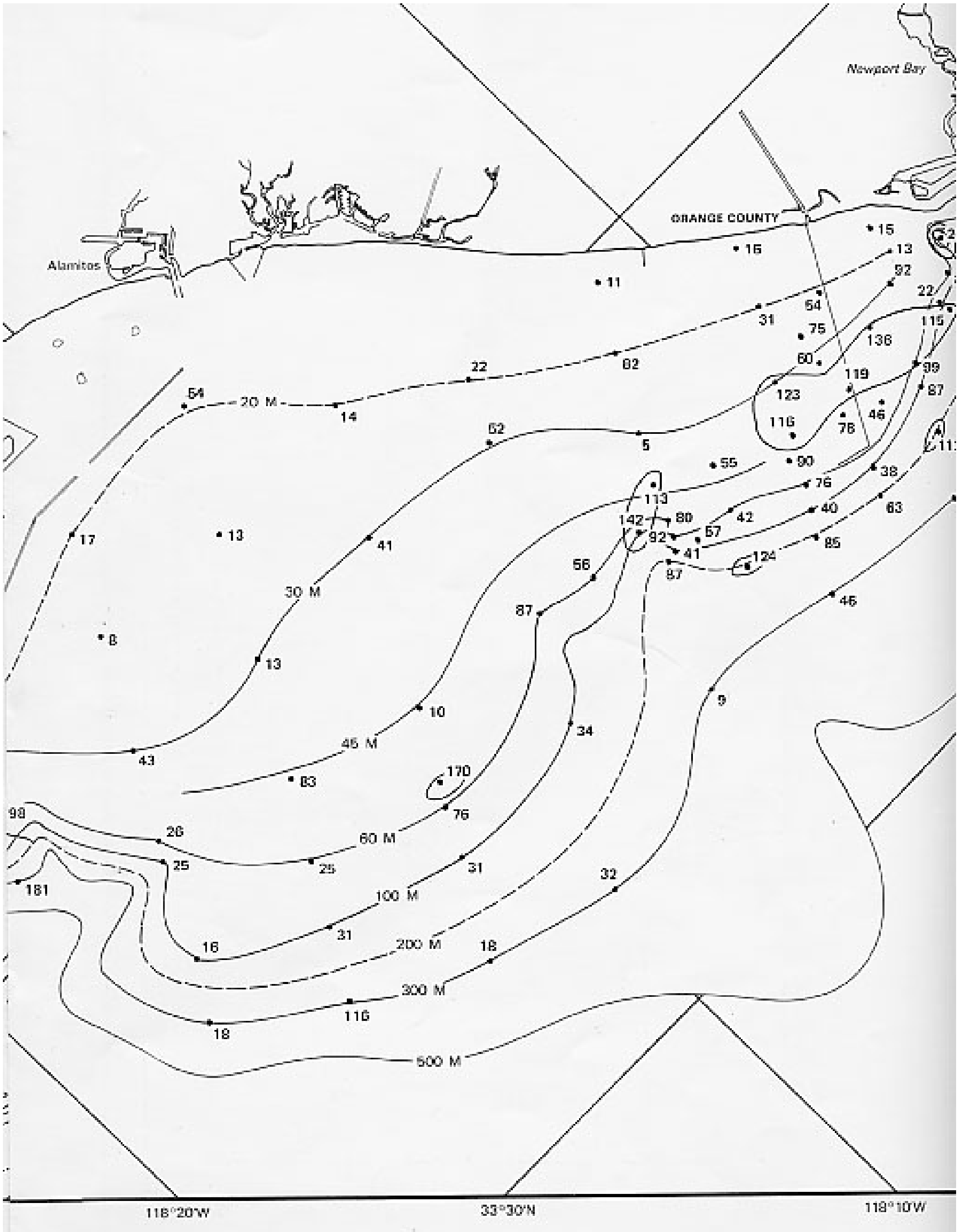

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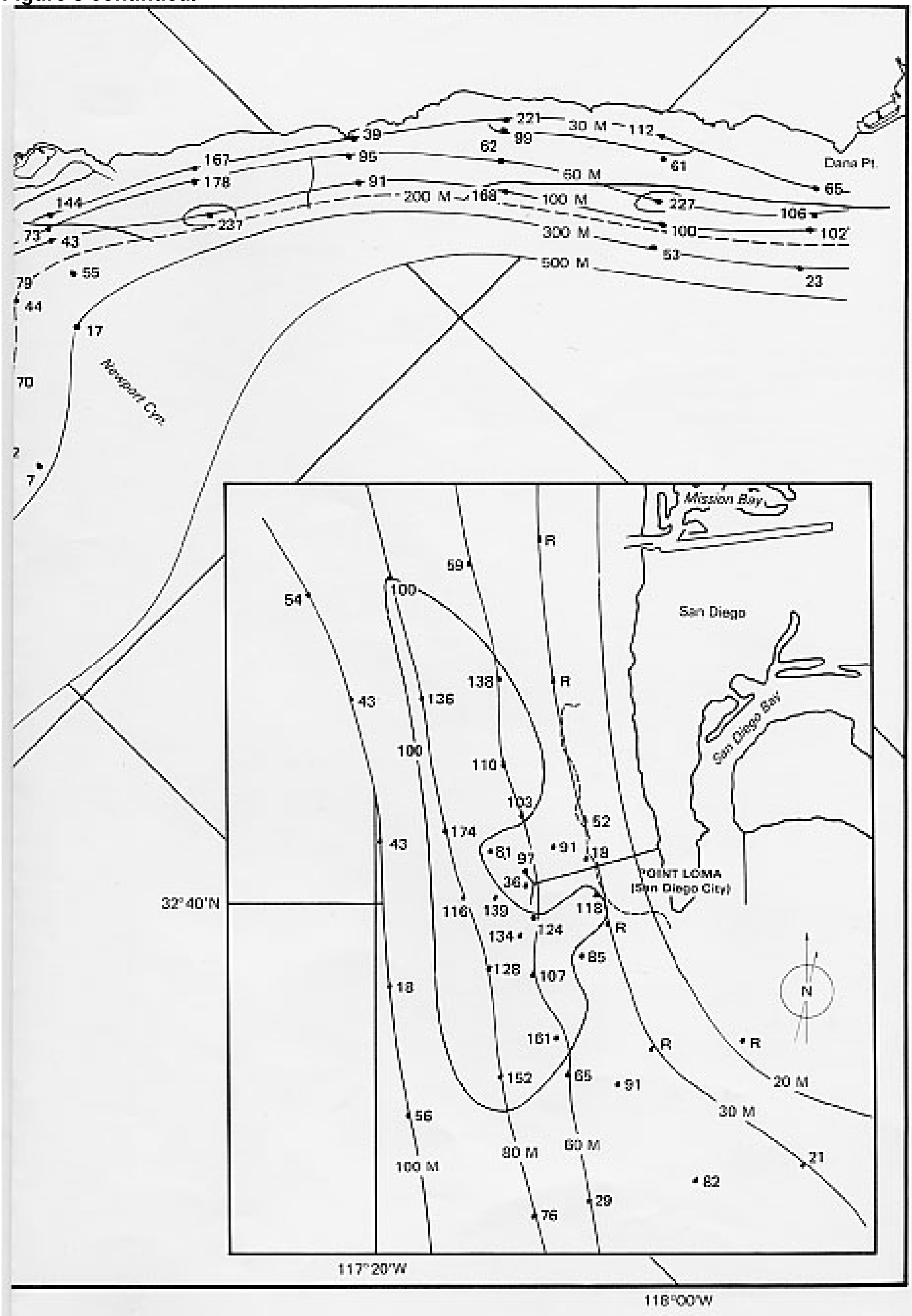

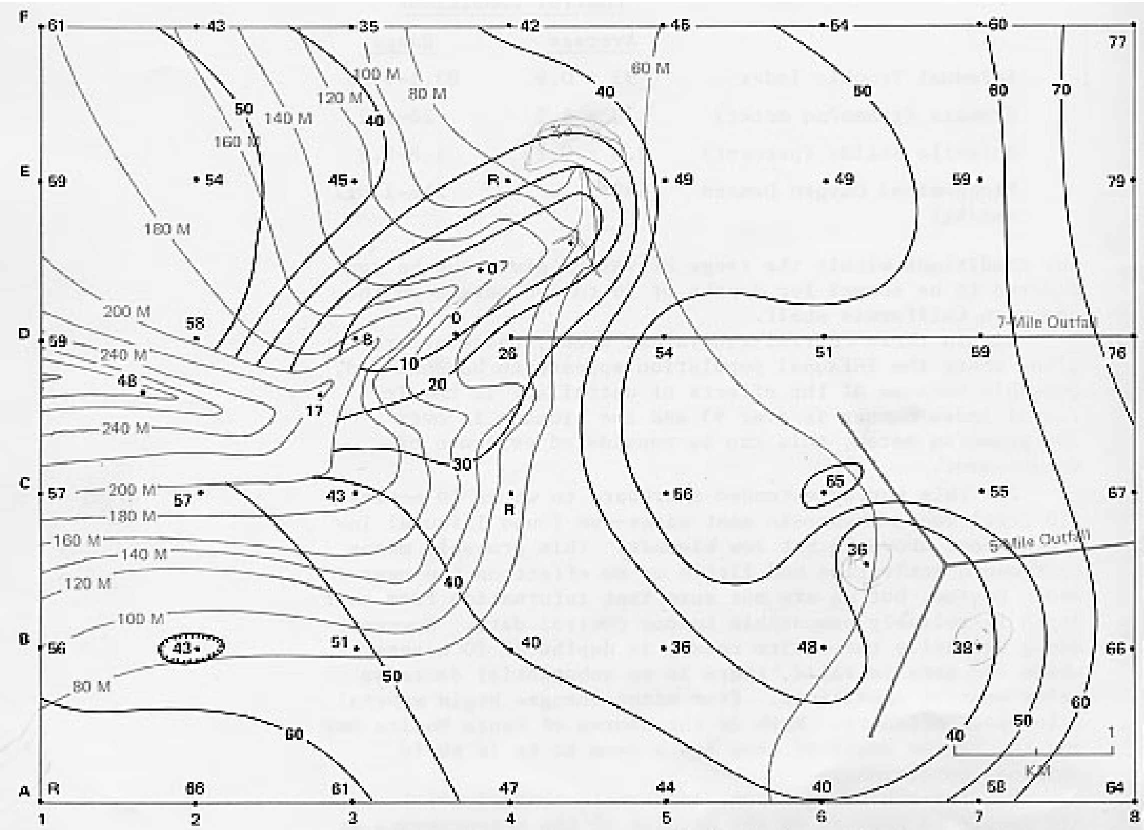

Figure 4. Infaunal Index values for Santa Monica Bay inner grid stations, synoptic survey, 1978. "R" means rocky bottom.

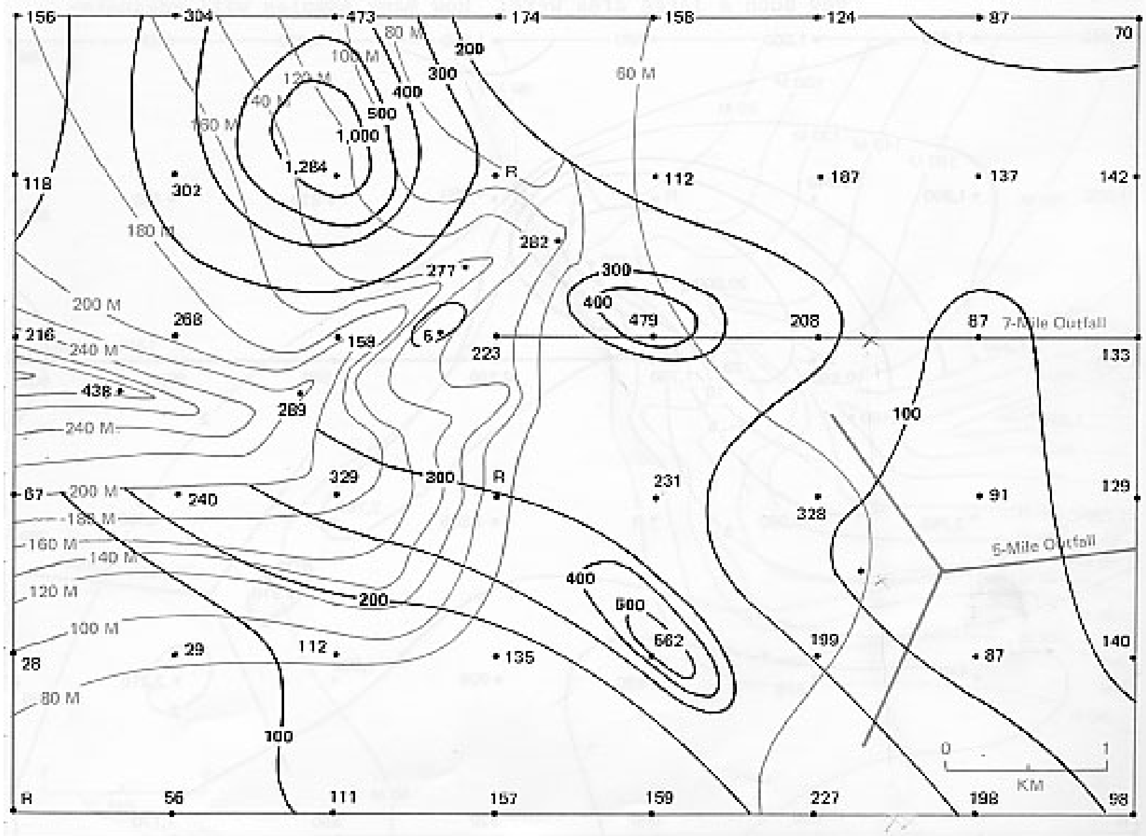

Figure 5. Infaunal biomass (grams/sq meter) at Santa Monica Bay inner grid stations, synoptic survey, 1978. "R" means rocky bottom.

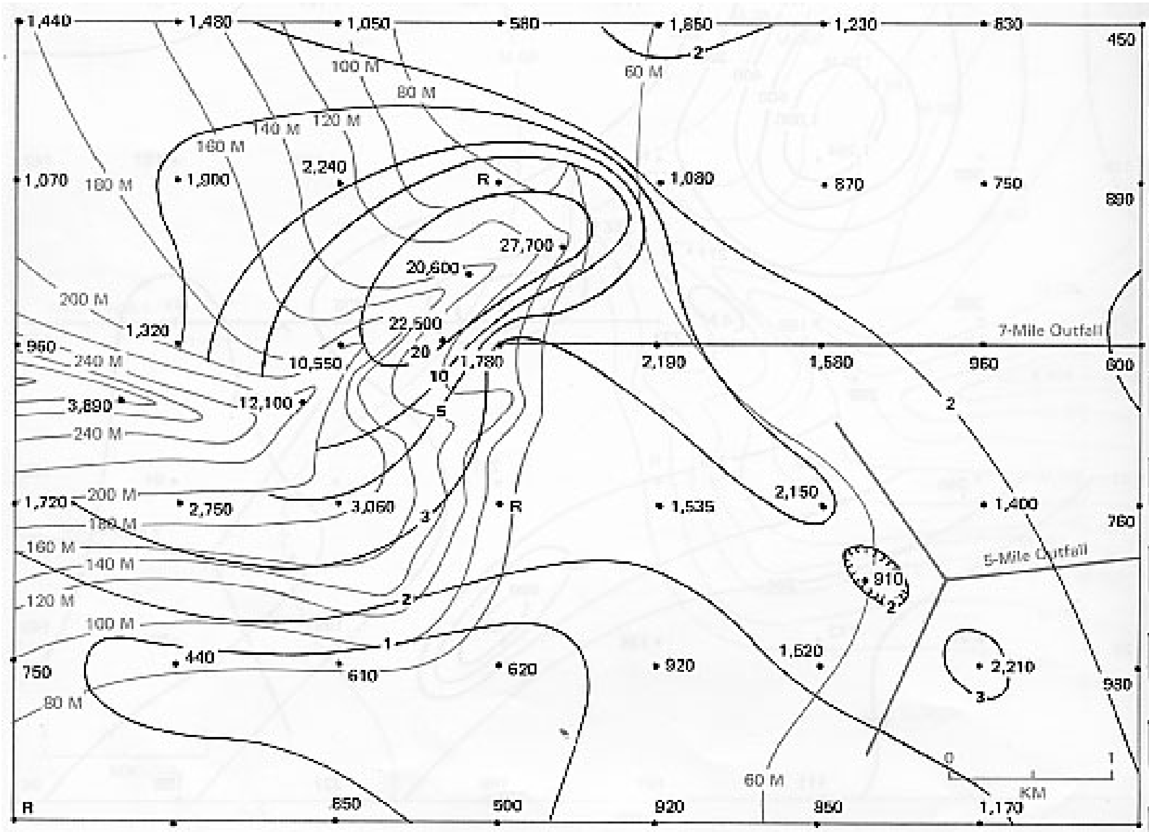

Figure 6. Sediment BOD (mg/dry kg) at Santa Monica Bay inner grid stations, synoptic survey, 1978. "R" means rocky bottom.

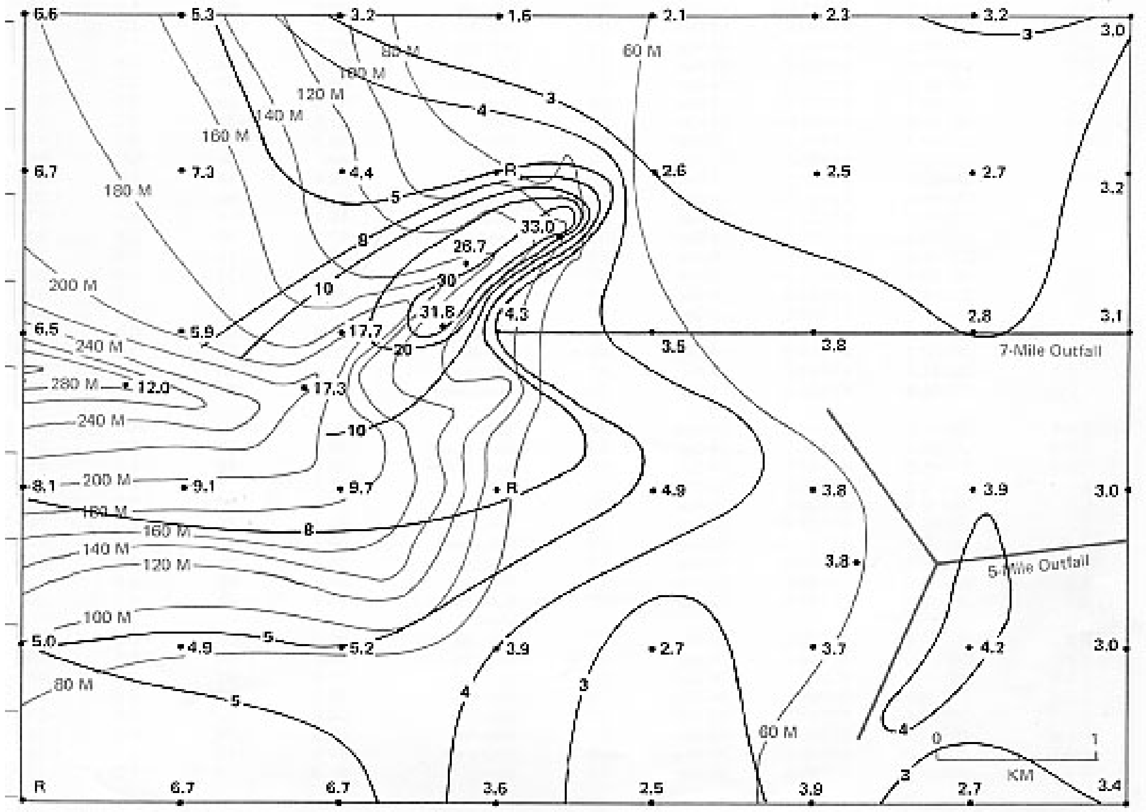

Figure 7. Percent volatile solids in sediment at Santa Monica Bay inner grid stations, synoptic survey, 1978. "R" means rocky bottom.

Table 1. Results of synoptic survey, 1978.*

Station	LORAN-C Position LOP 1	LOP 2	Date	Depth (m)	Bottom Material	In-faunal Trophic Index	Bio-mass (g/sq m)	% Vola-tile Solids	BOD (mg/kg)
Santa Monica Bay									
1-1	28126.5	41224.9	22 May	11	Sand	86.3	158	1.0	460
1-2	28126.2	41222.5	22 May	29	Silty sand	74.5	280	4.6	1,240
1-3	28127.4	41218.5	22 May	60	Sandy silt	89.8	58	3.1	1,210
1-4	28126.9	41215.3	22 May	107	Rocks	NA	NA	NA	NA
1-5	28126.5	41214.4	22 May	310	Sand	81.1	76	4.9	2,030
2-1	28138.4	41208.0	22 May	10	Sand	98.2	7	1.3	370
2-2	28137.9	41206.2	22 May	30	Silty clay	92.2	109	3.2	1,100
2-3	28137.0	41203.8	22 May	60	Silty clay	92.6	96	3.8	1,630
2-4	28136.3	41200.4	22 May	102	Rocks	NA	NA	NA	NA
2-5	28135.5	41198.5	22 May	305	Silty clay	79.4	35	5.3	2,510
3-1	28149.1	41191.0	30 Mar	10	Sand	79.2	15	1.7	300
3-2	28148.0	41189.5	30 Mar	30	Silty clay	84.5	72	4.7	810
3-3	28146.2	41187.6	30 Mar	60	Silty clay	81.3	48	5.2	980
3-4	28144.0	41184.5	30 Mar	100	Silty clay	90.4	60	3.7	560
3-5	28141.9	41181.5	30 Mar	300	Clay	72.5	54	7.9	2,350
4-1	28159.3	41171.4	29 Mar	11	Sand	88.1	24	2.0	550
4-2	28157.4	41170.5	29 Mar	31	Silty clay	91.8	78	3.3	450
4-3	28154.1	41169.1	29 Mar	60	Silty clay	93.8	61	3.2	770
4-4	28152.3	41168.9	29 Mar	96	Silty clay	72.8	41	3.4	720
4-5	28149.0	41167.8	5 Oct	208	Silty clay	64.2	44		
4-6	28145.0	41166.5	29 Mar	307	Silty clay	65.7	23	7.9	1,790
4.5-1	28157.2	41161.0	14 Dec	60	Silty clay	84.0	96	3.1	990
4.5-2	28155.4	41160.5	14 Dec	100	Silty clay	67.9	105	3.1	700
5-1	28168.5	41148.8	23 Mar	11	Silty clay	66.7	8	1.9	360
5-2	28165.0	41150.2	23 Mar	31	Silty sand	87.4	39	2.6	660
5-3	28162.0	41151.5	14 Dec	47	Sandy silt	86.8	130	3.3	570
5-4	28159.2	41152.6	23 Mar	60	Sandy silt	40.0	68	0.3	330
5-5	28156.8	41153.6	23 Mar	98	Sand	41.8	136	3.2	600
5-6	28149.8	41156.5	23 Mar	290	Silty Clay	62.3	113	8.3	1,410
6-1	28172.5	41129.6	27 Feb	10	Sand	NA	NA	NA	NA
6-2	28169.0	41132.8	27 Feb	30	Silty sand	88.9	54	2.3	360
6-3	28166.6	41135.5	14 Dec	40	Sandy silt	81.1	84	2.6	1,370
6-4	28161.6	41139.5	27 Feb	59	Sand	48.4	118	2.4	630
6-5	28149.4	41148.8	14 Dec	100	Sand	47.9	89	5.8	460
7-1	28174.8	41109.8	8 Dec	11	Sand	100	11	0.8	100
7-2	28170.8	41115.6	8 Dec	30	Silty clay	70.8	123	3.9	650
7-3	28164.0	41124.9	8 Dec	60	Sandy silt	36.3	38	3.8	910
7-4	28145.5	41150.5	8 Dec	101	Coarse sand	72.1	75	3.4	510
7-5	28142.0	41155.2	8 Dec	301	Sandy silt	63.6	96	6.6	560
7.5-1	28168.3	41114.0	14 Dec	49	Silty clay	75.5	84	3.6	730
7.5.2	28161.4	41120.9	14 Feb	59	Silty sand	42.1	150	5.4	220
7.5-3	28156.8	41128.8	14 Dec	70	Rocks, silty sand	NA	NA	NA	NA
7.5-4	28151.2	41136.7	30 May	78	Rocks	NA	NA	NA	NA
7.5-5	28148.3	41141.7	14 Dec	83	Sand, gravel	73.8	53	9.0	560
7.5-6	28145.8	41144.9	14 Feb	110	Sand, gravel	46.5	40	4.8	410
8-1	28175.2	41096.2	22 Mar	12	Sand	91.7	5	1.1	170
8-2	28172.5	41100.6	22 Mar	30	Sand	77.4	36	1.8	270
8-3	28168.0	41107.2	22 Mar	58	Silty sand	81.3	81	2.6	740
8-4	28163.7	41112.8	30 May	59	Silty sand	59.1	74	4.1	790
8-5	28158.8	41120.0	22 Mar	73	Silty clay	66.2	95	8.3	880
8-6	28154.0	41126.5	30 May	76	Silty clay	65.8	65	5.9	720
8-7	28148.7	41134.5	22 Mar	102	Rocks, sand, gravel	71.7	41	6.9	390
8-8	28144.8	41140.0	22 Mar	300	Silty clay	66.2	205	6.9	590
8.2-1	28161.0	41114.7	14 Feb	66	Silty clay	66.9	68	5.5	590
8.5-1	28171.7	41097.0	14 Dec	43	Sandy silt	71.4	47	2.2	450
8.5-2	28168.9	41098.9	14 Feb	64	Silty clay	76.3	72	2.5	450
8.5-3	28156.1	41117.7	14 Feb	97	Clay	64.2	45	5.9	770
8.5-4	28164.7	41105.9	14 Dec	99	Silty clay	66.5	339	6.3	1,260
8.5-5	28161.0	41110.5	30 May	102	Clayey silt	63.8	143	6.9	1,350
9-1	28176.5	41181.5	20 Mar	11	Sand	81.0	8	1.3	120

*NA means not applicable.

Table 1 continued.

Station	LORAN-C Position LOP 1	LOP 2	Date	Depth (m)	Bottom Material	In-faunal Trophic Index	Bio-mass (g/sq m)	% Vola-tile Solids	BOD (mg/kg)
9-2	28174.5	41084.2	20 Mar	28	Silty sand	64.7	43	1.3	370
9-3	28173.0	41086.5	20 Mar	58	Sandy silt	53.1	54	2.5	650
9-4	28165.7	41097.0	20 Mar	99	Silty sand	50.0	79	3.4	630
9-5	28160.5	41103.9	14 Feb	140	Clay	58.7	64	7.8	1,970
9-6	28156.5	41110.0	30 May	168	Silt, clay	63.5	108	6.3	1,670
9-7	28152.4	41116.0	20 Mar	303	Silty clay	77.9	21	6.4	910
10-1	28177.5	41073.5	15 Jun	49	Silty sludge	54.5	38	6.9	4,350
10-2	28175.8	41076.2	15 Jun	50	Silty clay	52.3	89	4.6	1,520
10-3	28171.5	41082.6	15 Jun	186	Silty clay	53.0	148	5.4	1,790
10-4	28167.2	41088.3	15 Jun	368	Clayey silt	47.0	57	8.3	2,780
10-5	28158.0	41101.4	15 Jun	552	Clayey silt	60.9	7	4.9	1,450
10.5-1	28171.0	41075.0	30 May	33	Sandy silt	65.1	46	4.4	930
10.5-2	28168.7	41079.8	14 Feb	66	Clay	50.8	82	6.8	500
10.5-3	28167.9	41083.5	30 May	165	Clayey silt	50.5	132	8.8	1,900
10.5-4	28166.0	41088.5	30 May	387	Silt, sludge	36.3	73	9.6	2,860
10.7-1	28163.7	41089.3	14 Feb	106	Rocks	NA	NA	NA	NA
11-1	28169.9	41072.8	13 Mar	11	Rocks	NA	NA	NA	NA
11-2	28168.0	41076.1	13 Mar	30	Sand, gravel	85.7	74	7.4	130
11-3	28165.6	41081.0	13 Mar	62	Silty clay	52.0	98	7.5	1,310
11-4	28159.5	41093.9	13 Mar	109	Sand	51.6	149	4.8	830
11-5	28156.6	41099.9	13 Mar	301	Sand, gravel	64.7	18	5.0	920
11.5-1	28167.0	41075.3	30 May	46	Sandy silt	72.0	155	10.7	2,210
11.5-2	28165.0	41078.2	30 May	70	Silty Clay	47.7	213	11.6	3,140
11.5-3	28163.2	41081.1	30 May	173	Clayey silt	52.8	188	8.4	1,710
11.5-4	28161.2	41084.5	30 May	366	Clayey silt	51.3	21	8.3	1,900
12-1	28168.5	41068.5	15 Mar	11	Rocks	NA	NA	NA	NA
12-2	28168.0	41068.0	15 Mar	30	Coarse sand, rocks	NA	NA	NA	NA
12-3	28166.7	41069.5	15 Mar	62	Silt	37.5	614	14.9	3,450
12-4	28165.5	41070.0	15 Mar	102	Sandy silt	49.4	183	9.4	2,040
12-5	28164.5	41070.9	15 Mar	312	Silty clay	46.5	88	11.1	3,630
San Pedro Bay/Orange County									
13-1	28189.1	41009.8	9 Jun	15	Sand, gravel over clay	66.2	39	6.4	940
13-2	28186.4	41010.0	9 Jun	30	Clay, sand gravel	61.2	120	4.4	780
13-3	28183.8	41010.2	9 Jun	59	Silty clay	41.6	98	3.8	1,340
13-4	28182.5	41010.8	9 Jun	101	Shells, silt clay	60.6	112	5.5	1,670
13-5	28181.5	41010.7	9 Jun	304	Silty clay	35.8	181	6.7	2,900
14-1	28198.2	40993.5	20 Oct	20	Sandy silt	68.8	17	1.8	470
14-2	28194.2	40994.0	20 Oct	24	Sand	86.7	8	1.3	220
14-3	28189.8	40994.6	20 Oct	30	Sand	73.0	43	1.4	540
14-4	28186.4	40995.0	20 Oct	60	Silt, shells	71.7	26	2.3	1,000
14-5	28185.5	40995.3	20 Oct	100	Silty clay	65.8	25	2.6	470
14-6	28181.9	40995.5	20 Oct	100	Silty sand	71.0	16	2.1	560
14-7	28179.4	40996.2	13 Sep	298	Silty clay	70.2	18	3.3	830
15-1	28206.5	40977.5	18 Oct	20	Sandy silt	63.9	54	1.6	550
15-2	28201.4	40978.1	18 Oct	28	Sand	56.7	13	1.1	320
15-3	28196.6	40978.9	18 Oct	30	Sand	67.7	13	1.1	410
15-4	28192.0	40979.8	18 Oct	48	Silty sand	76.8	83	1.5	500
15-5	28188.8	40980.3	18 Oct	60	Silty sand	78.0	25	1.9	420
15-6	28186.2	40981.2	15 Sep	99	Sandy silt	76.2	31	1.8	680
15-7	28183.4	40981.5	13 Sep	303	Silt, clay	87.2	116	3.3	650
16-1	28209.7	40962.0	15 Aug	30	Sand	63.7	14	0.6	450
16-2	28204.3	40963.4	15 Aug	31	Silty sand	76.1	41	1.4	540
16-3	28197.8	40964.5	15 Aug	45	Sand	86.1	10	1.2	500
16-4	28195.0	40965.0	13 Aug	49	Sand, gravel	66.9	170	1.5	440
16-5	28194.0	40965.4	15 Aug	57	Sand	74.8	76	1.3	430
16-6	28192.1	40965.3	13 Aug	100	Sand	70.3	31	1.5	320
16-7	28188.1	40966.5	13 Aug	310	Silty clay	79.4	18	3.5	580
17-1	28213.7	40947.5	1 Sep	20	Sand	64.7	22	1.4	400
17-2	28210.7	40948.0	1 Sep	30	Silty sand	59.2	52	1.5	630
7-3	28204.7	40949.0	1 Sep	60	Sandy silt	79.5	87	2.5	840

Continued

Table 1 continued.

Table 1 continued

Station	LORAN-C Position LOP 1	LOP 2	Date	Depth (m)	Bottom Material	Infaunal Trophic Index	Biomass (g/sq m)	% Volatile Solids	BOD (mg/kg)
17-4	28200.3	40950.0	1 Sep	100	Silt, clay, shells	75.6	34	3.9	840
17-5	28194.0	40951.5	1 Sep	300	Silty clay	100	32	4.6	790
17.5-1	28207.4	40942.5	5 Jul	60	Silty sand	84.2	56	2.2	890
17.8-1	28210.2	40936.4	5 Jul	100	Silt	71.7	142	3.2	1,470
18-1	28220.6	40931.3	2 May	10	Sand	92.6	11	2.7	850
18-2	28217.8	40932.1	5 Jul	20	Sand	79.5	82	1.1	220
18-3	28214.6	40932.6	2 May	30	Sand	80.6	5	0.6	80
18-4	28212.6	40933.4	5 Jul	37	Silty sand	85.9	113	1.6	510
18-5	28210.8	40933.2	2 May	60	Sandy silt	79.1	92	2.2	760
18-6	28211.3	40933.4	5 Jul	60	Sandy silt	81.0	80	2.4	1,110
18-7	28210.2	40933.5	2 May	101	Silty clay	58.5	41	3.4	1,160
18-8	28209.5	40934.6	5 Jul	200	Silty clay	66.7	87	4.3	590
18-9	28204.6	40935.1	2 May	300	Clay	76.7	9	5.8	1,540
18.2-1	28211.2	40930.8	5 Jul	100	Silt	55.4	57	3.0	480
18.5-1	28214.7	40936.0	5 Jul	38	Silty sand	70.8	55	1.7	970
18.5-2	28213.0	40926.5	5 Jul	60	Sandy silt	73.1	42	2.0	1,070
18.5-3	28211.0	40926.9	5 Jul	200	Silty clay	75.9	124	4.1	940
19-1	28224.7	40916.1	2 May	10	Sand	80.4	16	1.2	260
19-2	28222.6	40916.2	6 Jul	20	Silty sand	61.9	31	1.6	570
19-3	28219.6	40917.3	2 May	30	Sandy silt	84.2	123	1.7	520
19-4	28217.7	40918.0	6 Jul	45	Silty clay	73.7	116	2.0	1,750
19-5	28216.3	40919.1	3 Nov	51	Silty clay	72.1	90	2.0	570
19-6	28215.8	40918.3	2 May	60	Silty sand	51.5	76	1.9	580
19-7	28214.7	40918.9	2 May	100	Sandy silt	64.2	40	2.2	710
19-8	28213.6	40919.2	6 Jul	200	Silty clay	65.2	85	4.3	1,380
19-9	28211.5	40919.6	2 May	300	Clay	80.2	46	5.4	1,360
19.3-1	28224.6	40909.6	3 Nov	18	Green and black silt	56.0	54	1.9	500
19.3-2	28222.2	40913.1	3 Nov	27	Clay, silt	59.0	75	2.2	490
19.3-3	28221.4	40912.5	3 Nov	33	Silt, clay	79.5	60	2.1	520
19.3-4	28220.8	40910.2	6 Jul	45	Sandy silt	66.2	119	1.6	800
19.3-5	28219.5	40912.0	3 Nov	48	Sandy silt	60.8	78	2.1	580
19.3-6	28217.9	40910.9	6 Jul	100	Silty clay	58.9	38	2.1	620
19.3-7	28216.7	40911.2	6 Jul	200	Silty clay	70.6	63	3.6	1,080
19.7-1	28224.0	40906.0	3 Nov	40	Silty clay	92.6	136	2.2	430
19.7-2	28220.9	40908.0	3 Nov	55	Silty sand	59.3	46	2.0	640
20-1	28228.3	40902.1	3 May	10	Sand	77.8	15	0.9	420
20-2	28227.7	40901.2	6 Jul	20	Sand	66.7	13	0.7	450
20-3	28226.3	40902.0	3 May	30	Silty clay	88.5	92	2.0	620
20-4	28223.4	40902.9	3 May	60	Silty sand	61.1	99	2.2	560
20-5	28222.3	40903.0	3 May	100	Sandy silt	47.1	87	2.0	710
20-6	28220.7	40903.3	6 Jul	200	Silty clay	65.6	112	2.8	950
20-7	28218.2	40904.0	3 May	300	Silty clay	91.7	67	7.0	990
20.3-1	28222.3	40899.7	6 Jul	256	Silty clay	91.7	12	7.4	1,770
20.5-1	28228.0	40896.0	3 Nov	57	Clay, silt	89.2	81	3.7	420
20.5-2	28226.5	40898.1	6 Jul	97	Silty clay	65.5	22	5.6	1,930
20.5-3	28229.4	40895.5	7 Jul	113	Clay, silt	65.2	203	7.7	1,980
20.5-4	28226.4	40897.1	7 Jul	146	Silty clay	58.9	115	5.5	2,440
20.5-5	28225.9	40895.4	7 Jul	188	Silty clay	69.9	70	3.4	2,400
20.5-6	28222.6	40900.9	6 Jul	223	Silty clay	68.4	7	7.0	2,750
20.7-1	28229.3	40893.5	7 Jul	165	Clayey silt	45.7	79	7.3	1,450
20.7-2	28229.0	40892.1	7 Jul	200	Silty clay	72.2	44	6.1	2,630
21-1	28233.3	40886.0	3 May	30	Sandy silt	88.9	144	4.6	720
21-2	28232.7	40886.3	3 May	60	Silty clay	91.7	73	2.7	750
21-3	28232.3	40886.5	3 May	100	Silty clay	79.7	43	3.9	740
21-4	28231.3	40885.9	7 Jul	214	Silty clay	66.7	55	8.0	3,160
21-5	28229.2	40887.2	4 May	300	Silty clay	53.4	17	7.8	2,070
22-1	28237.9	40871.0	4 May	30	Silty clay	84.8	167	2.1	560
22-2	28237.5	40871.3	4 May	60	Silty clay	93.1	178	3.1	1,080
22-3	28236.2	40871.2	4 May	100	Silty clay	94.6	237	3.9	1,050
23-1	28242.2	40855.1	31 Aug	30	Sand	59.7	39	2.6	700
23-2	28241.3	40856.5	31 Aug	60	Silty clay	93.5	95	3.4	670
23-3	28240.2	40856.7	31 Aug	100	Silt over shells, gravel	50.9	91	3.5	800
24-1	28245.6	40840.9	31 Aug	30	Silty sand	67.0	221	2.8	610

Table 1 continued.

Station	LORAN-C Position LOP 1	LOP 2	Date	Depth (m)	Bottom Material	In-faunal Trophic Index	Bio-mass (g/sq m)	% Vola-tile Solids	BOD (mg/kg)
24-2	28245.1	40841.4	31 Aug	44	Silty clay	81.5	99	2.8	570
1-3	28243.8	40842.9	31 Aug	60	Silty clay	96.2	62	2.9	780
1-4	28242.5	40843.8	31 Aug	100	Silty clay	96.9	168	4.0	1,100
25-1	28247.6	40827.8	30 Aug	30	Silty sand	66.1	112	2.1	550
25-2	28246.7	40828.3	30 Aug	42	Silty clay	80.1	61	5.7	1,070
5-3	28245.0	40830.5	30 Aug	60	Silty clay	91.8	227	4.9	760
5-4	28244.0	40831.0	30 Aug	100	Silty clay	100	100	4.0	580
5-5	28242.9	40832.8	30 Aug	300	Silty clay	98.1	53	6.1	1,030
26-1	28248.2	40816.0	30 Aug	30	Sand	74.7	65	1.7	330
26-2	28247.1	40817.2	30 Aug	60	Silty clay	86.8	106	5.0	580
6-3	28246.3	40818.5	30 Aug	100	Silty clay	95.3	102	6.3	1,870
6-4	28244.6	40820.5	30 Aug	300	Silty clay	100.0	23	4.8	1,650
San Diego									
SD 1-1	28262.8	40624.8	21 Aug	30	Rocks	NA	NA	NA	NA
D 1-2	28260.1	40629.7	21 Aug	60	Sandy silt	87.2	59	2.4	1,260
D1-3	28256.8	40635.7	21 Aug	80	Sandy silt	90.7	100	2.2	1,030
SD1-4	28253.8	40641.2	9 May	100	Sandy silt	87.6	54	1.9	570
SD2-1	28261.6	40621.0	9 May	30	Rocks	NA	NA	NA	NA
D2-2	28259.4	40625.2	9 May	60	Silty clay	85.2	138	2.5	920
D2-3	28256.3	40630.6	9 May	80	Silt	97.0	136	2.3	1,010
D2-4	28253.9	40635.0	9 May	100	Silt	90.7	43	1.9	590
SD2.5-1	28258.4	40623.3	21 Aug	60	Silty clay	80.5	110	3.5	1,340
SD3-1	28260.4	40616.3	10 May	30	Kelp, coarse sand	82.8	52	0.6	280
D3-2	28258.3	40621.0	10 May	60	Silty clay	64.7	103	2.6	1,520
SD3-3	28255.3	40626.5	10 May	80	Clay, silt	96.6	174	2.5	1,050
SD3-4	28252.9	40631.0	10 May	100	Sandy silt	90.6	43	1.6	850
D3.3-1	28259.0	40618.0	11 May	53	Silty clay	69.0	91	2.5	1,000
D3.3-2	28256.7	40622.8	11 May	71	Silty clay	77.7	81	2.4	770
D3.4-1	28259.8	40615.9	11 May	32	Sand	85.0	18	0.5	300
SD3.4-2	28257.7	40620.0	21 Aug	65	Silt	53.0	97	2.5	1,580
SD3-5-1	28257.5	40619.5	11 May	63	Clay, sludge	33.3	36	3.6	1,750
D3.5-2	28256.3	40621.5	21 Aug	70	Silty clay	86.3	139	2.8	540
D3.5-3	28255.0	40623.9	11 May	80	Clay, silt	95.0	116	2.2	900
SD3.7-1	28259.5	40614.2	11 May	38	Silty clay	77.4	118	5.6	2,330
SD3.7-2	28257.3	40618.2	21 Aug	62	Silt	70.1	124	2.8	1,370
D3.8-1	28259.9	40612.8	10 May	30	Rocks	NA	NA	NA	NA
D3.8-2	28256.5	40619.0	11 May	68	Clay, silt	81.5	134	2.3	1,010
D4-1	28258.5	40614.5	21 Aug	47	Sandy silt	70.6	85	3.2	1,310
SD4-2	28256.5	50617.3	10 May	60	Silt, clay	76.9	107	2.2	1,200
SD4-3	28255.1	40620.5	10 May	80	Silty clay	97.4	128	2.5	930
D4-4	28251.2	40627.9	10 May	100	Sandy silt	88.2	18	2.3	1,150
D4.5-1	28256.4	40615.6	21 Aug	65	Silt, gravel shells	80.9	161	2.5	900
SD5-1	28263.0	40601.0	22 Aug	18	Sand, shells	NA	NA	NA	NA
D5-2	28250.5	40607.5	10 May	30	Rocks	NA	NA	NA	NA
D5-3	28258.0	40609.5	22 Aug	47	Silty clay	78.7	91	2.1	670
D5-4	28256.3	40613.0	10 May	60	Sandy silt	76.3	65	2.4	1,120
SD5-5	28253.8	40618.0	10 May	80	Clay, silt	97.0	152	2.6	1,150
SD5-6	28250.0	40624.1	10 May	100	Sand	85.1	56	1.9	520
D6-1	28263.3	40594.5	10 May	30	Sand	73.8	21	0.8	560
D6-2	28259.3	40601.9	10 May	45	Sand	85.0	62	1.4	530
SD6-3	28255.2	40609.3	10 May	60	Coarse sand	67.7	29	1.3	630
SD6-4	28253.4	40613.0	10 May	80	Silty sand	89.7	76	1.6	640
anta Monica Bay Inner Grid									
1	28152.2	41141.1	15 May	80	Rocks	NA	NA	NA	NA
A2	28153.9	41137.8	6 Feb	80	Sand, gravel	65.9	56	6.7	800
A3	28155.6	41134.6	6 Feb	76	Sand	61.0	111	6.7	850
4	28157.3	41131.5	6 Feb	70	Sand, gravel	47.0	157	3.6	500
5	28159.0	41128.4	6 Feb	62	Sand, gravel	44.0	159	2.5	920
6	28160.7	41125.4	17 Feb	61	Sand	39.6	227	3.9	850
A7	28162.4	41122.2	17 Feb	58	Sandy silt	57.8	198	2.7	1,170
A8	28164.1	41119.2	17 Feb	57	Silty clay	63.5	98	3.4	1,340
1	28152.7	41143.2	6 Feb	138	Sand, gravel, rocks	55.7	28	5.0	750

Continued

Table 1 continued.

Table 1 continued

Station	LORAN-C Position LOP 1	LOP 2	Date	Depth (m)	Bottom Material	Infaunal Trophic Index	Biomass (g/sq m)	% Volatile Solids	BOD (mg/kg)
B2	28154.4	41139.9	6 Feb	84	Sand	43.4	29	4.9	440
B3	28156.1	41136.7	6 Mar	80	Sand, gravel	50.8	112	5.2	61
B4	28157.8	41133.6	6 Mar	77	Sand, gravel	39.6	135	3.9	62
B5	28159.4	41130.4	15 May	65	Sand	35.7	562	2.7	92
B6	28161.2	41127.3	27 Feb	62	Silty sand, gravel	47.8	199	3.7	1,520
B7	28162.9	41124.2	27 Feb	61	Silty clay	37.5	87	4.2	2,21
B8	28164.6	41121.1	17 Feb	55	Silty clay	66.2	140	3.0	99
C1	28153.2	41145.3	6 Feb	240	Clay	56.6	67	8.1	1,720
C2	28154.9	41142.1	15 May	217	Silty clay	56.7	240	9.1	2,750
C3	28156.5	41138.8	15 May	191	Silty clay	42.7	329	9.7	3,06
C4	28158.3	41135.6	6 Mar	89	Rocks	NA	NA	NA	NA
C5	28160.0	41132.5	27 Feb	68	Sandy silt	56.0	231	4.9	1,53
C6	28161.7	41129.4	27 Feb	62	Silty clay, gravel	65.1	328	3.8	2,150
C7	28163.3	41126.5	27 Feb	58	Silty clay, gravel	55.1	91	3.9	1,40
C8	28165.1	41123.2	17 Feb	53	Silty clay	67.2	129	3.7	760
D1	28153.7	41147.4	6 Feb	210	Clay	59.3	216	6.5	960
D2	28155.4	41144.2	6 Feb	195	Silty clay	58.1	268	5.9	1,32
D3	28157.1	41140.9	6 Mar	201	Sludge	8.1	158	17.7	10,55
D4	28158.8	41137.7	6 Mar	95	Silty sand, rocks	25.9	223	4.3	1,78
D5	28160.5	41134.6	15 May	65	Silt, sludge	53.8	479	3.5	2,19
D6	28162.2	41131.4	27 Feb	60	Sandy silt	51.2	208	3.8	1,58
D7	28163.9	41128.3	27 Feb	54	Silt, gravel	59.0	87	2.8	95
D8	28165.6	41124.9	17 Feb	50	Silty clay	75.8	133	3.1	800
E1	28154.2	41149.4	6 Feb	195	Silty clay	59.1	118	6.7	1,070
E2	28159.9	41146.2	15 May	173	Silty clay	54.3	302	7.3	1,90
E3	28157.6	41143.1	6 Mar	132	Sandy silt	46.0	1,284	4.4	2,24
E4	28159.3	41139.8	15 May	95	Rocks	NA	NA	NA	NA
E5	28161.0	41136.6	27 Feb	60	Sand	48.7	112	2.6	1,080
E6	28162.7	41133.5	27 Feb	57	Sand	48.7	187	2.5	87
E7	28164.4	41130.4	27 Feb	51	Sandy silt	58.9	137	2.7	75
E8	28166.1	41127.3	17 Feb	45	Silty clay	79.4	142	3.2	89
F1	28154.7	41151.4	15 May	185	Silty clay	60.8	157	6.6	1,440
F2	28156.4	41148.3	6 Feb	147	Sandy silt	42.9	304	5.3	1,480
F3	28158.1	41145.1	6 Mar	96	Silt, sand, gravel	35.1	473	3.2	1,05
F4	28159.8	41141.9	6 Mar	63	Sand	42.4	174	1.6	58
F5	28161.5	41138.7	27 Feb	58	Sand	46.2	158	2.1	1,850
F6	28163.2	41135.6	15 May	53	Sandy silt	54.0	124	2.3	1,23
F7	28164.9	41132.4	27 Feb	50	Silty clay	59.5	87	3.2	83
F8	28166.6	41129.3	17 Feb	42	Silty clay	77.2	70	3.0	45
49	28159.7	41137.8	30 Jan	111	Sludge	0.0	282	33.0	27,700
50	28158.7	41139.2	30 Jan	153	Sludge, sand rocks	0.3	277	26.7	20,600
51	28158.2	41138.8	27 Feb	136	Sludge	0.0	6	31.8	22,50
52	28156.6	41140.9	30 Jan	198	Sandy silt	16.8	289	17.3	12,10
53	28154.6	41144.5	30 Jan	246	Silty clay	48.2	438	12.0	3,890
Palos Verdes									
PV2-1	28167.5	41063.3	16 Aug	60	Silt	44.7	879	11.3	6,79
PV3-1	28170.9	41053.8	18 Jul	60	Silt	52.3	493	14.1	11,12
PV3-2	28170.0	41053.5	18 Jul	98	Silty sand	46.5	216	13.8	10,760
PV3-3	28169.2	41053.3	18 Jul	320	Silty clay	52.4	61	9.8	4,03
PV4-1	28172.5	41048.4	16 Aug	61	Silt	33.3	241	10.5	12,06
PV5-1	28174.6	41041.5	16 Aug	61	Silt	11.6	93	14.3	15,18
PV7-1	28178.0	41035.2	18 Jul	30	Sand	63.7	80	9.6	4,820
PV7-2	28176.8	41035.0	19 Jul	60	Black silt	9.9	88	16.5	16,570
PV7-3	28176.8	41034.4	16 Aug	64	Silt	1.0	121	16.3	15,50
PV7-4	28176.0	41034.9	19 Jul	103	Black silt	6.2	244	16.5	21,38
PV7-5	28175.4	41034.8	19 Jul	304	Silt on clay	43.4	44	11.5	5,02
PV9-1	28180.2	41023.2	17 Jul	61	Sandy silt	14.3	206	13.2	11,300
PV9-2	28179.6	41023.0	20 Jul	91	Silt	48.8	430	13.5	15,81
PV9-3	28178.7	41022.9	20 Jul	282	Clay	55.0	102	5.3	1,35