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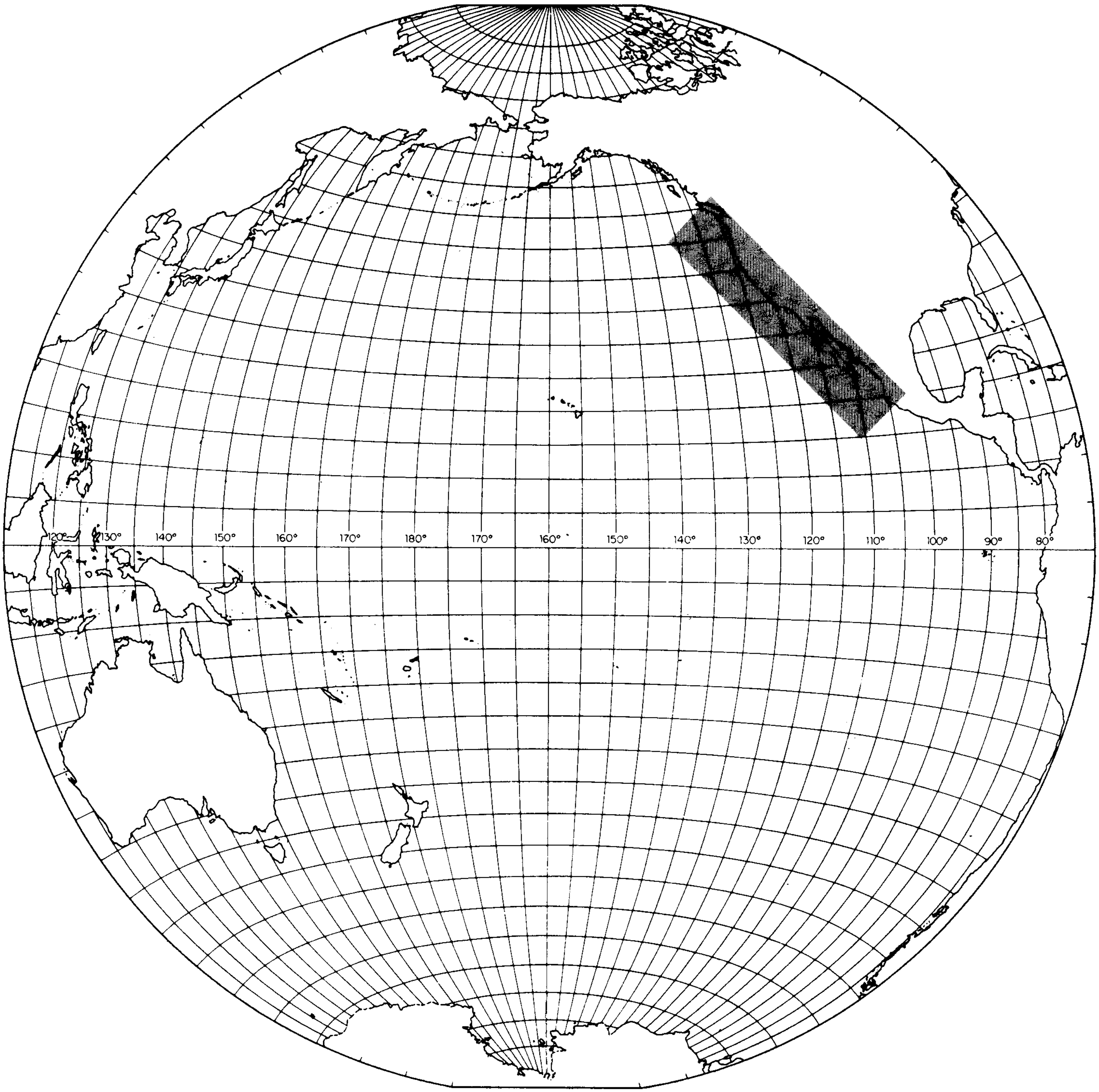
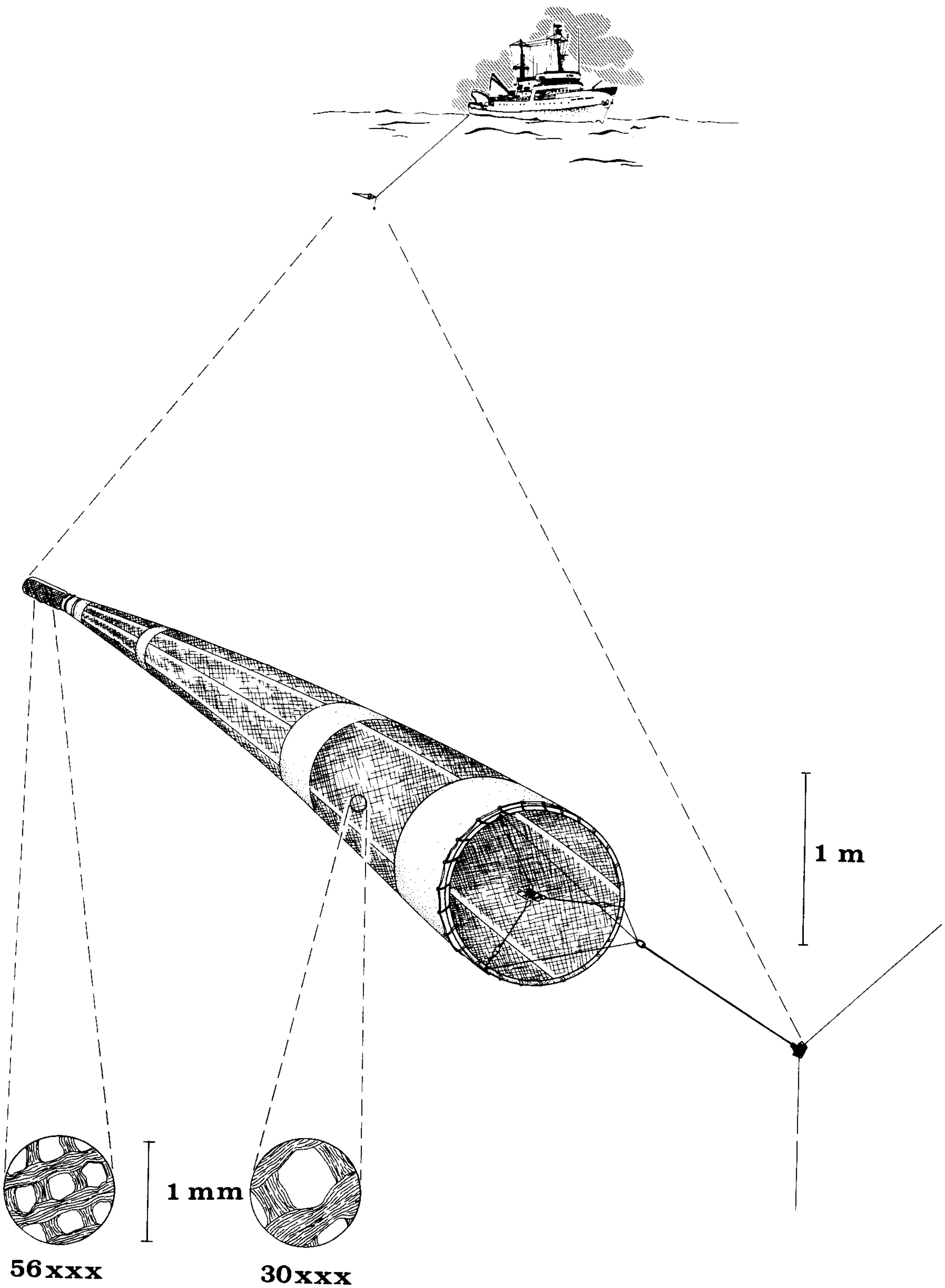


CALIFORNIA COOPERATIVE OCEANIC FISHERIES INVESTIGATIONS

ATLAS No. 13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CALIFORNIA COOPERATIVE OCEANIC FISHERIES INVESTIGATIONS

Atlas No. 13

STATE OF CALIFORNIA
MARINE RESEARCH COMMITTEE

Cooperating Agencies:
CALIFORNIA ACADEMY OF SCIENCES
CALIFORNIA DEPARTMENT OF FISH AND GAME
STANFORD UNIVERSITY, HOPKINS MARINE STATION
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NATIONAL MARINE FISHERIES SERVICE
UNIVERSITY OF CALIFORNIA, SCRIPPS INSTITUTION OF OCEANOGRAPHY

June, 1971

THE CALCOFI ATLAS SERIES

This is the thirteenth in a series of atlases containing data on the hydrography and plankton from the region of the California Current. The field work was carried out by the California Cooperative Oceanic Fisheries Investigations,[1] a program sponsored by the State of California under the direction of the State's Marine Research Committee. The cooperating agencies in the program are:

California Academy of Sciences
California Department of Fish and Game
Stanford University, Hopkins Marine Station
National Oceanic and Atmospheric Administration, National Marine Fisheries Service[2]
University of California, Scripps Institution of Oceanography

CalCOFI atlases[3] are issued as individual units as they become available. They provide processed physical, chemical and biological measurements of the California Current region. Each number may contain one or more contributions. A general description of the CalCOFI program with its objectives appears in the preface of Atlas No. 2.

This atlas was prepared by the Data Collection and Processing Group of the Marine Life Research Program, Scripps Institution of Oceanography.

CalCOFI Atlas Editorial Staff:

Abraham Fleminger and Hans T. Klein, Editors
John G. Wyllie, Cartographer

CalCOFI atlases in this series, through June 1971, are:

No. 1. Anonymous, 1963. CalCOFI atlas of 10-meter temperatures and salinities 1949 through 1959.

No. 2. Fleminger, A., 1964. Distributional atlas of calanoid copepods in the California Current region, Part I.

No. 3. Alvariño, A., 1965. Distributional atlas of Chaetognatha in the California Current region.

No. 4. Wyllie, J. G., 1966. Geostrophic flow of the California Current at the surface and at 200 meters.

No. 5. Brinton, E., 1957. Distributional atlas of Euphausiacea (Crustacea) in the California Current region, Part I.

No. 6. McGowan, J. A., 1967. Distributional atlas of pelagic molluscs in the California Current region.

No. 7. Fleminger, A., 1967. Distributional atlas of calanoid copepods in the California Current region, Part II.

No. 8. Berner, L., 1967. Distributional atlas of Thaliacea in the California Current region.

No. 9. Kramer, D., and E. H. Ahlstrom, 1968. Distributional atlas of fish larvae in the California Current region: Northern Anchovy, *Engraulis mordax* Girard, 1951 through 1965.

No. 10. Isaacs, J. D., A. Fleminger and J. K. Miller, 1969. Distributional atlas of zooplankton biomass in the California Current region: Spring and Fall 1955-1959.

No. 11. Ahlstrom, E. H., 1969. Distributional atlas of fish larvae in the California Current region: jack mackerel, *Trachurus symmetricus,* and Pacific hake, *Merluccius productus,* 1951 through 1966.

No. 12. Kramer, D., 1970. Distributional atlas of fish eggs and larvae in the California Current region: Pacific sardine, *Sardinops caerulea* (Girard), 1951 through 1966.

No. 13. Smith, P. E., 1971. Distributional atlas of zooplankton volume in the California Current region, 1951 through 1966.

[1]Usually abbreviated CalCOFI, sometimes CALCOFI or CCOFI.
[2]Formerly called U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries.
[3]For citation this issue in the series should be referred to as CalCOFI Atlas No. 13.

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DISTRIBUTIONAL ATLAS OF ZOOPLANKTON VOLUME IN THE CALIFORNIA CURRENT REGION, 1951 THROUGH 1966

Paul E. Smith

CALCOFI ATLAS NO. 13

Data Collection and Processing Group
Marine Life Research Program
Scripps Institution of Oceanography
La Jolla, California

June, 1971

DISTRIBUTIONAL ATLAS OF ZOOPLANKTON VOLUME IN THE CALIFORNIA CURRENT REGION, 1951 THROUGH 1966

Paul E. Smith[1]

Text

INTRODUCTION

Bigelow and Sears (1939, p. 200) stated, "The most striking feature of volumetric distribution of zooplankton throughout has been the irregularity from station to station, often with volumes differing up to a hundredfold, between localities only a few miles apart . . . comparatively regular gradients nevertheless appear, both secular and regional, when averages are compared, for subdivisions large enough to include several stations each . . ." Small-scale irregularities within spatially and temporally persistent gradients also characterize the volumes of plankton collected in the California Current system.

The basic data for this atlas have been obtained from 11 years of monthly and five years of quarterly cruises generally centered on the United States-Mexican border and extending from Pt. Reyes near San Francisco to Cape San Lazaro in southern Baja California (Staff, South Pacific Fishery Investigations, 1952, 1953, 1954a, 1954b, 1955, 1956; Thrailkill, 1956, 1957, 1959, 1961, 1963, 1969, MS.). In general, the same techniques of sampling and the same station grid were used throughout.

To a certain extent, the local variability of plankton volume at adjacent stations obscures regular seasonal, annual and regional changes. As an aid to the interpretation of the individual cruise charts in this atlas, generalizations which have emerged from the analysis of the volume data will be discussed after the description of the important features of the sampling grid, sampling techniques, sampling gear, and laboratory techniques.

THE BASIC STATION PATTERN

The CalCOFI station grid may be referred to as a centric-systematic-area-sampling scheme (Milne, 1959) with respect to the routine of placing a single sampling station in the center of a rectangle or square which exactly subdivides the entire survey area. Geographic placement of the main axis and the cardinal lines at right angles are shown inside the back cover of each atlas in this series. In the CalCOFI sampling area, particularly near islands, river mouths, and underwater canyons, there remains considerable danger that the systematically placed station represents a far smaller area than that assigned to it in the cruise summary. Even far at sea it is possible for a sample to be taken in a patch of plankton characteristic of only a few tens of meters. For this reason, when scanning charts of this kind, one must be aware that contour intervals based on a single station could represent far less than the 400-1600 square miles usually represented by a station.

To simplify description of the sampling results, stations have been pooled into roughly 4800 square mile areas (Fig. 1). The boundaries of the areas have been aligned to the basic CalCOFI station grid so that each pooled area contains all lines with the same number in the "10's" position, irrespective of the numeral in the "units" position, i.e. 80., 83., 85., 87., and all stations on a line with the same number in the "10's" position, i.e., .50, .53, .55, so that, for example, 80.55, 83.53, 83.55, 87.50, 87.55 all occur in the pooled area "8.5." With the exception of the coastal regions, pooled areas

[1]National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Fishery - Oceanography Center, La Jolla, California 92037.

are 40 miles perpendicular to the coastline and 120 miles parallel to the coastline. Irregularities of the coastline cause pooled areas to vary between 2,027 and 8,388 square miles ("12.3" and "11.3"). Stations in the Los Angeles Bight ("8.4") and in Vizcaino Bay ("11.3") were arbitrarily pooled regardless of station or line number.

A special closely-spaced grid of stations in an area within the California Current region was occupied on five successive days in April, 1952. It seems clear from Kramer's (1963) study of these grids that major increases in the number of samples per unit area would have been necessary to substantially improve the estimates of mean zooplankton volume. It is equally clear that the same number of stations occupied on a random or stratified random basis would not have resulted in an appreciable improvement in precision, and Milne's (1959) conclusion can be applied to this set of field samples, that "with proper caution, one will not go very far wrong, if wrong at all, in treating the centric-systematic-area sample as if it were random."

SAMPLING TECHNIQUE

The towing method used over the period reported here may be characterized as an "even oblique" tow as contrasted with a stepped oblique tow or vertical tow. The objective of the oblique tow was to encompass the vertical distribution of fish eggs and larvae found largely in the mixed layer.

The tow itself requires the slowing of the ship to about 2 knots, lowering a 100-pound weight (45.5 kg) on a 3/16-inch (5 mm) wire to 10 meters and affixing the cable clamp to the wire. The cable clamp is lowered to the water and the wire meter is set at zero. With the ship's speed at about 2 knots, the net is lowered at about 50 meters per minute. After about one minute of lowering, the ship's forward motion is adjusted until the wire is at an angle of 45 degrees relative to the horizon. This angle is maintained within plus or minus 3 degrees for the remainder of the tow. The wire is retrieved smoothly at 20 meters per minute with the aid of a stop-watch. It is frequently possible by this technique to carry out a tow to within five seconds of the allotted tow period of 14.5 minutes. Experienced marine technicians can do this regularly.

THE CALCOFI STANDARD NET

The CalCOFI net is preceded through the water by a cable clamp, three or more meters of leadline, the junction of a three-leg bridle one meter ahead of the mouth and the bridle itself. Flow disturbances caused by the structures very likely contribute to underestimates of the numbers of more mobile organisms (Fleminger and Clutter, 1965; Clutter and Anraku, 1968). About 10-15 per cent of the water encountered by the mouth of the net is shunted aside because there is not enough aperture area in the body of the net to accept all the water encountered (Smith, Counts and Clutter, 1968). It appears unlikely that clogging appreciably lowers the filtering efficiency in the oblique tow over much of the extent of the California Current region.

The silk gauze used in the CalCOFI standard net is of two sizes: 30 xxx grit gauze (0.55 mm shrunken mesh), and 56 xxx grit gauze (0.25 mm shrunken mesh) in the proportions described by Ahlstrom (1948, Table 1). The smaller 56 xxx grit gauze was used in the cod end bag and in a 40 cm section immediately in front of it. The remainder of the mesh was 30 xxx comprising a 65-cm cylinder behind the mouth followed by a 270-cm truncate cone that tapers from 1 m to 20 cm in diameter. With canvas sleeves and seams the net is nearly five meters long.

Between July, 1956 and August, 1959, a nylon net was used on 21 cruises. On eight cruises the nylon net was used for every sample. Table 1 is a list of the cruises and ships on which the nylon net was used. Details of construction are essentially the same as the silk standard net except that the mesh was 0.471 mm rather than 0.55 mm typical of silk net after shrinking. The section with 56 xxx grit gauze was replaced by 0.280 mm nylon. This net very likely retained more zooplankton than the standard net but no

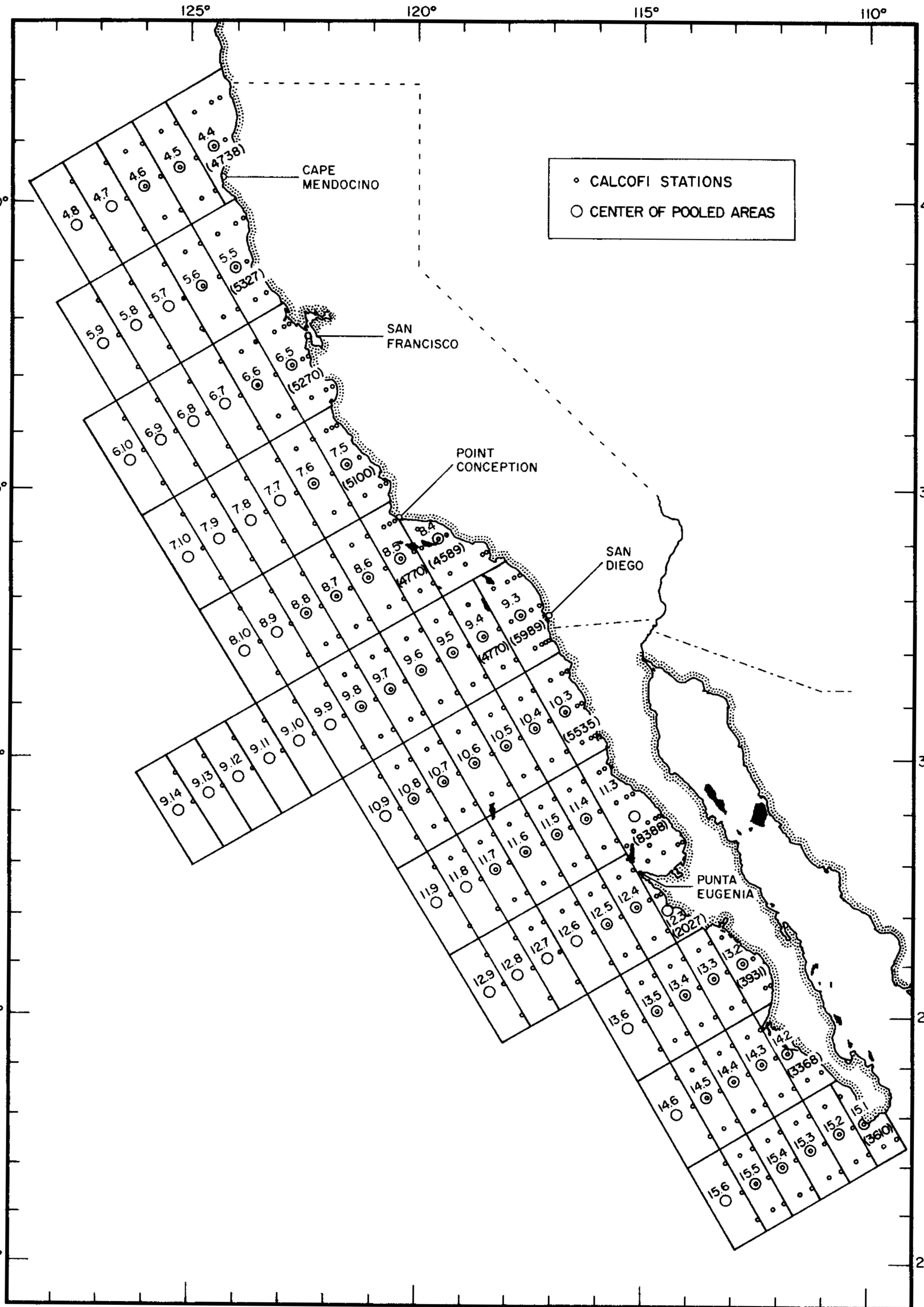


Figure 1. Pooled statistical areas of the CalCOFI pattern. Each rectangle represents 4,800 square miles (40 x 120 nautical miles) unless otherwise indicated as in the nearshore delineations.

estimates of the value of this difference have been made. Comparison with used silk nets at 0.55 mm and nylon nets of 0.505 mm yielded a 20 percent difference in plankton volumes in favor of the smaller mesh (unpublished data). The nylon mesh was abandoned (Ahlstrom, 1959b) when it was noted that filtration efficiency decreased when towing volume was listed in the order in which tows were taken. This clogging between tows was more severe than changes in silk nets with age; thus silk was retained for the surveys through 1966.

Table 1. Cruises conducted in part with 0.471 mm nylon nets.

BLACK DOUGLAS	ORCA	PAOLINA-T	HORIZON	SPENCER F. BAIRD	STRANGER	HUGH M. SMITH
5607*	5607	5607	5612	5702	5707	5908*
5608*	5610		5702	5804	5710*	
5609	5611		5704			
5702	5701		5705			
5703*	5711		5706*			
5705	5807					
5709*	5901					
5805*						

*Nylon net used throughout.

LABORATORY TECHNIQUES

Through 1959, the plankton sample was preserved by adding formalin to make a 3% formalin solution in sea water. After 1959, the strength was increased to a 5% formalin solution. Plankton sample jars were filled to the top with sea water to prevent the damage that accompanies sloshing in partly filled jars and stored for periods of one month to two years before the volume was measured.

Two methods have been used for the determination of plankton volume by displacement. The first method consisted of measuring the total volume of plankton plus preserving liquid in a graduated cylinder. The plankton was poured into a draining sock and the preservative drained into a graduated cylinder; the difference in the volumes was the measure of the plankton (Ahlstrom and Thrailkill, 1963). The second, more recent method consists of measuring the total volume of plankton and preservative in a calibrated quart jar in which the plankton is originally preserved at sea. When their total volume is brought to the inscribed volume of the jar the plankton is poured into a drainage cone, the preservative is caught in a graduated cylinder and, as in the first method, the difference in the volumes is the measure of the plankton (Thrailkill, in MS.). Between 20% and 50% of the displacement volume of the wet sample is due to water in the interstices of the plankton and 35% appears to be a representative central value for this error (Ahlstrom and Thrailkill, 1963, Table 6). More exhaustive treatment of the plankton sample to remove this error has not been done routinely because excessive handling adversely affects the condition of some of the organisms which must be subsequently sorted, identified, counted and measured.

In time, samples with appreciable quantities of coelenterates and thaliacians may undergo diminution of volume in direct proportion to the shrinking of these specimens. Most of the shrinkage occurs in the first 30 days (Ahlstrom and Thrailkill, 1963, Table 4). Shrinkage is slight among the crustacean constituents. For most samples the time between collection and determination has not been measured and is likely to vary between one month and two years.

Technical errors, such as partial spilling of a sample, malfunctioning flow meters, or excessive tow length occurred in a small proportion of the samples. If the error was detected on station, the tow was usually repeated. Estimates of missing flow meter readings were obtained from the revolutions per second as a function of wire angle that is routinely established for each flow meter in use.

Organisms exceeding 5 cc as well as adult and juvenile fish were removed and their displacement volume redetermined. While total volume and total volume less "large" organisms are both reported in the original data, only the latter volume is presented in this atlas.

LIMITATIONS OF THE DATA

Due to the "patchy" distribution of zooplankton, the interpretation of a series of charts in an atlas must be done with considerable care. It is the purpose of this section to discuss the magnitude of contouring error caused by patchiness and day-night differences in catch and to sort them out from regional and seasonal trends.

Patchiness—Contouring obscures patchiness due to the assumption of continuity of zooplankton standing stock between adjacent stations. The importance of this problem diminishes as one widens the intervals of contour. The contouring intervals used here are similar to those appearing in CalCOFI Atlas No. 10, on zooplankton biomass (Isaacs, Fleminger and Miller, 1969, p. xiii). The values are in cc/1000 m^3 of sea water strained and the series increases by a factor of 4, i.e., 4, 16, 64, 256 . . . Accordingly, the broad range of plankton volumes encountered in the California Current region can usually be represented by about six contours.

In 1940, duplicate plankton hauls were taken on 141 stations off southern California, with gear similar to that used later in the CalCOFI program. Table 2 shows the distribution of plankton volumes from the second tow on each station relative to that of the first tow when the measurements are arranged in the contouring intervals used in the present atlas. Of the 141 pairs, 106 (77%) would have been placed in the same contour intervals. Of the remaining 23% of paired tows none differed by more than one interval. Ahlstrom (in MS.) concluded that one could discriminate differences between stations of less than 0.6 or more than 1.7 times as large at the 95% level.

Table 2. Percent distribution of the plankton volume of a second tow on station compared to the plankton volume of the first tow.

	Second tow (cc/1000 m^3)				
	5-16	17-64	65-256	257-1024	N
First tow (cc/1000 m^3)					
5-16	0%	100%	0%	0%	1
17-64	0	67	33	0	39
65-256	0	14	84	2	88
257-1024	0	0	54	46	13
					141

Day-night difference—Often there exists a day-night difference in the standing stock of zooplankton. King and Hida (1954) showed a sine wave correction which was suitable for the zooplankton in Hawaiian waters. Isaacs, Fleminger and Miller (1969) illustrated differences among functional groups and due to the resulting complexity chose the relatively simple method of ratio of medians for day and night to adjust catch size to the higher (night) values. The day-night difference may be ascribed to daily changes in vertical distribution which result in more organisms in the upper 140 m at night, and a marked day-night difference in the ability of mobile organisms to avoid capture by the slow moving (less than 2 knots) CalCOFI standard plankton net. Brinton (1962) described the catches of euphausiids in a relatively long series of tows on the same stations (October 1950, Stations 72.62, 70.90 and 70.130; April 1952, Station 123.40). The zooplankton volumes have also been assembled for the same stations (Ahlstrom, unpublished data; Kramer, 1963). Table 3 illustrates the frequency with which contour values may change day and night. At Station 70.90 in October 1950, and Station 123.40 in April 1952, about half of the tows increased one contour level at night. At 70.130, however, 63 tows showed virtually no effect of time of day on zooplankton volume. The Kruskal-Wallis test (a non-parametric analogue of the variance-ratio test) of the data from Stations 70.90 and 70.130 supported the null hypothesis of identical sum of ranks for 70.130 (3 degrees of freedom, $H = 0.654$, $0.900 > p > 0.750$) but did not support the null hypothesis for Station 70.90 ($H = 12.012$, $0.017 > p > 0.005$). Brinton (1962) found day-night differences in the numbers of euphausiids from the same tows on both stations.

Table 3. Percent distribution of day and night samples with repetitive tows in the same area.

Plankton volume (cc/1000 m³)	17-64	65-256	257-1024	1025-4096	N
Cruise 5010					
Station 70.90					
Time—Day	0%	88%	13%	0%	16
Dusk	0	44	56	0	16
Night	0	38	63	0	16
Dawn	0	50	44	6	16
Station 70.130					
Time—Day	60%	40%	0%	0%	15
Dusk	63	38	0	0	16
Night	63	38	0	0	16
Dawn	69	31	0	0	16
Cruise 5204					
Station 123.40					
Drogue — Day	73%	27%	0%	0%	15
Night	7	93	0	0	14
Anchor — Day	93	7	0	0	15
Night	53	47	0	0	15
Grid — Day	81	19	0	0	68
Night	16	80	2	2	51

Of the three errors noted here, the day-night difference probably imposes an appreciable bias over much of the California Current region, and patchiness can have effects similar in magnitude but produce either over- or under-estimates. Shrinkage due to fixation appears to be a negligible source of variability.

SPATIAL AND TEMPORAL TRENDS

Figure 2 illustrates the major regional and seasonal trends of median zooplankton volume data for the period 1951-1960. The data for each pooled statistical area in each adequately sampled month are presented in Table 4. Medians are used here to represent the central value of a suite of samples.

It may be observed in Table 4 that peak values commonly occur from May through July and minimum values occur in October and January. Also, the months of August, September, November and December are not sampled adequately for a decade summary. The best sampling has been during the spawning seasons of the pelagic fish in this region (January to

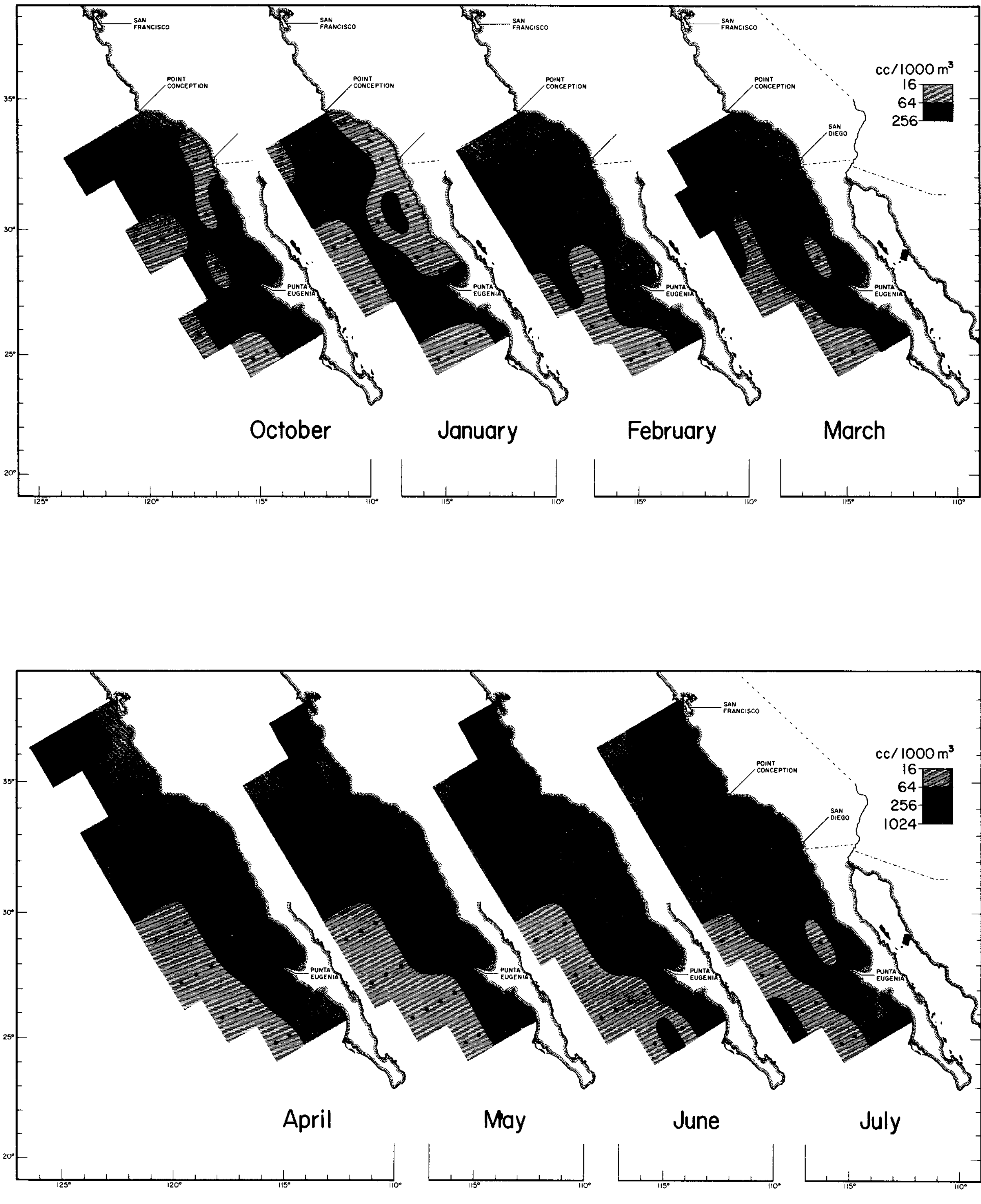


Figure 2. Median zooplankton volumes (cc/1000 m^3; large organisms removed) 1951-1960 (based on Table 4).

Table 4. Median zooplankton volumes ($cc/1000\ m^3$; large organisms removed) 1951-1960, listed by months and pooled areas.

Area	January	February	March	April	May	June	July	October
6.5	*	–	–	238	264	272	376	–
6.6	–	–	–	496	455	300	377	–
6.7	–	–	–	291	–	–	400	–
6.8	–	–	–	273	–	–	209	–
6.9	–	–	–	565	–	–	195	–
7.5	–	–	–	202	254	347	354	–
7.6	–	–	–	232	325	390	305	–
7.7	–	–	–	188	388	272	448	–
7.8	–	–	–	–	135	310	286	–
7.9	–	–	–	–	160	96	215	–
8.4	63	114	121	221	234	210	166	94
8.5	64	143	222	195	209	352	225	110
8.6	167	185	187	189	312	330	300	109
8.7	103	154	181	149	155	291	196	142
8.8	63	92	124	84	95	149	138	86
8.9	–	–	–	170	84	85	115	69
9.3	48	70	97	120	128	147	145	58
9.4	73	82	64	126	154	142	137	89
9.5	97	93	84	127	167	205	204	83
9.6	67	142	91	121	122	176	117	86
9.7	82	135	100	99	84	146	116	82
9.8	65	94	109	67	90	92	89	–
9.9	–	–	93	64	91	84	75	–
10.3	41	79	86	114	140	134	122	87
10.4	69	70	66	64	94	93	98	58
10.5	55	93	76	69	85	108	92	66
10.6	65	98	69	67	85	74	73	54
10.7	59	77	58	56	53	61	64	46
10.8	56	65	81	45	55	40	52	43
10.9	–	–	–	43	48	58	60	–
11.3	62	84	115	170	200	174	184	78
11.4	63	65	51	65	79	79	60	81
11.5	72	55	64	73	69	92	120	56
11.6	71	47	67	69	67	76	64	77
11.7	44	70	46	50	44	63	44	–
11.8	37	49	31	34	36	48	54	–
11.9	–	–	–	22	33	–	–	–
12.3	73	135	182	403	192	349	109	81
12.4	76	86	90	102	126	96	122	87
12.5	71	73	70	74	58	59	68	110
12.6	66	45	58	42	51	39	54	99
12.7	–	58	–	40	40	43	55	100
12.8	–	–	–	34	45	37	70	59
13.2	70	100	178	176	323	811	522	136
13.3	53	80	100	120	113	103	149	76
13.4	37	59	61	64	70	59	67	67
13.5	32	51	44	51	61	64	37	55
13.6	37	55	46	55	52	39	48	56

*Undersampled; pooled area sampled in less than 8 of the 10 years or fewer than 10 samples in total.

July) when zooplankton volumes are rising. When zooplankton standing stock is decreasing (August to January), only the months of October and January are available to indicate the decrease.

While the median value for a ten-year period is instructive, it must be remembered that the distribution of zooplankton, and especially individual species, is extremely complex and changeable from year to year. As an example, the ten-year distribution of zooplankton volumes is shown in Table 5. While this area of 4589 square miles is composed primarily of the waters of the gyre in the Los Angeles Bight, the diversity of zooplankton volumes within its boundaries is great. The seasonal cycle of medians is among the best defined (mean 133 cc/1000 m^3, amplitude 84 cc/1000 m^3) but nearly a 1000-fold range is possible with individual sample values in any month.

Table 5. Percent occurrence of sample volumes (cc/1000 m^3) by month in Los Angeles Bight (pooled area "8.4").

	5-16	17-64	65-256	257-1024	1025-4096	4097-16384	Md	N
October	10%	31%	53%	6%	0%	0%	94	51
January	9	41	48	2	0	0	63	46
February	2	20	71	7	0	0	114	55
March	4	13	74	9	0	0	121	54
April	0	3	59	38	0	0	221	61
May	1	10	42	45	1	0	234	69
June	2	9	42	36	8	3	210	64
July	2	16	54	18	9	2	166	56

Extreme differences may also be seen over the entire surveyed area of 200,000 square miles. For example, compare the July results for the years 1956 and 1958 (Chart No. 82 and 84).

Onshore-offshore trends—Onshore-offshore trends by percent frequency distribution, median and arithmetic mean are shown for pooled areas "8.4" through "8.9" running from the Los Angeles Bight 240 miles southwest approximately normal to the coast and the California Current (Table 6). In these pooled areas the zooplankton maximum is offshore 80-120 miles, diminishing toward the coast as well as toward the central water mass. This general offshore-onshore trend of higher standing stocks offshore which diminish seaward and inshore is typical of the rest of the coastline but is most pronounced in this transect.

The analysis of onshore-offshore trends is complicated by the incidence of tows in shallow water. Such an oblique tow spends an inordinate amount of time in the upper layers. When a tow from 140 meters deep to the surface is compared with a tow from 70 meters deep for example, the latter should normally yield more plankton per 1000 m^3 strained. In the section used for illustration, advection from the north may bring plankton-rich water into the nearshore and offshore regions (pooled areas "8.4," "8.5") which are derived from the nearshore regions of the coast of Central California (pooled area "7.5") (Fleminger, personal communication).

Upstream-downstream trends

In the northern portion of the California Current surveys, the zone of high plankton standing stock is relatively broad, usually more than 100 miles wide. In the south, the band of high standing stock is often less than 80 miles wide (Table 4). An index of this trend may be derived from the histograms present on each chart of the atlas.

GROUP COMPOSITION

Large sample estimates of the group composition of the zooplankton volumes are now becoming available (Table 7, after Isaacs, Fleminger and Miller, 1969). The April and October samples from 1955-1959, show the extent of changes in group composition. In all years except 1957, the rank of components changed very little from spring to fall. The year 1957 has previously been noted as a year of transition over the entire California Current area (Thrailkill, 1959) with regard to zooplankton volumes. Thaliaceans and larvaceans were second to crustaceans in 1955 and became first for the April cruises of 1956, 1957 and the intervening October. In October 1957, the thaliaceans and larvaceans were ranked fourth and remained there through April and October of 1958.

Table 6. Percent distribution of zooplankton volumes (cc/1000 m^3) along onshore-offshore transect at Los Angeles Bight, 1951-1960.

	<16	17-64	65-256	257-1024	1025-4096	>4096	Md	$\bar{x}$	N
October									
8.4	10%	31%	53%	6%	0%	0%	99	117	51
8.5	4	28	48	20	0	0	110	148	50
8.6	4	21	64	14	0	0	109	144	28
8.7	0	13	73	13	0	0	142	149	15
8.8	0	36	57	7	0	0	86	111	14
8.9	7	33	60	0	0	0	69	68	15
January									
8.4	9%	41%	48%	2%	0%	0%	63	80	46
8.5	2	51	33	13	0	0	64	126	45
8.6	0	11	57	32	0	0	167	224	28
8.7	0	17	72	11	0	0	103	142	18
8.8	0	50	38	13	0	0	63	159	16
8.9	8	38	38	8	8	0	87	185	13
April									
8.4	0%	3%	59%	38%	0%	0%	221	246	61
8.5	2	9	54	33	2	0	195	333	57
8.6	0	5	61	27	7	0	189	289	41
8.7	0	8	67	18	8	0	149	344	39
8.8	0	32	54	14	0	0	84	141	37
8.9	0	21	39	32	7	0	170	286	28
July									
8.4	2%	16%	54%	18%	9%	2%	166	406	56
8.5	2	5	50	32	11	0	225	464	56
8.6	0	2	42	44	9	2	300	576	43
8.7	0	10	52	39	0	0	196	232	31
8.8	0	21	55	24	0	0	138	209	29
8.9	0	22	39	28	11	0	115	334	18

It is important to know the group composition, for differences in the proportions of the crustaceans and thaliaceans bear on the carbon content of the sample. The thaliaceans differ from the crustaceans in dry weight per unit wet weight and in carbon per unit dry weight (Curl, 1962; Ahlstrom and Thrailkill, 1963).

Plankton volume data have been used (Lasker, 1970) to describe the use of zooplankton energy by the Pacific sardine. The location and timing of zooplankton increases coincide with the migration, fat deposition and spawning of that species. It is apparent that the usefulness of plankton volume data would increase if we knew more about 1) estimates of the transport of plankton from one area to another, 2) the species composition of the individual samples, 3) the population dynamics of the major crustacean and thaliacean species and 4) the abundance of zooplankton of smaller sizes.

Table 7. Group composition of zooplankton samples (in percent) representing five spring and fall surveys: data from Isaacs, Fleminger and Miller, 1969.

Cruise	5504	5510	5604	5610	5704	5710	5804	5810	5904	5910
Crustacea	55%	49%	39%	17%	24%	35%	60%	51%	47%	37%
Thaliacea and Larvacea	34	21	45	75	65	17	7	10	34	23
Coelenterata	7	14	11	3	6	18	15	17	9	25
Chaetognatha	4	10	4	4	4	27	17	17	7	11
Radiolaria	0.3	5	0.6	1	0.4	0.8	1	2	0.4	0.8
Mollusca	0.2	2	0.2	2	0.3	4	2	4	2	3

Table 8. Page numbers of charts. Charts arranged by month and year. (-) No cruise. (*) Distribution for early and late monthly cruises are shown on the same chart. (**) Special cruises, no distribution charts included.

	1951	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
Jan. (01)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Feb. (02)	18	19	20	21	22	23	24	25	26	27	—	—	—	—	—	28
Mar. (03)	29	30*	31*	32	33	34	35	36	37	38	—	—	—	—	—	—
Apr. (04)	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
May (05)	55	56	57	58	59	60	61	62	63	64	—	—	—	—	—	65
June (06)	66	67	68	69	70	71	72	73	74	75	—	—	—	—	—	76
July (07)	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92
Aug. (08)	93	94	95	96	**	97	98	99	100	101	—	—	—	—	—	102
Sept. (09)	103	104*	105	**	**	106	107	108	109	110	—	—	—	—	111	112
Oct. (10)	113	114	115	116	117	118	119	120	121	122	123	124	125	125	—	127
Nov. (11)	128	129	130	**	**	131	132	133	134	—	—	—	—	—	—	135
Dec. (12)	136	—	137	138	139	140	141	142	143	—	—	—	—	—	—	144

REFERENCES

Ahlstrom, E. H., 1948. A record of pilchard eggs and larvae collected during surveys made in 1939-41. U. S. Fish Wildl. Serv. Spec. Sci. Rep., Fish. No. 54: 76 pp.

————, 1959b. Sardine eggs and larvae and other fish larvae, Pacific coast, 1957. U. S. Fish Wildl. Serv. Spec. Sci. Rep. Fish., No. 328: 99 pp.

————, MS. Variability in plankton tow-net catches.

Ahlstrom, E. H., and J. R. Thrailkill, 1963. Plankton volume loss with time of preservation. Calif. Coop. Oceanic Fish. Invest. Rep. 9: 57-73.

Bigelow, H. B., and M. Sears, 1939. Studies of the waters of the continental shelf, Cape Cod to Chesapeake Bay. Part III. A volumetric study of the zooplankton. Contrib. 194. Memoirs of the Museum of Comparative Zoology, Harvard College, 50(4): 189-378.

Brinton, E., 1962. Variable factors affecting the apparent range and estimated concentration of euphausiids in the north Pacific. Pac. Sci., **16**: 374-408.

Clutter, R. I., and M. Anraku, 1968. 4. Avoidance of samplers. UNESCO Zooplankton sampling. Monograph on Oceanographic Methodology, Paris, 1968.

Curl, H., Jr., 1962. Analyses of carbon in marine plankton. J. Mar. Res., **20**(3): 181-188.

Fleminger, A., and R. I. Clutter, 1965. Avoidance of towed nets by zooplankton. Limnol. Oceanogr., **10**(1): 96-104.

Isaacs, J. D.. A. Fleminger and J. K. Miller, 1969. Distributional atlas of zooplankton biomass in the California Current region: Spring and fall 1955-1959. CalCOFI Atlas, No. 10: i-xxv, 1-252.

King, J. E., and T. S. Hida, 1954. Variations in zooplankton abundance in the Hawaiian waters, 1950-52. U. S. Fish Wildl. Serv. Spec. Sci. Rep., Fish. No. 18: 66 pp.

Kramer, D., 1963. Records and observations from plankton grid studies off Baja California, April 1952. U. S. Fish Wildl. Serv. Spec. Sci. Rep., Fish., No. 422: 42 pp.

Lasker, R., 1970. Utilization of zooplankton energy by a Pacific sardine population in the California Current. In J. H. Steele (Ed.), Marine Food Chains. Univ. Calif. Press: 265-284.

Milne, A., 1959. The centric systematic area-sample treated as a random sample. Biometrics, **15**(2): 270-297.

Smith, P. E., R. C. Counts and R. I. Clutter, 1968. Changes in filtering efficiency of plankton nets due to clogging under tow. J. Cons., **32**(2): 232-248.

Staff, South Pacific Fishery Investigations, 1952. Zooplankton volumes off the Pacific coast, 1951. U. S. Fish Wildl. Serv., Spec. Sci. Rep., Fish. No. 73: 33 pp.

————, 1953. Zooplankton volumes off the Pacific coast, 1952. U. S. Fish Wildl. Serv., Spec. Sci. Rep., Fish. No. 100: 41 pp.

————, 1954. Zooplankton volumes off the Pacific coast, 1949-50. U. S. Fish Wildl. Serv., Spec. Sci. Rep., Fish. No. 125: 54 pp.

————, 1954b. Zooplankton volumes off the Pacific coast, 1953. U. S. Fish Wildl. Serv., Spec. Sci. Rep., Fish. No. 132: 38 pp.

————, 1955. Zooplankton volumes off the Pacific coast, 1954. U. S. Fish Wildl. Service, Spec. Sci. Rep., Fish. No. 161: 35 pp.

————, 1956. Zooplankton volumes off the Pacific coast, 1955. U. S. Fish Wildl. Serv., Spec. Sci. Rep., Fish. No. 177: 31 pp.

Thrailkill, J. R., 1956. Relative areal zooplankton abundance off the Pacific coast. U. S. Fish Wildl. Service, Spec. Sci. Rep., Fish. No. 188: 85 pp.

————, 1957. Zooplankton volumes off the Pacific coast, 1956. U. S. Fish Wildl. Serv., Spec. Sci. Rep., Fish. No. 232: 50 pp.

————, 1959. Zooplankton volumes off the Pacific coast, 1957. U. S. Fish Wildl. Serv., Spec. Sci. Rep., Fish. No. 326: 57 pp.

————, 1961. Zooplankton volumes off the Pacific coast, 1958. U. S. Fish Wildl. Serv., Spec. Sci. Rep., Fish. No. 374: 70 pp.

————. 1963. Zooplankton volumes off the Pacific coast, 1959. U. S. Fish Wildl. Serv., Spec. Sci. Rep., Fish. No. 414: 77 pp.

————, 1969. Zooplankton volumes off the Pacific coast, 1960. U. S. Fish Wildl. Serv., Spec. Sci. Rep., Fish. No. 581: 50 pp.

————, MS. Zooplankton volumes off the Pacific coast, 1961-65.

JANUARY

FEBRUARY

MARCH

APRIL

MAY

JUNE

JULY

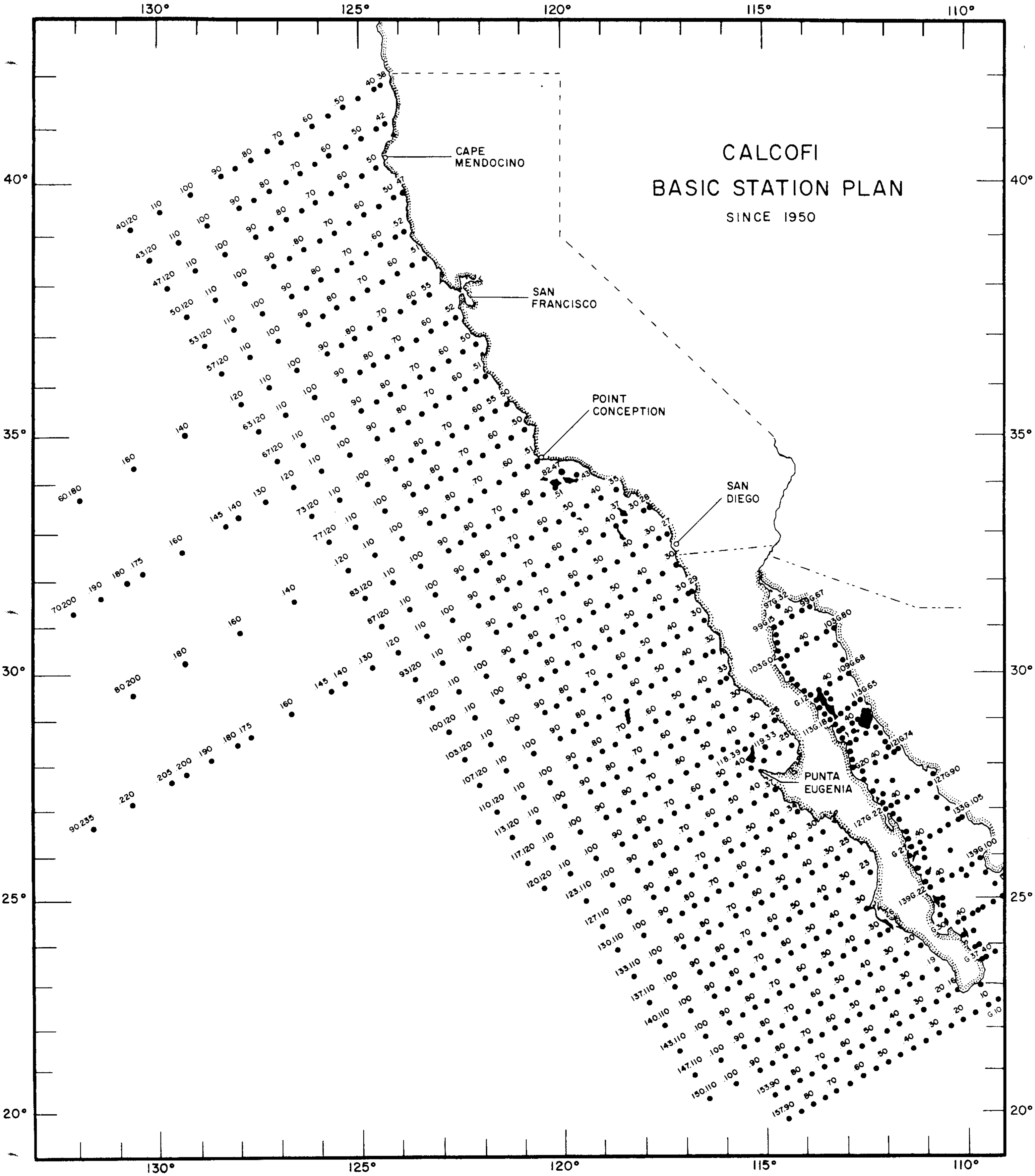
AUGUST

SEPTEMBER

OCTOBER

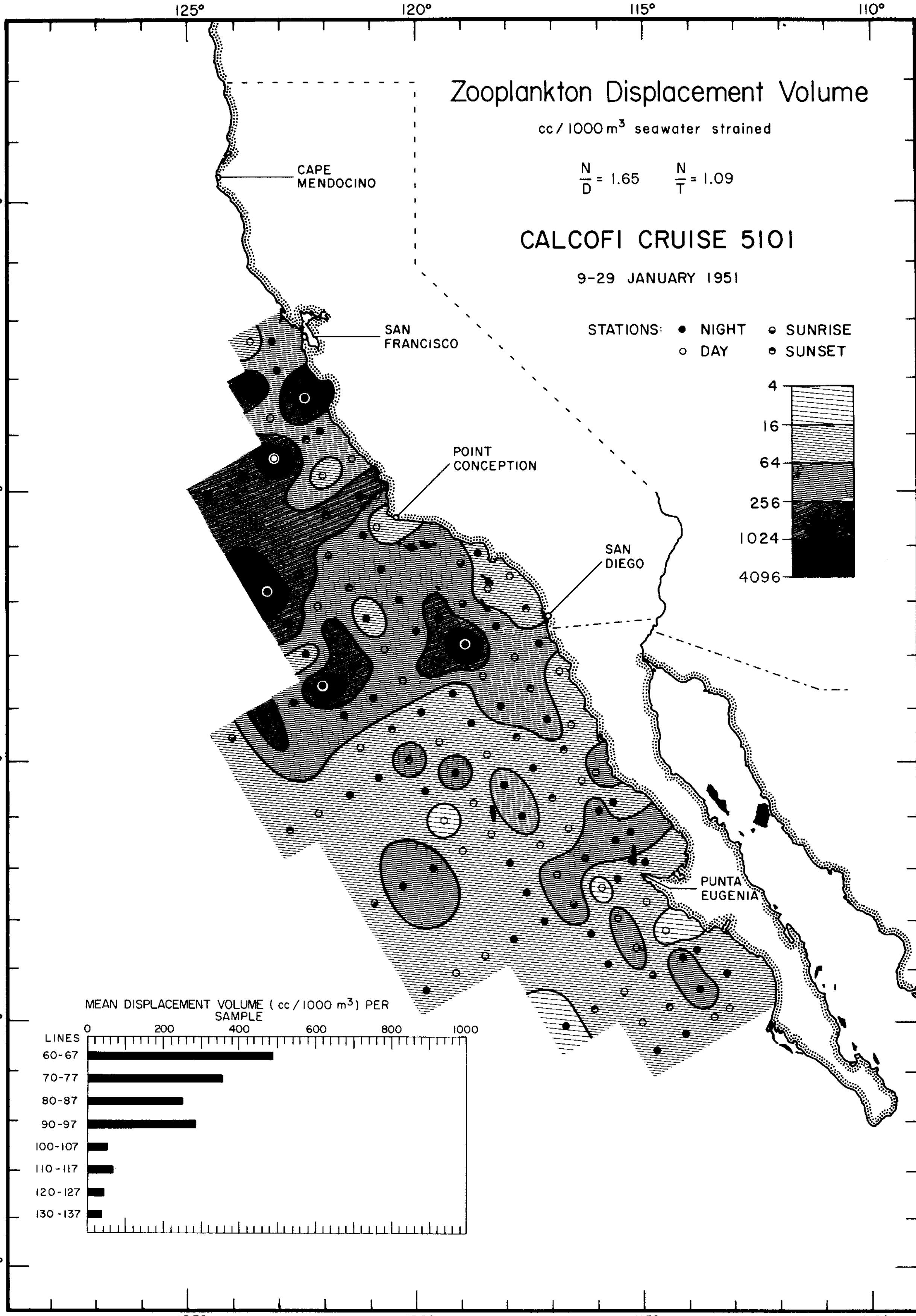
NOVEMBER

DECEMBER

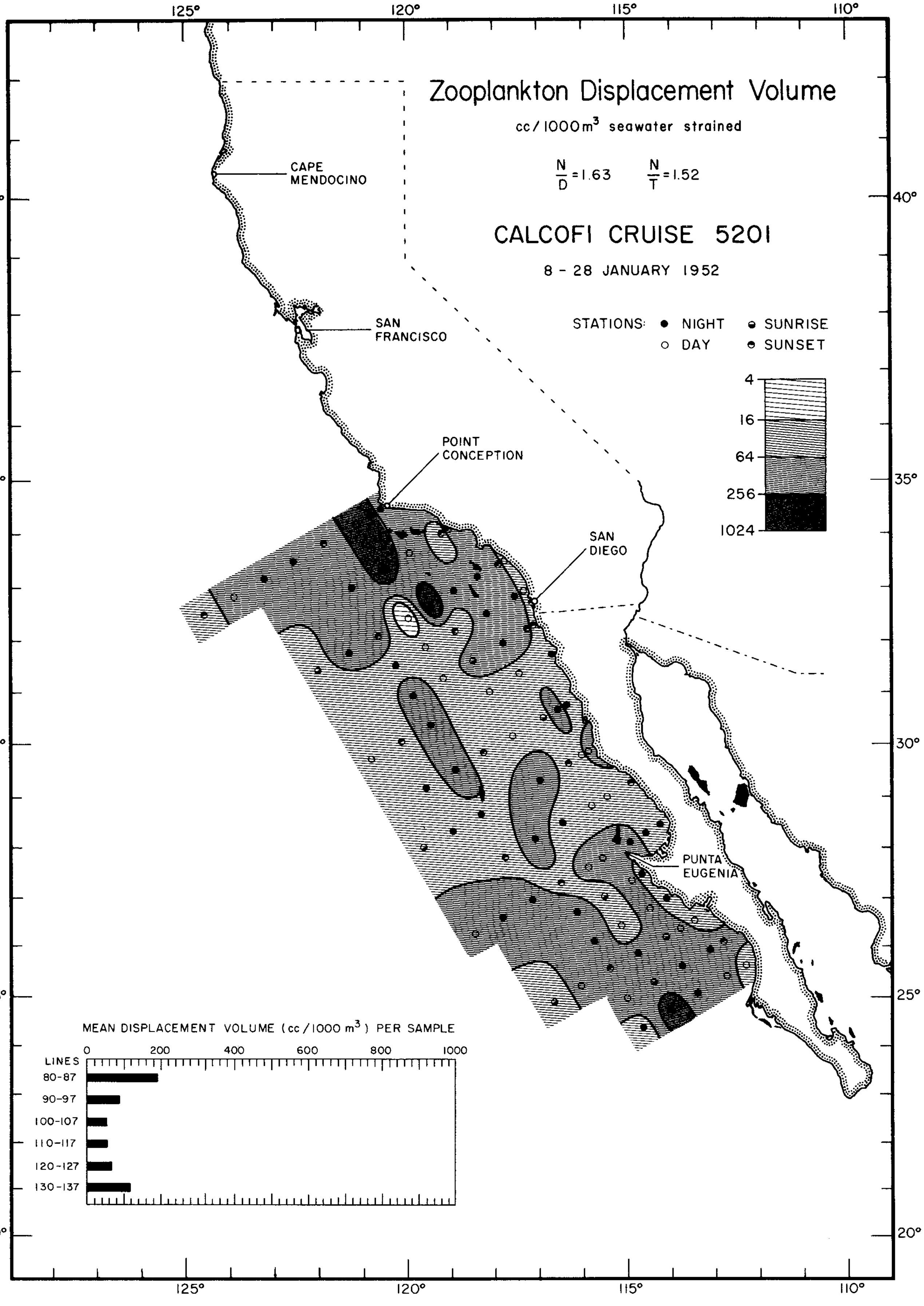


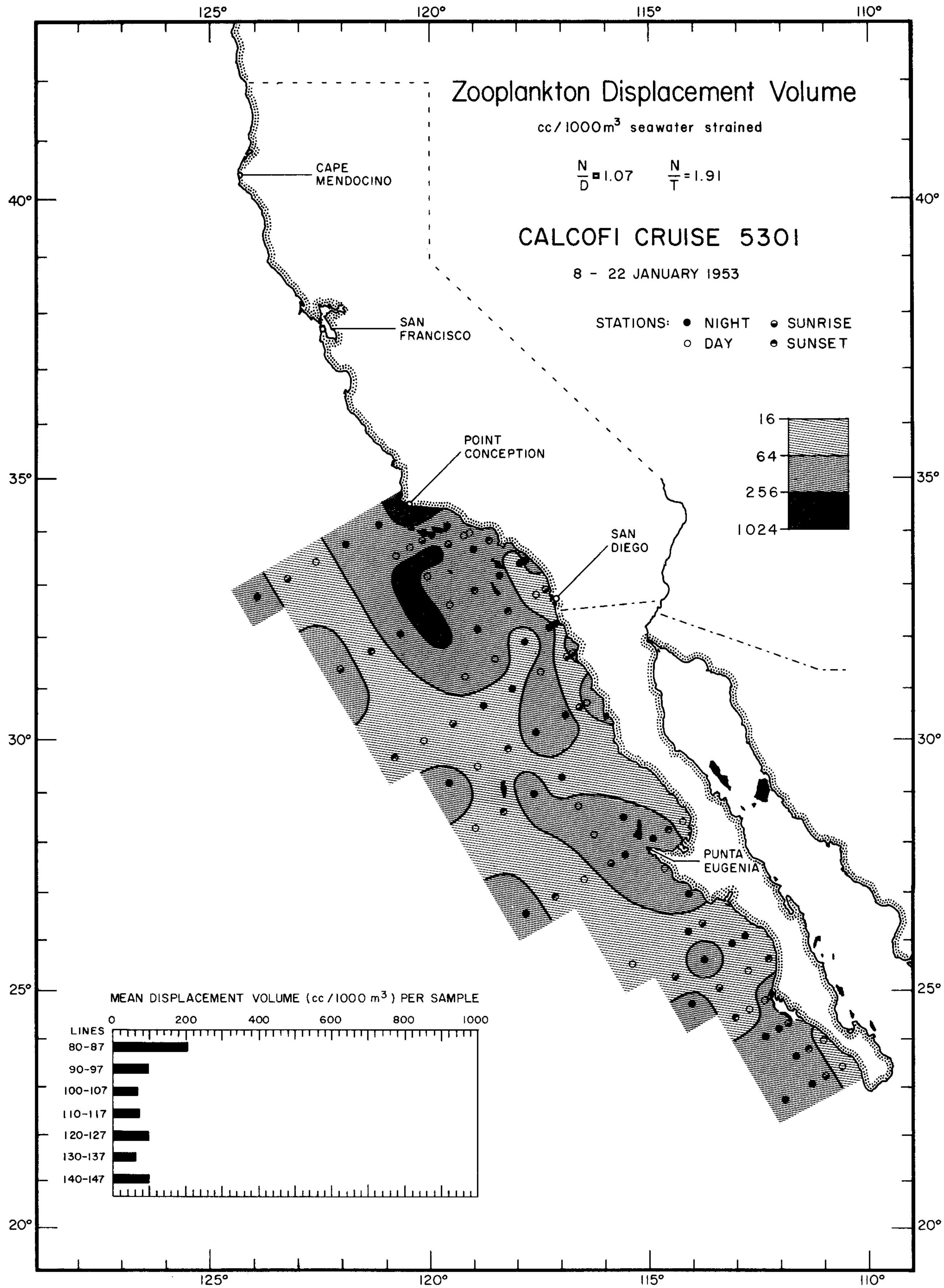
CALCOFI

BASIC STATION PLAN
SINCE 1950

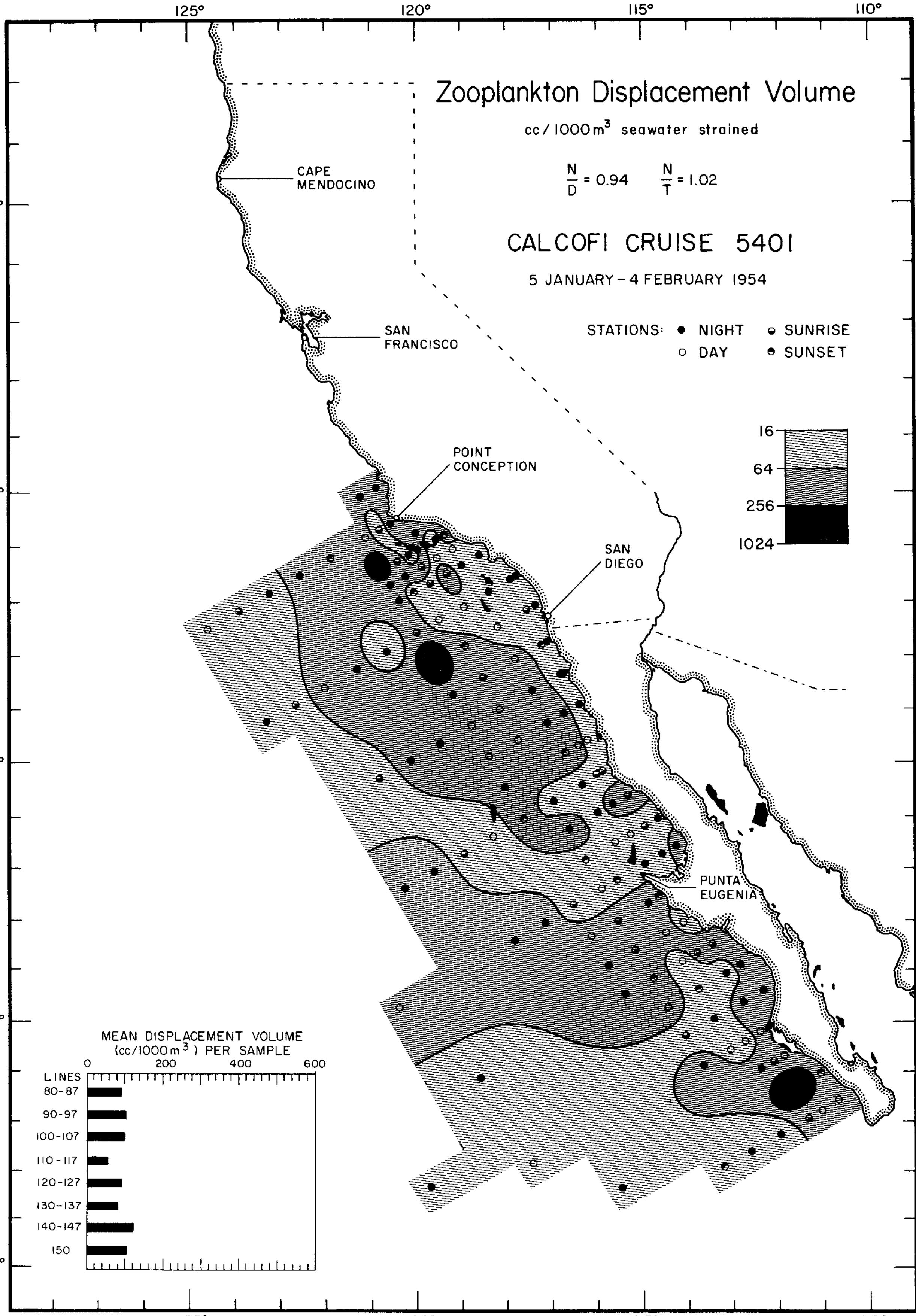


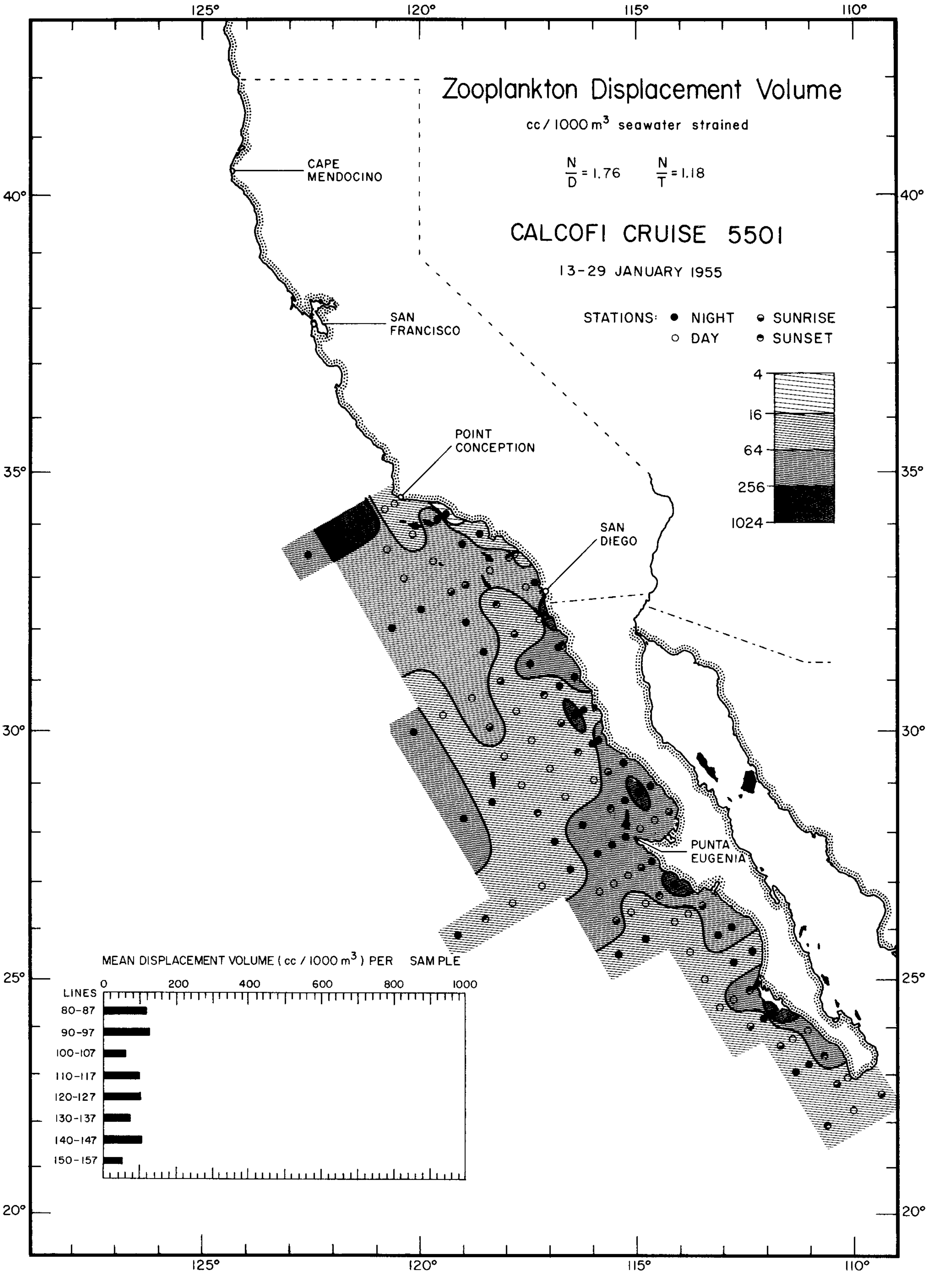
Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.65 N/T = 1.09
CALCOFI CRUISE 5101
9-29 JANUARY 1951
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
60-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137


125°
120°
115°
110°
40°
35°
30°
25°
20°
Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.63   N/T = 1.52
CALCOFI CRUISE 5201
8 - 28 JANUARY 1952
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97
100-107
110-117
120-127
130-137

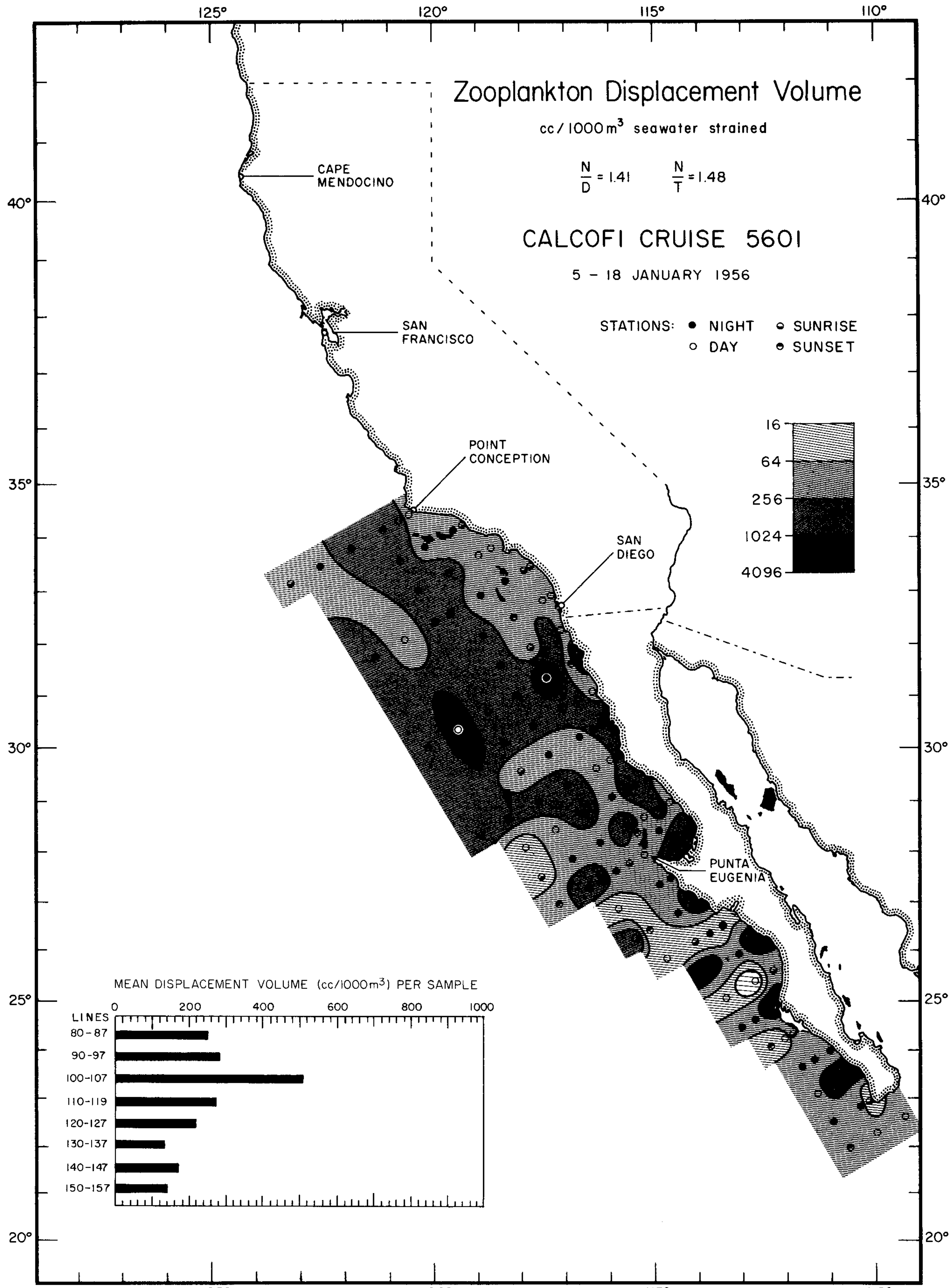


Zooplankton Displacement Volume
cc/1000m3 seawater strained
N/D = 1.07
N/T = 1.91
CALCOFI CRUISE 5301
8 - 22 JANUARY 1953
STATIONS: NIGHT SUNRISE DAY SUNSET
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m3) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97
100-107
110-117
120-127
130-137
140-147

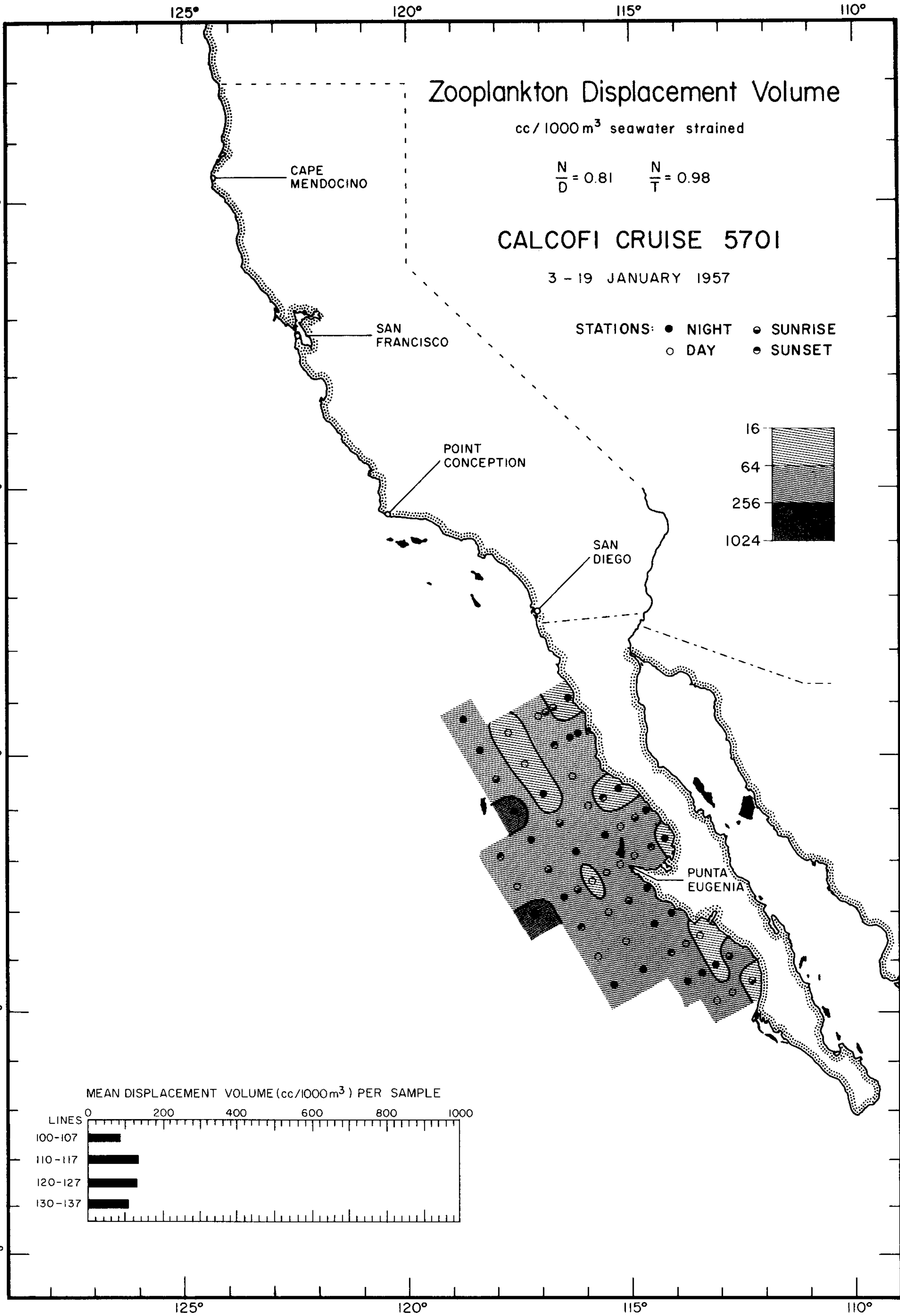

Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 0.94 N/T = 1.02
CALCOFI CRUISE 5401
5 JANUARY - 4 FEBRUARY 1954
STATIONS: NIGHT SUNRISE DAY SUNSET
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0 200 400 600
LINES
80-87
90-97
100-107
110-117
120-127
130-137
140-147
150
125° 120° 115° 110°
40° 35° 30° 25° 20°

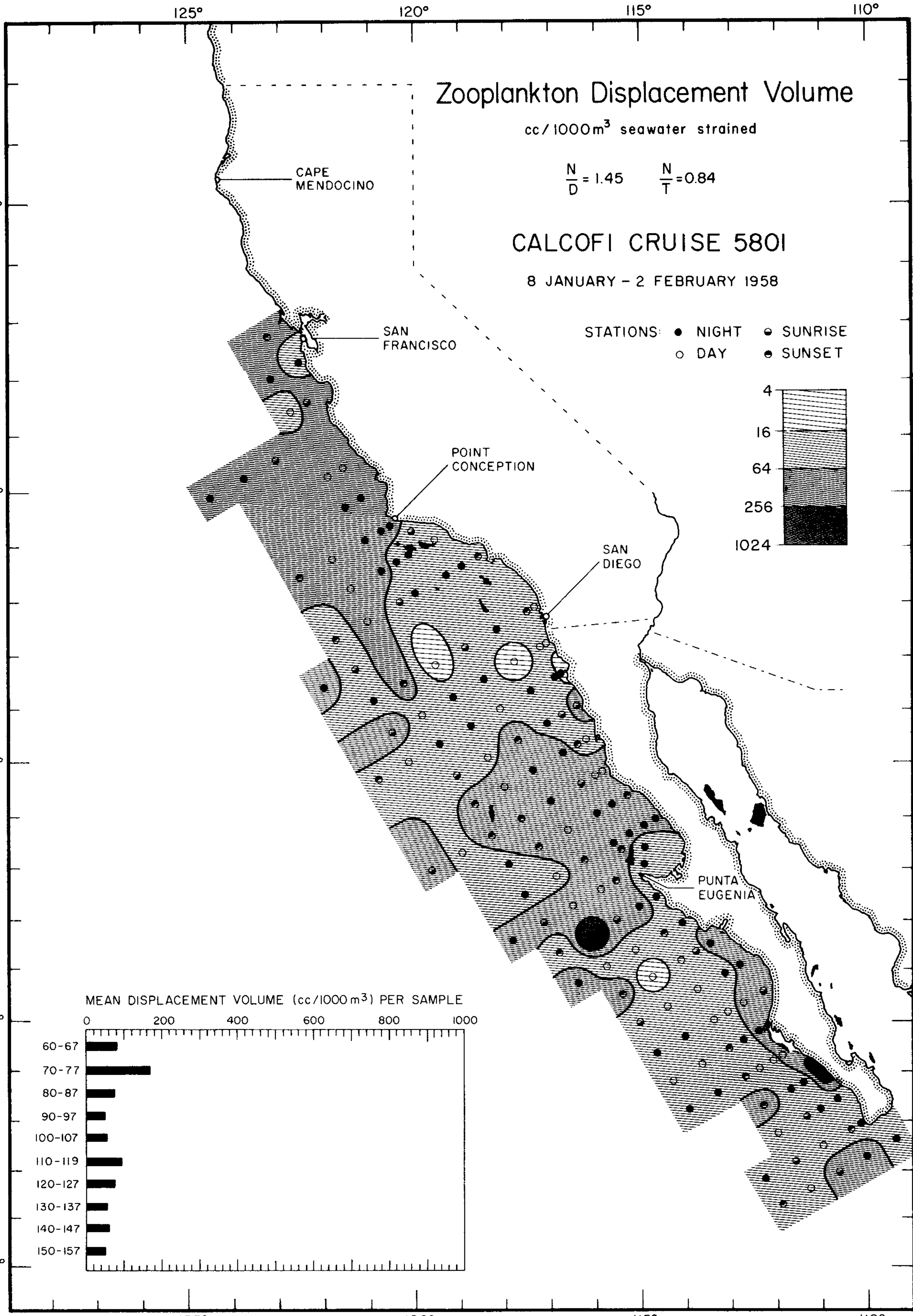


Zooplankton Displacement Volume
cc/1000 m3 seawater strained
N/D = 1.76 N/T = 1.18
CALCOFI CRUISE 5501
13-29 JANUARY 1955
STATIONS: ● NIGHT ○ DAY SUNRISE SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc / 1000 m3) PER SAMPLE
LINES
0
200
400
600
800
1000
80-87
90-97
100-107
110-117
120-127
130-137
140-147
150-157

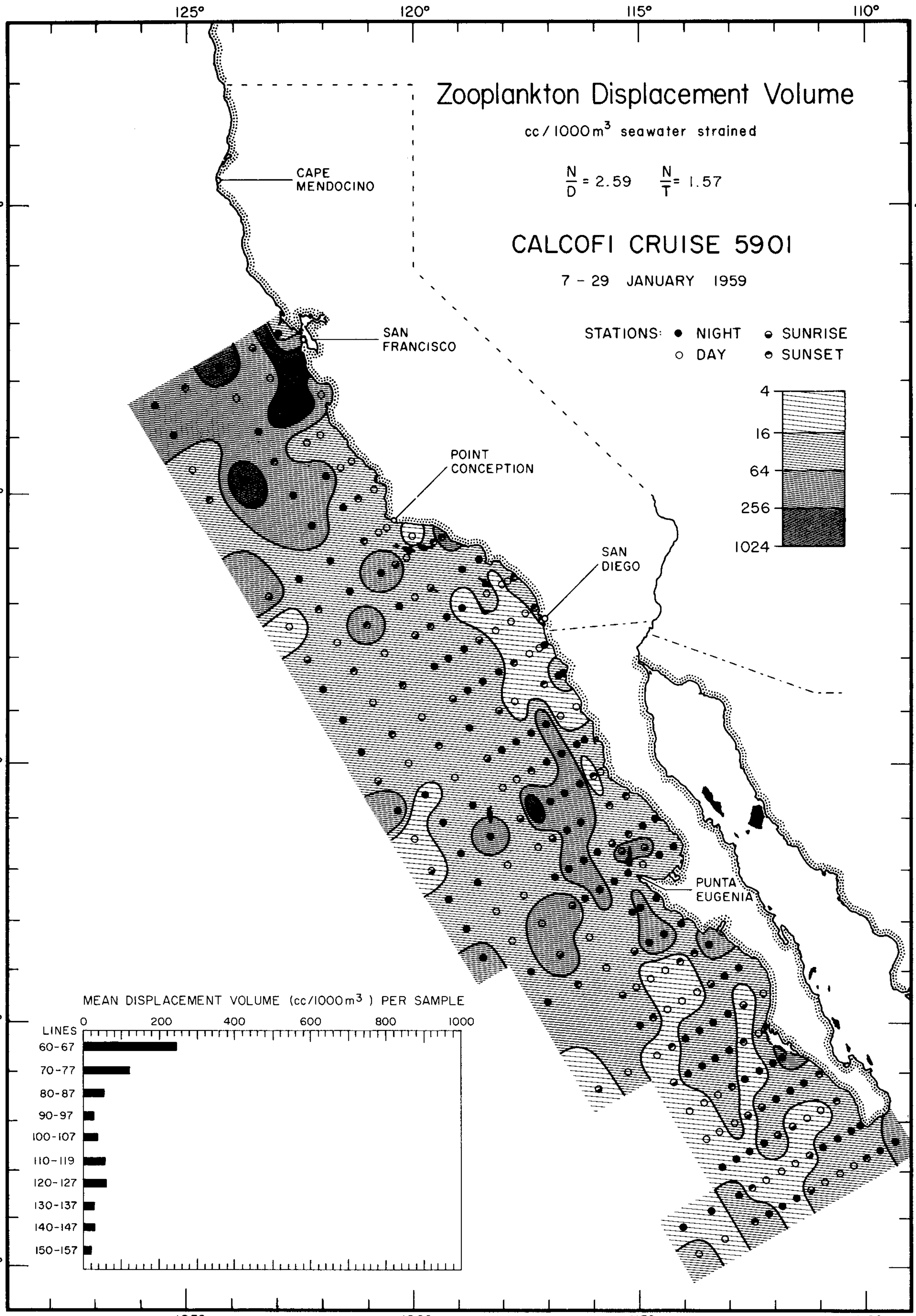


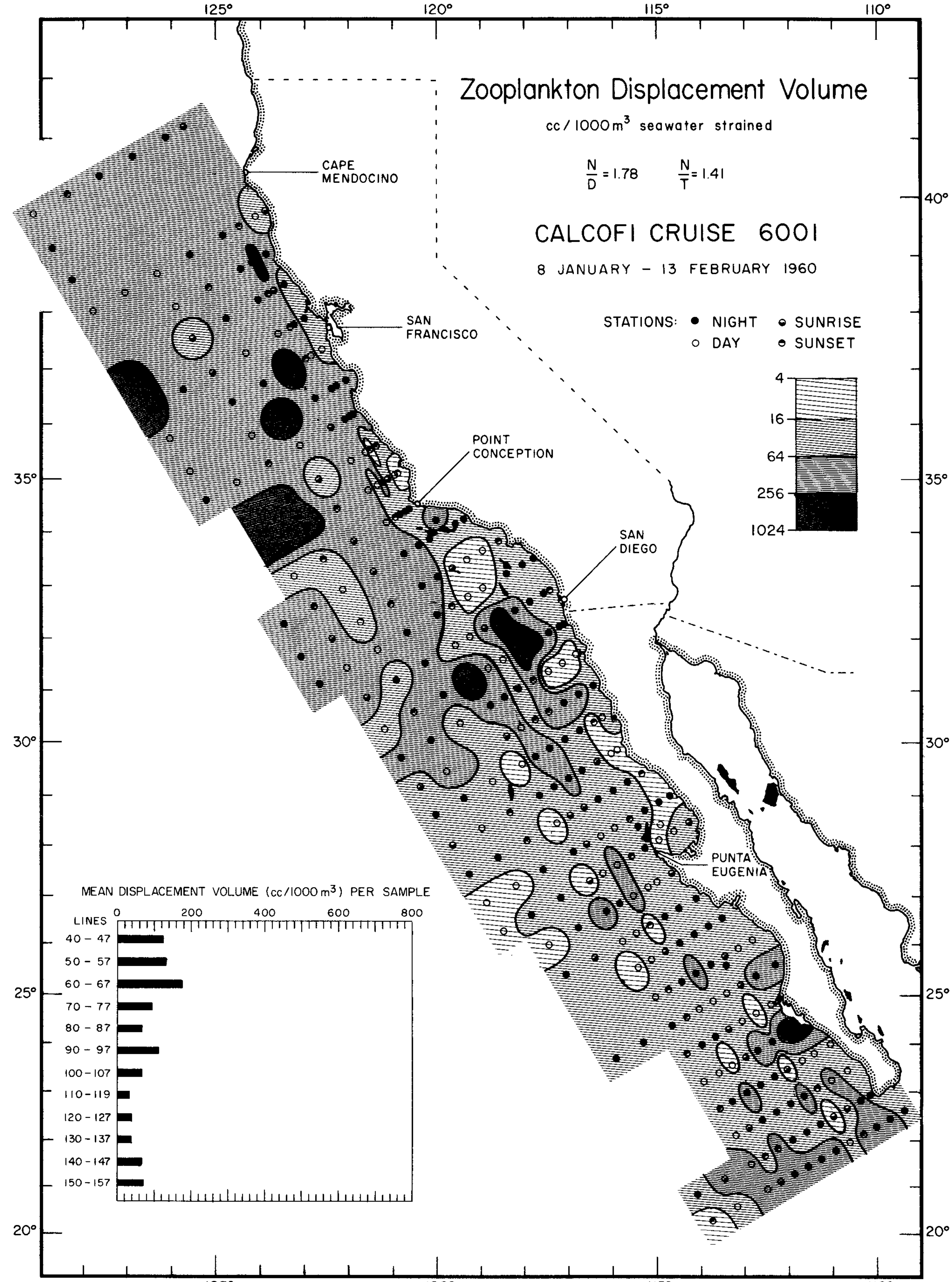
Zooplankton Displacement

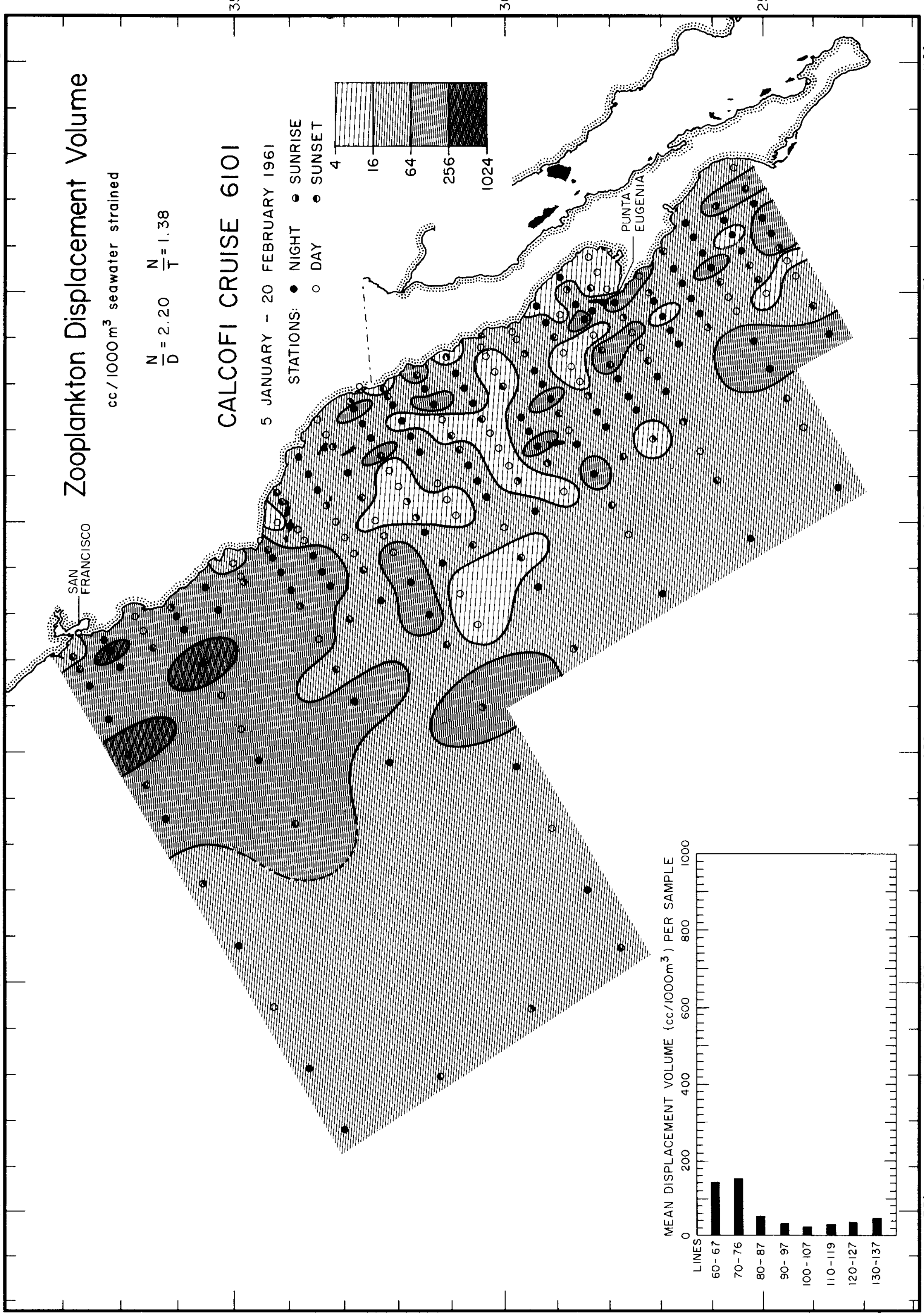

Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 0.81 N/T = 0.98
CALCOFI CRUISE 5701
3 - 19 JANUARY 1957
STATIONS: ● NIGHT ○ DAY SUNRISE SUNSET
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125° 120° 115° 110°
40° 35° 30° 25° 20°
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
LINES
0 200 400 600 800 1000
100-107
110-117
120-127
130-137

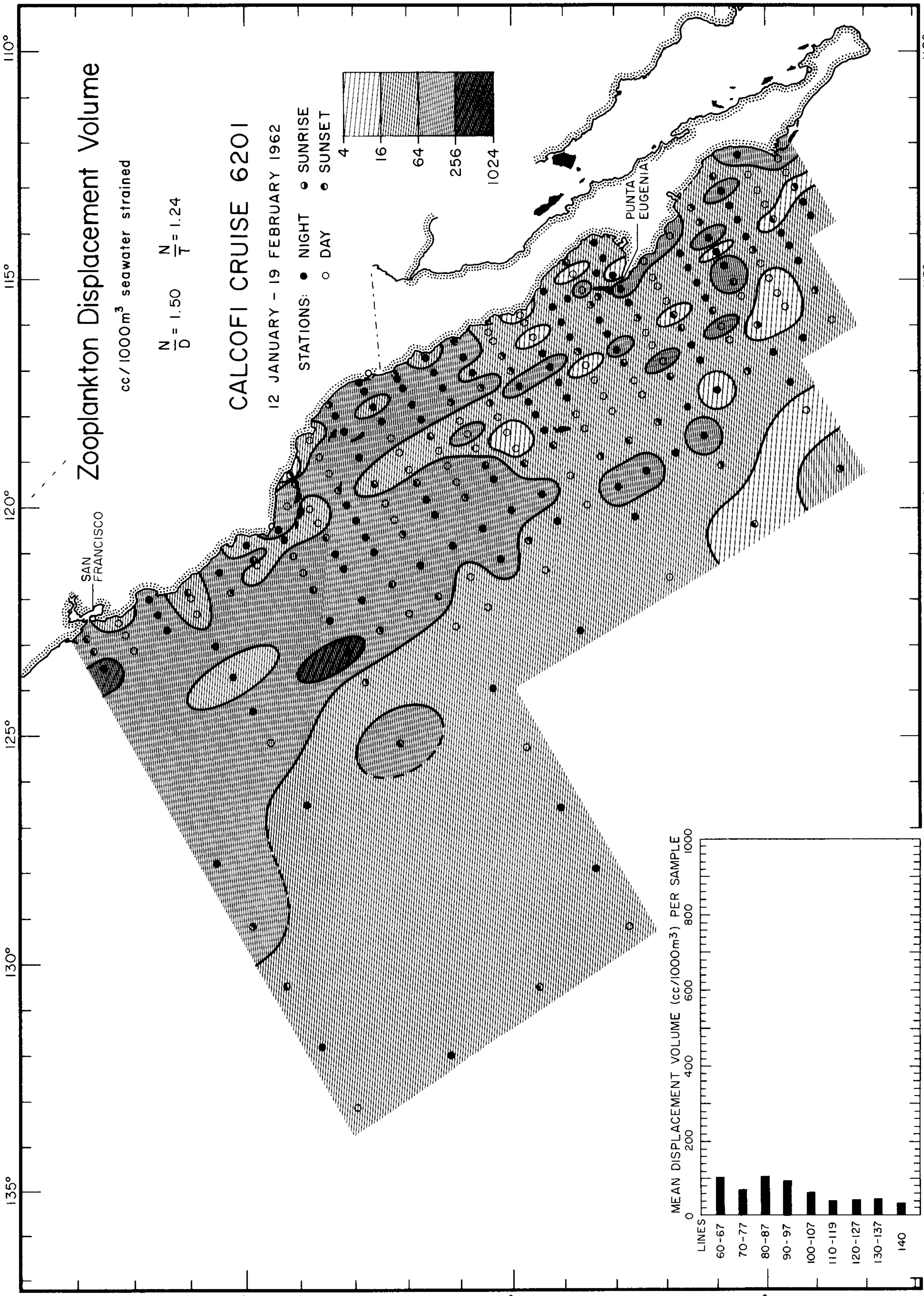


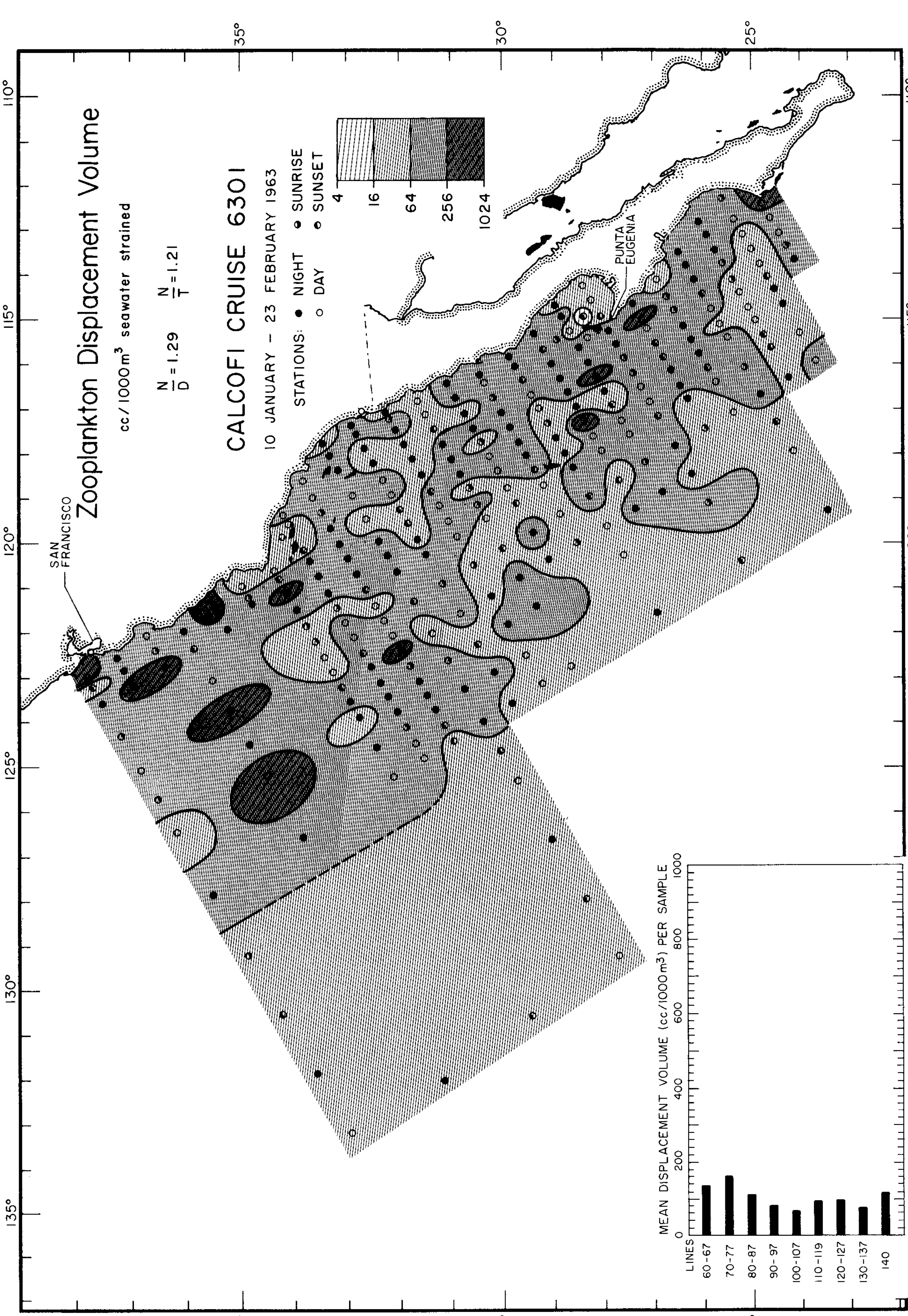
Zooplankton Displacement Volume
cc/1000m^3 seawater strained
$\frac{N}{D}$ = 1.45
$\frac{N}{T}$ = 0.84
CALCOFI CRUISE 5801
8 JANUARY – 2 FEBRUARY 1958
STATIONS: ● NIGHT ○ DAY ◒ SUNRISE ◓ SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m^3) PER SAMPLE
0
200
400
600
800
1000
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137
140-147
150-157


Zooplankton Displacement Volume
cc / 1000 m3 seawater strained
N/D = 2.59 N/T = 1.57
CALCOFI CRUISE 5901
7 - 29 JANUARY 1959
STATIONS: NIGHT SUNRISE
DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m3) PER SAMPLE
0
200
400
600
800
1000
LINES
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137
140-147
150-157

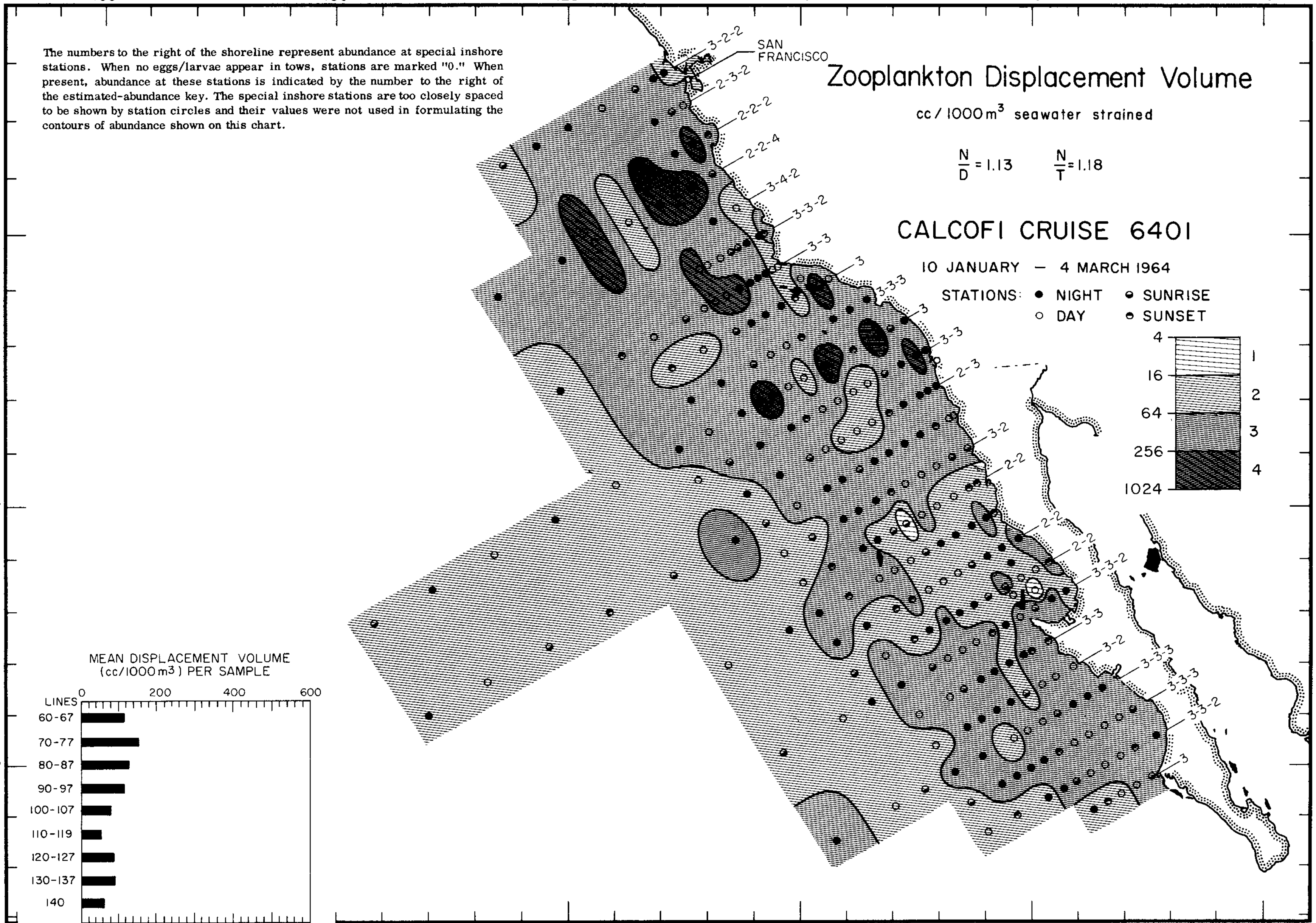

Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.78
N/T = 1.41
CALCOFI CRUISE 6001
8 JANUARY – 13 FEBRUARY 1960
STATIONS:
NIGHT
DAY
SUNRISE
SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
LINES
0
200
400
600
800
40 – 47
50 – 57
60 – 67
70 – 77
80 – 87
90 – 97
100 – 107
110 – 119
120 – 127
130 – 137
140 – 147
150 – 157

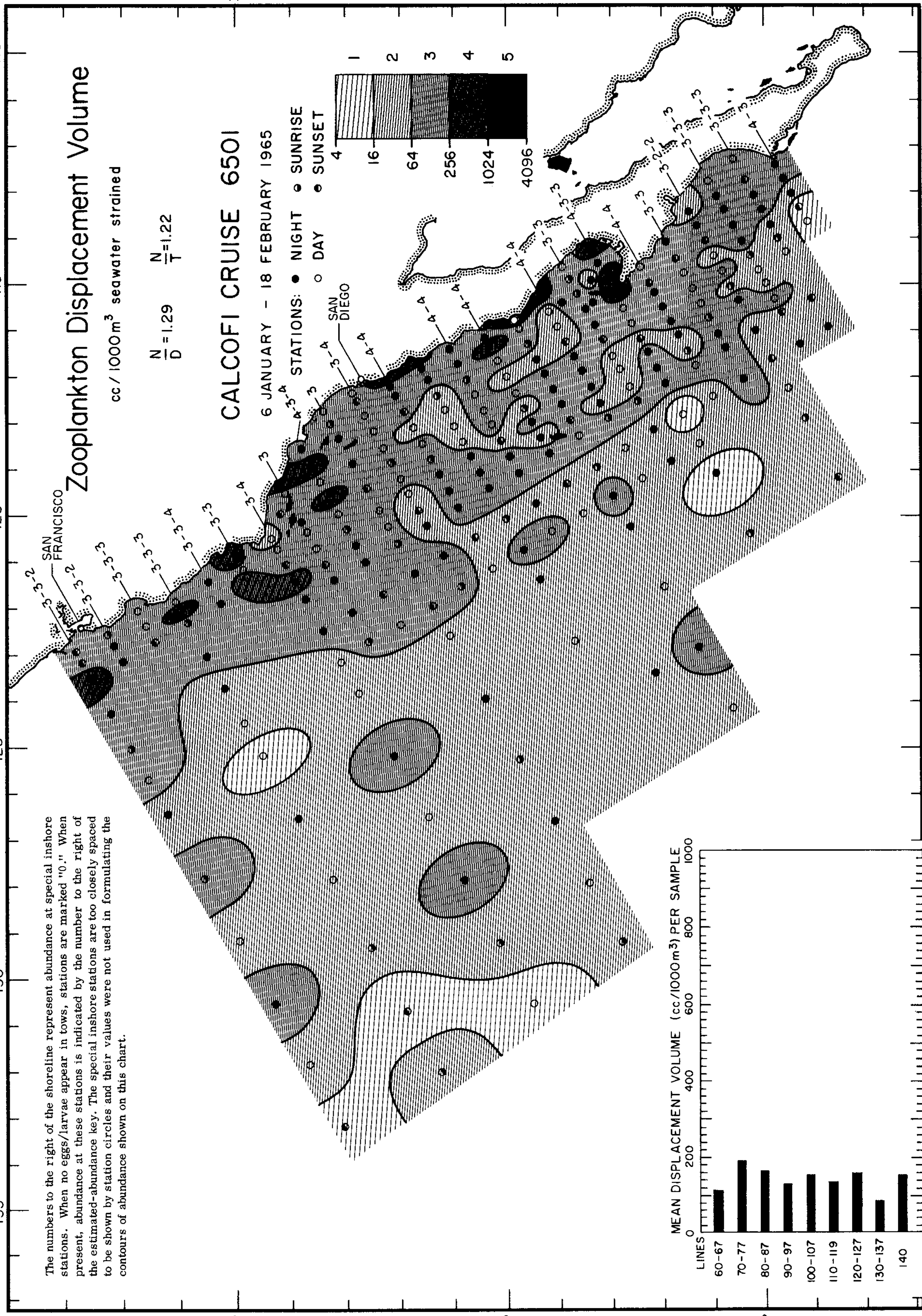

Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 2.20 N/T = 1.38
CALCOFI CRUISE 6101
5 JANUARY - 20 FEBRUARY 1961
STATIONS: ● NIGHT ◐ SUNRISE
○ DAY ◑ SUNSET
4
16
64
256
1024
SAN FRANCISCO
PUNTA EUGENIA
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0
200
400
600
800
1000
LINES
60-67
70-76
80-87
90-97
100-107
110-119
120-127
130-137
35°
30°
25°
110°
115°
120°
125°
130°
135°


Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.50
N/T = 1.24
CALCOFI CRUISE 6201
12 JANUARY - 19 FEBRUARY 1962
STATIONS: ● NIGHT ◐ SUNRISE
○ DAY ◑ SUNSET
4
16
64
256
1024
SAN FRANCISCO
PUNTA EUGENIA
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0
200
400
600
800
1000
LINES
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137
140
35°
30°
25°
110°
115°
120°
125°
130°
135°

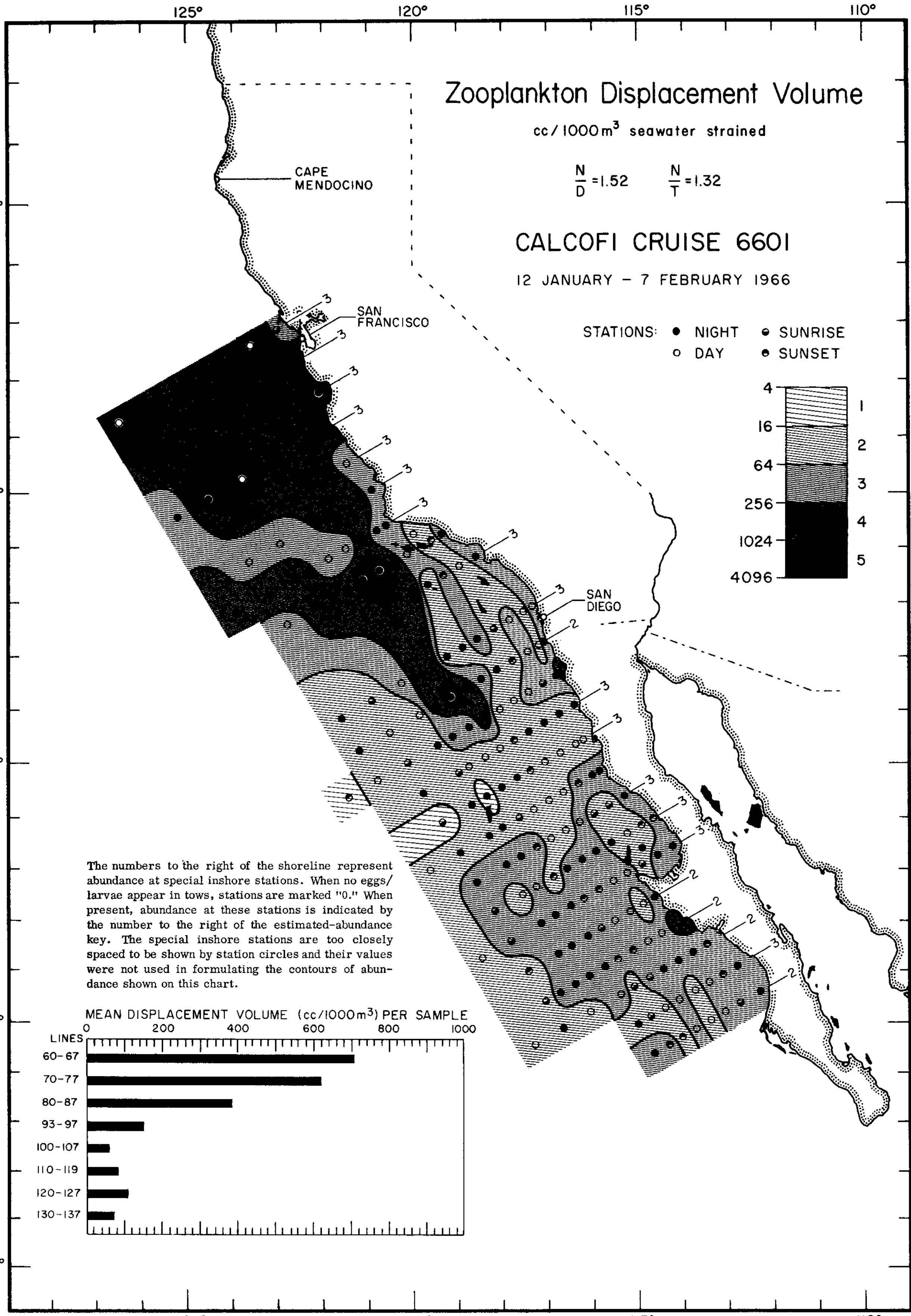


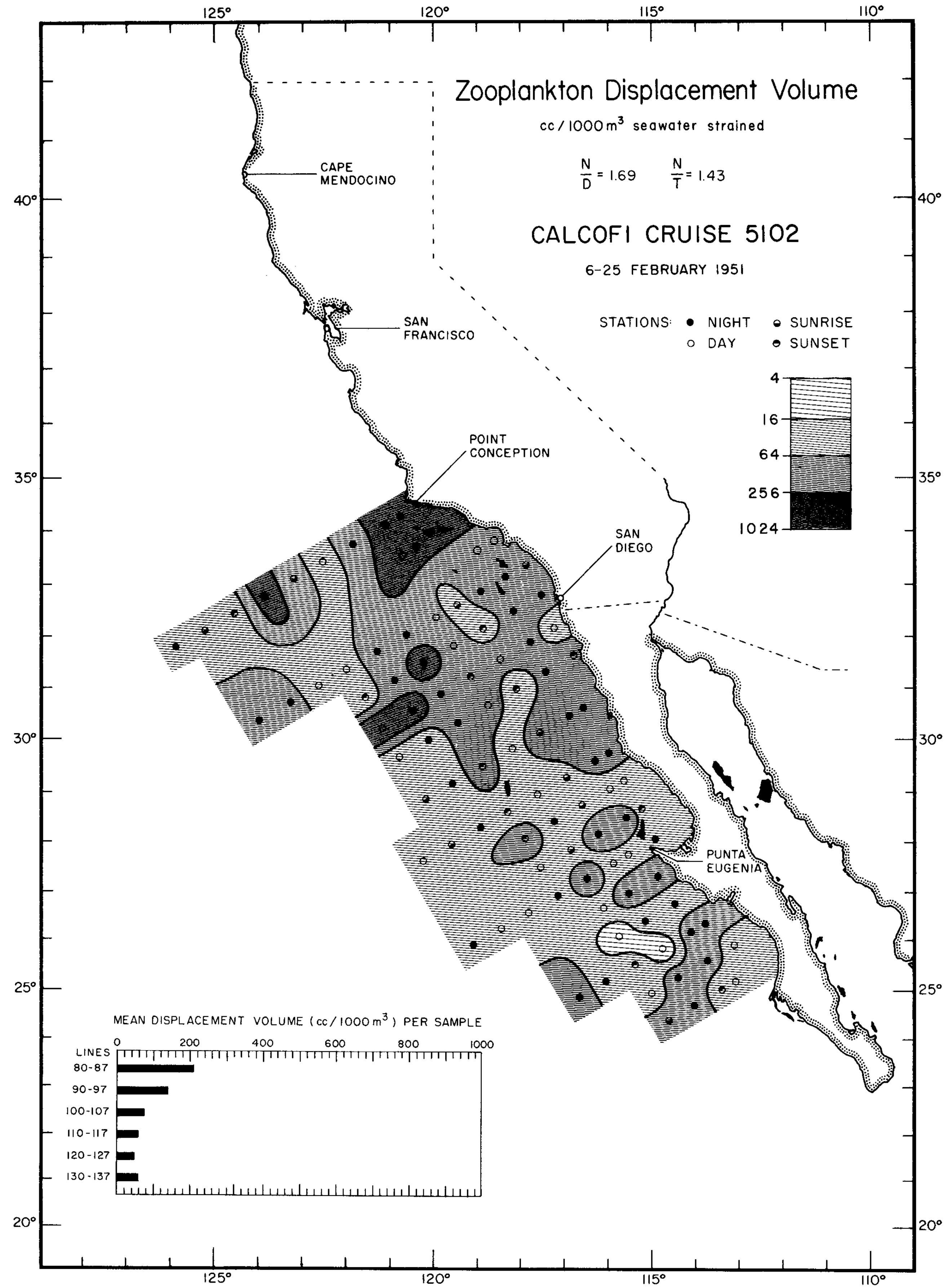
Zooplankton Displacement Volume

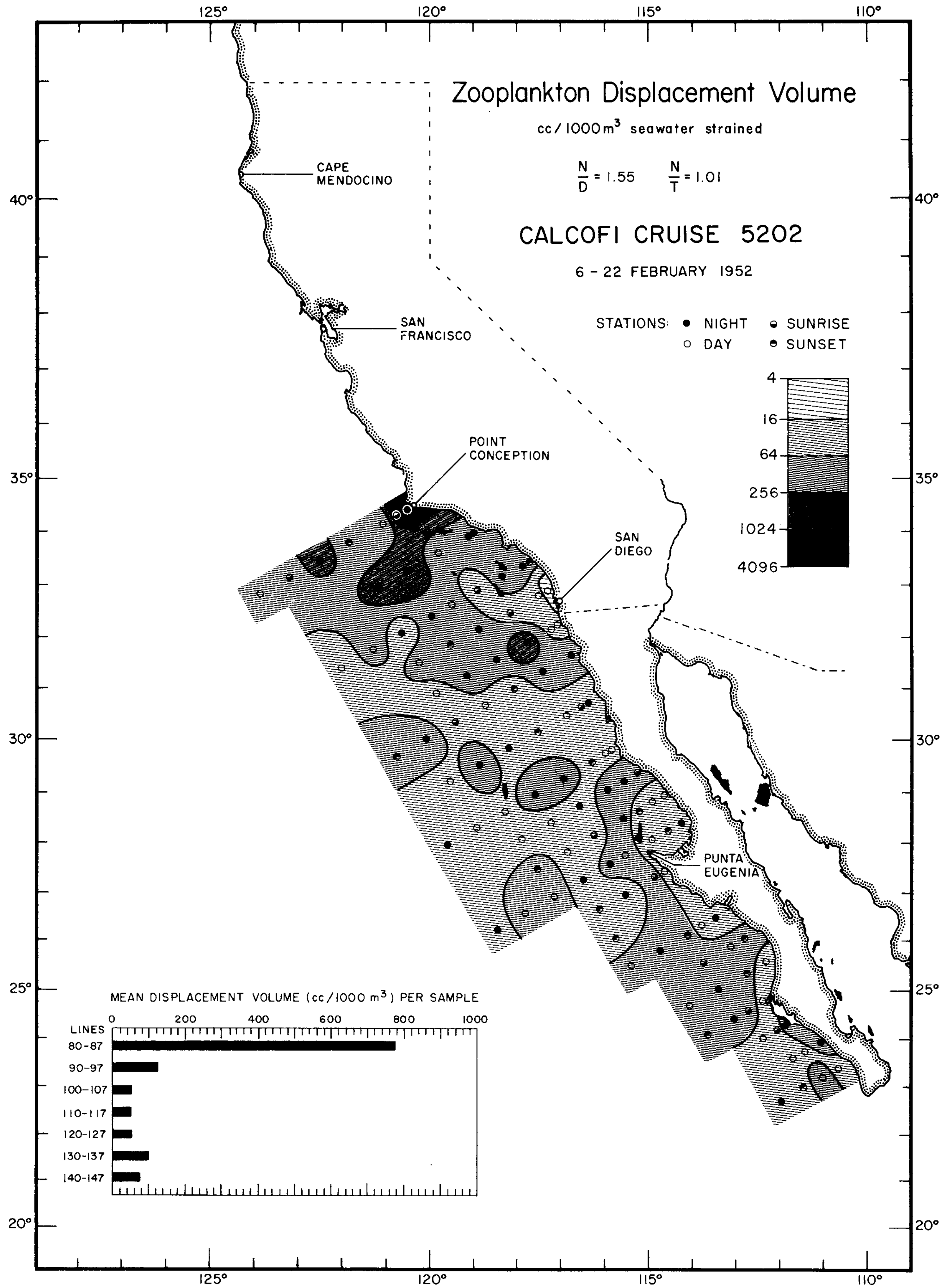

The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
Zooplankton Displacement Volume
cc / 1000 m3 seawater strained
N/D = 1.13   N/T = 1.18
CALCOFI CRUISE 6401
10 JANUARY — 4 MARCH 1964
STATIONS: ● NIGHT ◒ SUNRISE
○ DAY ◓ SUNSET
4 16 64 256 1024
1 2 3 4
SAN FRANCISCO
MEAN DISPLACEMENT VOLUME
(cc/1000 m3) PER SAMPLE
LINES
0 200 400 600
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137
140
135° 130° 125° 120° 115° 110°
35° 30° 25°

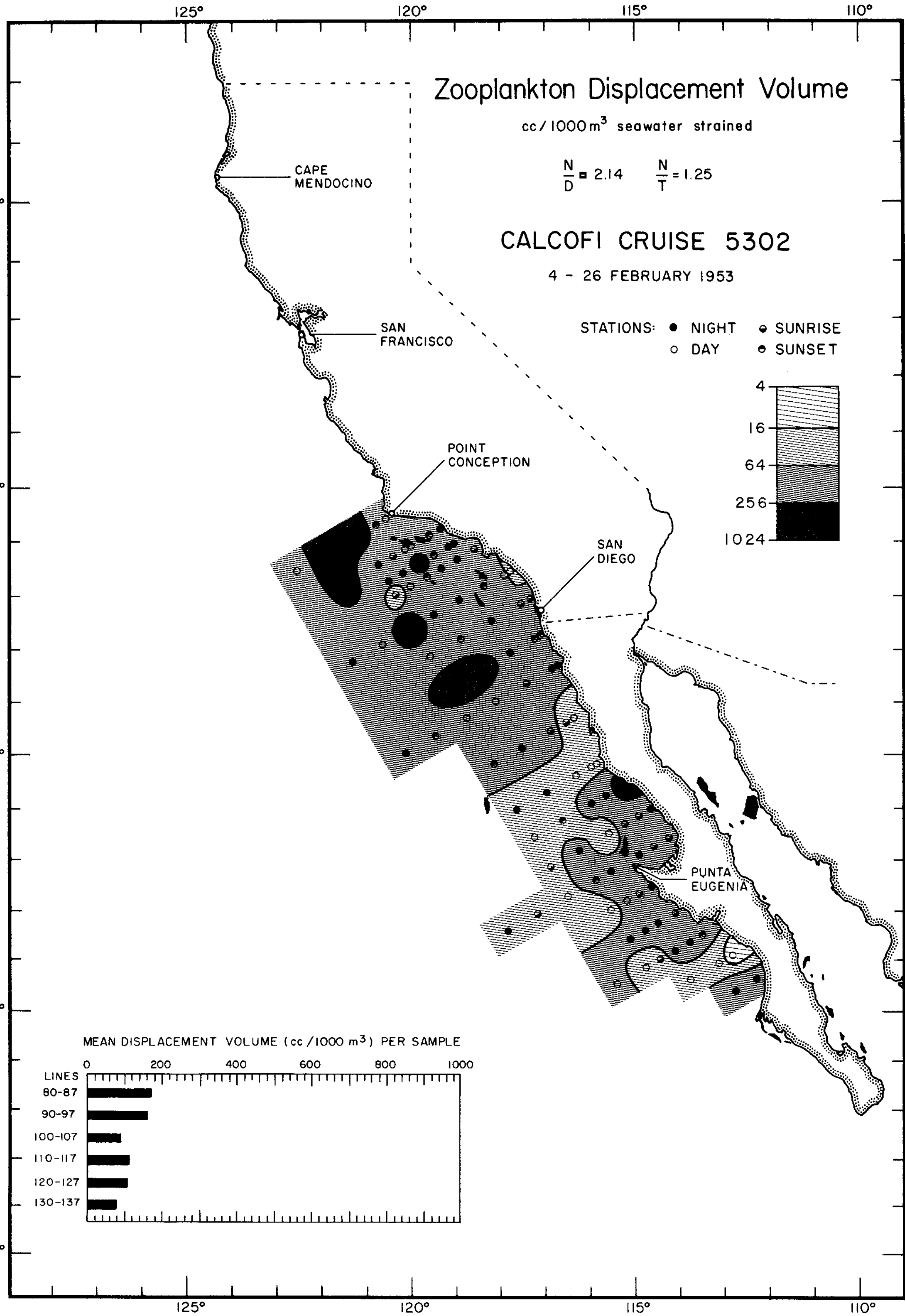


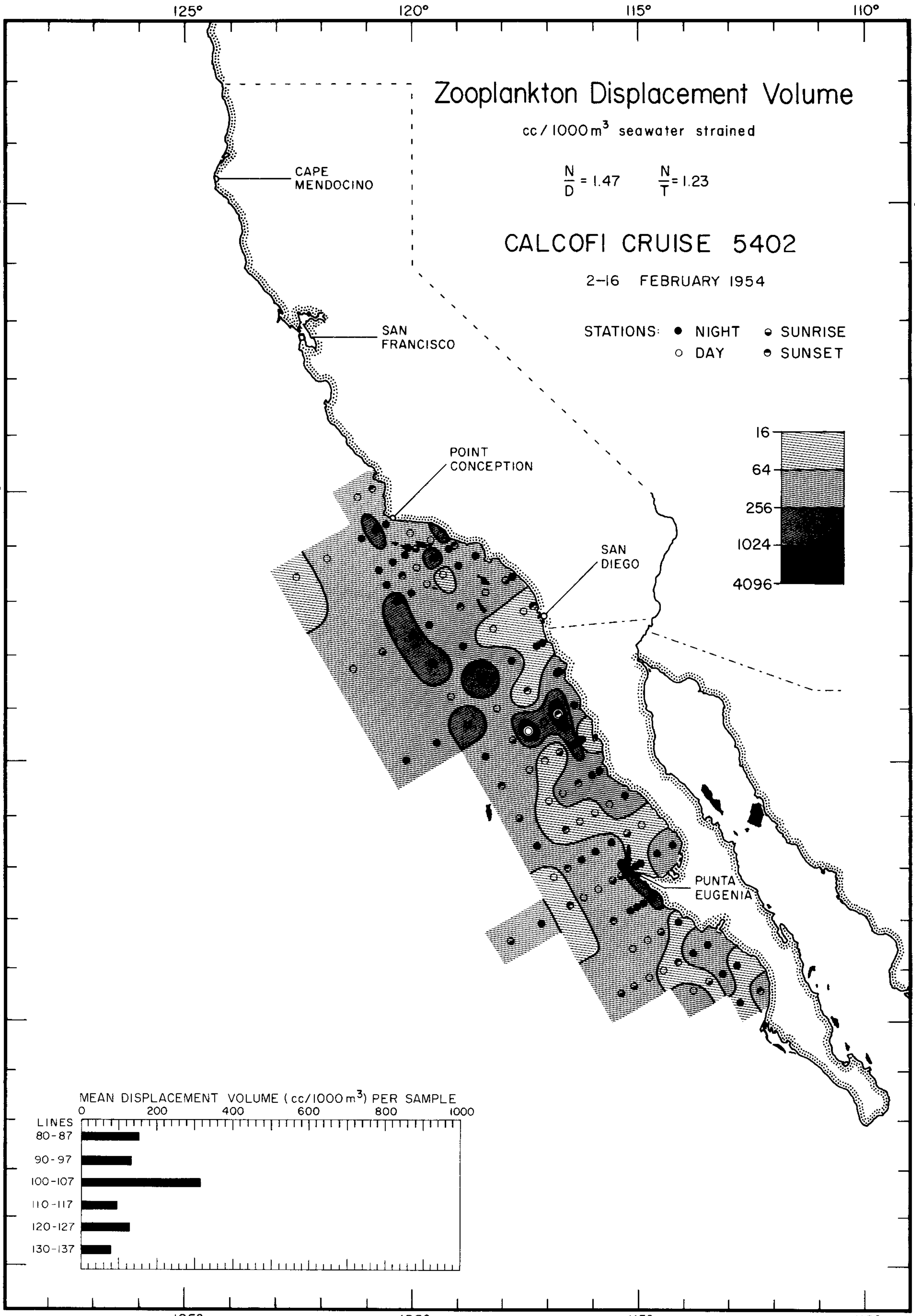
Zooplankton Displacement Volume

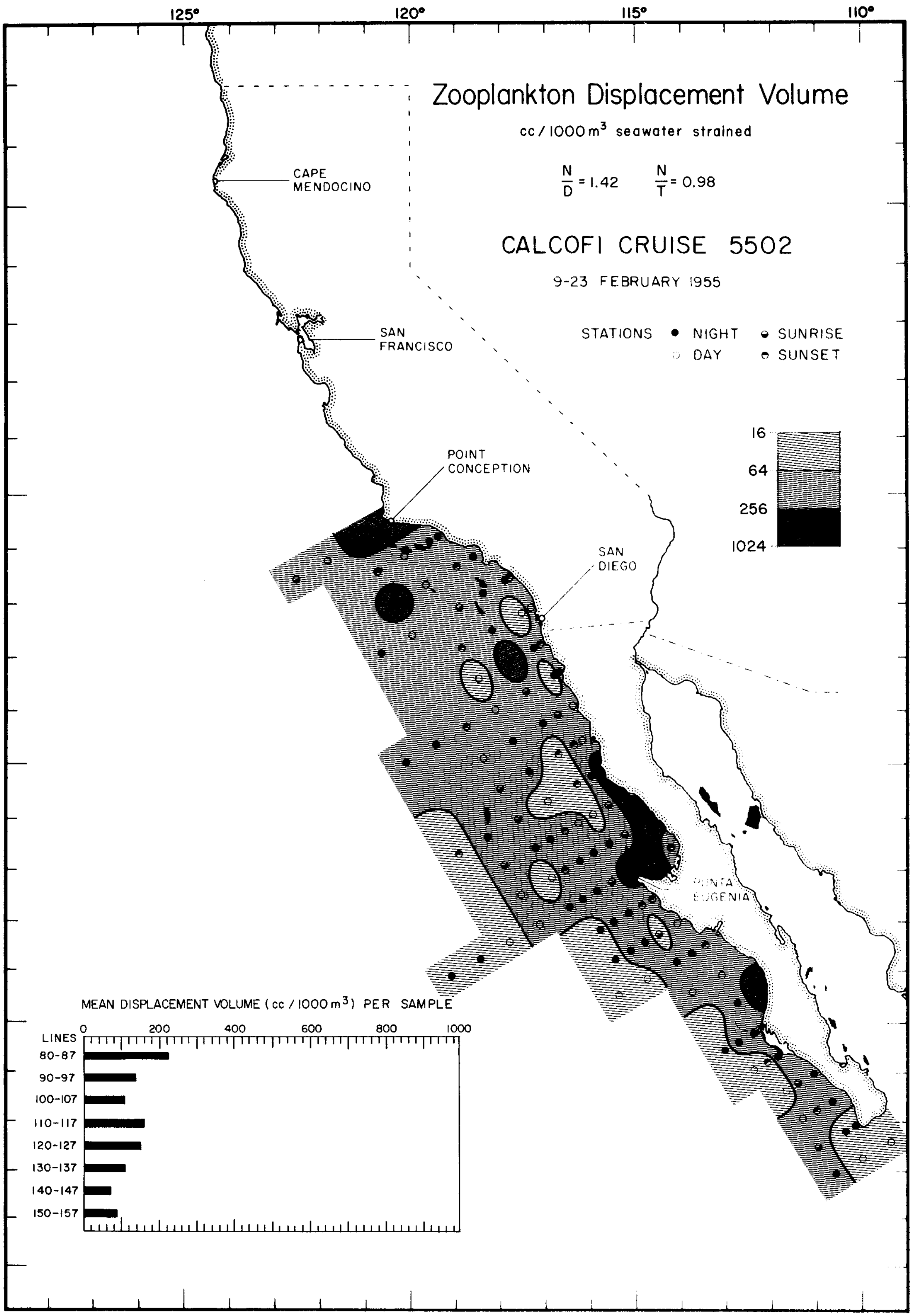

Zooplankton Displacement Volume
cc/1000m^3 seawater strained
$\frac{N}{D}$ = 1.52 $\frac{N}{T}$ = 1.32
CALCOFI CRUISE 6601
12 JANUARY – 7 FEBRUARY 1966
STATIONS: ● NIGHT ○ DAY SUNRISE SUNSET
4 16 64 256 1024 4096
1 2 3 4 5
CAPE MENDOCINO
SAN FRANCISCO
SAN DIEGO
125° 120° 115° 110°
40° 35° 30° 25° 20°
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000m^3) PER SAMPLE
0 200 400 600 800 1000
LINES
60-67
70-77
80-87
93-97
100-107
110-119
120-127
130-137

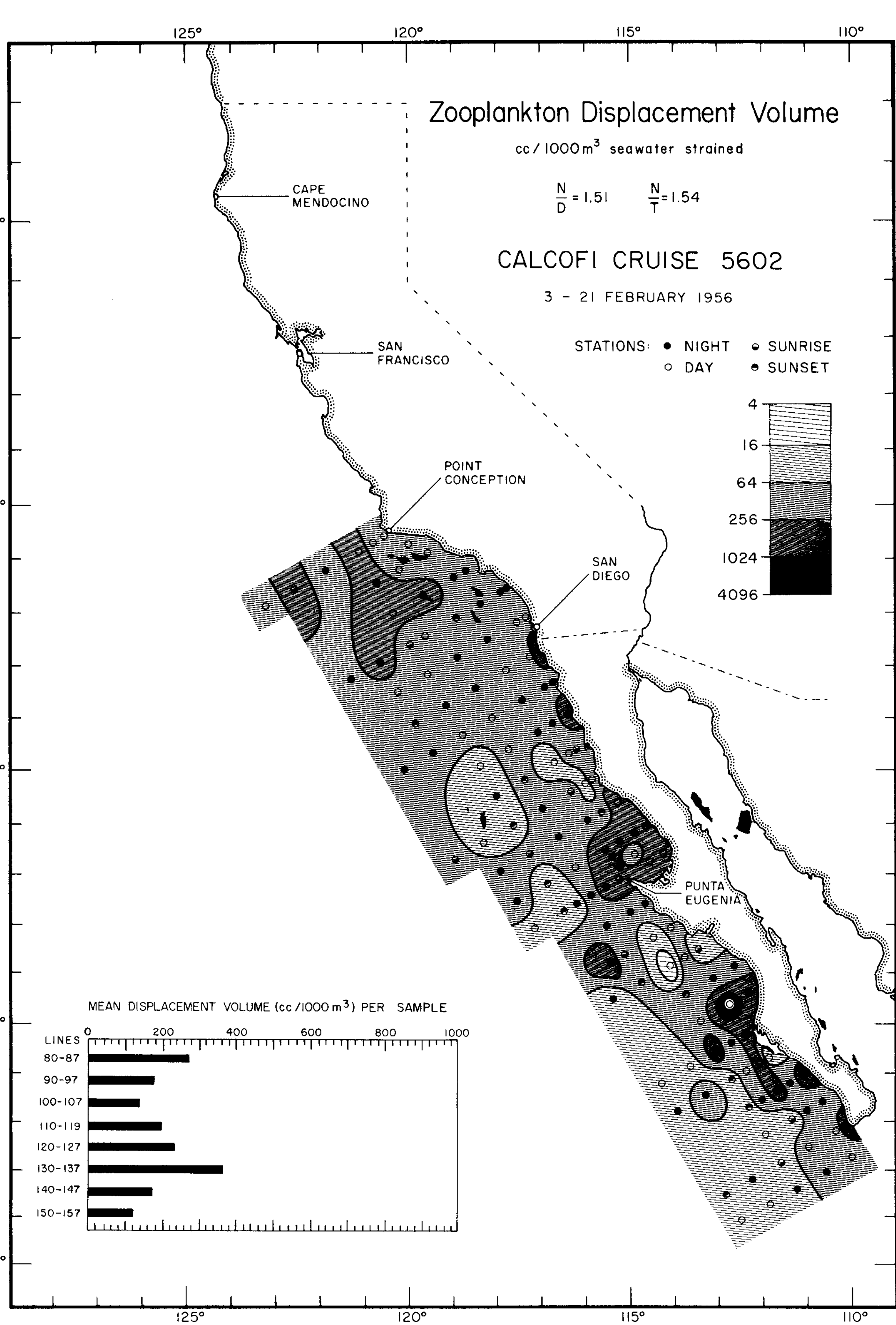

125°
120°
115°
110°
40°
35°
30°
25°
20°
Zooplankton Displacement Volume
cc/1000 m3 seawater strained
N/D = 1.69
N/T = 1.43
CALCOFI CRUISE 5102
6-25 FEBRUARY 1951
STATIONS: NIGHT
DAY
SUNRISE
SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
MEAN DISPLACEMENT VOLUME (cc/1000 m3) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97
100-107
110-117
120-127
130-137

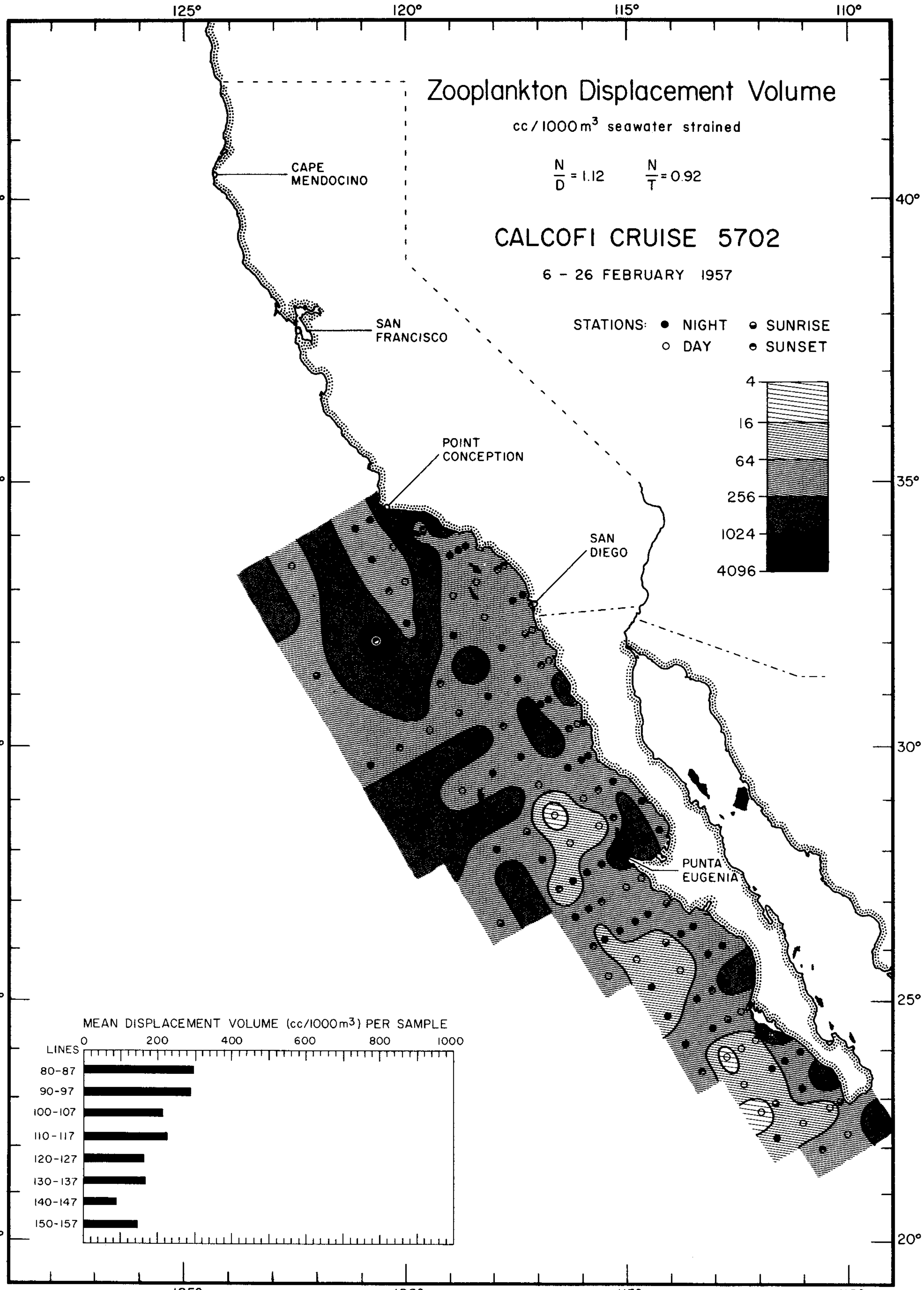

Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.55 N/T = 1.01
CALCOFI CRUISE 5202
6 - 22 FEBRUARY 1952
STATIONS: NIGHT DAY SUNRISE SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97
100-107
110-117
120-127
130-137
140-147


Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 2.14   N/T = 1.25
CALCOFI CRUISE 5302
4 - 26 FEBRUARY 1953
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125° 120° 115° 110°
40° 35° 30° 25° 20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000
LINES
80-87
90-97
100-107
110-117
120-127
130-137

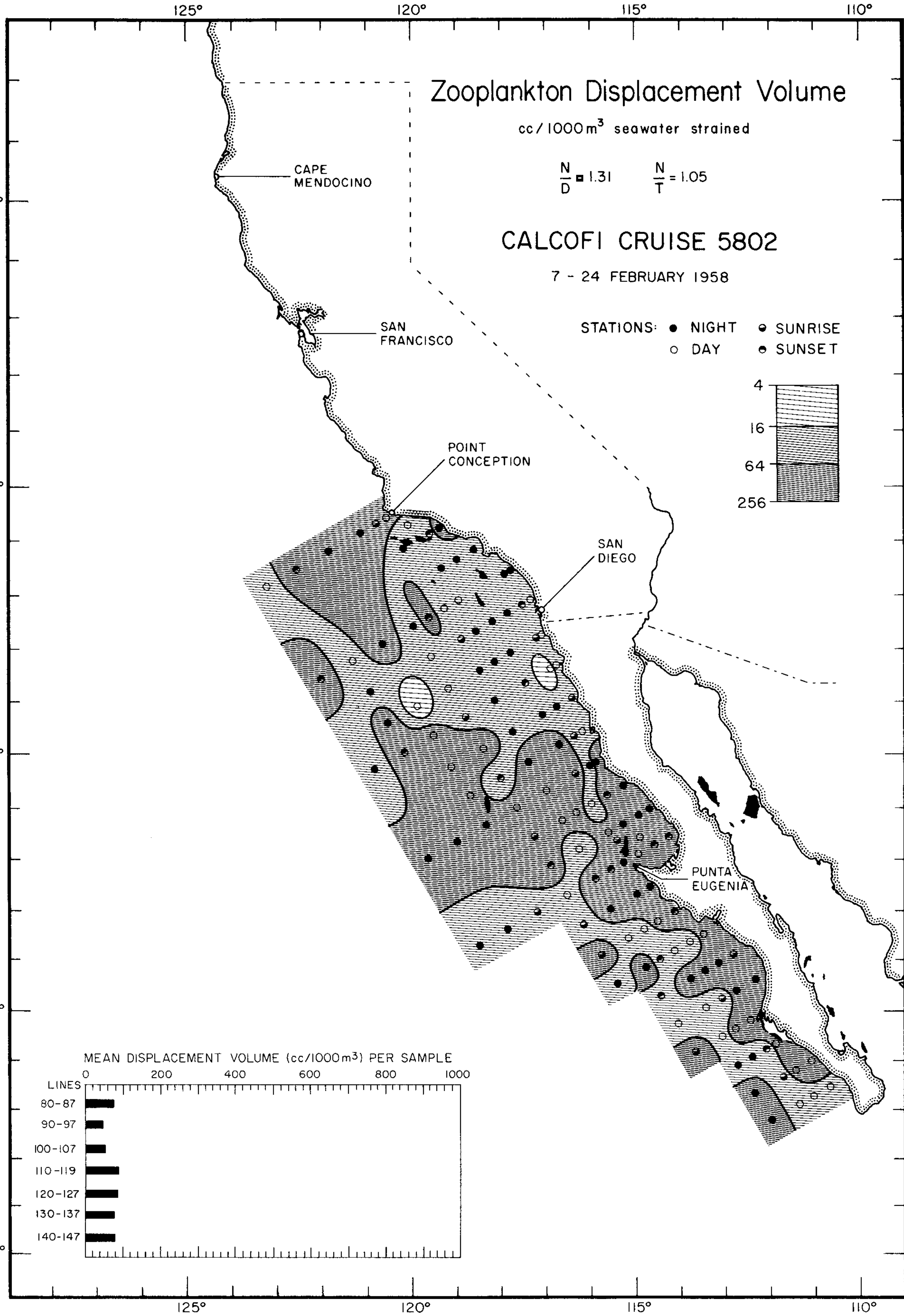

Zooplankton Displacement Volume
cc/1000 m3 seawater strained
N/D = 1.47
N/T = 1.23
CALCOFI CRUISE 5402
2–16 FEBRUARY 1954
STATIONS:
NIGHT
DAY
SUNRISE
SUNSET
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m3) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97
100-107
110-117
120-127
130-137

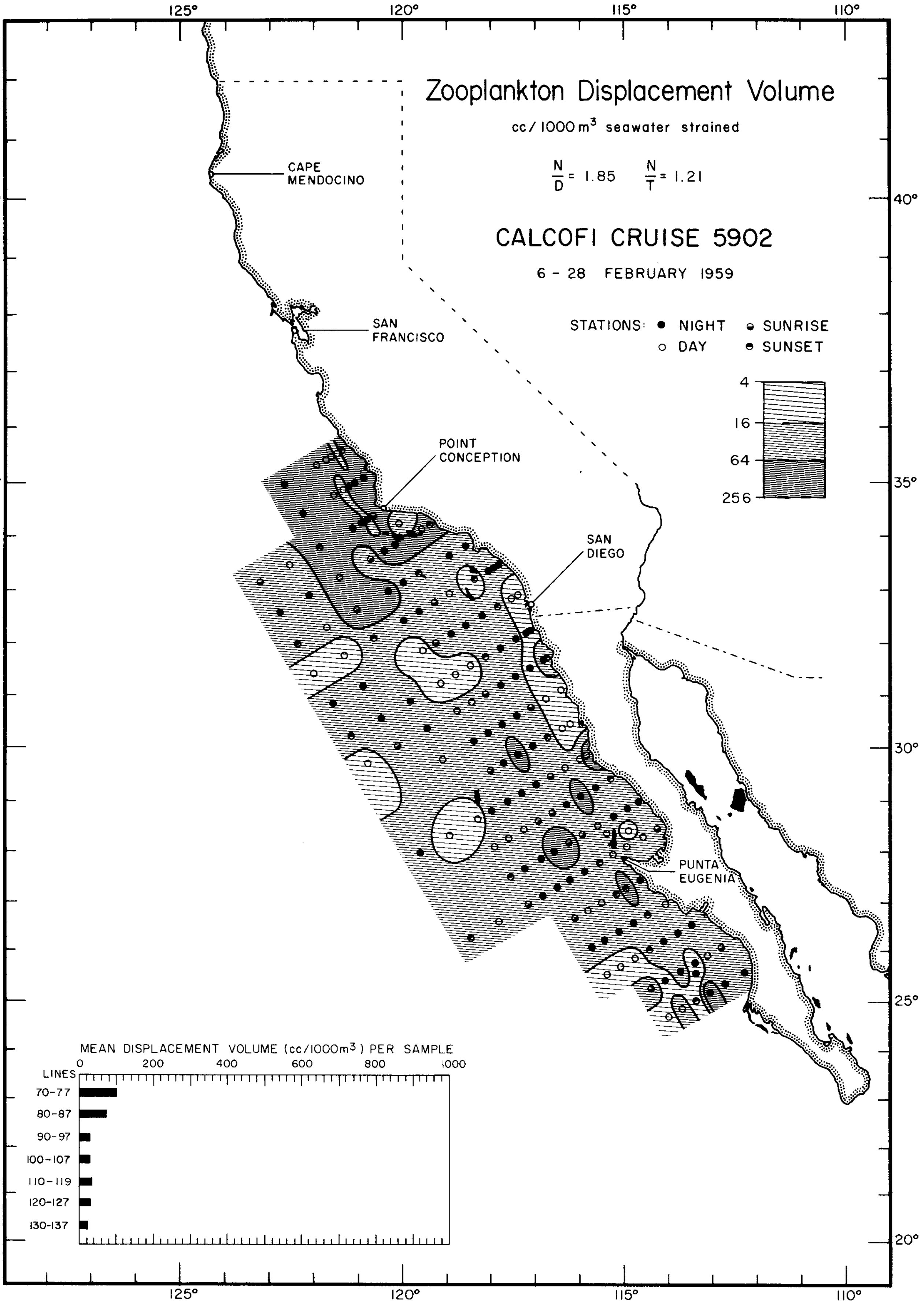

Zooplankton Displacement Volume
cc / 1000 m3 seawater strained
N/D = 1.42 N/T = 0.98
CALCOFI CRUISE 5502
9-23 FEBRUARY 1955
STATIONS ● NIGHT ◒ SUNRISE
○ DAY ◓ SUNSET
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc / 1000 m3) PER SAMPLE
LINES
0
200
400
600
800
1000
80-87
90-97
100-107
110-117
120-127
130-137
140-147
150-157

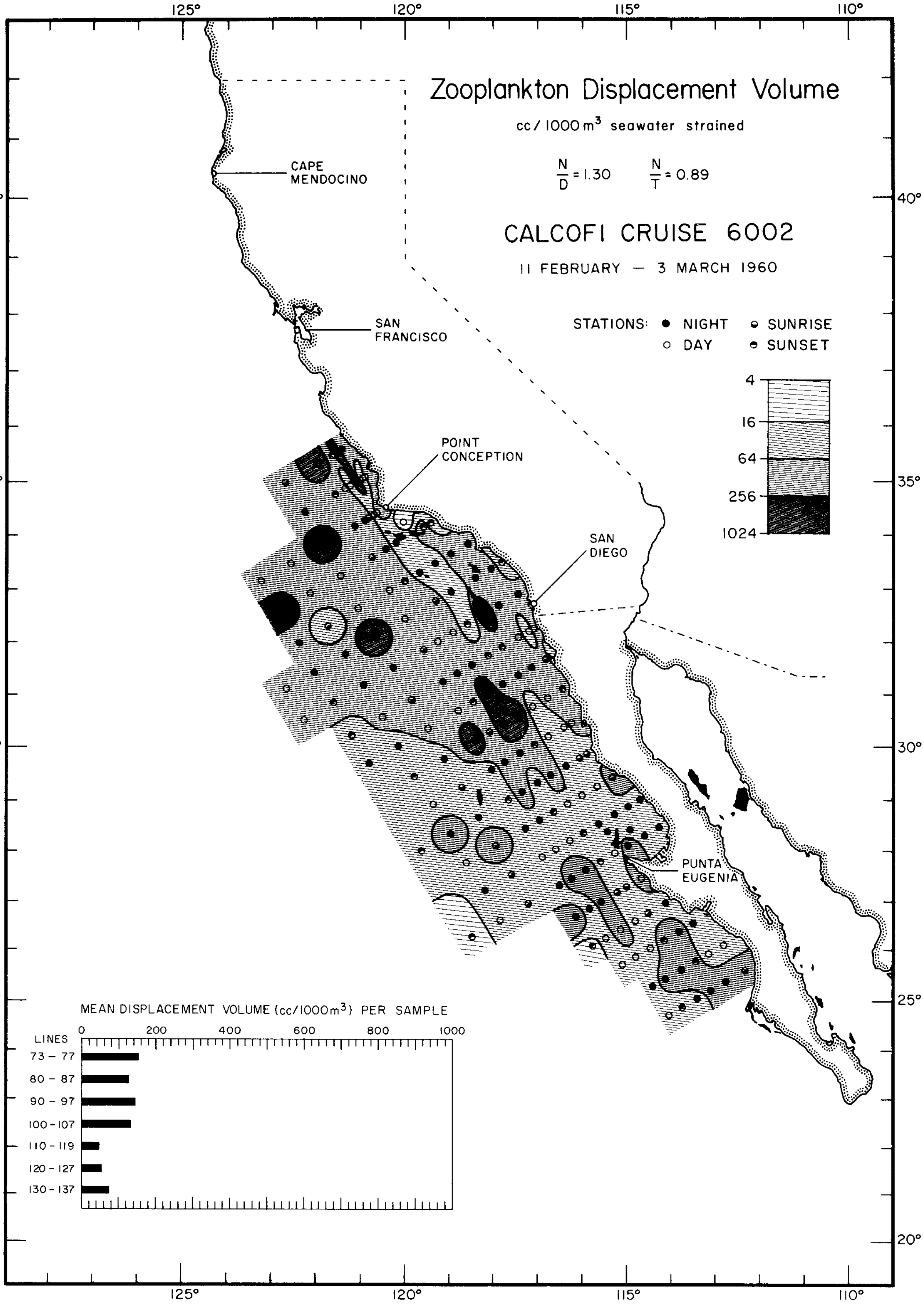

Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.51 N/T = 1.54
CALCOFI CRUISE 5602
3 - 21 FEBRUARY 1956
STATIONS: NIGHT SUNRISE
DAY SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97
100-107
110-119
120-127
130-137
140-147
150-157

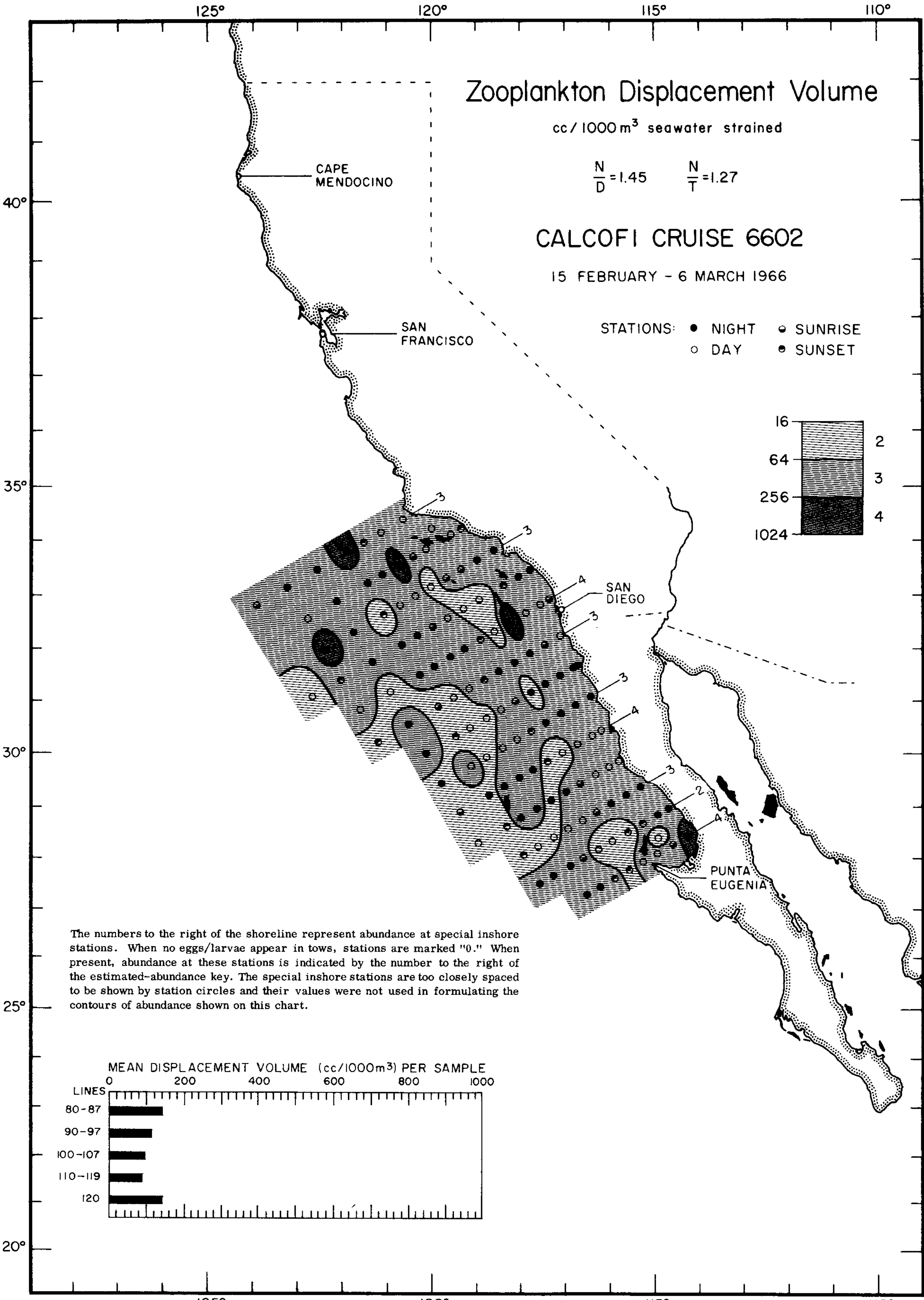


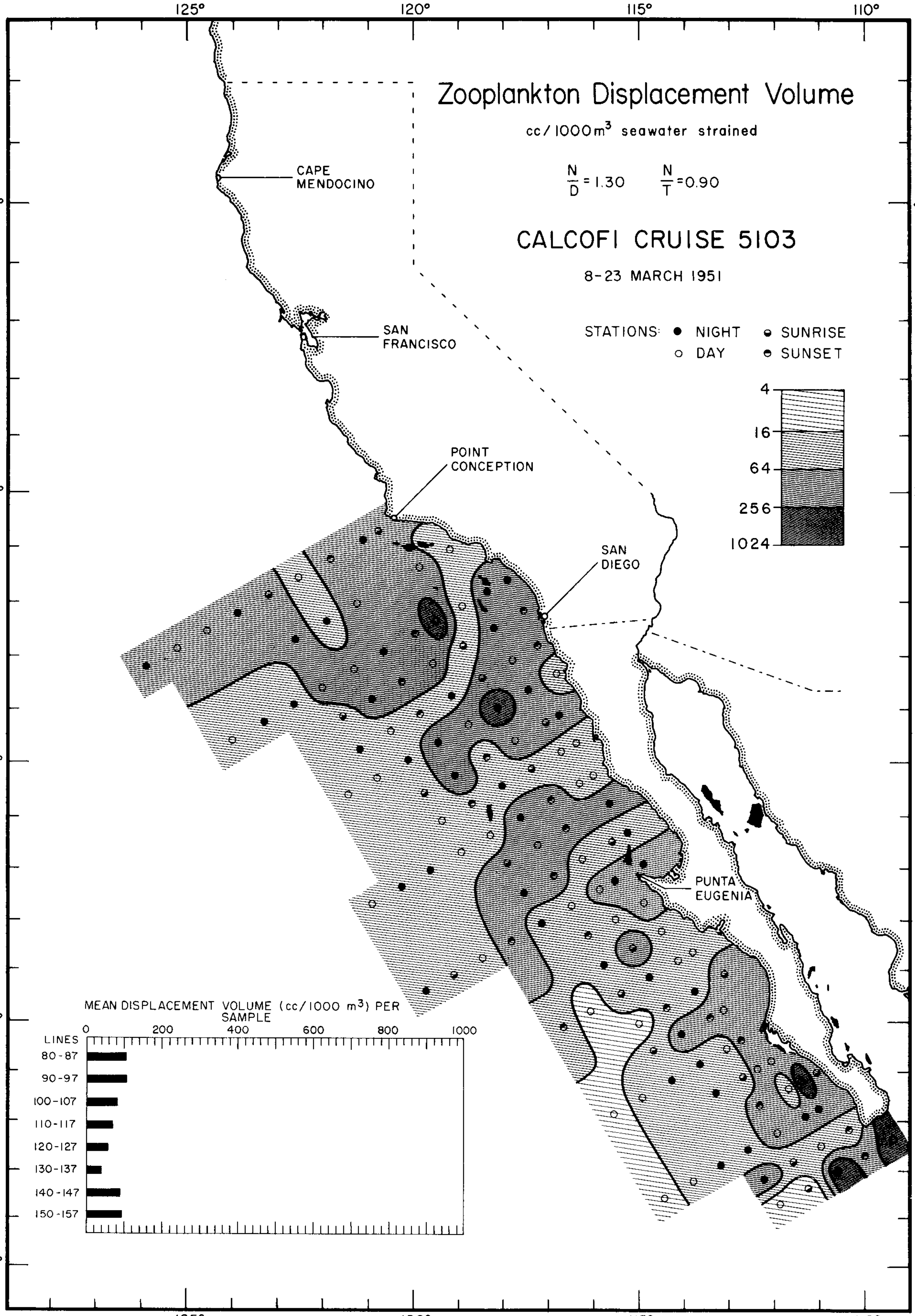
Zooplankton Displacement Volume

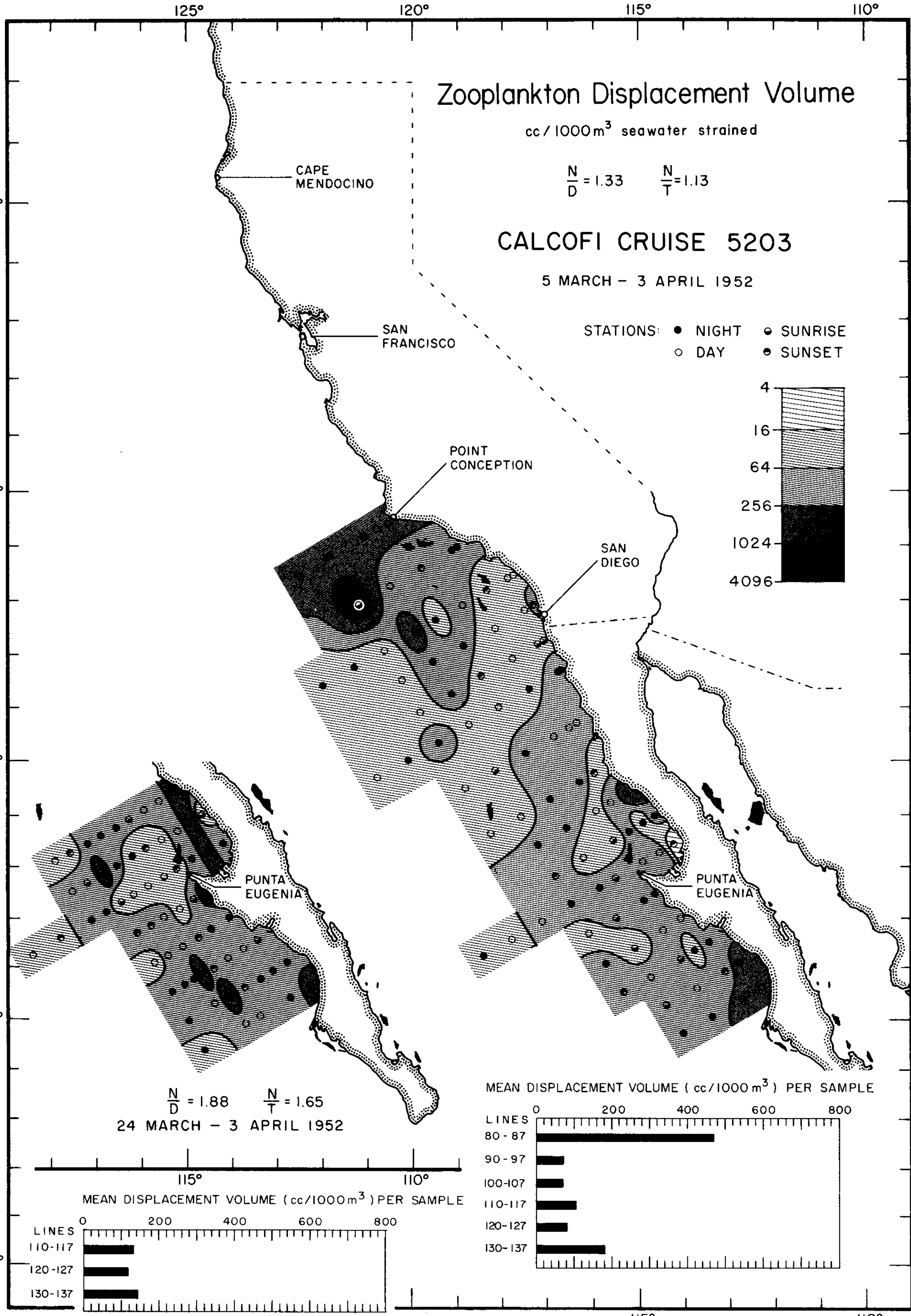

Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.31 N/T = 1.05
CALCOFI CRUISE 5802
7 - 24 FEBRUARY 1958
STATIONS: ● NIGHT ◒ SUNRISE
○ DAY ◓ SUNSET
4
16
64
256
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97
100-107
110-119
120-127
130-137
140-147

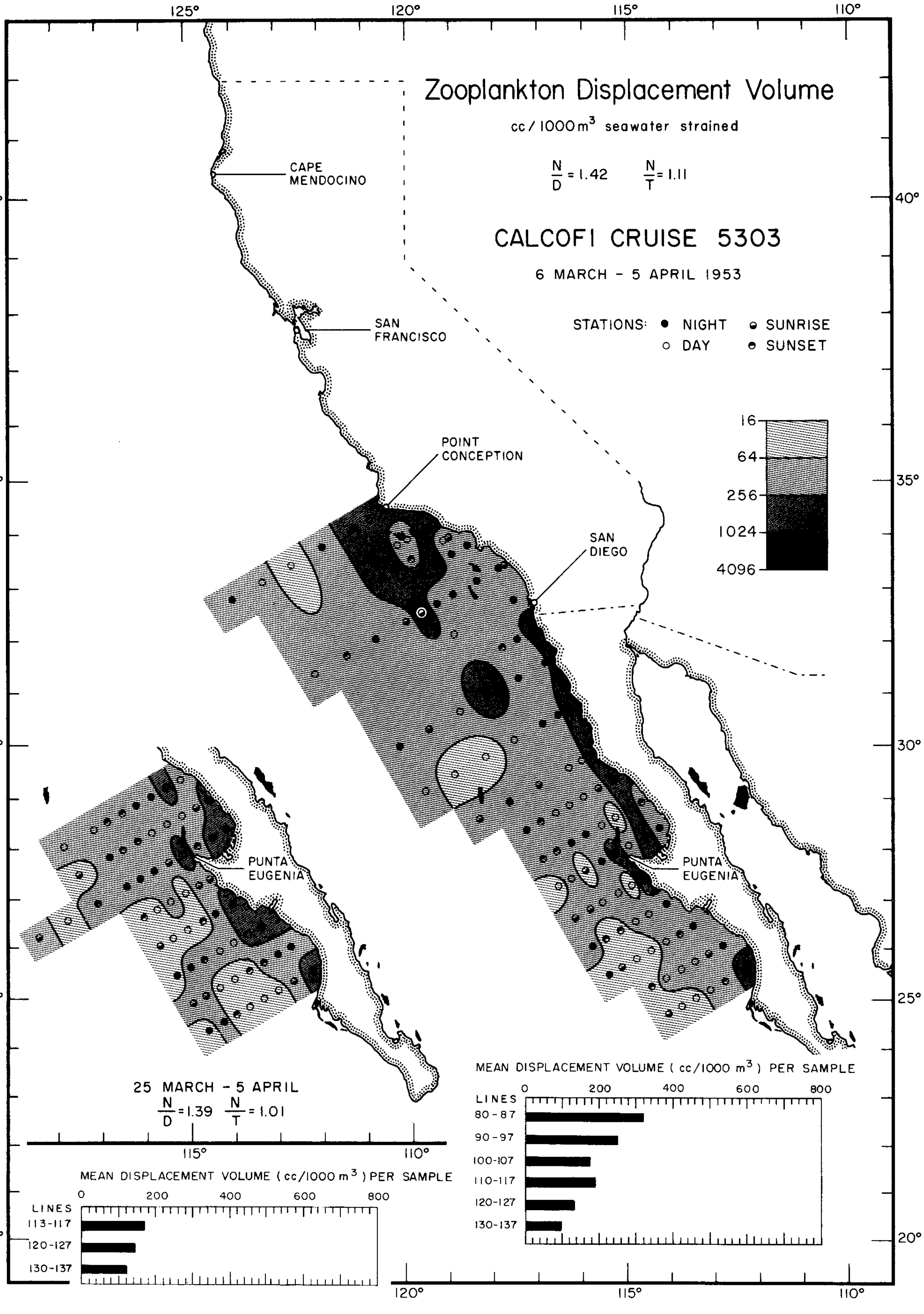

125°
120°
115°
110°
40°
35°
30°
25°
20°
Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.85
N/T = 1.21
CALCOFI CRUISE 5902
6 - 28 FEBRUARY 1959
STATIONS: NIGHT
SUNRISE
DAY
SUNSET
4
16
64
256
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0
200
400
600
800
1000
LINES
70-77
80-87
90-97
100-107
110-119
120-127
130-137

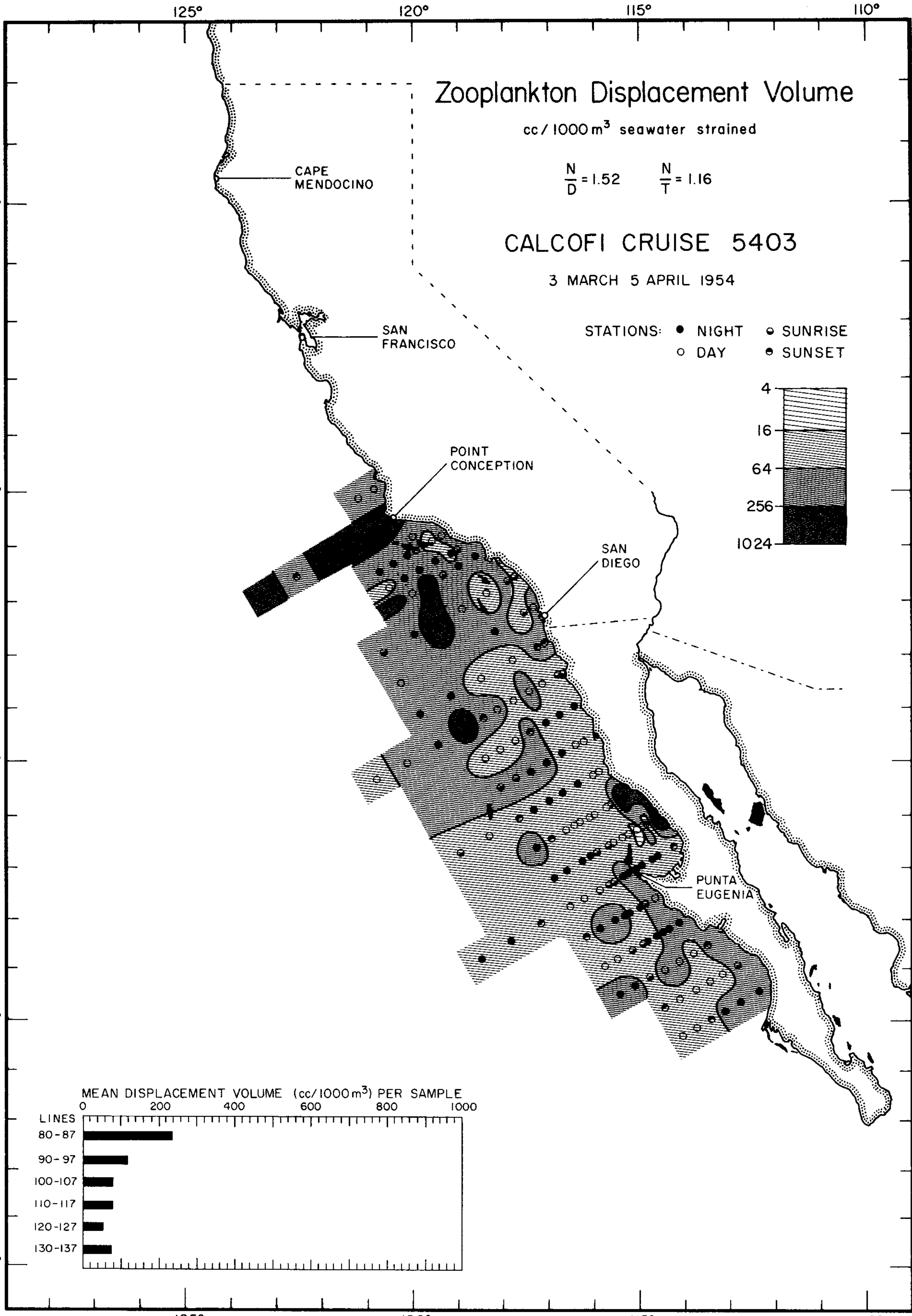

Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.30 N/T = 0.89
CALCOFI CRUISE 6002
11 FEBRUARY — 3 MARCH 1960
STATIONS: ● NIGHT ○ DAY ◐ SUNRISE ◓ SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
LINES
0
200
400
600
800
1000
73 - 77
80 - 87
90 - 97
100 - 107
110 - 119
120 - 127
130 - 137


125°
120°
115°
110°
40°
35°
30°
25°
20°
Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.45   N/T = 1.27
CALCOFI CRUISE 6602
15 FEBRUARY - 6 MARCH 1966
STATIONS: ● NIGHT ○ DAY ◒ SUNRISE ◓ SUNSET
16
64
256
1024
2
3
4
CAPE MENDOCINO
SAN FRANCISCO
SAN DIEGO
PUNTA EUGENIA
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97
100-107
110-119
120

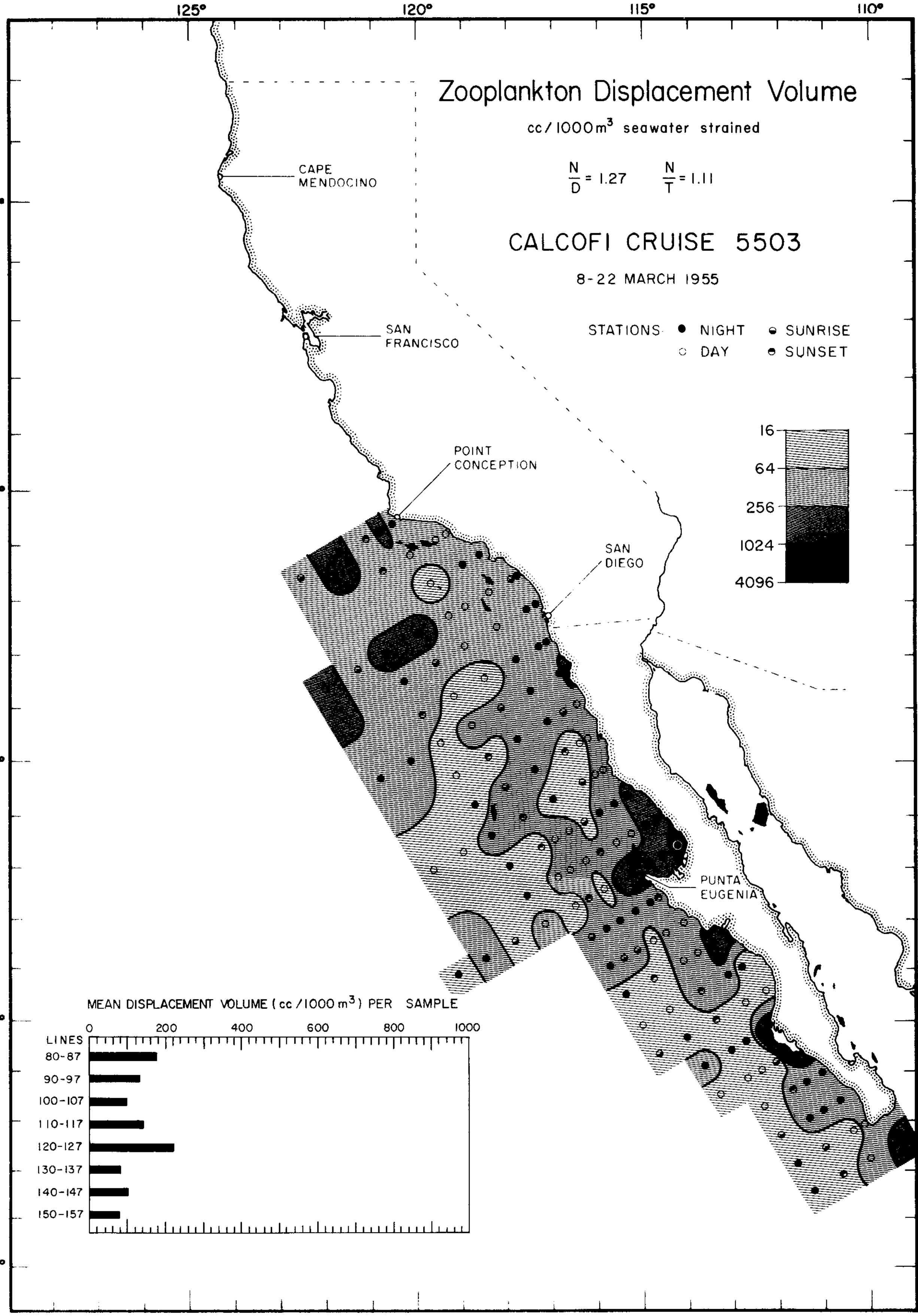

Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.30 N/T = 0.90
CALCOFI CRUISE 5103
8-23 MARCH 1951
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125° 120° 115° 110°
40° 35° 30° 25° 20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000
LINES
80-87
90-97
100-107
110-117
120-127
130-137
140-147
150-157


Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.33   N/T = 1.13
CALCOFI CRUISE 5203
5 MARCH – 3 APRIL 1952
STATIONS: NIGHT DAY SUNRISE SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
N/D = 1.88   N/T = 1.65
24 MARCH – 3 APRIL 1952
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
LINES
0
200
400
600
800
110-117
120-127
130-137
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
LINES
0
200
400
600
800
80-87
90-97
100-107
110-117
120-127
130-137

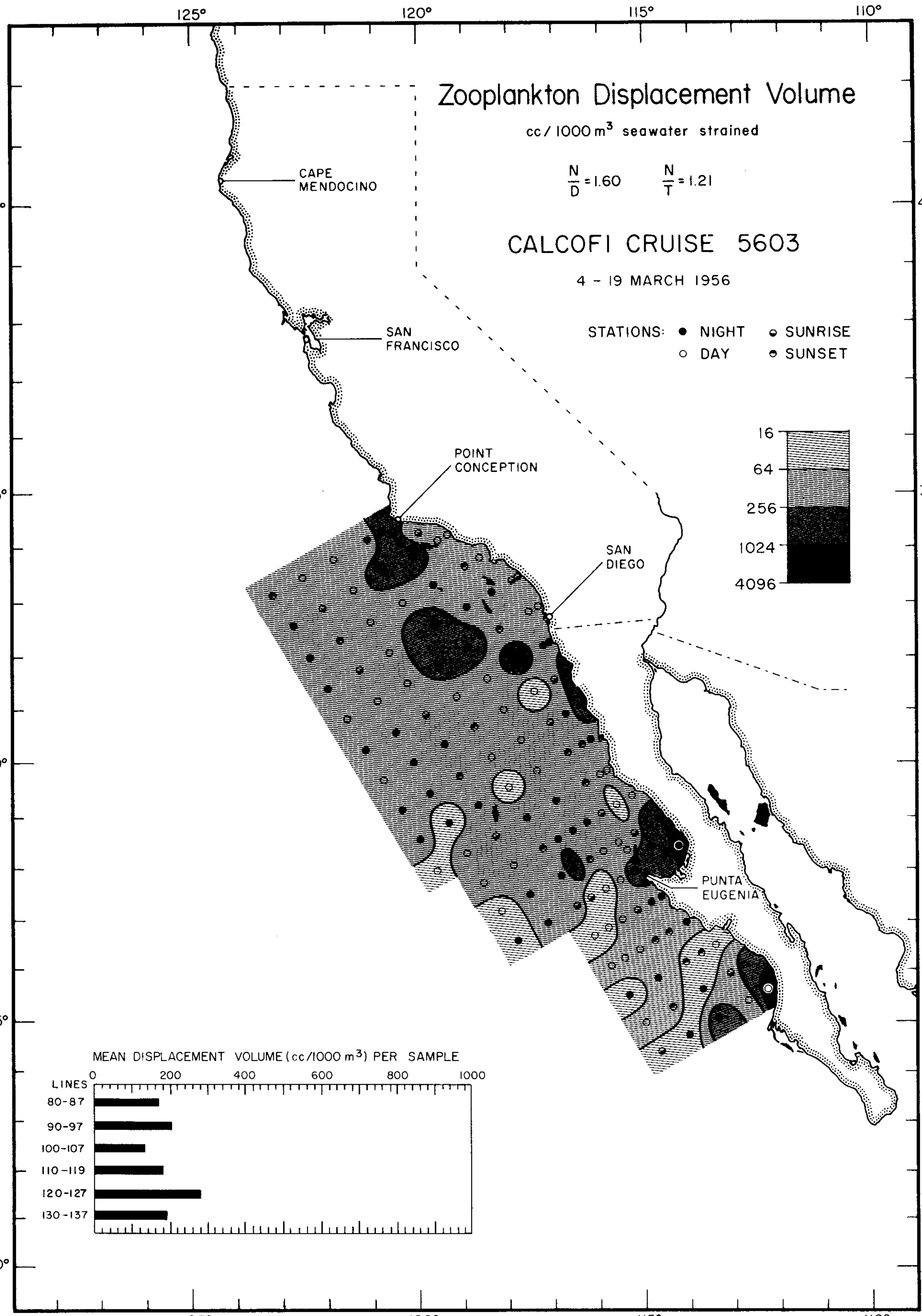

Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.42   N/T = 1.11
CALCOFI CRUISE 5303
6 MARCH - 5 APRIL 1953
STATIONS: NIGHT SUNRISE DAY SUNSET
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
25 MARCH - 5 APRIL
N/D = 1.39   N/T = 1.01
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800
LINES
113-117
120-127
130-137
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800
LINES
80-87
90-97
100-107
110-117
120-127
130-137



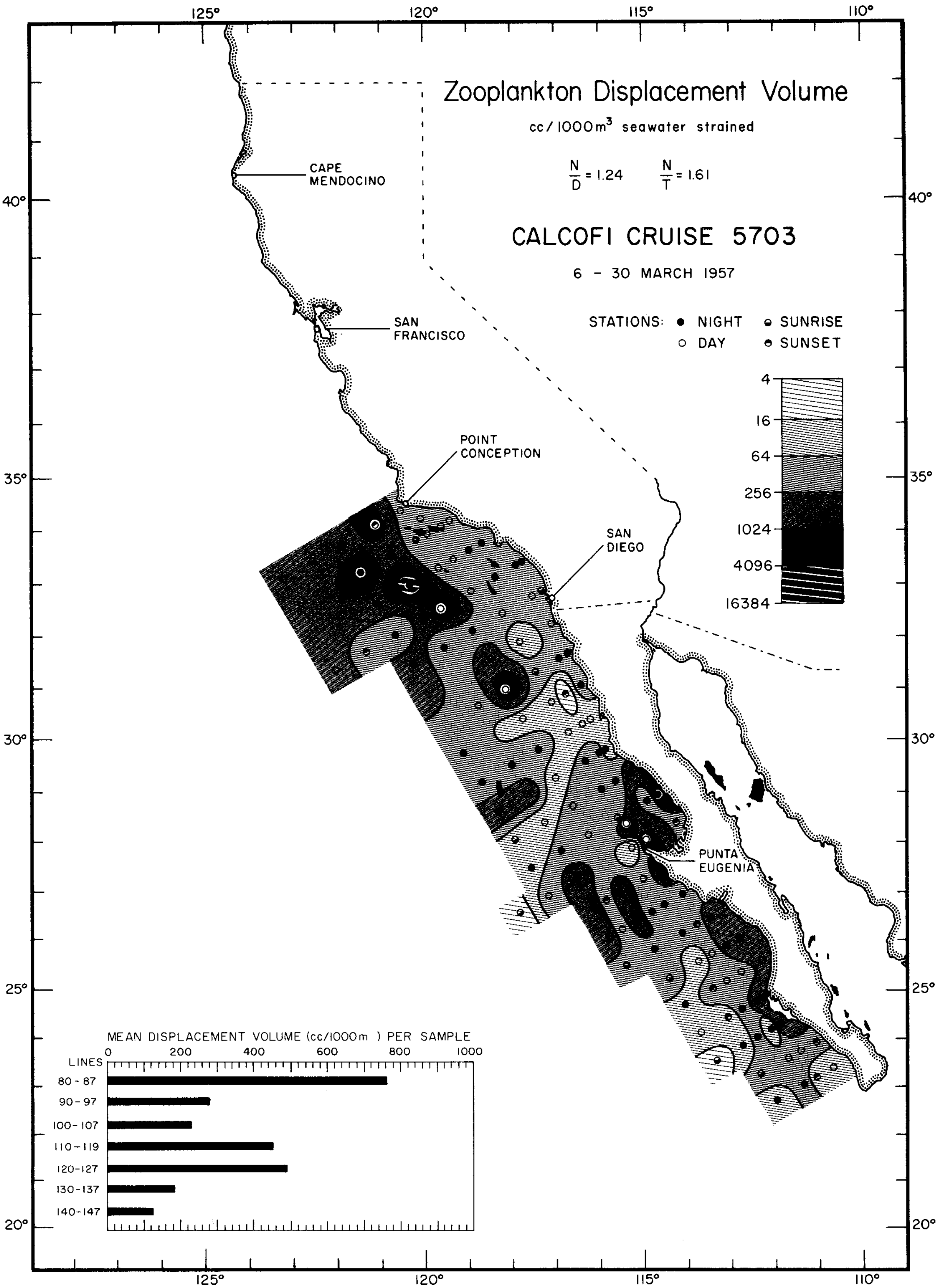
Zooplankton Displacement Volume



Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.27 N/T = 1.11
CALCOFI CRUISE 5503
8-22 MARCH 1955
STATIONS: NIGHT SUNRISE DAY SUNSET
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125° 120° 115° 110°
40° 35° 30° 25° 20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000
LINES
80-87
90-97
100-107
110-117
120-127
130-137
140-147
150-157

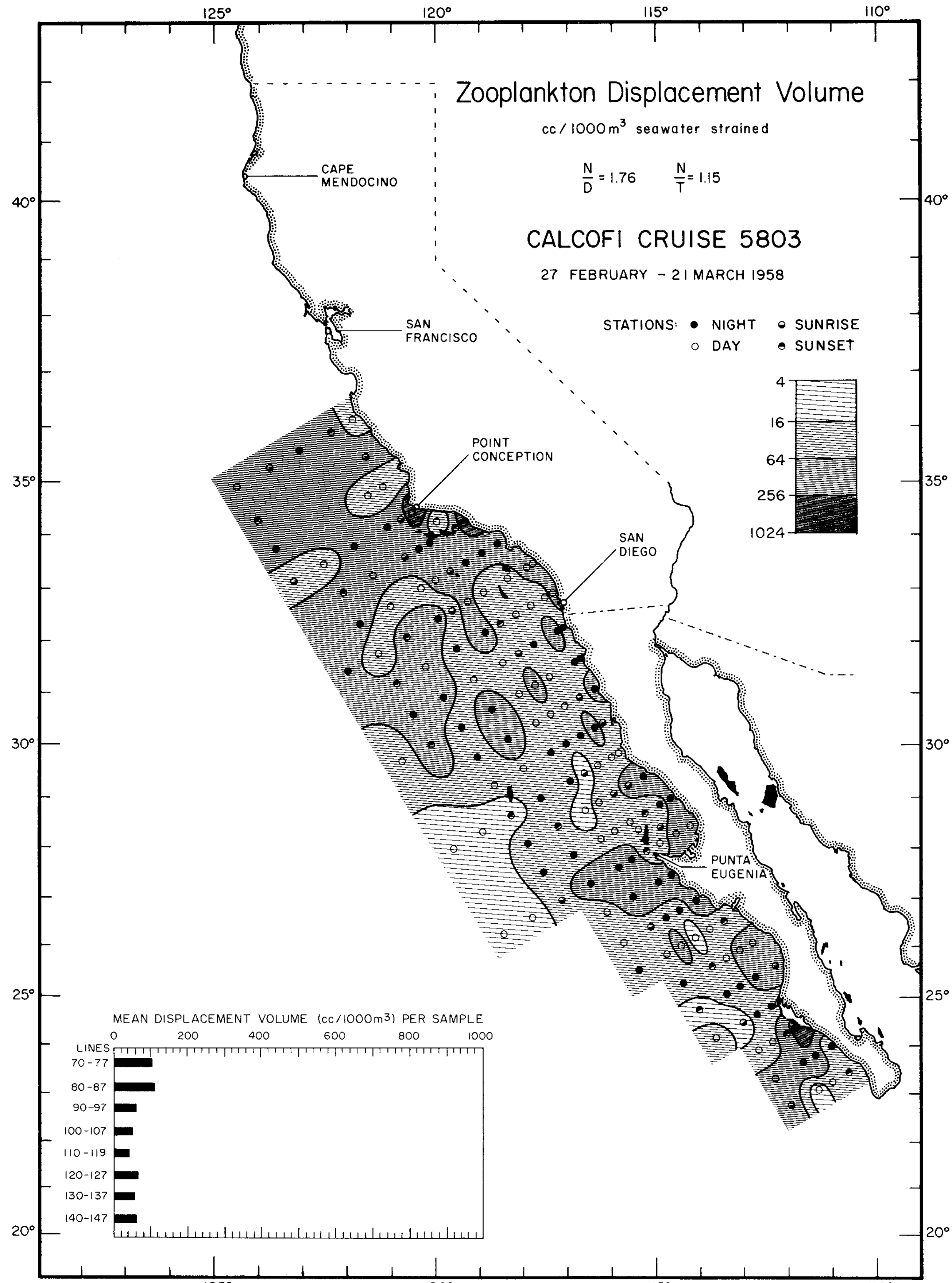


Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.60 N/T = 1.21
CALCOFI CRUISE 5603
4 - 19 MARCH 1956
STATIONS: NIGHT SUNRISE DAY SUNSET
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m3) PER SAMPLE
LINES
0
200
400
600
800
1000
80-87
90-97
100-107
110-119
120-127
130-137



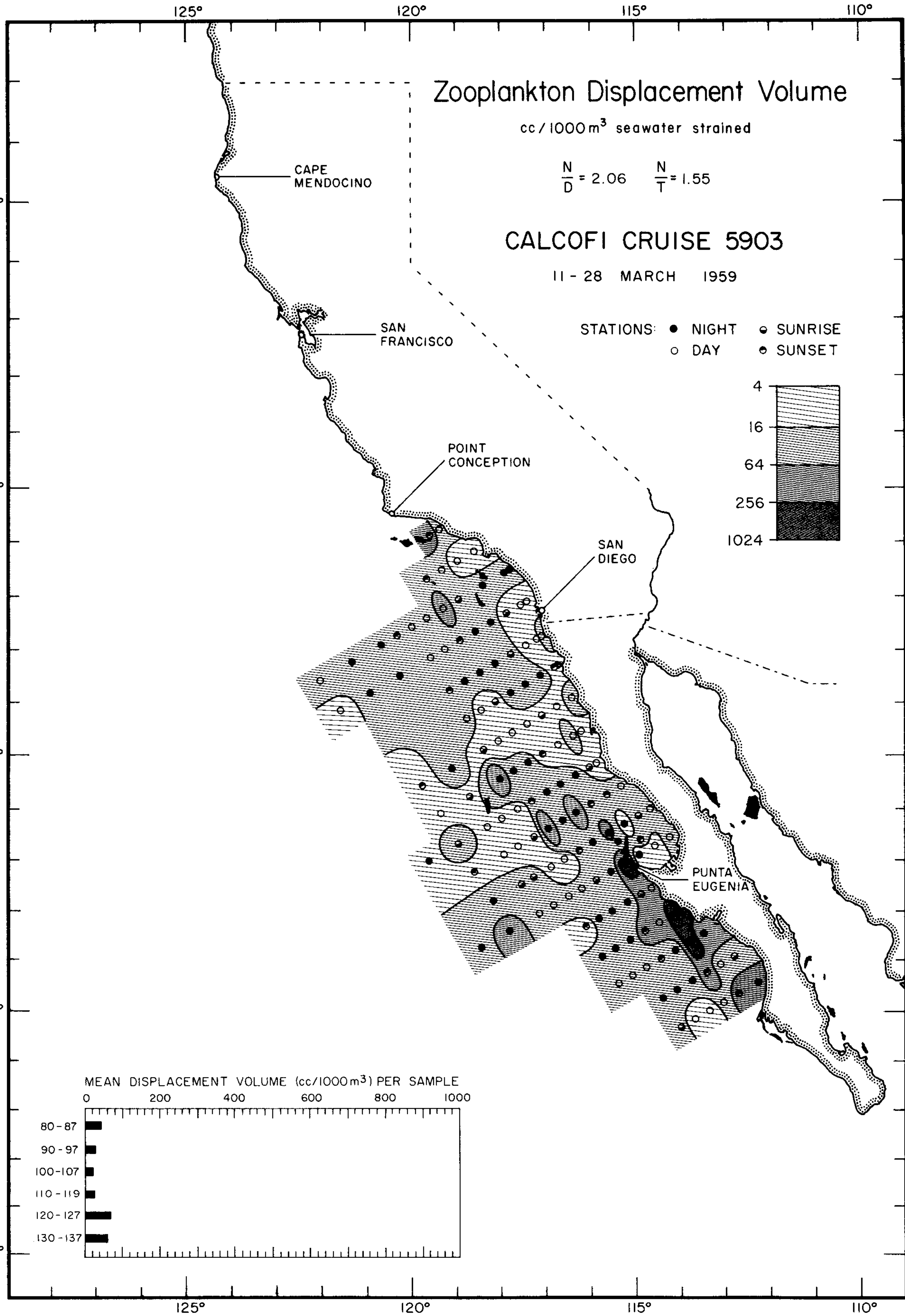
Zooplankton Displacement Volume

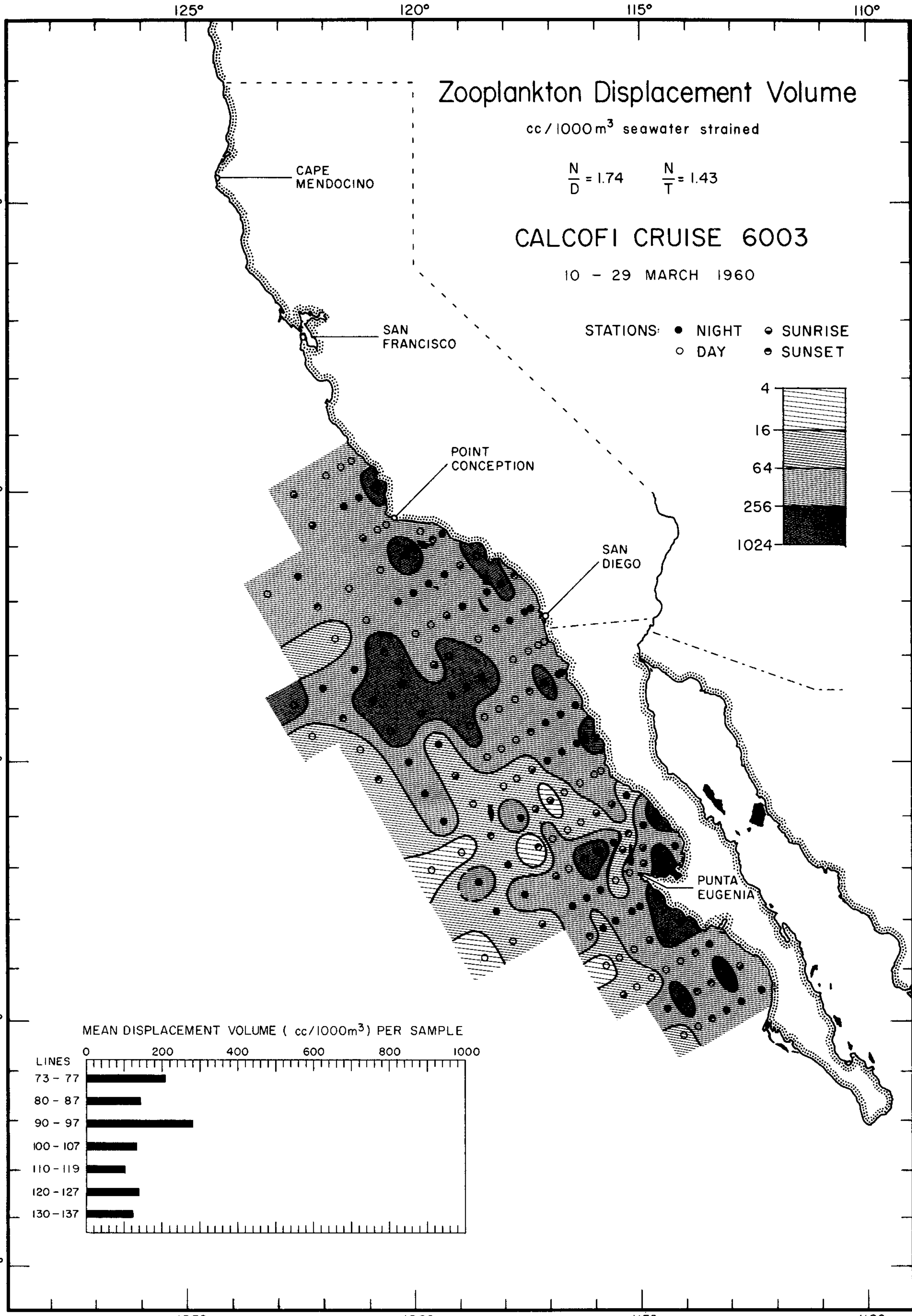
5703



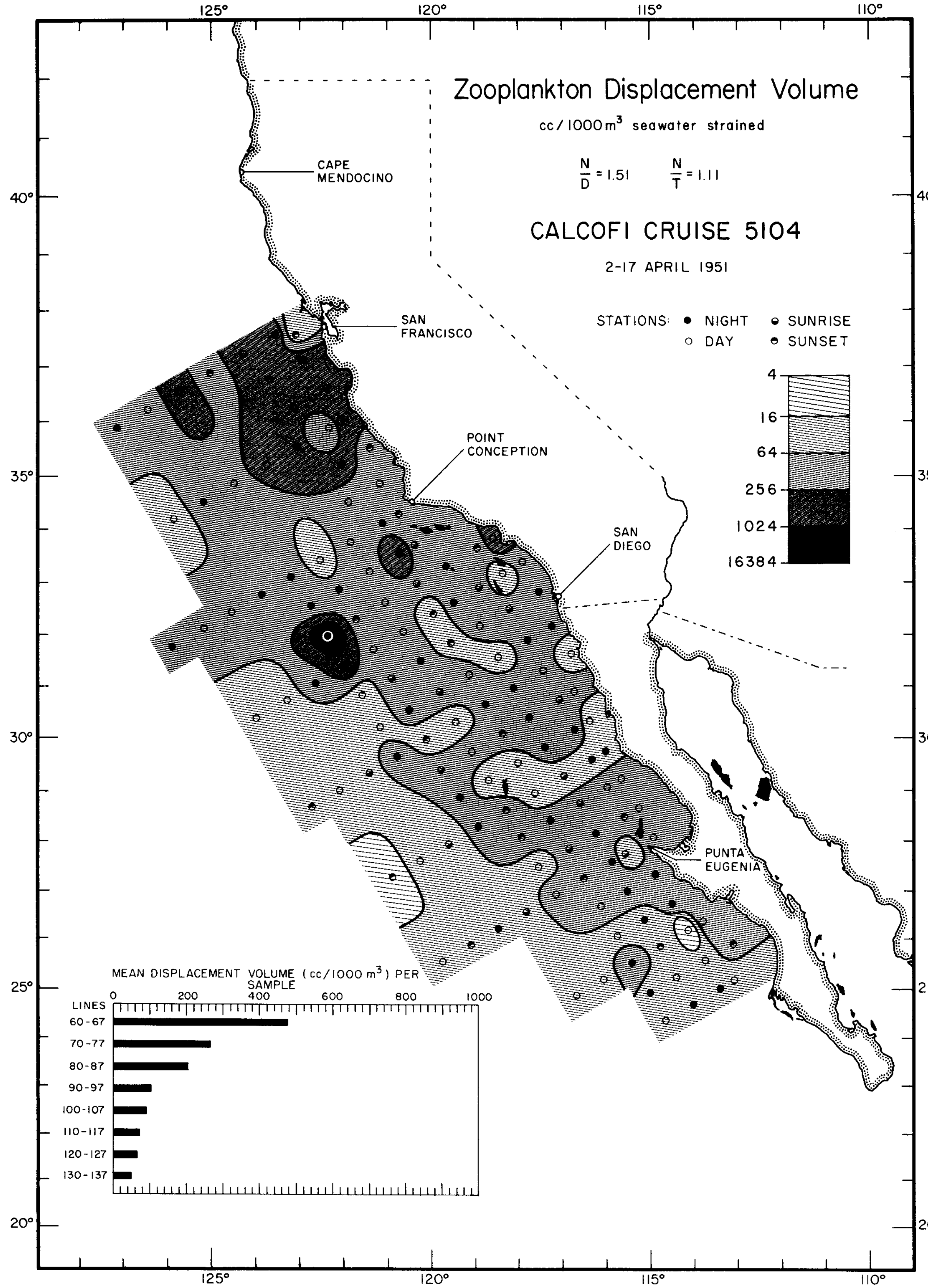
Zooplankton Displacement Volume

5803


Zooplankton Displacement Volume
cc / 1000 m3 seawater strained
N/D = 2.06   N/T = 1.55
CALCOFI CRUISE 5903
11 - 28 MARCH 1959
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m3) PER SAMPLE
0
200
400
600
800
1000
80-87
90-97
100-107
110-119
120-127
130-137

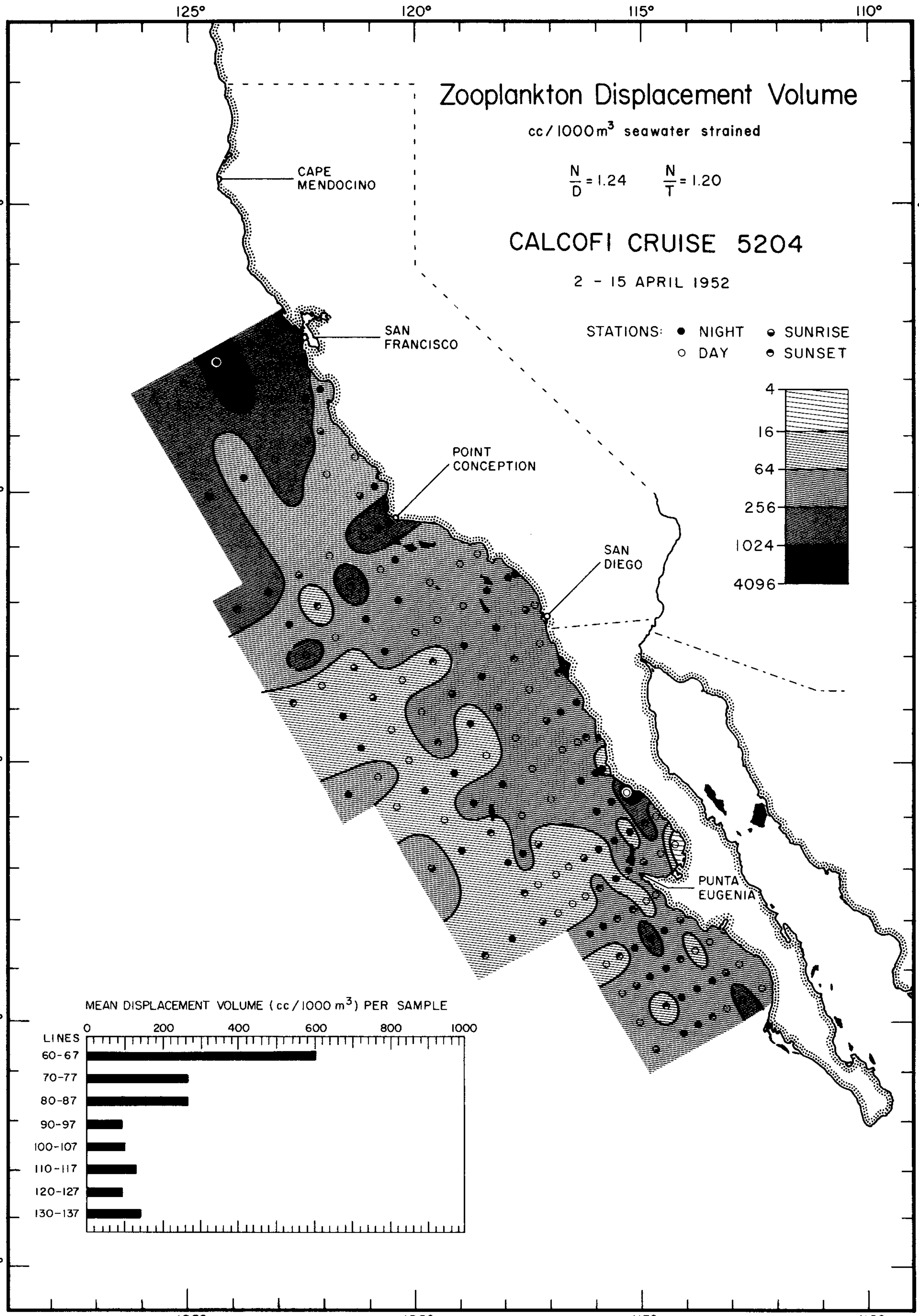


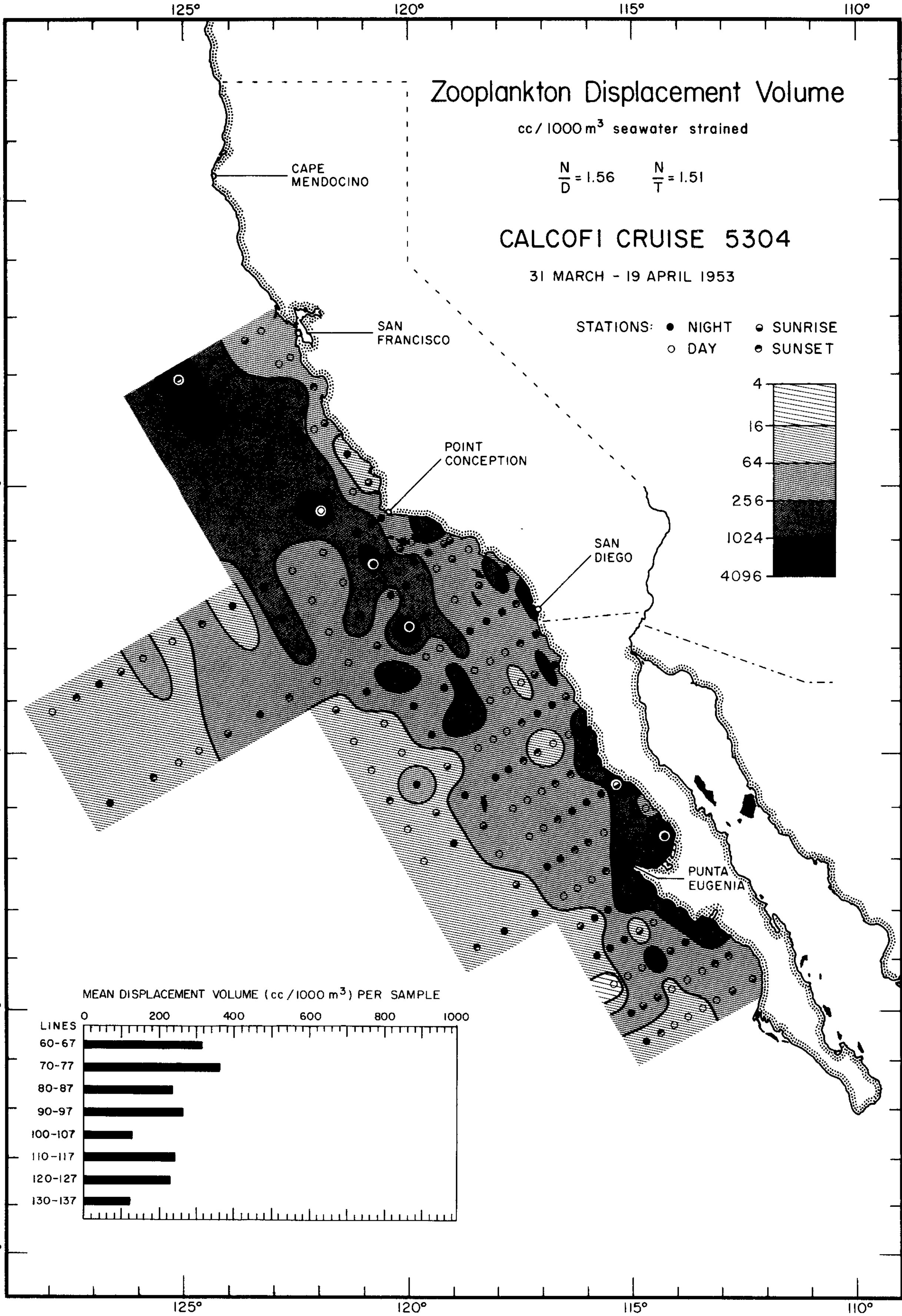
Zooplankton Displacement Volume
cc / 1000 m³ seawater strained
N/D = 1.74 N/T = 1.43
CALCOFI CRUISE 6003
10 - 29 MARCH 1960
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0
200
400
600
800
1000
LINES
73 - 77
80 - 87
90 - 97
100 - 107
110 - 119
120 - 127
130 - 137



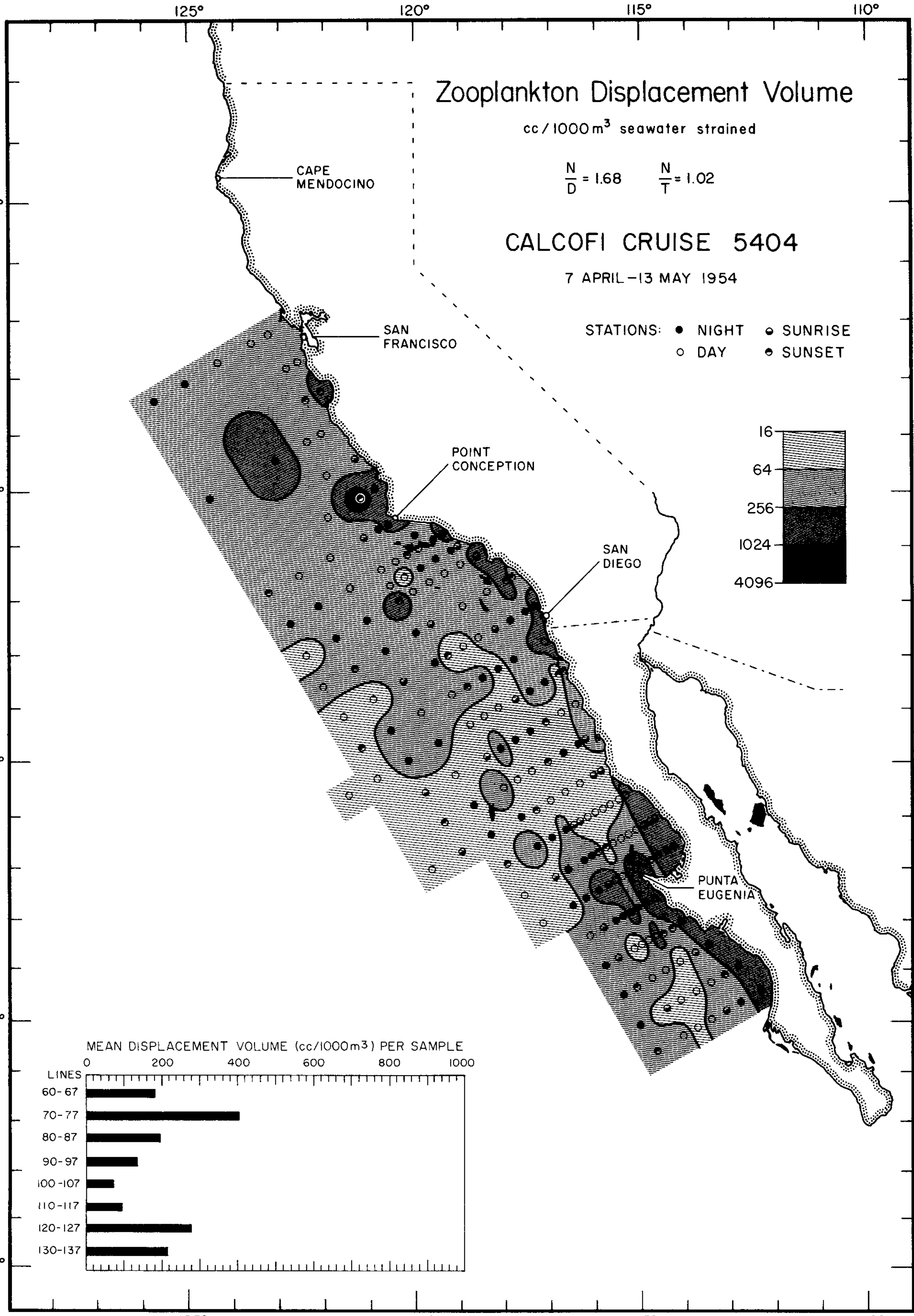
Zooplankton Displacement Volume

5104


Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.24 N/T = 1.20
CALCOFI CRUISE 5204
2 - 15 APRIL 1952
STATIONS: ● NIGHT ◒ SUNRISE
○ DAY ◓ SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000
LINES
60-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137

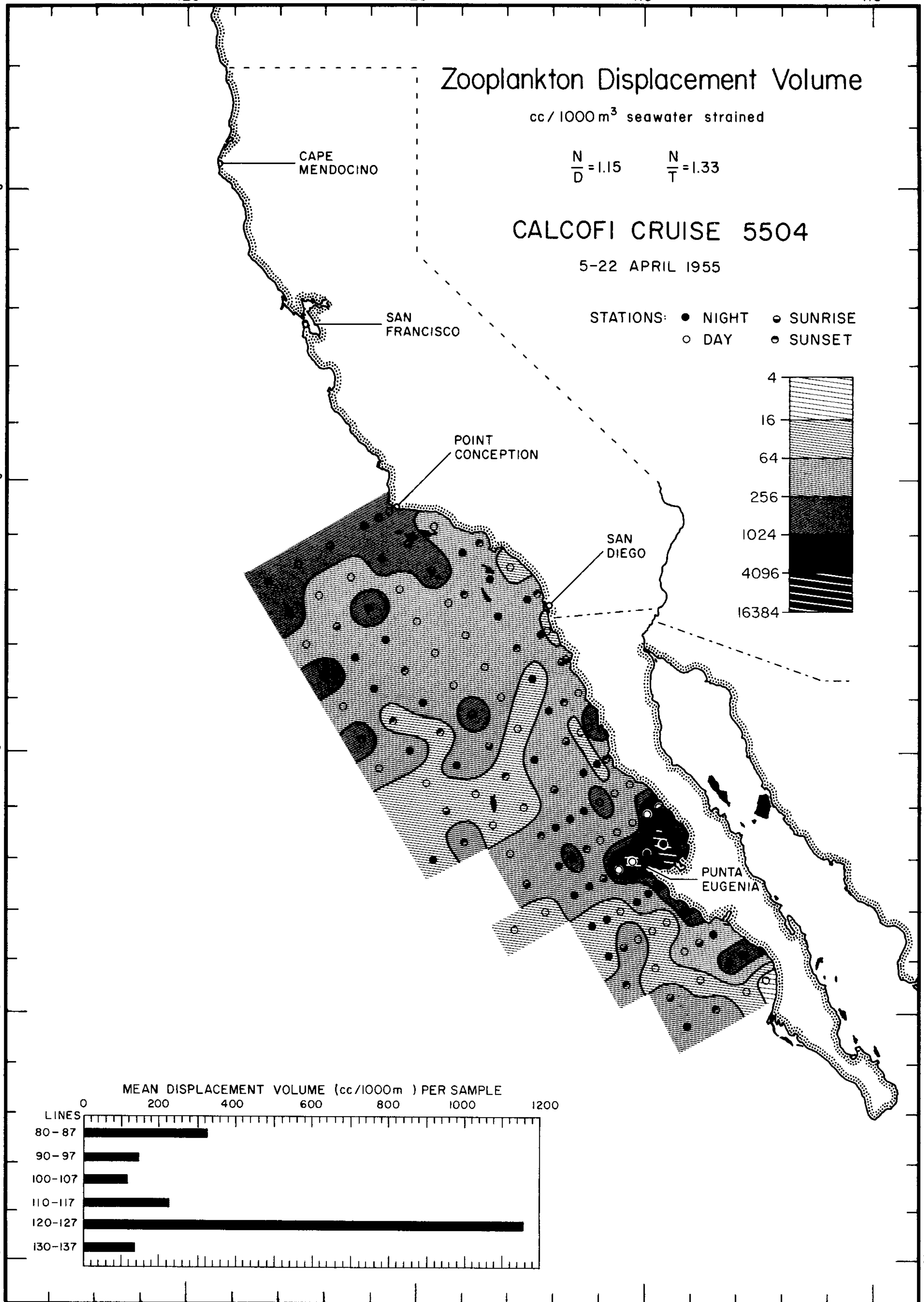


Zooplankton Displacement Volume

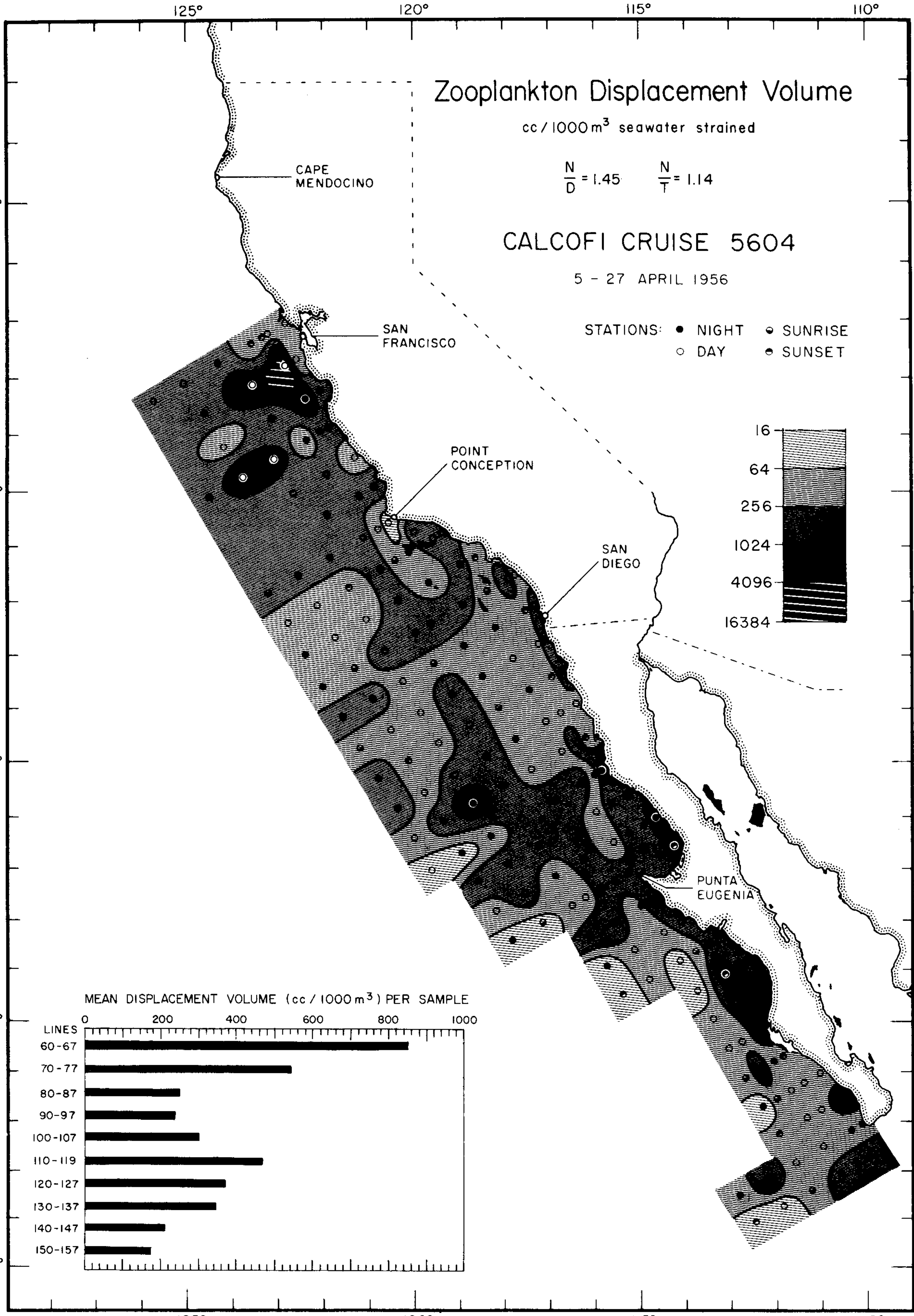


Zooplankton Displacement Volume

5404

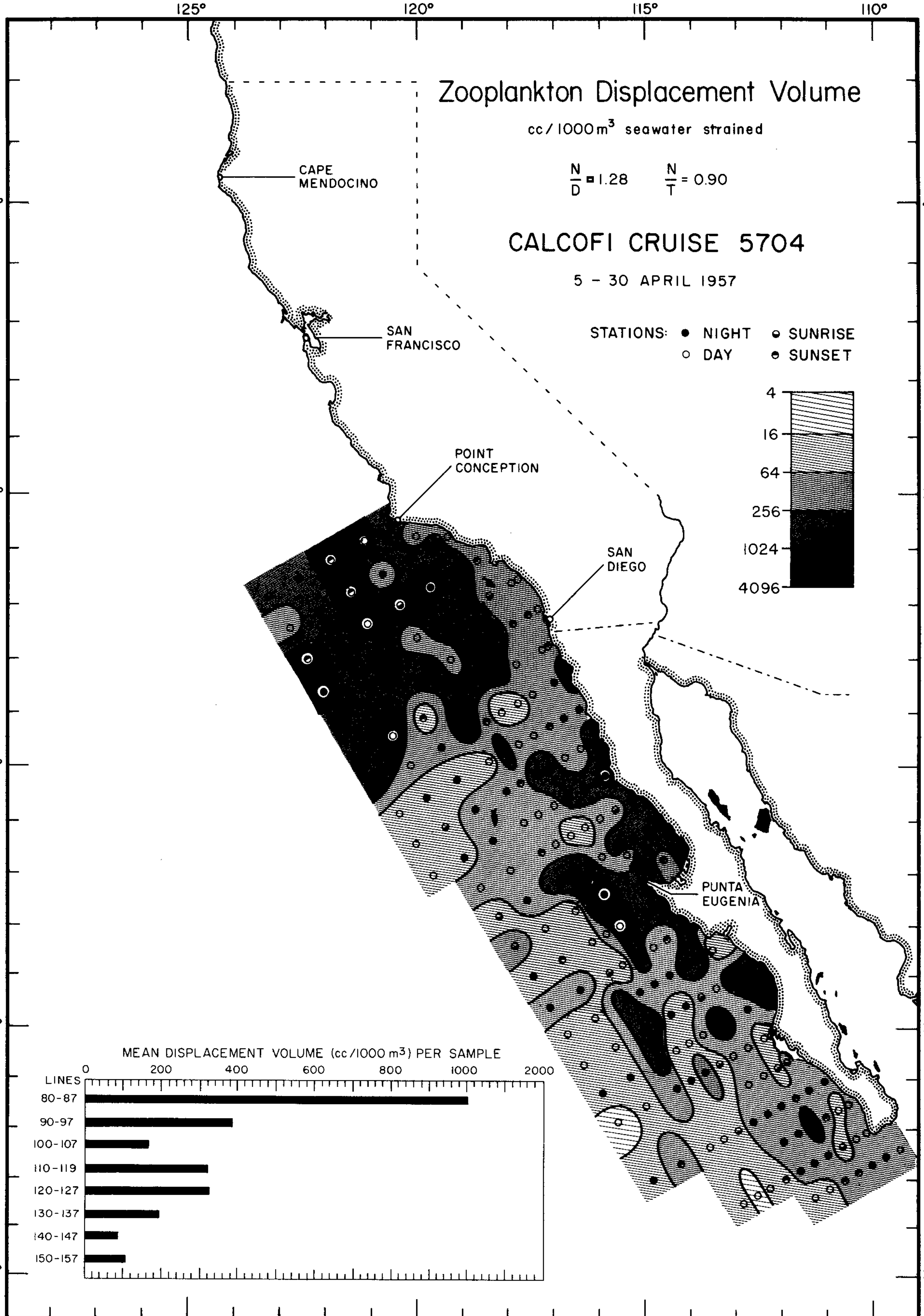


Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.15
N/T = 1.33
CALCOFI CRUISE 5504
5-22 APRIL 1955
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
4096
16384
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000m) PER SAMPLE
0
200
400
600
800
1000
1200
LINES
80-87
90-97
100-107
110-117
120-127
130-137

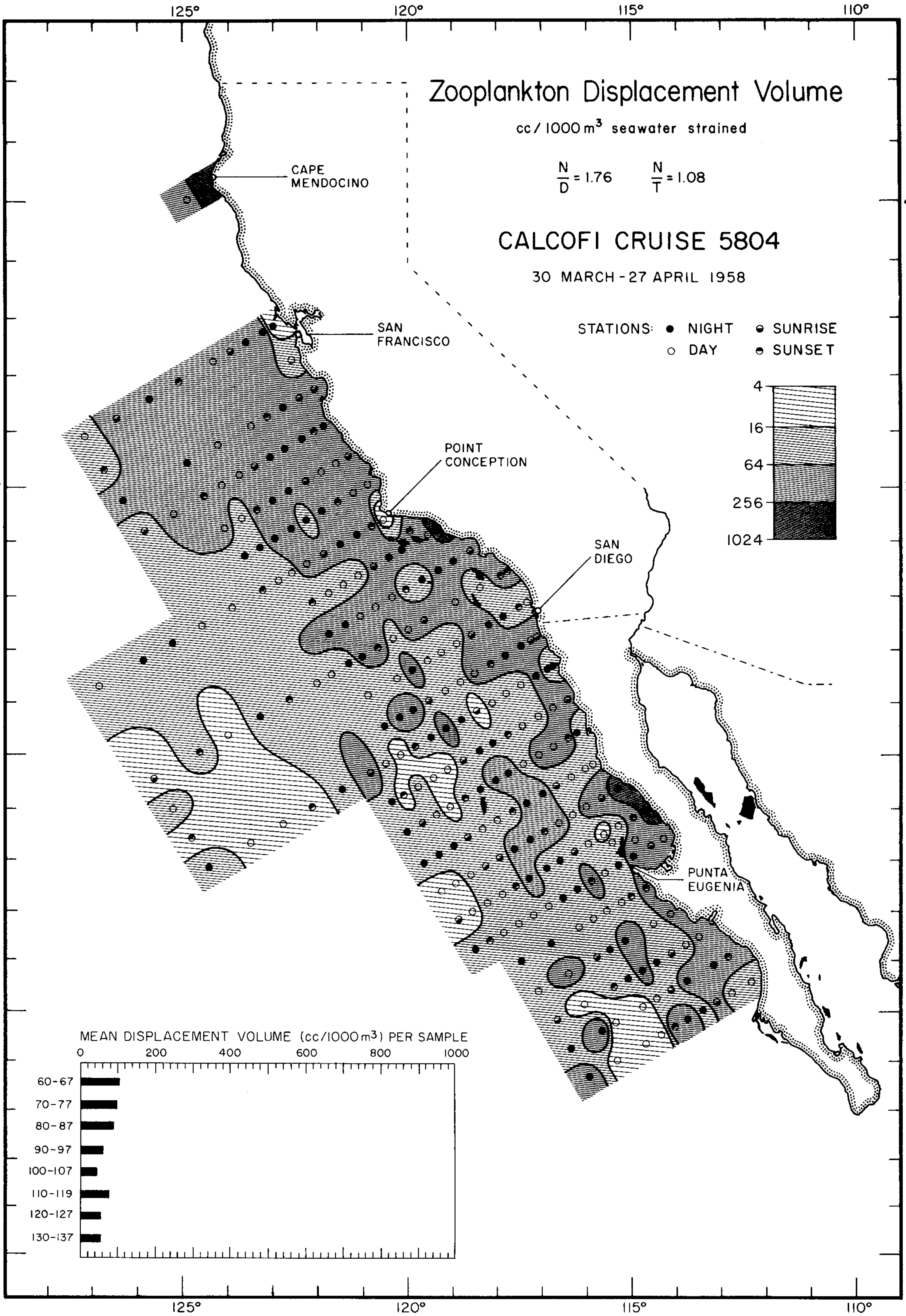


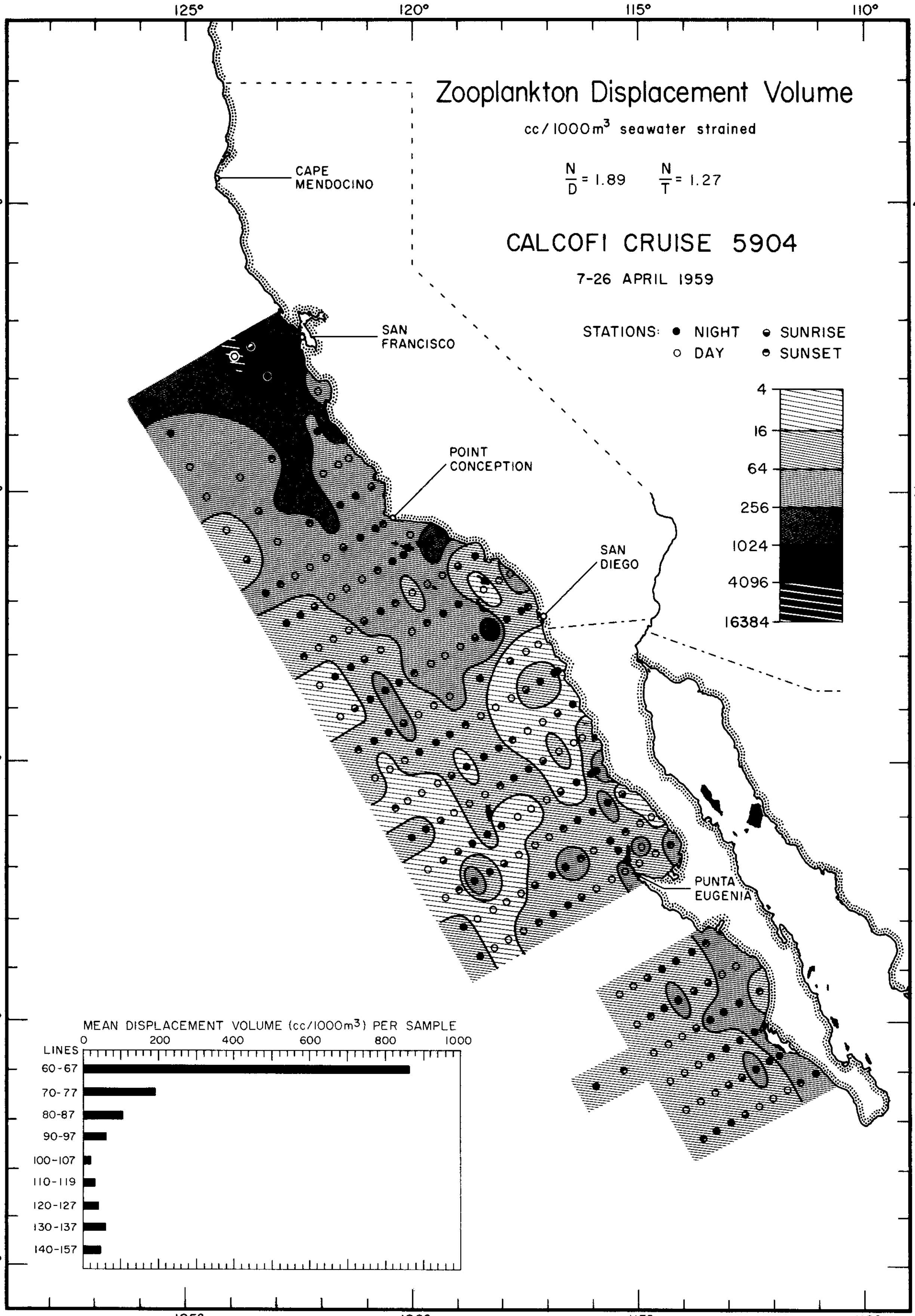
Zooplankton Displacement Volume

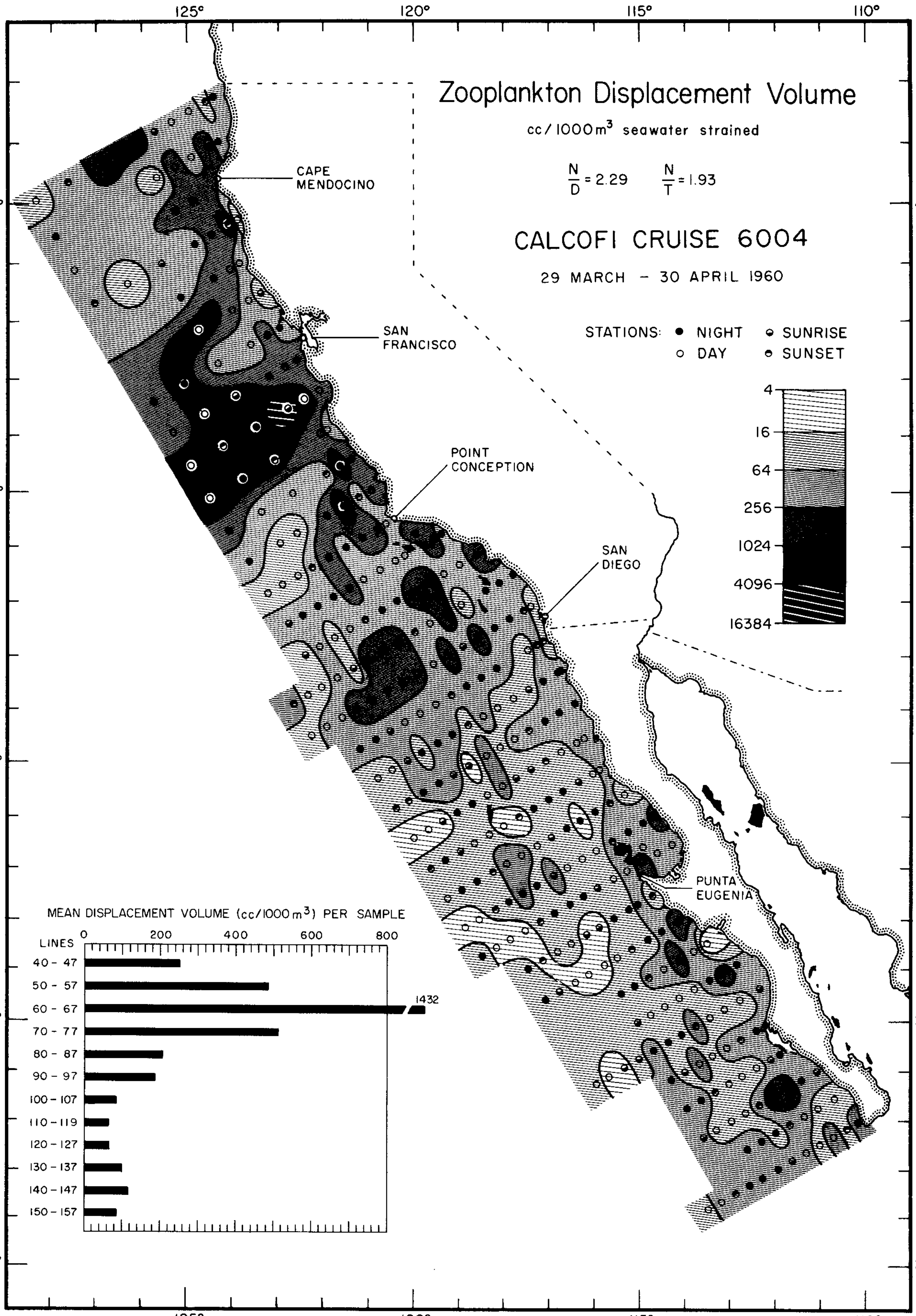
5604



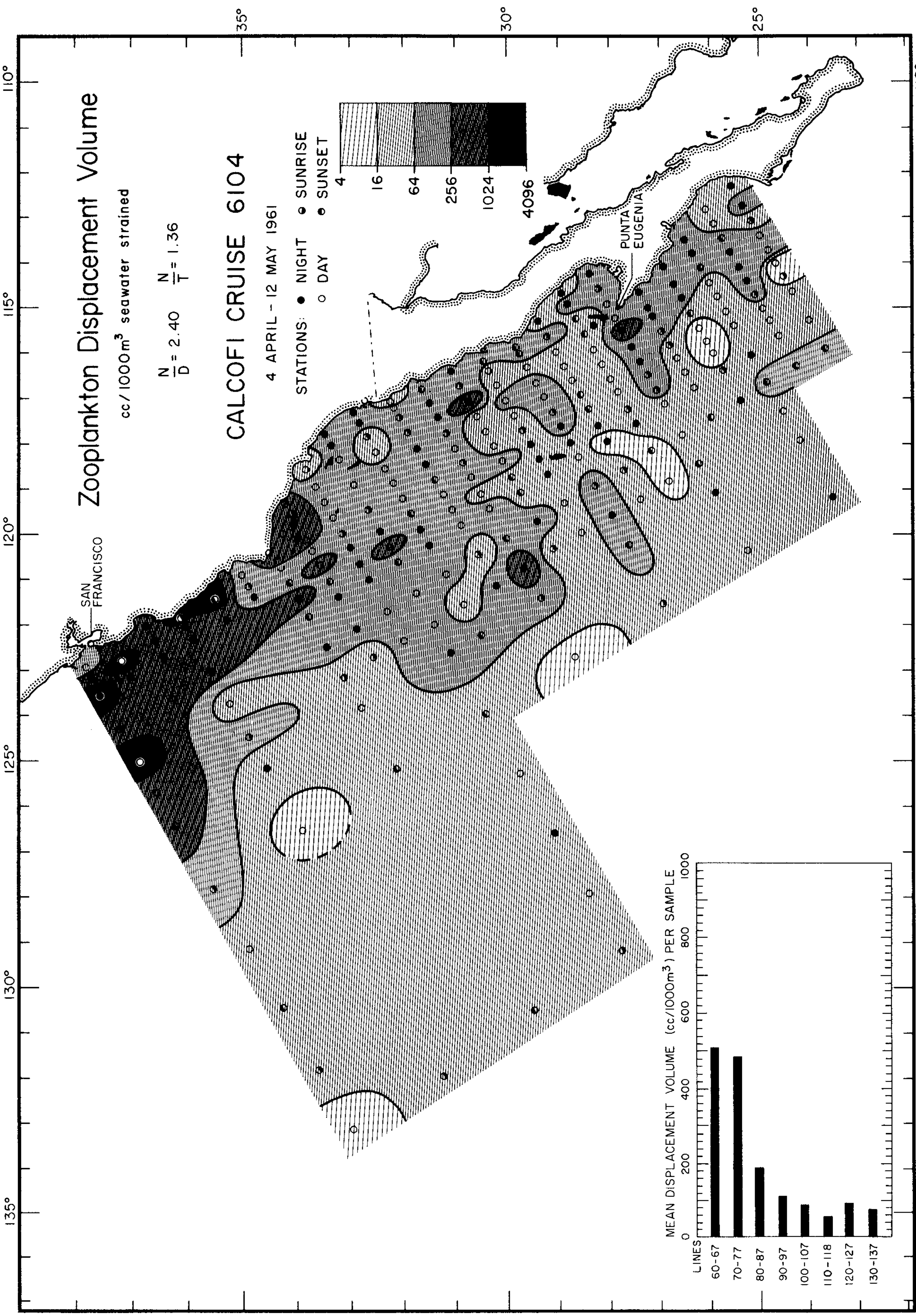
Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.28 N/T = 0.90
CALCOFI CRUISE 5704
5 - 30 APRIL 1957
STATIONS: ● NIGHT ○ DAY SUNRISE SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m3) PER SAMPLE
0
200
400
600
800
1000
2000
LINES
80-87
90-97
100-107
110-119
120-127
130-137
140-147
150-157


Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.76 N/T = 1.08
CALCOFI CRUISE 5804
30 MARCH - 27 APRIL 1958
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125° 120° 115° 110°
40° 35° 30° 25° 20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137

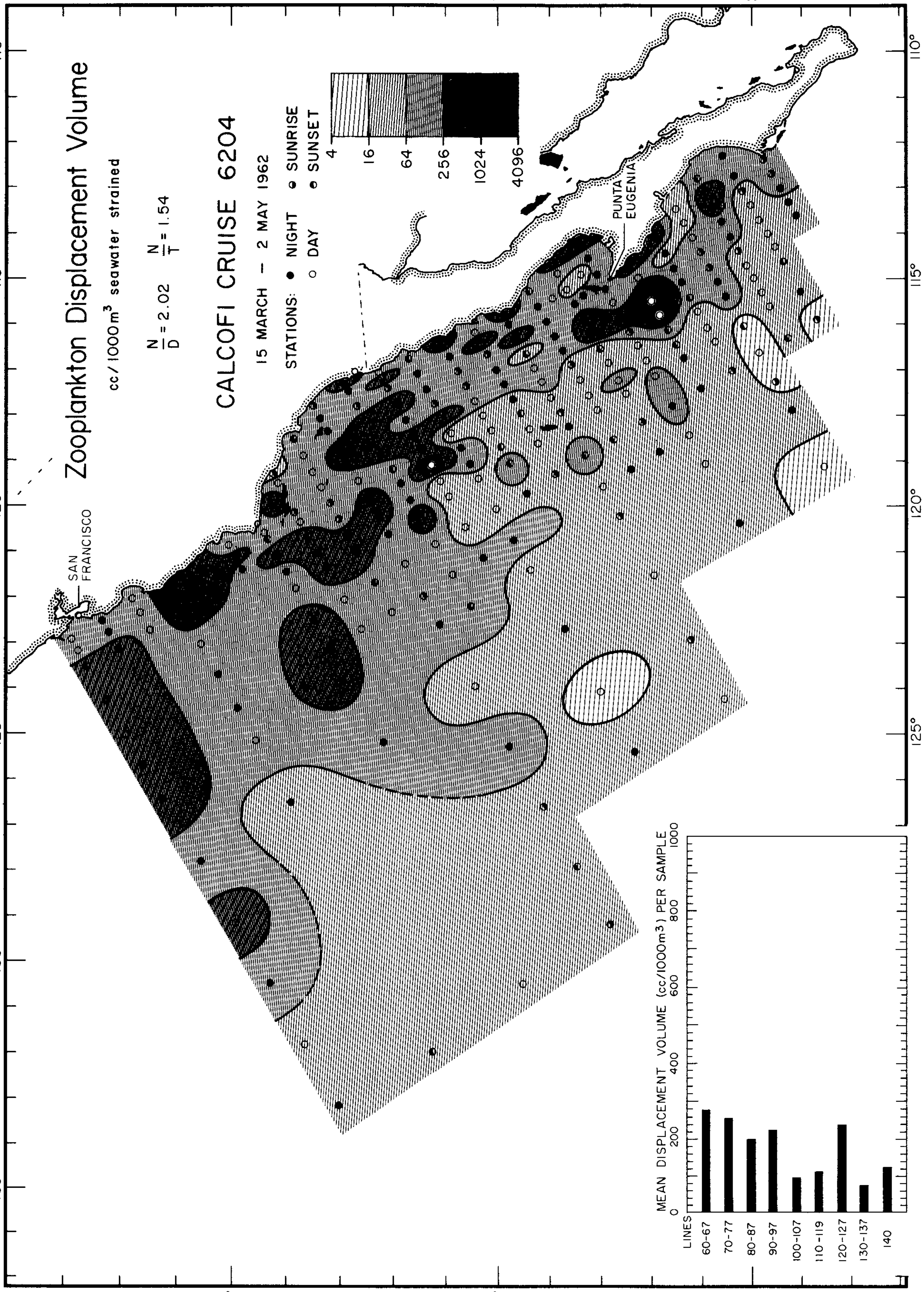

Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.89   N/T = 1.27
CALCOFI CRUISE 5904
7-26 APRIL 1959
STATIONS: ● NIGHT ◒ SUNRISE
○ DAY ◓ SUNSET
4
16
64
256
1024
4096
16384
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0
200
400
600
800
1000
LINES
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137
140-157



Zooplankton Displacement Volume

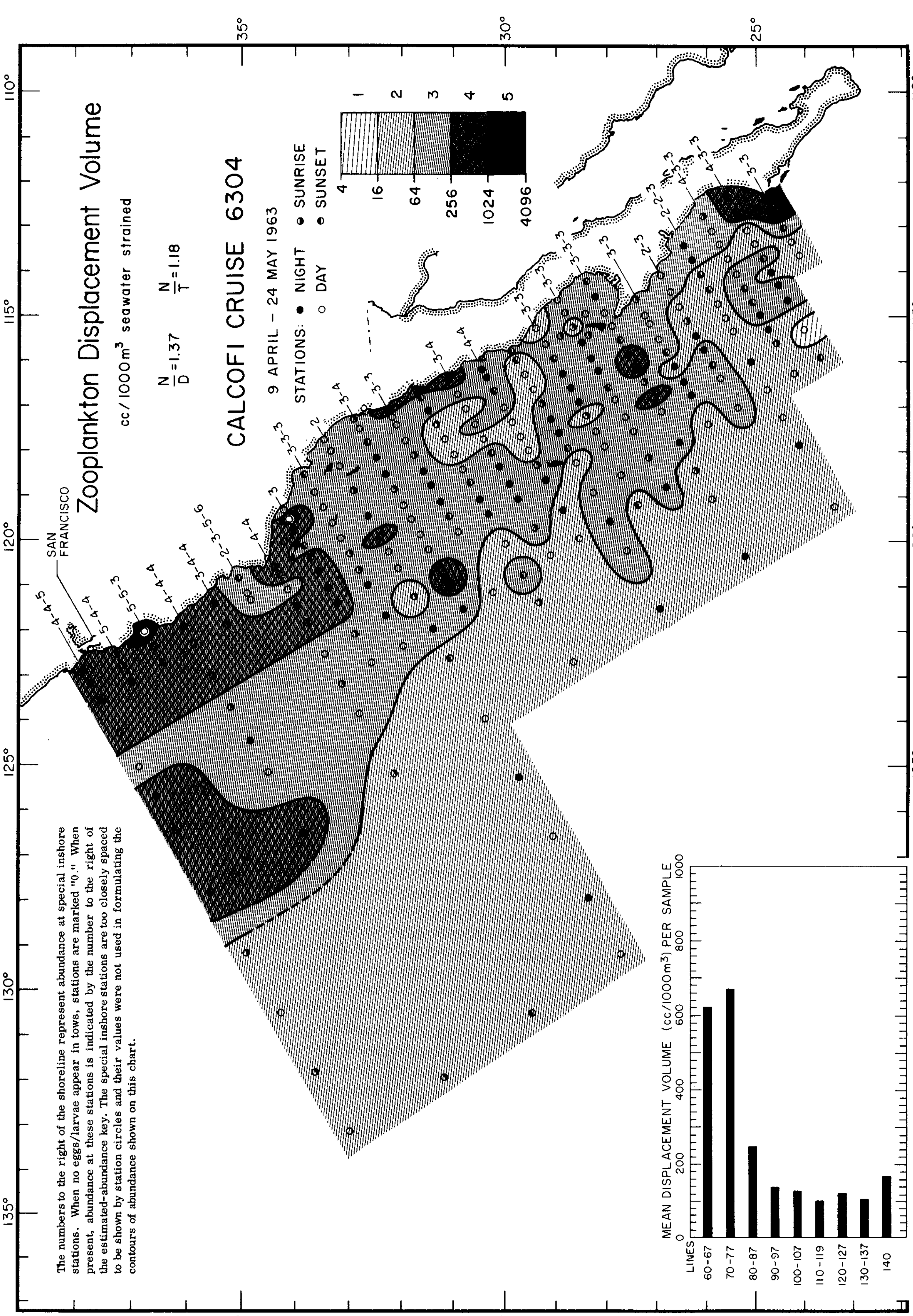


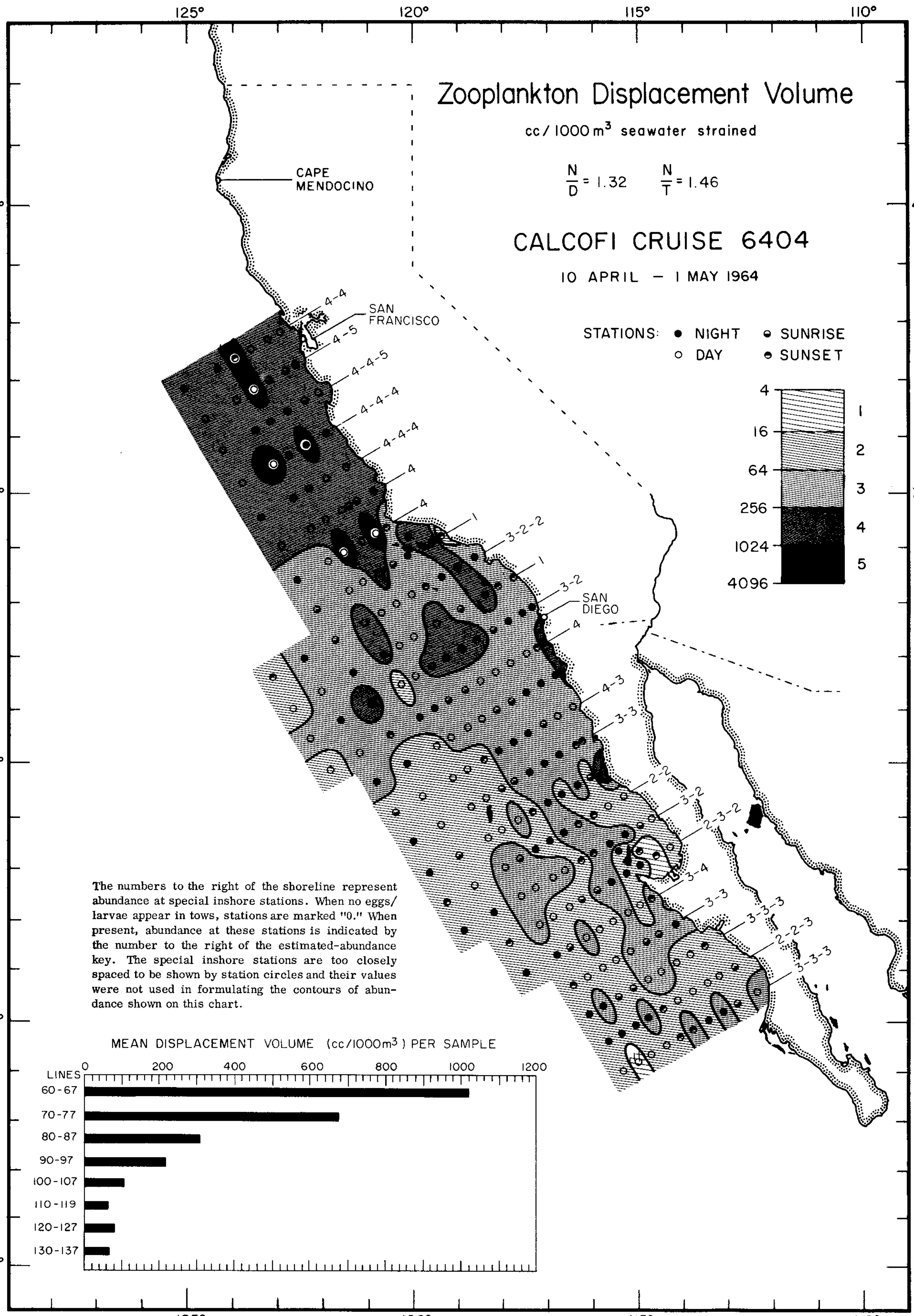
Zooplankton Displacement Volume



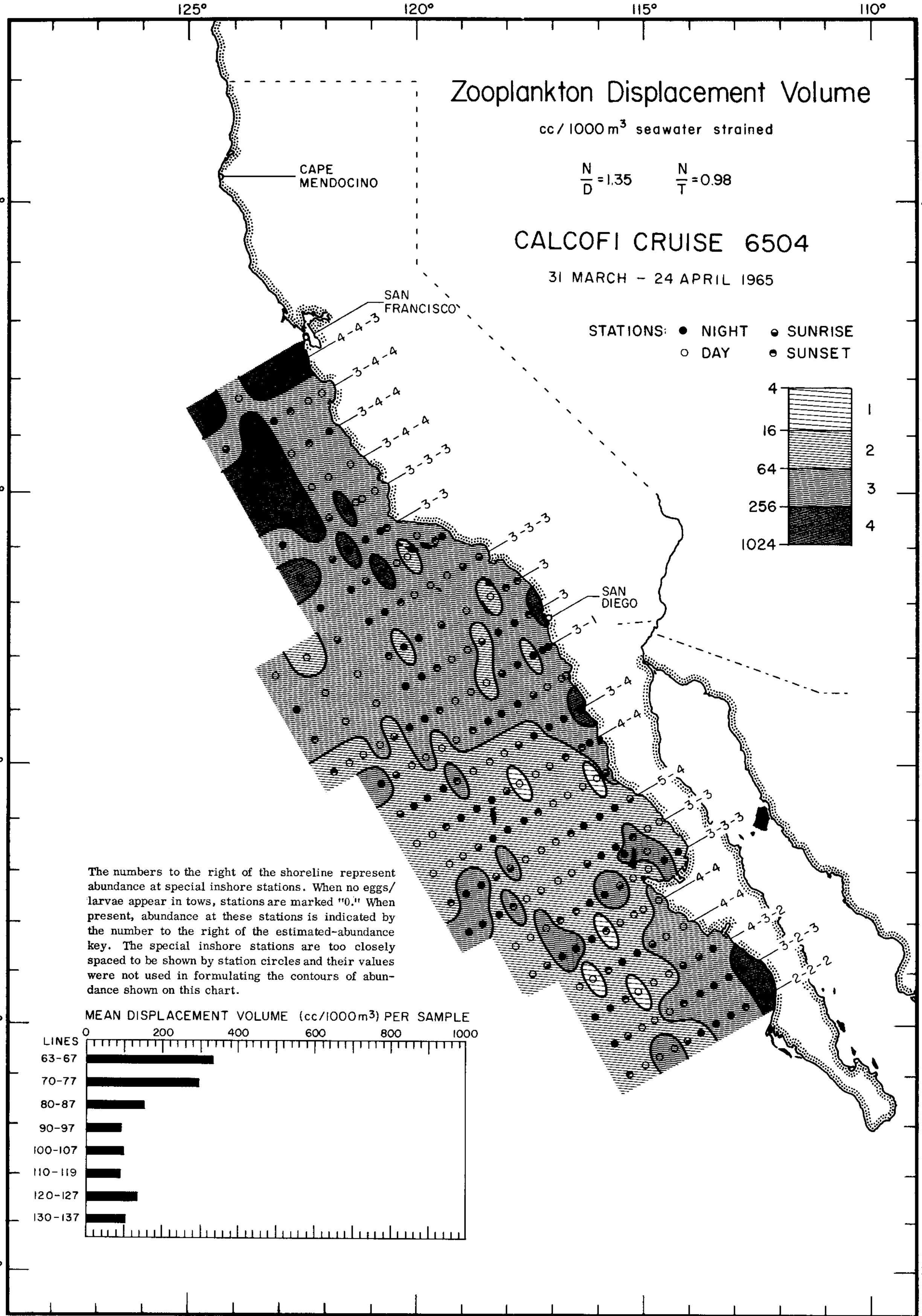
Zooplankton Displacement Volume

6204

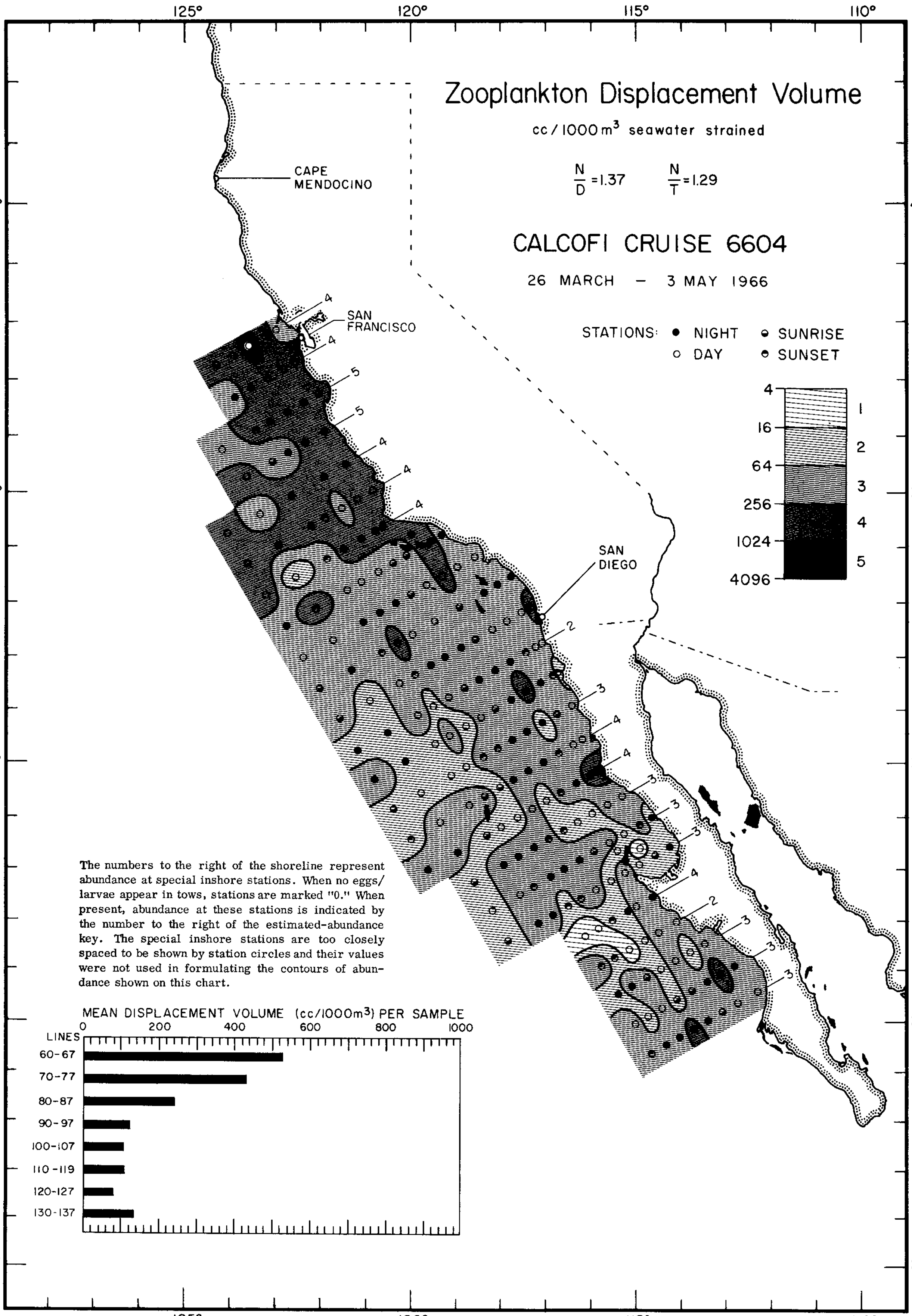

Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.37
N/T = 1.18
CALCOFI CRUISE 6304
9 APRIL - 24 MAY 1963
STATIONS: ● NIGHT ◐ SUNRISE
○ DAY ◐ SUNSET
4 16 64 256 1024 4096
1 2 3 4 5
SAN FRANCISCO
35° 30° 25°
110° 115° 120° 125° 130° 135°
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0 200 400 600 800 1000
LINES
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137
140

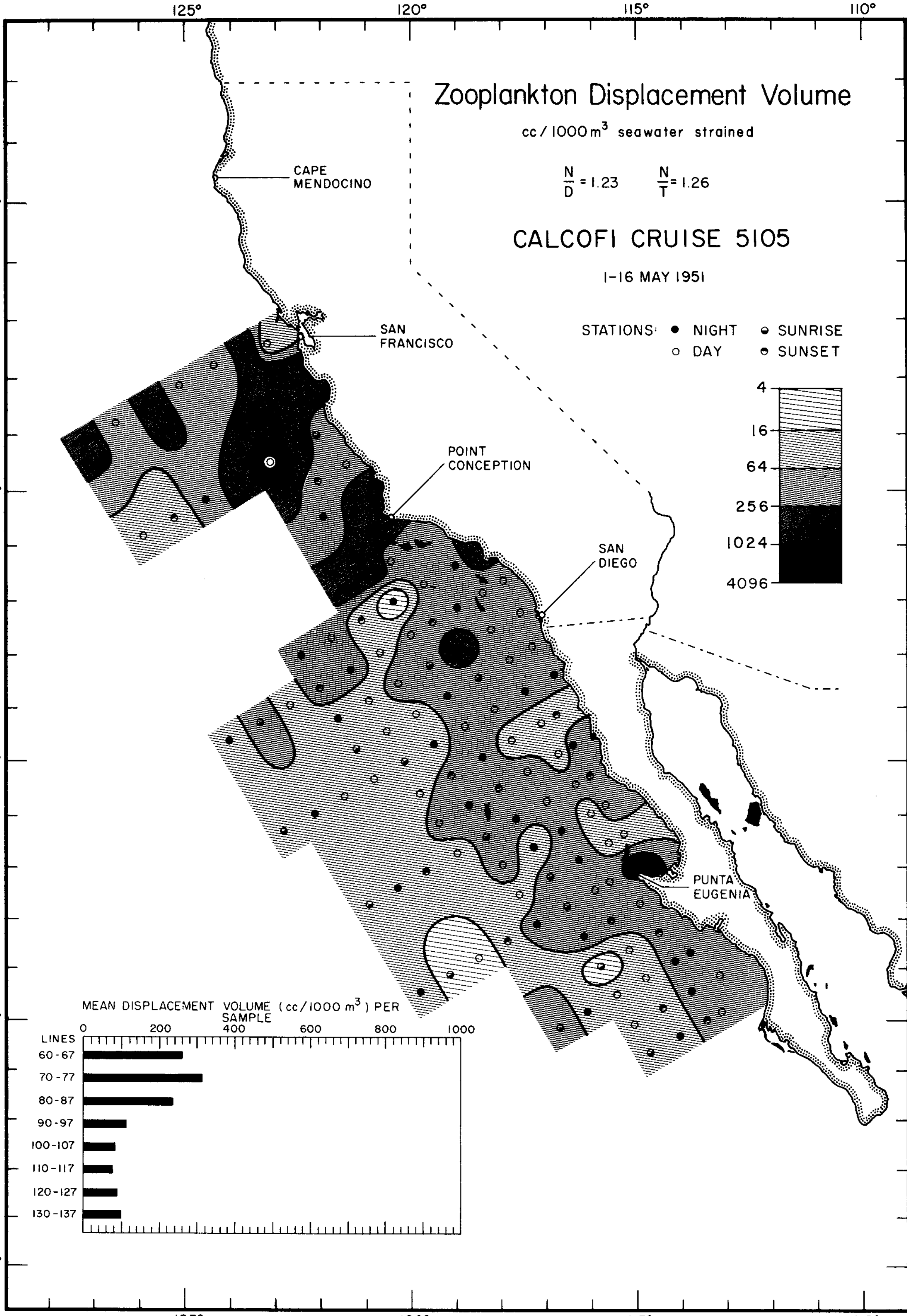


Zooplankton Displacement Volume
cc/1000 m^3 seawater strained
$\frac{N}{D}$ = 1.32 $\frac{N}{T}$ = 1.46
CALCOFI CRUISE 6404
10 APRIL – 1 MAY 1964
STATIONS: ● NIGHT ○ DAY ◒ SUNRISE ◓ SUNSET
4 16 64 256 1024 4096
1 2 3 4 5
CAPE MENDOCINO
SAN FRANCISCO
SAN DIEGO
125° 120° 115° 110°
40° 35° 30° 25° 20°
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000m^3) PER SAMPLE
LINES
0 200 400 600 800 1000 1200
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137

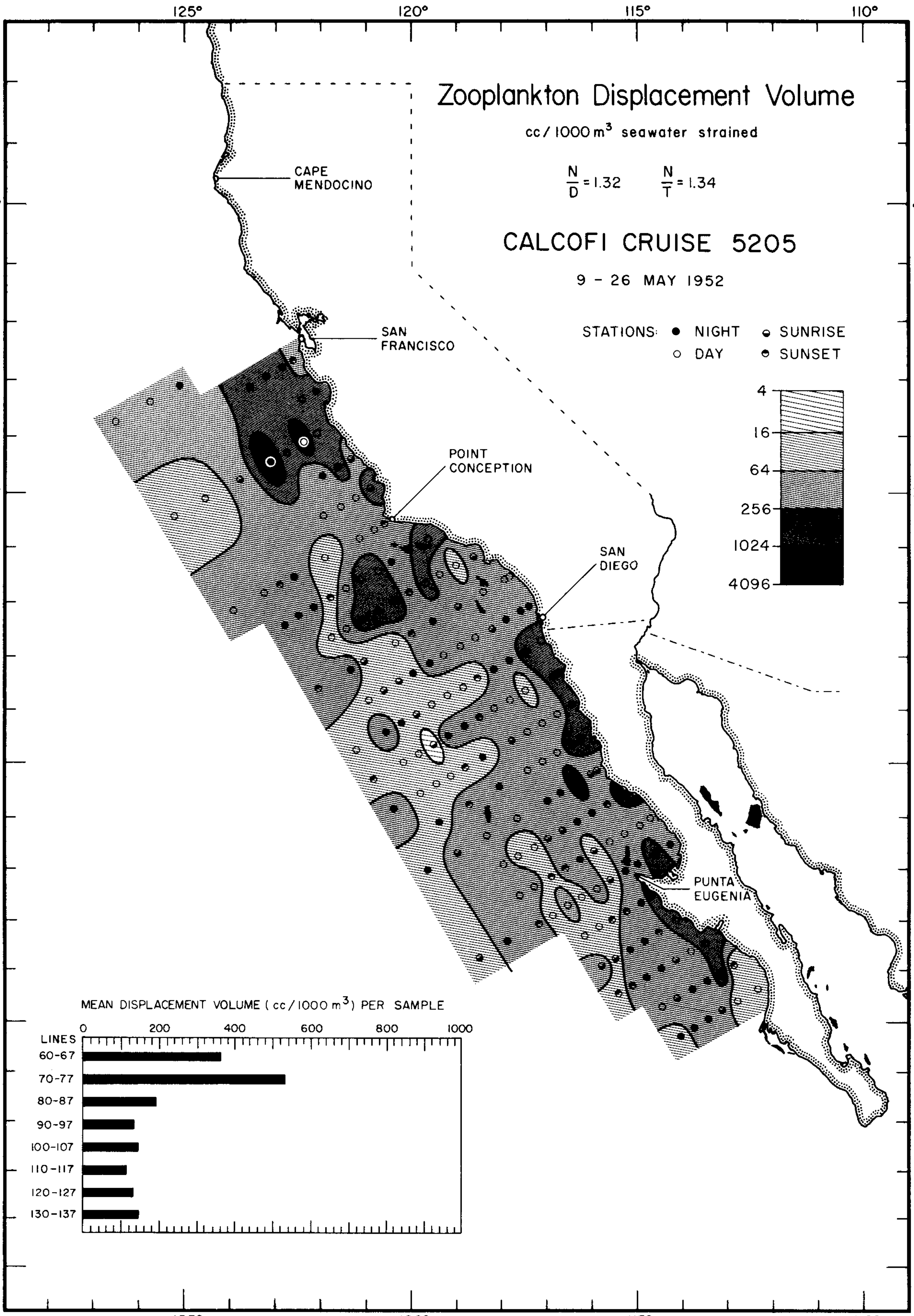


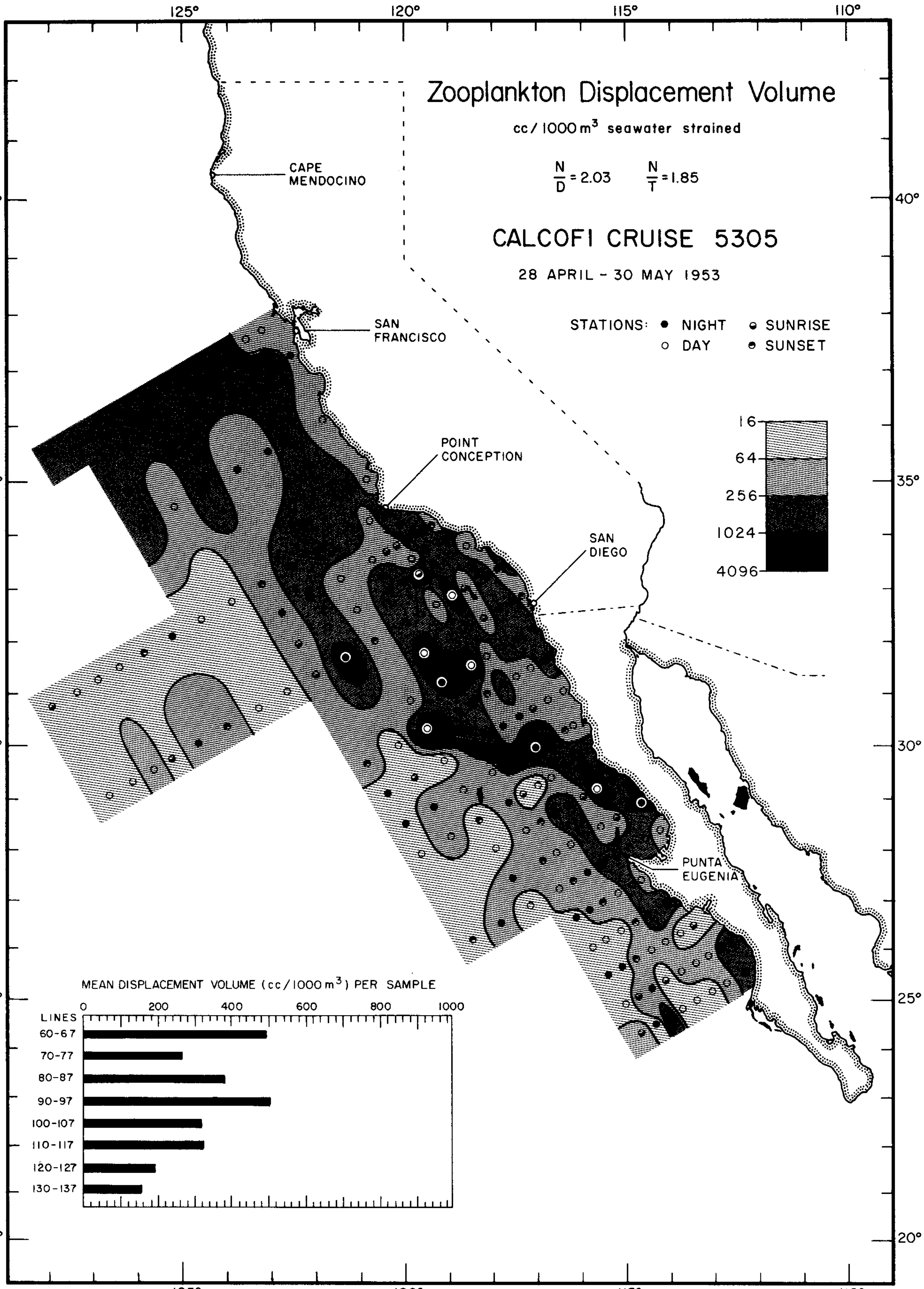
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.

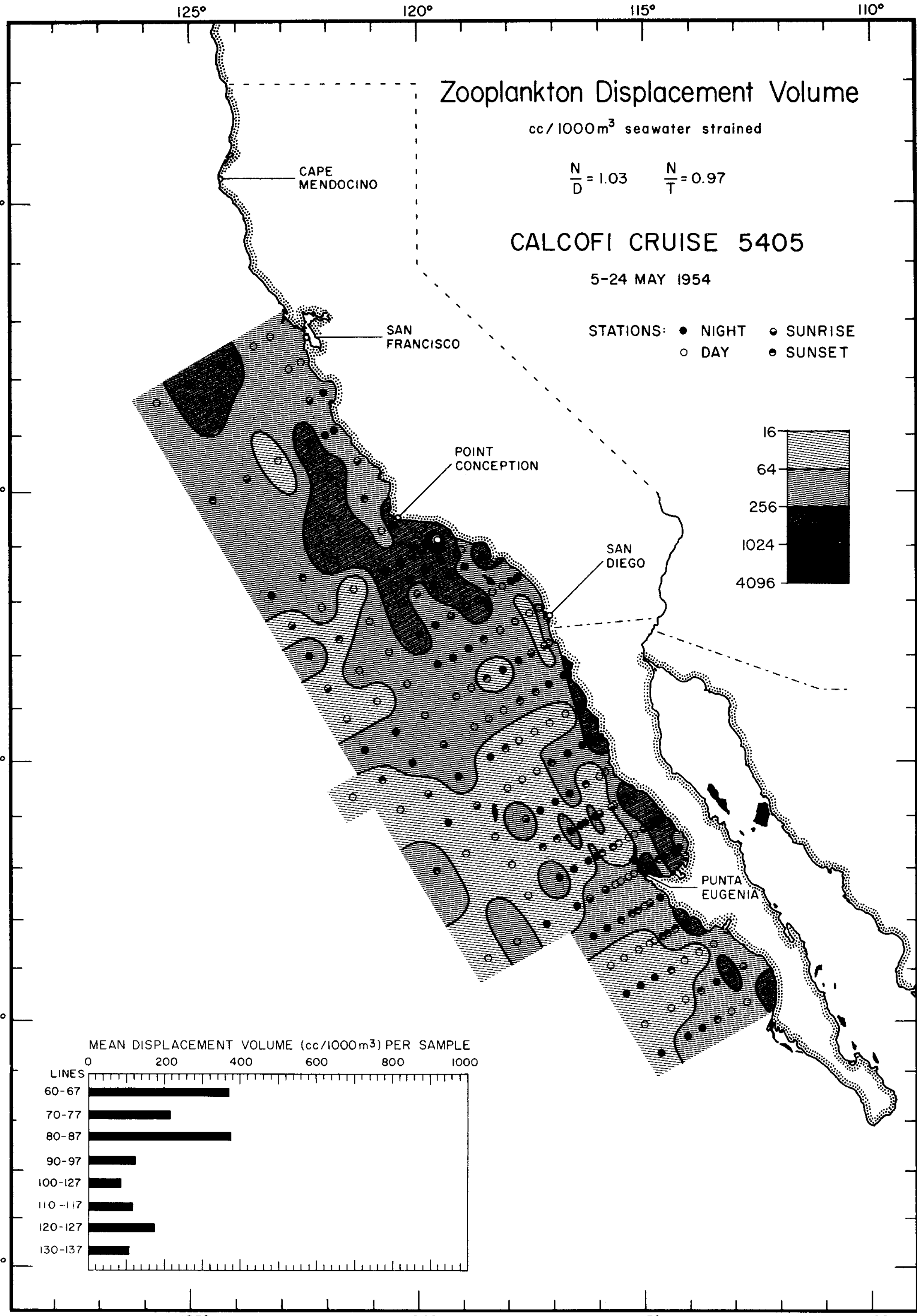

Zooplankton Displacement Volume
cc/1000 m3 seawater strained
N/D = 1.37   N/T = 1.29
CALCOFI CRUISE 6604
26 MARCH – 3 MAY 1966
STATIONS: NIGHT SUNRISE DAY SUNSET
4 16 64 256 1024 4096
1 2 3 4 5
CAPE MENDOCINO
SAN FRANCISCO
SAN DIEGO
125° 120° 115° 110°
40° 35° 30° 25° 20°
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000m3) PER SAMPLE
0 200 400 600 800 1000
LINES
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137

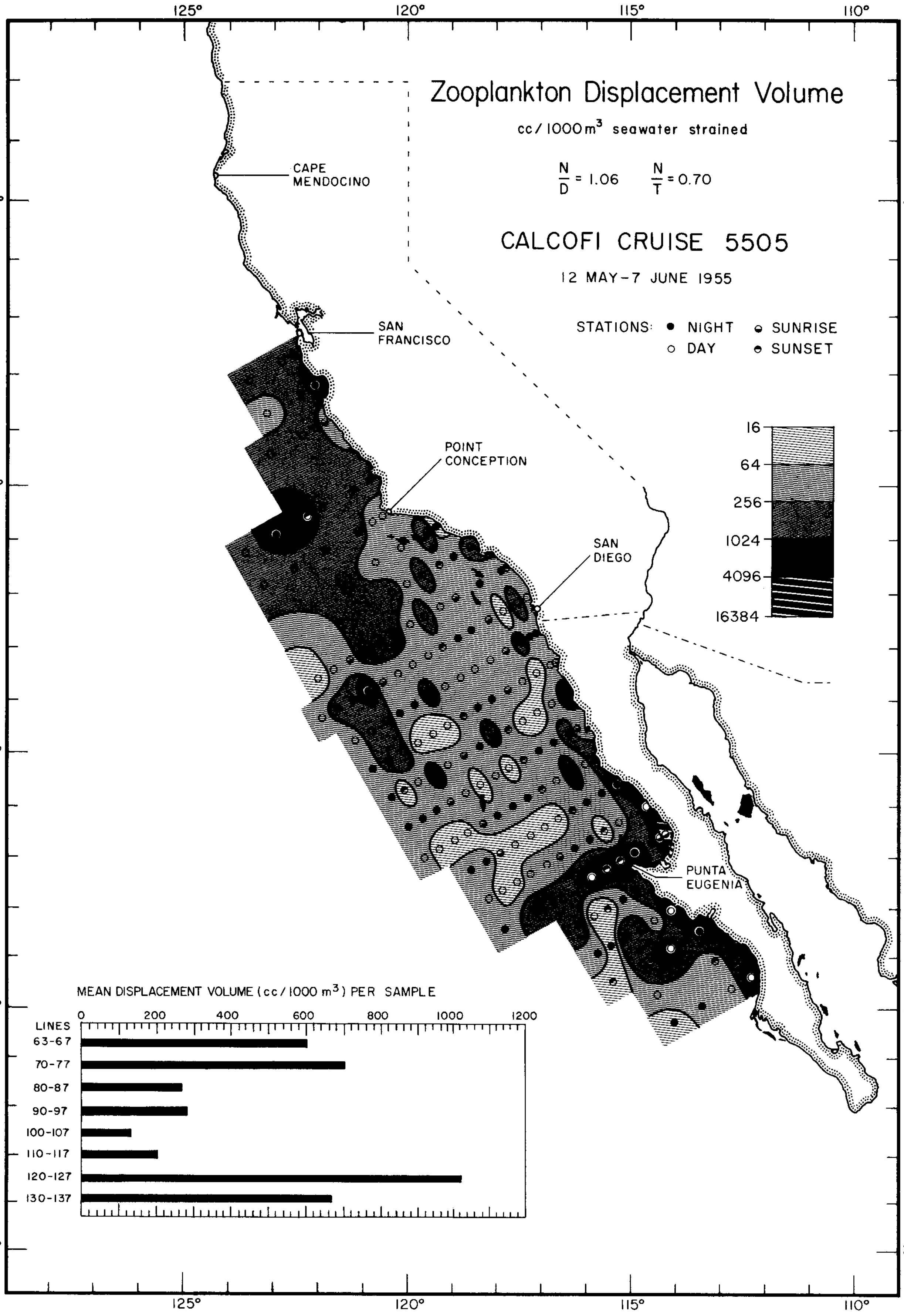


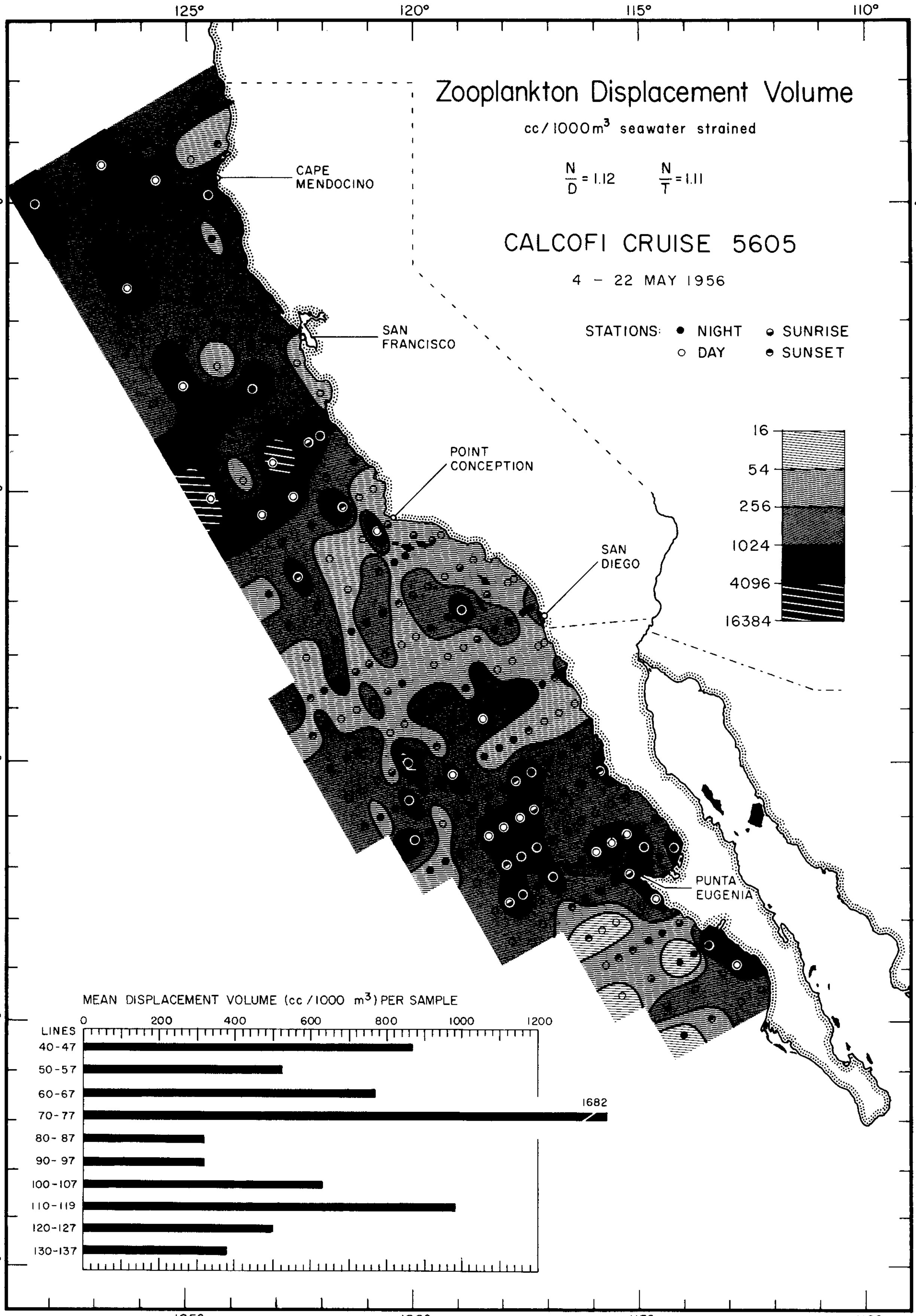
Zooplankton Displacement Volume
cc / 1000 m³ seawater strained
N/D = 1.23
N/T = 1.26
CALCOFI CRUISE 5105
1-16 MAY 1951
STATIONS: NIGHT
SUNRISE
DAY
SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
LINES
0
200
400
600
800
1000
60-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137

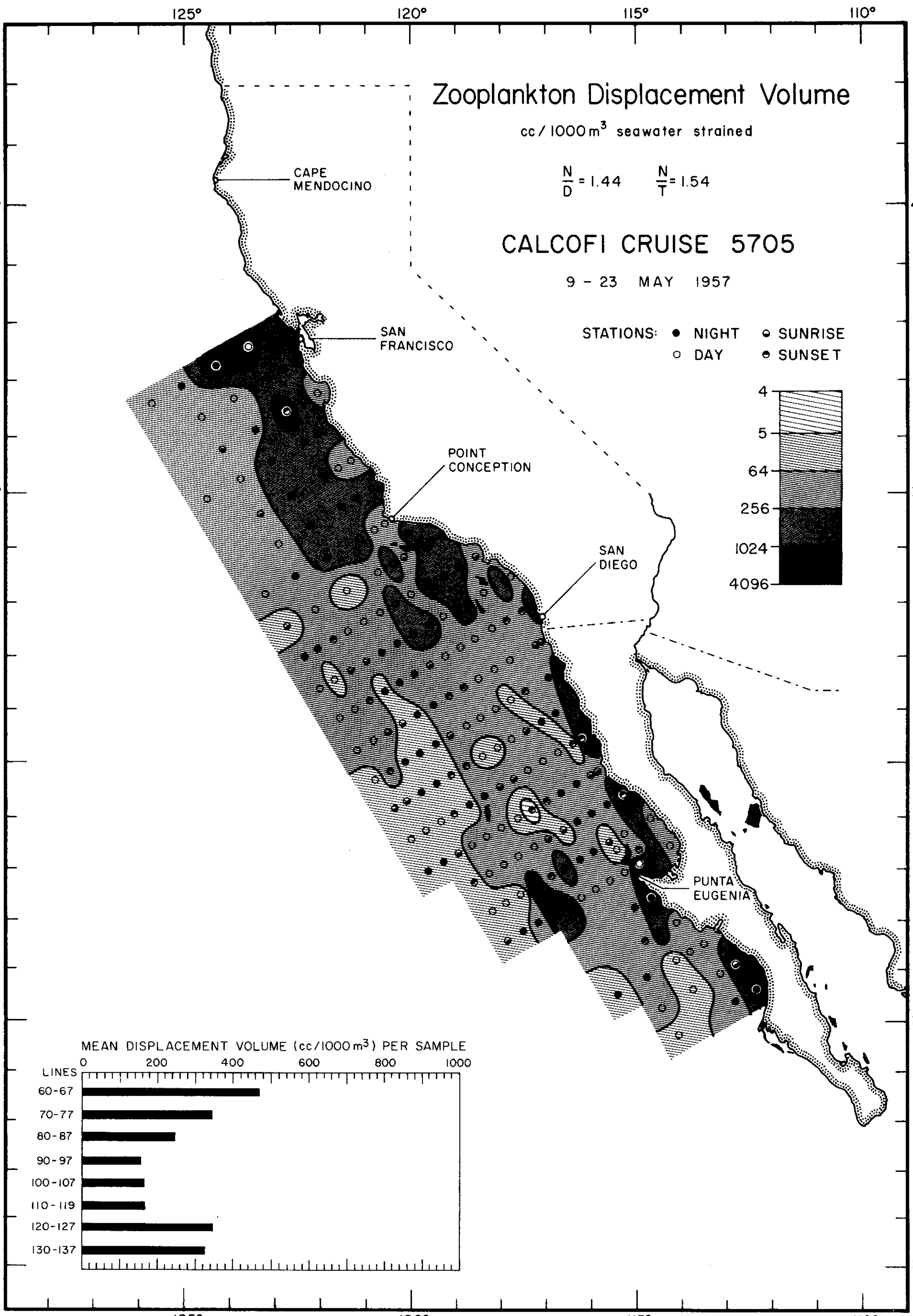

Zooplankton Displacement Volume
cc/1000 m3 seawater strained
N/D = 1.32
N/T = 1.34
CALCOFI CRUISE 5205
9 - 26 MAY 1952
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m3) PER SAMPLE
0
200
400
600
800
1000
LINES
60-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137

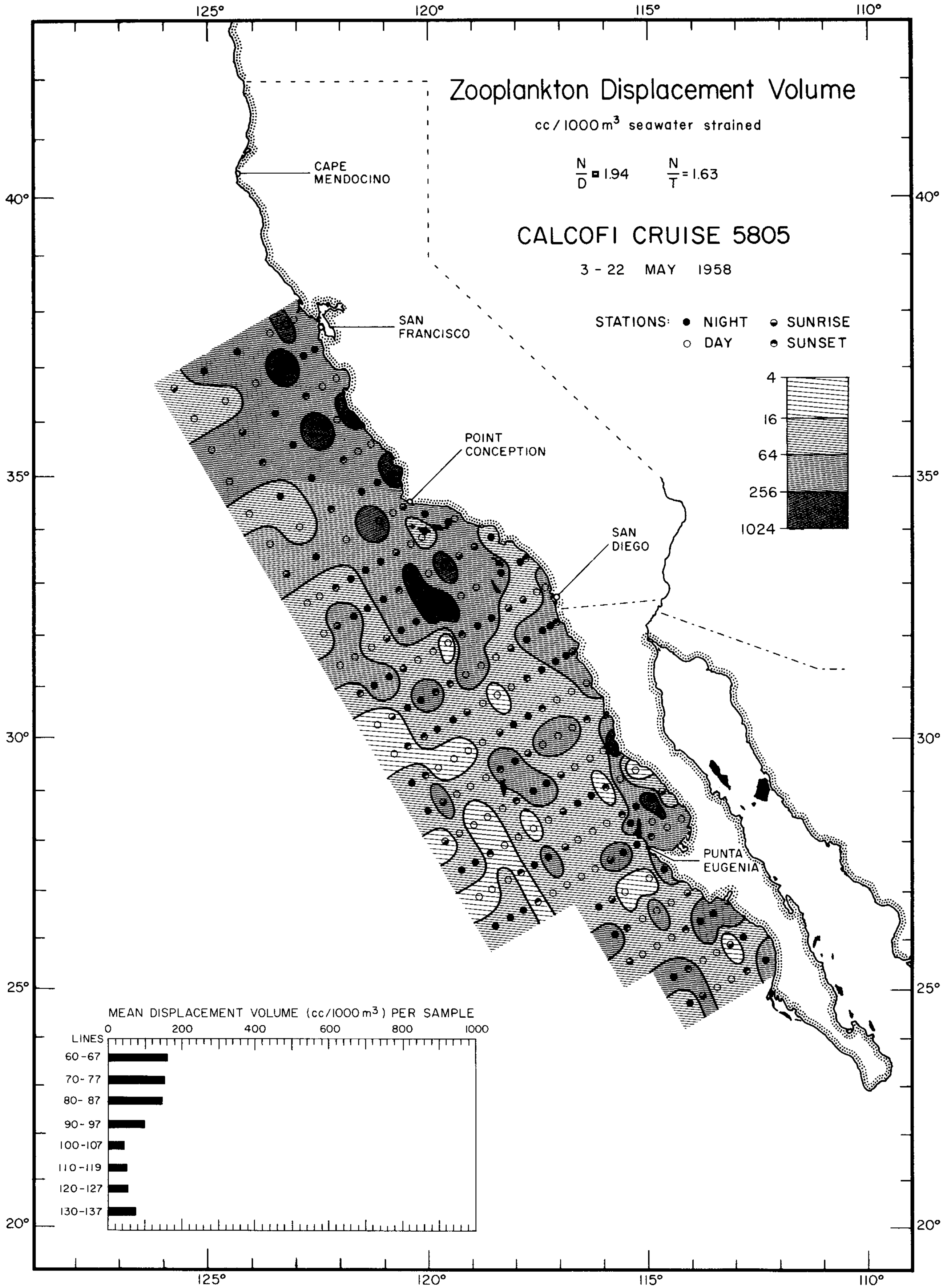

Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 2.03 N/T = 1.85
CALCOFI CRUISE 5305
28 APRIL - 30 MAY 1953
STATIONS: NIGHT SUNRISE DAY SUNSET
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000
LINES
60-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137

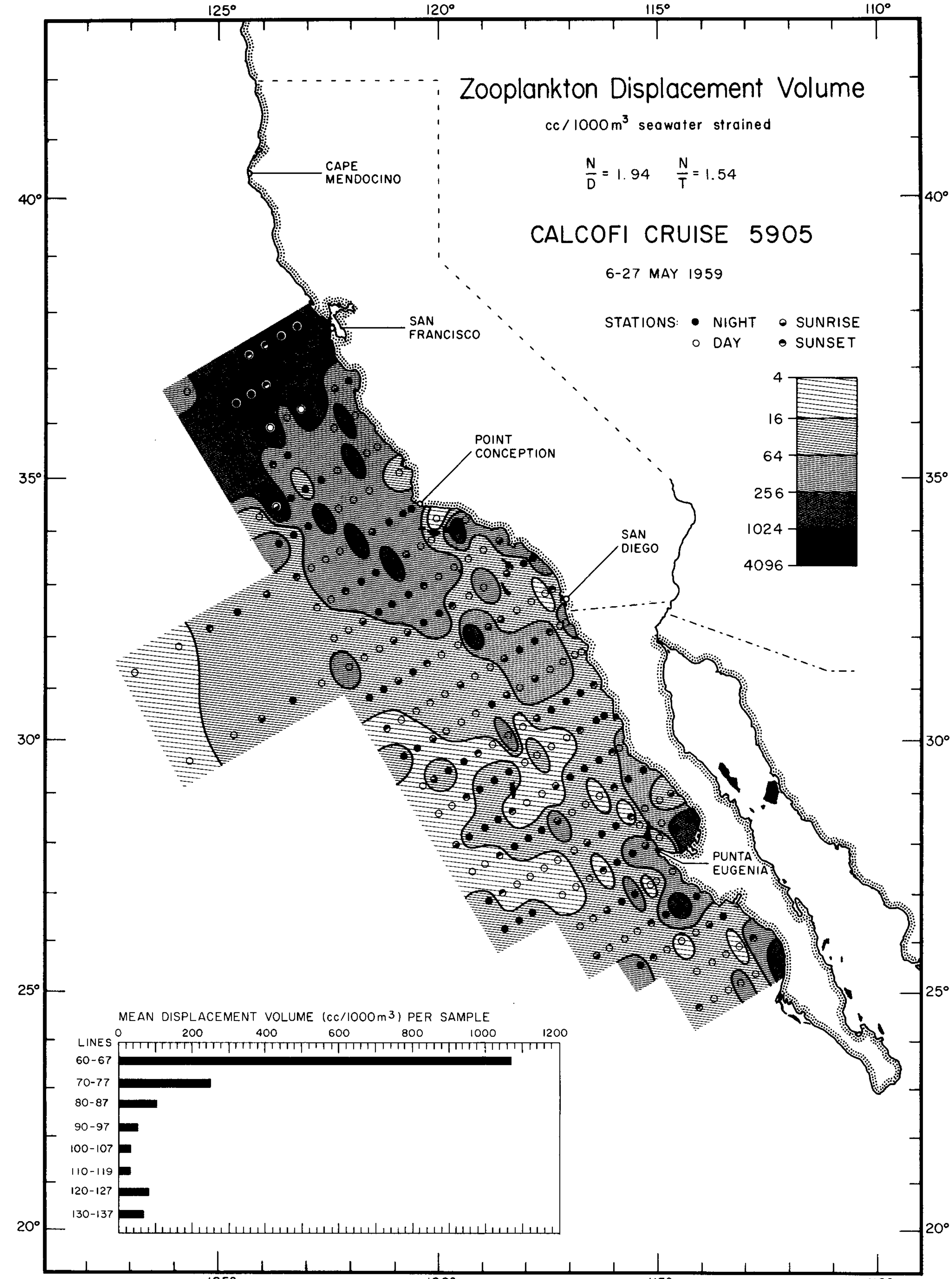

Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.03   N/T = 0.97
CALCOFI CRUISE 5405
5-24 MAY 1954
STATIONS: NIGHT SUNRISE DAY SUNSET
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000m3) PER SAMPLE
0
200
400
600
800
1000
LINES
60-67
70-77
80-87
90-97
100-127
110-117
120-127
130-137

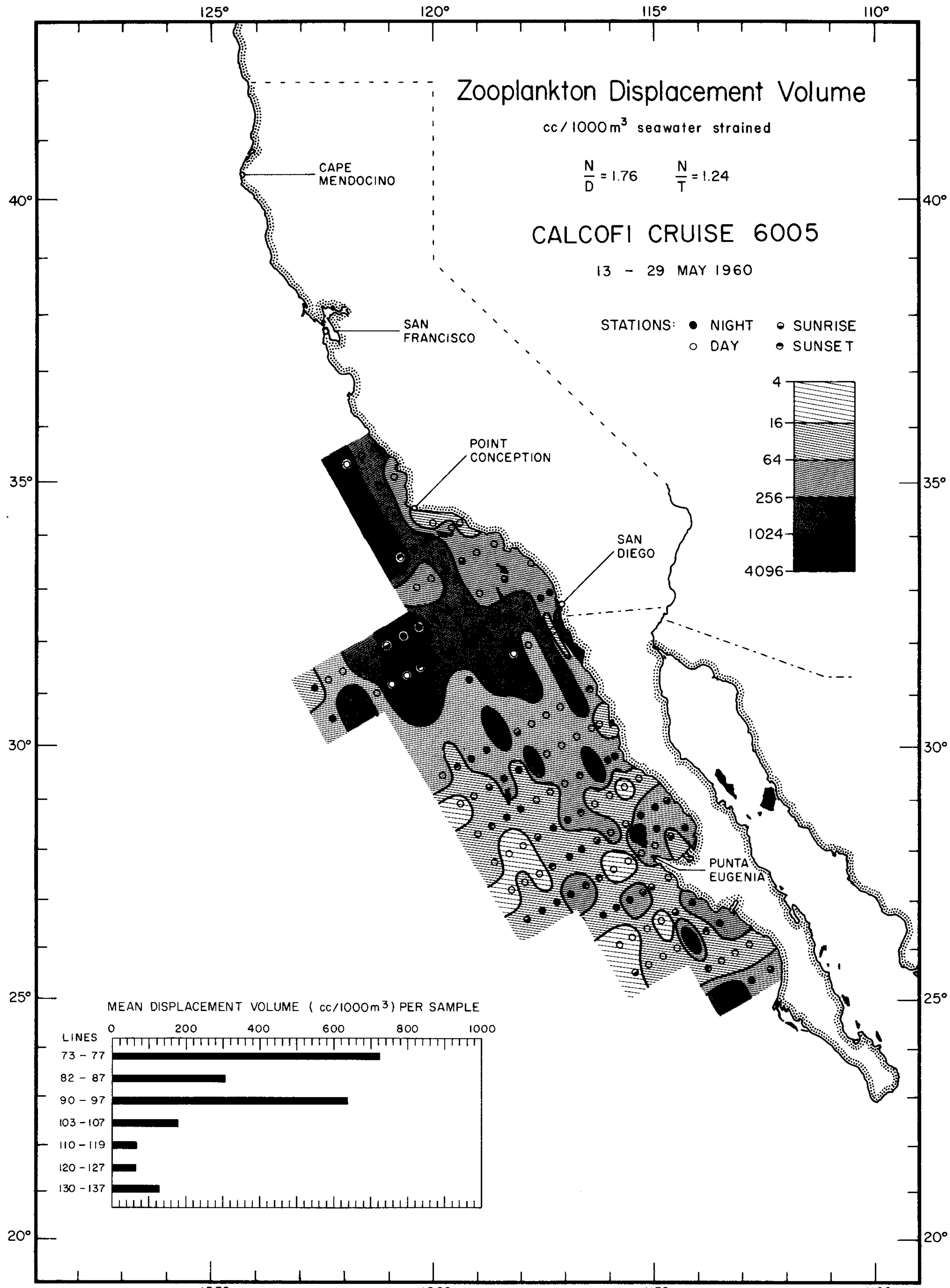

125°
120°
115°
110°
40°
35°
30°
25°
20°
Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.06 N/T = 0.70
CALCOFI CRUISE 5505
12 MAY-7 JUNE 1955
STATIONS: NIGHT SUNRISE
DAY SUNSET
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
16
64
256
1024
4096
16384
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
1200
LINES
63-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137


Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.12   N/T = 1.11
CALCOFI CRUISE 5605
4 - 22 MAY 1956
STATIONS: NIGHT SUNRISE DAY SUNSET
16
54
256
1024
4096
16384
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
LINES
0
200
400
600
800
1000
1200
40-47
50-57
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137
1682


Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.44   N/T = 1.54
CALCOFI CRUISE 5705
9 - 23 MAY 1957
STATIONS: ● NIGHT ○ DAY ◉ SUNRISE ◉ SUNSET
4
5
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0
200
400
600
800
1000
LINES
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137

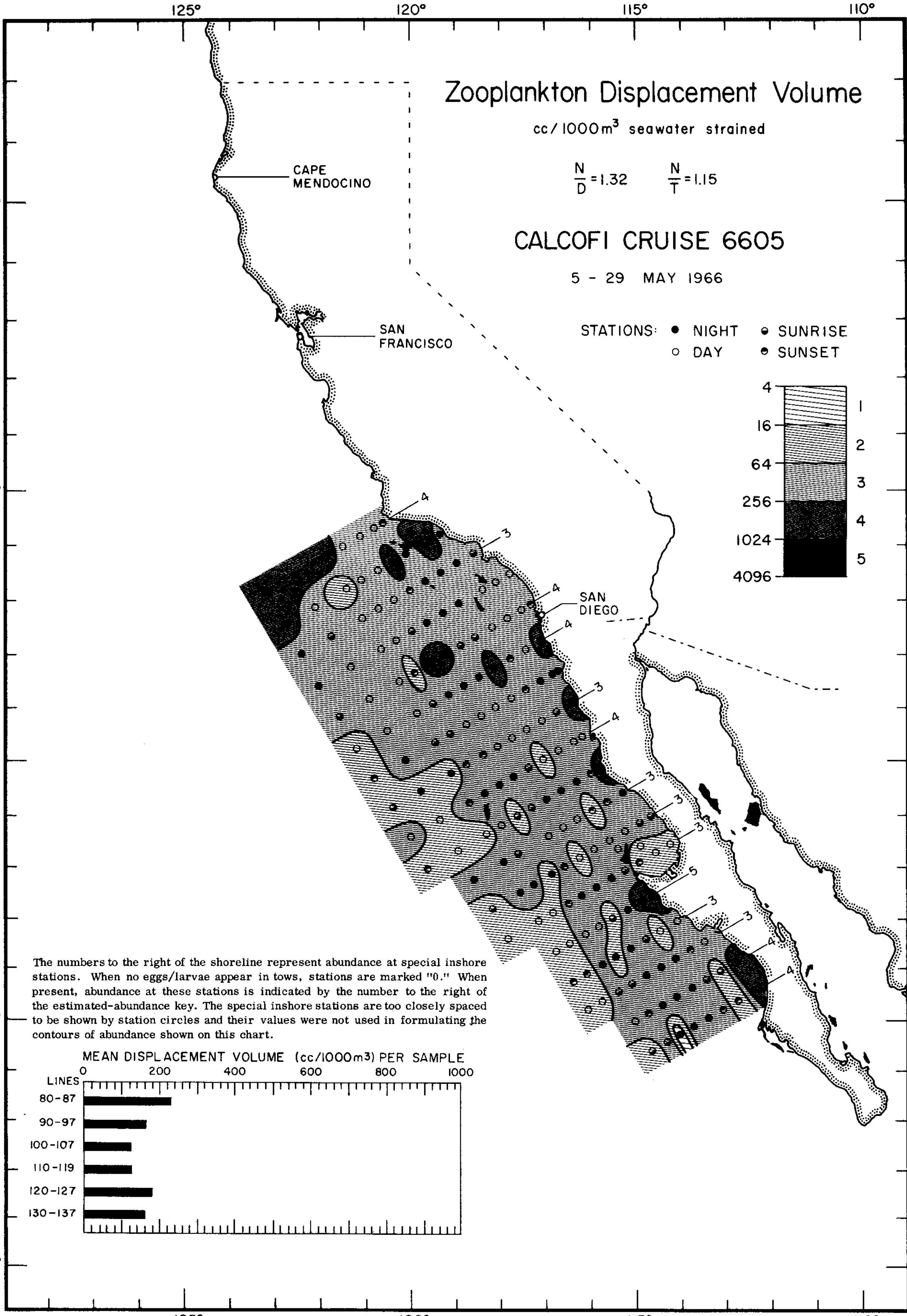

Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.94
N/T = 1.63
CALCOFI CRUISE 5805
3 - 22 MAY 1958
STATIONS: NIGHT SUNRISE
DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137


Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.94   N/T = 1.54
CALCOFI CRUISE 5905
6-27 MAY 1959
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0
200
400
600
800
1000
1200
LINES
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137

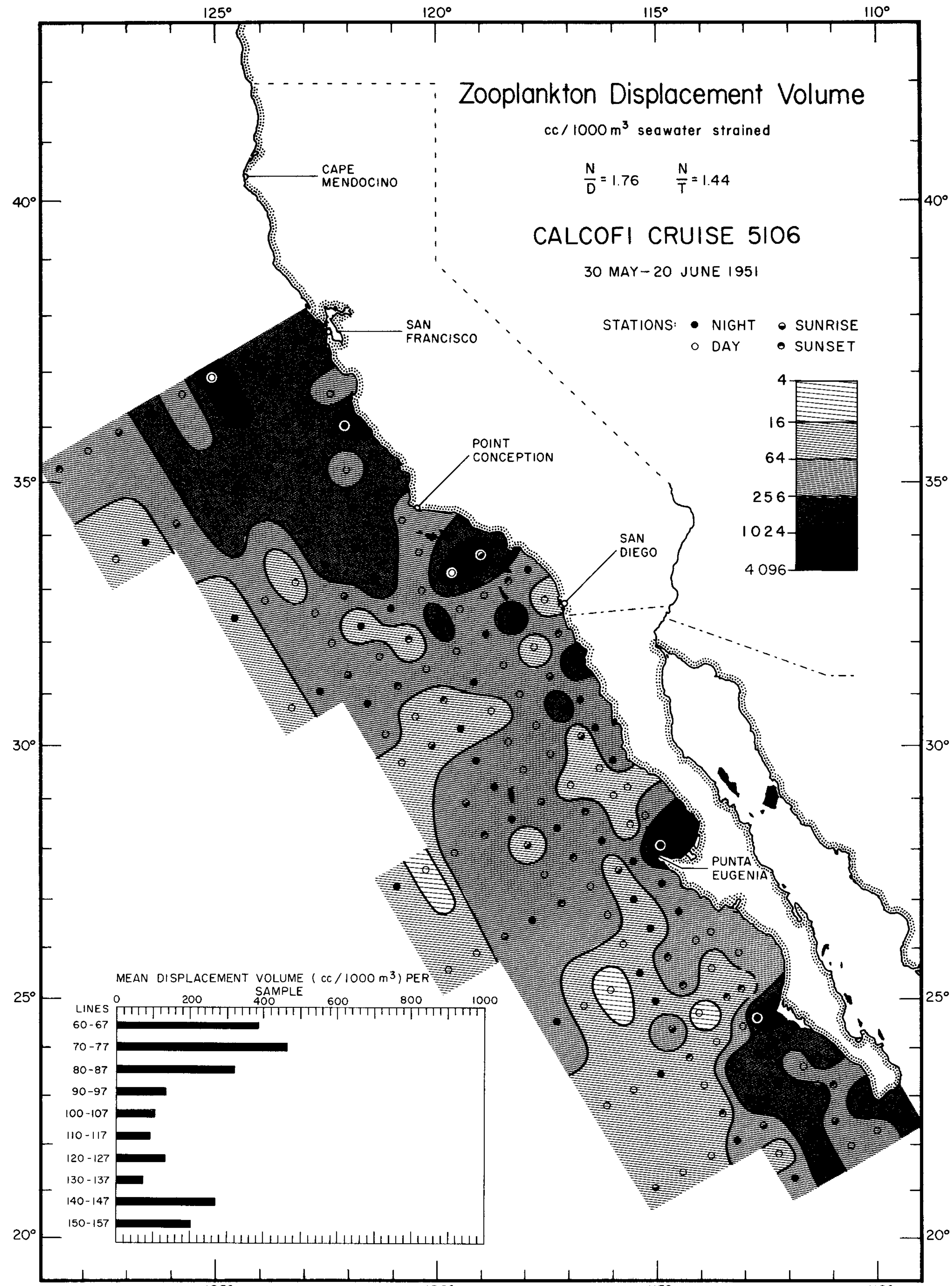


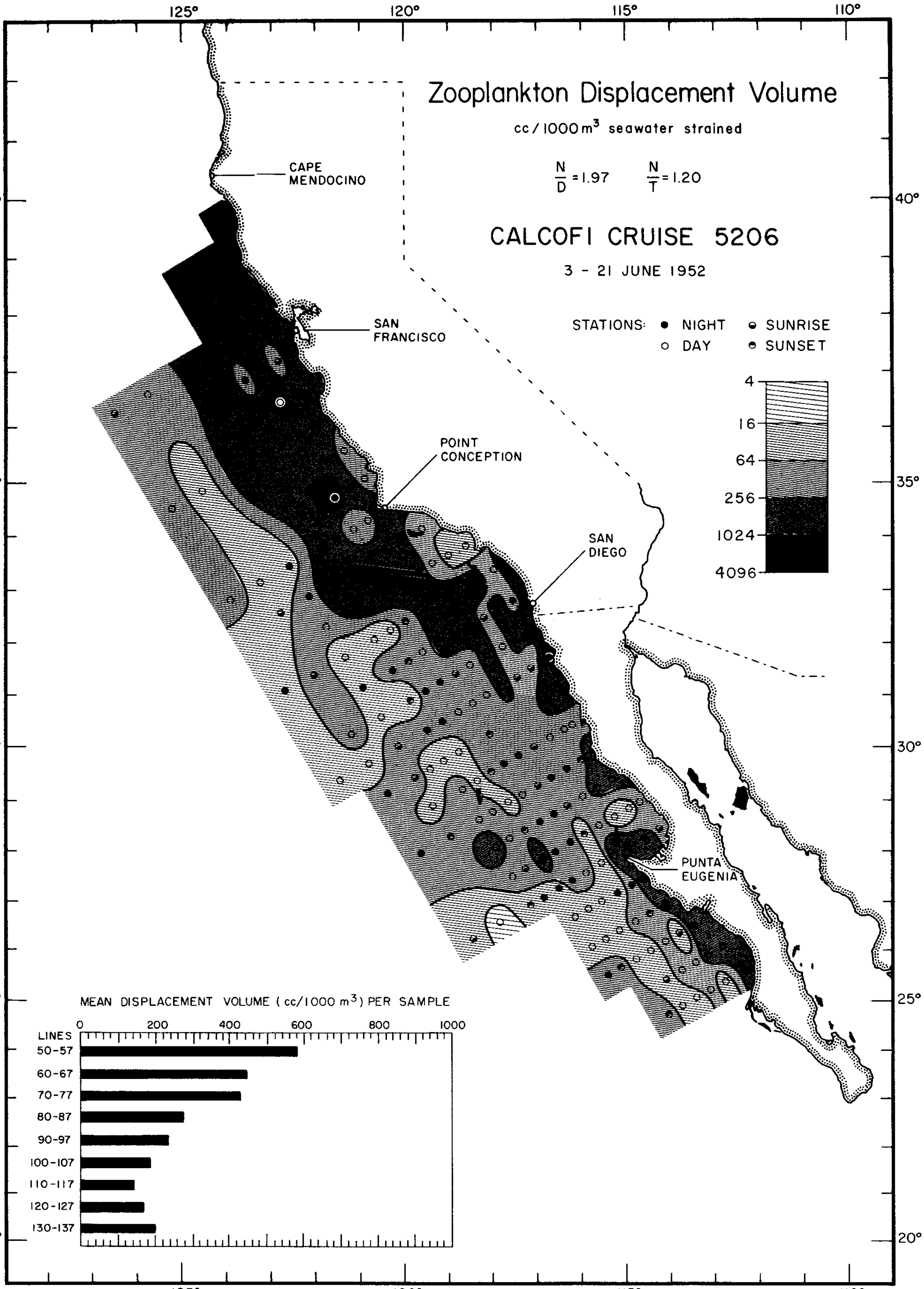
Zooplankton Displacement Volume

6005



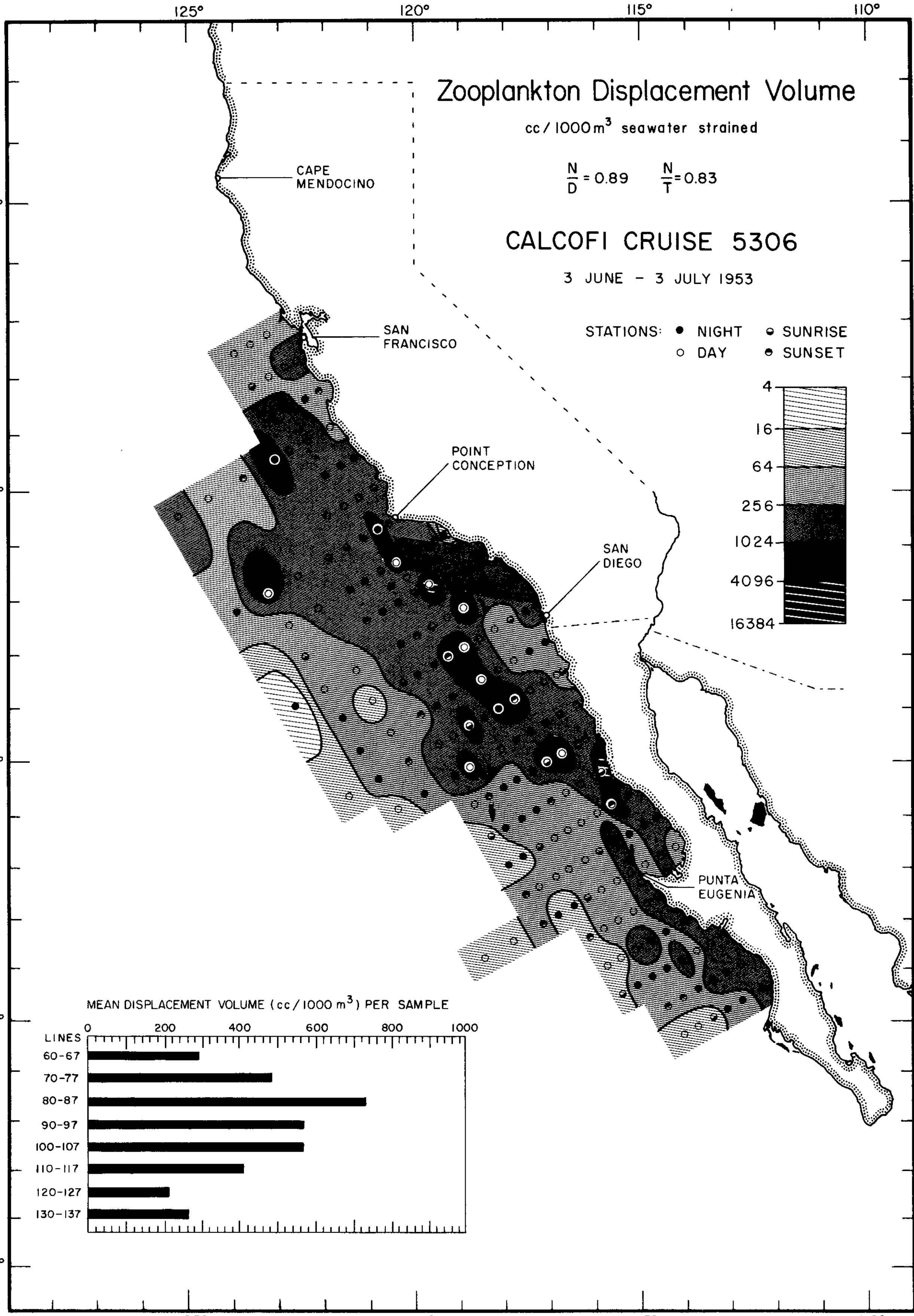
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.


Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.76 N/T = 1.44
CALCOFI CRUISE 5106
30 MAY–20 JUNE 1951
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125° 120° 115° 110°
40° 35° 30° 25° 20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000
LINES
60-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137
140-147
150-157

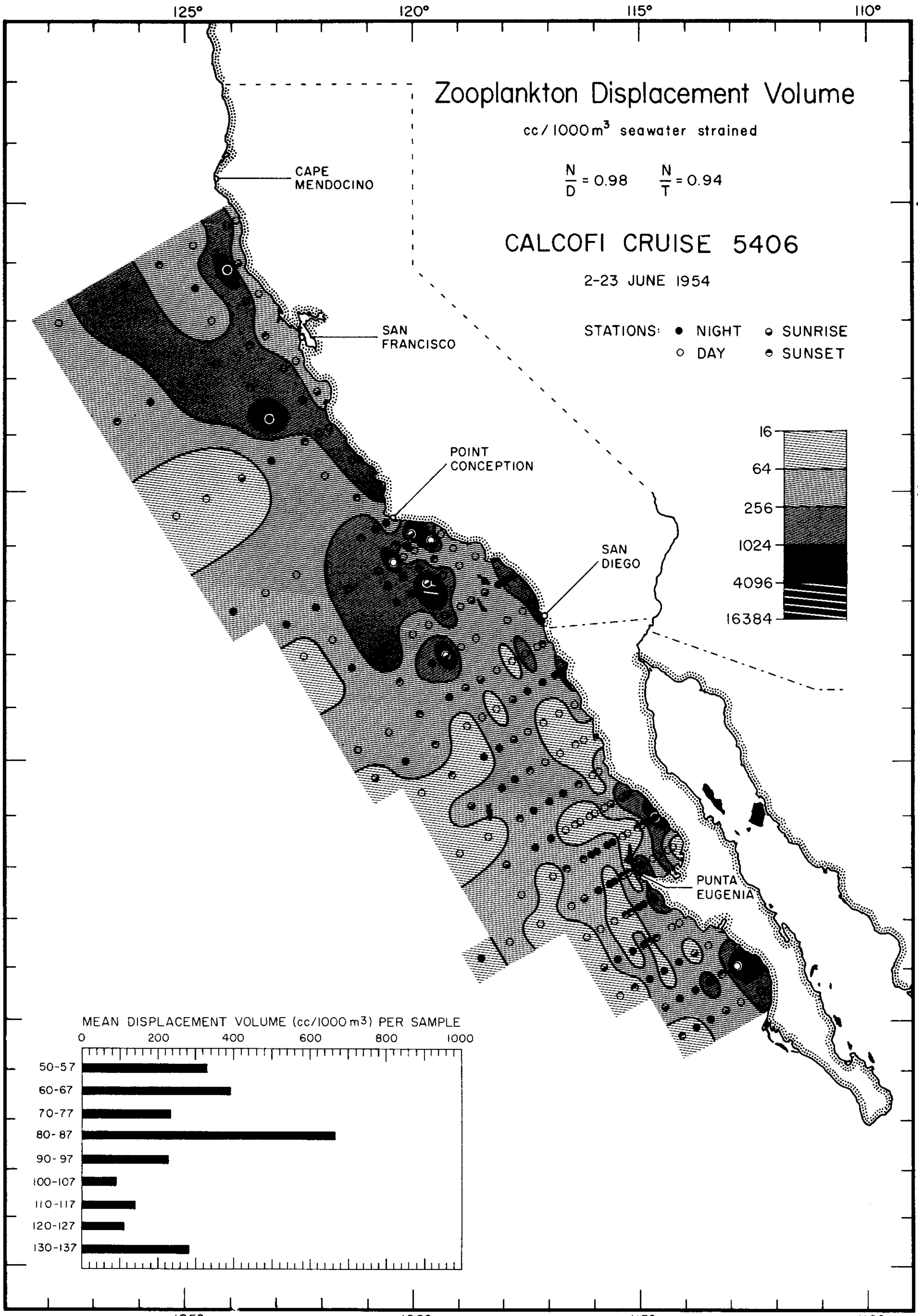


Zooplankton Displacement Volume

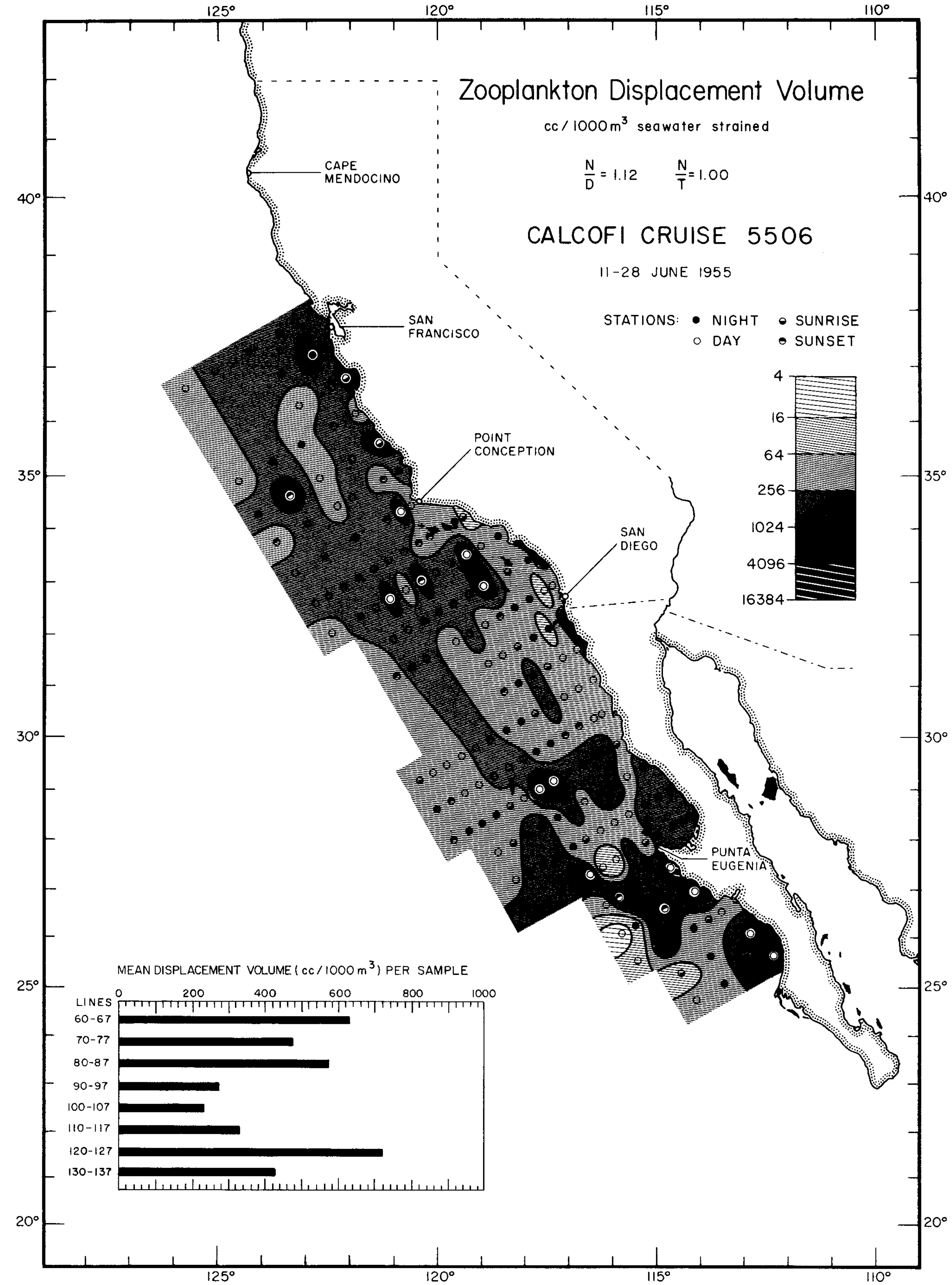
5206



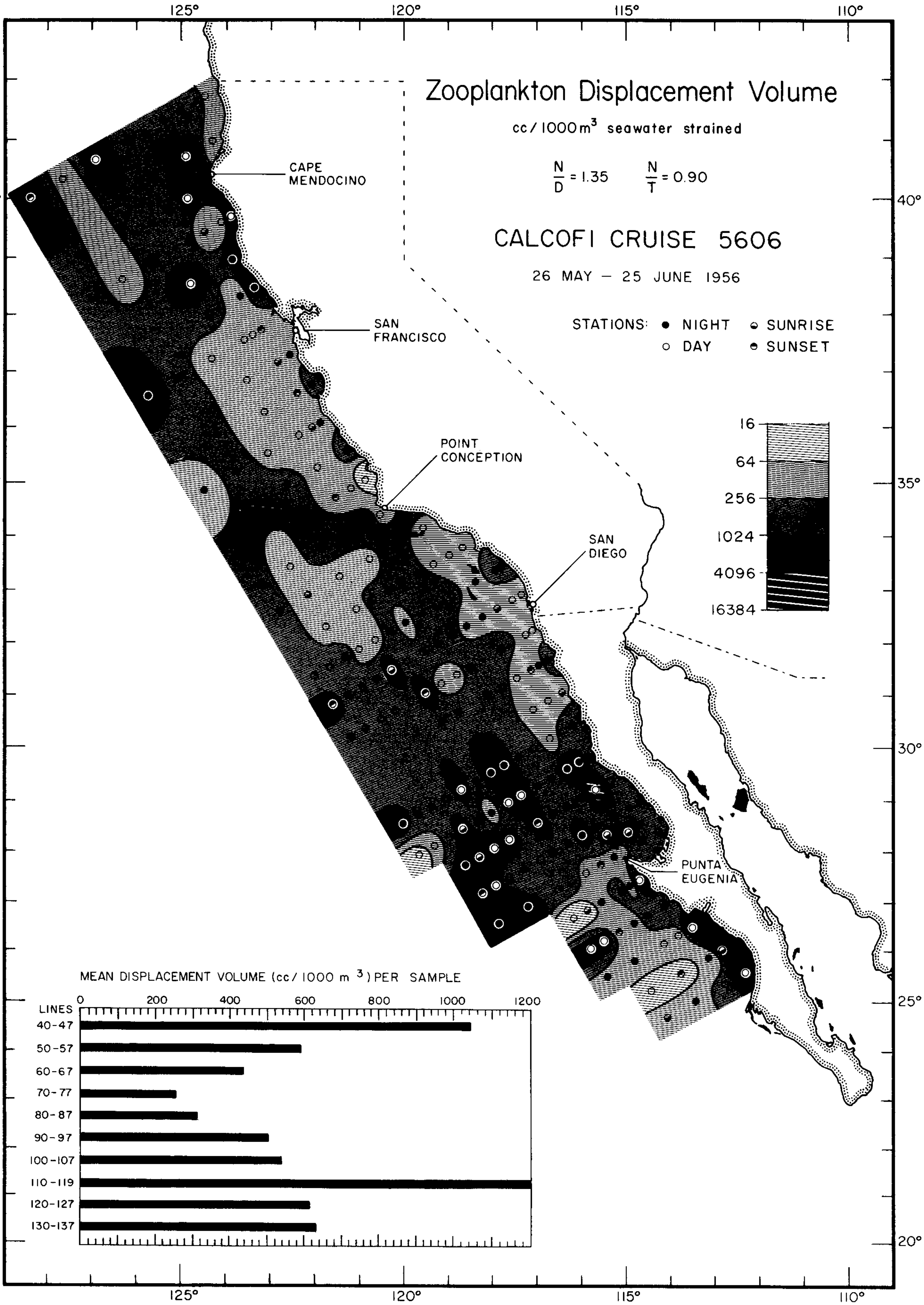
Zooplankton Displacement Volume

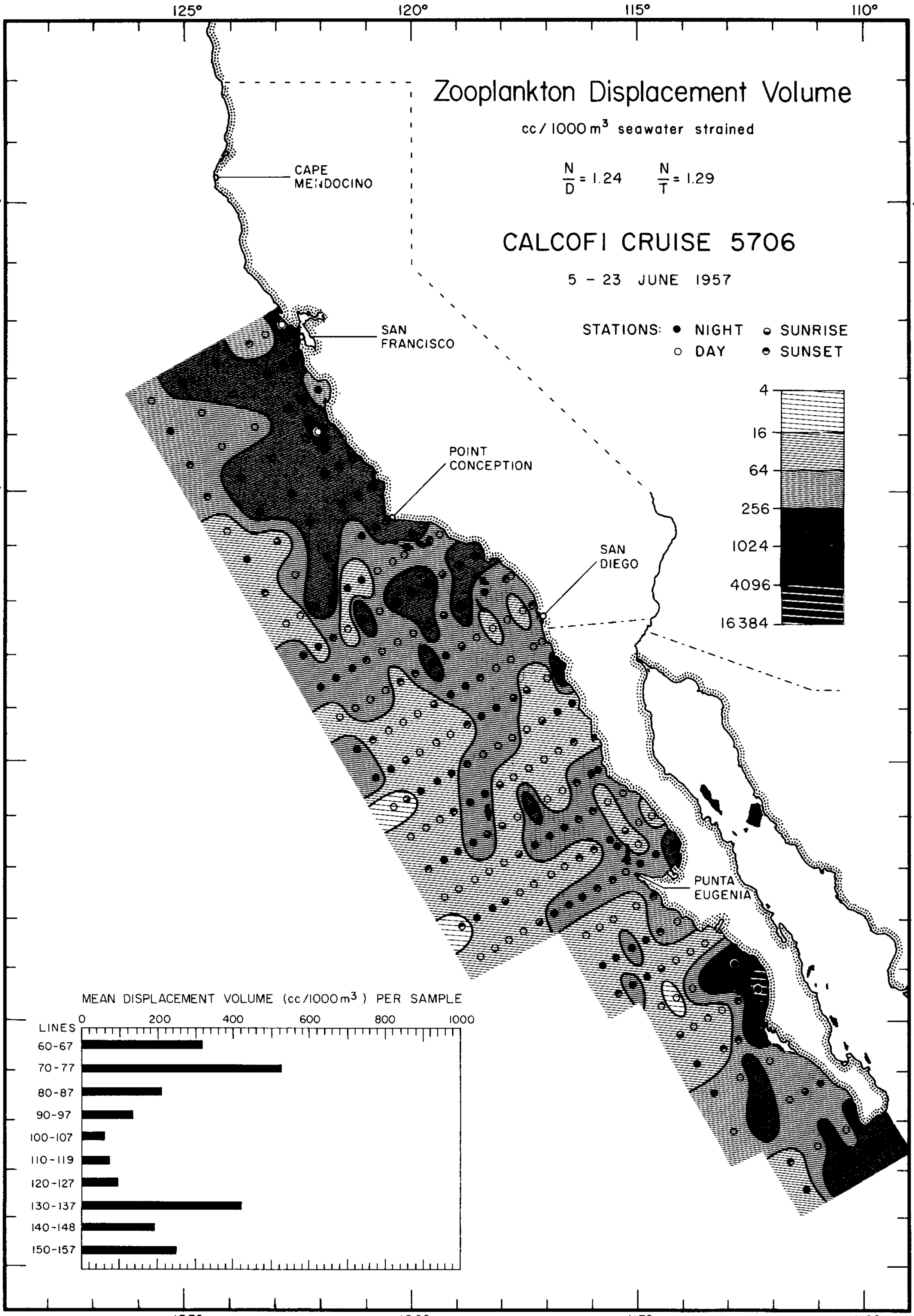


Zooplankton Displacement Volume



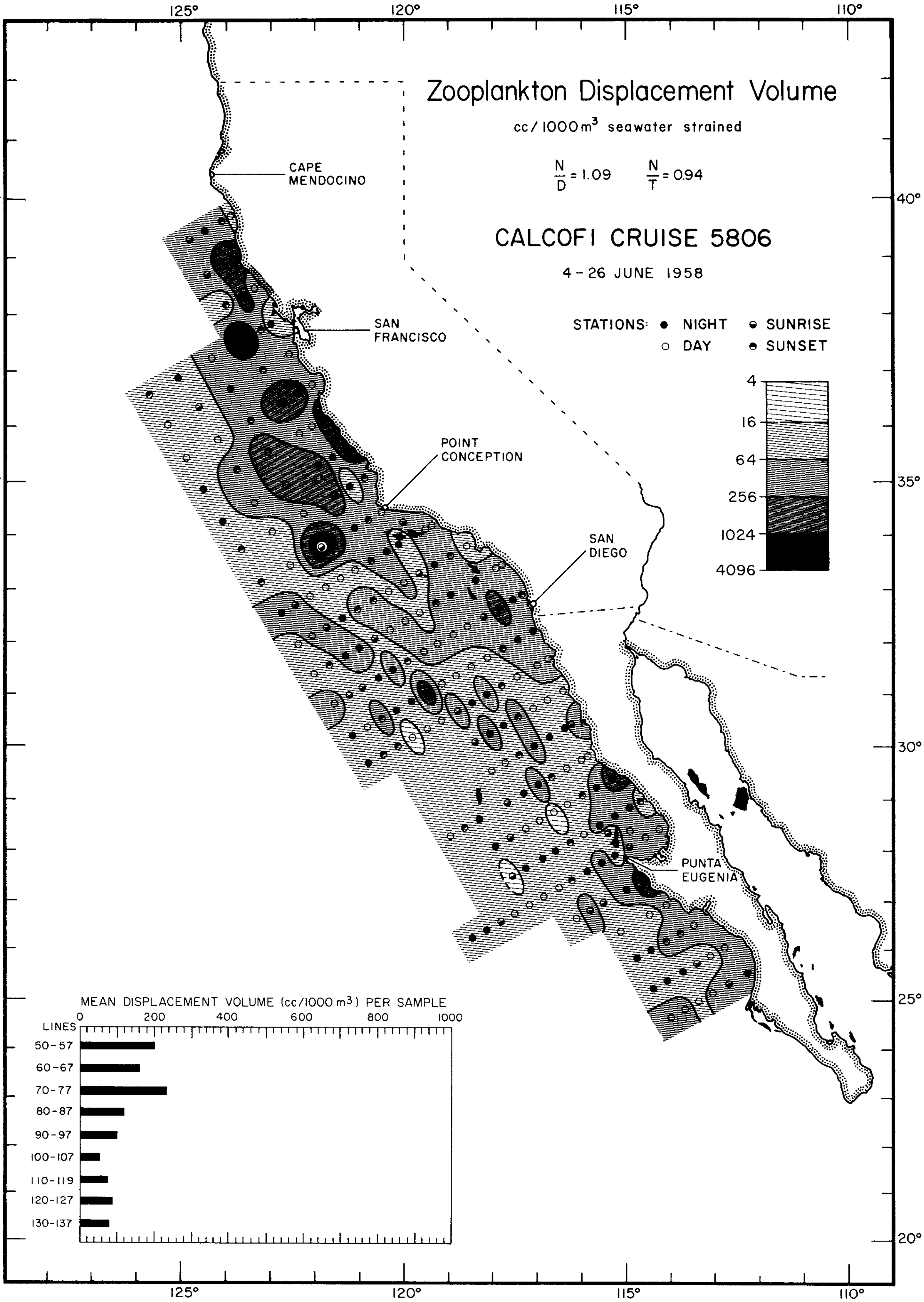
Zooplankton Displacement Volume

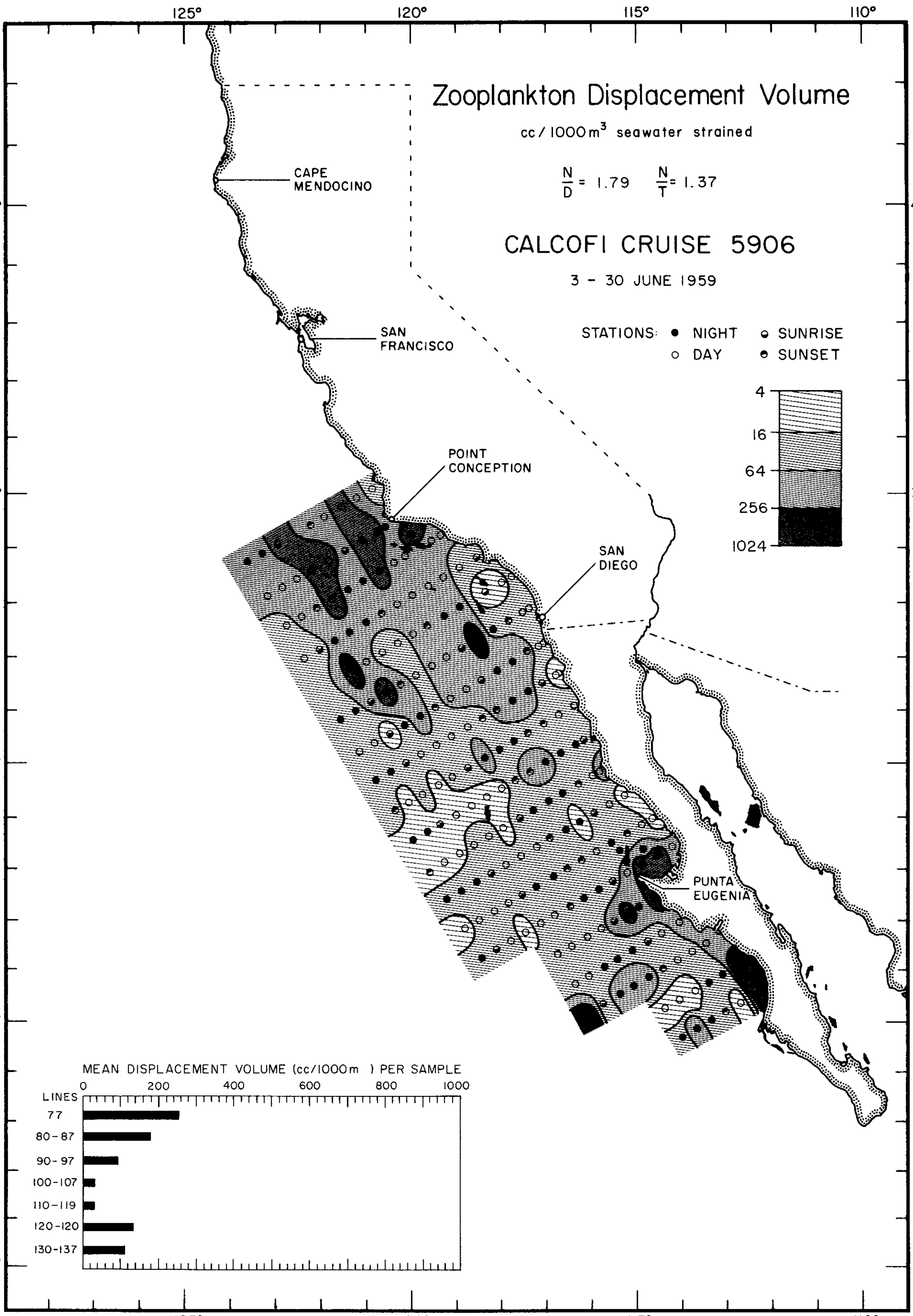

Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.35   N/T = 0.90
CALCOFI CRUISE 5606
26 MAY – 25 JUNE 1956
STATIONS: ● NIGHT ○ DAY SUNRISE SUNSET
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
16
64
256
1024
4096
16384
125° 120° 115° 110°
40° 35° 30° 25° 20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000 1200
LINES
40-47
50-57
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137



Zooplankton Displacement Volume

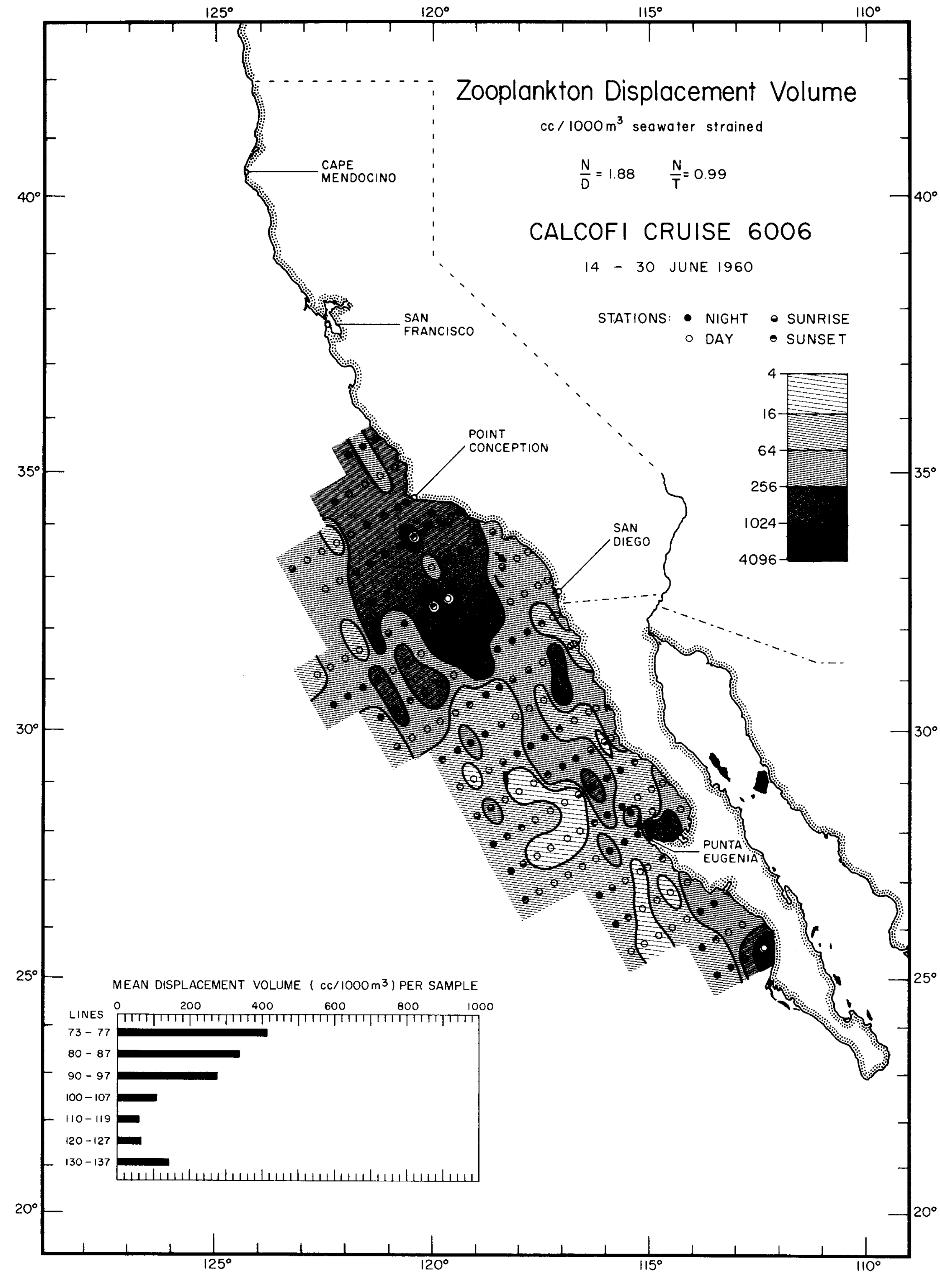
5706


Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.09 N/T = 0.94
CALCOFI CRUISE 5806
4-26 JUNE 1958
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
50-57
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137



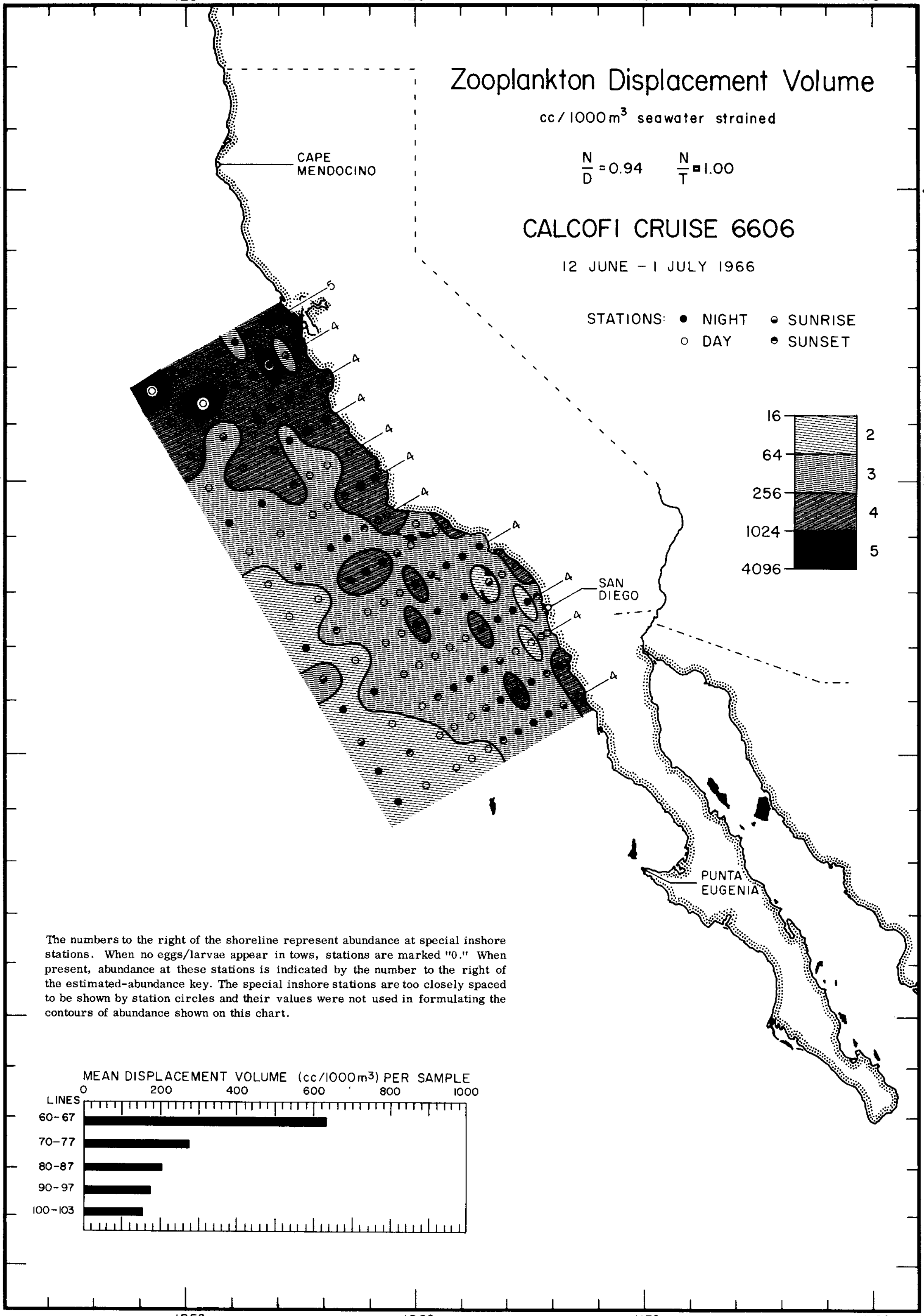
Zooplankton Displacement Volume

5906

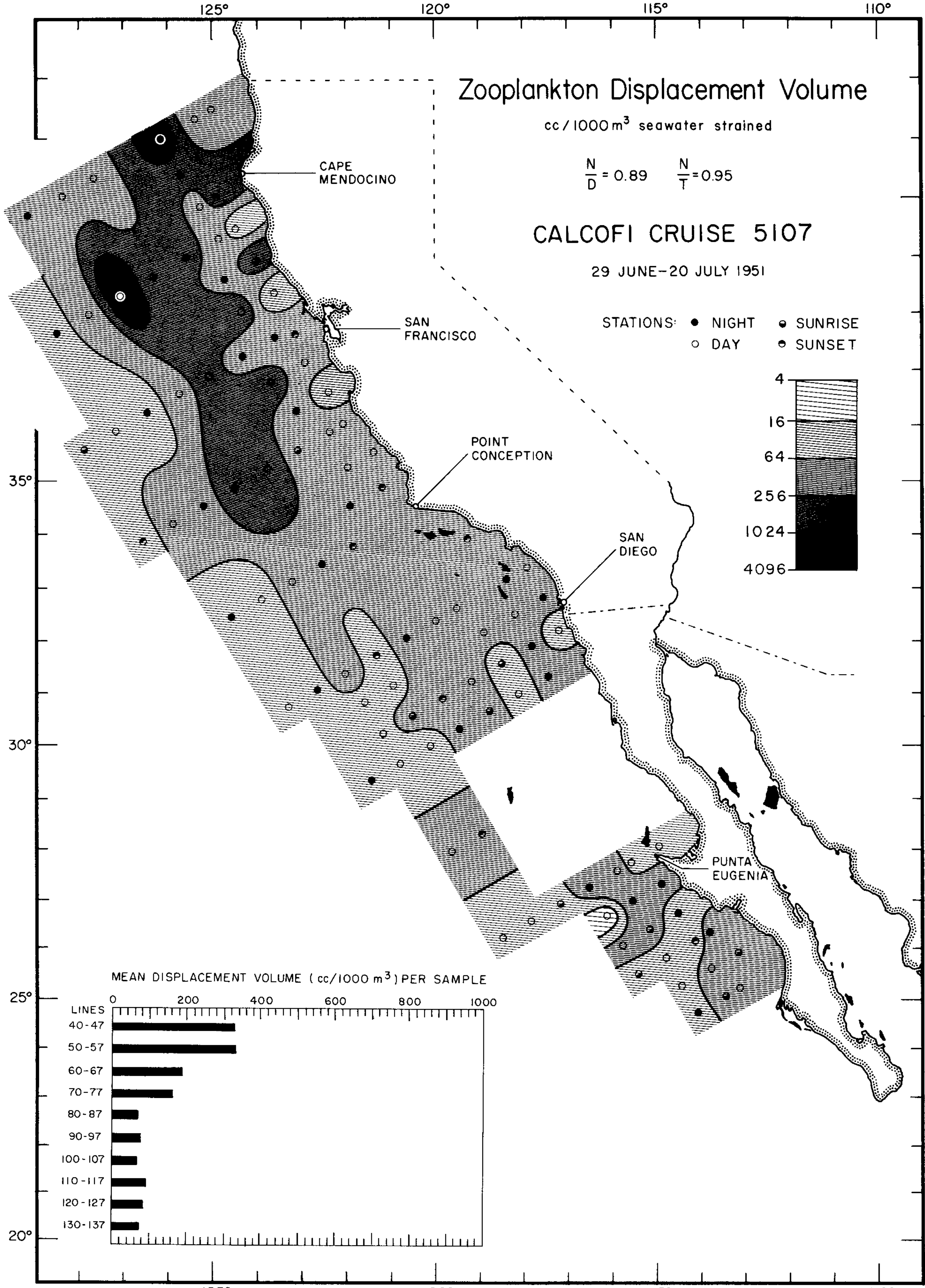


Zooplankton Displacement Volume

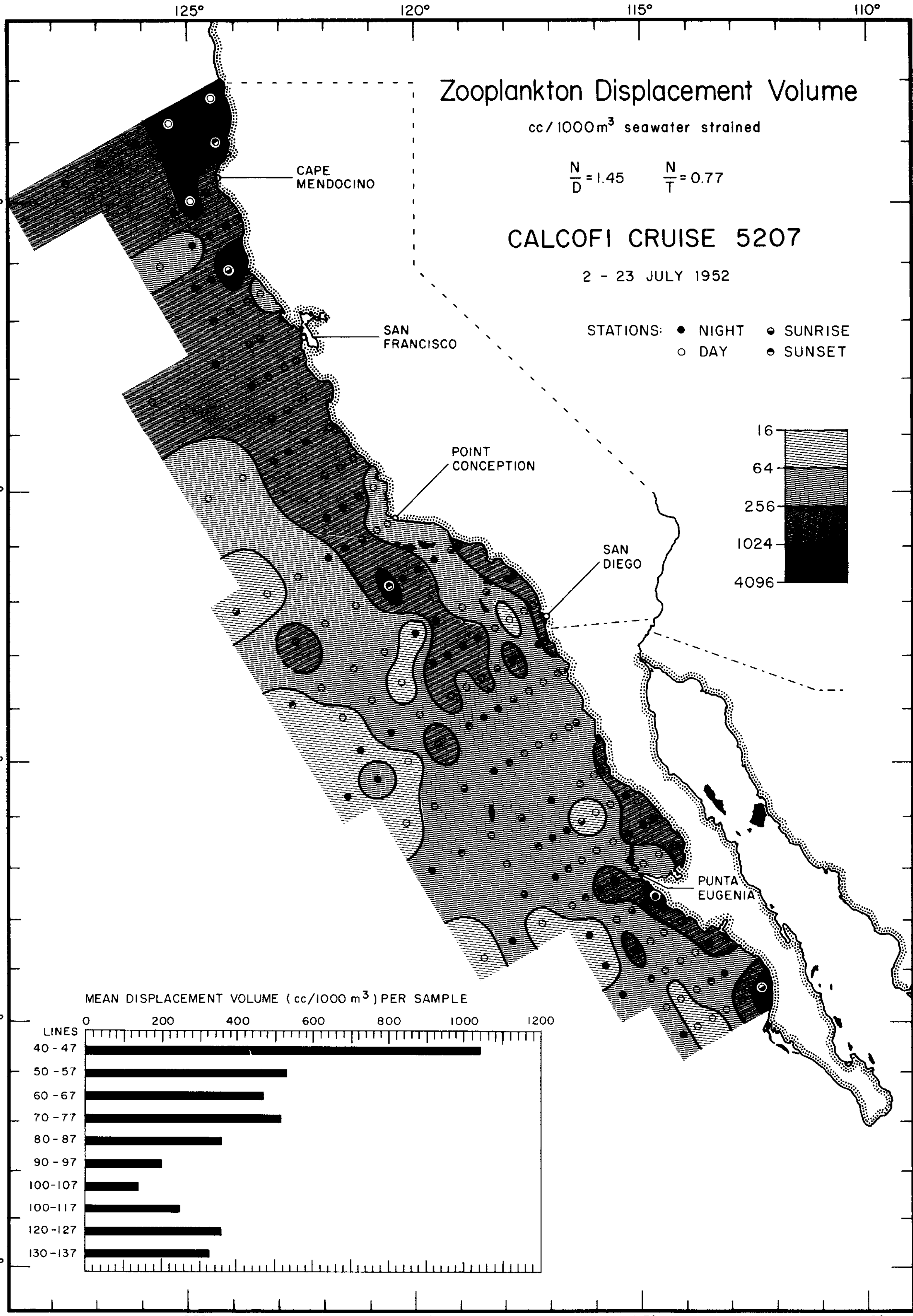
6006



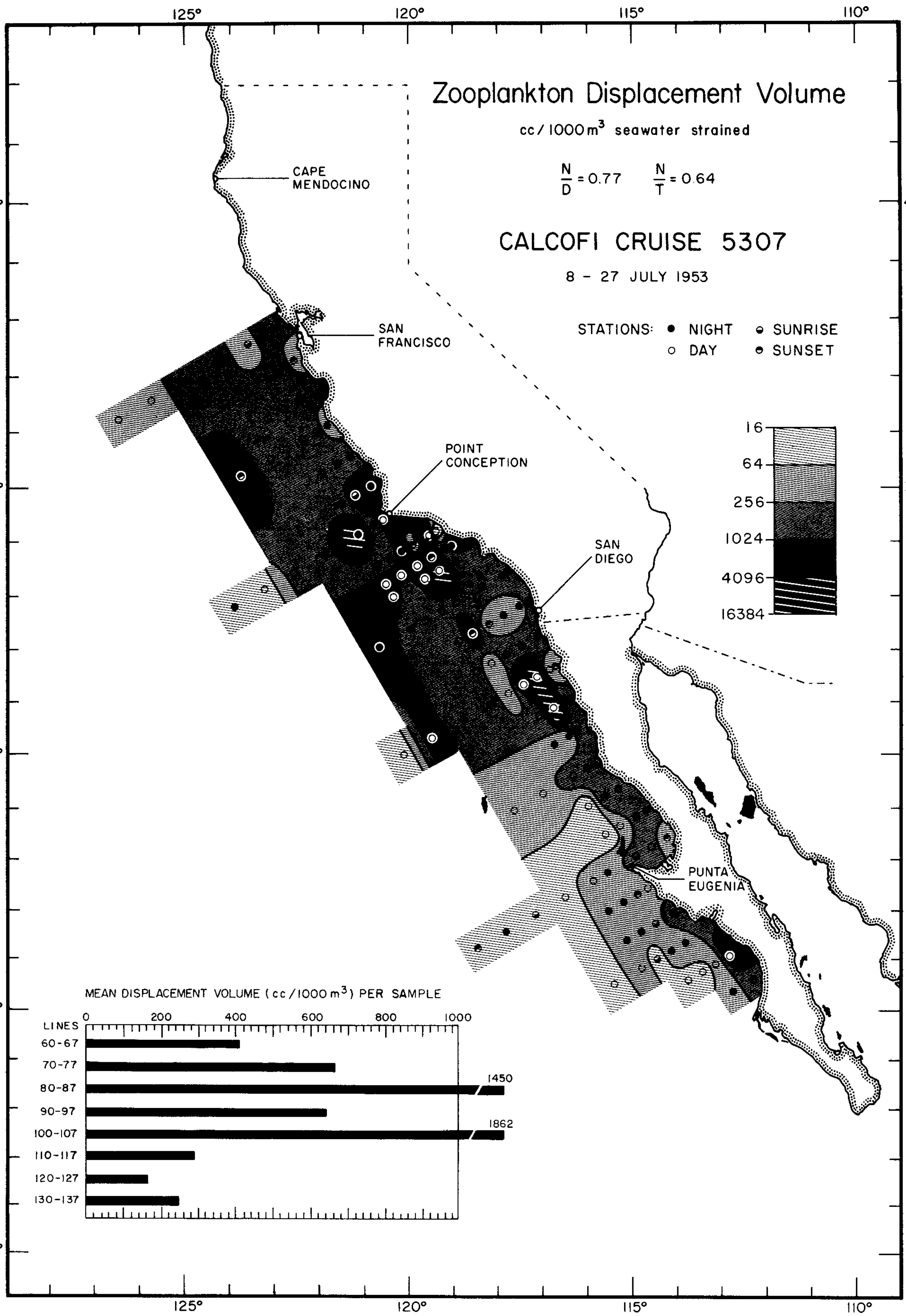
Zooplankton Displacement Volume



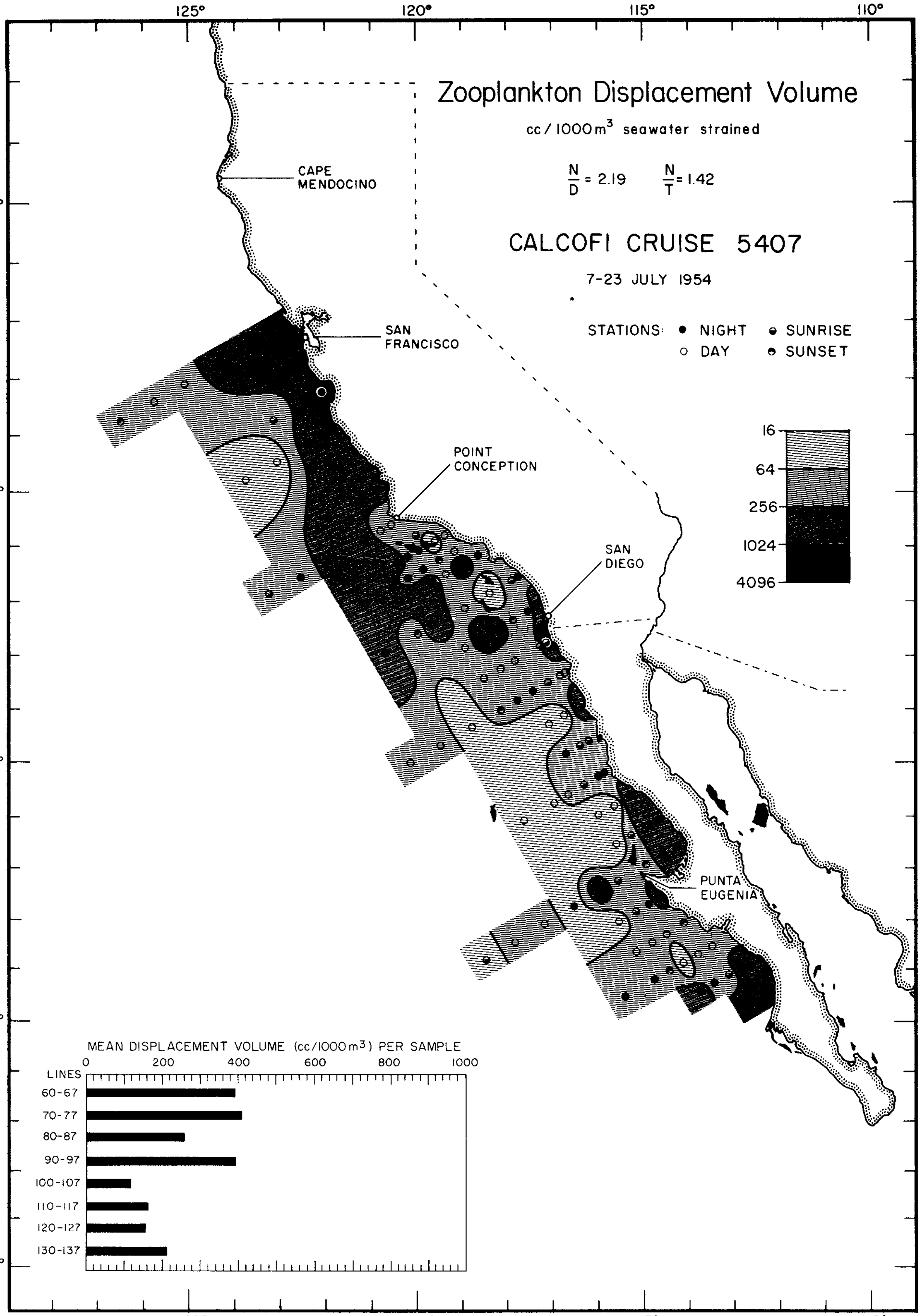
Zooplankton Displacement Volume
cc / 1000 m³ seawater strained
N/D = 0.89 N/T = 0.95
CALCOFI CRUISE 5107
29 JUNE–20 JULY 1951
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000
LINES
40-47
50-57
60-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137



Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.45   N/T = 0.77
CALCOFI CRUISE 5207
2 - 23 JULY 1952
STATIONS: NIGHT SUNRISE DAY SUNSET
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
16
64
256
1024
4096
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
1200
LINES
40 - 47
50 - 57
60 - 67
70 - 77
80 - 87
90 - 97
100-107
100-117
120-127
130-137

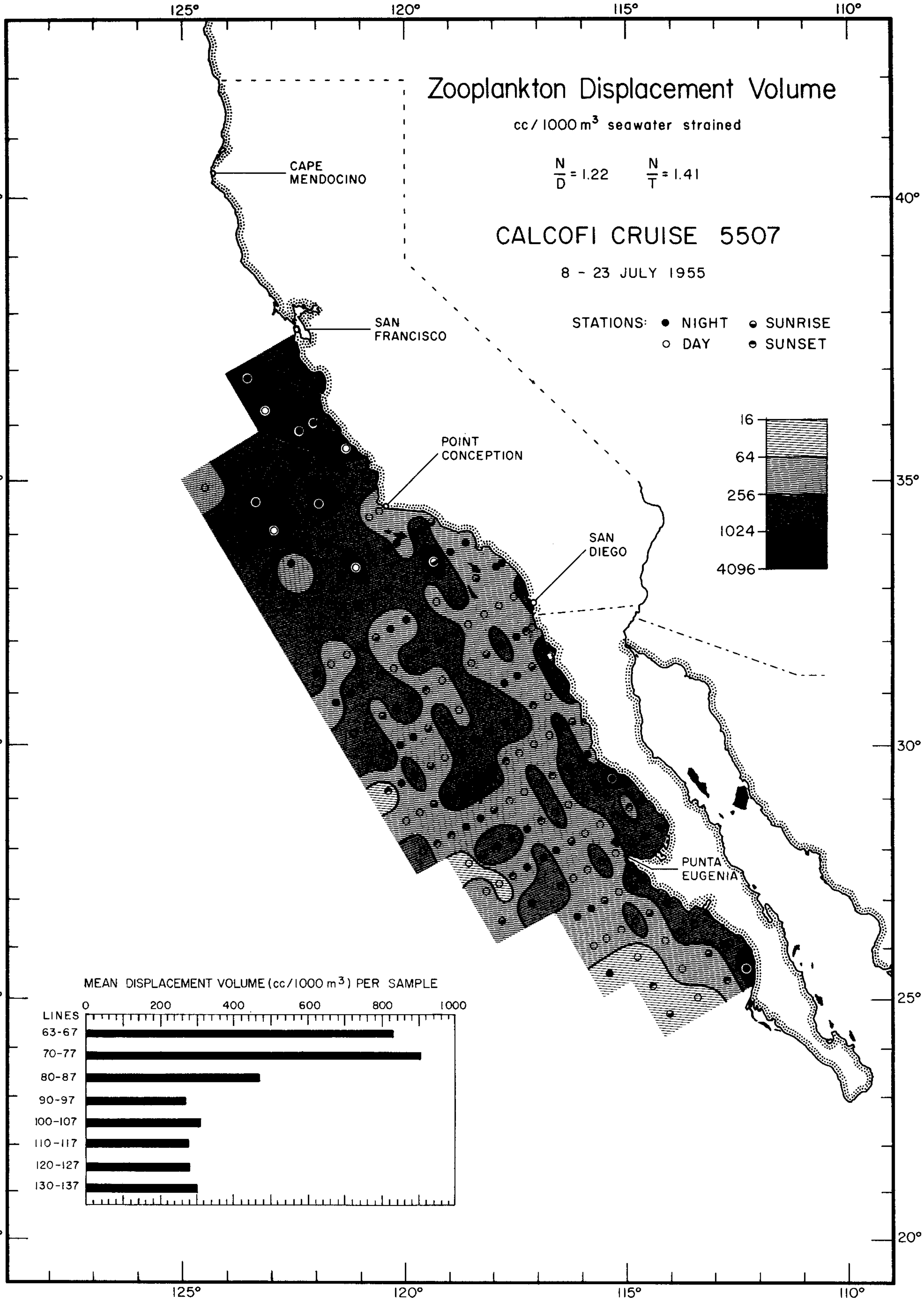


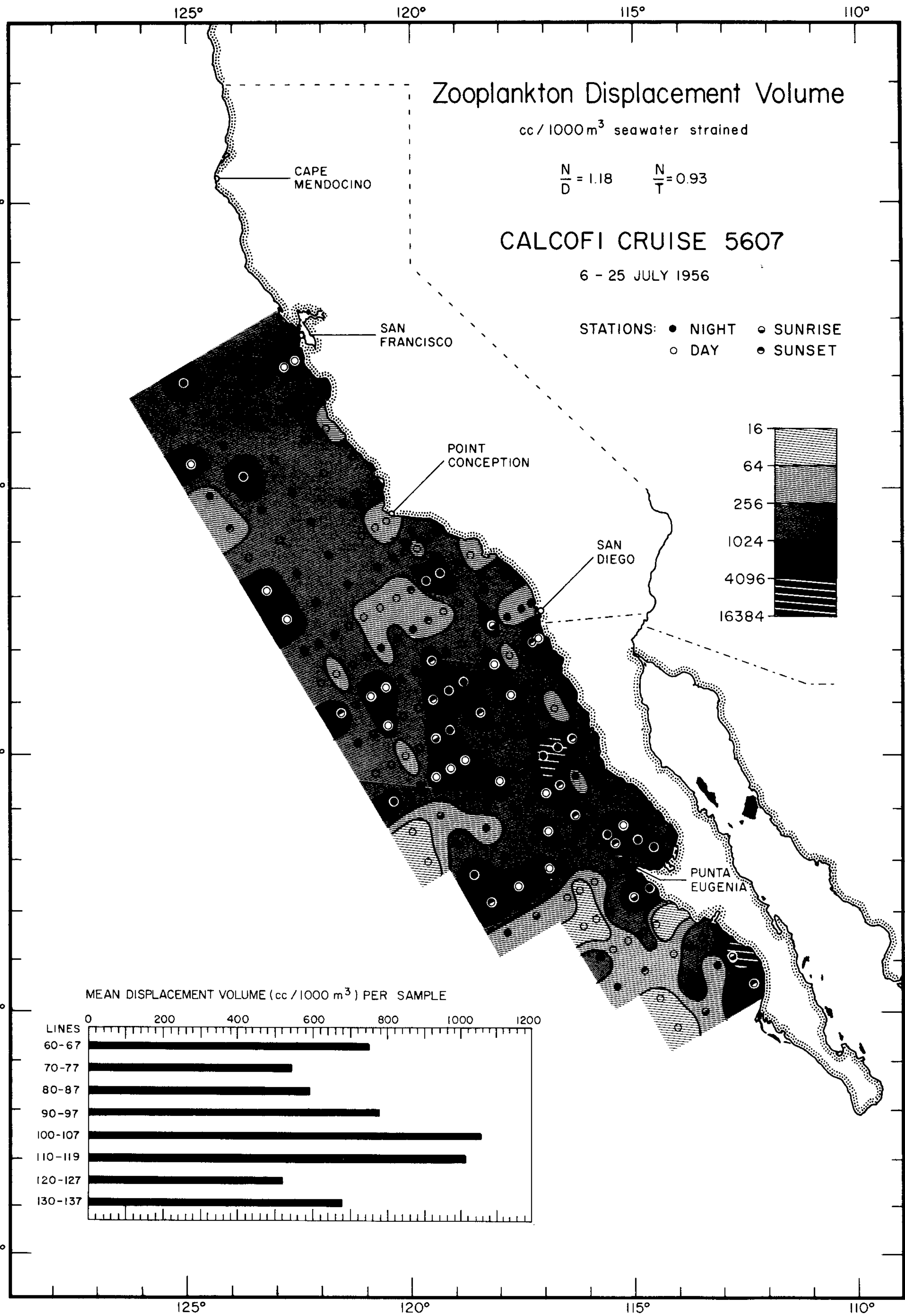
Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 0.77
N/T = 0.64
CALCOFI CRUISE 5307
8 - 27 JULY 1953
STATIONS: NIGHT SUNRISE DAY SUNSET
16
64
256
1024
4096
16384
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
60-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137
1450
1862



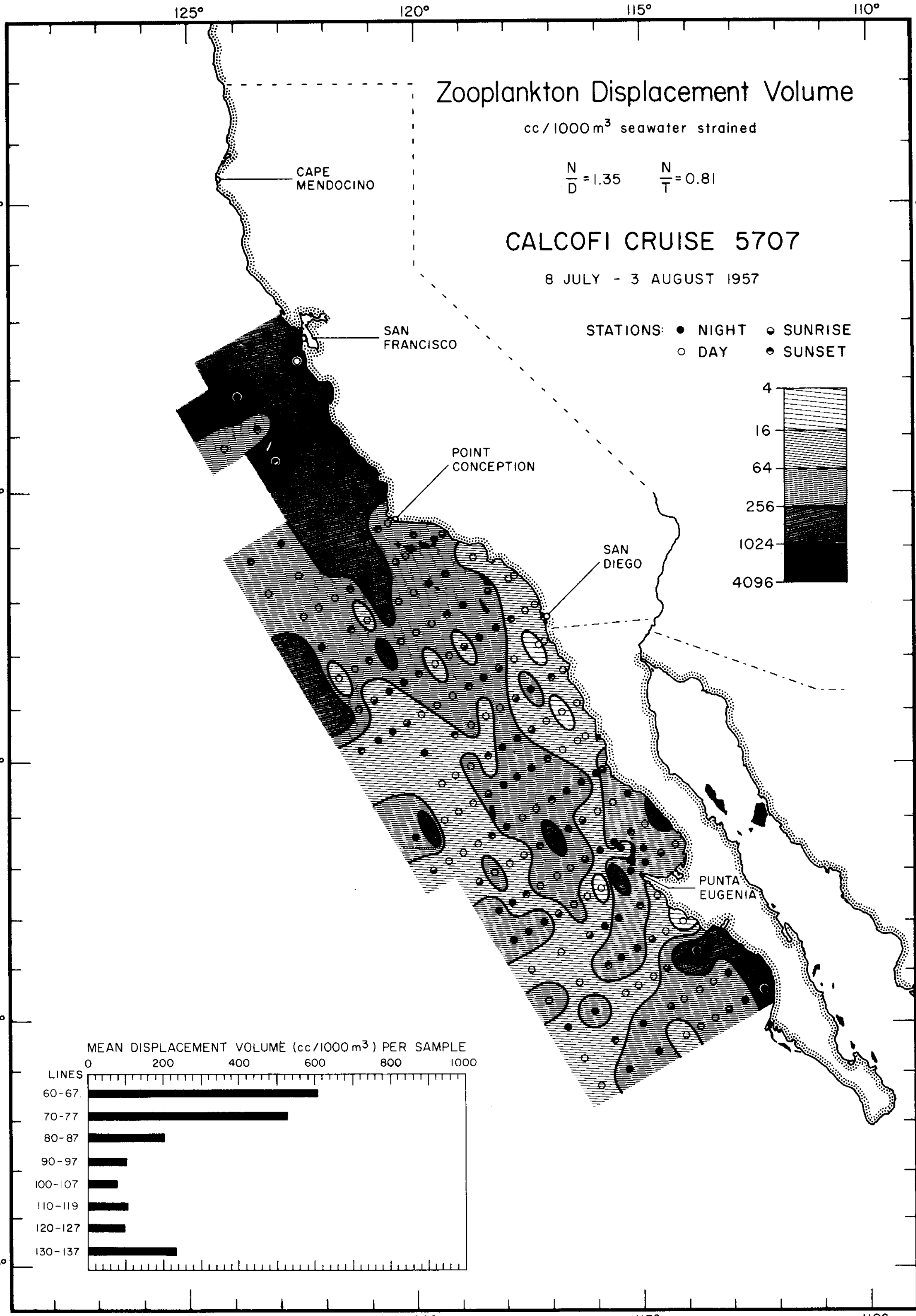
Zooplankton Displacement Volume

5407

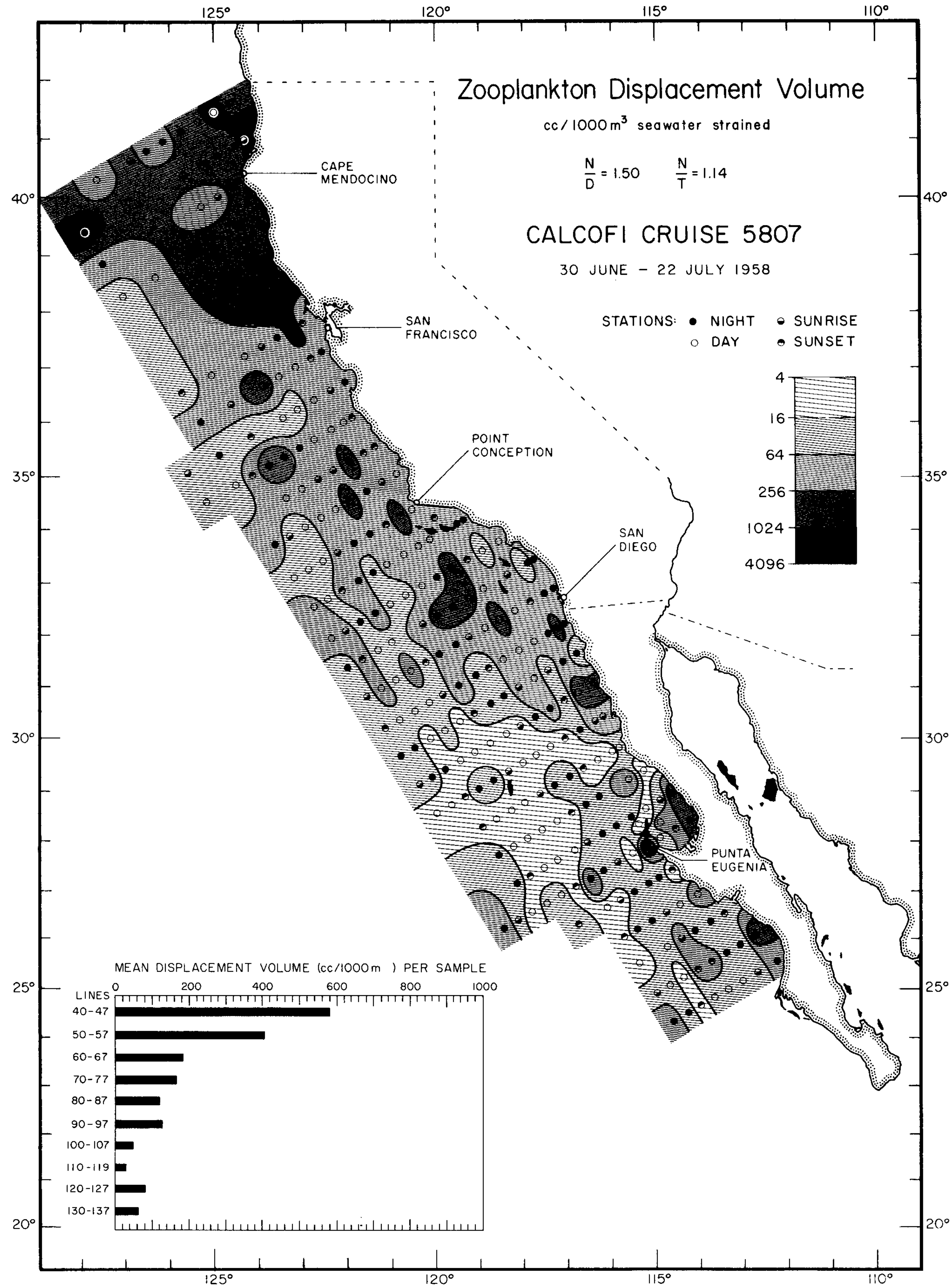

Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.22 N/T = 1.41
CALCOFI CRUISE 5507
8 - 23 JULY 1955
STATIONS: ● NIGHT ○ DAY SUNRISE SUNSET
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125° 120° 115° 110°
40° 35° 30° 25° 20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000
LINES
63-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137



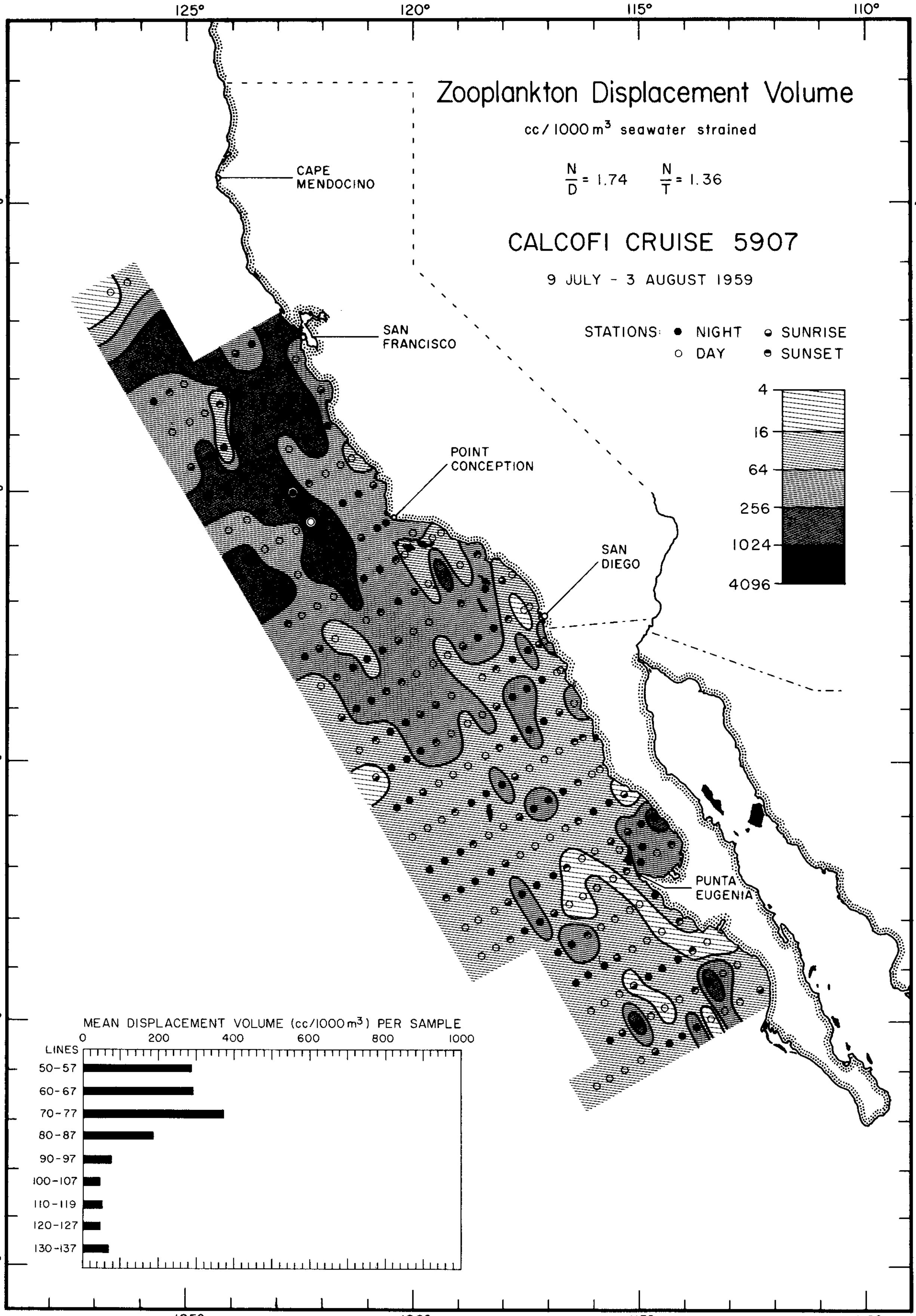
Zooplankton Displacement Volume
cc / 1000 m3 seawater strained
N/D = 1.18 N/T = 0.93
CALCOFI CRUISE 5607
6 - 25 JULY 1956
STATIONS: ● NIGHT ○ DAY SUNRISE SUNSET
16
64
256
1024
4096
16384
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc / 1000 m3) PER SAMPLE
0
200
400
600
800
1000
1200
LINES
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137

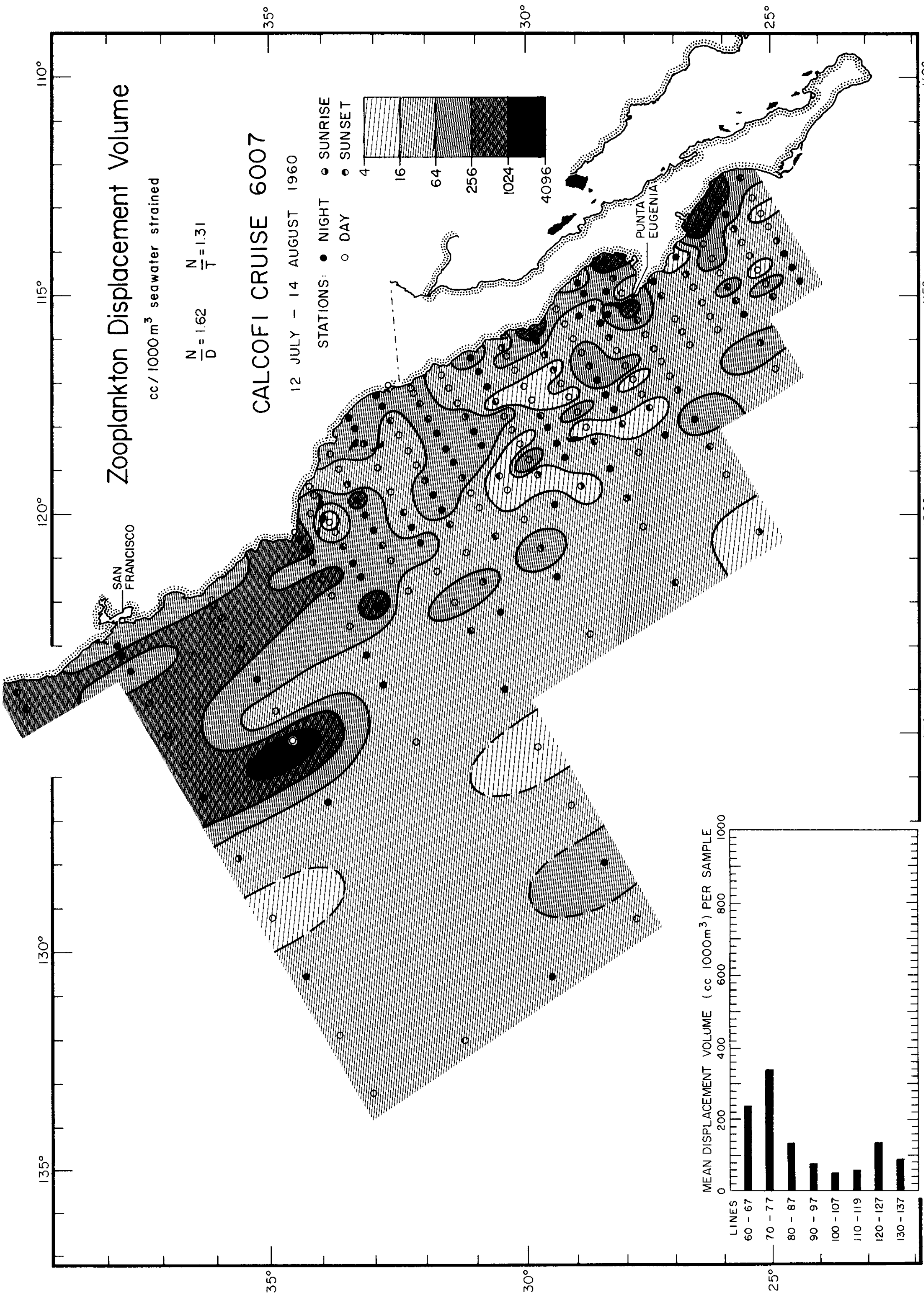


Zooplankton Displacement Volume
cc/1000 m3 seawater strained
N/D = 1.35 N/T = 0.81
CALCOFI CRUISE 5707
8 JULY - 3 AUGUST 1957
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m3) PER SAMPLE
0
200
400
600
800
1000
LINES
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137



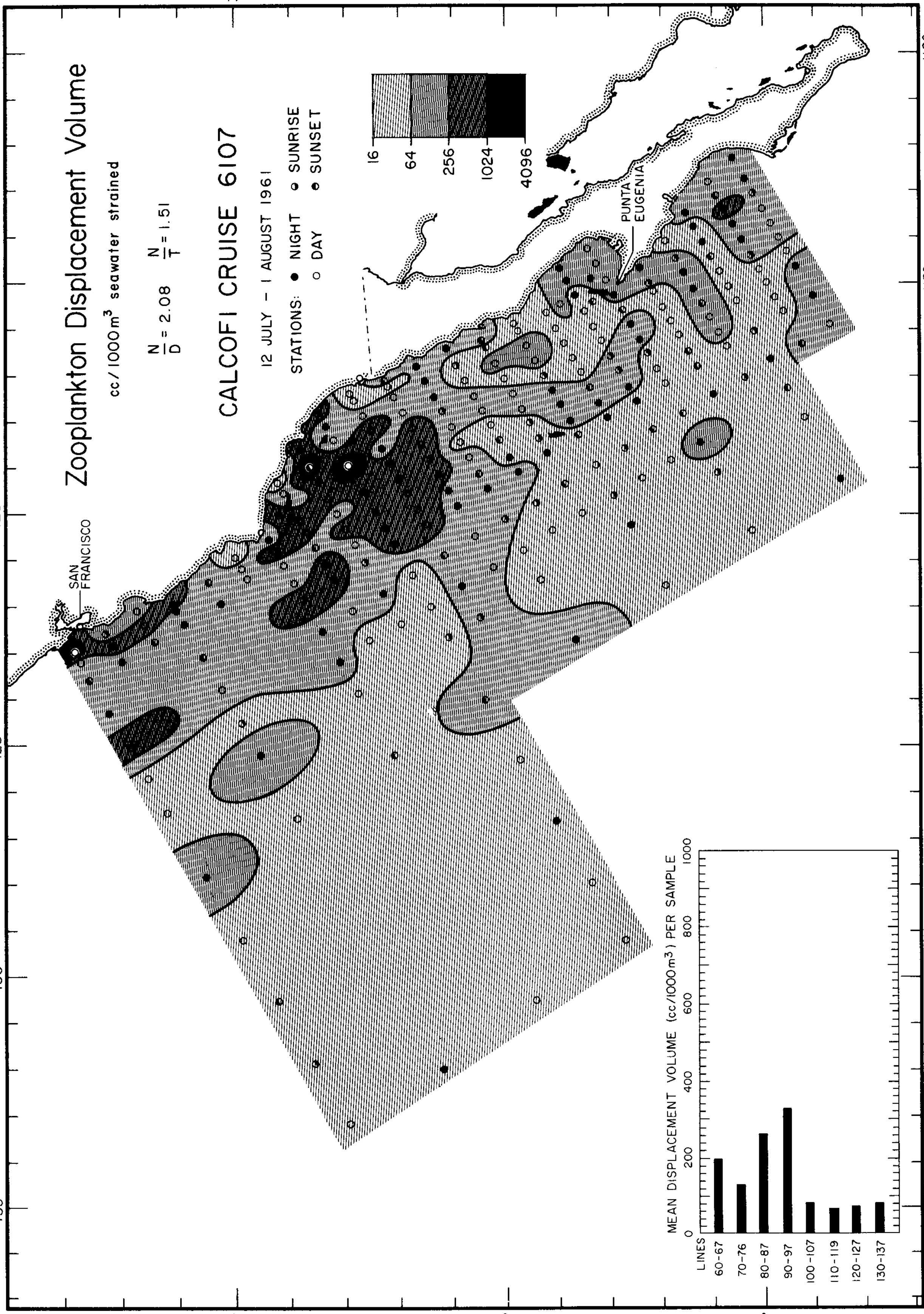
Zooplankton Displacement Volume


Zooplankton Displacement Volume
cc/1000 m3 seawater strained
N/D = 1.74 N/T = 1.36
CALCOFI CRUISE 5907
9 JULY - 3 AUGUST 1959
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m3) PER SAMPLE
0
200
400
600
800
1000
LINES
50-57
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137



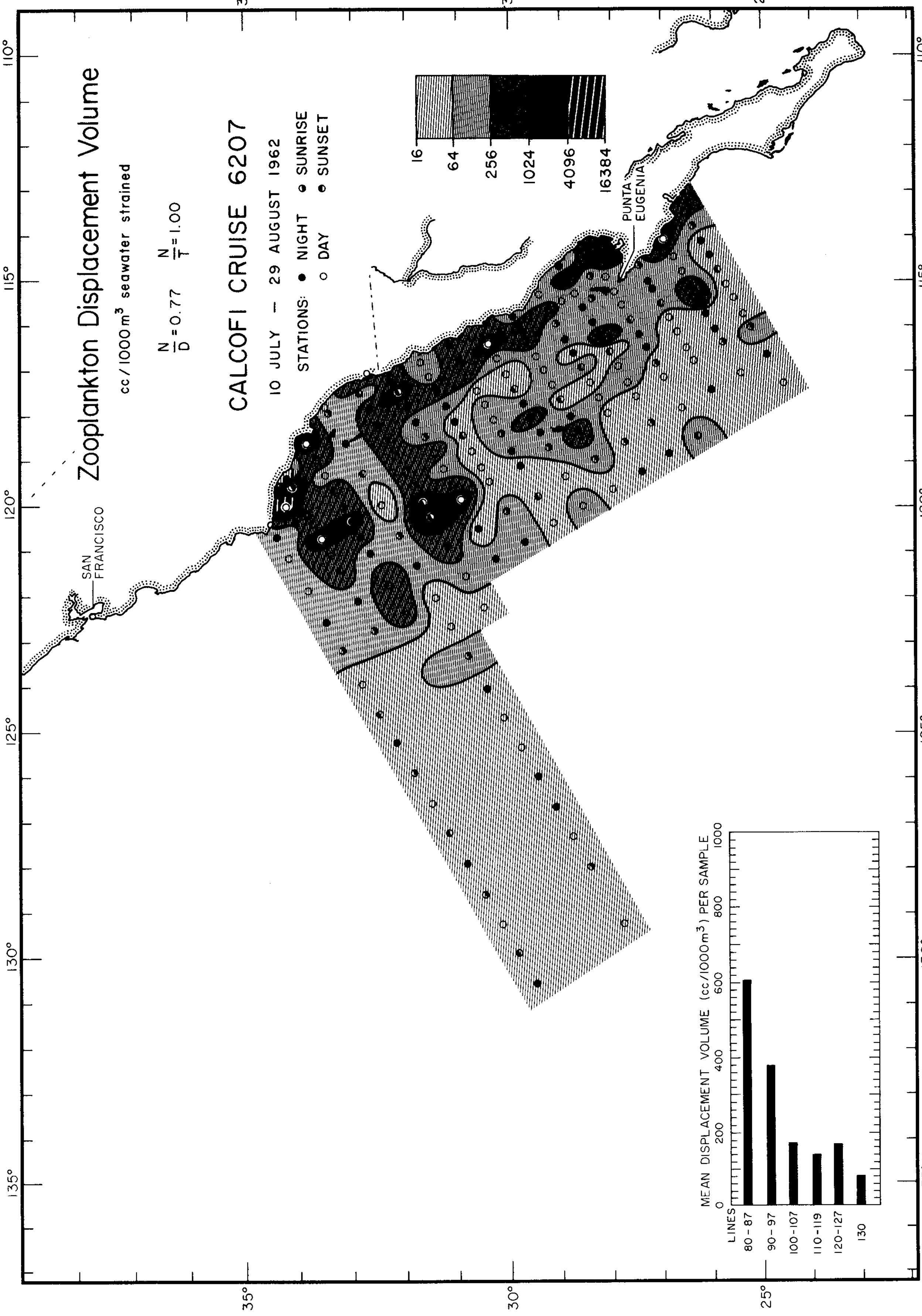
Zooplankton Displacement Volume

6007

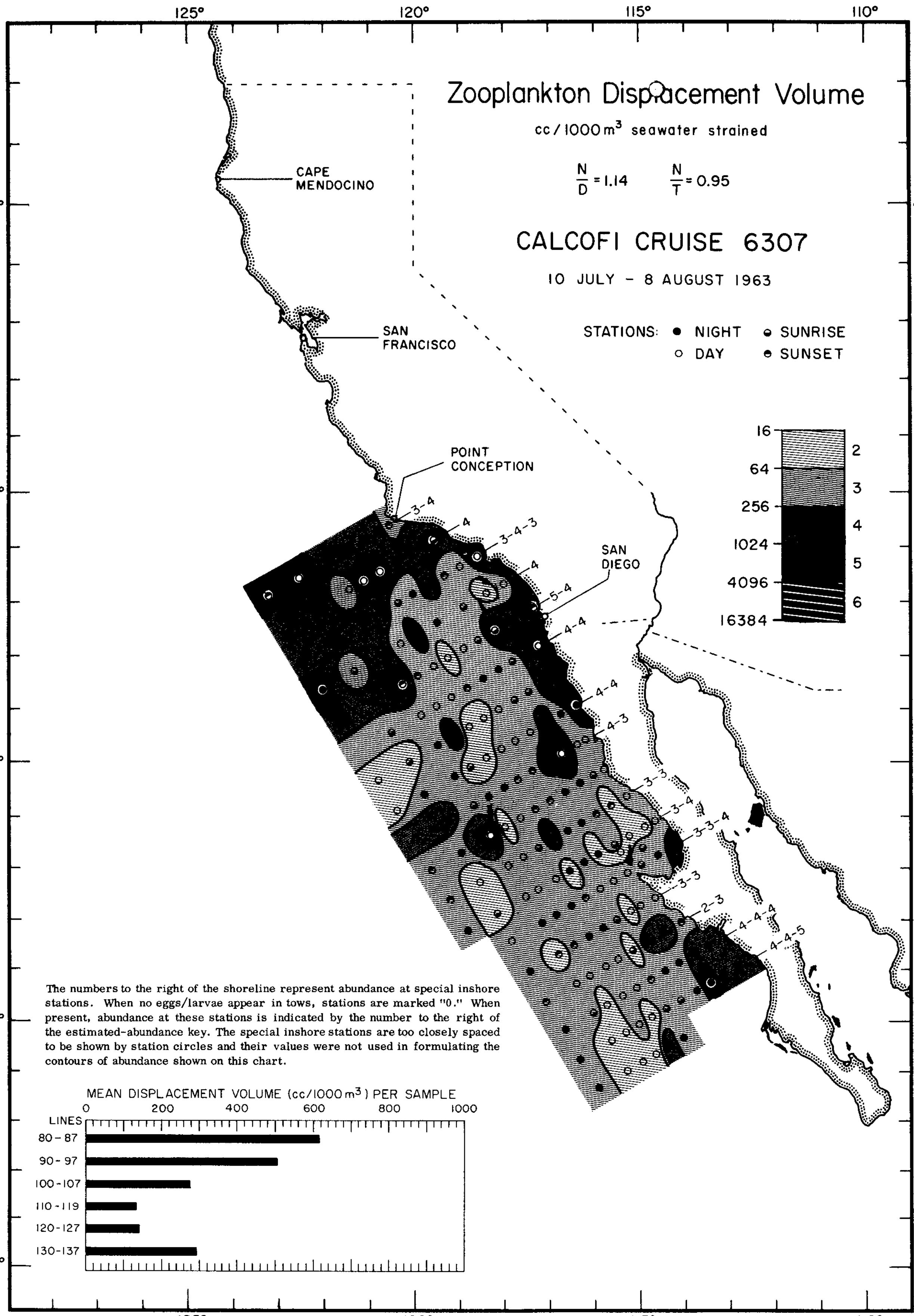


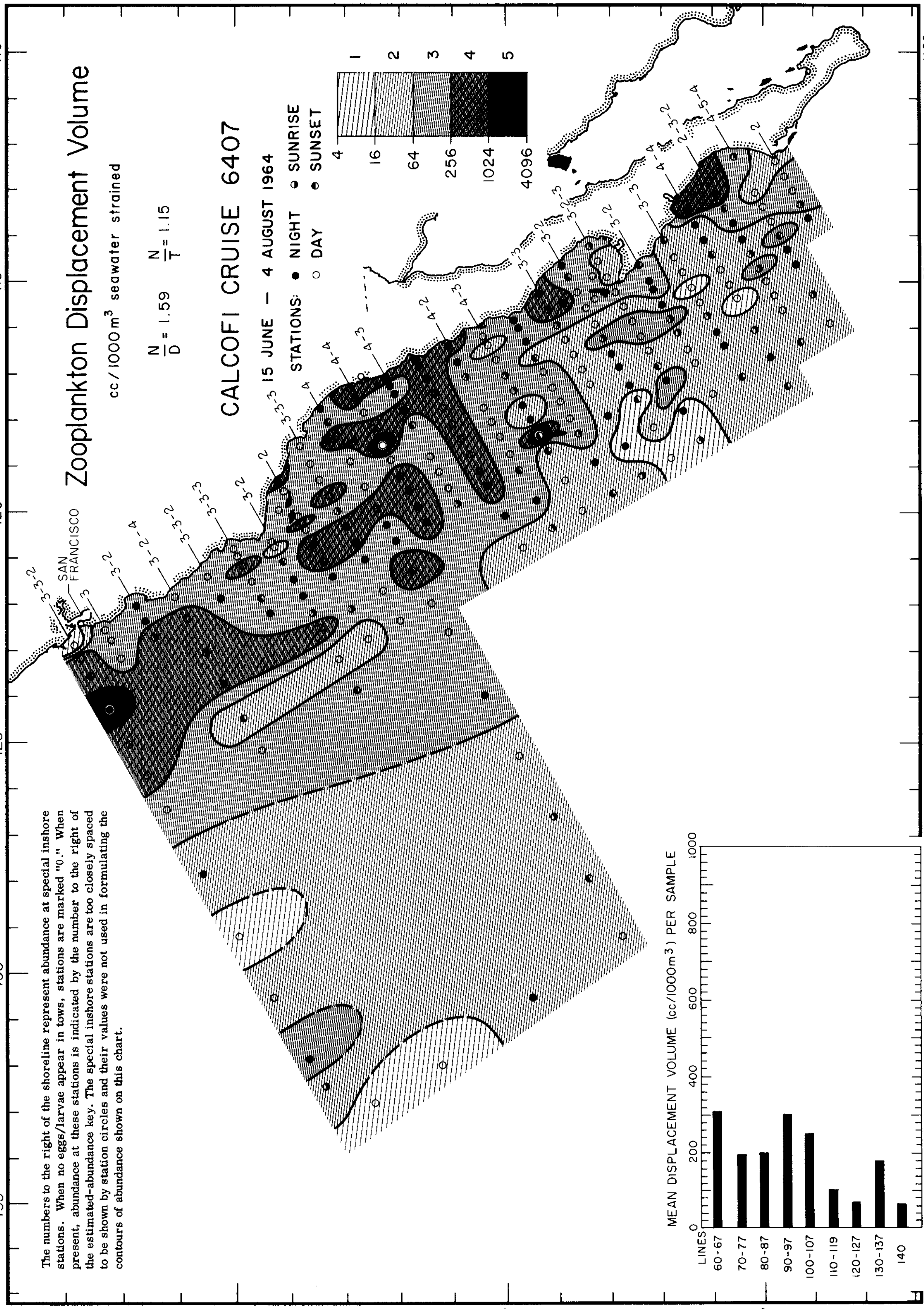
Zooplankton Displacement Volume

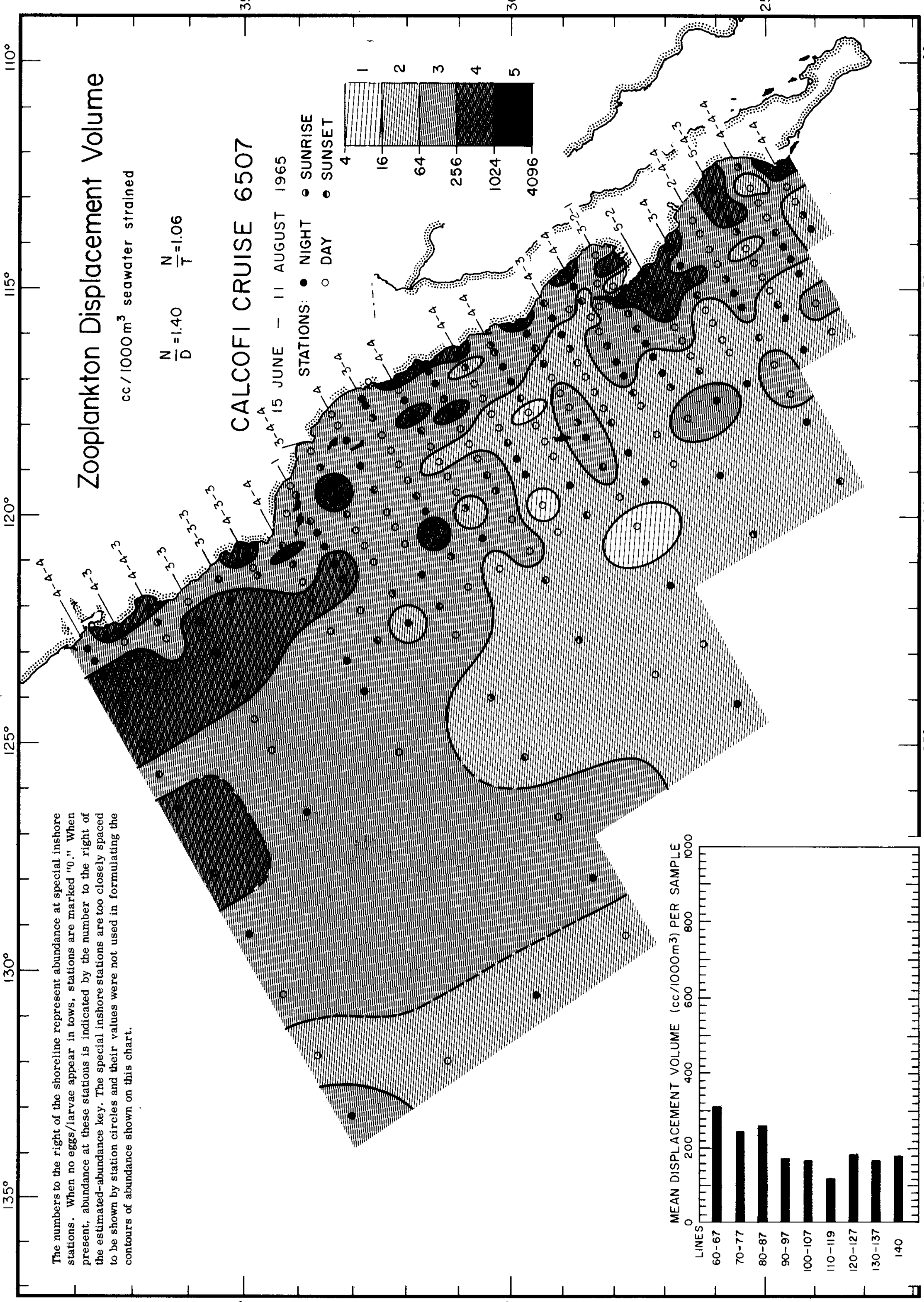
6107

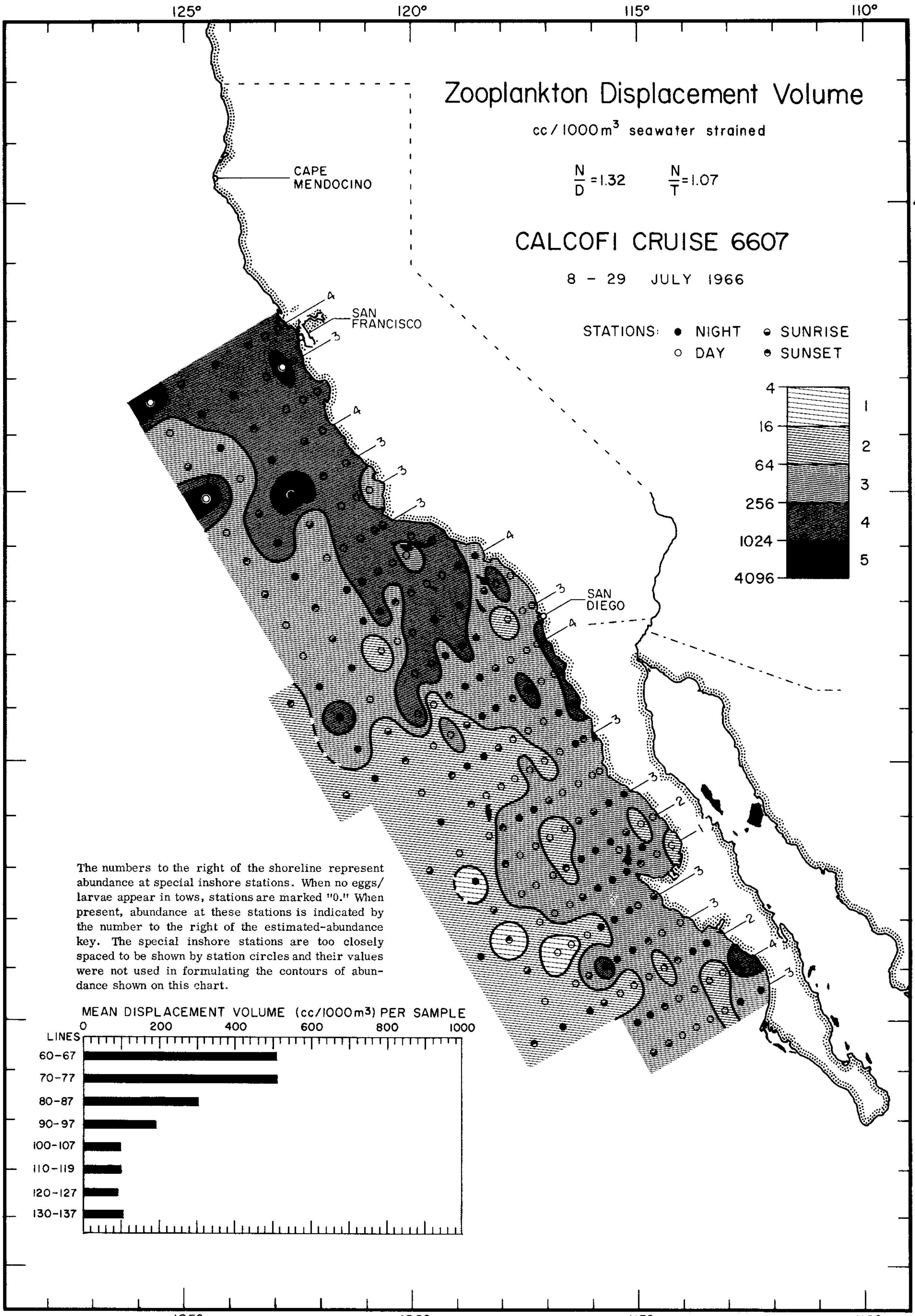


Zooplankton Displacement Volume

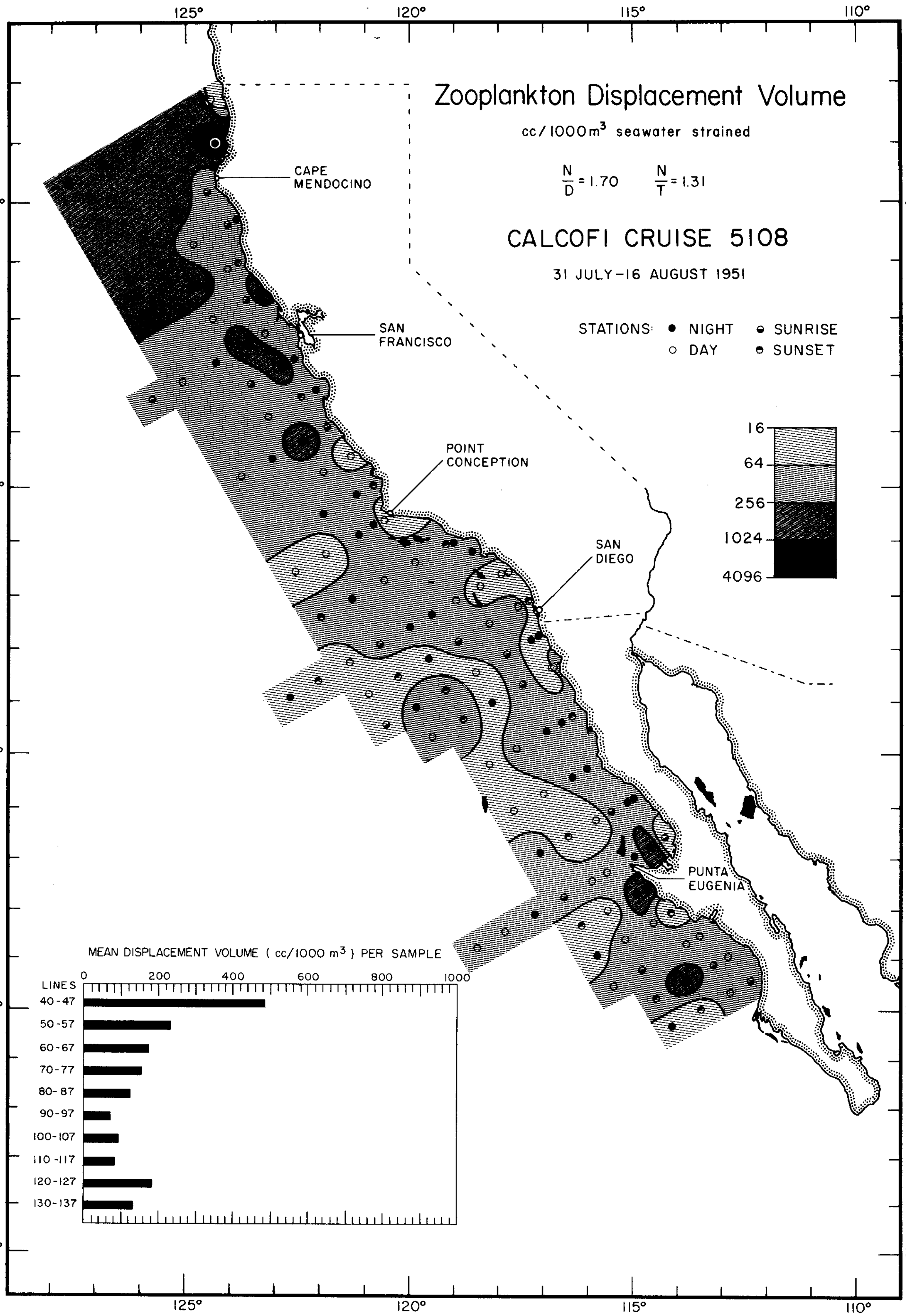

Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.14   N/T = 0.95
CALCOFI CRUISE 6307
10 JULY - 8 AUGUST 1963
STATIONS: NIGHT SUNRISE DAY SUNSET
16 64 256 1024 4096 16384
2 3 4 5 6
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
125° 120° 115° 110°
40° 35° 30° 25° 20°
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000
LINES
80-87
90-97
100-107
110-119
120-127
130-137

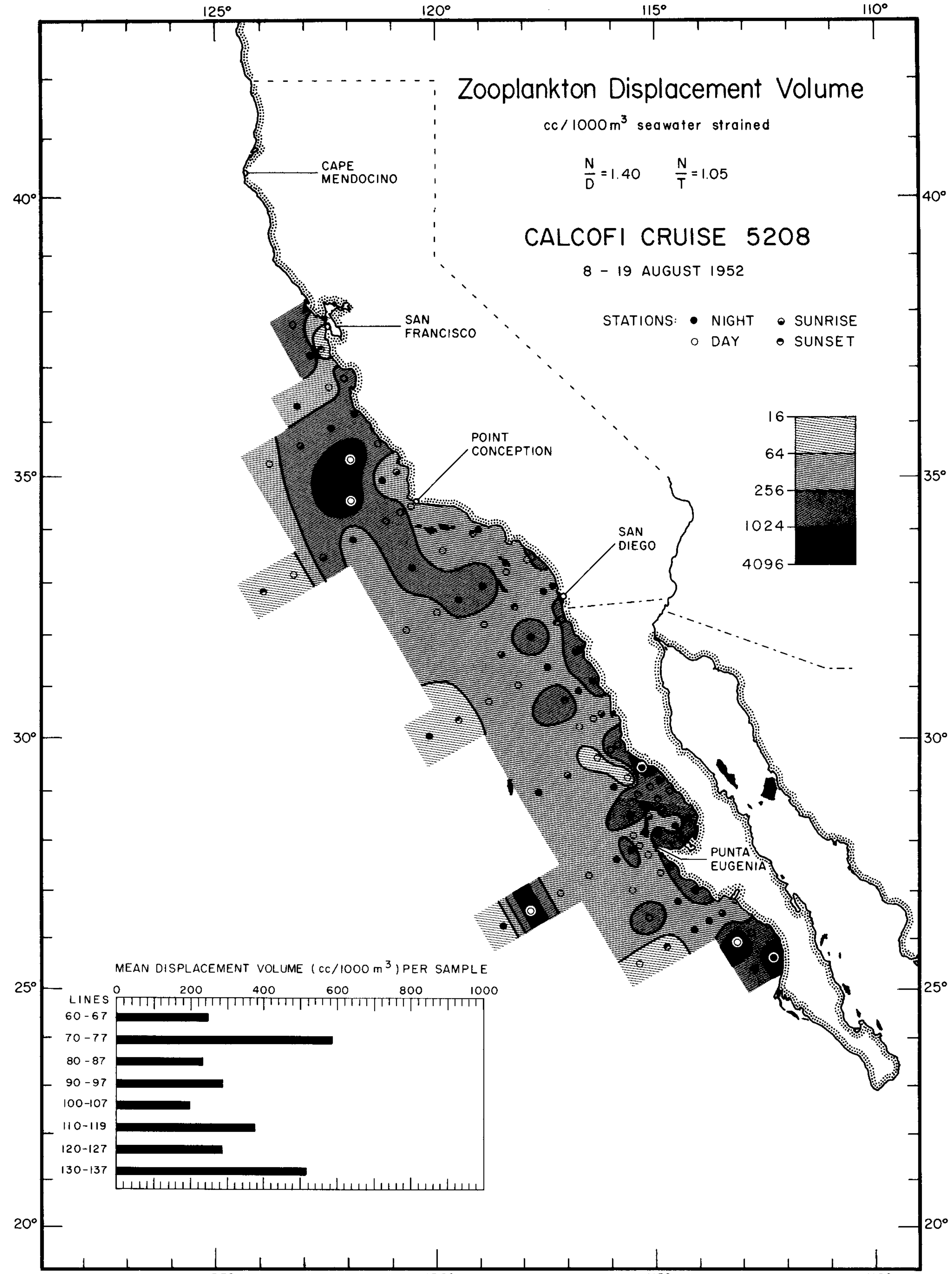

Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.59   N/T = 1.15
CALCOFI CRUISE 6407
15 JUNE – 4 AUGUST 1964
STATIONS: ● NIGHT ◐ SUNRISE
○ DAY ◑ SUNSET
4 16 64 256 1024 4096
1 2 3 4 5
SAN FRANCISCO
110° 115° 120° 125° 130° 135°
35° 30° 25°
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0 200 400 600 800 1000
LINES
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137
140


Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.40   N/T = 1.06
CALCOFI CRUISE 6507
15 JUNE – 11 AUGUST 1965
STATIONS: ● NIGHT ○ DAY ◐ SUNRISE ◑ SUNSET
4 16 64 256 1024 4096
1 2 3 4 5
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000
LINES 60-67 70-77 80-87 90-97 100-107 110-119 120-127 130-137 140
35° 30° 25°
110° 115° 120° 125° 130° 135°

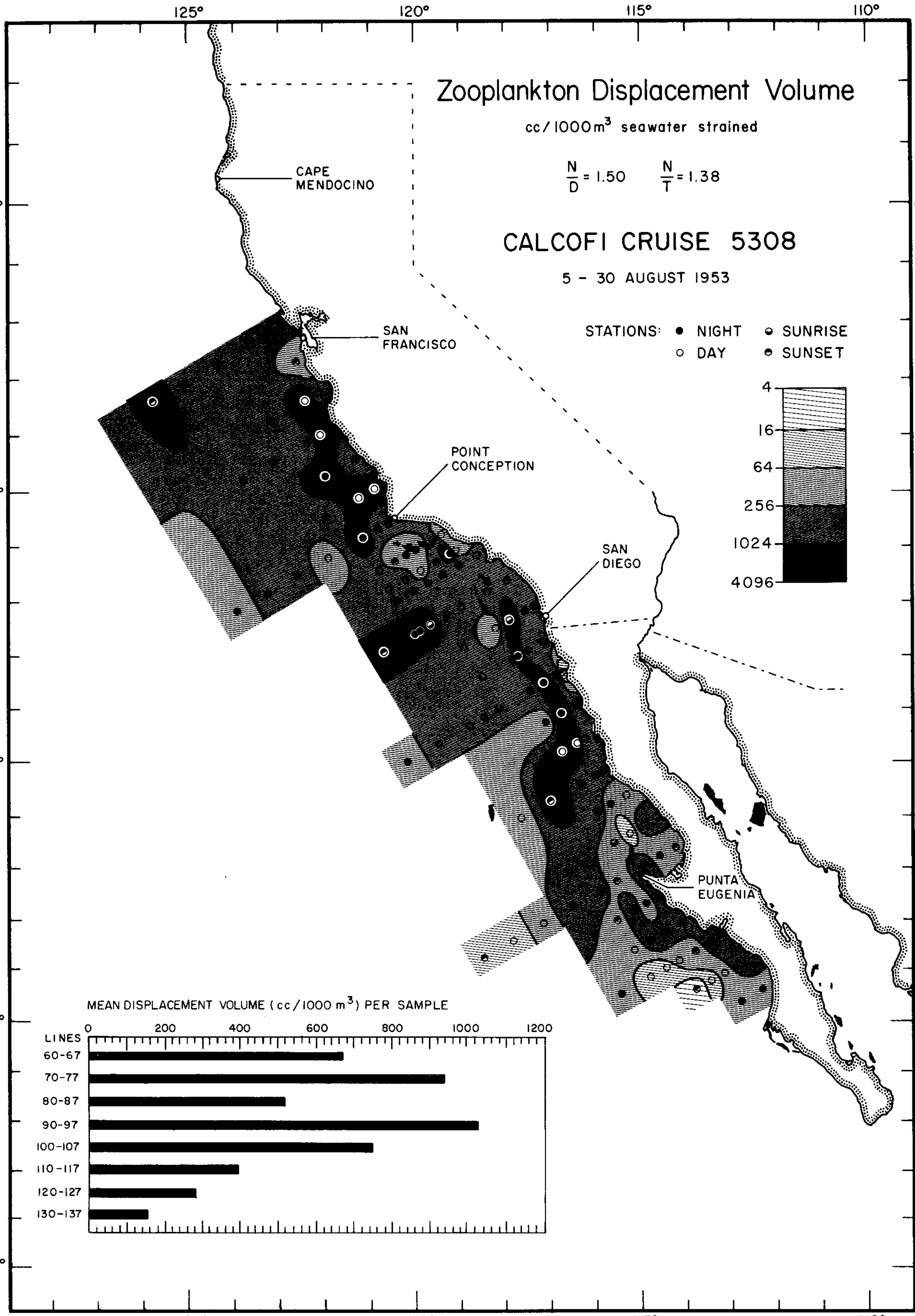


Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.32 N/T = 1.07
CALCOFI CRUISE 6607
8 - 29 JULY 1966
STATIONS: ● NIGHT ○ DAY SUNRISE SUNSET
4 16 64 256 1024 4096
1 2 3 4 5
CAPE MENDOCINO
SAN FRANCISCO
SAN DIEGO
125° 120° 115° 110°
40° 35° 30° 25° 20°
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000m3) PER SAMPLE
0 200 400 600 800 1000
LINES
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137

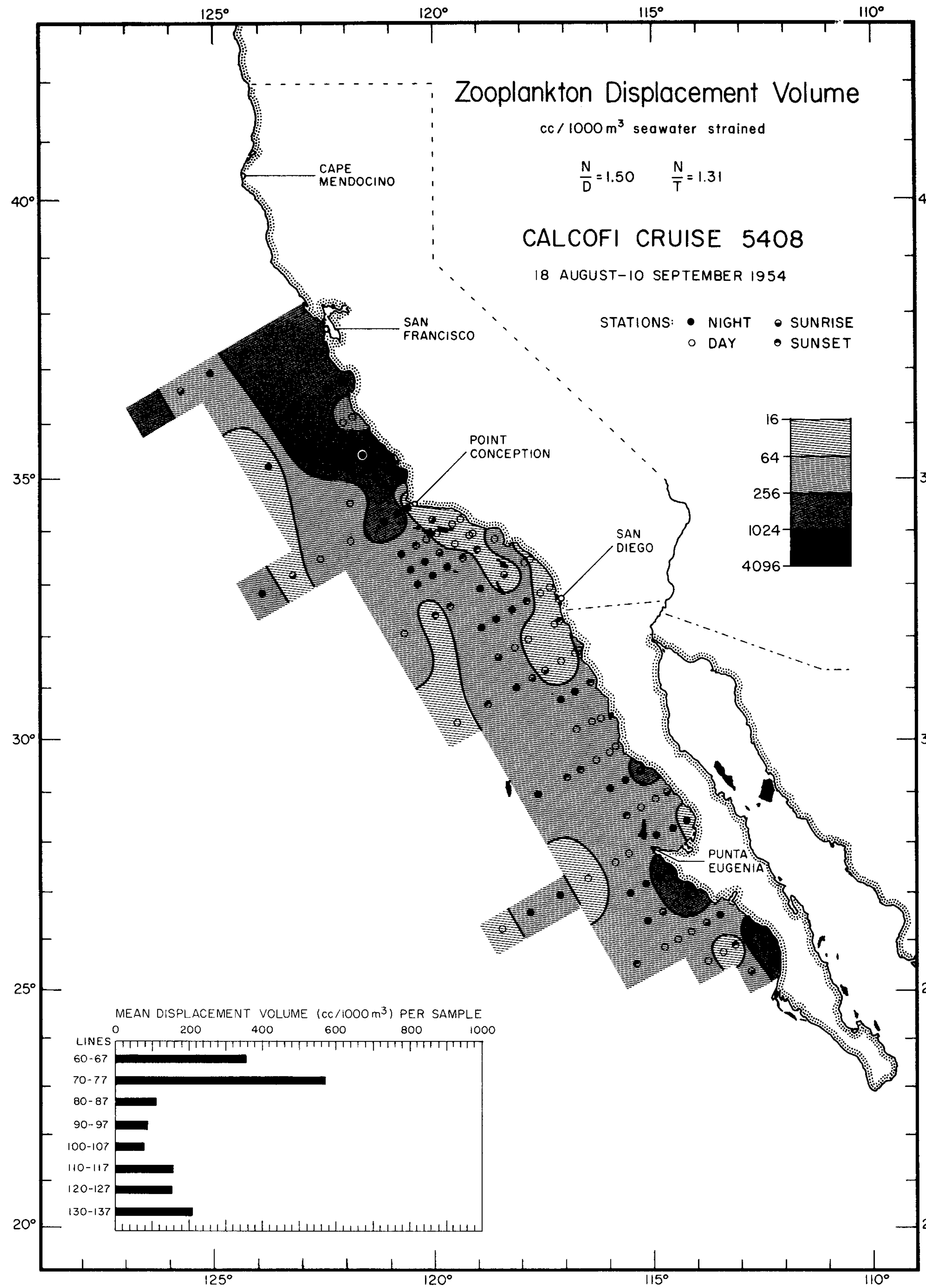

125°
120°
115°
110°
Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.70
N/T = 1.31
CALCOFI CRUISE 5108
31 JULY-16 AUGUST 1951
STATIONS: NIGHT DAY SUNRISE SUNSET
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
40-47
50-57
60-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137



Zooplankton Displacement Volume

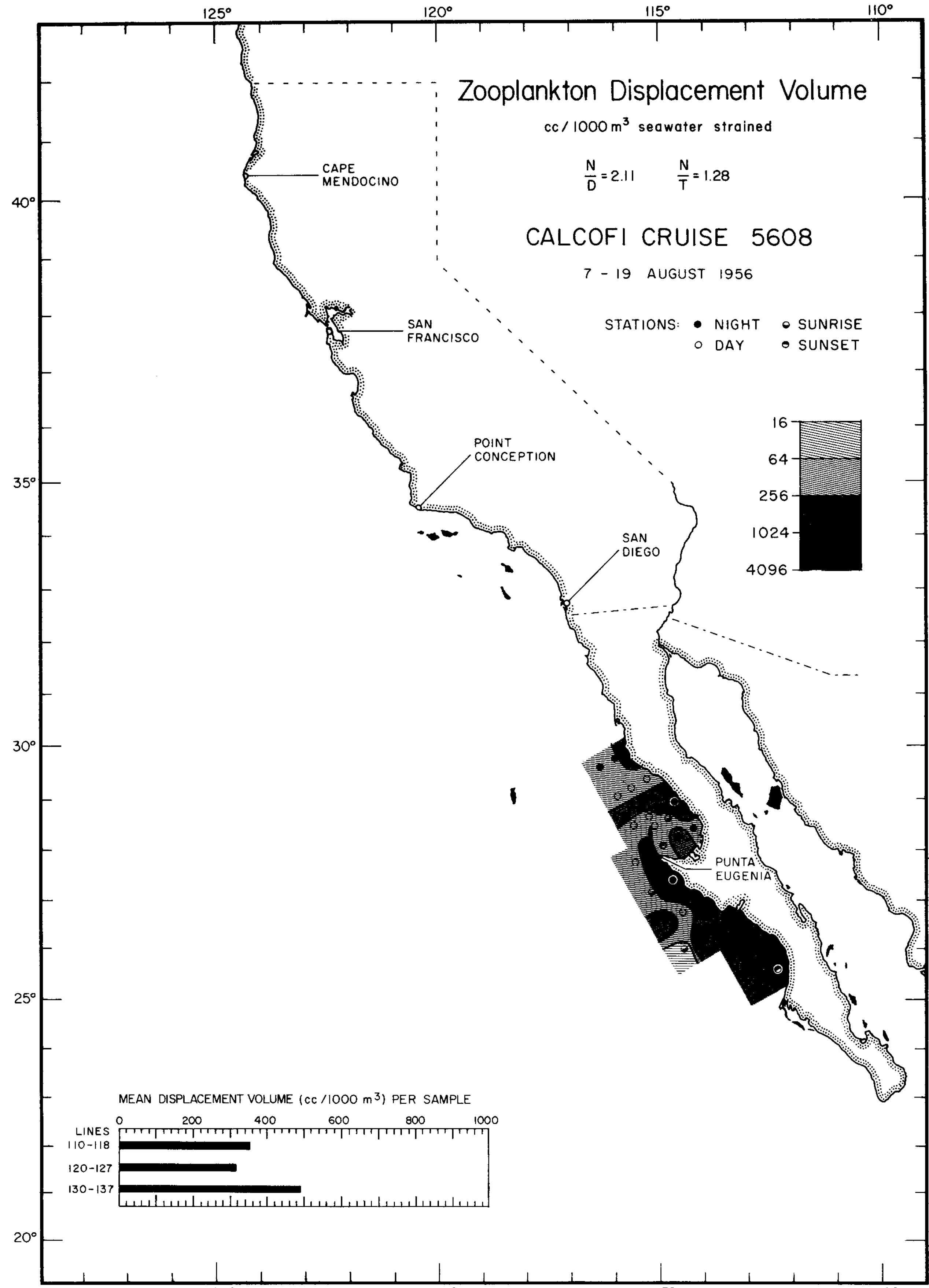


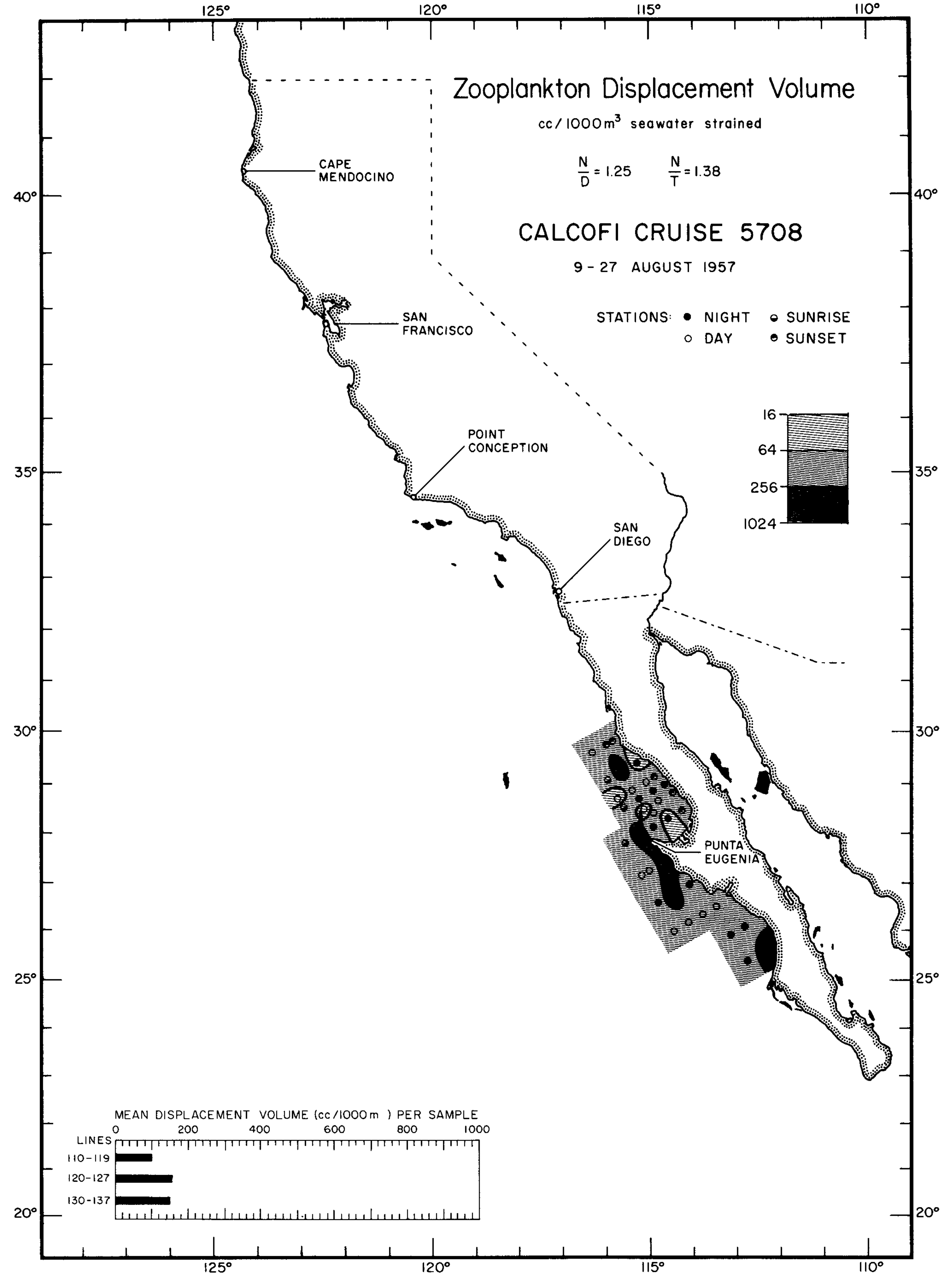
Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.50   N/T = 1.38
CALCOFI CRUISE 5308
5 - 30 AUGUST 1953
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
1200
LINES
60-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137



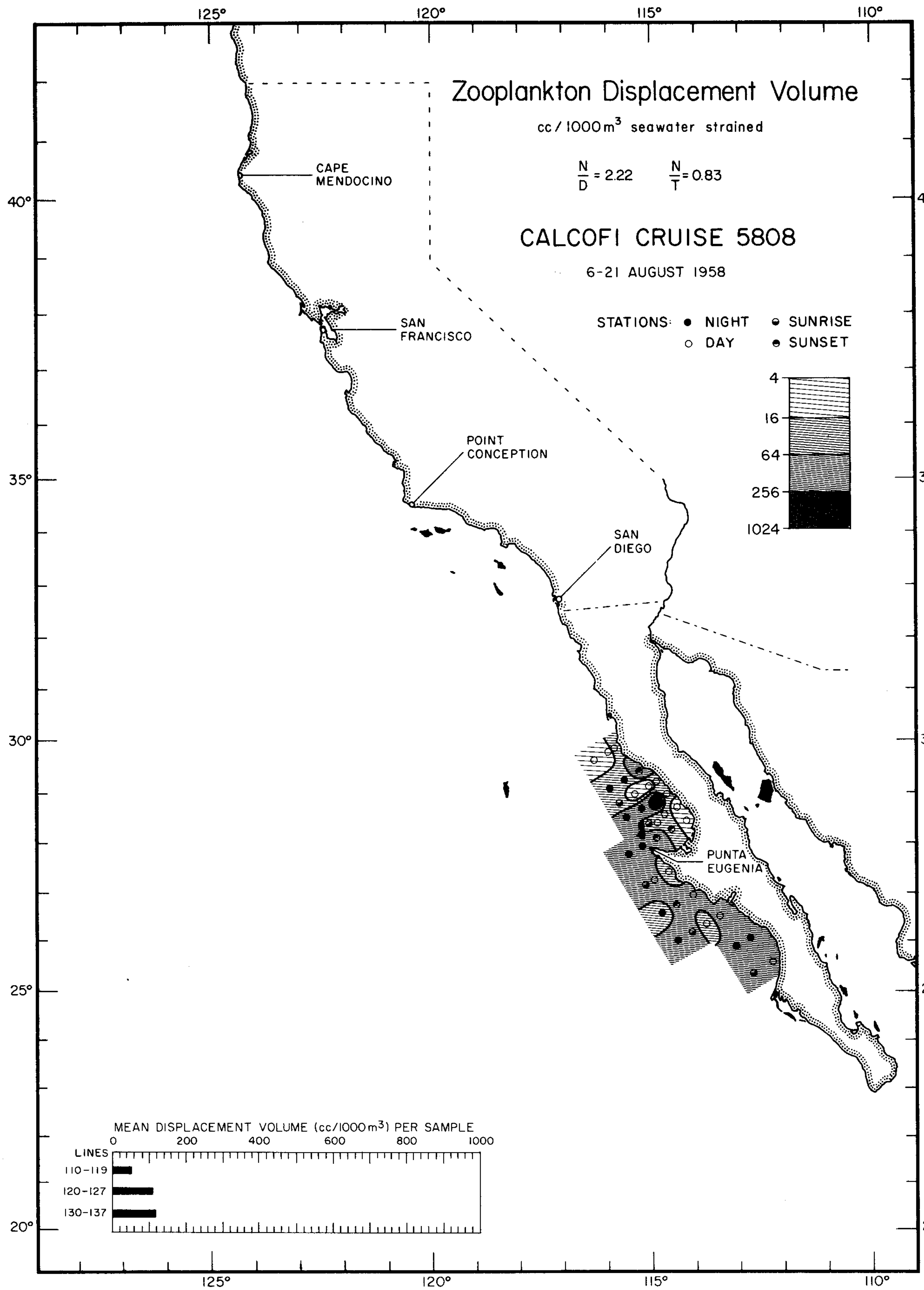
Zooplankton Displacement Volume

5408

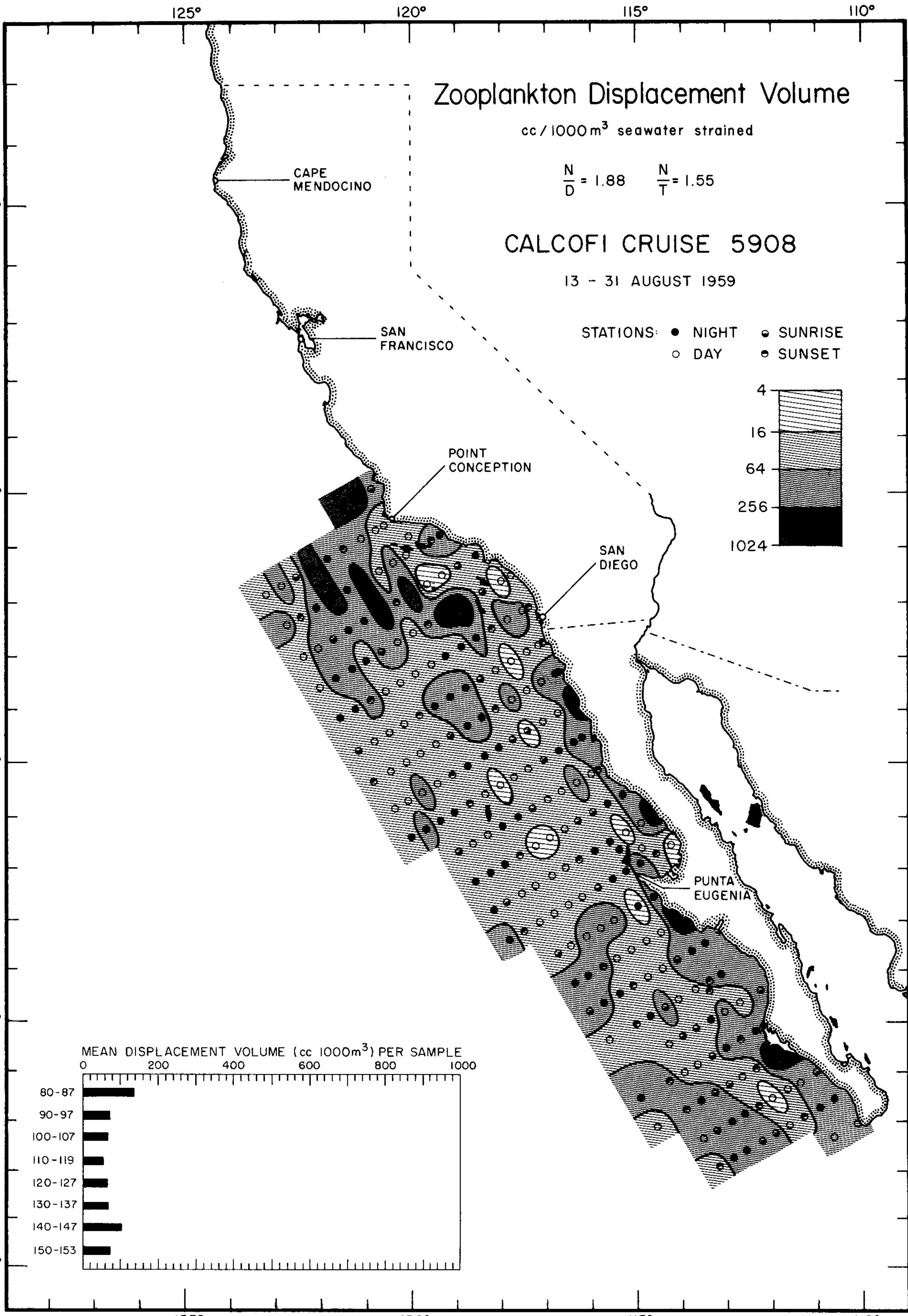

Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 2.11 N/T = 1.28
CALCOFI CRUISE 5608
7 - 19 AUGUST 1956
STATIONS: NIGHT SUNRISE
DAY SUNSET
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
110-118
120-127
130-137



125°
120°
115°
110°
40°
35°
30°
25°
20°
Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.25
N/T = 1.38
CALCOFI CRUISE 5708
9 - 27 AUGUST 1957
STATIONS:
NIGHT
DAY
SUNRISE
SUNSET
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
MEAN DISPLACEMENT VOLUME (cc/1000 m) PER SAMPLE
0
200
400
600
800
1000
LINES
110-119
120-127
130-137

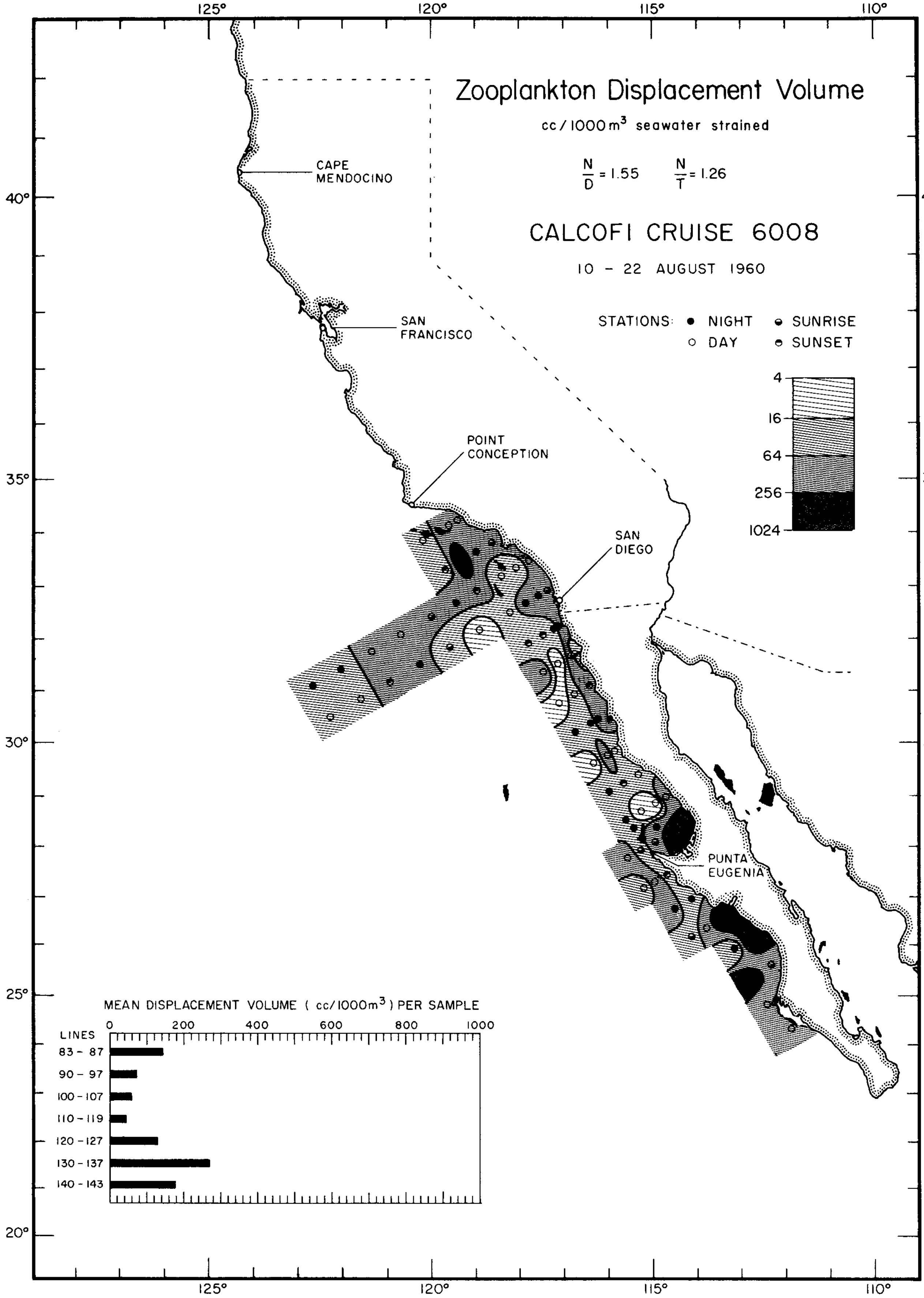


125°
120°
115°
110°
Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 2.22
N/T = 0.83
CALCOFI CRUISE 5808
6-21 AUGUST 1958
STATIONS: ● NIGHT
○ DAY
SUNRISE
SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0
200
400
600
800
1000
LINES
110-119
120-127
130-137

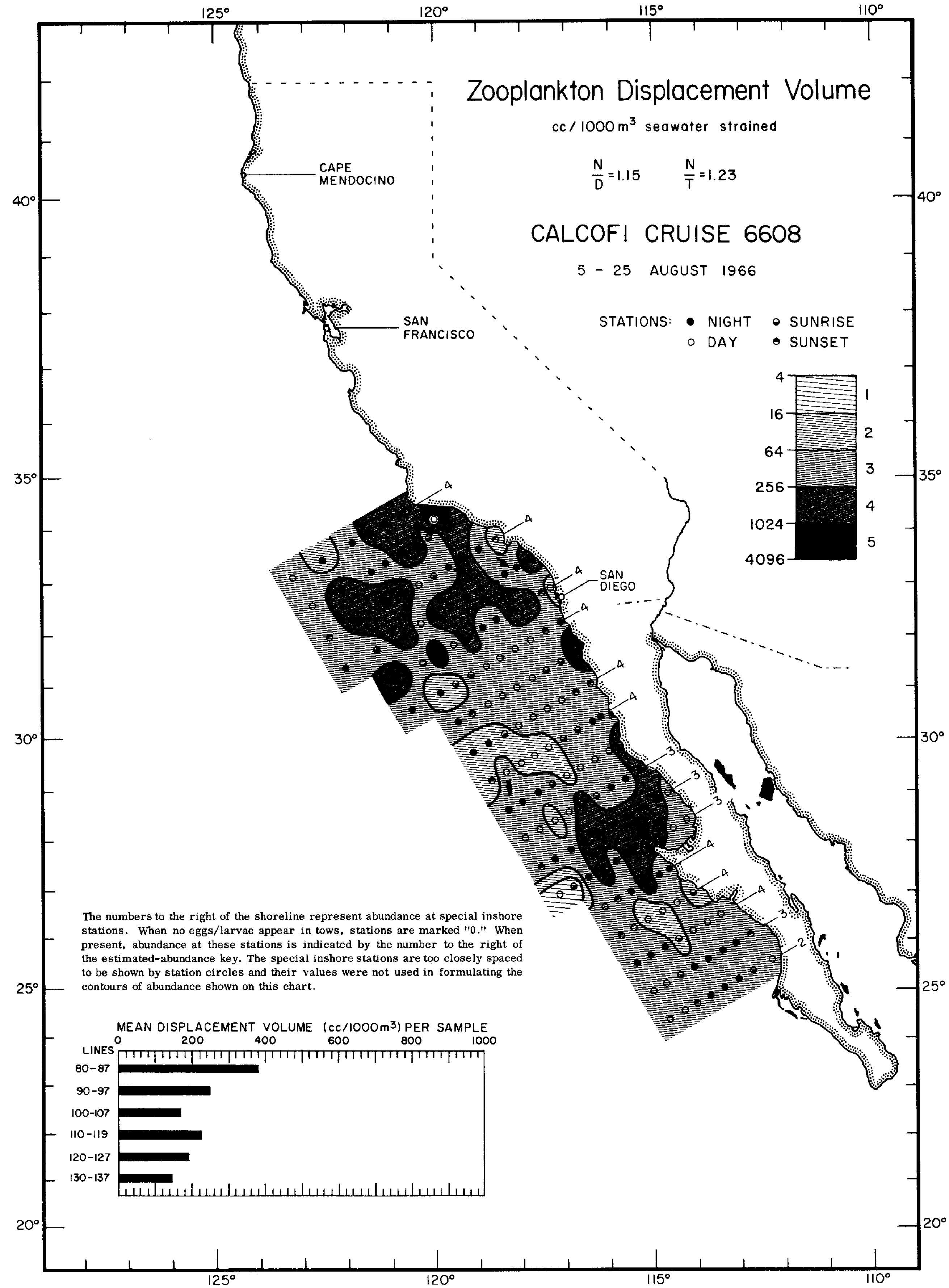


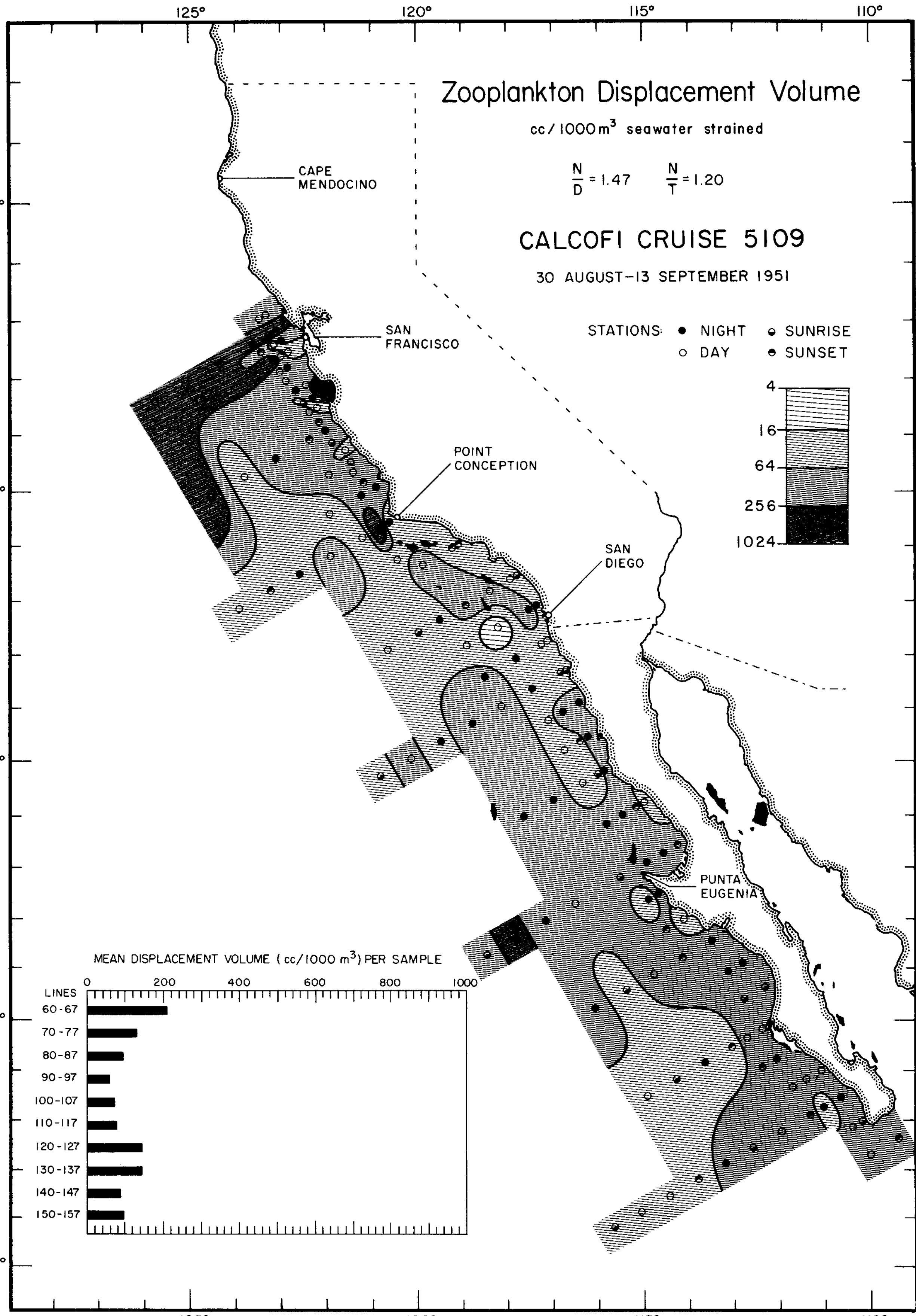
Zooplankton Displacement Volume

5908

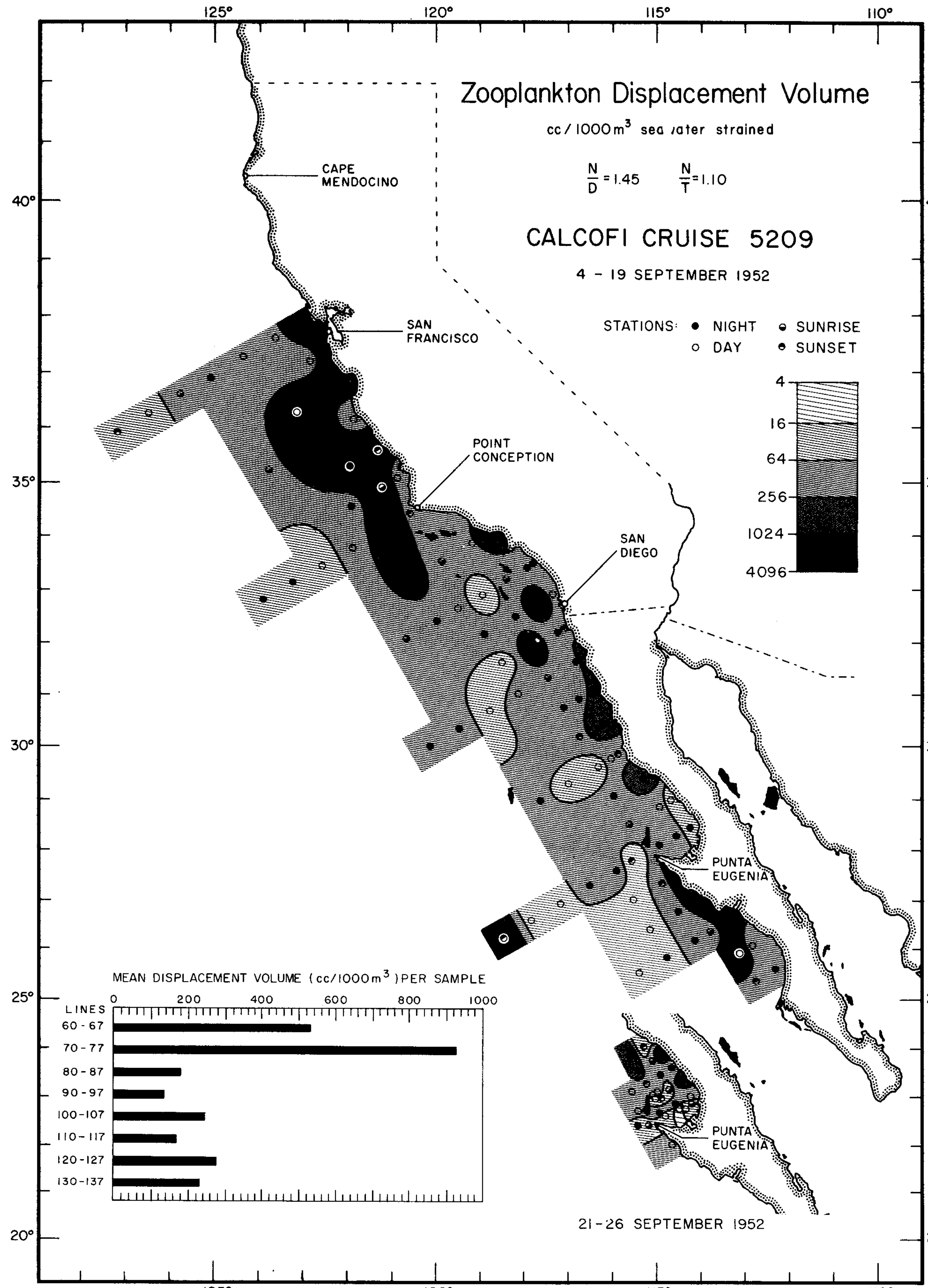


Zooplankton Displacement Volume
cc/1000 m3 seawater strained
N/D = 1.55 N/T = 1.26
CALCOFI CRUISE 6008
10 - 22 AUGUST 1960
STATIONS: ● NIGHT ◒ SUNRISE
○ DAY ◓ SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000m3) PER SAMPLE
0
200
400
600
800
1000
LINES
83 - 87
90 - 97
100 - 107
110 - 119
120 - 127
130 - 137
140 - 143


125°
120°
115°
110°
40°
35°
30°
25°
20°
Zooplankton Displacement Volume
cc / 1000 m3 seawater strained
N/D = 1.15
N/T = 1.23
CALCOFI CRUISE 6608
5 - 25 AUGUST 1966
STATIONS: ● NIGHT
○ DAY
SUNRISE
SUNSET
4
16
64
256
1024
4096
1
2
3
4
5
CAPE MENDOCINO
SAN FRANCISCO
SAN DIEGO
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000m3) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97
100-107
110-119
120-127
130-137

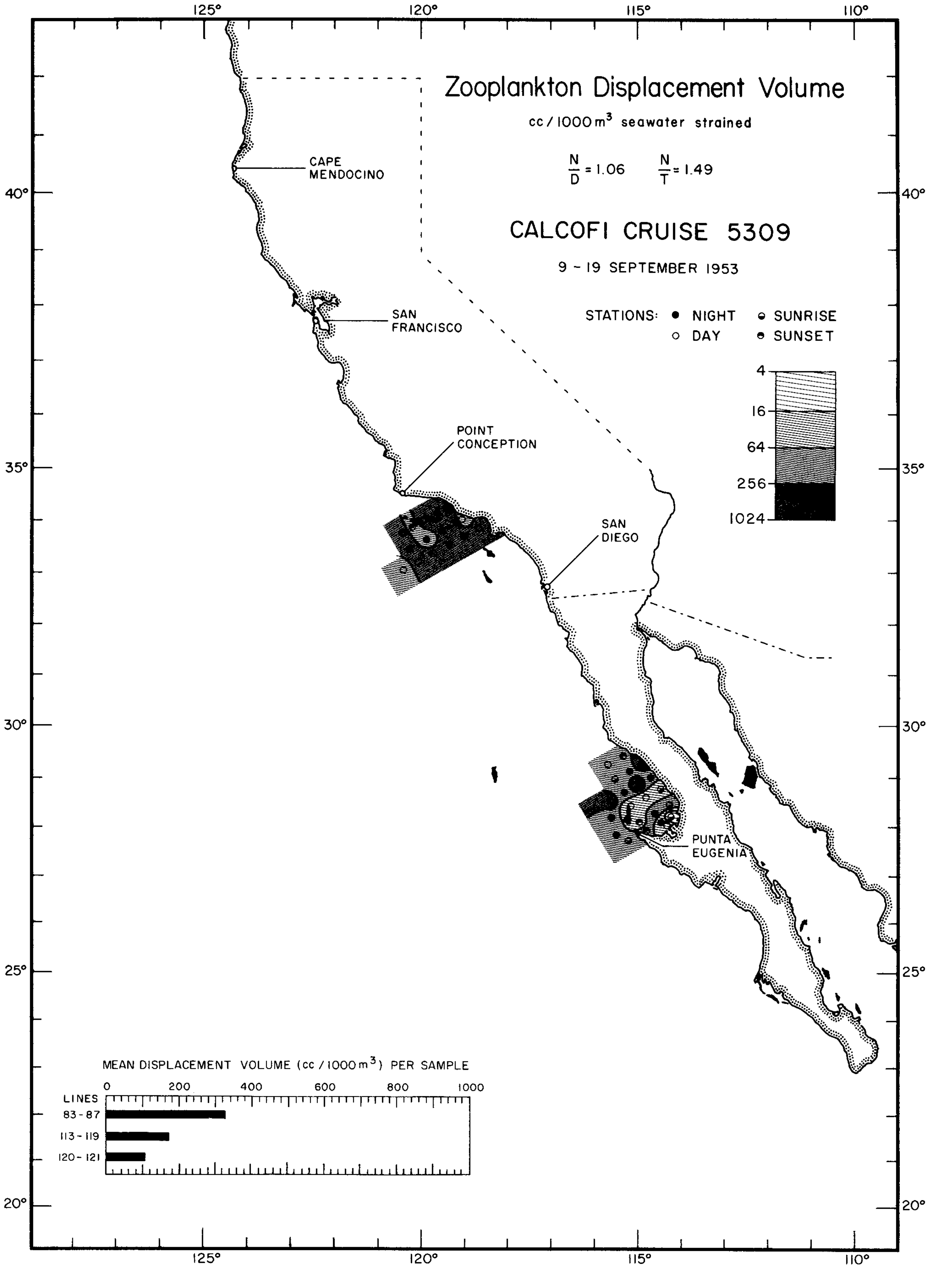


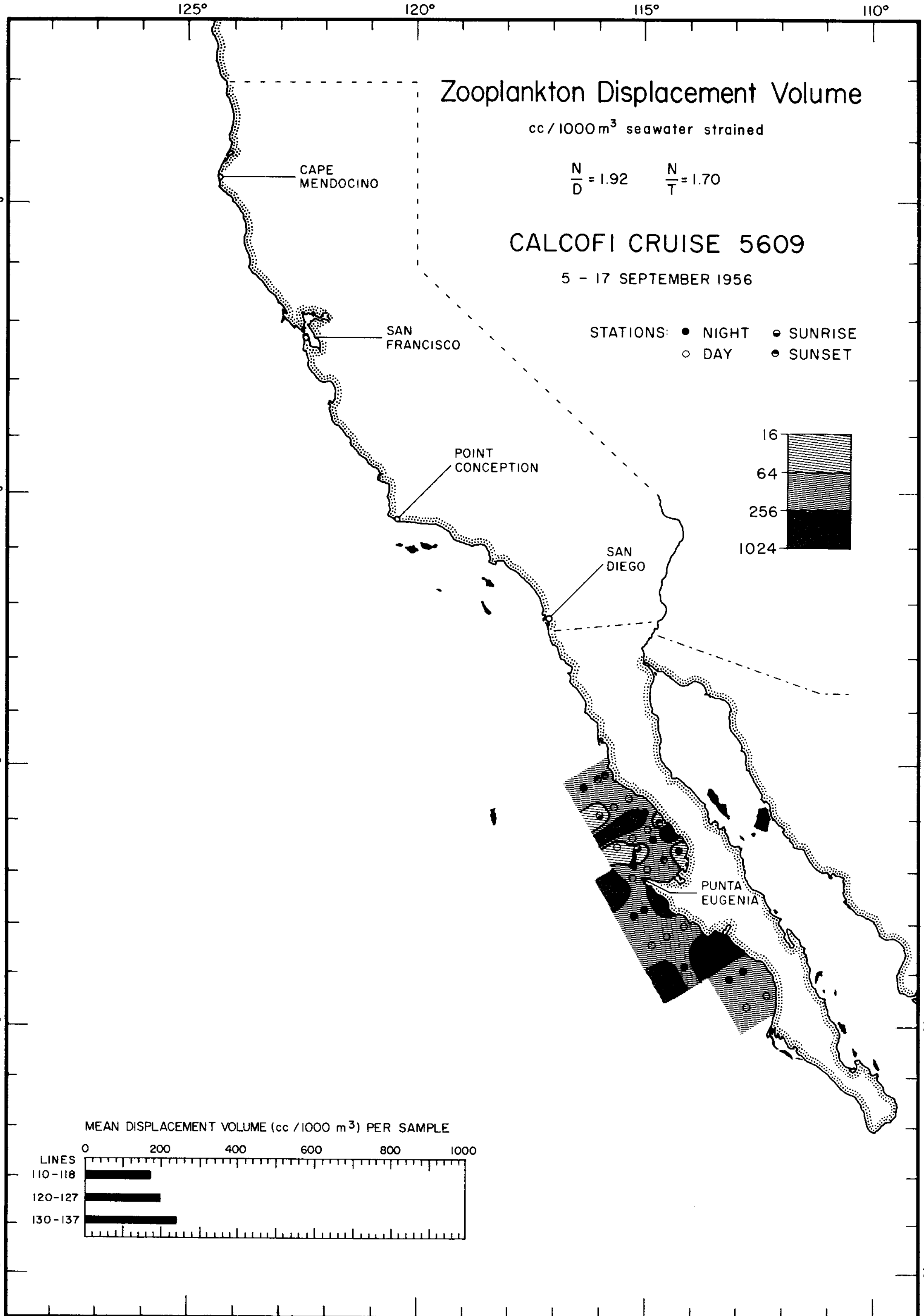
Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.47   N/T = 1.20
CALCOFI CRUISE 5109
30 AUGUST-13 SEPTEMBER 1951
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
60-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137
140-147
150-157

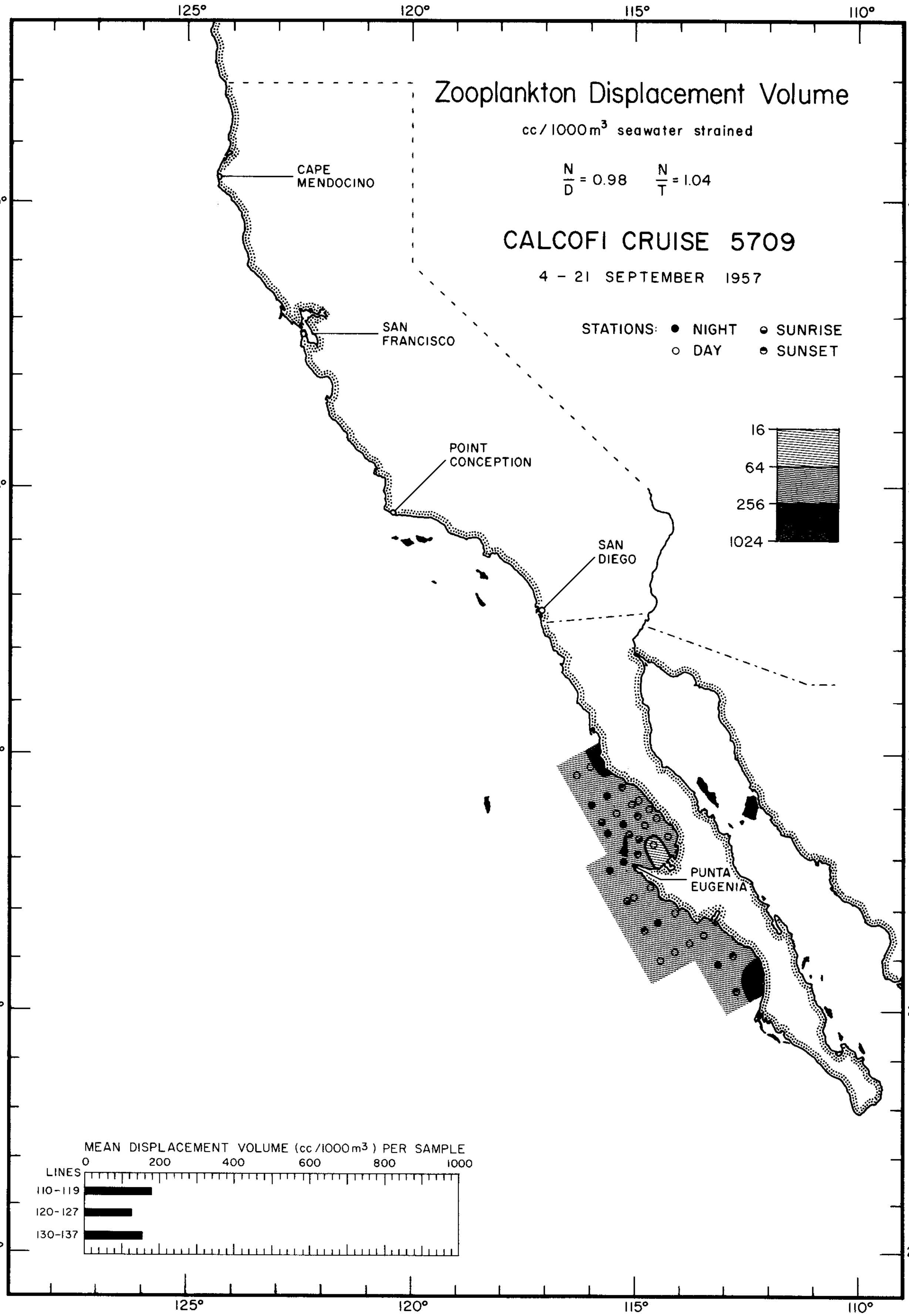


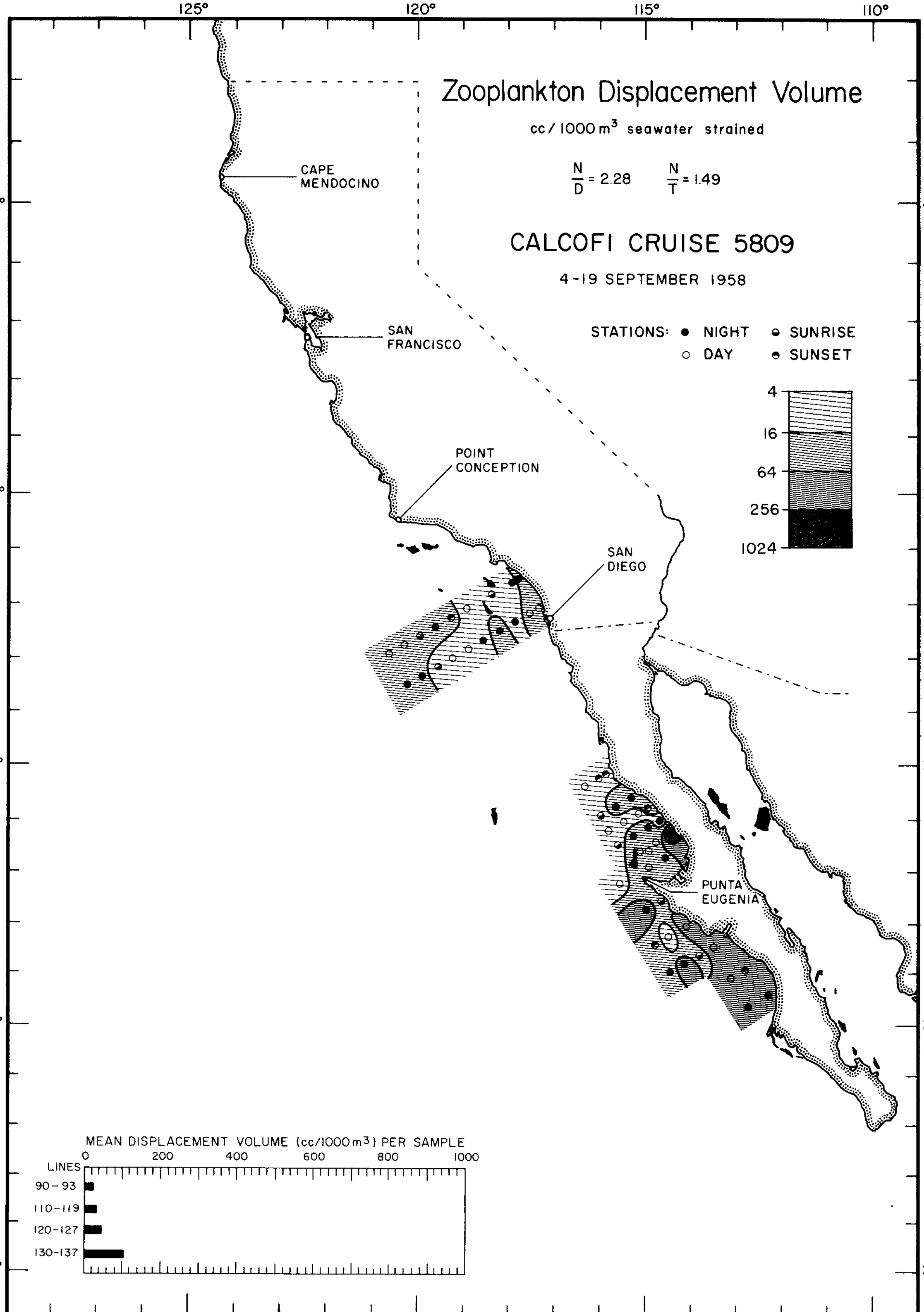
Zooplankton Displacement Volume

5209

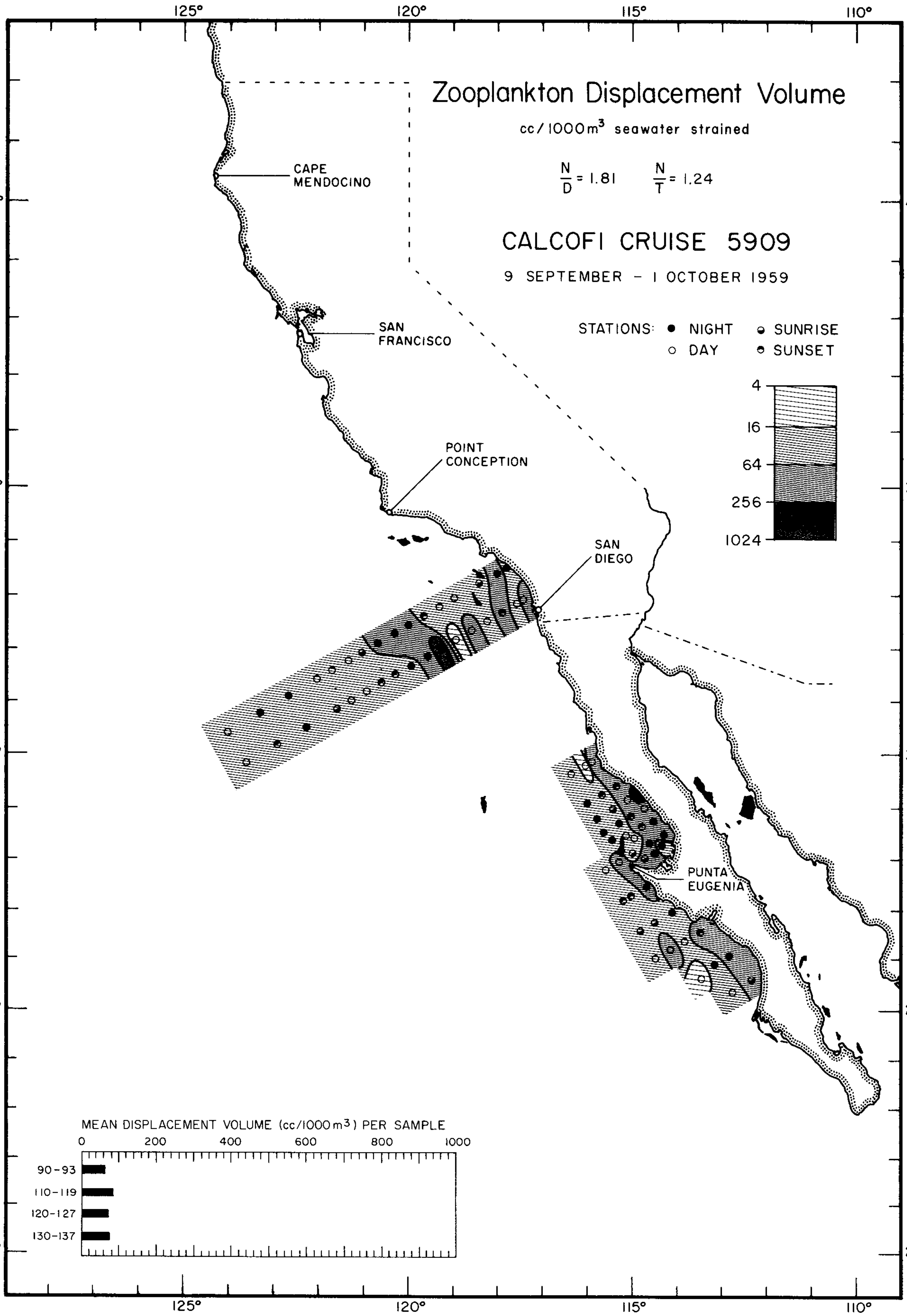

Zooplankton Displacement Volume
cc / 1000 m³ seawater strained
N/D = 1.06 N/T = 1.49
CALCOFI CRUISE 5309
9 - 19 SEPTEMBER 1953
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc / 1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
83 - 87
113 - 119
120 - 121


Zooplankton Displacement Volume
cc / 1000 m3 seawater strained
N/D = 1.92   N/T = 1.70
CALCOFI CRUISE 5609
5 - 17 SEPTEMBER 1956
STATIONS: NIGHT SUNRISE DAY SUNSET
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125° 120° 115° 110°
40° 35° 30° 25° 20°
MEAN DISPLACEMENT VOLUME (cc / 1000 m3) PER SAMPLE
0 200 400 600 800 1000
LINES
110-118
120-127
130-137

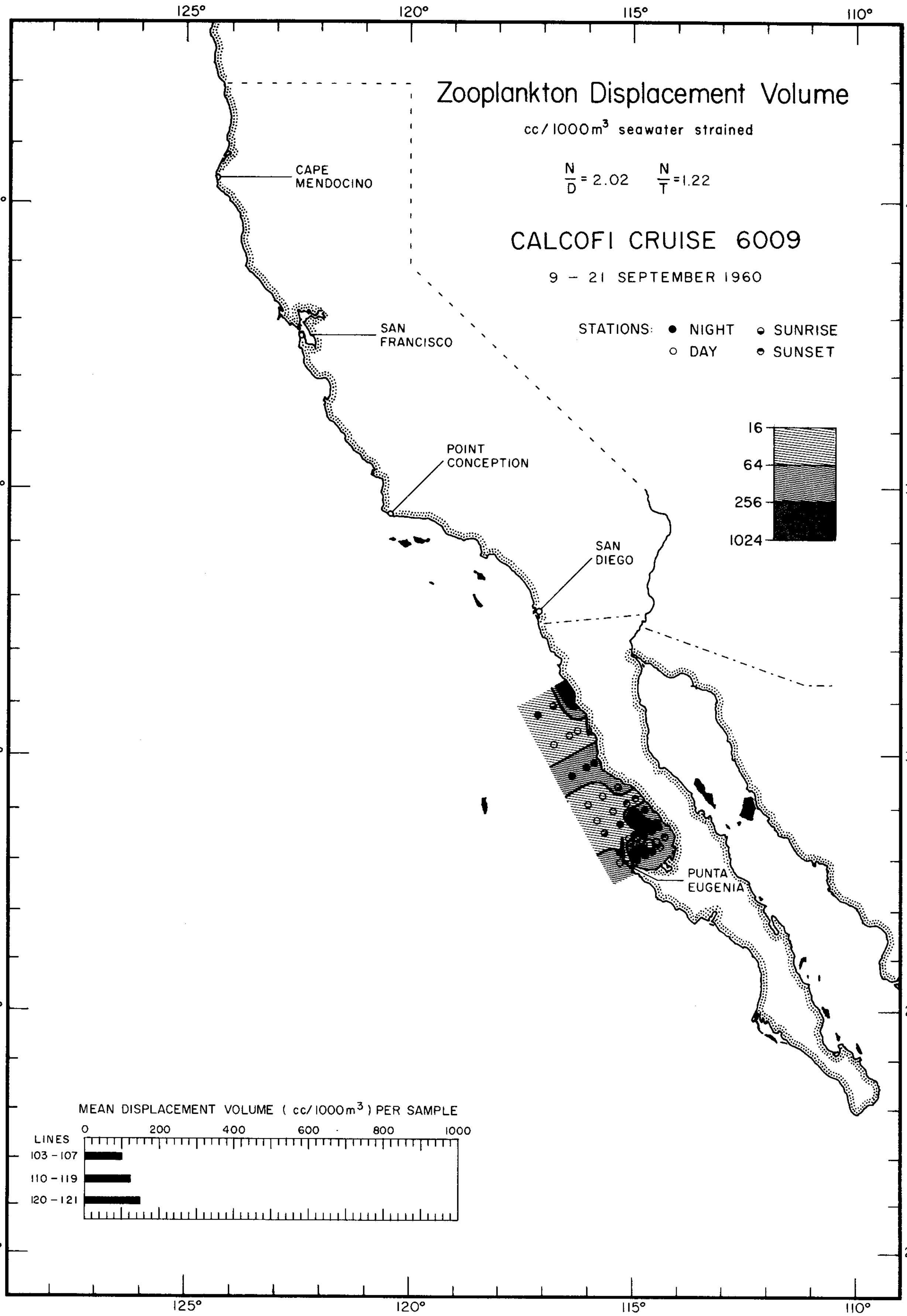

Zooplankton Displacement Volume
cc/1000m3 seawater strained
N/D = 0.98   N/T = 1.04
CALCOFI CRUISE 5709
4 - 21 SEPTEMBER 1957
STATIONS: NIGHT SUNRISE DAY SUNSET
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000m3) PER SAMPLE
0
200
400
600
800
1000
LINES
110-119
120-127
130-137



Zooplankton Displacement Volume

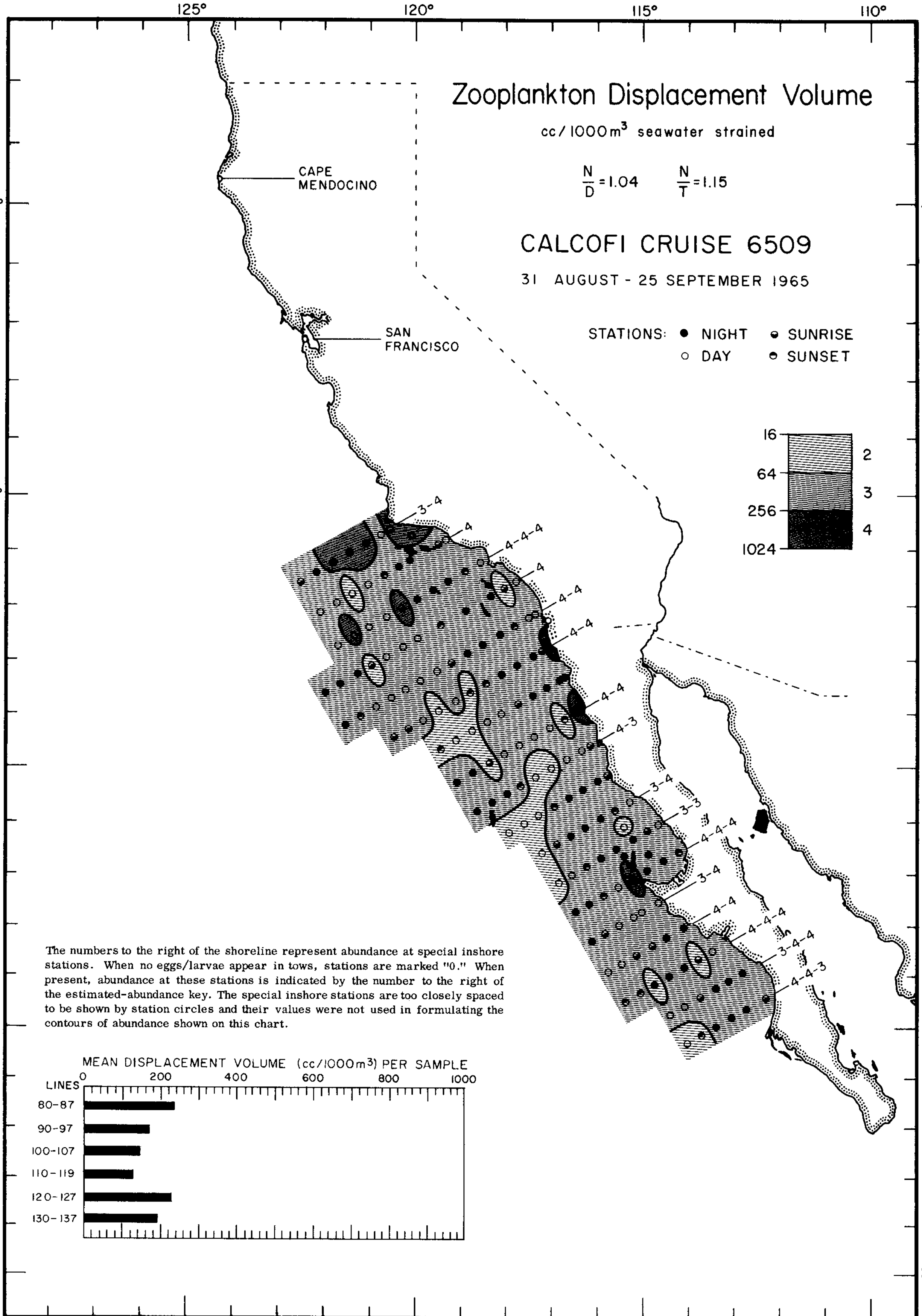


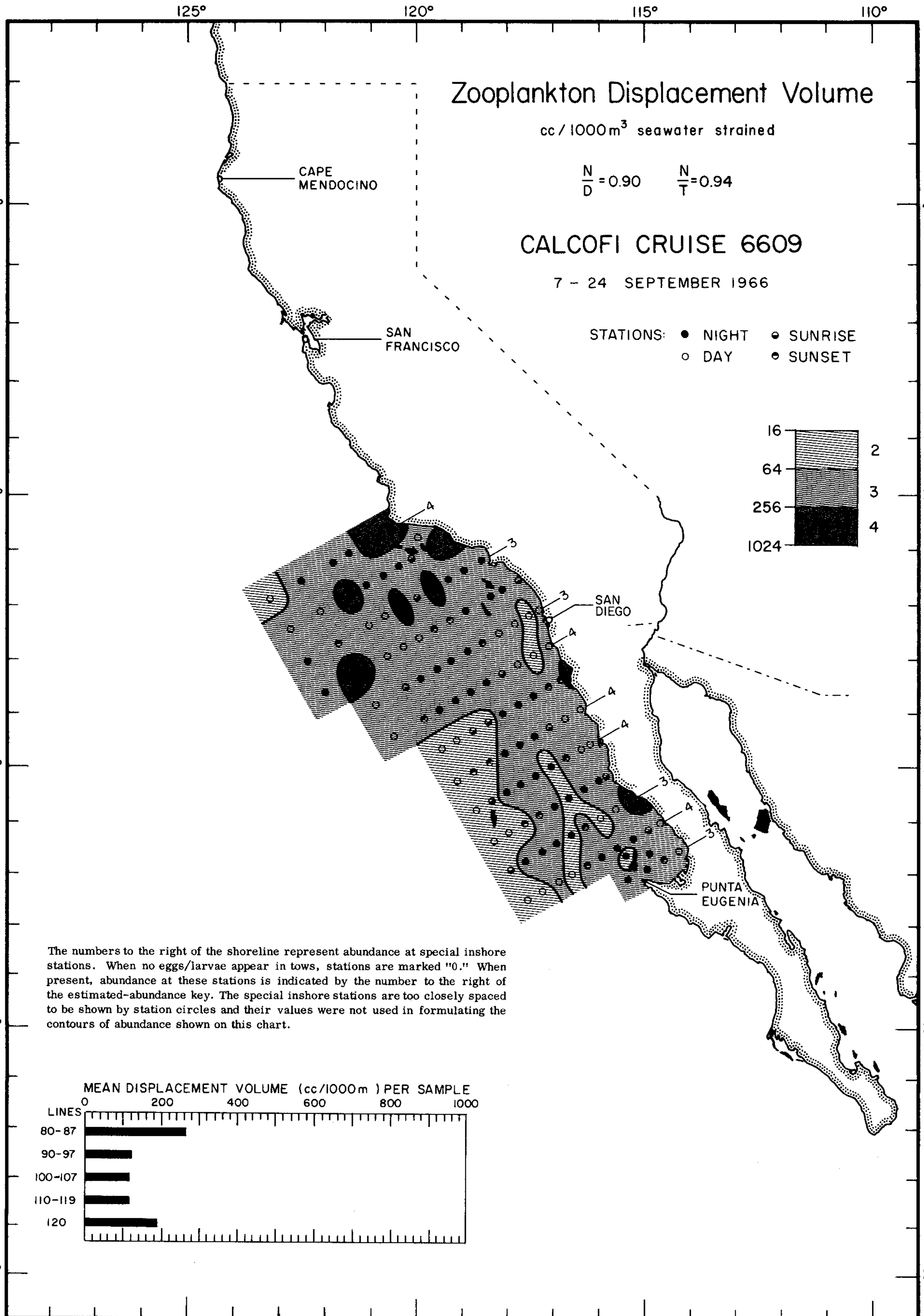
Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.81 N/T = 1.24
CALCOFI CRUISE 5909
9 SEPTEMBER – 1 OCTOBER 1959
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
90-93
110-119
120-127
130-137



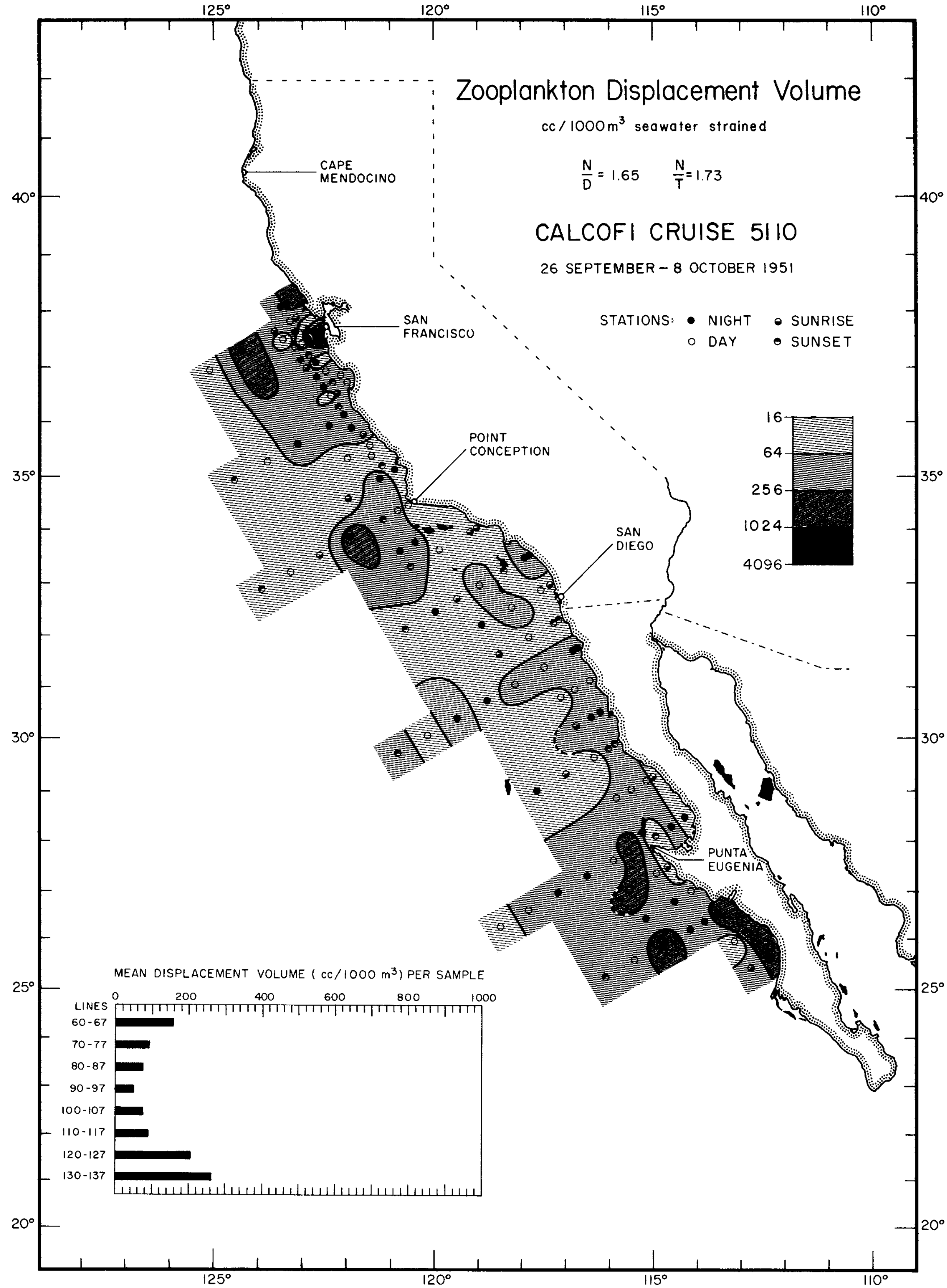
Zooplankton Displacement Volume

6009

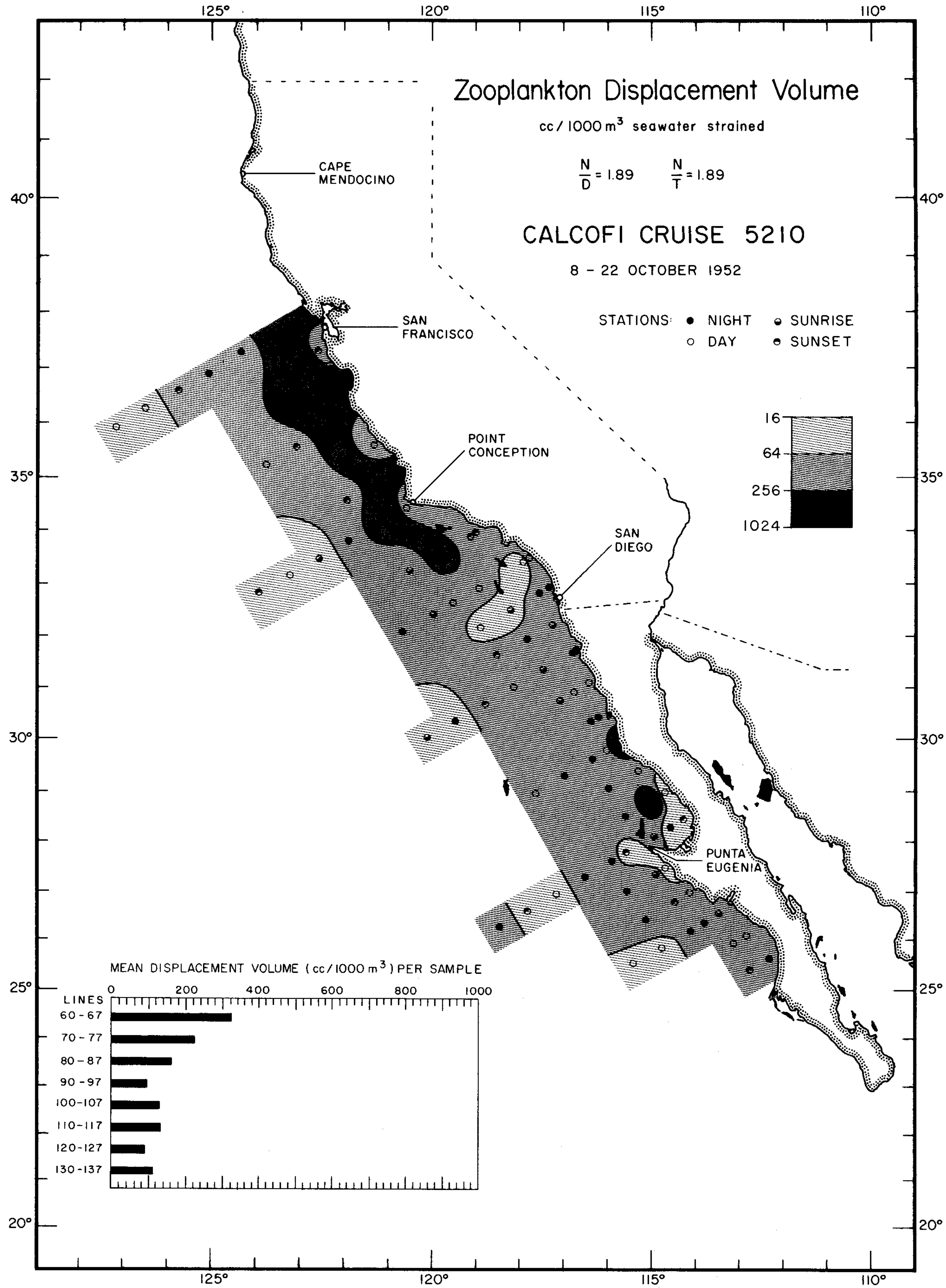

Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.04   N/T = 1.15
CALCOFI CRUISE 6509
31 AUGUST - 25 SEPTEMBER 1965
STATIONS: ● NIGHT ○ DAY ◒ SUNRISE ◓ SUNSET
CAPE MENDOCINO
SAN FRANCISCO
16
64
256
1024
2
3
4
125°
120°
115°
110°
40°
35°
30°
25°
20°
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
LINES
0
200
400
600
800
1000
80-87
90-97
100-107
110-119
120-127
130-137

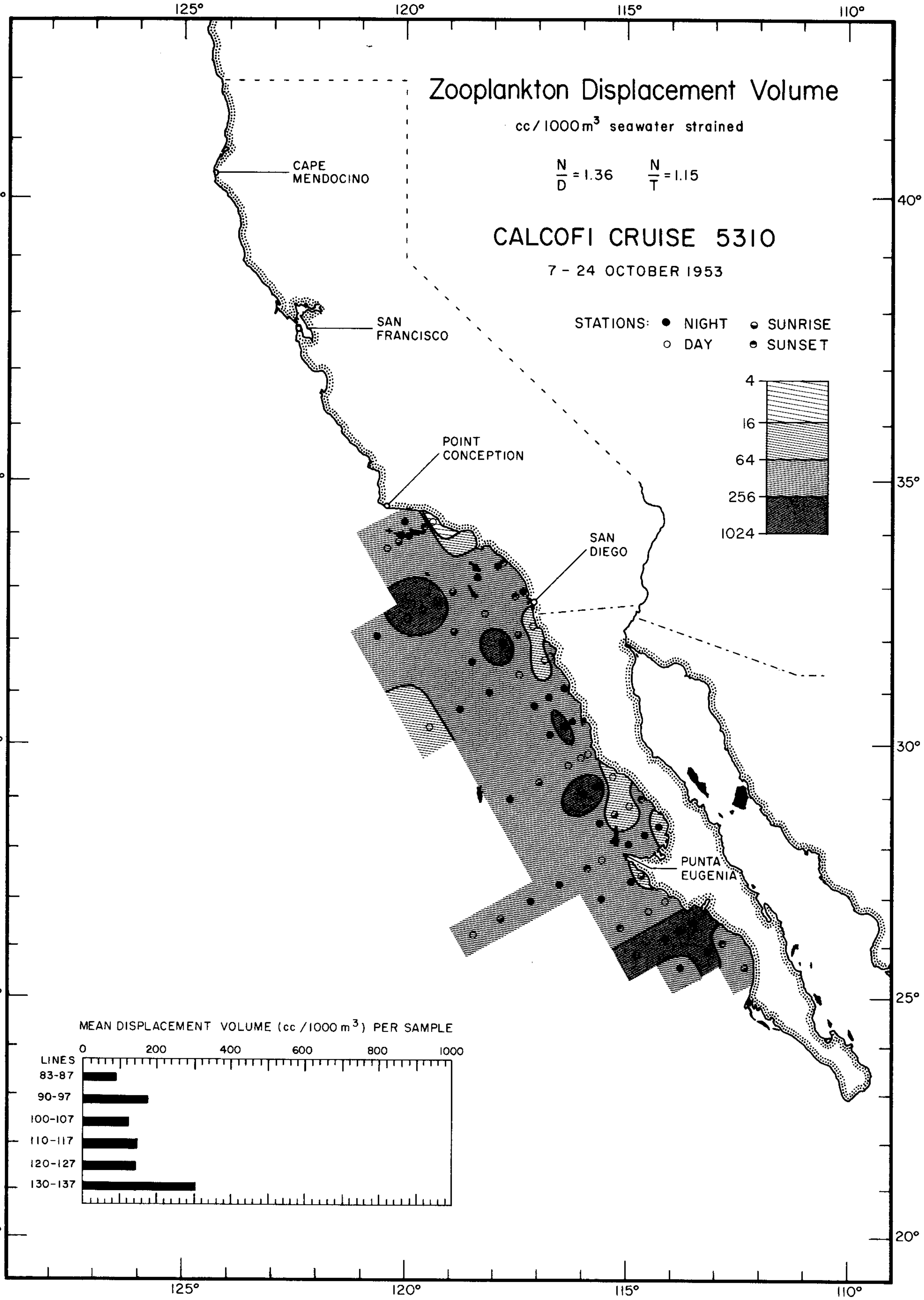


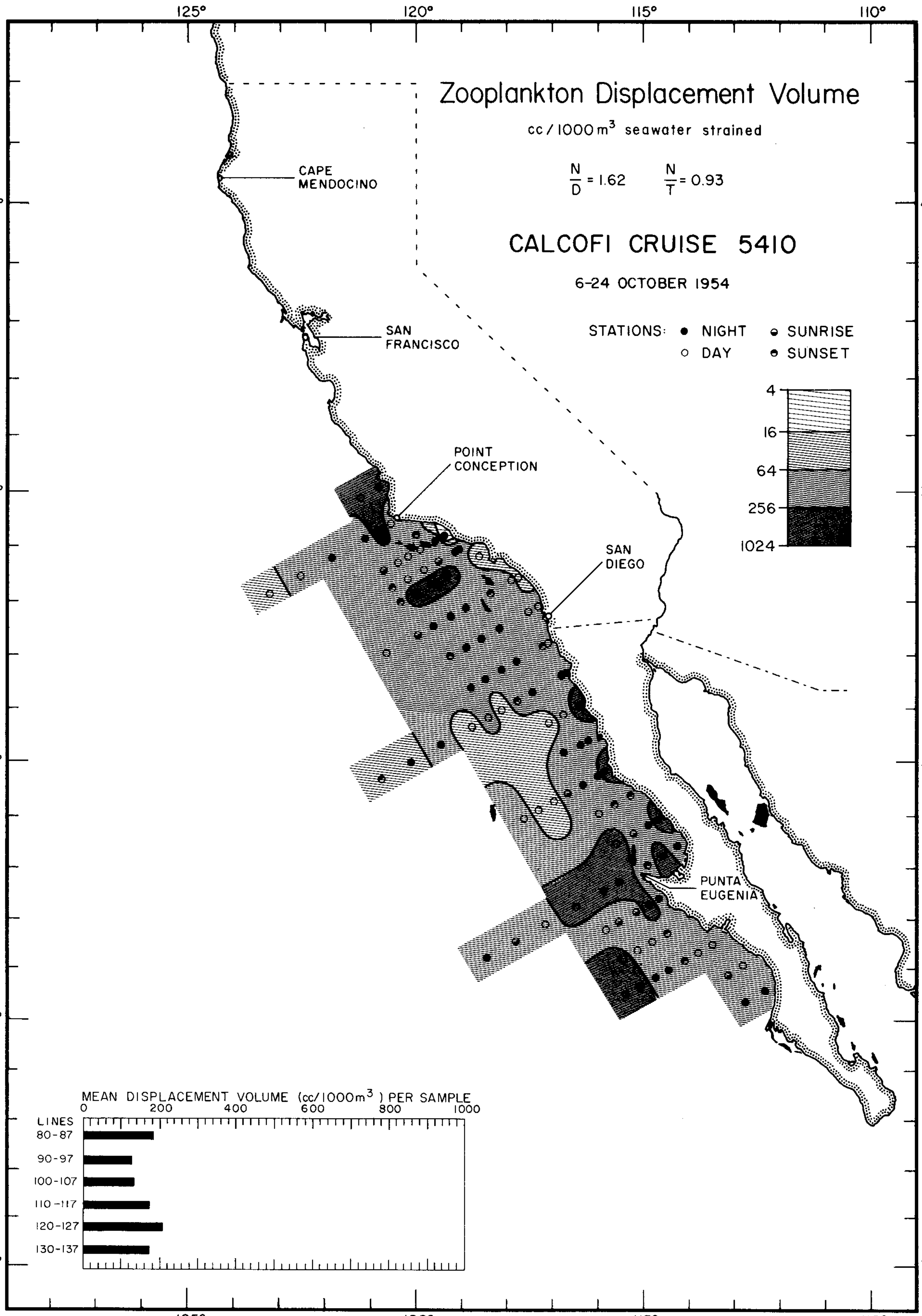
Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 0.90   N/T = 0.94
CALCOFI CRUISE 6609
7 - 24 SEPTEMBER 1966
STATIONS: ● NIGHT ○ DAY ◒ SUNRISE ◓ SUNSET
16
64
256
1024
2
3
4
CAPE MENDOCINO
SAN FRANCISCO
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000m) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97
100-107
110-119
120

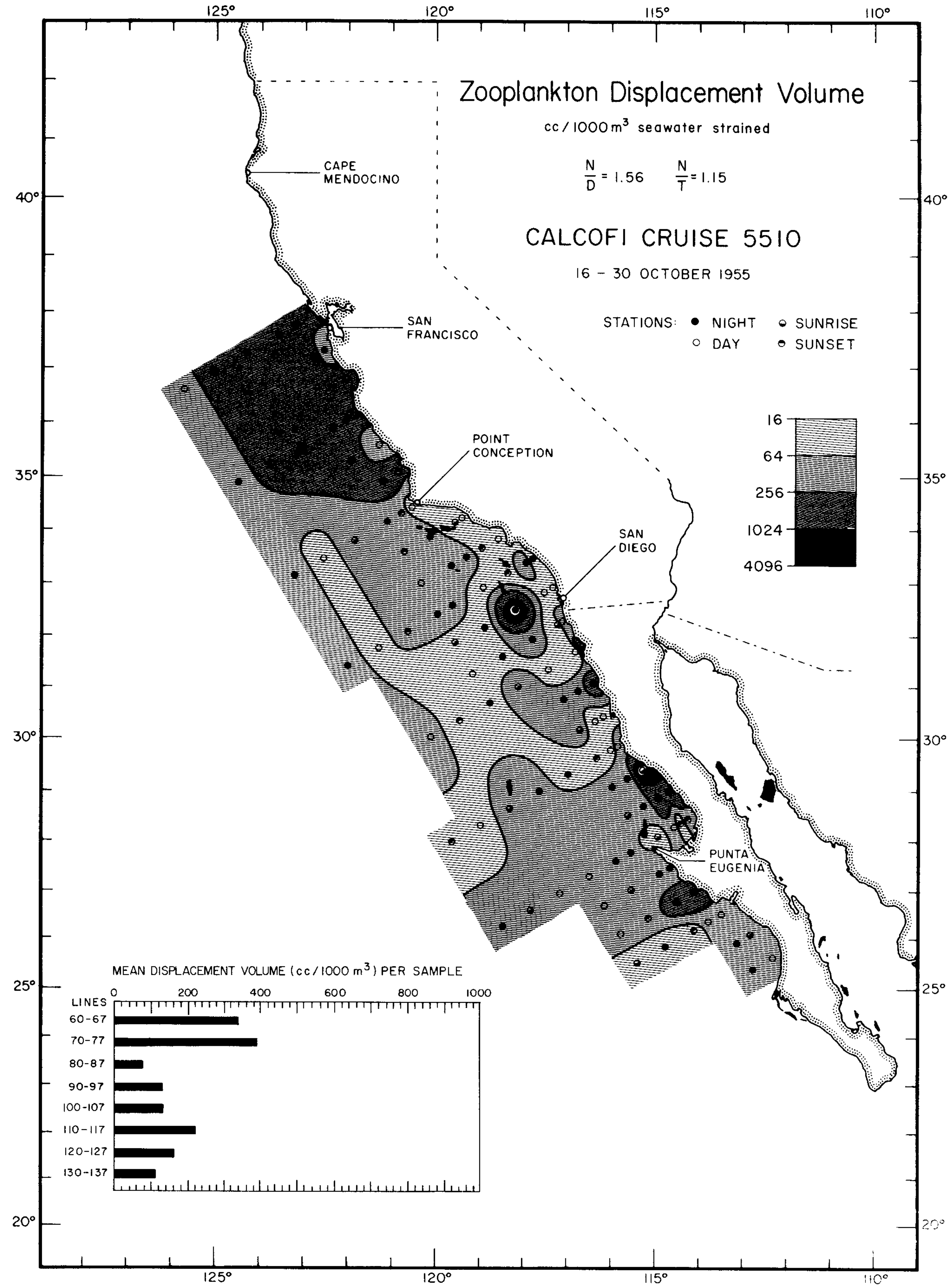


Zooplankton Displacement Volume

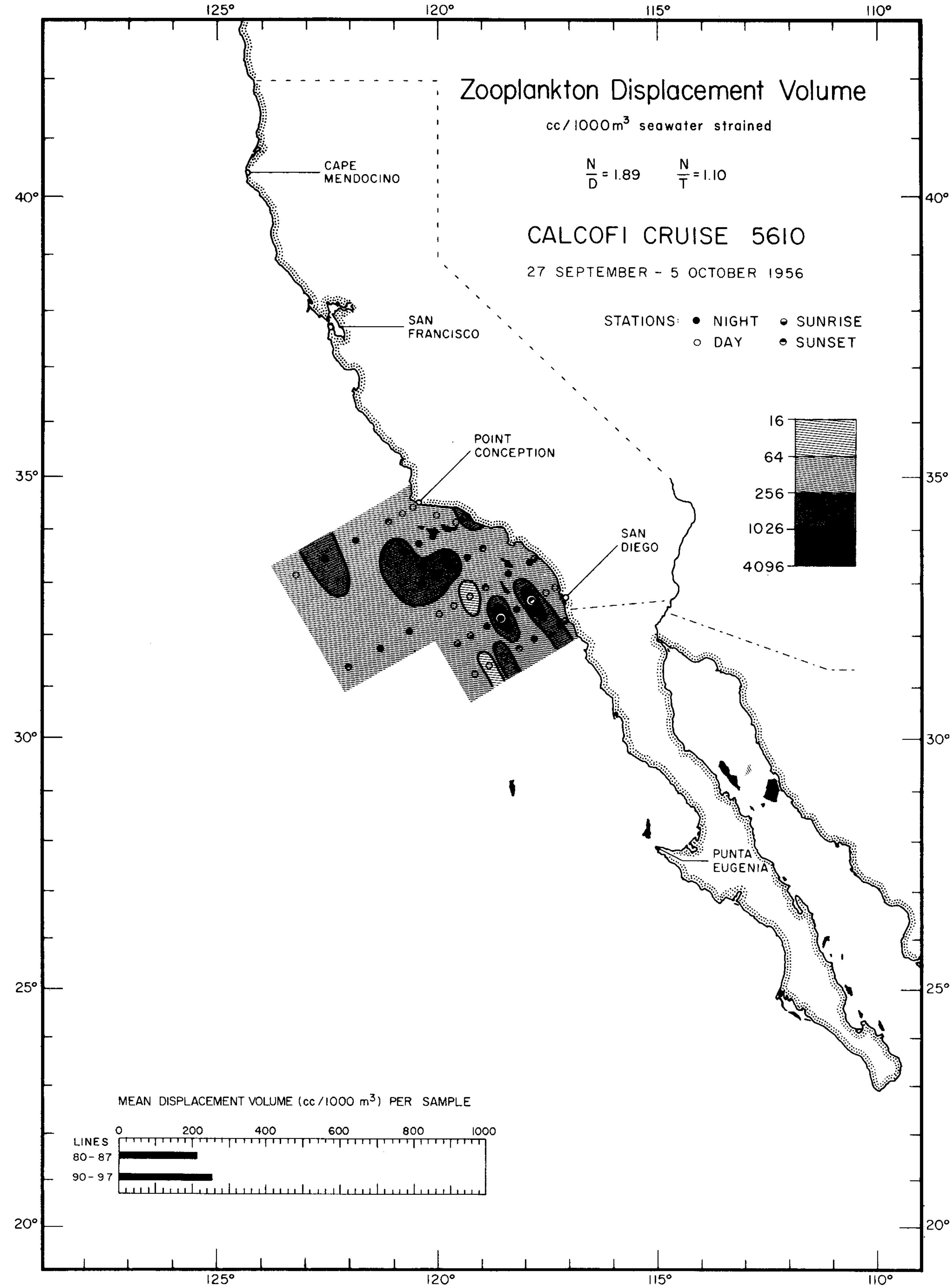

125°
120°
115°
110°
Zooplankton Displacement Volume
cc / 1000 m3 seawater strained
N/D = 1.89
N/T = 1.89
CALCOFI CRUISE 5210
8 - 22 OCTOBER 1952
STATIONS:
NIGHT
DAY
SUNRISE
SUNSET
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
16
64
256
1024
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m3) PER SAMPLE
0
200
400
600
800
1000
LINES
60 - 67
70 - 77
80 - 87
90 - 97
100-107
110-117
120-127
130-137


Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.36 N/T = 1.15
CALCOFI CRUISE 5310
7 - 24 OCTOBER 1953
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
83-87
90-97
100-107
110-117
120-127
130-137

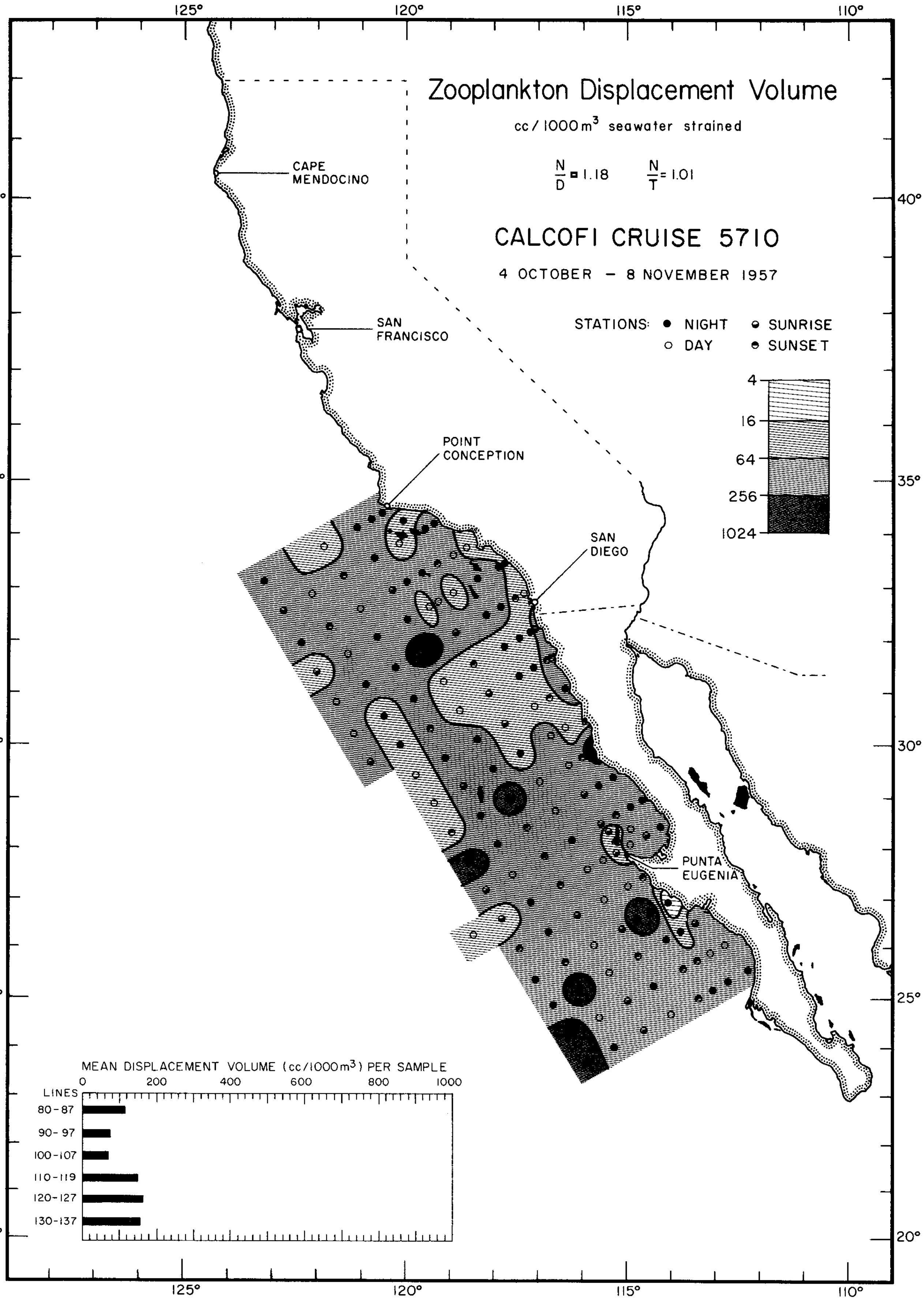

Zooplankton Displacement Volume
cc / 1000 m³ seawater strained
N/D = 1.62 N/T = 0.93
CALCOFI CRUISE 5410
6-24 OCTOBER 1954
STATIONS: NIGHT DAY SUNRISE SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125° 120° 115° 110°
40° 35° 30° 25° 20°
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0 200 400 600 800 1000
LINES
80-87
90-97
100-107
110-117
120-127
130-137



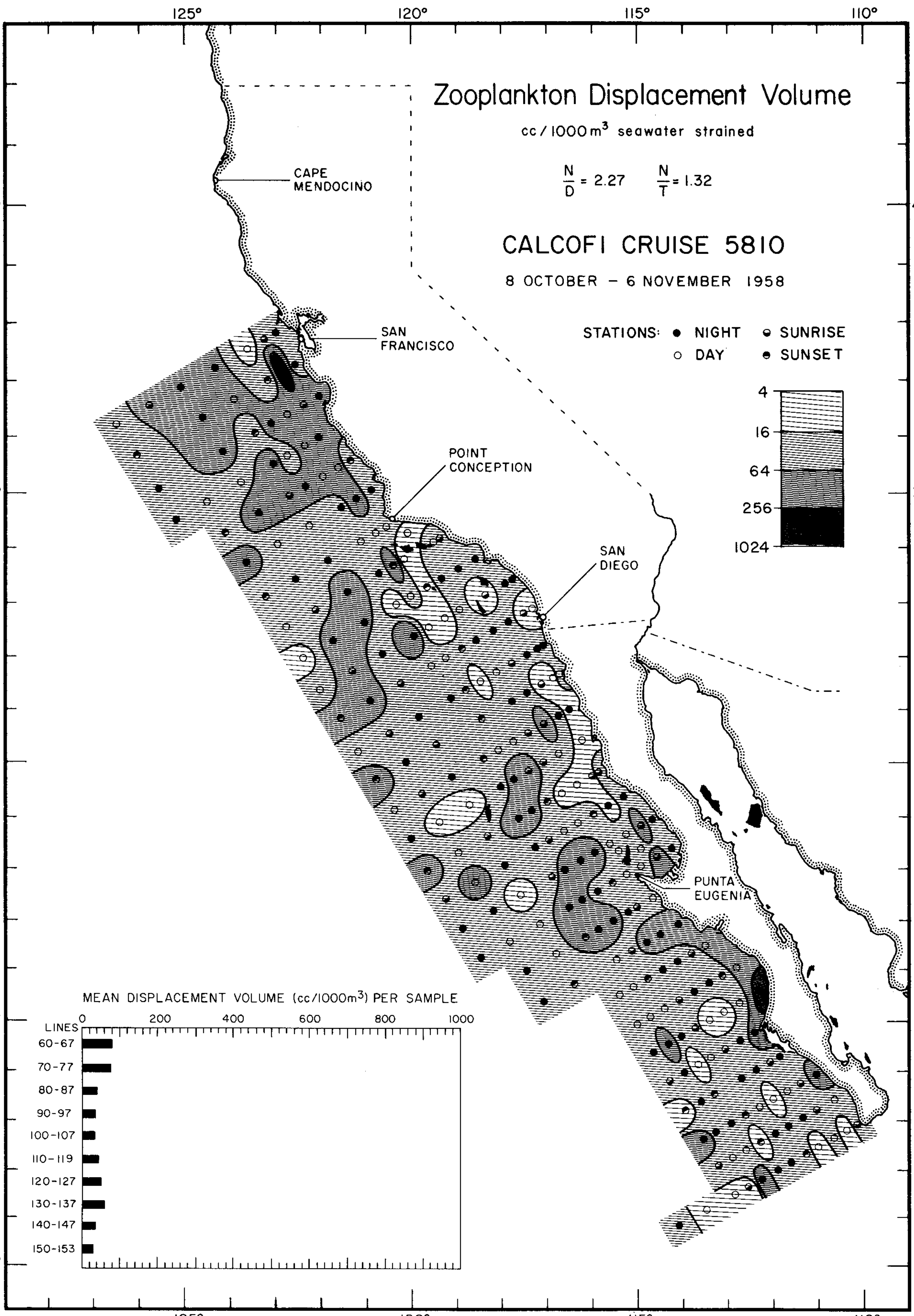
125°
120°
115°
110°
40°
35°
30°
25°
20°
Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.56   N/T = 1.15
CALCOFI CRUISE 5510
16 – 30 OCTOBER 1955
STATIONS: ● NIGHT ○ DAY SUNRISE SUNSET
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
60-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137



Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.89
N/T = 1.10
CALCOFI CRUISE 5610
27 SEPTEMBER - 5 OCTOBER 1956
STATIONS:
NIGHT
SUNRISE
DAY
SUNSET
16
64
256
1026
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97

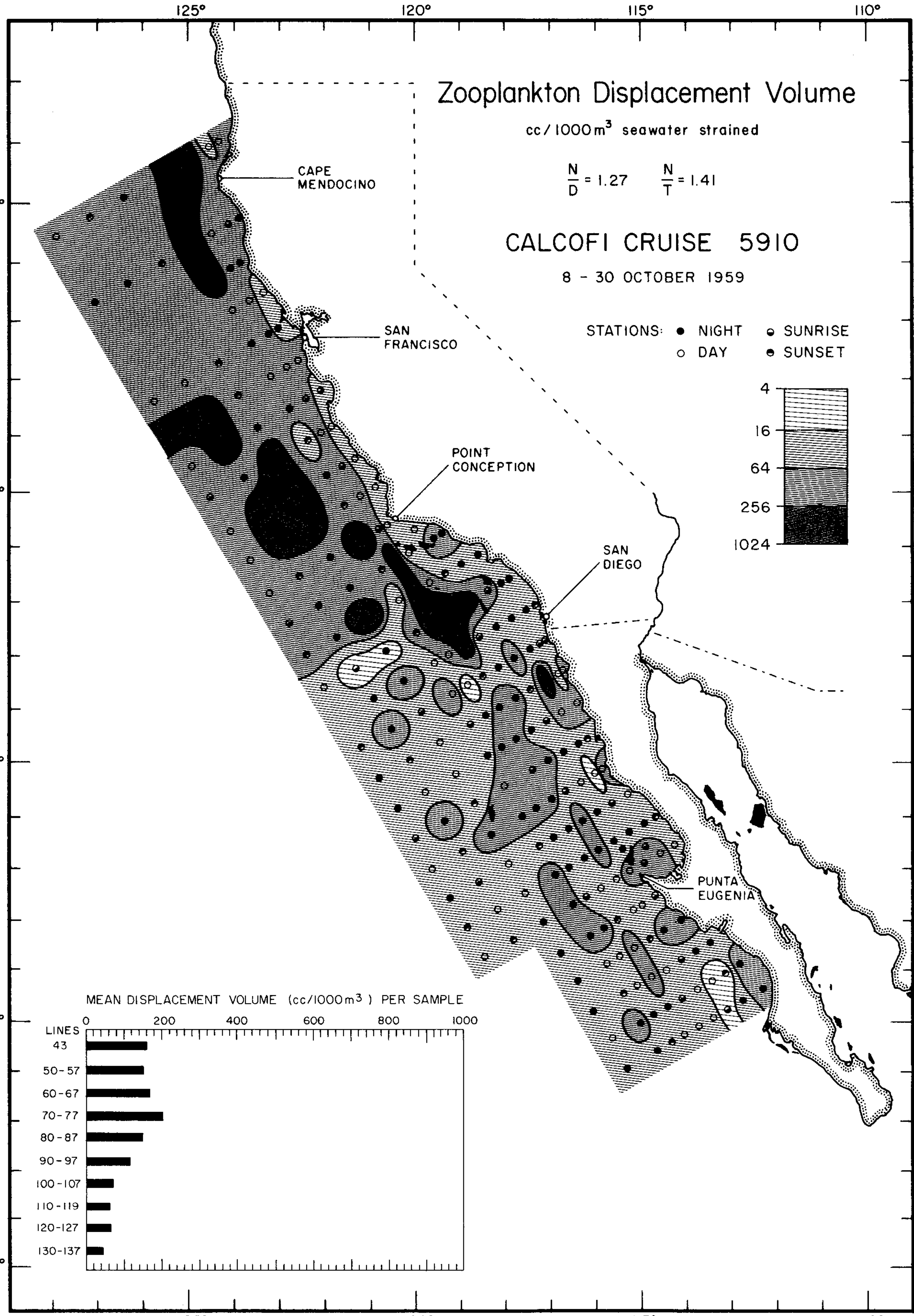


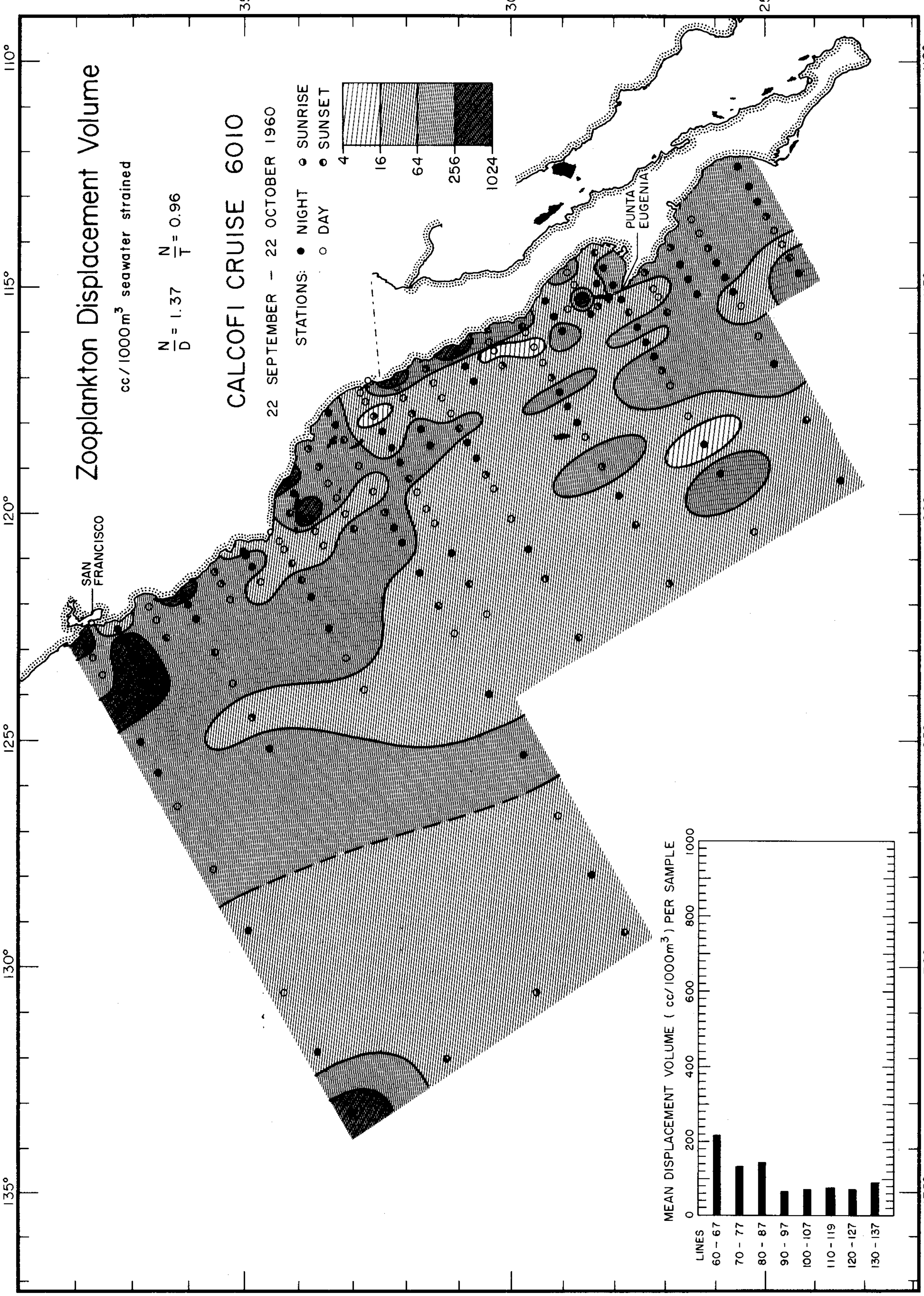
Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.18 N/T = 1.01
CALCOFI CRUISE 5710
4 OCTOBER – 8 NOVEMBER 1957
STATIONS: NIGHT SUNRISE
DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97
100-107
110-119
120-127
130-137



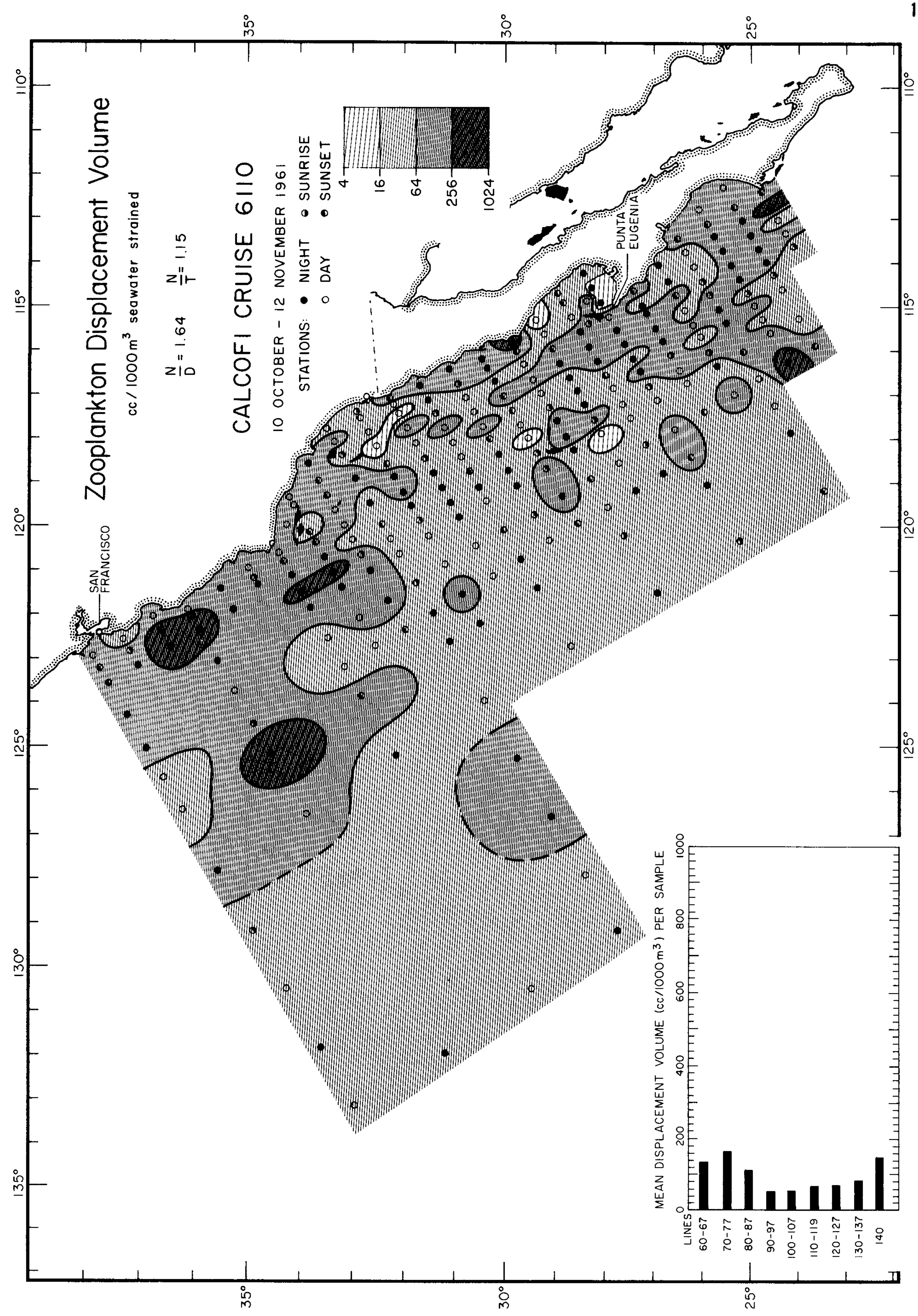
Zooplankton Displacement Volume

5810

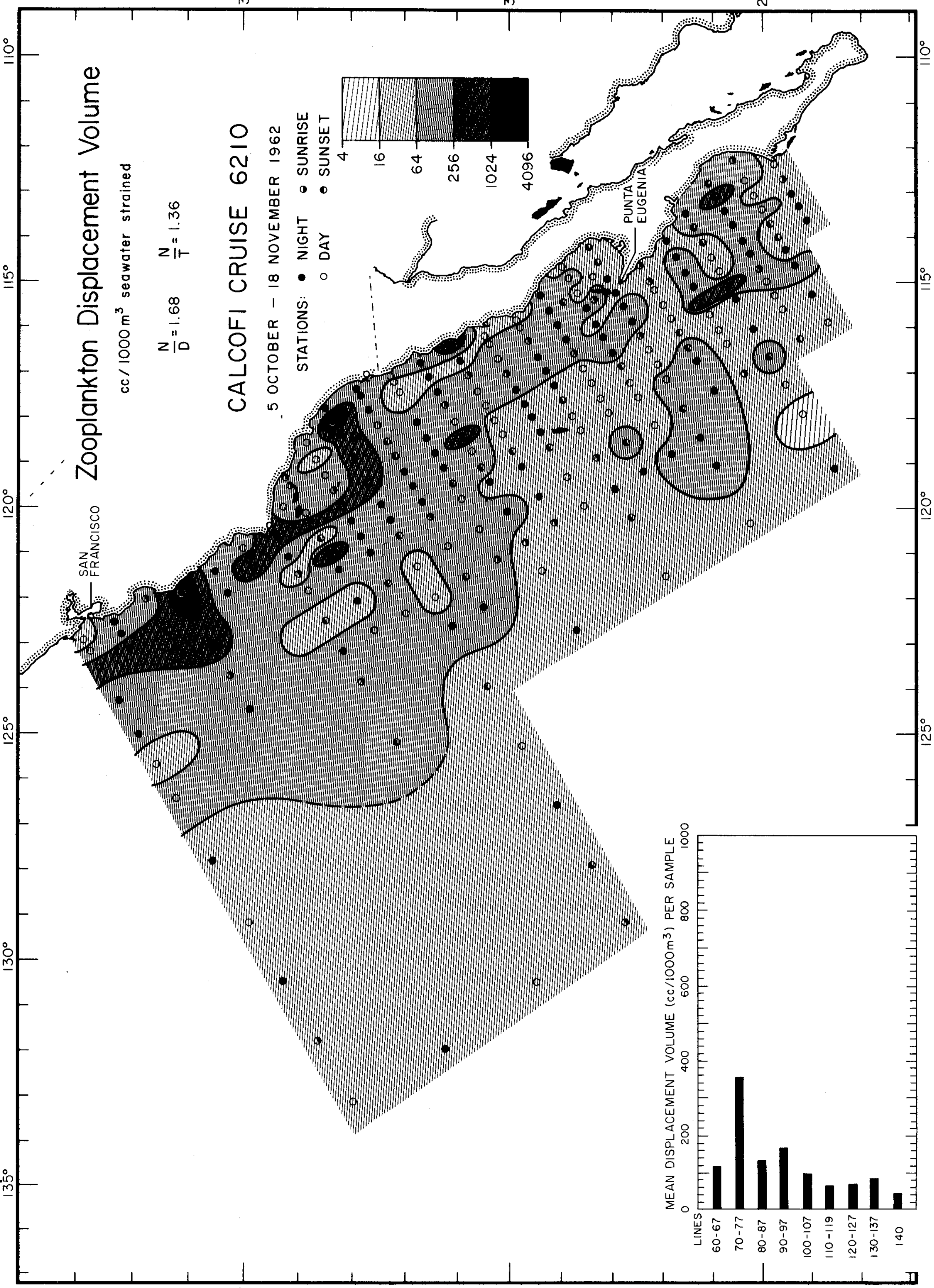

Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.27 N/T = 1.41
CALCOFI CRUISE 5910
8 - 30 OCTOBER 1959
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0 200 400 600 800 1000
LINES
43
50-57
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137



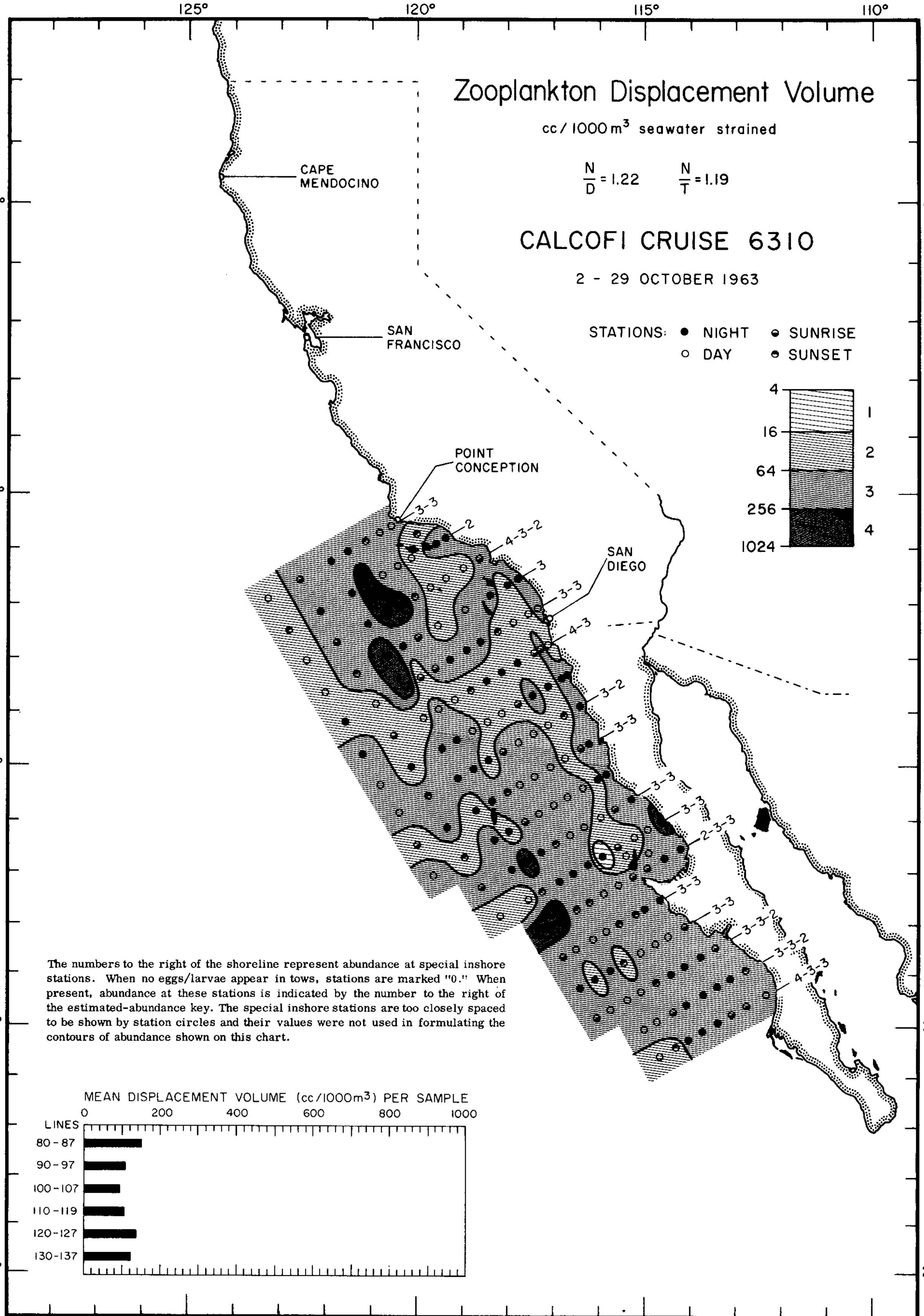
Zooplankton Displacement Volume



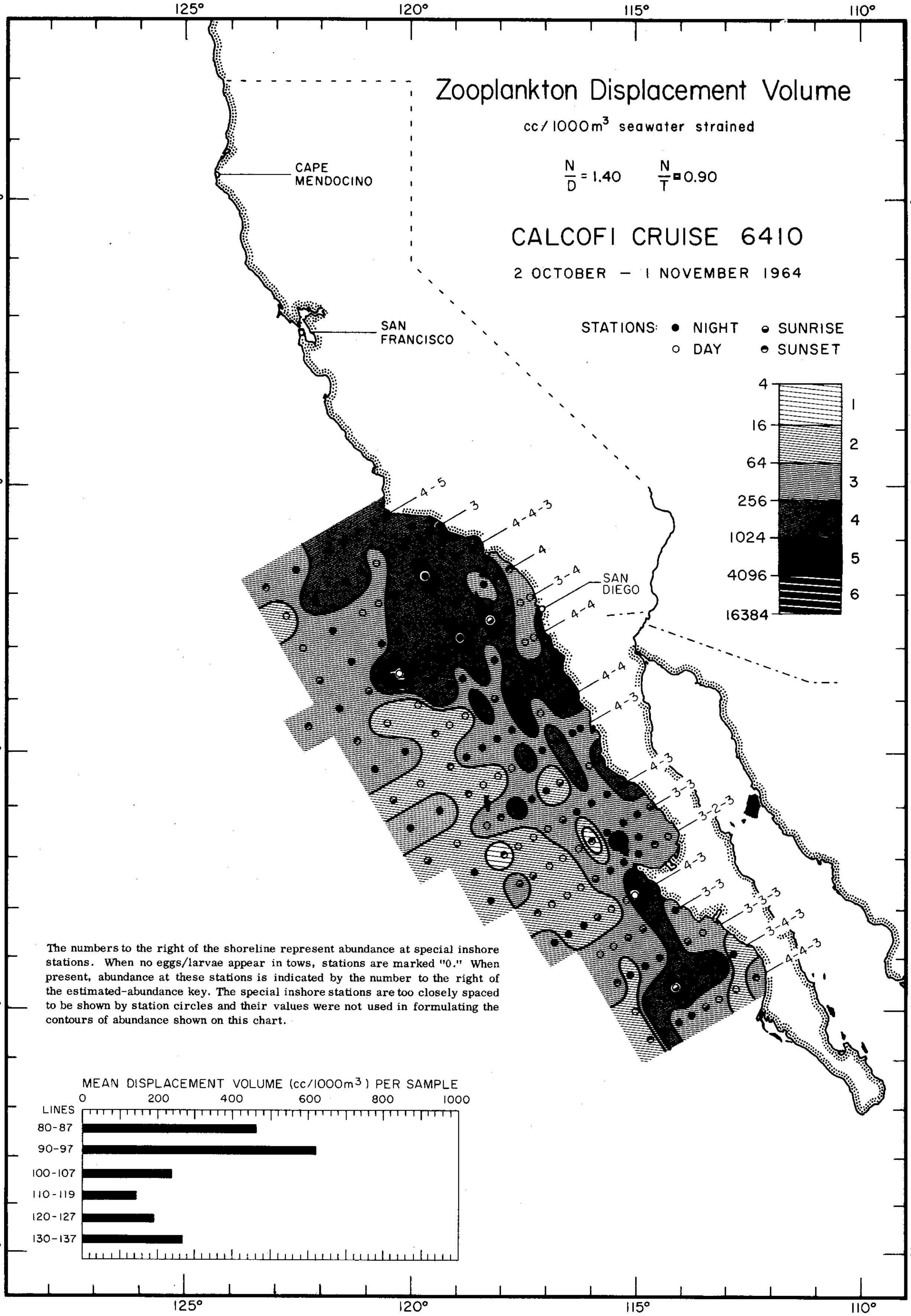
Zooplankton Displacement Volume

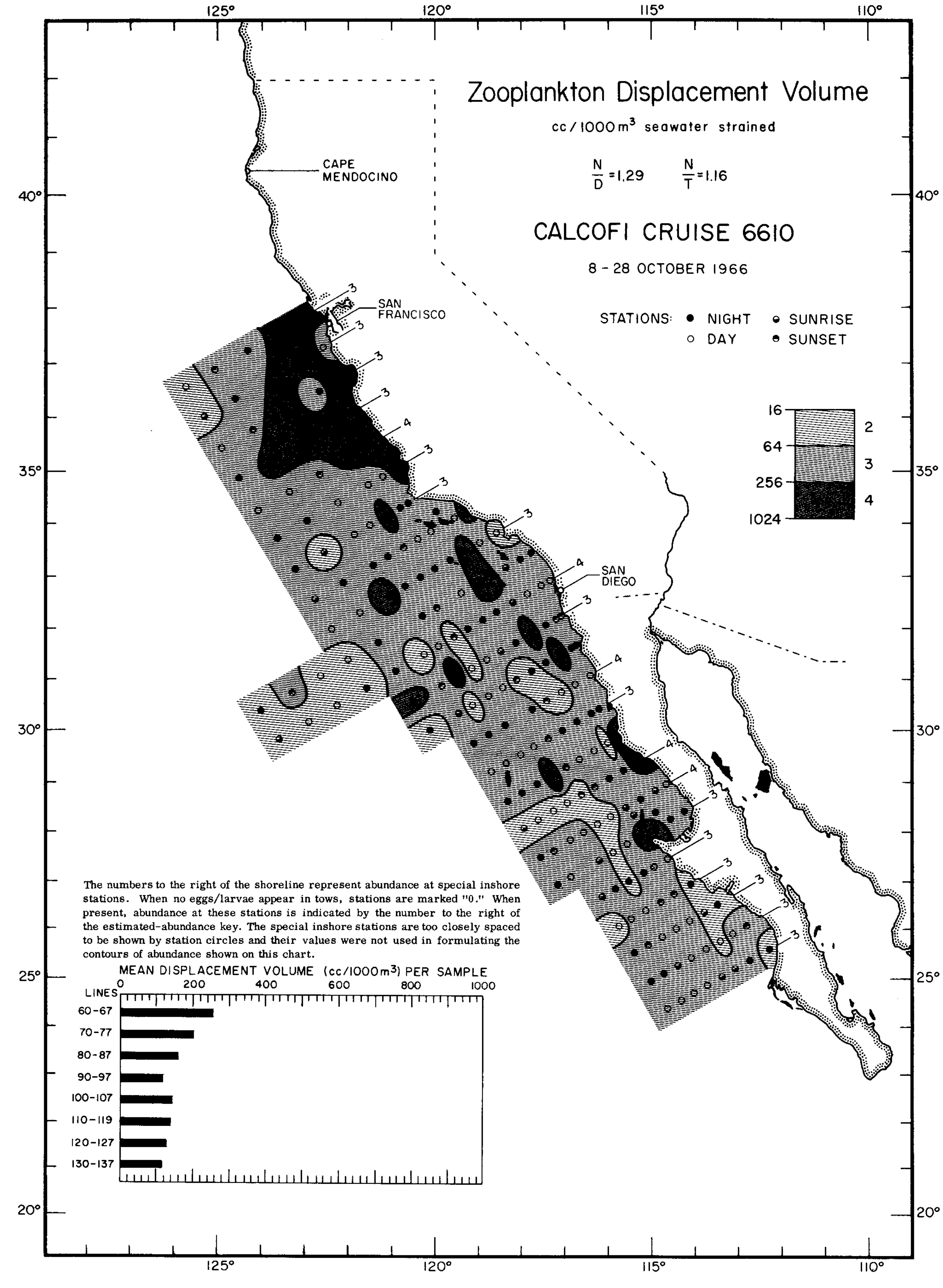


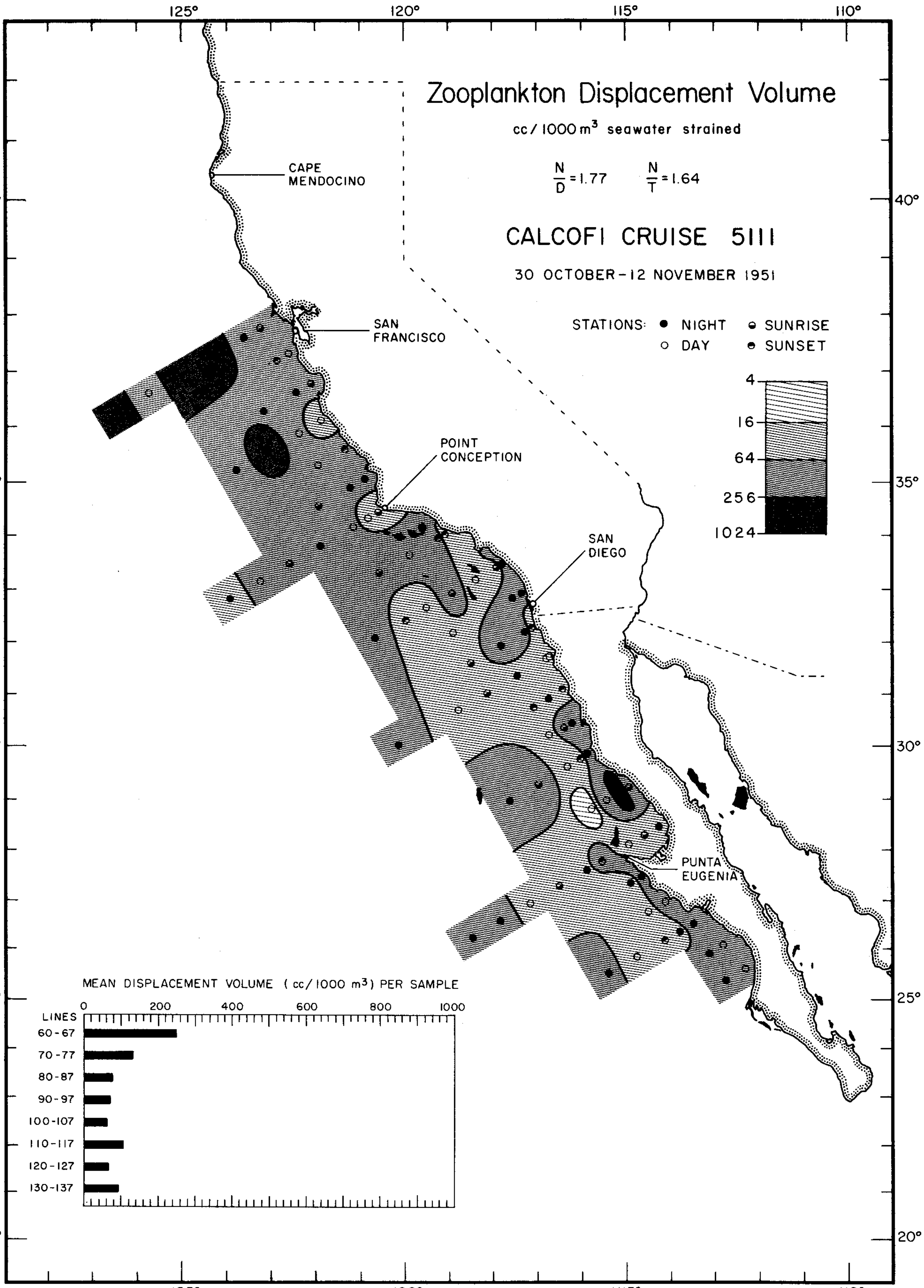
Zooplankton Displacement Volume

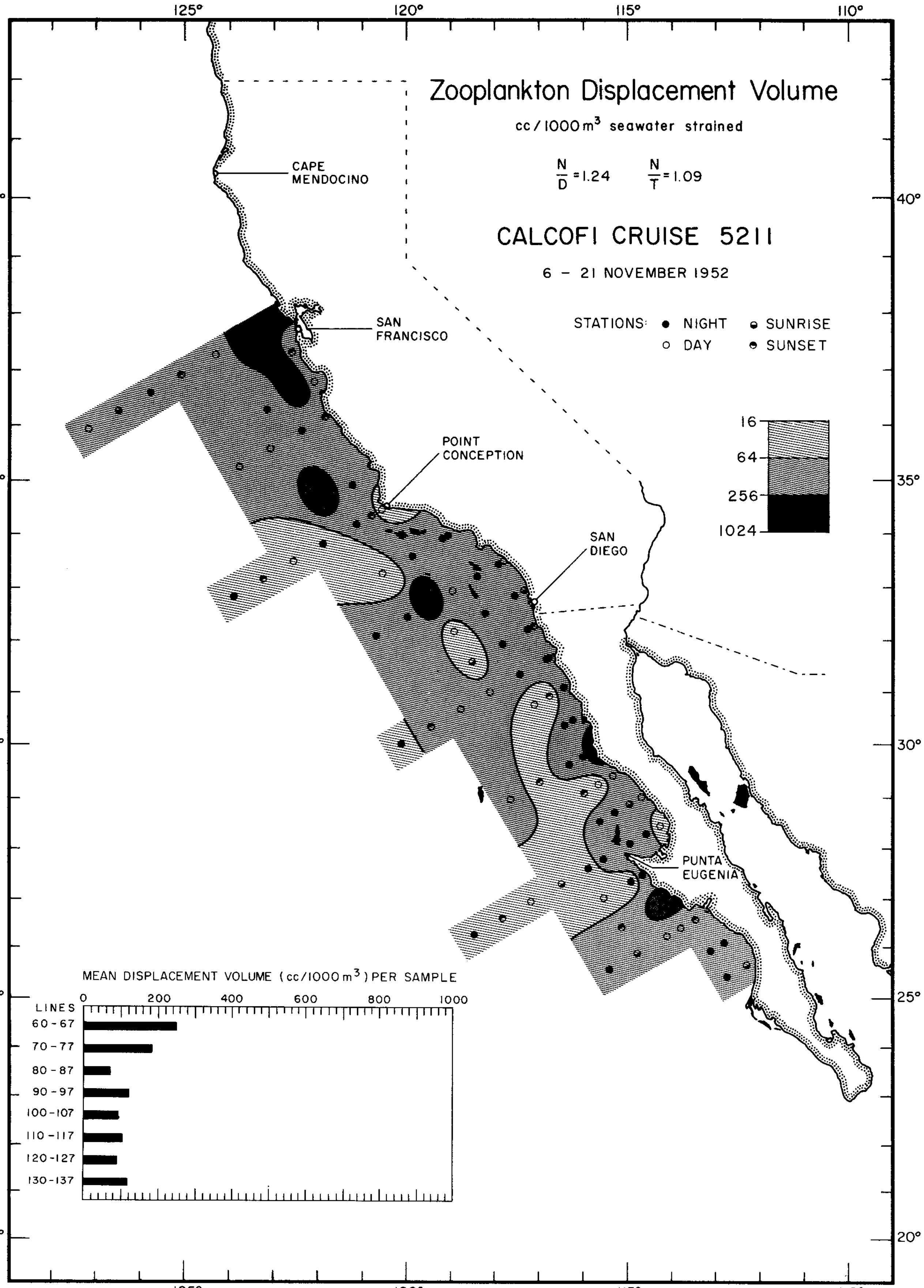


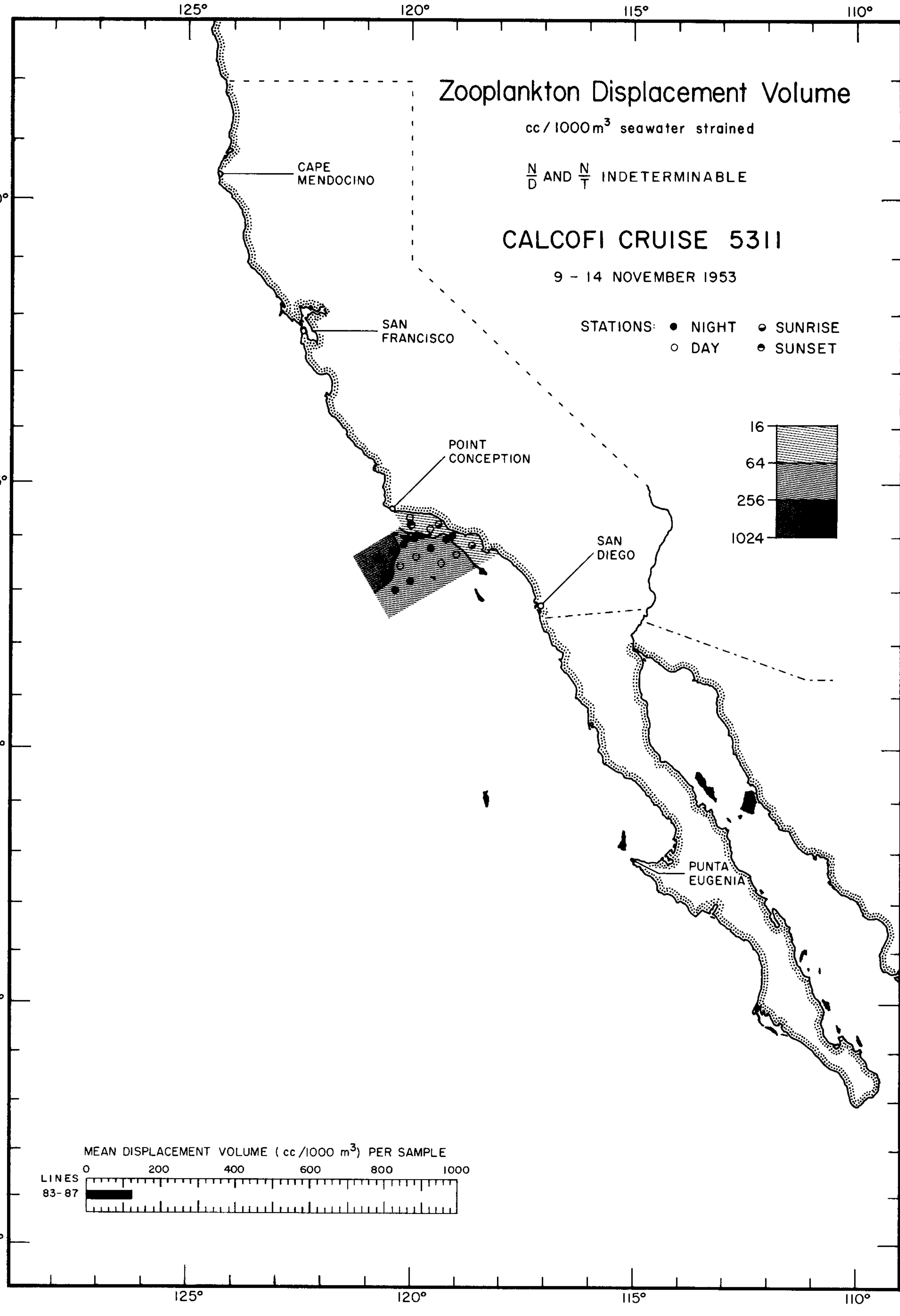
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.

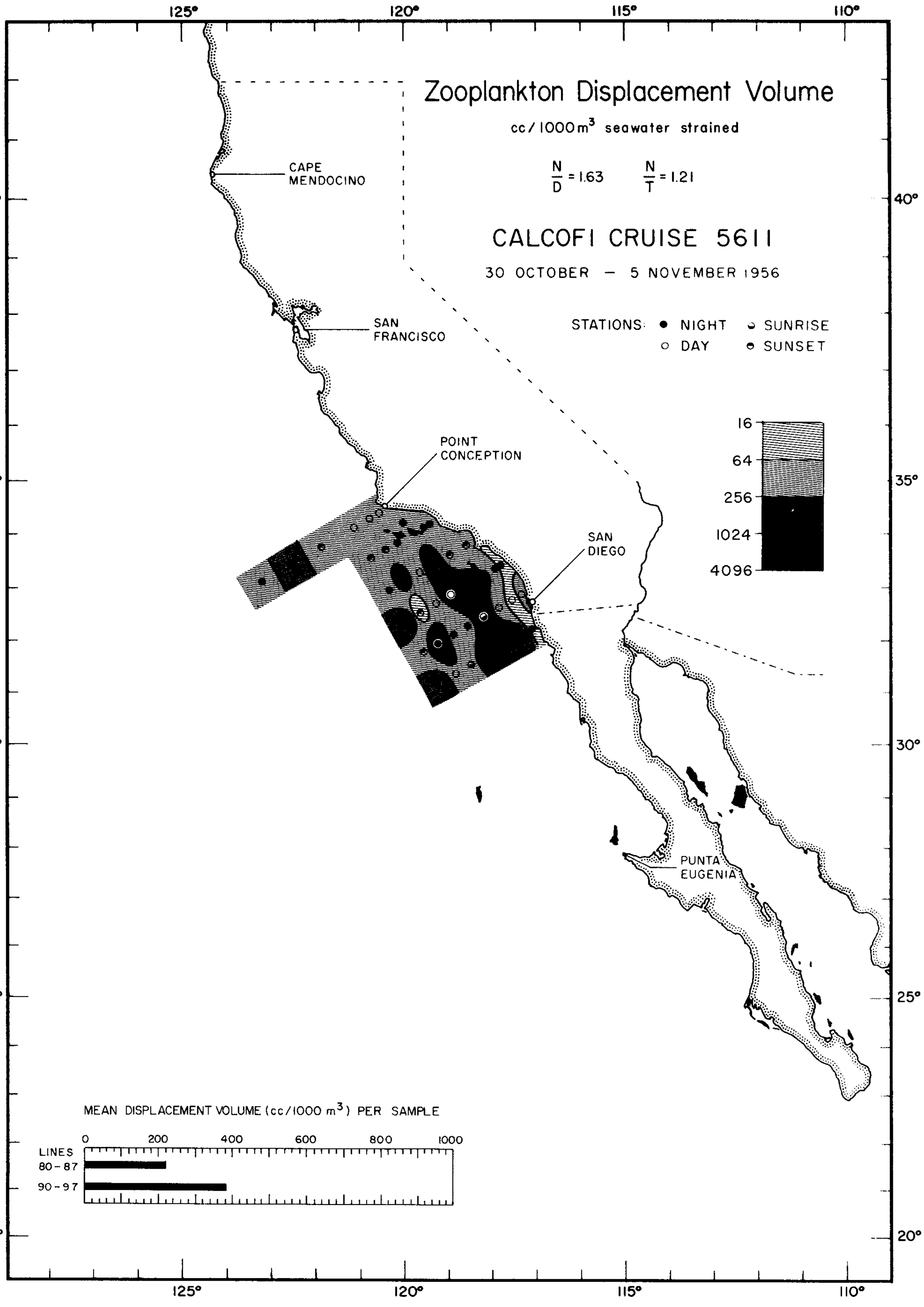

Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.40 N/T = 0.90
CALCOFI CRUISE 6410
2 OCTOBER – 1 NOVEMBER 1964
STATIONS: ● NIGHT ◒ SUNRISE
○ DAY ◓ SUNSET
4 16 64 256 1024 4096 16384
1 2 3 4 5 6
CAPE MENDOCINO
SAN FRANCISCO
SAN DIEGO
125° 120° 115° 110°
40° 35° 30° 25° 20°
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0 200 400 600 800 1000
LINES
80-87
90-97
100-107
110-119
120-127
130-137

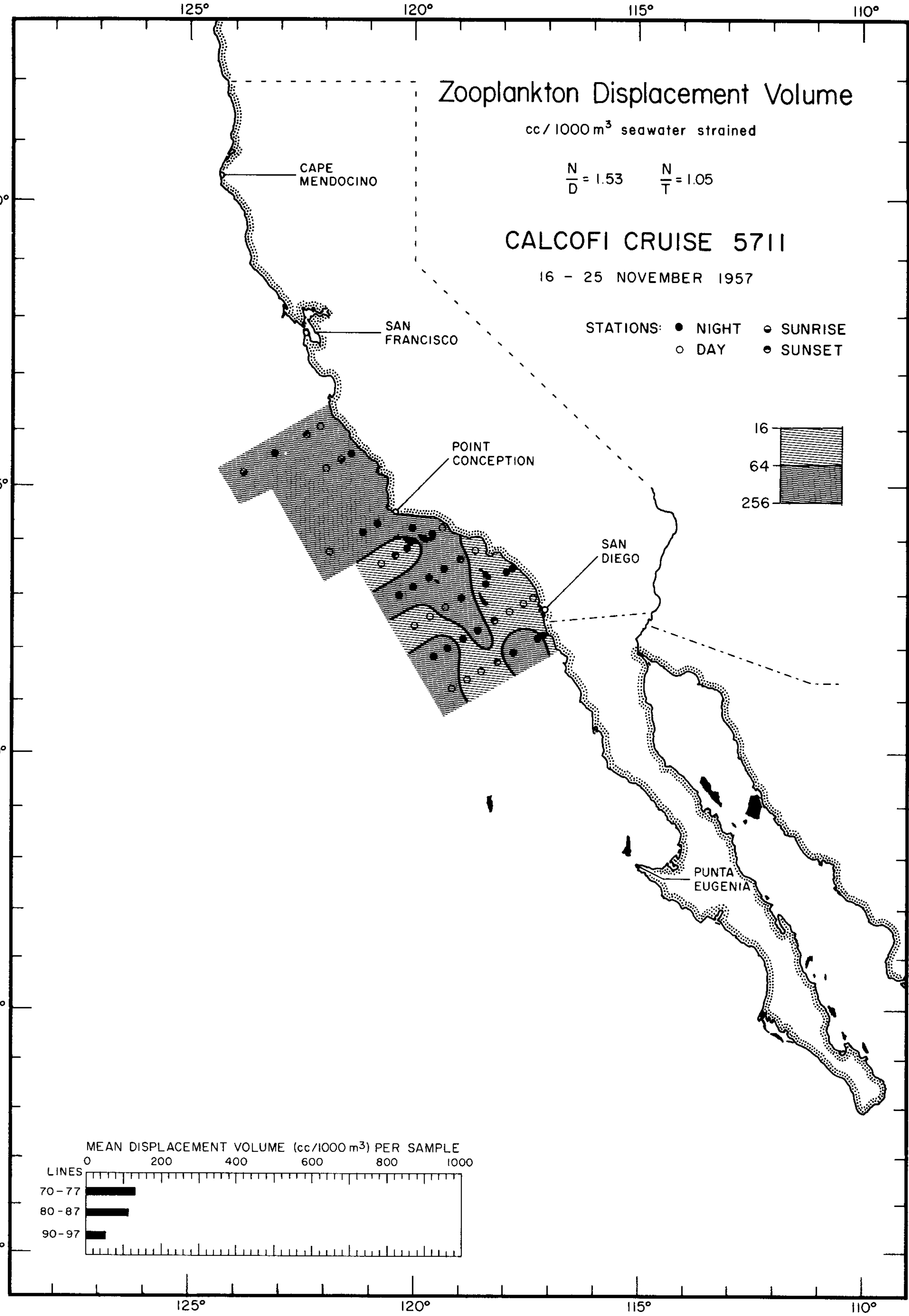

Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.29 N/T = 1.16
CALCOFI CRUISE 6610
8 - 28 OCTOBER 1966
STATIONS: ● NIGHT ○ DAY ◉ SUNRISE ◉ SUNSET
16 64 256 1024
2 3 4
CAPE MENDOCINO
SAN FRANCISCO
SAN DIEGO
125° 120° 115° 110°
40° 35° 30° 25° 20°
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0 200 400 600 800 1000
LINES
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137

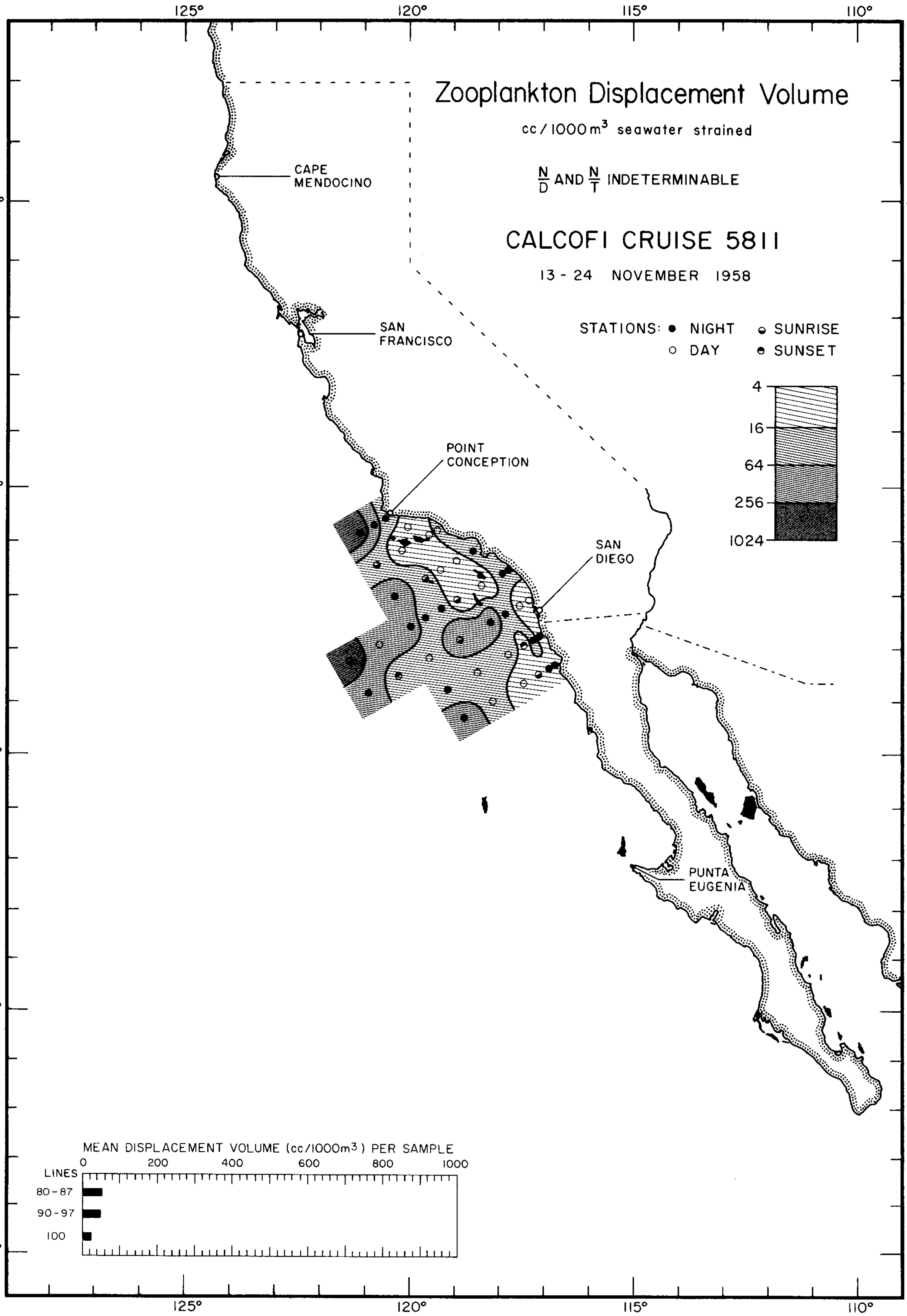

Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.77   N/T = 1.64
CALCOFI CRUISE 5111
30 OCTOBER - 12 NOVEMBER 1951
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000
LINES
60-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137

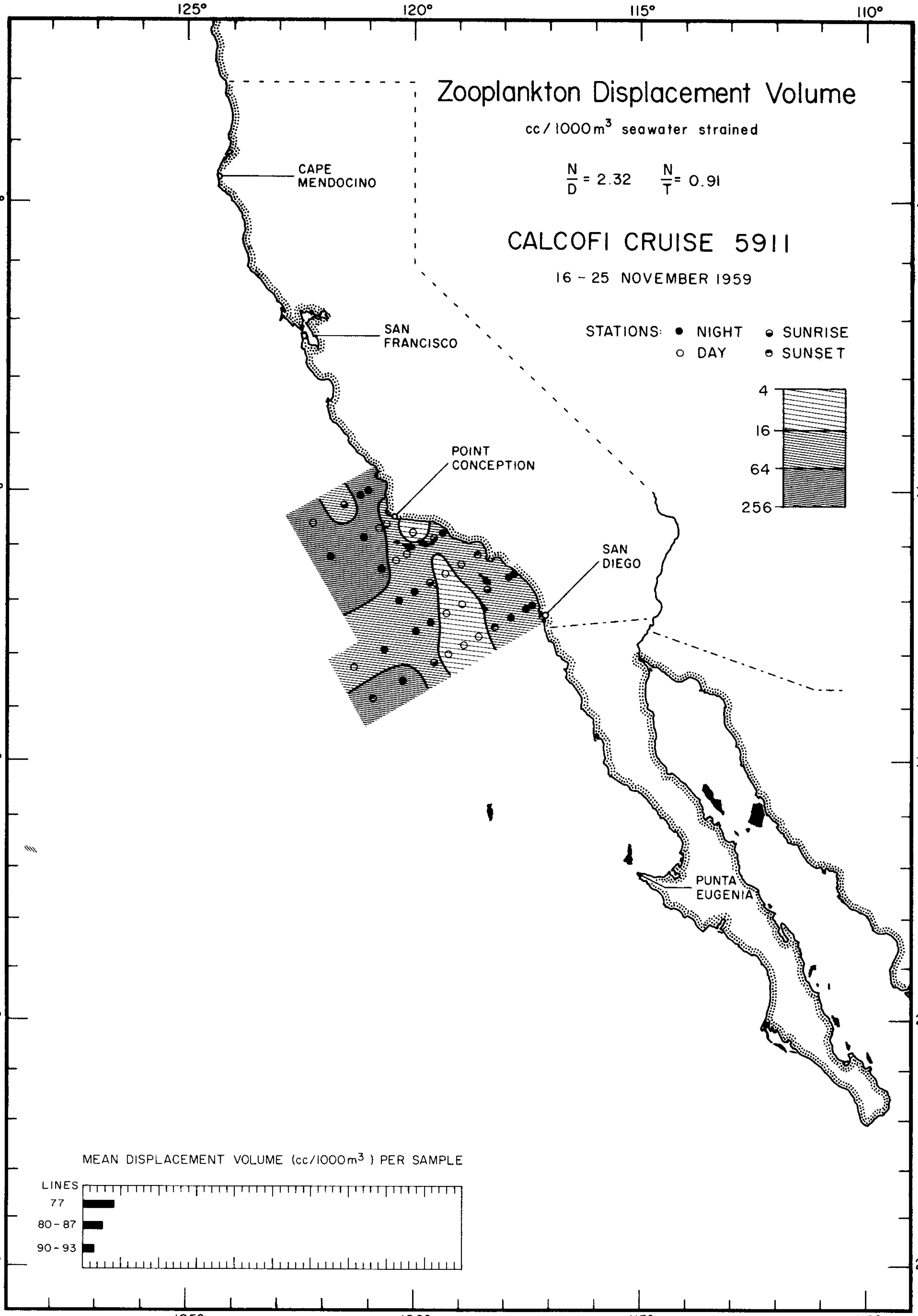

Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.24 N/T = 1.09
CALCOFI CRUISE 5211
6 - 21 NOVEMBER 1952
STATIONS: NIGHT SUNRISE
DAY SUNSET
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
LINES
0
200
400
600
800
1000
60-67
70-77
80-87
90-97
100-107
110-117
120-127
130-137


125°
120°
115°
110°
Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D AND N/T INDETERMINABLE
CALCOFI CRUISE 5311
9 - 14 NOVEMBER 1953
STATIONS: NIGHT SUNRISE
DAY SUNSET
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
16
64
256
1024
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
83-87


Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.63   N/T = 1.21
CALCOFI CRUISE 5611
30 OCTOBER — 5 NOVEMBER 1956
STATIONS: NIGHT SUNRISE DAY SUNSET
16
64
256
1024
4096
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125° 120° 115° 110°
40° 35° 30° 25° 20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000
LINES
80-87
90-97

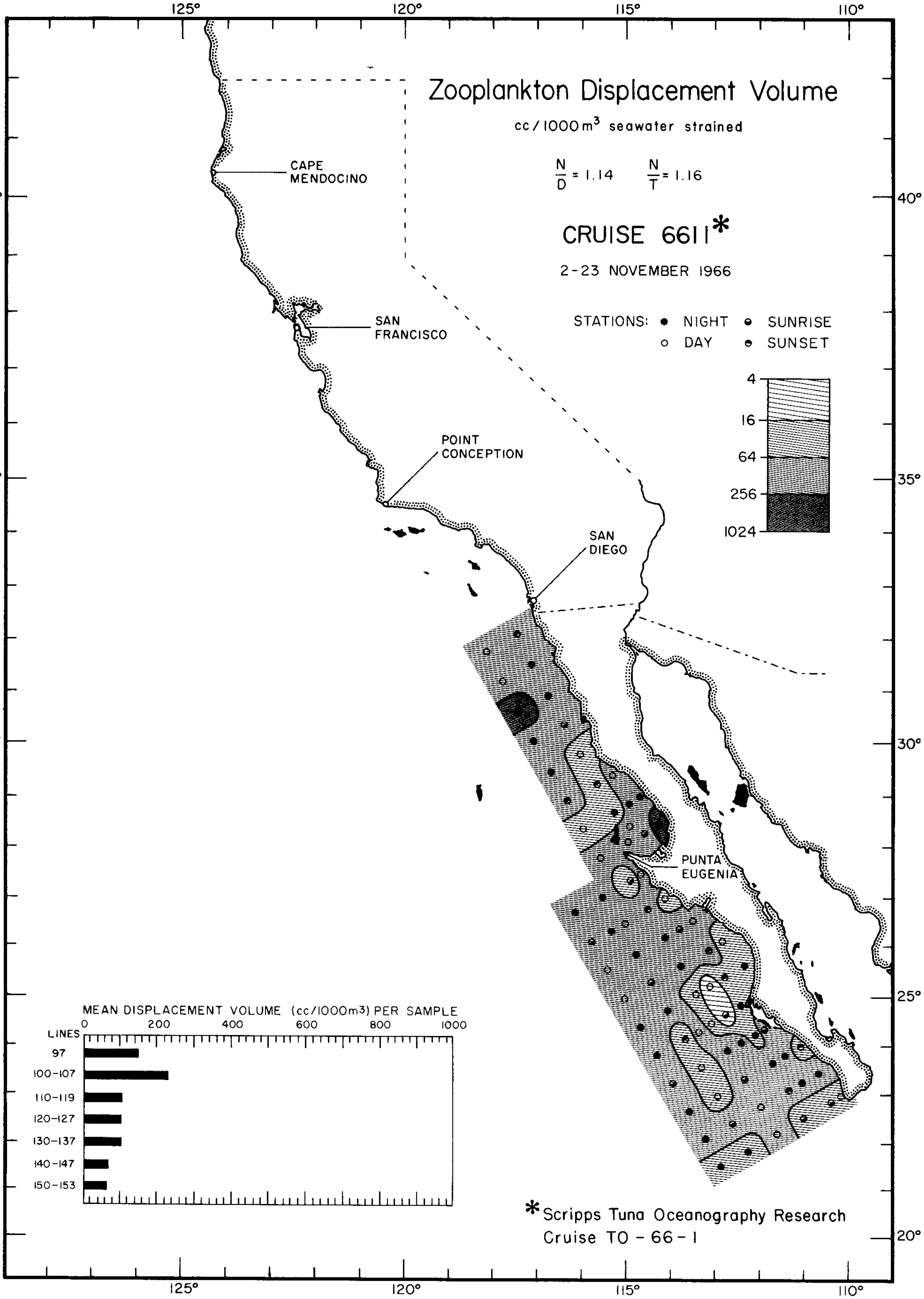

Zooplankton Displacement Volume
cc / 1000 m³ seawater strained
N/D = 1.53   N/T = 1.05
CALCOFI CRUISE 5711
16 - 25 NOVEMBER 1957
STATIONS: ● NIGHT ○ DAY ⊖ SUNRISE ⊕ SUNSET
16
64
256
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
70-77
80-87
90-97

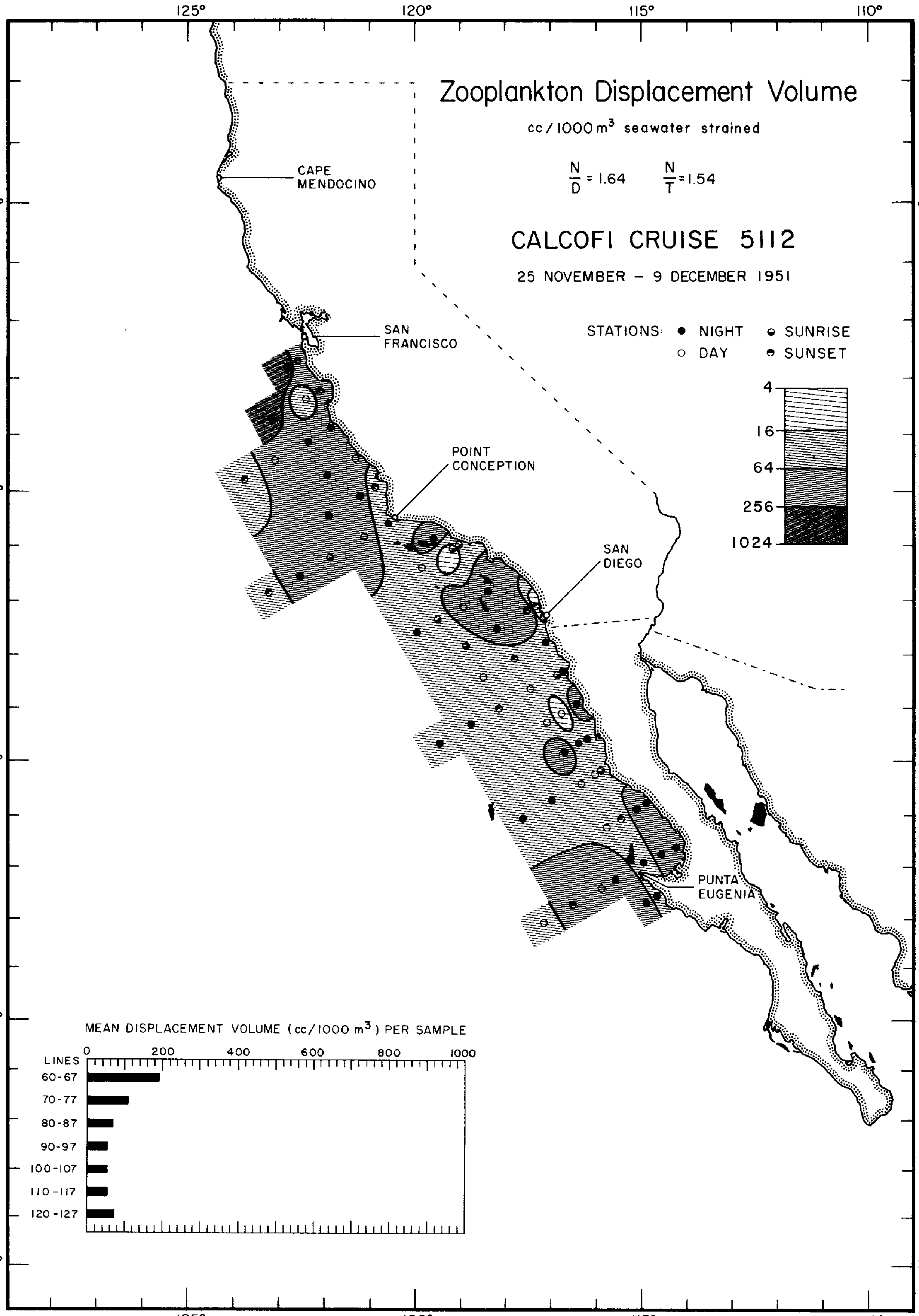

Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D AND N/T INDETERMINABLE
CALCOFI CRUISE 5811
13 - 24 NOVEMBER 1958
STATIONS: ● NIGHT ○ DAY SUNRISE SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125° 120° 115° 110°
40° 35° 30° 25° 20°
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0 200 400 600 800 1000
LINES
80-87
90-97
100



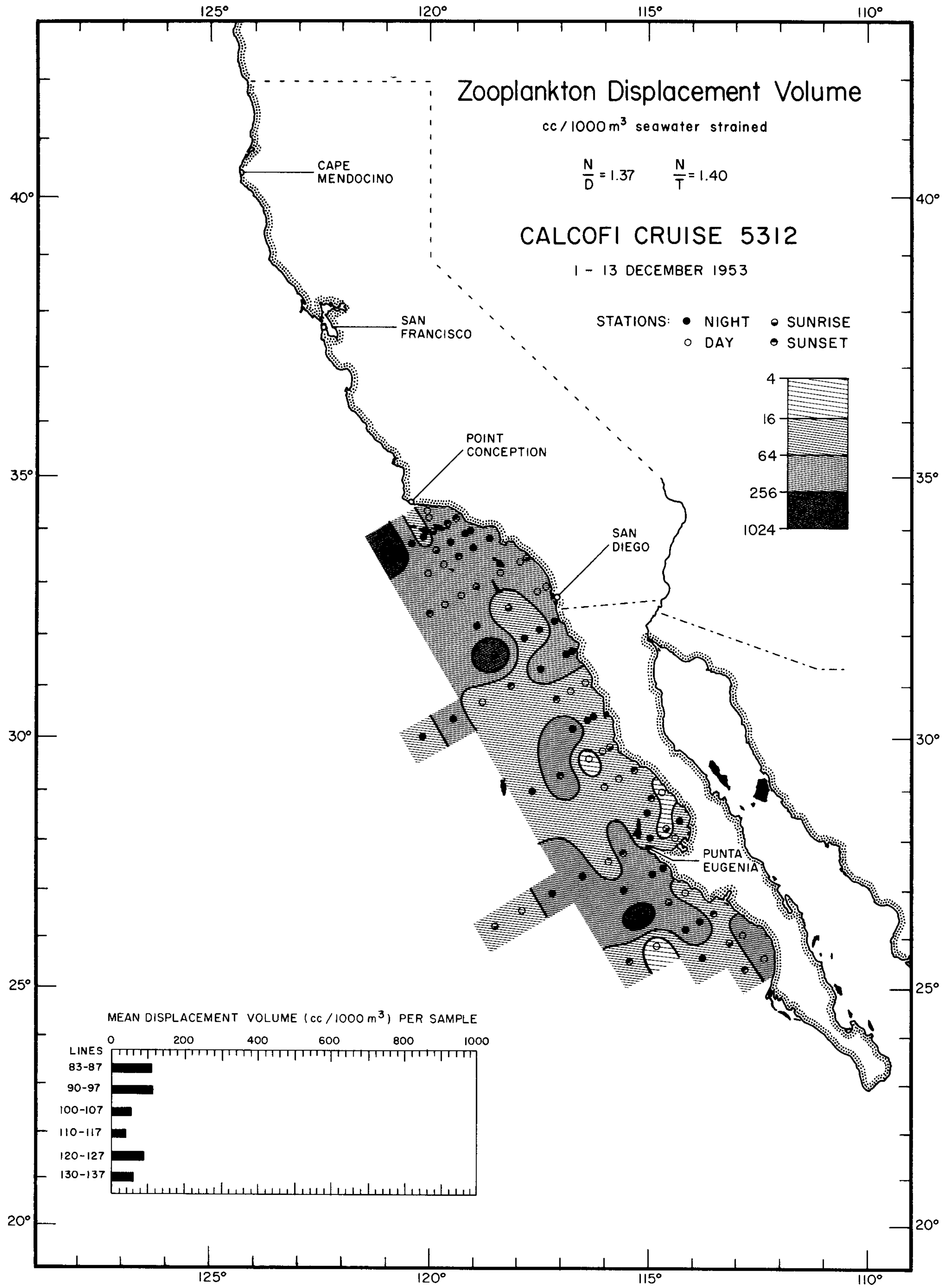
Zooplankton Displacement Volume

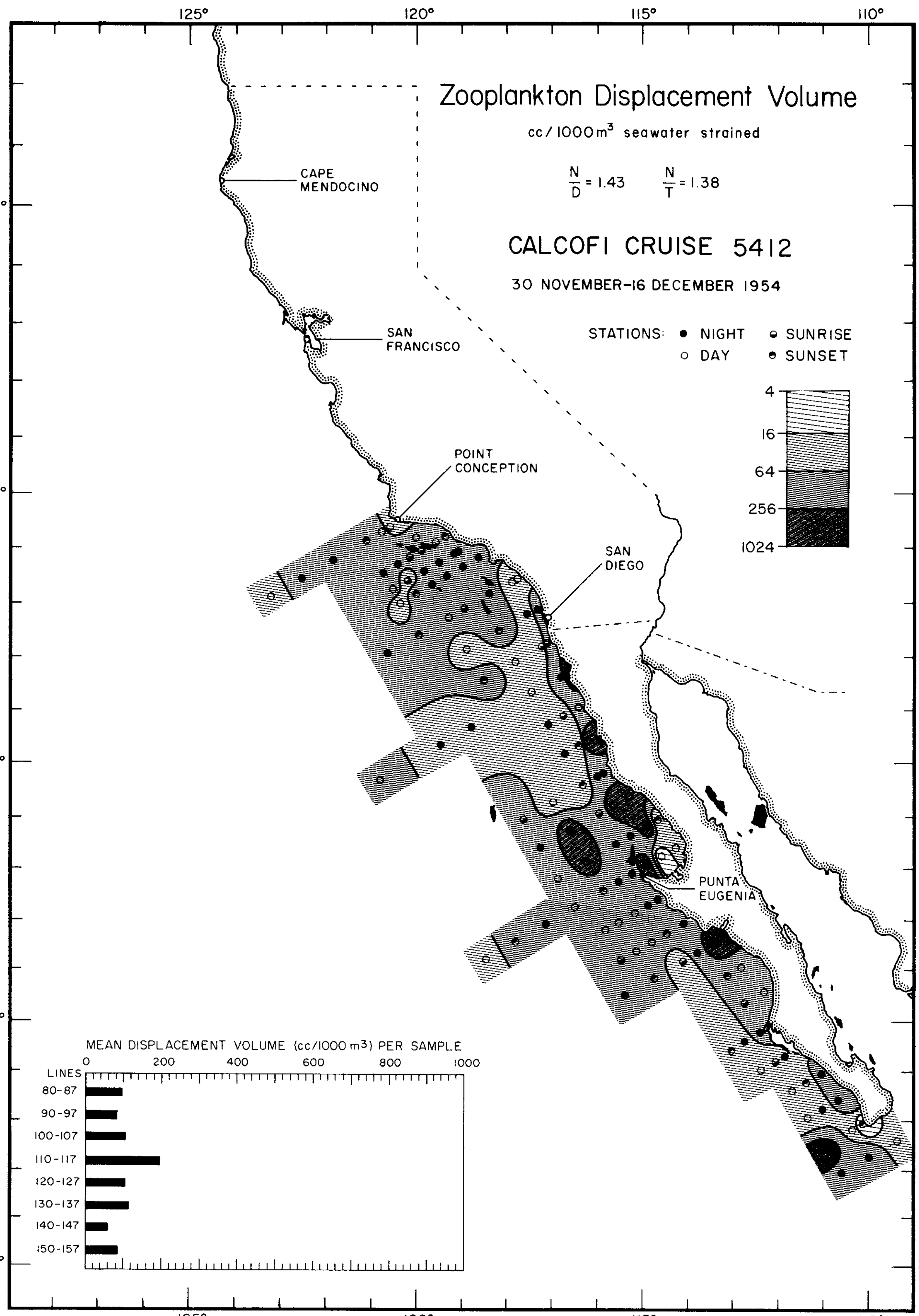
5911

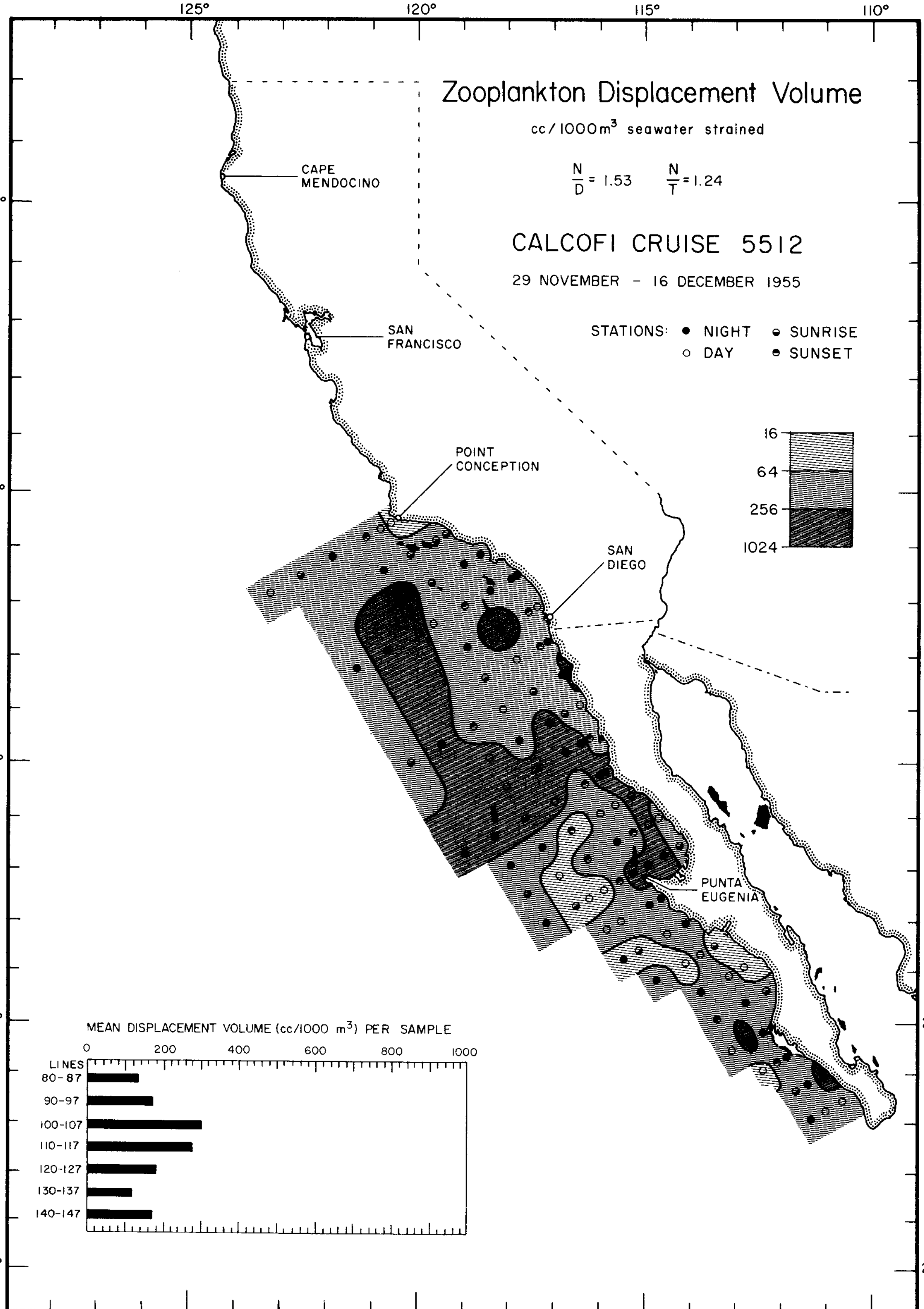

Zooplankton Displacement Volume
cc / 1000 m3 seawater strained
N/D = 1.14   N/T = 1.16
CRUISE 6611*
2-23 NOVEMBER 1966
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000m3) PER SAMPLE
0 200 400 600 800 1000
LINES
97
100-107
110-119
120-127
130-137
140-147
150-153
*Scripps Tuna Oceanography Research Cruise TO - 66 - 1

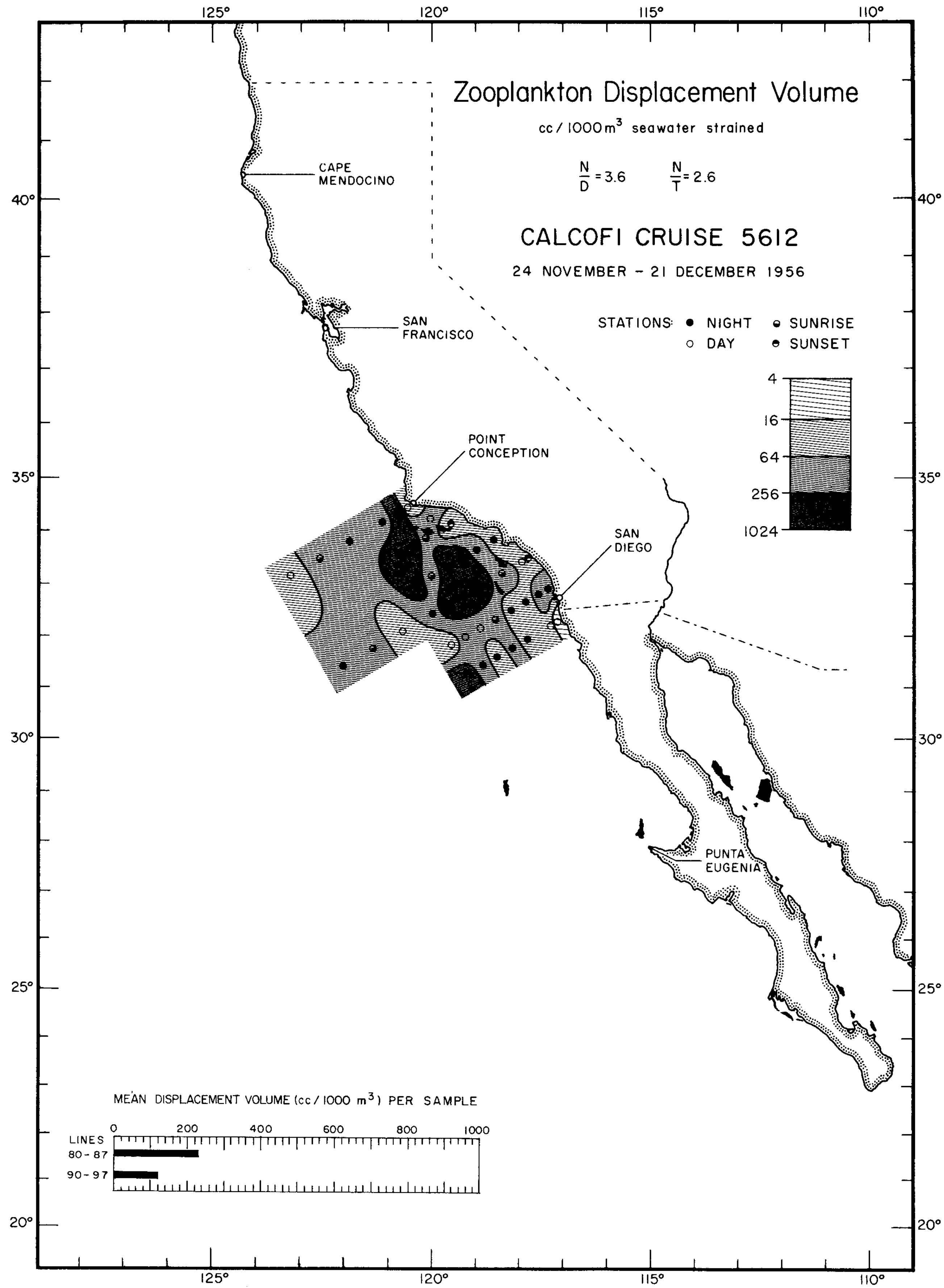


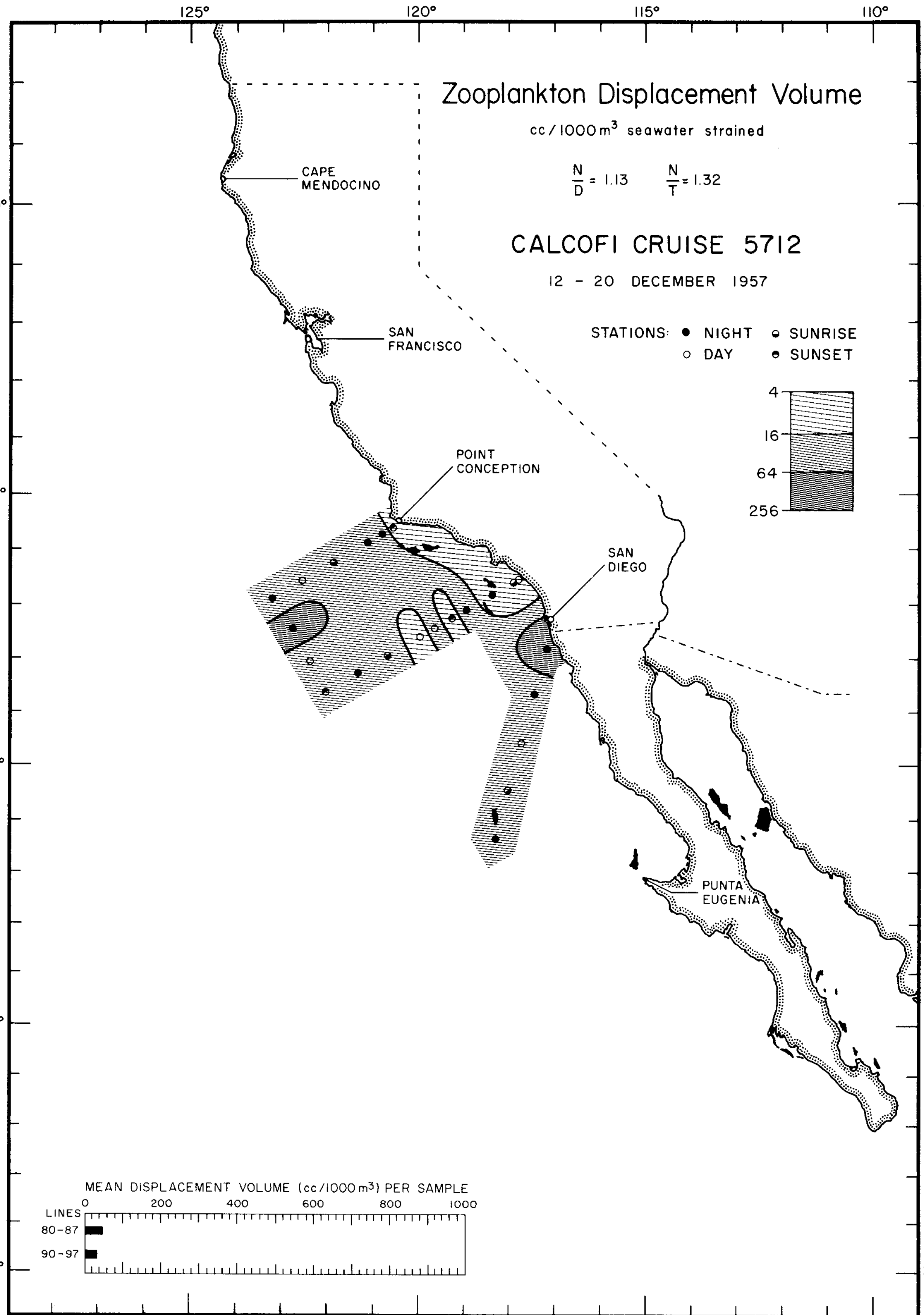
Zooplankton Displacement Volume
cc / 1000 m³ seawater strained
N/D = 1.64   N/T = 1.54
CALCOFI CRUISE 5112
25 NOVEMBER – 9 DECEMBER 1951
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
60-67
70-77
80-87
90-97
100-107
110-117
120-127

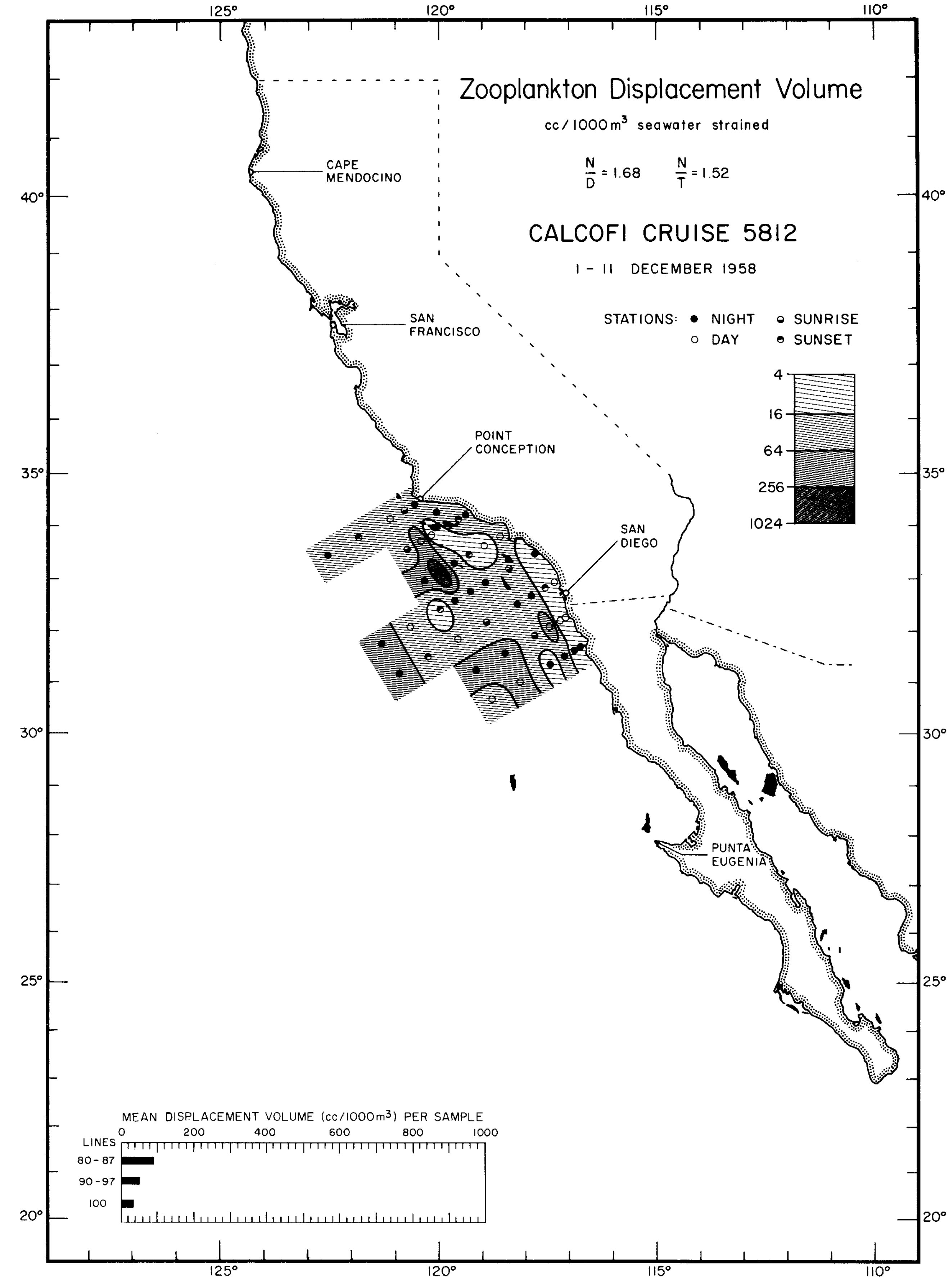

125°
120°
115°
110°
Zooplankton Displacement Volume
cc / 1000 m³ seawater strained
N/D = 1.37
N/T = 1.40
CALCOFI CRUISE 5312
1 - 13 DECEMBER 1953
STATIONS: ● NIGHT ○ DAY SUNRISE SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc / 1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
83-87
90-97
100-107
110-117
120-127
130-137

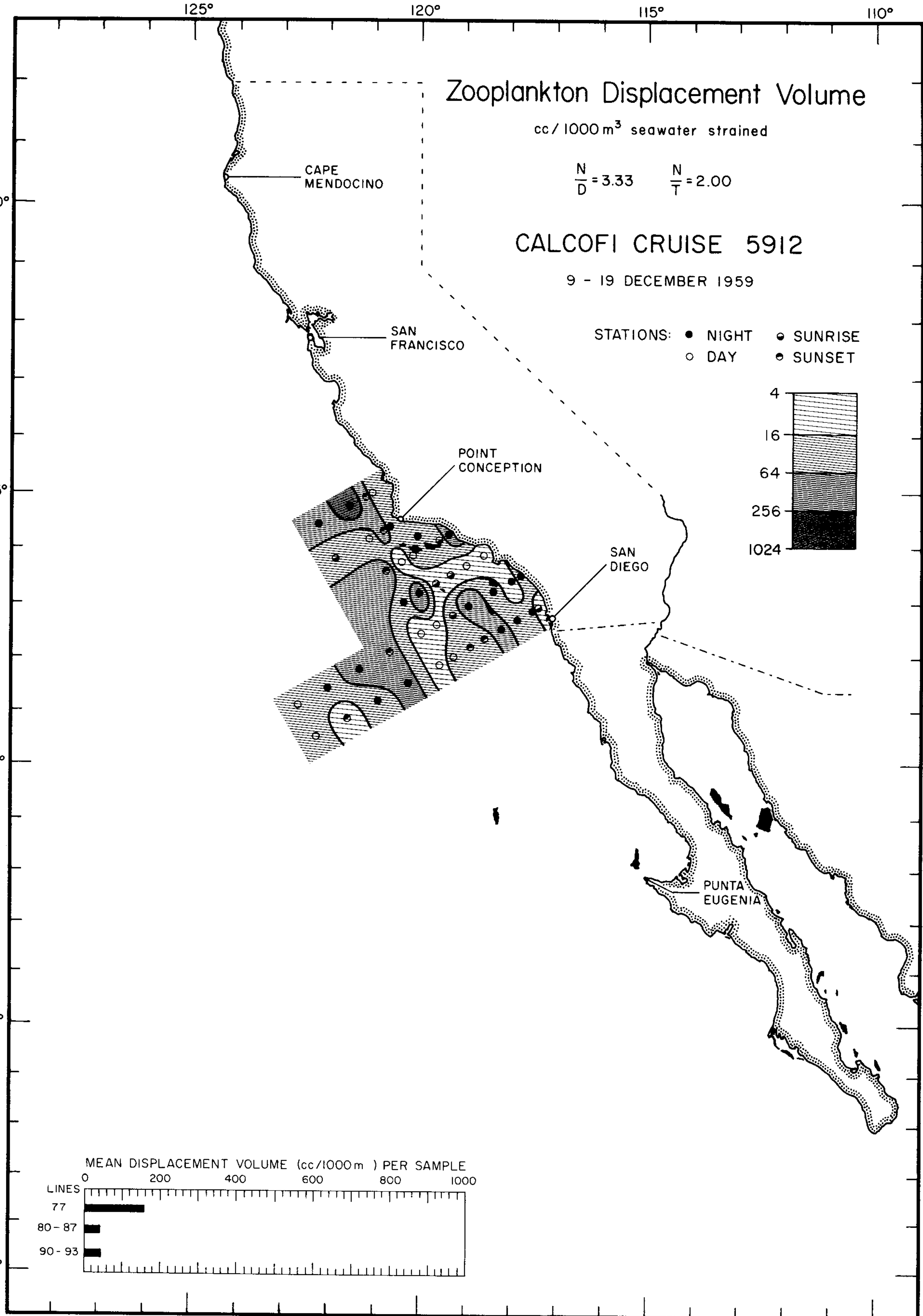

Zooplankton Displacement Volume
cc/1000m3 seawater strained
N/D = 1.43 N/T = 1.38
CALCOFI CRUISE 5412
30 NOVEMBER-16 DECEMBER 1954
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000 m3) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97
100-107
110-117
120-127
130-137
140-147
150-157


Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.53
N/T = 1.24
CALCOFI CRUISE 5512
29 NOVEMBER - 16 DECEMBER 1955
STATIONS: NIGHT SUNRISE DAY SUNSET
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125° 120° 115° 110°
40° 35° 30° 25° 20°
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0 200 400 600 800 1000
LINES
80-87
90-97
100-107
110-117
120-127
130-137
140-147


125°
120°
115°
110°
Zooplankton Displacement Volume
cc / 1000 m³ seawater strained
N/D = 3.6
N/T = 2.6
CALCOFI CRUISE 5612
24 NOVEMBER - 21 DECEMBER 1956
STATIONS: ● NIGHT ○ DAY SUNRISE SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc / 1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
80 - 87
90 - 97

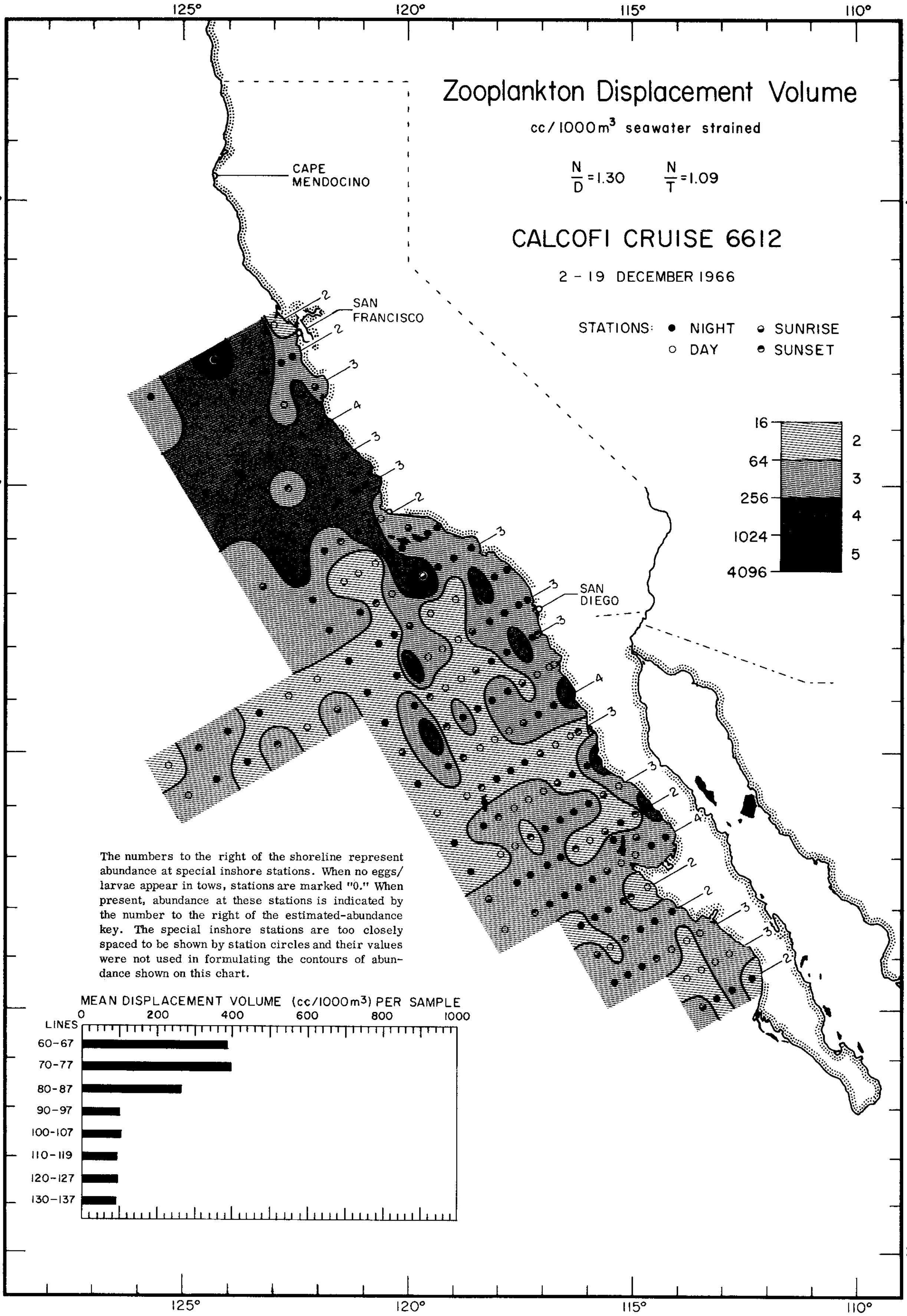

125°
120°
115°
110°
40°
35°
30°
25°
20°
Zooplankton Displacement Volume
cc/1000 m³ seawater strained
N/D = 1.13
N/T = 1.32
CALCOFI CRUISE 5712
12 - 20 DECEMBER 1957
STATIONS: NIGHT
DAY
SUNRISE
SUNSET
4
16
64
256
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
MEAN DISPLACEMENT VOLUME (cc/1000 m³) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97

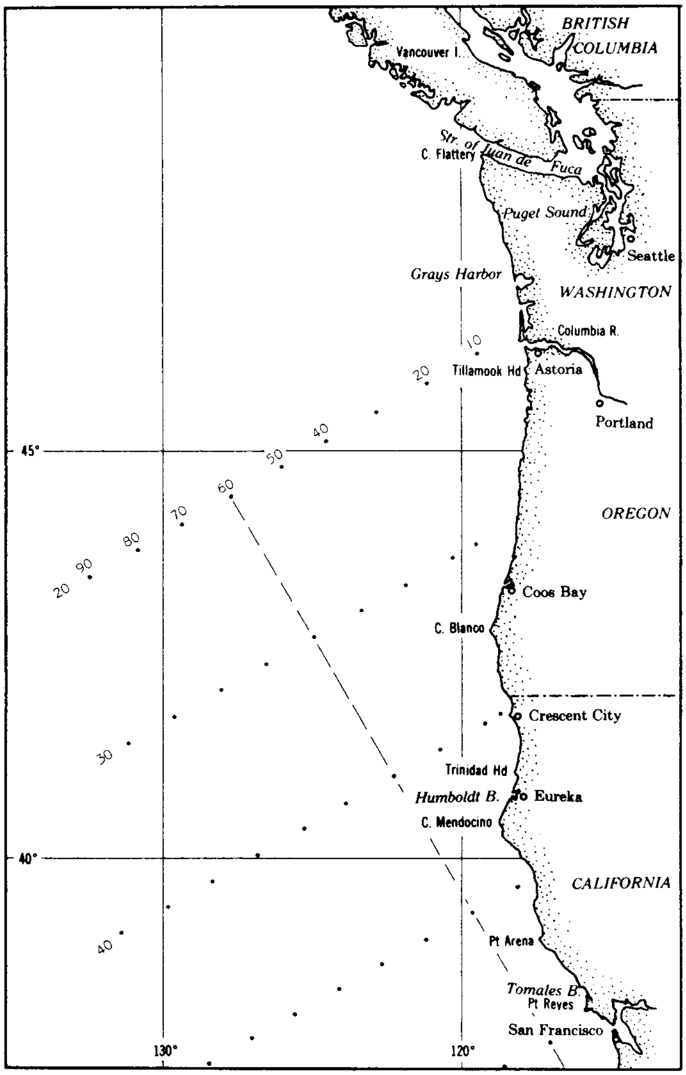

Zooplankton Displacement Volume
cc/1000 m3 seawater strained
N/D = 1.68
N/T = 1.52
CALCOFI CRUISE 5812
1 - 11 DECEMBER 1958
STATIONS: NIGHT SUNRISE DAY SUNSET
4
16
64
256
1024
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
125°
120°
115°
110°
40°
35°
30°
25°
20°
MEAN DISPLACEMENT VOLUME (cc/1000m3) PER SAMPLE
0
200
400
600
800
1000
LINES
80-87
90-97
100

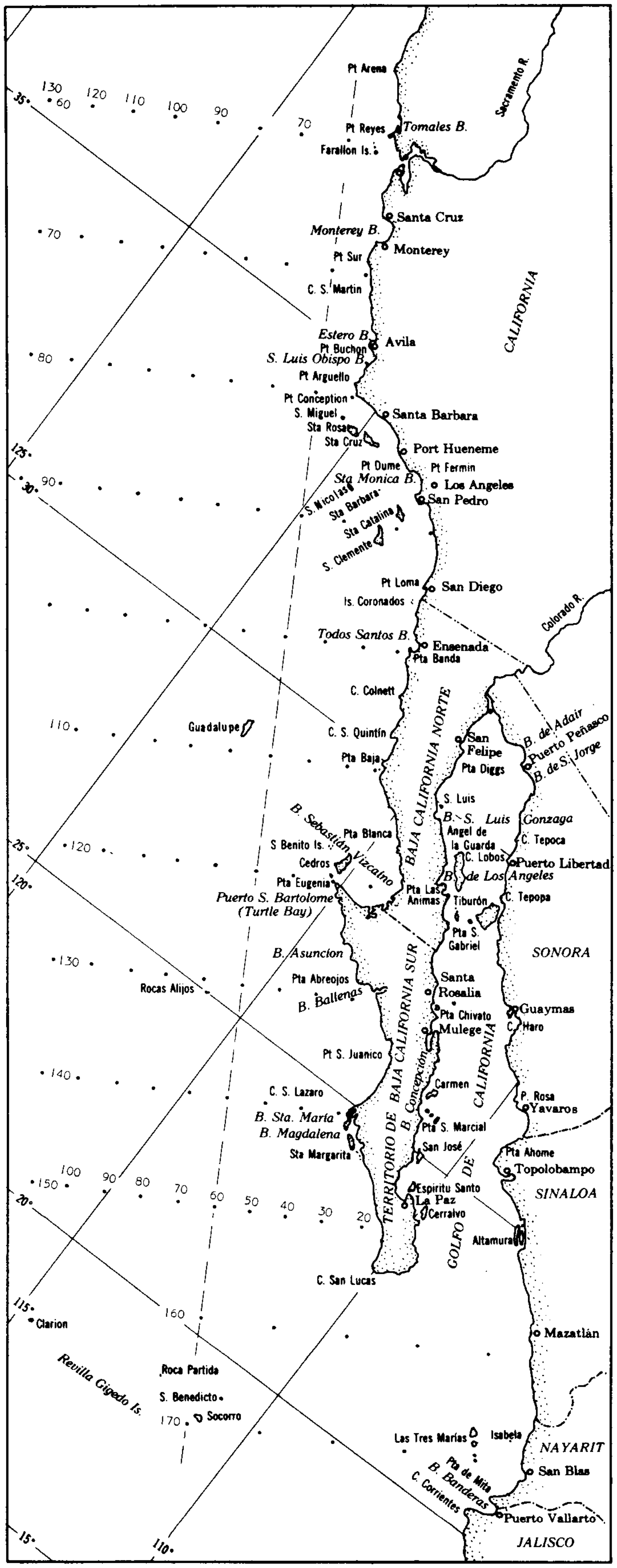


Zooplankton Displacement Volume

5912


Zooplankton Displacement Volume
cc/1000m³ seawater strained
N/D = 1.30   N/T = 1.09
CALCOFI CRUISE 6612
2 - 19 DECEMBER 1966
STATIONS: ● NIGHT ○ DAY ◒ SUNRISE ◓ SUNSET
16 64 256 1024 4096
2 3 4 5
CAPE MENDOCINO
SAN FRANCISCO
SAN DIEGO
125° 120° 115° 110°
40° 35° 30° 25° 20°
The numbers to the right of the shoreline represent abundance at special inshore stations. When no eggs/larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
MEAN DISPLACEMENT VOLUME (cc/1000m³) PER SAMPLE
0 200 400 600 800 1000
LINES
60-67
70-77
80-87
90-97
100-107
110-119
120-127
130-137





These maps are designed to show essential details of the area most intensively studied by the California Cooperative Oceanic Fisheries Investigations. This is approximately the same area as is shown in color on the front cover. Geographical place names are those most commonly used in the various publications emerging from the research. The cardinal station lines extending southwestward from the coast are shown. They are 120 miles apart. Additional lines are utilized as needed and can be as closely spaced as 12 miles apart and still have individual numbers. The stations along the lines are numbered with respect to the station 60 line, the numbers increasing to the west and decreasing to the east. Most of them are 40 miles apart, and are numbered in groups of 10. This permits adding stations as close as 4 miles apart as needed. An example of the usual identification is 120.65. This station is on line 120, 20 nautical miles southwest of station 60.

The projection of the front cover is Lambert's Azimuthal Equal Area Projection. The detail maps are a Mercator projection.

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