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Atlas 24: Brinton, E. and J. G. Wyllie. Distributional atlas of euphausiid growth stages off southern California, 1953-1956. Published June 1976.

16 May 2007

The taxonomic nomenclature in the atlas is exactly as published, even though the euphausiids have undergone taxonomic revision. Below are several references that may be useful in updating the species names:

Brinton, E., M. D. Ohman, A. W. Townsend, M. D. Knight, and A. L. Bridgeman. 2000. Euphausiids of the world ocean. Series: World Biodiversity Database CD-Rom Series Window version 1.0. Expert Center for Taxonomic Identification, Amsterdam, Netherlands, Springer Verlag, New York.

Brinton, E. 1975. Euphausiids of Southeast Asian waters. Naga Reports 4(5): 1-287.

Baker, A. de C., B. P. Boden and E. Brinton. 1990. A Practical Guide to the Euphausiids of the World. Natural History Museum Publications. London, 96 pp.

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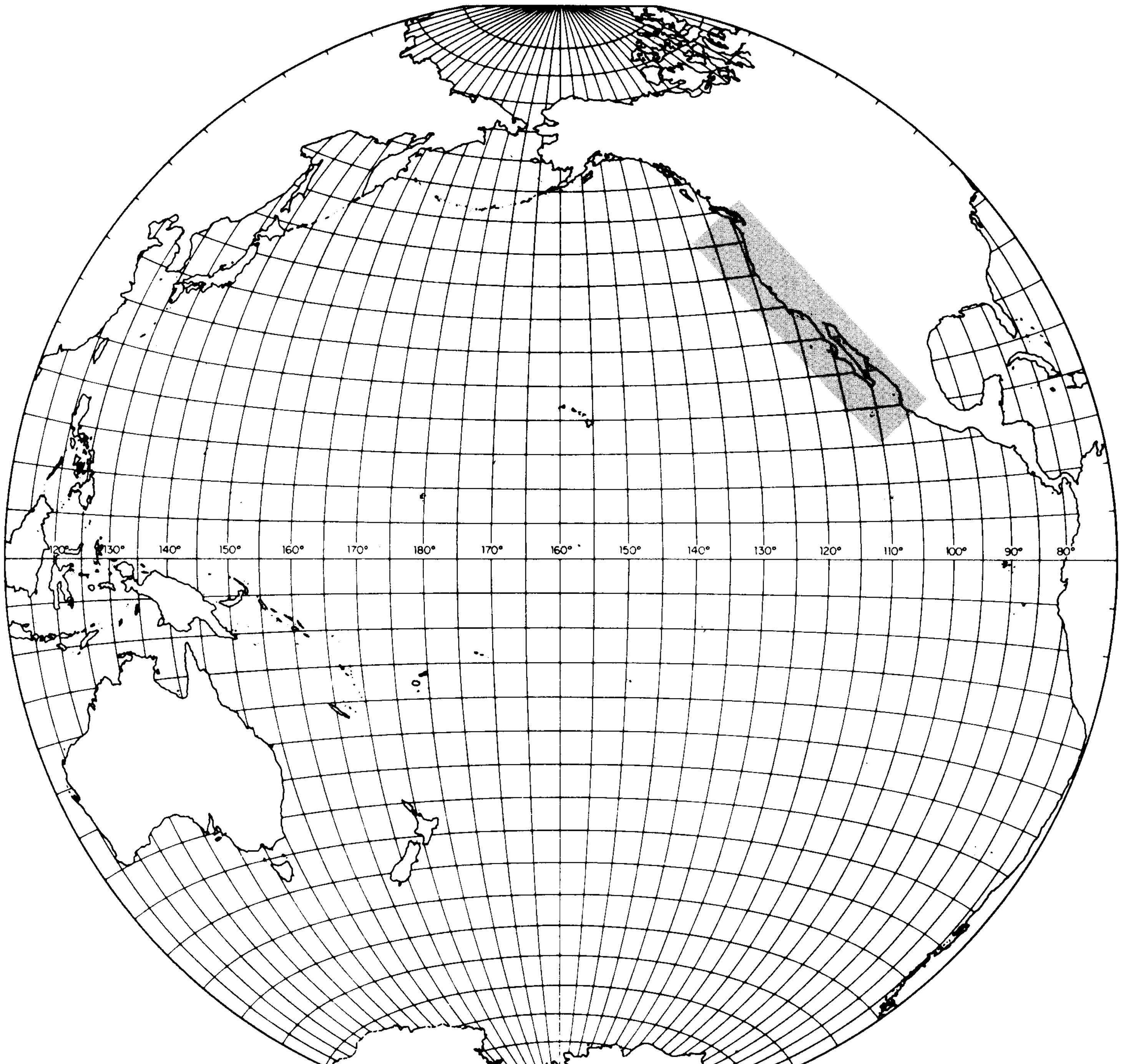
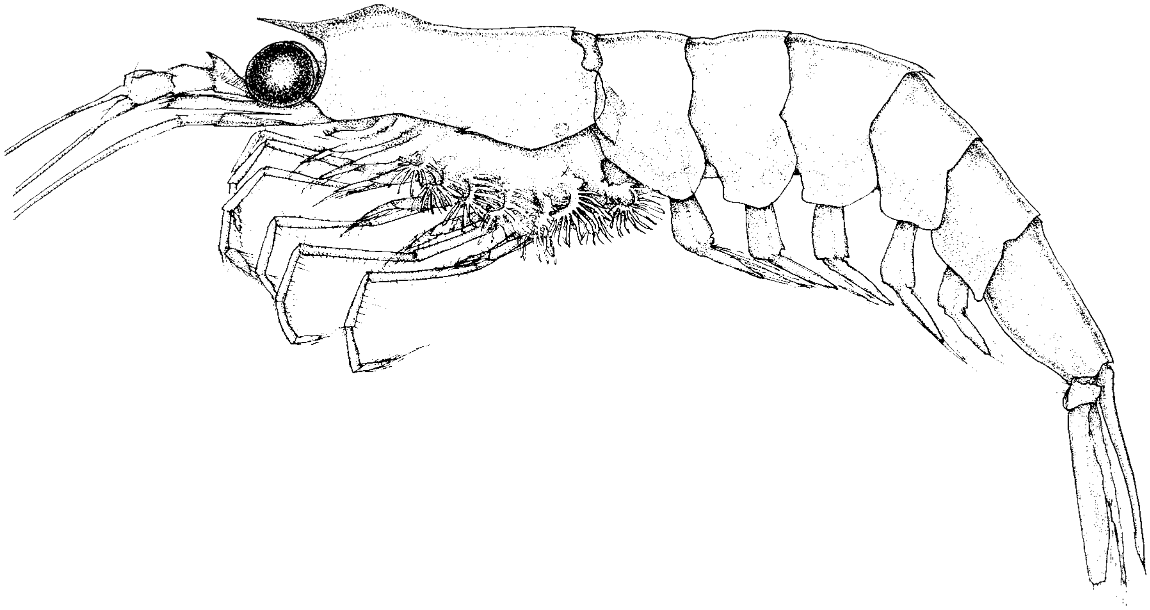
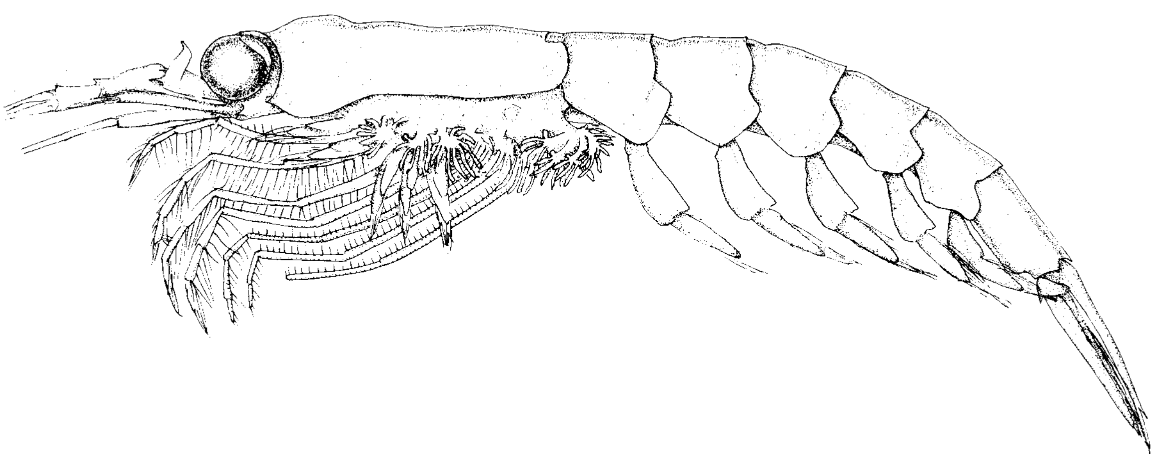


CALIFORNIA COOPERATIVE OCEANIC FISHERIES INVESTIGATIONS

ATLAS No. 24



Euphausia gibboides



Nyctiphanes simplex

CALIFORNIA COOPERATIVE OCEANIC FISHERIES INVESTIGATIONS

Atlas No. 24

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UNIVERSITY OF CALIFORNIA, SCRIPPS INSTITUTION OF OCEANOGRAPHY

June, 1976

THE CALCOFI ATLAS SERIES

This is the twenty-fourth 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 John G. Wyllie, Editors

CalCOFI atlases in this series, through June 1976, 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. Alvarino, 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., 1967. 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.D., 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.
No. 14. Isaacs, J. D., A. Fleminger and J. K. Miller, 1971. Distributional atlas of zooplankton biomass in the California Current region: Winter 1955-1959.
No. 15. Wyllie, J.G., and R.J. Lynn, 1971. Distribution of temperature and salinity at 10 meters, 1960-1969 and mean temperature, salinity and oxygen at 150 meters, 1950-1968 in the California Current.
No. 16. Crowe, F. J. and R. A. Schwartzlose, 1972. Release and recovery records of drift bottles in the California Current region, 1955 through 1971.
No. 17. Ahlstrom, E. H., 1972. Distributional atlas of fish larvae in the California Current region: six common mesopelagic fishes—*Vinciguerria lucetia, Triphoturus mexicanus. Stenobrachius leucopsarus, Leuroglossus stilbius, Bathylagus wesethi* and *Bathylagus ochotensis.* 1955 through 1960.
No. 18. Brinton, E., 1973. Distributional atlas of Euphausiacea (Crustacea) in the California Current region. Part II.

No. 19. Bowman, T. E. and M. W. Johnson, 1973. Distributional atlas of calanoid copepods in the California Current region, 1949 and 1950.

No. 20. Thomas, W. H. and D. L. R. Seibert, 1974. Distribution of nitrate, nitrite, phosphate and silicate in the California Current Region, 1969.
Owen, R. W., Jr., 1974. Distribution of primary production, plant pigments and Secchi depth in the California Current region, 1969.
Smith, P. E., 1974. Distribution of zooplankton volumes in the California Current region, 1969.

No. 21. Fleminger, A., J.D. Isaacs and J. G. Wyllie, 1974. Zooplankton biomass measurements from CalCOFI cruises of July 1955 to 1959 and remarks on comparison with results from October, January, and April cruises of 1955 to 1959.

No. 22. Namias, J., 1975. Northern hemisphere seasonal sea level pressure and anomaly charts, 1947-1974.

No. 23. Ahlstrom, E. H. and H. G. Moser, 1975. Distributional atlas of fish larvae in the California Current region: Flatfishes, 1955 through 1960.

No. 24. Brinton, E., and J. G. Wyllie. Distributional atlas of euphausiid growth stages off southern California, 1953 through 1956.

[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. 24.

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DISTRIBUTIONAL ATLAS OF EUPHAUSIID GROWTH STAGES OFF SOUTHERN CALIFORNIA, 1953 THROUGH 1956

E. Brinton and J. G. Wyllie

CALCOFI ATLAS NO. 24

A. Fleminger and J.G. Wyllie, Editors
Marine Life Research Program
Scripps Institution of Oceanography
La Jolla, California

June, 1976

DISTRIBUTIONAL ATLAS OF EUPHAUSIID GROWTH STAGES OFF SOUTHERN CALIFORNIA, 1953 THROUGH 1956

E. Brinton and J.G. Wyllie

INTRODUCTION

Material and Methods

This atlas illustrates the distributions of the eight euphausiid species characteristic of southern Californian waters during 1953-56. The area considered is outlined on the station grid of Chart 1. Identification of these euphausiids has become a routine matter as a consequence of the long term (1949-present) study of species in the CalCOFI area. All post-naupliar stages are distinguishable. Larval series of two species have recently been described in detail, *Euphausia gibboides* by Knight (1975) and *Nematoscelis difficilis* by Gopalakrishnan (1973).

The distributions are charted according to growth stages. For the four most abundant species, these stages are 2 mm body-length increments. For the others, groupings are by the developmental phases, larvae, juveniles, and adults, distinguished by conventional morphological characteristics.

Body length is the total length (T-L) measured between the anterior limit of the frontal plate and the tip of the telson. In each species there is individual variability in T-L at which the change from larva (last furcilia stage) to juvenile, and from juvenile to adult takes place. The 1-2 mm (<2.5 mm) and 3-4 mm (2.5-<4.5 mm) groups which are charted here for *Euphausia pacifica*, *Nematoscelis difficilis* and *Nyctiphanes simplex* include most larvae of these species. However, the 5-6 mm group (4.5-<6.5 mm) lumps together the largest larvae and the smallest juveniles. Because these larger larvae show characteristics of morphology (e.g. all pleopods developed) and behavior (vertical migration) that are common also to subsequent phases of development in these species, the 5-6 mm groups are included with the juveniles in the ongoing studies of euphausiid population biology.

Thysanoessa gregaria is smaller. In this species, the 3-4 mm group includes both larvae and juveniles. For population studies, 3 mm individuals are considered larvae, and 4 mm individuals, juveniles. 2 mm specimens of *T. gregaria* are more slender than in the other species. Whereas many 2 mm larvae of *E. pacifica*, *N. difficilis* and *N. simplex* are retained by the meshes of the CalCOFI net, few *T. gregaria* of this T-L are caught.

Although 2 mm specimens appear not to be representatively sampled in any of the species, counts of these have nevertheless been recorded indicating the presence of these small calyptopis larvae.

Free floating eggs of *Euphausia* and *Thysanoessa* are usually not retained by this net. In the genera *Nematoscelis*, *Nyctiphanes* and *Stylocheiron*, the eggs remain attached to the spawner's thoracic limbs until hatching.

Approximate T-L ranges of the larvae, juveniles and adults of the species charted in this atlas are as follows:

	Larvae	Juveniles	Adults
Euphausia gibboides	<6 mm	6-15	16-26
Euphausia pacifica	<6 mm	6-10	11-22
Euphausia eximia	<5 mm	5-14	15-23
Nematoscelis difficilis	<6 mm	6-15	16-24
Nyctiphanes simplex	<6 mm	6-7	8-12
Thysanoessa gregaria	<4 mm	4-6	7-13
Thysanoessa spinifera	<5 mm	5-15	16-25
Stylocheiron affine	<4 mm	4-6	7-9

Population biology studies are in progress on certain of the species, using the data upon which the 1953-56 distributions are based. This atlas should serve as a companion volume to those reports. The data for *Euphausia pacifica* has been analysed with respect to reproduction, growth and development of cohorts, successions in population structure and biomass (Brinton, 1976), and for estimates of biotic production and yield (Mathews and Brinton, MS). Analyses of the data for *Nematoscelis difficilis* and *Thysanoessa gregaria* are in preparation (Brinton, MS).

In addition, the distributional charts are instrumental in analyses being undertaken of variability in local characteristics of length-frequency of these populations as related to transport within the hydrographic regime which incorporates both advected streams and eddies of differing duration.

Samples were obtained by oblique tows, 0-140 m depth (except where the water was shallower), using the CalCOFI standard net, 1-m mouth diameter and 0.55 mm mesh-width (Ahlstrom, 1948). The mesh-width of the cod end and of a 40 cm section in front of it was 0.25 mm. The net was towed at about 1.5 knots. The volume of water strained through a net was determined with a TSK flowmeter. Most volumes were in the range of 300-400 m^3. The 1953-56 cruises generally provided month-to-month data, including more frequent surveys in late 1955 (four in September, three in November).

The area of study yielded between 7 and 43 nighttime samples per cruise. 819 samples from 48 cruises, 5301 (January, 1953) through 5612 (December, 1956), are the basis of this atlas. Only nighttime samples were used because juveniles and adults of most species are expected to be less representatively sampled in the daytime, owing to vertical migration to depths >140 m by *Euphausia* and *Nematoscelis*, and avoidance of the net in the upper layers by non-migrating *Thysanoessa*, *Stylocheiron*, and perhaps *Nyctiphanes* (Brinton, 1967a). "Night" was considered to be the period from one hour after sunset to one hour before sunrise. A few sunrise and sunset samples were used if they were collected under overcast skies. A sample marginal to, but outside of, the area was used when such a sample was from a locality nearer to a portion of the area than any of the sampled localities within the area. Thus some samples from Station Lines 77 (northern) and 97 (southern), or designated 80.80, etc. (western) were occasionally used (See Chart 1).

The samples were examined in the following way. An aliquot containing 100-400 euphausiids was counted; the specimens were measured to the nearest millimeter of body length. If, for adults, the initial aliquot contained fewer than about three specimens of any particular length, a second aliquot of equal size was examined for specimens of that size or larger. In this way, increasingly larger fractions of the sample were examined for specimens of those length-intervals which were progressively determined to be fewest in the sample. This made it possible to count the rarer (usually the larger) specimens with a degree of accuracy comparable with that to which the consistently more abundant small specimens were counted. This procedure was facilitated by the use of the Folsom plankton splitter which, through successive splitting operations, provides aliquots of 1/2, 1/4, 1/8, 1/16, etc. of the sample. Usually, the entire sample was examined for specimens of more than about 14 mm body length. All counts were standardized for 1000 m^3 of water strained by the net.

The CalCOFI program has recently attempted to compare the catching efficiency of the 1-m net with that of the paired bongo nets which sample without the use of a bridle in front of the nets. Preliminary estimates indicate that the bongo nets are significantly more efficient in catching juveniles and adults of large plankton species such as the euphausiids *E. pacifica*, *N. difficilis* and *Thysanoessa spinifera*. In the case of *N. difficilis* of 10-19 mm length, abundance estimates from bongo net samples are about three times higher than those from the 1-m net, and estimates of specimens >19 mm are about seven times higher. In *E. pacifica* and *T. spinifera* the difference may be even greater. In this atlas no attempt is made to adjust the estimates of population densities obtained by the CalCOFI 1-m net. Additional inter-calibration studies are planned.

Physical Characteristics of the Southern California Area

The currents within the southern California study area are sluggish and meandering. On the average at the surface, cyclonic flow is found paralleling the ocean-side of the Channel Island chain. At a depth of 200 meters, the cyclonic trough is slightly farther west than at the surface. The

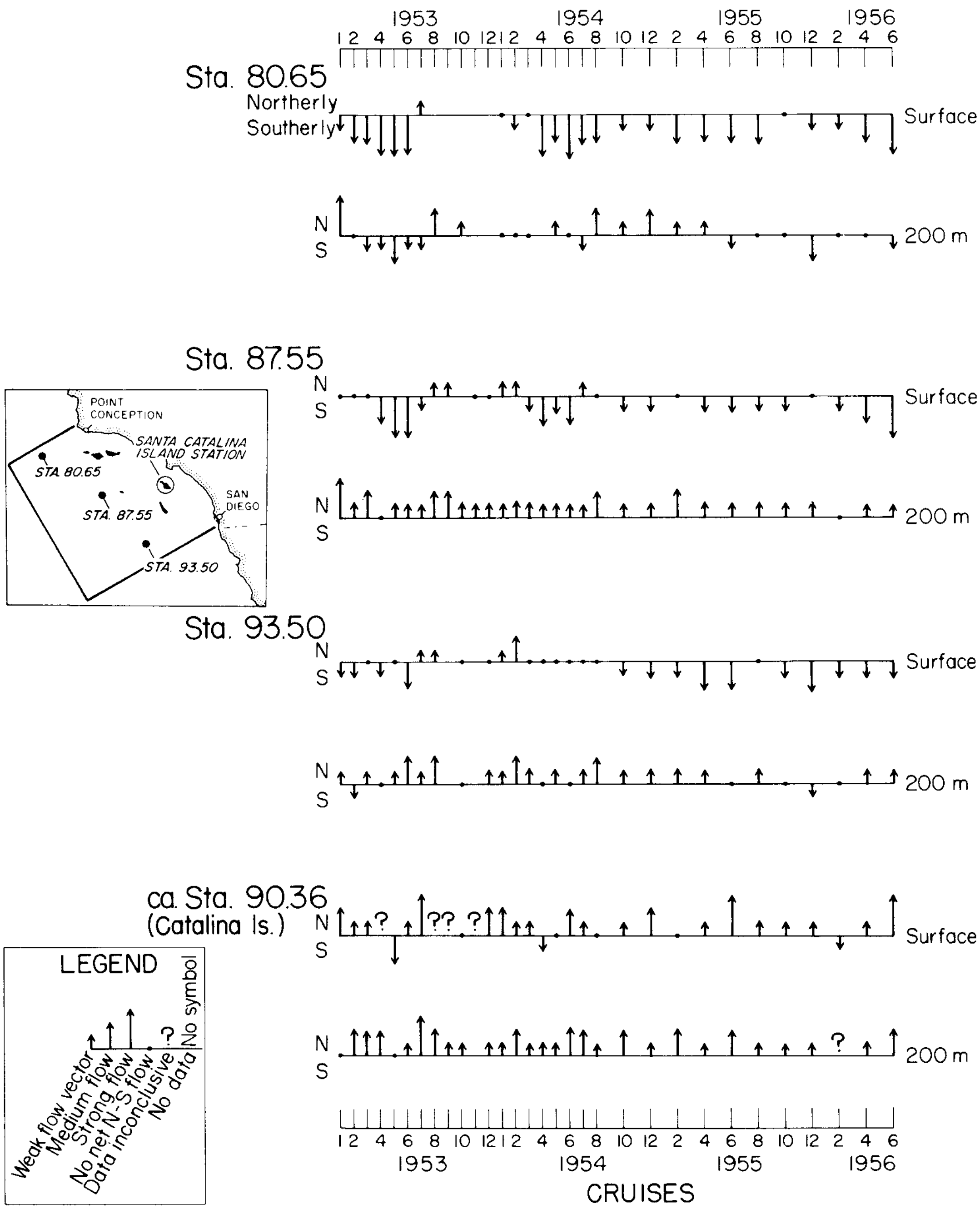


Figure 1. Relative estimates of north-south component of geostrophic flow at four localities, 1953-1956. Determined for surface and 200 m depth using flow diagrams in Wyllie (1966).

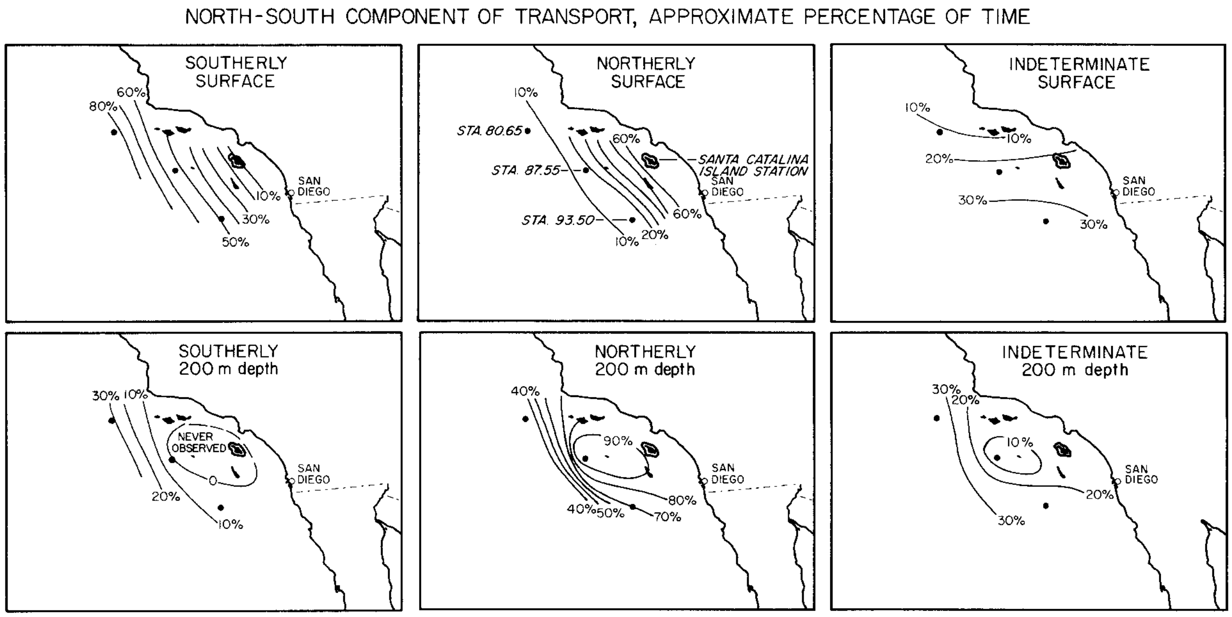


Figure 2. Percentages of time, 1953-1956, showing southerly, northerly or indeterminate component of geostrophic flow, summarized from Figure 1.

cyclonic trough line tends to move shoreward during the spring months. When the California Current weakens, a shallow anticyclonic eddy frequently develops in the southeastern portion of the study area between San Diego and Santa Catalina-San Clemente Islands.

Wave-like perturbations appear along the general southeastward flow of the California Current, resulting in alternating cyclonic and anticyclonic flow along the course of the current. These perturbations seem to have "preferred" locations but shift enough to make predictability difficult. One such "preferred" anti-cyclonic perturbation is the one mentioned as occurring between San Diego and Santa Catalina or San Clemente islands. Another is frequently found 100-150 miles farther west. When the California Current weakens, these eddies may either move slowly through or die within the area. This eddy mechanism may allow plankton of western origin to be transported shoreward across the current by way of cyclonic and anticyclonic eddies.

Approximations of the relative intensity of the north or south component of flow are given for four different localities in the study area (Fig. 1). The approximate percentages of time these components were observed are shown for these localities (Fig. 2).

To the north at station 80.65, halfway between Point Conception and the western limit of the study area, southerly surface flow is more persistent than elsewhere. This flow was strongest during April to July of each year. At a depth of 200 meters, which is near the daytime depth of many of the vertically migrating euphausiids, the north-south components are weaker and more variable. This location, station 80.65, is apparently near the center line of the trough at 200 meters. At the surface a southerly component was evident about 80% of the time but at 200 meters only 30% of the time (Fig. 2).

At a mid-area locality near San Nicholas Island, station 87.55, the surface flow direction appears to be particularly irregular. Again, southerly flow at the surface was most persistent in the spring. At a depth of 200 meters a weak but persistent northerly component exists.

In the south of the study area at station 93.50, the north-south component of surface flow was again weak and irregular. No seasonal pattern is evident; however, in 1955 and 1956 the trend was southerly. At 200 meters a northerly component of flow persists, although weak.

In the vicinity of Santa Catalina Island, shoreward of the main axis of the island chain, surface flow showed a northerly component greater

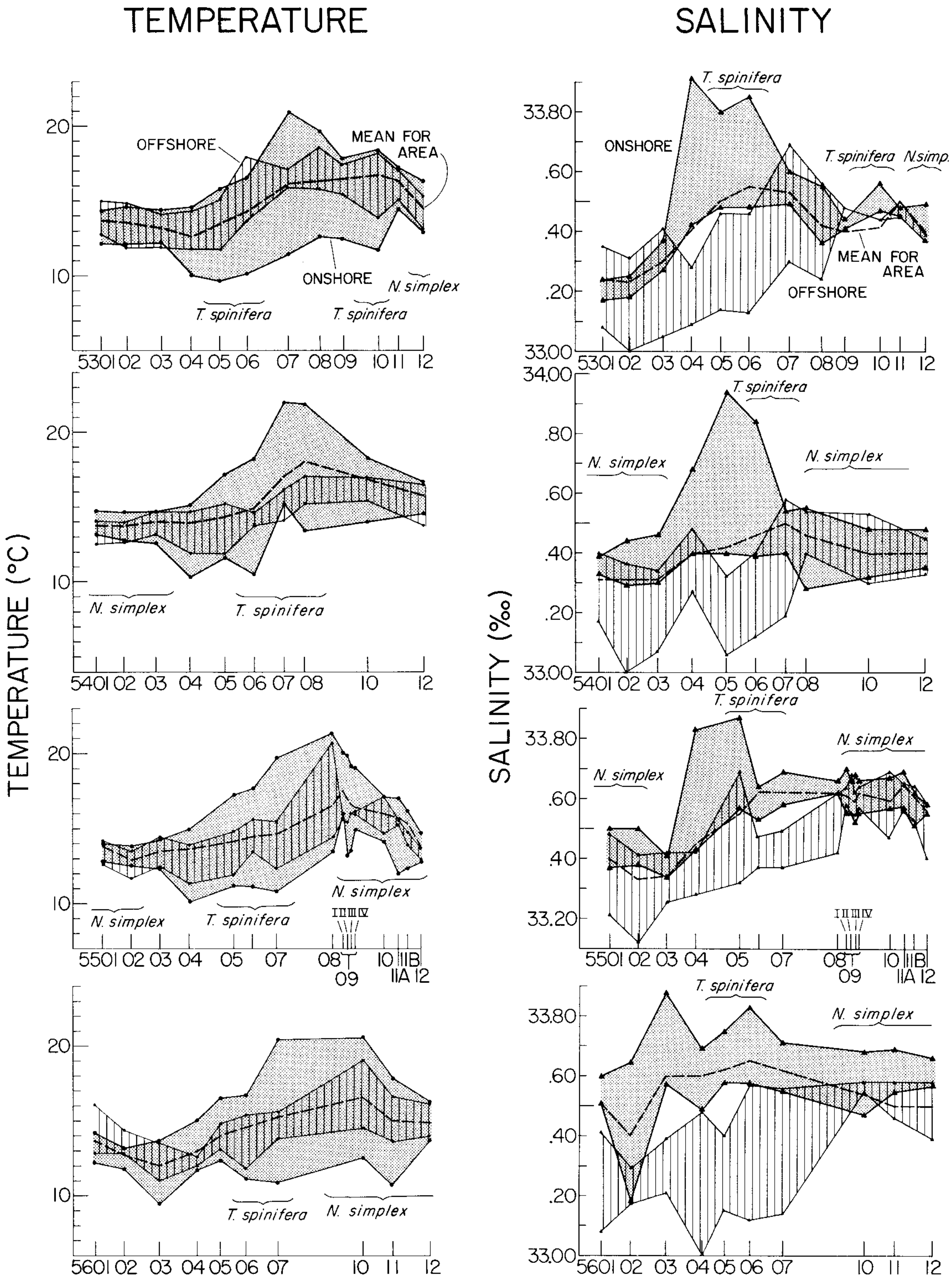


Figure 3. Temperature and salinity ranges (10 m depth) in offshore (hatched) and onshore (stippled halves) of southern California area, 1953-56. Dashed line represents mean for area. Estimates were made using charts in Anonymous (1963) and data in Reid, Arthur and Bennett (1962, 1963, 1965a, b). Periods of significant development in the area of the two most inshore species, *Thysanoessa spinifera* (northern) and *Nyctiphanes simplex* (southern), are shown.

TABLE 1.

Growth Sequences in *Euphausia pacifica*, Based on Cohorts Traced in Brinton (1976).

Chart No.										Chart No.
3	5302 3-4 mm									3
4	6-7	5303 3-4 mm								4
5	10	7-8								5
6	15	10		5305 3-4 mm						6
7		13		7	5306 3-4 mm					7
8		15		9-10	7					8
9		16		13	8-10					9
10		18-19		15	12		5309 3-4 mm			10
11							7-8			11
12							7-8			12
13							9-10			13
14							11-12			14
15							12			15
16							14-15			16
17			5404 3-4 mm				15-16			17
18			7-8				17-18			18
19			10		5406 3-4 mm		18			19
20			12		5-6		18			20
21					9					21
22					10					22
23					11					23
24					12					24
25	5502 3-4 mm				15-16					25
26	7				17					26
27	12		5504 3-4 mm		17-18					27
28	15		7	5505 3-4 mm	18-19					28
29	17-18		11-12	7	20					29
30	17-18		13	10	20-22	5507 3-4 mm				30
31	18		14-15	13		9-10				31
32-35	18		15-16	14		10				32-35
36			15-16	14-15		11				36
37-38						11-12				37-38
39						12			5512 3-4 mm	39
40						12-13			7-8	40
41	5602 3-4 mm					14-15			11-12	41
42	7-8	5603 3-4 mm				17			14-16	42
43	10	5-6							17-18	43
44	12	7-8		5605 3-4 mm					18-19	44
45		8		6-7					19-20	45
46		13-14		11		5607 3-4 mm				46
47		15-16		15		9-10		5610 4 mm		47
48		16		16		11		8-9		48
49						12		9-10		49

than 60% and a southerly component only 10% of the time (Fig. 2). A persistent northerly component of flow was found at a depth of 200 meters.

Monthly characteristics of temperature and salinity at 10 m depth (from Anonymous, 1963; Reid, Arthur, and Bennett, 1962, 1963, 1965 a, b; Wyllie and Lynn, 1971) are diagrammed separately for the onshore and offshore halves of the southern California area (Fig. 3). The onshore half of the eddy is part of the coastal upwelling regime, particularly during spring and summer, while the offshore half is influenced more by southerly flow, advected from the north as the main stream of the California Current.

In the onshore region, many of the extreme monthly temperature minima are considered to have been induced by upwelling (e.g. Brinton, 1976). During 1953-55 these minima reached lowest values in April, and in 1956 in March. These were coincident with large increases in the range of the 10 m salinity values, again indicating ascent of subsurface water presumed to be of southern origin (following Reid, Roden and Wyllie, 1958). The high surface salinities which prevail through June appear to be more reliable indications of upwelling than temperature which is subject to radiation-induced seasonal change. The onshore temperature range increased during June or July through October (November in 1956). This was brought about by patchy upwelling and southerly advection into a generally warming water mass. Hence, the apparent intrusion of offshore and southern species (e.g. *Euphausia gibboides* and *E. eximia*) is adjacent to water occupied by onshore species with northern affinities (*Euphausia pacifica, Thysanoessa spinifera*).

Offshore, the range of temperature was less, remaining at 2-4°C through the year. As in the onshore region, it was generally least variable through the winter and spring months, December to April. However, in 1956, the spring minima appeared in March and April; this is suggested by the somewhat low salinities at that time but not by the estimates of current speed at the northern

TABLE 2.

Growth Sequences in *Nematoscelis difficilis*, Based on Cohorts Traced in Brinton (MS).

Chart No.											Chart No.
50	52--? 9-15 mm	5301 3-5 mm									50
51	11-17	6-9	5302 3-4 mm								51
52	13-18	8-11	5-6	5303 2-4 mm							52
53	16-21	13-15	9-10	5							53
54	19-22	14-18	11-13	8							54
55	20-21	17-20	15-16	10-11							55
56	23	17-23	17-19	11-12							56
57		20-23	20-23	14							57
58				15-16				5309-10 2-4 mm			58
59							53--? 10-13 mm	2-6			59
60							11-14	5-8			60
61							12-16	7-10		5312 3-4 mm	61
62							12-17	8-10		5	62
63							13-19	9-11		6	63
64							15-19	10-13		7-8	64
65					5404 2-3 mm		15-20	10-14		7-8	65
66					5-6		17-21	11-15		9	66
67					8-9	5406-08 2-4 mm	17-21	14-17		9-11	67
68					9-11	2-7	18-21	15-18		10-13	68
69					10-13	2-7	19-21	17-20		13-16	69
70					12-15	5-9	19-22	19-22	5410 2-4 mm	15-18	70
71					12-16	8-10		20-23	4-7	18-20	71
72					14-18	10-12			6-8	21	72
73			5502-03 2-3 mm		14-19	12-14			7-10		73
74			3-4		16-20	15-17			11-13		74
75			5-8		17-22	15-18			12-14		75
76			6-9		18-21	17-19			14-16		76
77			8-11		18-21	18-21			15-17		77
78			10-12		19-21	19-21			16-18		78
79			10-14						16-20		79
80-83			10-16					5509 2-5 mm	17-22		80-83
84			13-18					5-8	19-22		84
85-87			15-22					7-12	19-22	5511-12 2-4 mm	85-87
88			18-22					9-14		2-7	88
89			20-23					12-17		4-9	89
90			21-24	5602-03 2-3 mm				12-18		6-10	90
91			21-25	3-5				13-19		6-11	91
92				4-6				15-21		7-13	92
93				5-9				17-21		11-15	93
94				7-10		5606-07 2-3 mm		17-21		11-15	94
95				8-11		3-5		18-21		15-18	95
96				10-14		6-8		19-23		16-20	96
97				12-16		7-10		19-23		17-20	97
98				12-17		9-12		19-24			98

locality off Pt. Conception (Fig. 1). As with temperature, the range of salinity is least during fall and winter, i.e., September to January.

Notes on the Dominant Residents of the Area

During 1953-56 the numerically dominant euphausiids in the southern California area were the three species typical of the main stream of the cooler part of the California Current and extending southward to the tropics: *Euphausia pacifica*, *Nematoscelis difficilis* and *Thysanoessa gregaria*. Horizontal ranges are sufficiently similar that these, together with *Euphausia gibboides*, were considered members of a Transition Zone (between 35 and 45°N across the North Pacific)-California Current euphausiid assemblage (Brinton, 1962). Of these four, *E. pacifica* ranges farthest north and has highest onshore densities along the California coast. *E. gibboides* tends to be the most southerly and offshore, while *N. difficilis* and *T. gregaria* are intermediate, peaking in the warm-temperate cores of the North Pacific Drift-California Current system.

Euphausia pacifica (Charts 2-49)

Euphausia pacifica is a diel vertical migrant, the juveniles and adults occupying daytime depths of ca. 200-300 m and rising to the surface layer at night.

The biology of *E. pacifica*, based on this 1953-56 sampling, has been discussed at some length by Brinton (1976) and Mathews and Brinton (MS). Additional notes on characteristics of swarms and on adult-larva interrelationships are included in the present introduction.

E. pacifica reproduces locally throughout the year. However, during 1953-56, maxima in number of larvae were associated with the spring to summer (April to September) period of maximum upwelling, when advection from the more northern part of the California Current was usually also at its peak. Of the four years, 1954 was particularly anomalous with respect to reproduction in *E. pacifica*, June and July being the only months of a clear crest in recruitment.

Cohorts were distinguished as modes in monthly size-frequency histograms, usually appearing during months when peak production of larvae took place (Brinton, 1976). Those cohorts traced (with differing amounts of certainty) as modal progressions through life spans of 7 to 12 months are indicated in Table 1. The period during which the egg develops to a late furcilia larva is considered the first month.

The distributional charts which are relevant to respective developmental stages of these cohorts are tabulated (Table 1) for reference purposes. It is to be noted that the distinguishable cohorts included not only those originating during April through September, but others originating in February, October and December. These latter could be recognized because, in each case, production of larvae was relatively low during the months immediately preceding and following, thereby providing the circumstance for distinguishing a size-mode in subsequent samplings of the total population.

It is evident from the charts of distribution that some species, or T-L (Total Length) groups within species, usually occur throughout the southern California area, cruise to cruise, while others do not. As a measure of local regularity of occurrence, the percentage of cruises in which a given T-L group was present was determined for each of eleven representative localities in the area. These were approximate localities, because sampling places differed among cruises. Presence vs. absence of the T-L group was the parameter considered.

In the most common species, *Euphausia pacifica*, all T-L groups were usually present throughout the area (Fig. 4). Only the smaller larvae (1-2 mm) and the larger adults (>17 mm) were less regular than 80%, and they drop to lower values farther offshore. From 3 mm to 16 mm, *E. pacifica* was present everywhere >80% of the time. Values of 100% prevailed from Point Conception through the island areas, including adjacent coastal and southern localities.

Nematoscelis difficilis (Charts 50-97)

Nematoscelis difficilis is second in abundance to *Euphausia pacifica* among the euphausiids of this region. It also migrates through a vertical range of ca. 300 m but it does not rise above the thermocline at night unless the mixed layer is poorly defined, as during strong upwelling (Brinton, 1967 a). As in *E. pacifica*, recruitment of *N. difficilis* occurred throughout the year. Table 2 shows that distinguishable cohorts were recruited in each of the four years, 1953 to 1956. These are discussed in Brinton (MS). In 1953, strongest recruitment of *N. difficilis* larvae (1 to 4 mm total length) was during February and March (Charts 51, 52), September and October (Charts 58, 59), and December (Chart 61). Identity of the December cohort as post-larvae was particularly indistinct, apparently due to relatively high mortality.

As in *E. pacifica*, *N. difficilis* produced one particularly dominant cohort in 1954, arising during June to August (Charts 67-69), (cf. June and July in *E. pacifica*).

In 1955 the heaviest recruitment of *N. difficilis* larvae was in September (Charts 80-83). These were apparently distinguishable as a cohort through November 1956 (total length of 19-24 mm).

1956 showed no such distinct periods of recruitment. The life span in *N. difficilis* (attainment of total length of 19-25 mm) appears to be approximately 7 to 15 months.

With respect to regularity of occurrence through the southern California area, *N. difficilis* provides a picture that is complementary to that shown by *Euphausia pacifica*. Local regularity usually increases in an offshore direction (Fig. 5), although there are some high values centered within the Pt. Conception to San Diego bight. The 1-2 mm larvae were most regular (>70%) off the middle of the southern California coast. The larger larvae, 3-4 mm, were present >90% of the time throughout the area with 100% regularity off Santa Barbara and San Diego. During the juvenile and adult phases (>7 mm body length) occurrence of *N. difficilis* was most regular in the southwestern quadrant of the area, coincident with that part of the California Current which is transitional between the Central gyre to the west and the coastal upwelling centers.

Thysanoessa gregaria (Charts 146-193)

Thysanoessa gregaria does not migrate vertically. Highest densities of adults are found within the seasonal thermocline. This is the smallest of the dominant species; most adults are in the size range of 7-8 mm, few attaining 11-12 mm.

The slender larvae appear in the samples only after about 3 mm body length is attained, apparently because smaller specimens escape through the meshes of the net. Maximum recruitment in 1953, estimated from abundances of 3-4 mm larvae, was during February and March (Charts 147-148) and September through December (Charts 154-157). In 1954 it occurred through August to December (Charts 165-167). In 1955 recruitment peaks were intermittent: March (Chart 170), May (Chart 172), July (Chart 173), and September through December (Charts 177-183). In 1956, peaks were during June (Chart 189), October (Chart 191) and December (Chart 193).

Thysanoessa gregaria shows a pattern of consistency (Fig. 6) like that of *Nematoscelis difficilis* (Fig. 5). However, 1-2 mm larvae are rare, evidently because *T. gregaria*'s particularly slender body at this growth stage easily passes through the net meshes. Significant occurrences were only near San Diego. Subsequent developmental stages in the range of 3-8 mm were >80% regular in the southwestern half of the area. Large adults, 9-12 mm, occurred most frequently toward the west, implying occupancy of the southerly stream of the California Current.

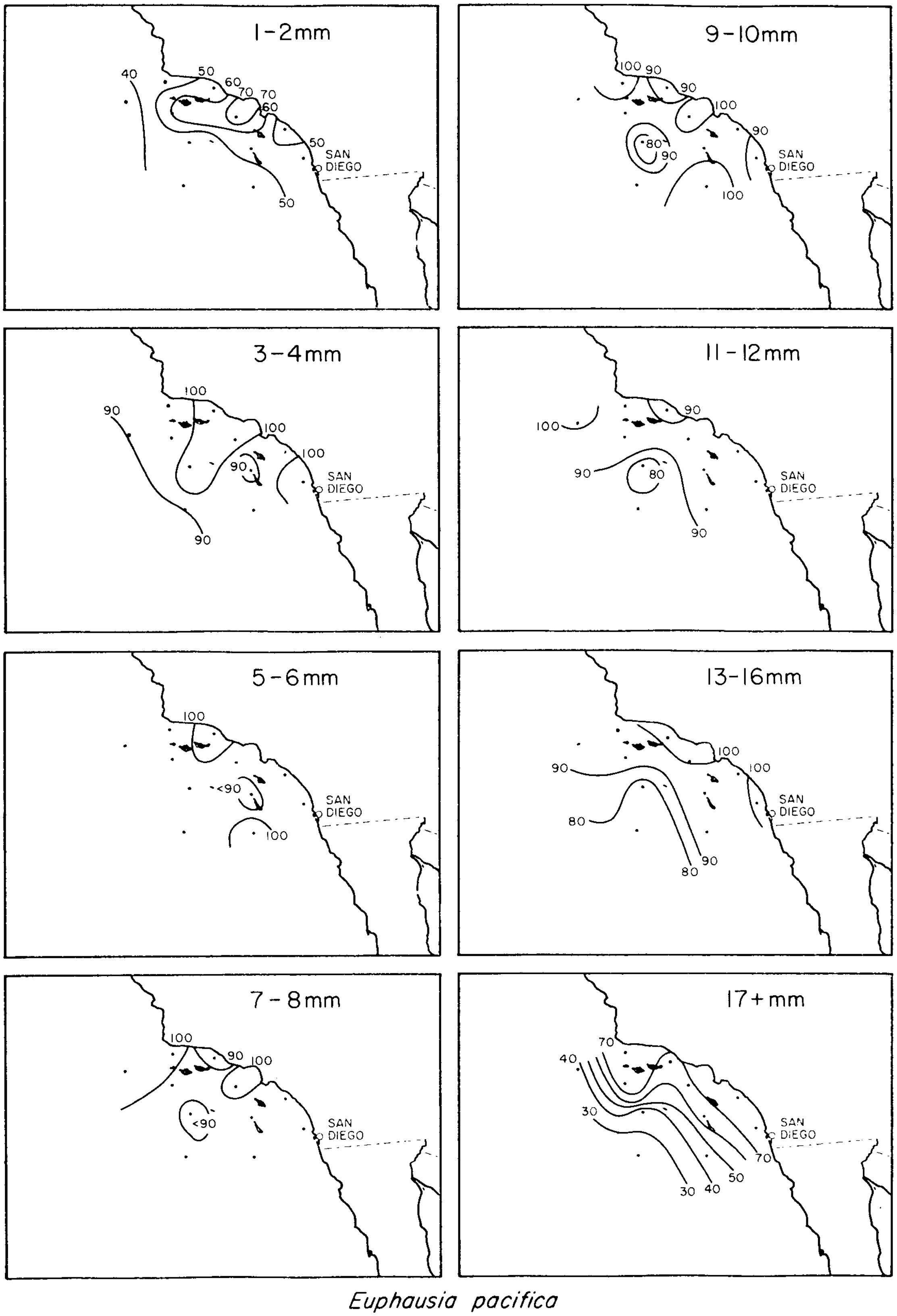
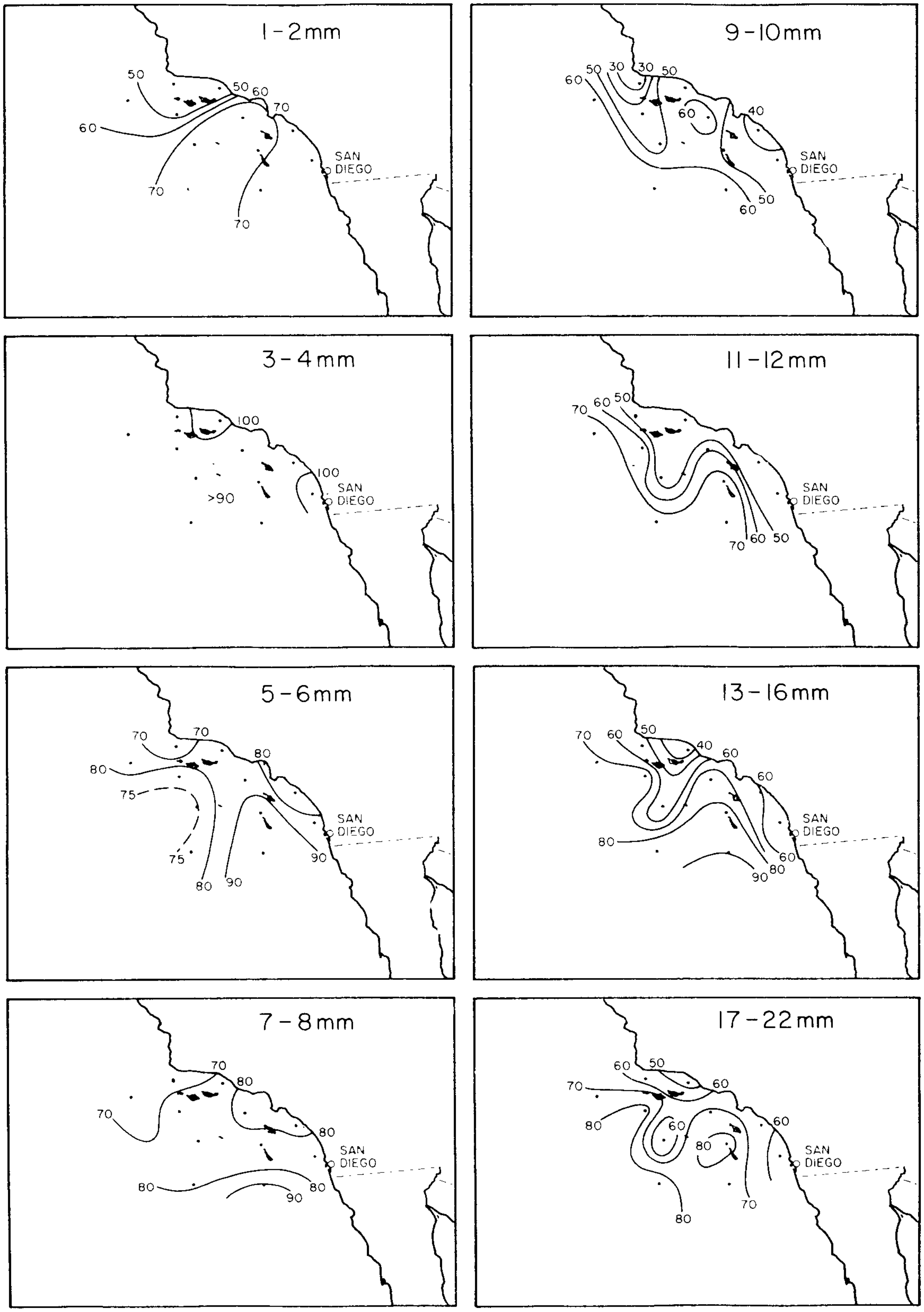
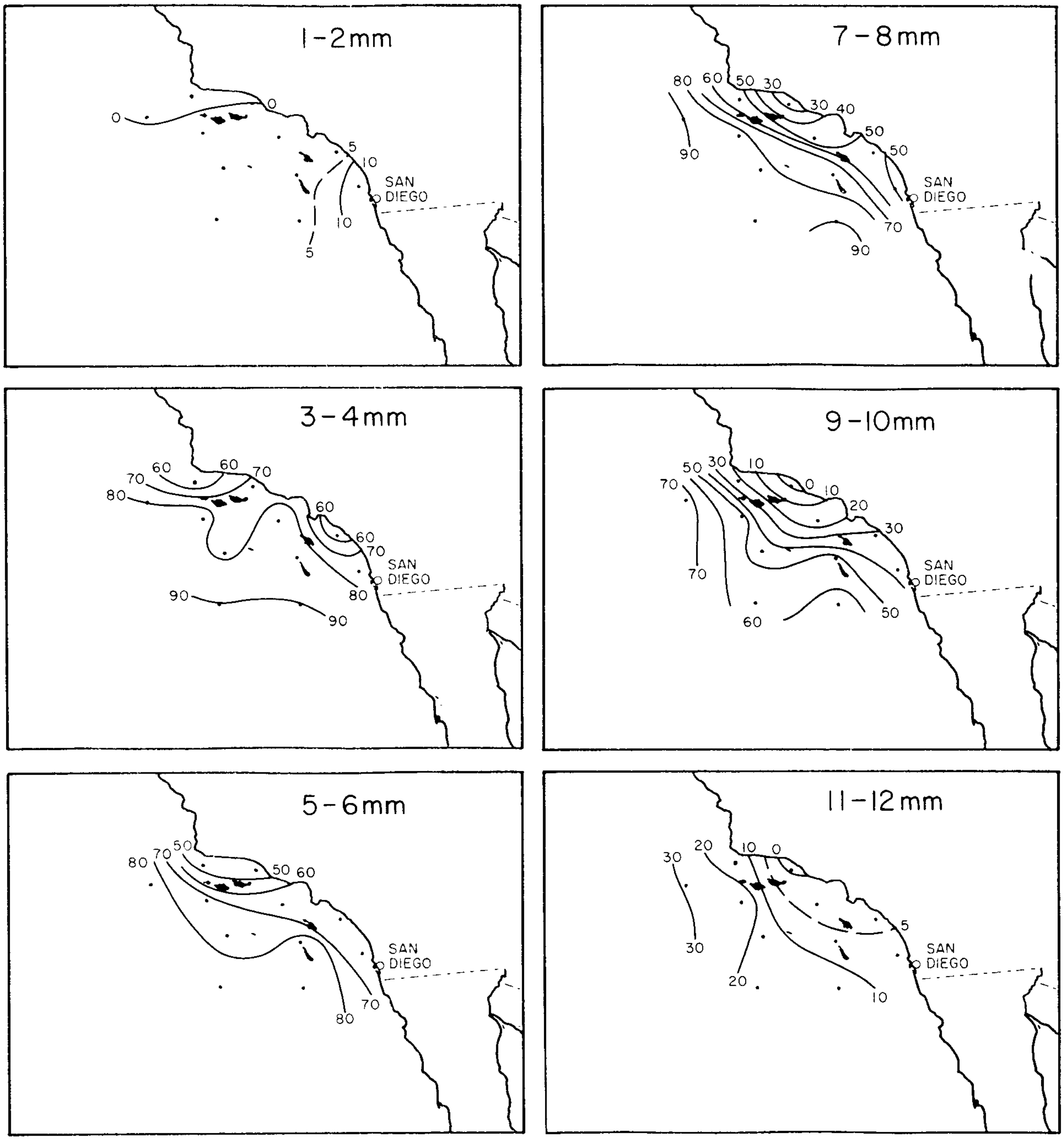


Figure 4. Percentages of records of the eight growth stages (or size classes) of *Euphausia pacifica* at localities selected as representative of study area, 48 cruises, 1953-1956.



Nematoscelis difficilis

Figure 5. Percentages of records of the eight growth stages (or size classes) of *Nematoscelis difficilis* at localities selected as representative of study area, 48 cruises, 1953-1956.



Thysanoessa gregaria

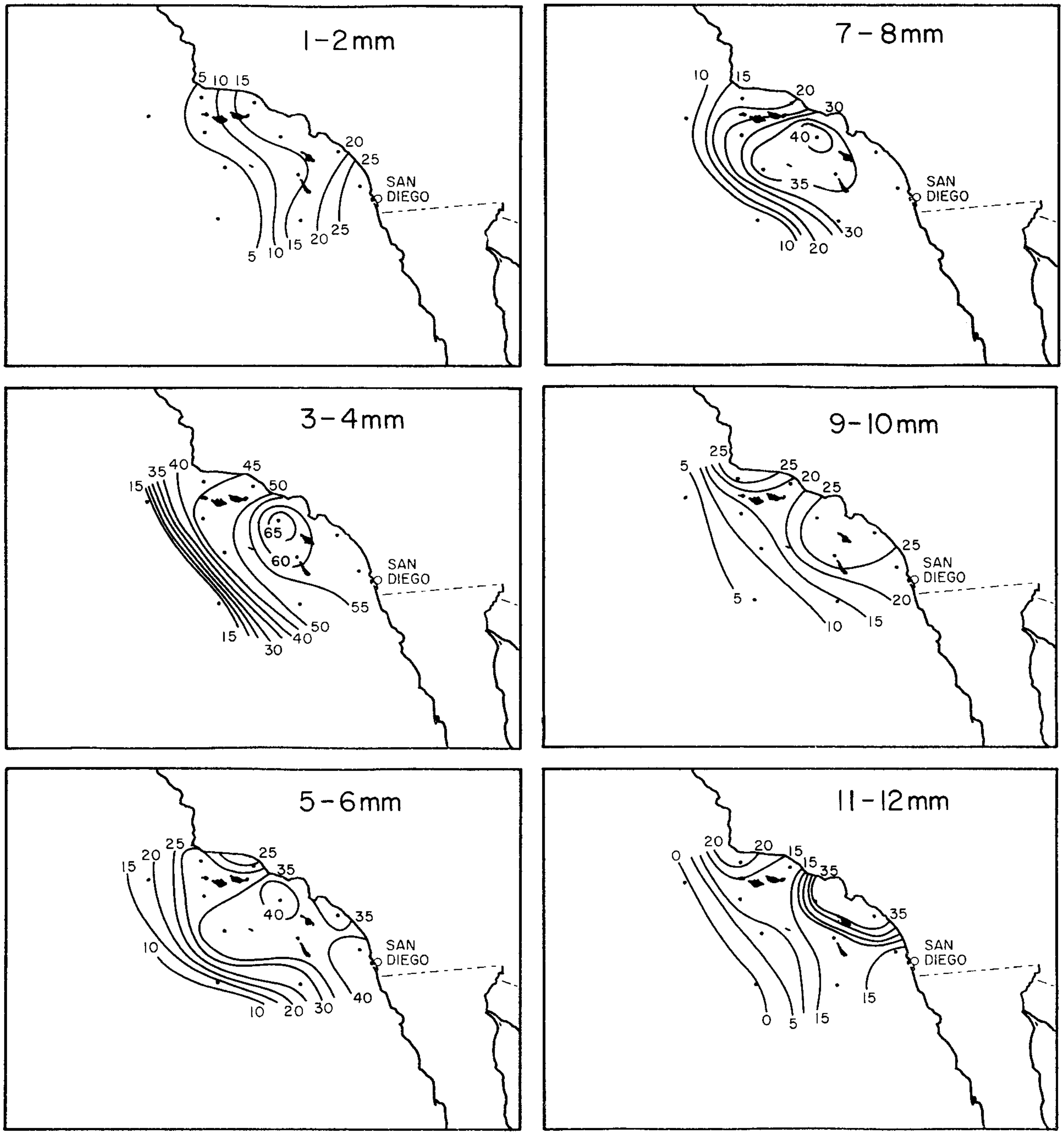
Figure 6. Percentages of records of six growth stages (or size classes) of *Thysanoessa gregaria* at localities selected as representative of study area, 48 cruises, 1953-1956.

Notes on Distribution of the Species Showing Variable Ranges in the Area

Nyctiphanes simplex (Charts 98-145)

Nyctiphanes simplex is a coastal species. It usually ranges from southern California southward to the cape of Baja California and has a disjunct population off Peru and Chile. (The other coastal species, *Thysanoessa spinifera*, is more northern, ranging from mid-Baja California to the Gulf of Alaska.)

Nyctiphanes simplex is usually commonest to the south, outside of the study area. Figure 7 shows that occurrences of 1-2 mm larvae were attained only 25% of the time and only at the southeastern corner of the area. Larger larvae reached >60% regularity toward the center of the region of islands, while juveniles, 5-8 mm, peaked at 40% in

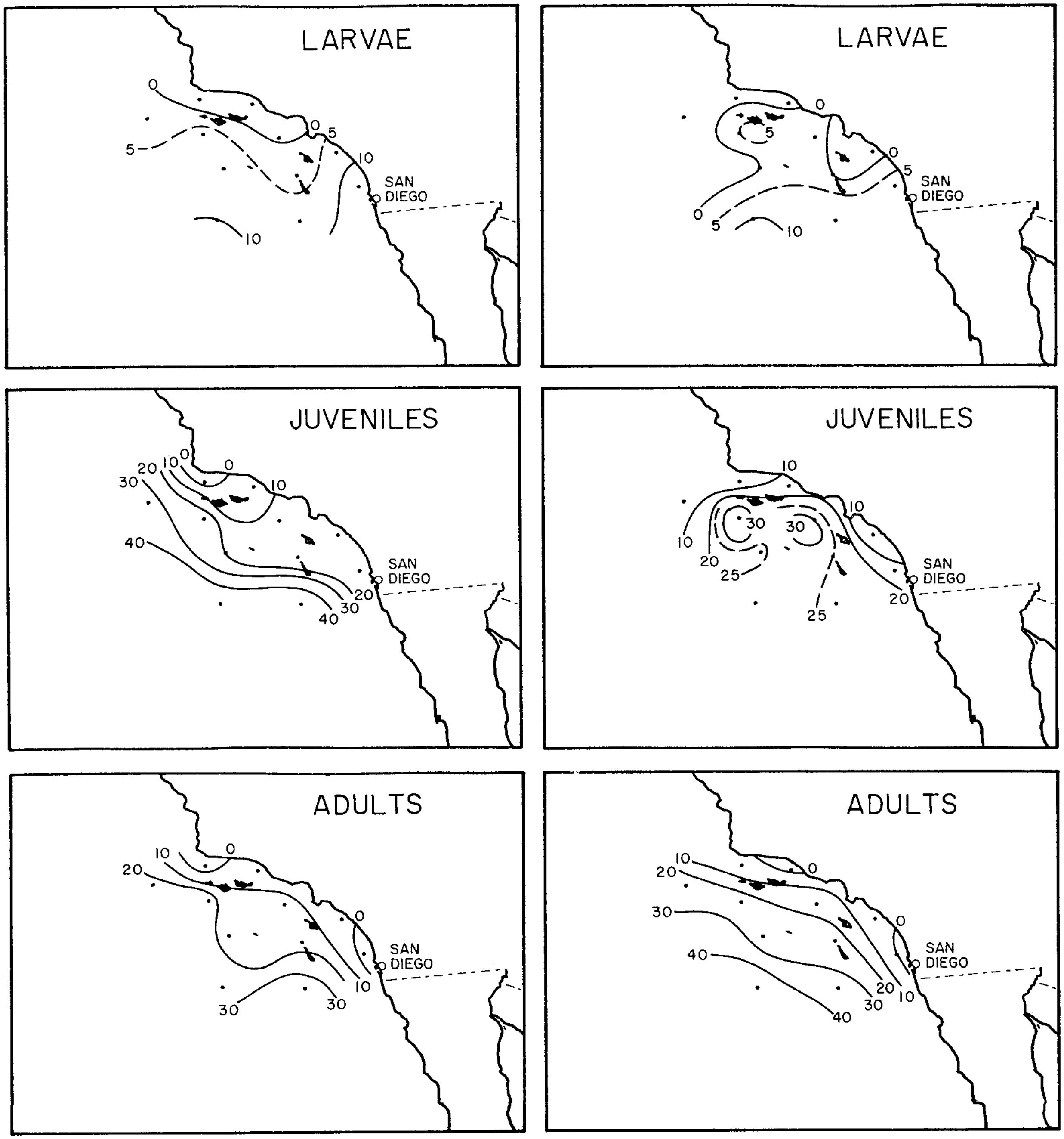


Nyctiphanes simplex

Figure 7. Percentages of records of the six growth stages (or size classes) of *Nyctiphanes simplex* at localities selected as representative of study area, 48 cruises, 1953-1956.

the same place. Adults of 9-12 mm occurred most regularly, 25 to 35% within the coastal part of the southern California bight.

In spite of northerly flow in the southern part of the area during cruise 5307-08 (Fig. 1), there were few occurrences of *N. simplex* until cruise 5312, when larvae and juveniles appeared along the coast. During January and February (5401-02), all developmental stages except 1-2 mm larvae were present in the coastal half of the area, accompanying peak northerly flow. These persisted into March and all but disappeared during April through June. *N. simplex* reappeared in July (5407) after the June height of a weak upwelling season. It became increasingly widespread during late 1954 and achieved a maximum distributional spread of all stages in January and February, 1955, while remaining densest nearshore. Occurrences re-



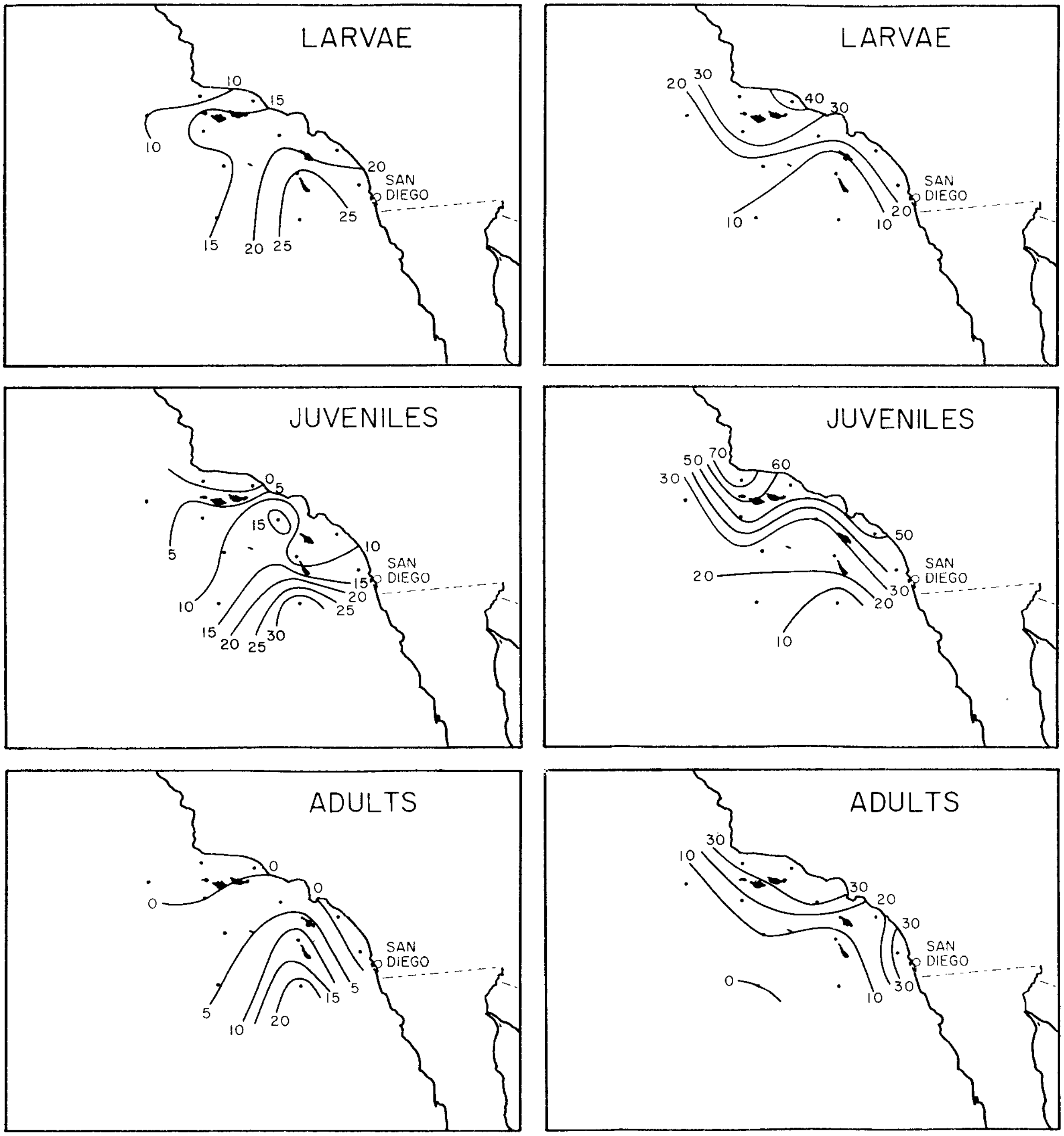
Euphausia gibboides *Stylocheiron affine*

Figure 8. Percentages of records of larvae, juveniles and adults of *Euphausia gibboides* and *Stylocheiron affine* at localities selected as representative of study area, 48 cruises, 1953-1956.

mained substantial into March (5503). Offshore displacement was evident in April as intense upwelling commenced, but the winter to spring (1954-55) build-up persisted into July (5507).

Except for early September, 1955 (5508), there was no substantial decline of *N. simplex* in the area until January, 1956, which was followed by renewal in February and March (5602-03). Again, there was decline in April, followed by a general broadening of the area occupied during 1956, except at the June height of the 1956 upwelling season.

Estimates of the extent (percentage) of the study area occupied by *N. simplex*, and also by the other species showing variable ranges in area, are given in Figure 10. The broad occurrence of *N. simplex* in the area during August through November, 1955 accompanied a decline in occurrences of the other coastal species, *Thysanoessa spinifera*. This decline



Euphausia eximia *Thysanoessa spinifera*

Figure 9. Percentages of records of larvae, juveniles and adults of *Euphausia exemia* and *Thysanoessa spinifera* at localities selected as representative of study area, 48 cruises, 1953-1956.

extended through 1956, while *N. simplex* increased its range in the area during June through December, 1956.

Euphausia gibboides and *Stylocheiron affine* California Current Form (Charts 194-241)

Euphausia gibboides was described above as a member of a Transition Zone-California Current euphausiid assemblage. Its North Pacific range extends from Japan to America in the zone of 30° to 45° N, then bends southward in the California Current to 20° N. Its vertical range, both before and during adulthood, extends from the seasonal thermocline (night) to about 400 to 500 m depth (day).

Stylocheiron affine is a widespread species, tropical and subtropical throughout the world ocean. A "California Current Form" of *S. affine*

(Brinton, 1962) appears restricted to waters off southern California and Baja California. It lives in and above the thermocline, 0 to ca 200 m, and does not migrate vertically.

These two species occur sporadically throughout the area, though rarely with onshore distributions (Fig. 8). Their principal affinities are subtropical, but abundance maxima appear on the offshore edge of the coastal upwelling strip (Brinton, 1967b, 1973). Larvae of both were infrequent in the area while juveniles and adults attained 30-40% regularity usually toward the southwest.

In 1953, *S. affine* was most abundant in the area during January through March (5301-03) and August through October (5308-10). Thereafter, the broadest occurrences of *S. affine* and *E. gibboides* coincided in time (Fig. 10), also corresponding to the peak in the area occupied by the southerly-coastal species, *Nyctiphanes simplex.*

In 1954, both *E. gibboides* and *S. affine* were widespread during August through October (5408-10). In 1955, *E. gibboides* was widespread during August (5508), and again in October (5510) in association with *S. affine.*

In 1956, their ranges were broadest during October and November (5610-11), largely in the offshore and westerly part of the area, though occurrences were fewer than during their peak seasons in 1953 to 55.

Thus, with respect to extent-of-area-occupied off southern California, *N. simplex*, *E. gibboides* and *S. affine* were generally in phase after November, 1953, but not in the earlier part of 1953 (Fig. 10).

Euphausia eximia (Charts 242-289)

Euphausia eximia ranges throughout the eastern equatorial Pacific, extending northward only to the present study area and southward to Chile. Hence it is the most tropical of the southern Californian species.

The ranges of *Euphausia eximia* and *Thysanoessa spinifera*, a northern species, coalesce in the area (Fig. 9). Hence, these show stronger north to south gradients in regularity than the above species which showed onshore to offshore gradients. Clearly, *E. eximia* enters the area from the south, rarely extending to Point Conception, while *T. spinifera* appears to derive from the north but with some adults apparently residual near the coast along most of southern California.

A maximum spread of *E. eximia* was evident in the study area during October, 1953 to January, 1954 (Fig. 10). Larvae and juveniles first appeared during October (5310) in the southern part of the eddy system, then extended northward through the island areas during December and January (5312-5401). After February (5402), occurrences were more offshore. *E. eximia* all but disappeared by June (5405), the 1954 upwelling peak.

Resurgence, apparently from the south, took place in August (5408), with juveniles and larvae still present into October, followed by new larvae in December (5412).

After January 1955, occurrences were sparse and toward the south. *E. eximia* remained rare thereafter, as the relatively intense upwelling seasons of 1955 and 1956 prevailed.

Thysanoessa spinifera (Charts 242-289)

Adults of *T. spinifera*, a larger species than the others in this area, appear to be poorly sampled, judging by their scarcity. However, there appear to be persisting near-shore populations of adults, as indicated by their capture on 35 of the 48 cruises. The peaks in numbers of larvae generally agreed with those of another cold-water species, *Euphausia pacifica* (Brinton, 1976), except during 1956.

In 1953 larvae and juveniles were at a maximum during May and June (5305-06). The distribution through the island areas suggests a relationship to coastal upwelling maxima rather than to the relatively strong southerly flow in the offshore region.

In 1954 maxima were during June through August (5406-08). Larvae appeared to be entering from the north in an offshore stream (5406), with larvae and juveniles appearing to be established in the area by July (5407). Juveniles remained scattered through August (5408).

In 1955 maxima were found during May through July (5505-07). Larvae and juveniles appeared then to be resident in the area, without tongues of distribution extending from the north. Again, these occurrences seem to relate to the local upwelling period rather than to southerly flow into the area, then relatively weak (Fig. 1).

In 1956 there were no conspicuous occurrences, in spite of the substantial upwelling season from March to November, as evidenced for example by relatively high 10 m salinities throughout the year (Fig. 3). *T. spinifera* was present in the area but the distributions of larvae and juvenines were particularly restricted and patchy, associated with uneven climate over the area, including temperatures that were cooler than usual by 1 to 2°C (Fig. 3).

An inverse relationship is to be seen between the extent of the areas occupied by northern *T. spinifera* and southern *Nyctiphanes simplex* (Fig. 10).

The North Pacific Central Species and the Deep Living Species

A number of species characteristic of the more offshore central North Pacific gyre community enter the southern California eddy system from time to time. These include *Euphausia recurva*, *E. mutica*, *E. hemigibba*, *Nematoscelis atlantica*, *Thysanopoda astylata* (=*T. aequalis* in Brinton

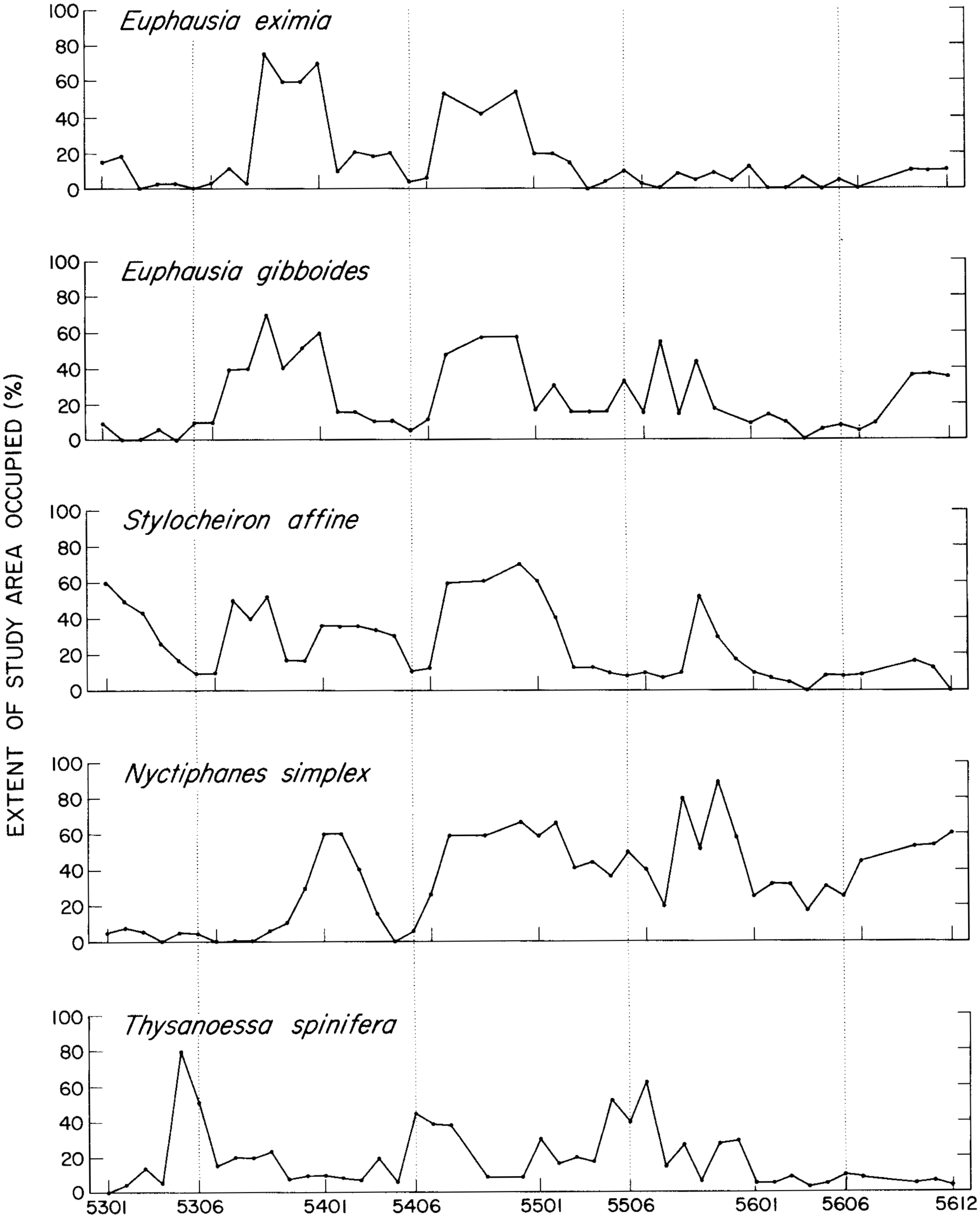


Figure 10. Estimates of extent of study area occupied by species showing variable ranges in the area, 1953-1956.

1967b, 1973), and *Stylocheiron suhmii.* These species were at low local densities during 1953 through 1956 as compared, for example, with the year 1958 (cf. Brinton, 1967b) and are not included in this atlas. The easterly incursions of these species into these waters are considered a separate subject.

Four other euphausiid species, *Nematobrachion flexipes, Stylocheiron longicorne, S. maximum* and *Thysanopoda orientalis* tend to live deeper than the layers sampled and, while occurring through most of the southern California area, are also omitted from this atlas.

Composition of High Density Aggregations of Adult *Euphausia pacifica*

Highest densities of a species, particularly of adults, are of interest because swarming by certain euphausiids is a conspicuous but little understood phenomenon. If it may be related to the reproductive phase, which Komaki (1967) considered a possibility for *E. pacifica* off Japan, characteristics of the swarms such as sex ratios and reproductive states might be distinctive.

Of the two most abundant species, only *Euphausia pacifica* appeared regularly at densities of adults high enough to permit analysis of the composition of aggregations. *Nematoscelis difficilis* yielded >500 adults/1000 m^3 at only one station, as compared to *E. pacifica* adults which were at that density at 169 of the 820 stations. Furthermore, *E. pacifica* adults were >1000/1000 m^3 in 105 samples (13%), and >5000/1000 m^3 in 12 samples (4 of these were from adjacent localities during Cruise 5509 I, Chart 32, hence, may have reflected such density over >3000 km^2).

It is not known whether these densities relate to aggregations extending throughout and beyond the water strained or to swarms which are still denser than the estimates, having intersected only part of the 0.8 km-long path of each tow. Swarms consisting of >5000 adults/1000 m^3 are evidently rare not only in the southern California region but elsewhere in the California Current. Of ca. 4000 samples examined throughout the Current between 20° and 45°N, from the period 1949 to 1964, only six, other than those just cited, yielded *E. pacifica* adults in the density range of 5000 to 9000/1000 m^3, and only one at a still higher density, 20,400/1000 m^3. None were from daytime samples, though Komaki (1967) has seen daytime swarms of this species near Japan.

If mating and spawning are a cause of swarms, one would expect to find relatively high densities of ripe females in them. In most high-density samples of adult *E. pacifica*, >1000/1000 m^3, <25% of the females were ripe (Fig. 11). At increasing densities, >5000 and >10,000/1000 m^3, there was no increase in the relative frequency of samples in which >25% of the females were ripe.

There was also no tendency for densities of >1000 adults per 1000 m^3 to show that female to male ratios increase with an increase in the ratio of ripe to unripe females. On the contrary, 11 of the 17 samples yielding highest female to male ratios (>2:1) included no ripe or spent females at all. Since mating in *E. pacifica* takes place only after the ovary has matured (Brinton, 1976), it is concluded that the observed high densities of adults of this species are not due to reproductive behavior. It is therefore assumed that the localities are either good places for the adults to live or that hydrographic processes are the agent, as also suggested by Komaki (1967), or both.

Highest percentages of stations showing densities of adults >1000/1000 m^3 were found in the months of February and August in 1953, March and August in 1954, February, April to June, and September to December in 1955, and February in 1956. These peaks, particularly those in February and March appear to be related to times when observed large cohorts simply attained adulthood (Brinton, 1976). Therefore, adults are then expected to be at generally high densities in the area. They include spawners at proportions which appear to be independent of the density of total adults.

Spatial Interrelationships of Adults and Calyptopis Larvae

Densities of larvae in relation to the densities of co-occurring adults might also be of consequence in the life histories of the species. It is known, for example, that under laboratory conditions, suitable food for *E. pacifica* includes naupliar larvae of the crustacean, *Artemia* (Lasker and Theilacker, 1965). They are similar in size to *E. pacifica*'s own calyptopis larvae (1.2-2.5 mm in length) which might be food for the adults in nature, though such feeding would not be conducive to survival of the species.

In the case of *E. pacifica*, which sheds its eggs freely into the water, eggs and parental stock would necessarily be in the same place for at least a brief period following spawning. This is especially the case if spawning takes place at night when the adults are near the surface, because eggs of *E. pacifica* are found within the uppermost 50 m, day and night. Subsequent downward migration of adults at dawn would separate the parental stock from its eggs, since deep currents often differ in velocity and direction from surface currents (Fig. 1). Such migration might or might not introduce the adults into another area of recruitment where other larvae might be consumed by the feeding adults. It could at least diminish the predation pressure of particular adults on their own eggs and larvae.

If spawning takes place in the daytime and the eggs then bouy up above the position of the spawners, differential transport may already occur

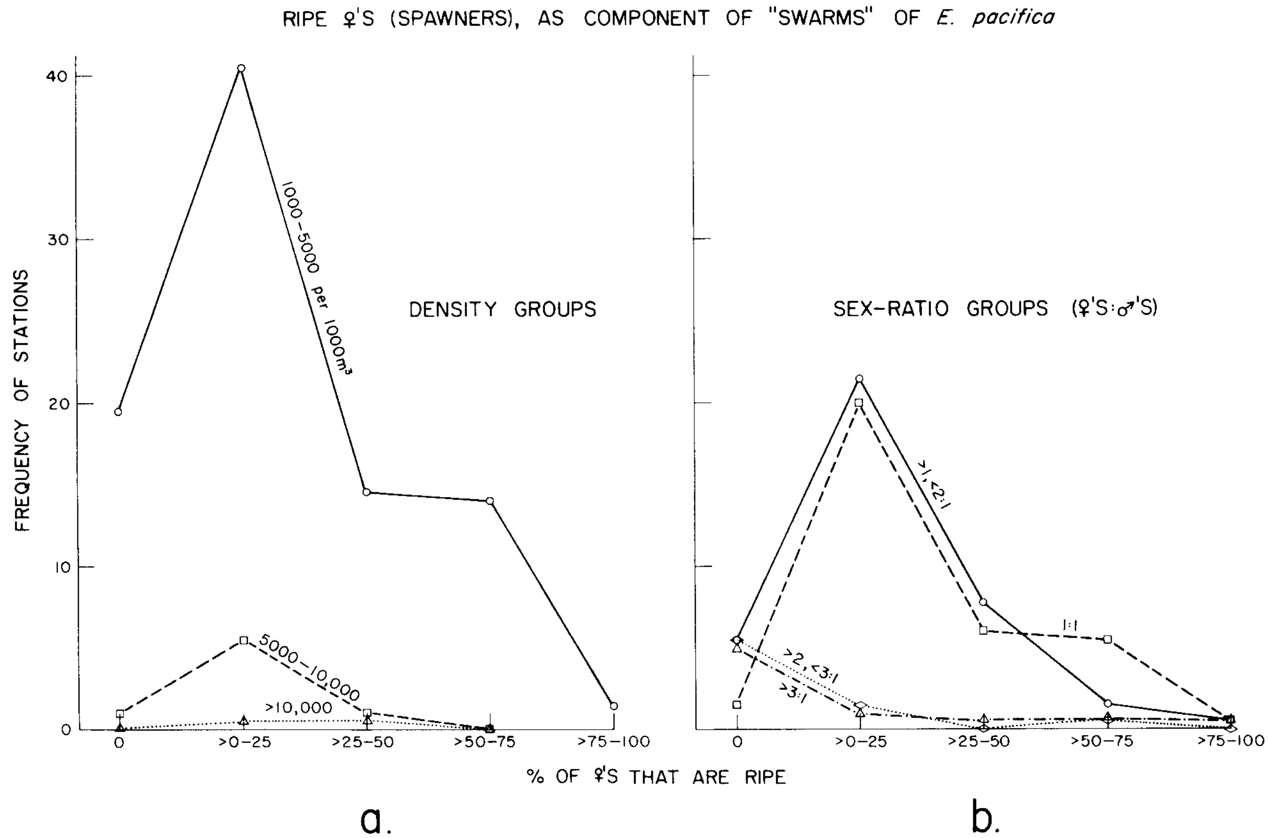


Figure 11. Ripe females as components of high density samples of adult *Euphausia pacifica*. a. as function of total adult density in sample. b. as function of female/male sex ratio, four groupings of samples: ca. 1:1 (dashed line), >1:1 to <2:1 (solid line), 2:1 to <3:1 (dotted line), and at least 3:1 (dash-dot line).

before night. The data and distributions shed some light on the possible frequency of such displacement. Stations were categorized according to densities of adults and calyptopes (Fig. 12). Calyptopis Stage I is attained 5 days after spawning in *E. pacifica* (Banse and Komaki, 1966), but these are the youngest larvae regularly sampled in this program. By this time, a parental population can no longer be distinguished as such on the basis of condition of ovaries (developing, ripe, or spent). Therefore, in assessing evidence relating to parent-larva cooccurrence, it seems appropriate only to compare densities of adults with the calyptopis larvae.

In *E. pacifica* the observed mean ratio of calyptopes to adults is 0.73:1 based on mean densities of 423:577/1000 m^3, from all stations at which either adults or larvae were present. However, at stations where densities of either adults or calyptopes were >50 per 1000 m^3, which are arbitrarily designated the habitat localities, the mean ratio was rarely observed. Usually either adults or calyptopes were in substantial dominance over the other.

Where adults dominated, calyptopes were usually absent (Fig. 12): 88% of the time when adults were >5000 per 1000 m^3, and 62 to 71% of the time when adults were at the lesser density class. It is also seen that the mean number of larvae per station increased somewhat with each increase in density of adults. However standard deviations also increased with the density of adults, each being overlapped by that of the successive density class. In other words, where adults were dominant, mean densities of calyptopes were roughly independent of densities of adults.

Calyptopis larvae dominated over adults at fewer stations than where adults dominated over calyptopes. However, the degree of dominance was greater at the higher densities of the dominant form, >1000 per 1000 m^3, than was the case in the adult:calyptopis comparison. Here, however, total absence of the subordinate group (adults) was rare, but such absence was again most frequent (29% of the time) at highest densities of the dominant form, >5000 per 1000 m^3. Furthermore, the mean number of adults was relatively low at this high density class of calyptopes.

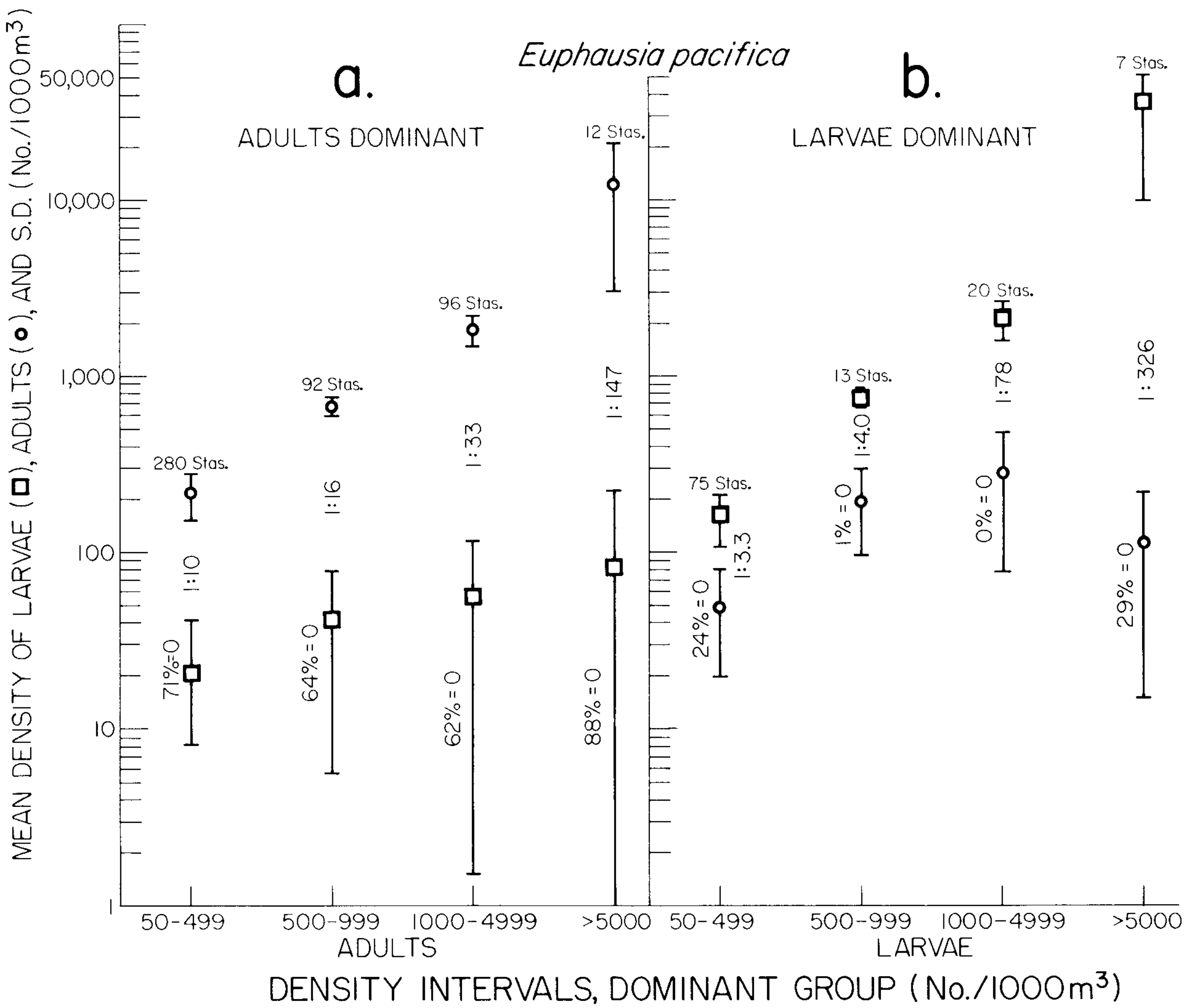


Figure 12. Calyptopis larvae and adults of *Euphausia pacifica*, means and standard deviations of densities, as function of density of form in plurality (considered dominant), grouped in four density classes. a. stations where adults were dominant form. b. stations where calyptopis larvae were dominant form. Mean ratios of dominant form to subordinate and percentages of stations at which subordinate form was entirely absent (zero density) are shown.

In summary, displacement of the numerically dominant form (either adults or larvae) away from concentrations of the subordinate form may be a population characteristic, particularly at highest densities of the dominant form. Thus, high density swarms of adults or larvae may realistically reflect an adaptive relationship whereby principal reproductive areas tend to occur in areas where differential transport of adults and larvae is relatively efficient.

Alternatively, the possibility remains that high adults to larvae ratios could result from consumption of larvae by aggregations of feeding adults.

Nematoscelis difficilis is usually the second most abundant euphausiid in the southern California region. Adults of *N. difficilis*, in particular, are far fewer than adults of *E. pacifica* in these collections. Therefore ratios of adults to calyptopis larvae in *N. difficilis* commonly differ from those in *E. pacifica*. In *N. difficilis* the mean ratio of calyptopis larvae (1-2 mm) to adults was 4.4:1 (cf. 0.7:1 in *E. pacifica*) based on mean densities of 116:26/1000 m^3 (cf. 423:557/1000 m^3 in *E. pacifica*). When the dominant form, either adult or calyptopis, was at a density of >50 per 1000 m^3, calyptopes were dominant at 293 of the 353 stations.

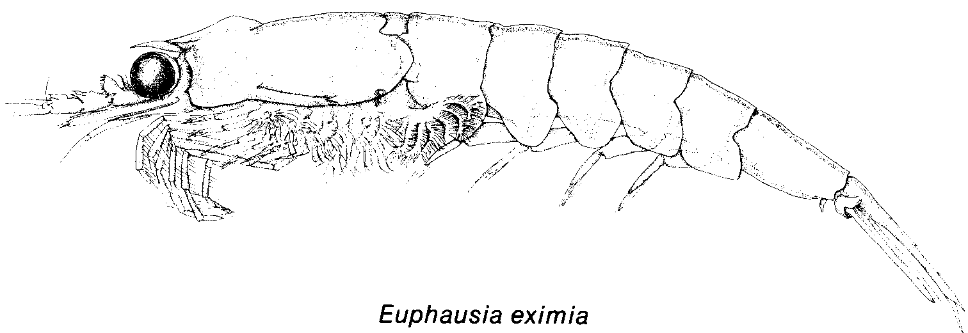
Absence of adults at highest densities of calyptopes (>1000 per 1000 m^3) was observed at 4 of the 15 stations. At the single station which yielded >1000 adults per 1000 m^3 there were no calyptopes.

At intermediate densities of calyptopes, 50-499 per 1000 m^3, adults were lacking at 99 of 130 stations, a higher proportion than when calyptopes were at their greatest density. When adults were at 50-499 per 1000 m^3, the larvae were lacking at 3 of the 50 stations. Hence, as the dominant form (*N. difficilis* adult or calyptopis) increased in density, there was no accompanying increase in the proportion of stations yielding zero density of the subordinate form. This differed from *Euphausia pacifica*, in which a relatively larger number of stations showed total separation of adults or calyptopes when densities were highest (>5000 per 1000 m^3).

The significance of this difference is not evident. However, the raptorial limbs in *N. difficilis* imply possibly stronger selectivity in feeding by that species than in *E. pacifica* with its filtering basket. This could permit active avoidance or rejection of its larvae by *N. difficilis* when it is feeding. Also, in *N. difficilis* the expelled fertilized eggs are held attached to thoracic legs for several days of brooding. Hence, young are not available as food until they hatch as metanauplii. Such larvae are doubtless better swimmers than the free eggs and nauplii of *E. pacifica*. More detail must be known about spatial and temporal distributions of eggs, larvae and adults, including vertical distributions, in order to understand the above relationships.

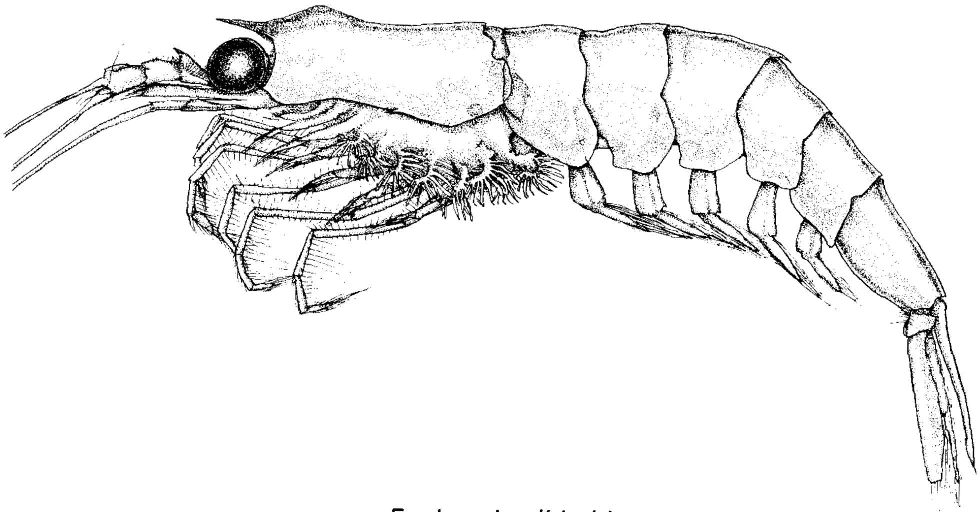
Illustrations of the Species

The eight euphausiid species included in this atlas are depicted in the adult phase in Figures 13-20. Certain gross morphological characteristics commonly used for purposes of identification in the southern California area are annotated in the figure legends.



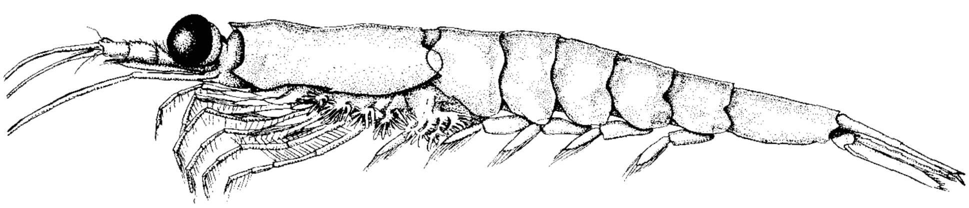
Euphausia eximia

Figure 13. *Euphausia eximia* Hansen
Eye: round.
Rostrum: long, sharply pointed.
1st segment of antennule base: upper forward angle has large forward-directed comb-like leaflet.
Lateral carapace denticles: two on each side.
Thoracic legs: form essentially uniform filtering basket.
3rd segment of abdomen: no dorsal spine.
Adult body length (eye to tip of telson): 15-23 mm.



Euphausia gibboides

Figure 14. *Euphausia gibboides* Ortmann
Eye: round.
Rostrum: long, sharply pointed.
1st segment of antennule base: upper forward angle has high, forward-curving tooth.
Lateral carapace denticles: one on each side.
Thoracic legs: as in *E. eximia.*
3rd segment of abdomen: upper posterior edge has sharp, backward-directed spine.
Adult body length: 16-26 mm.



Euphausia pacifica

Figure 15. *Euphausia pacifica* Hansen
Eye: round.
Rostrum: lacking; frontal plate is obtuse triangle.
1st segment of antennule base: upper, forward angle has low, sharp, forward directed tooth.
Lateral carapace denticles: one on each side.
Thoracic legs: as in *E. eximia.*
3rd segment of abdomen: no dorsal spine.
Adult body length: 11-22 mm.

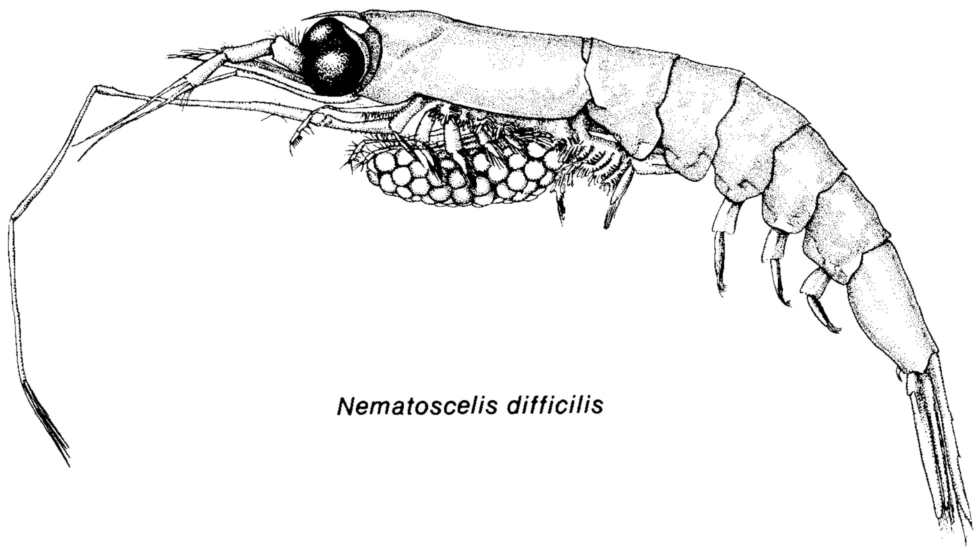


Figure 16. *Nematoscelis difficilis* Hansen

Eye: two-lobed, in adult, upper lobe is nearly as broad as lower lobe.

Rostrum: long slender, sharply pointed in female: often much shorter in male.

1st segment of antennule base: upper forward angle has low, blunted or truncated projection.

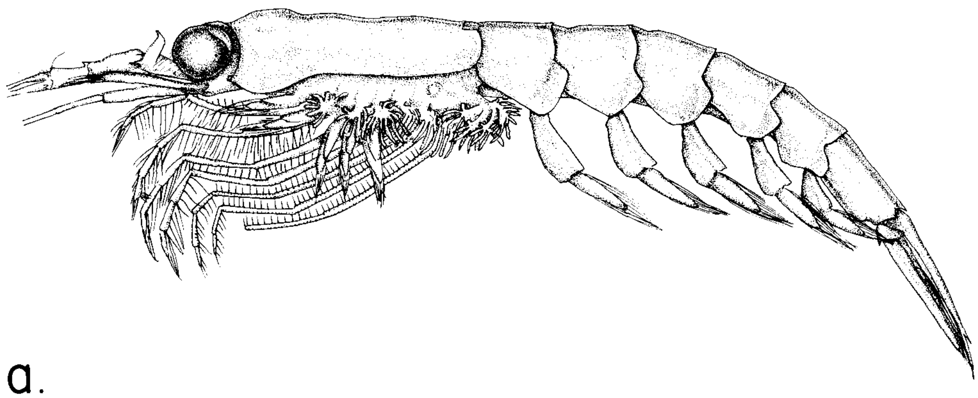
Lateral carapace denticles: usually none in large adults, sometimes one on each side in small adults.

Thoracic legs: 2nd pair is very long with straight distal spines, other legs short.

3rd segment of abdomen: no dorsal spine.

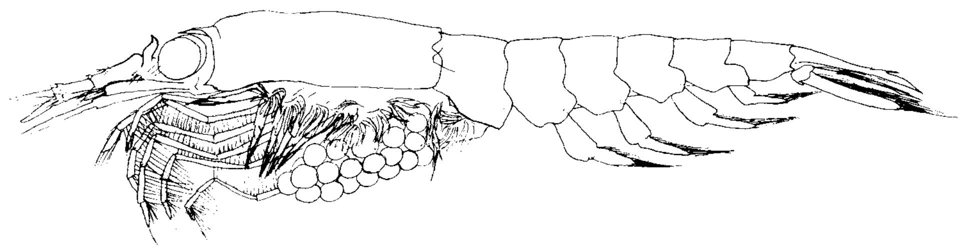
Adult body length: 16-24 mm.

Female bears eggs externally.



a.

Nyctiphanes simplex



b.

Figure 17. *Nyctiphanes simplex* Hansen. a. male, b. female
Eye: round.
Rostrum: lacking; frontal plate is short, forms acute triangle.
1st segment of antennule base: upper forward angle has high leaflet directed upward, more backwardly directed in male.
Lateral carapace denticles: none.
Thoracic legs: generally uniform, as in *Euphausia*; most posterior pair lacks the three distal segments.
3rd segment of abdomen: no dorsal spine.
Adult body length: 8-12 mm.
Female bears eggs externally.

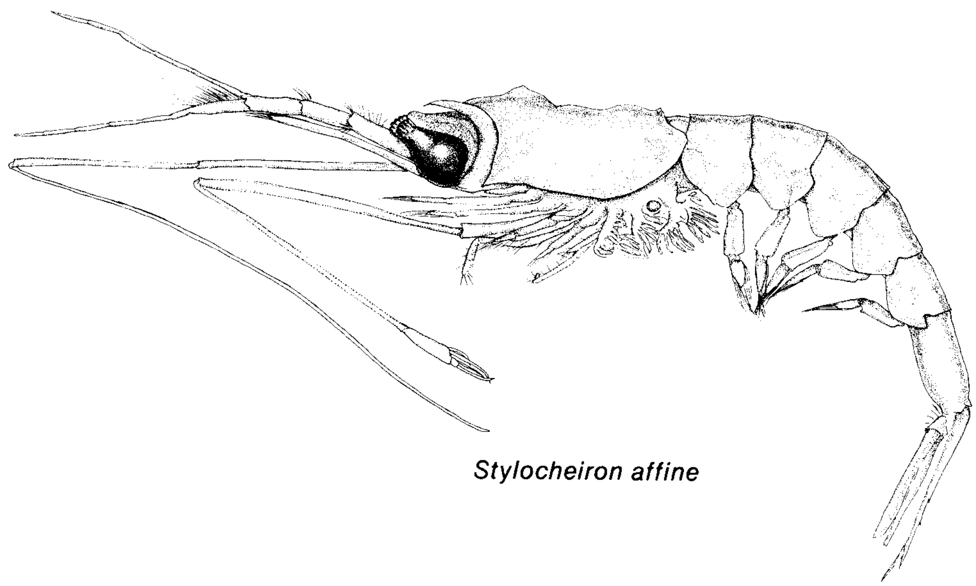


Figure 18. *Stylocheiron affine* Hansen

Eye: elongate, upper part a little more than half the width of lower part.

Rostrum: long, slender, sharply pointed in female; a short acute triangle in male.

1st segment of antennular base: upper forward angle has a short, toothlike projection, not raised up. This basal segment is longer in female than in male.

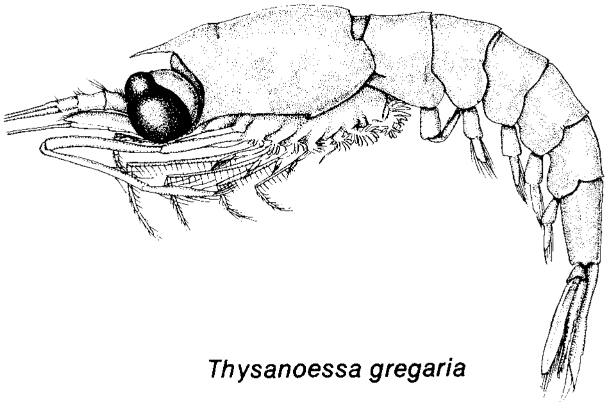
Lateral carapace denticles: none.

Thoracic legs: 3rd pair is very long with curving distal spines, forming a "false chaela"; other legs short.

3rd segment of abdomen: no dorsal spine.

Adult body length: 7-9 mm.

Female bears eggs externally.



Thysanoessa gregaria

Figure 19. *Thysanoessa gregaria* G.O. Sars

Eye: two-lobed, upper lobe is low, rounded, about half the width of lower lobe.

Rostrum: a long narrow plate, narrowing towards the tip.

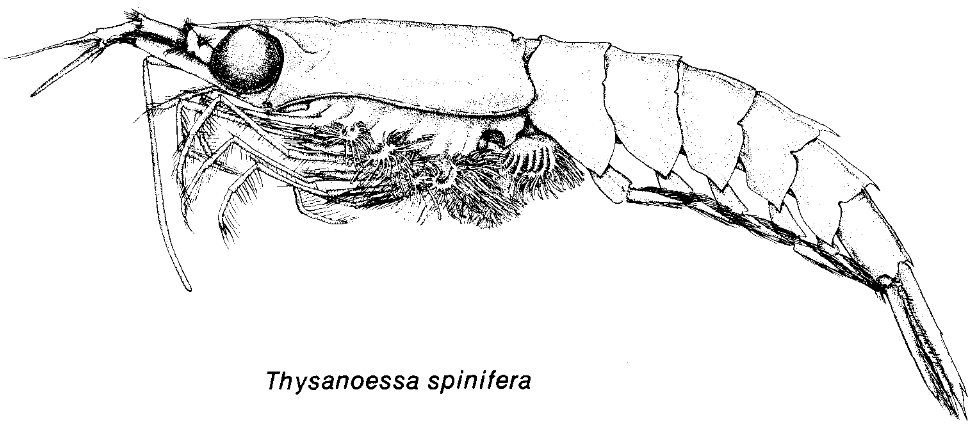
1st segment of antennular base: upper forward angle has a low very short, forward-directed tooth-like projection.

Lateral carapace denticles: one on each side.

Thoracic legs: all are brush-like, but second pair is about two times longer than next longest.

3rd segment of abdomen: no dorsal spine.

Adult body length: 7-13 mm.



Thysanoessa spinifera

Figure 20. *Thysanoessa spinifera* Holmes

Eye: almost round, upper part hardly narrower.

Rostrum: long, stout, sharply pointed.

1st segment of antennular base: upper forward angle is low, blunted, scarcely projecting.

Lateral carapace denticles: none.

Thoracic legs: all bear screen-like setae as in *Euphausia*, but second pair is somewhat longer than first or third pairs.

2nd and 3rd segments of abdomen have dorsal keels, and 4th, 5th and 6th segments have heavy, dorsal, backward-directed spines.

Adult body length: 16-25 mm.

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Euphausia pacifica

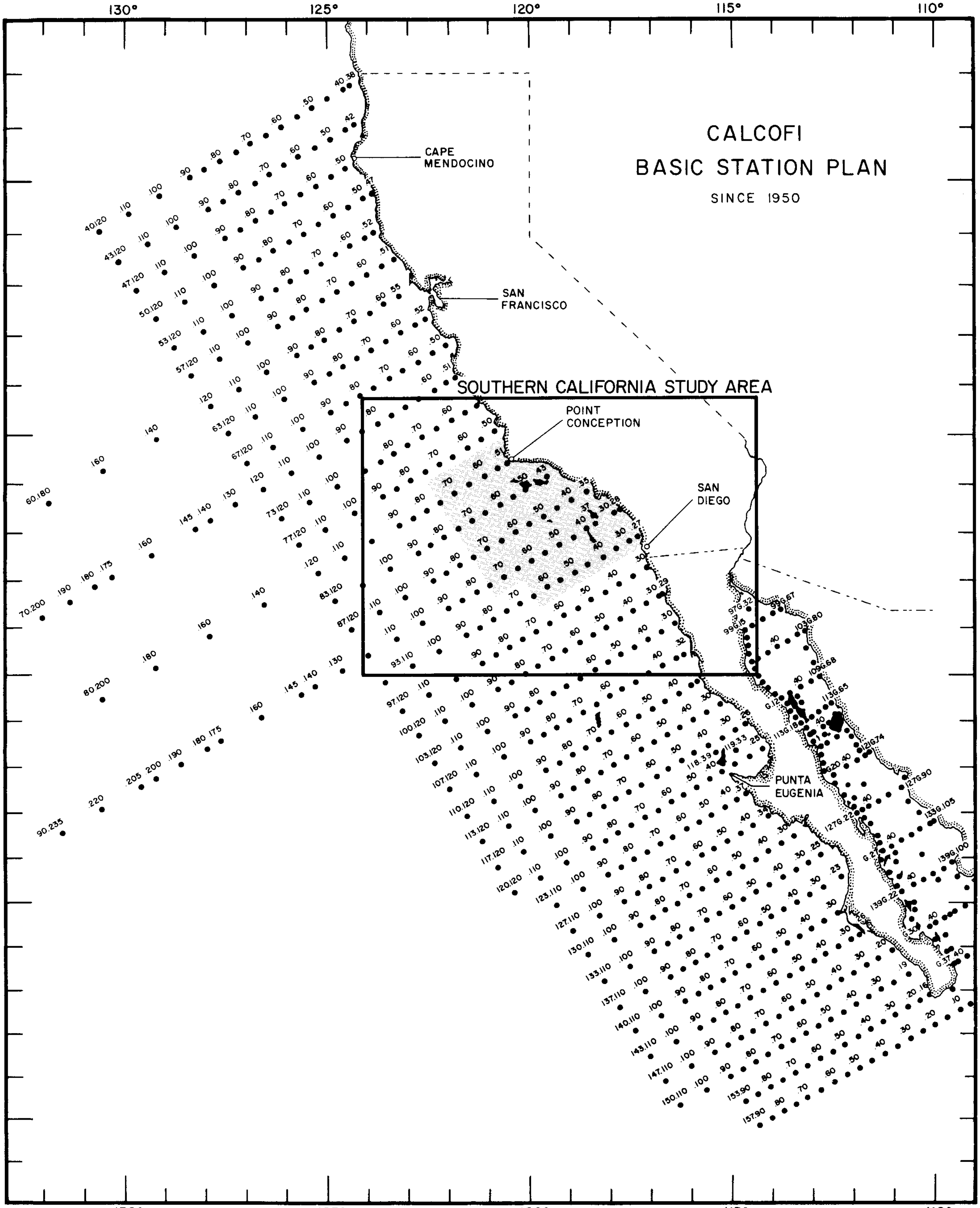
Nematoscelis difficilis

Nyctiphanes simplex

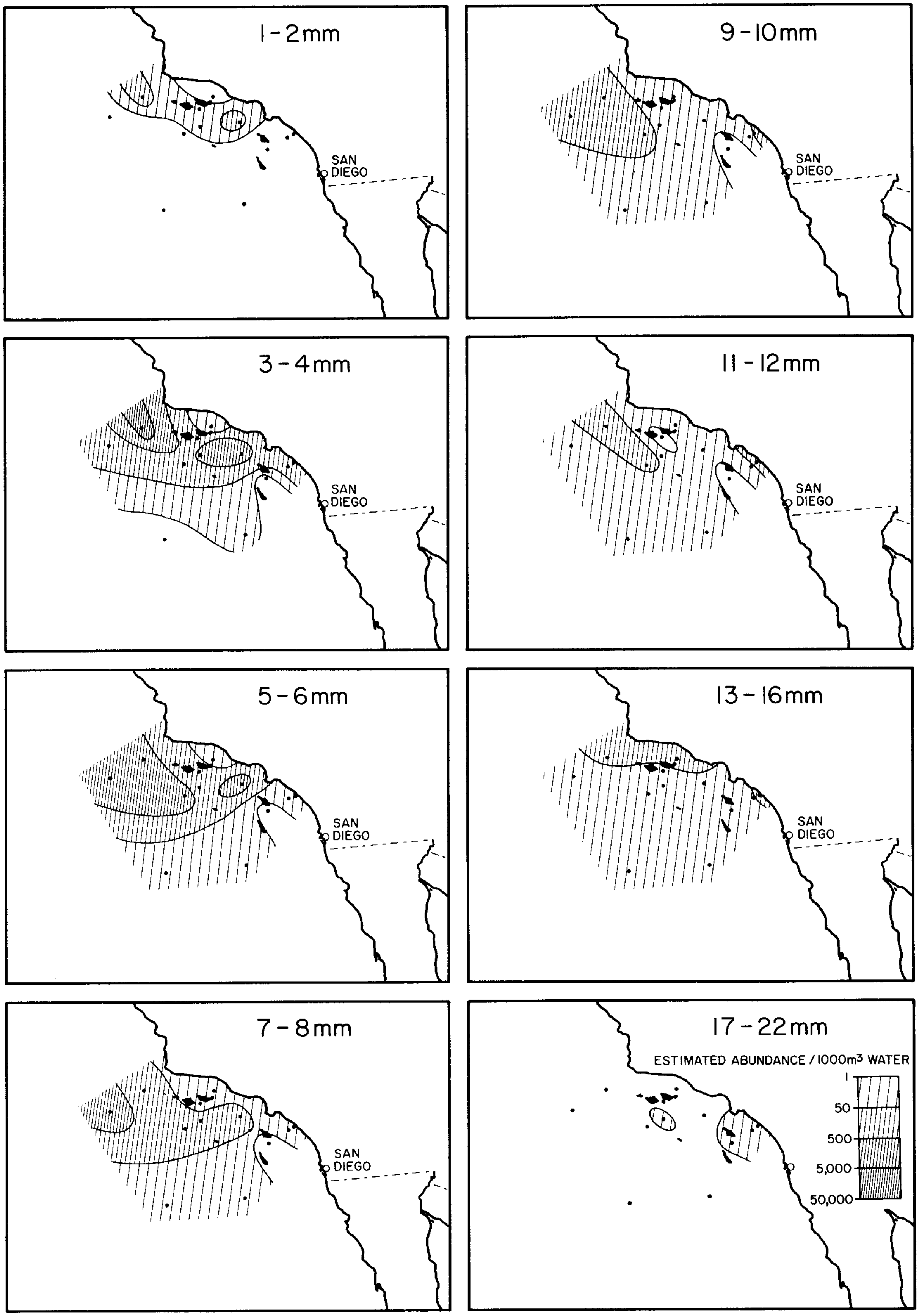
Thysanoessa gregaria

Euphausia gibboides
Stylocheiron affine

Thysanoessa spinifera
Euphausia eximia

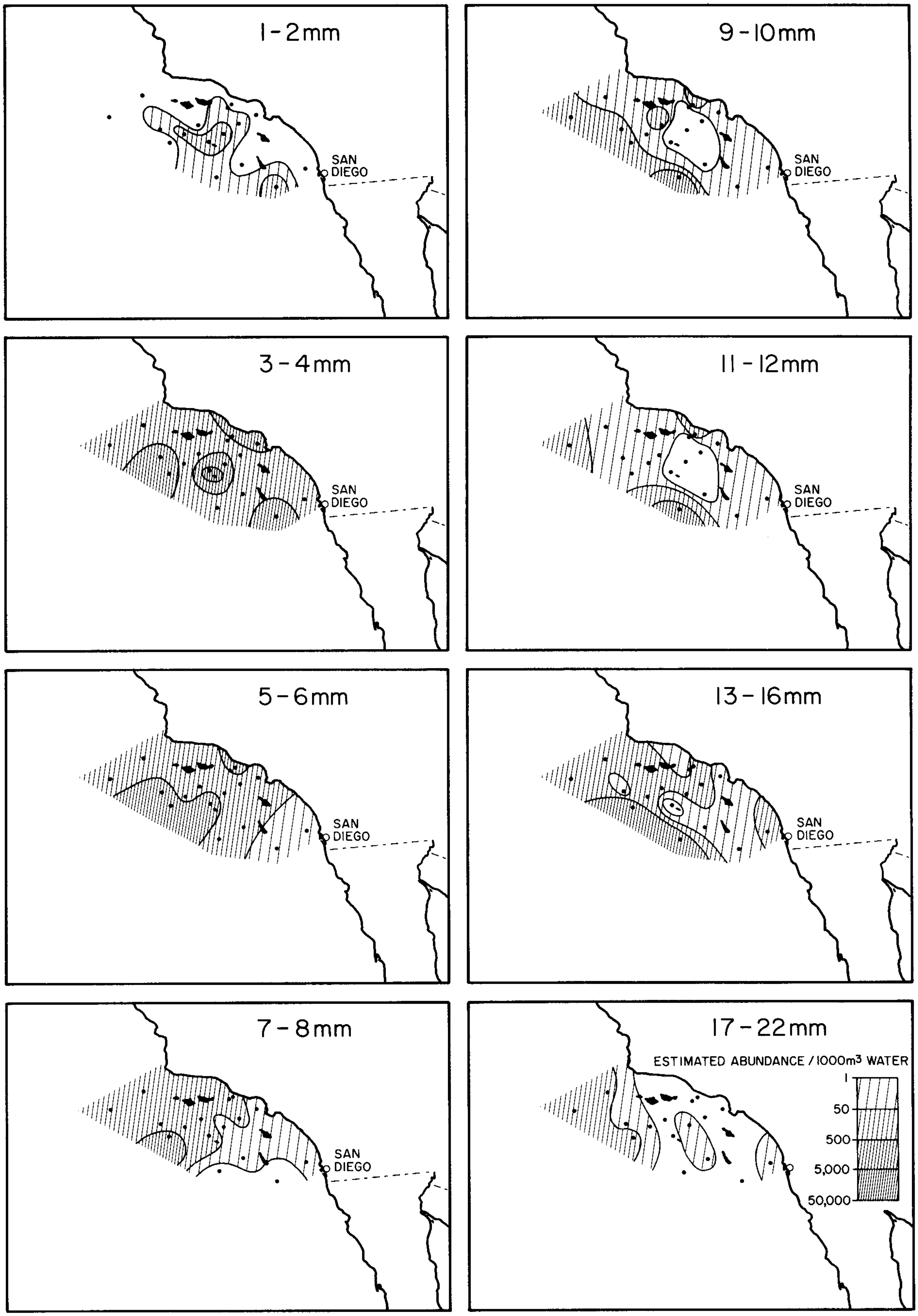


CALCOFI BASIC STATION PLAN
SINCE 1950



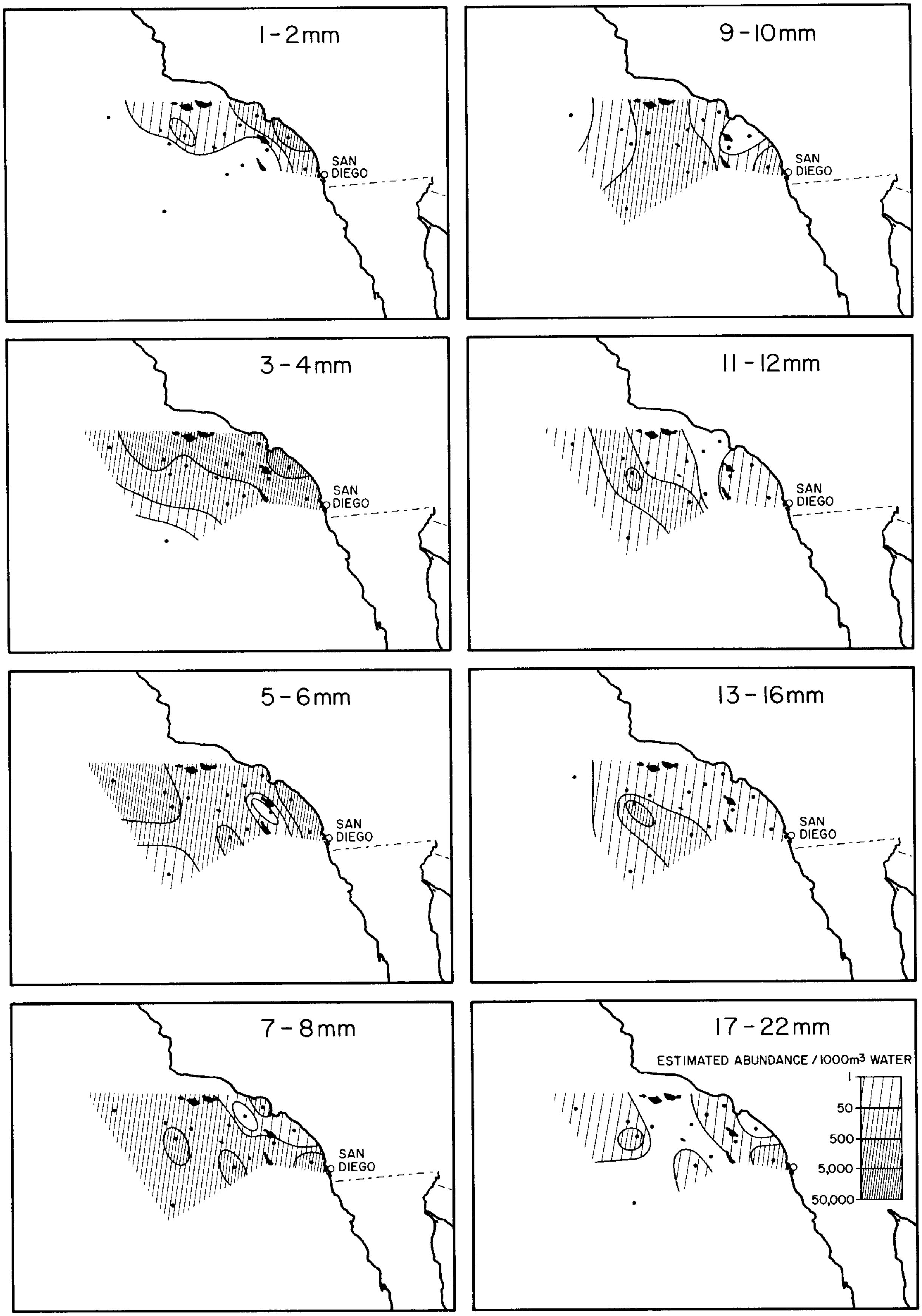
CALCOFI CRUISE 5301
9 - 17 JANUARY 1953

Euphausiacea
Euphausia pacifica
5301



CALCOFI CRUISE 5302
4-14 FEBRUARY 1953

Euphausiacea
Euphausia pacifica
5302



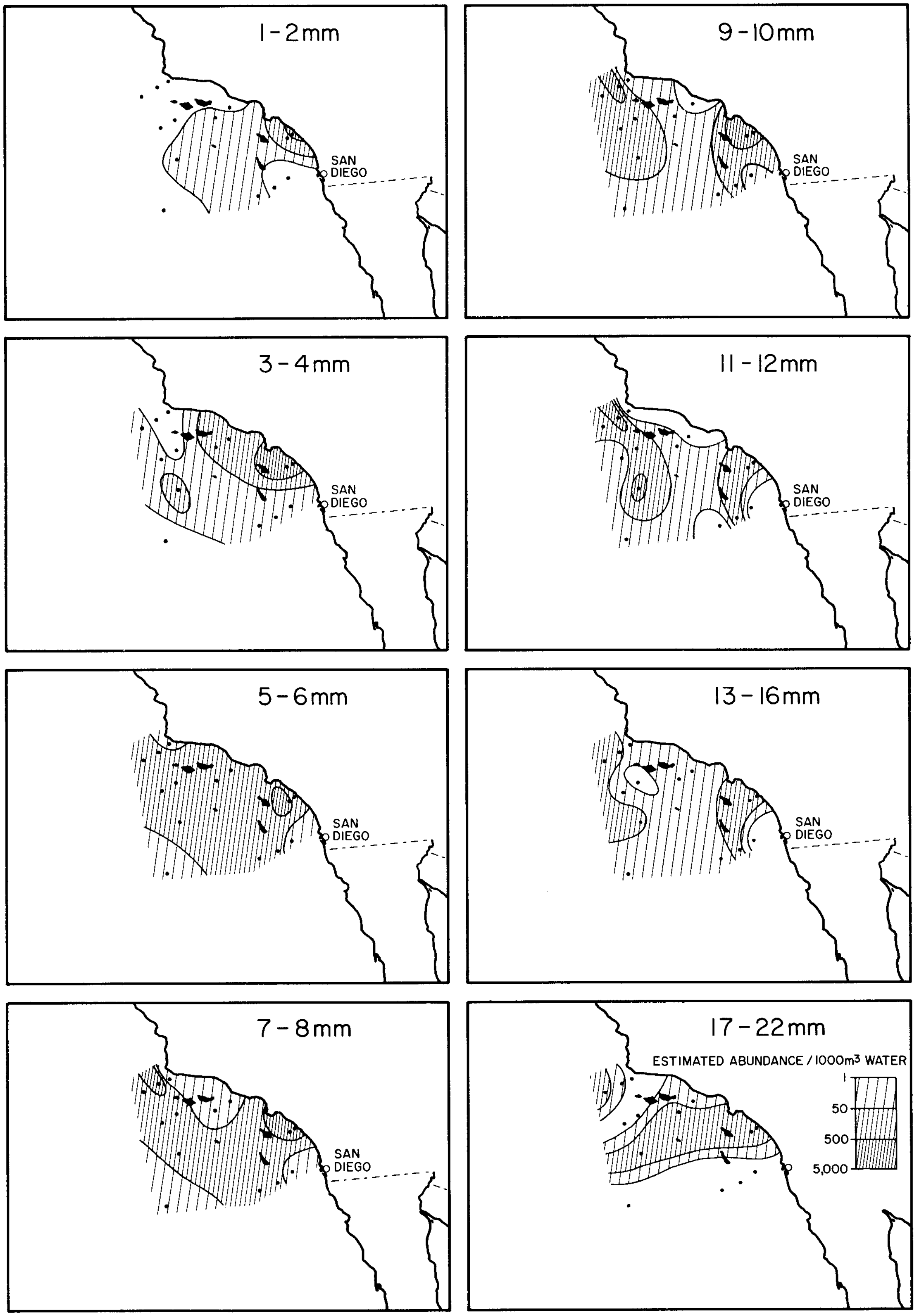
CALCOFI CRUISE 5303

6 - 20 MARCH 1953

Euphausiacea

Euphausia pacifica

5303



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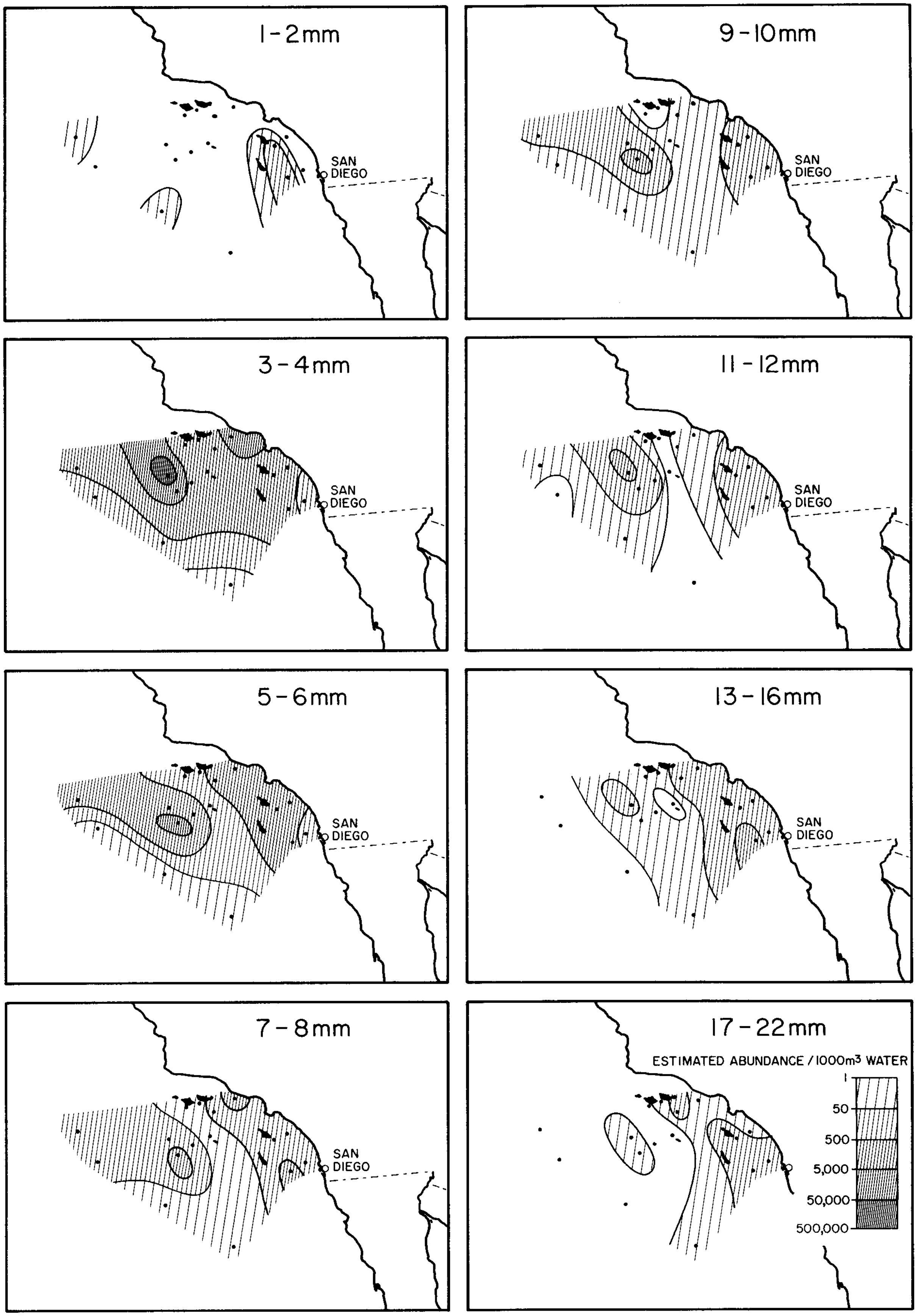
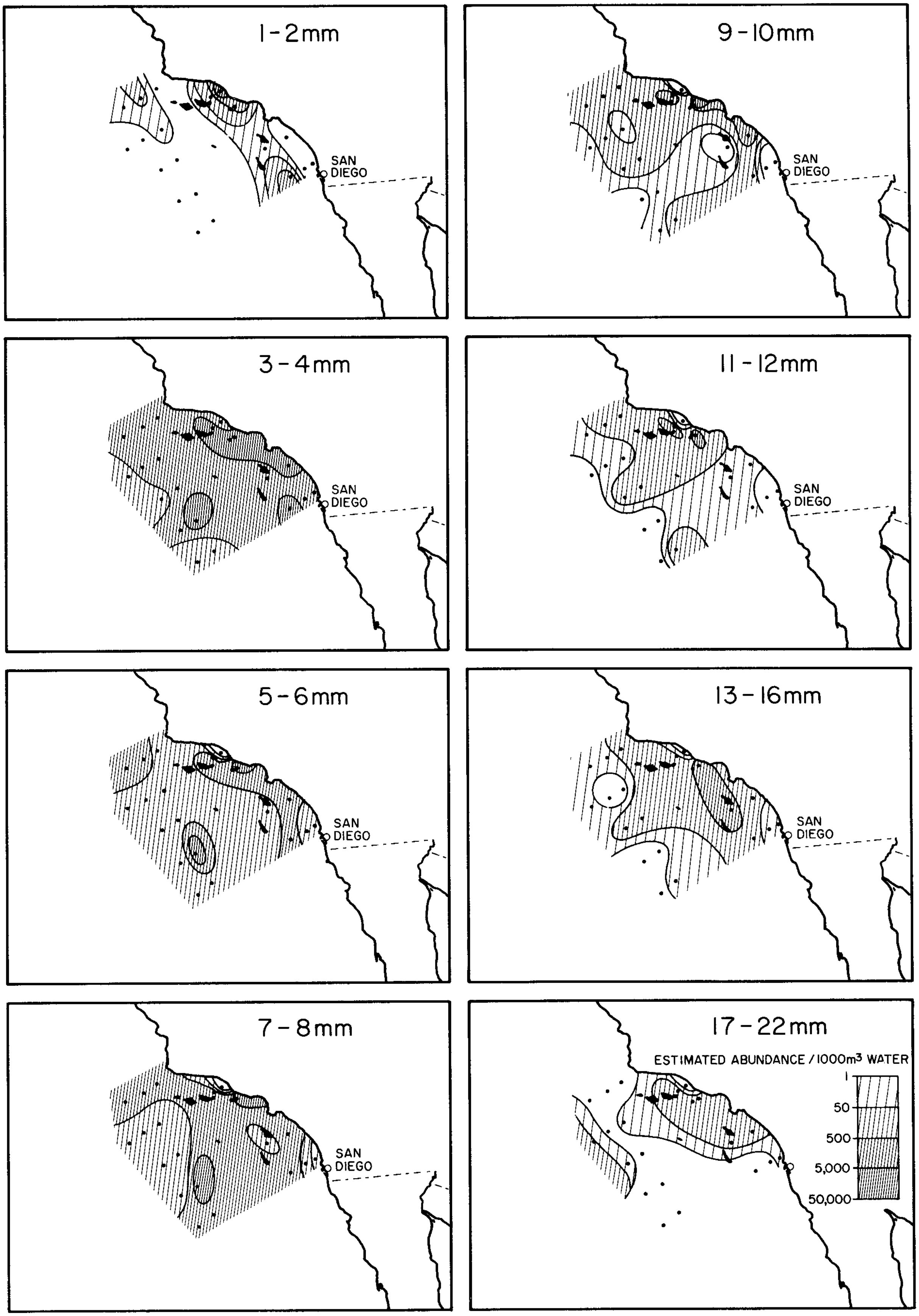
7 - 17 APRIL 1953

Euphausiacea
Euphausia pacifica
5304



CALCOFI CRUISE 5305
5 - 18 MAY 1953

Euphausiacea
Euphausia pacifica
5305



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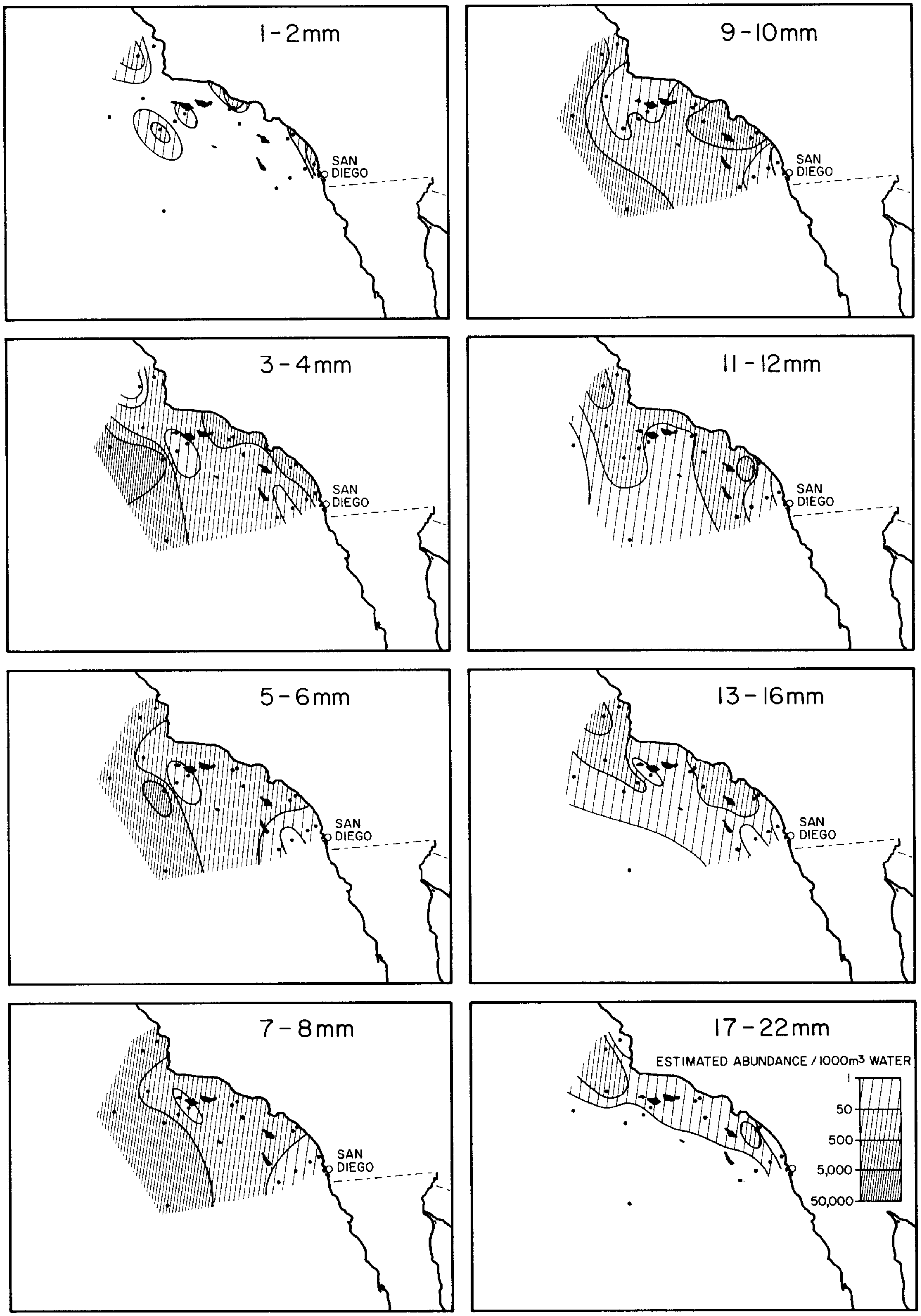
5 - 12 JUNE 1953

Euphausiacea

Euphausia pacifica

5306



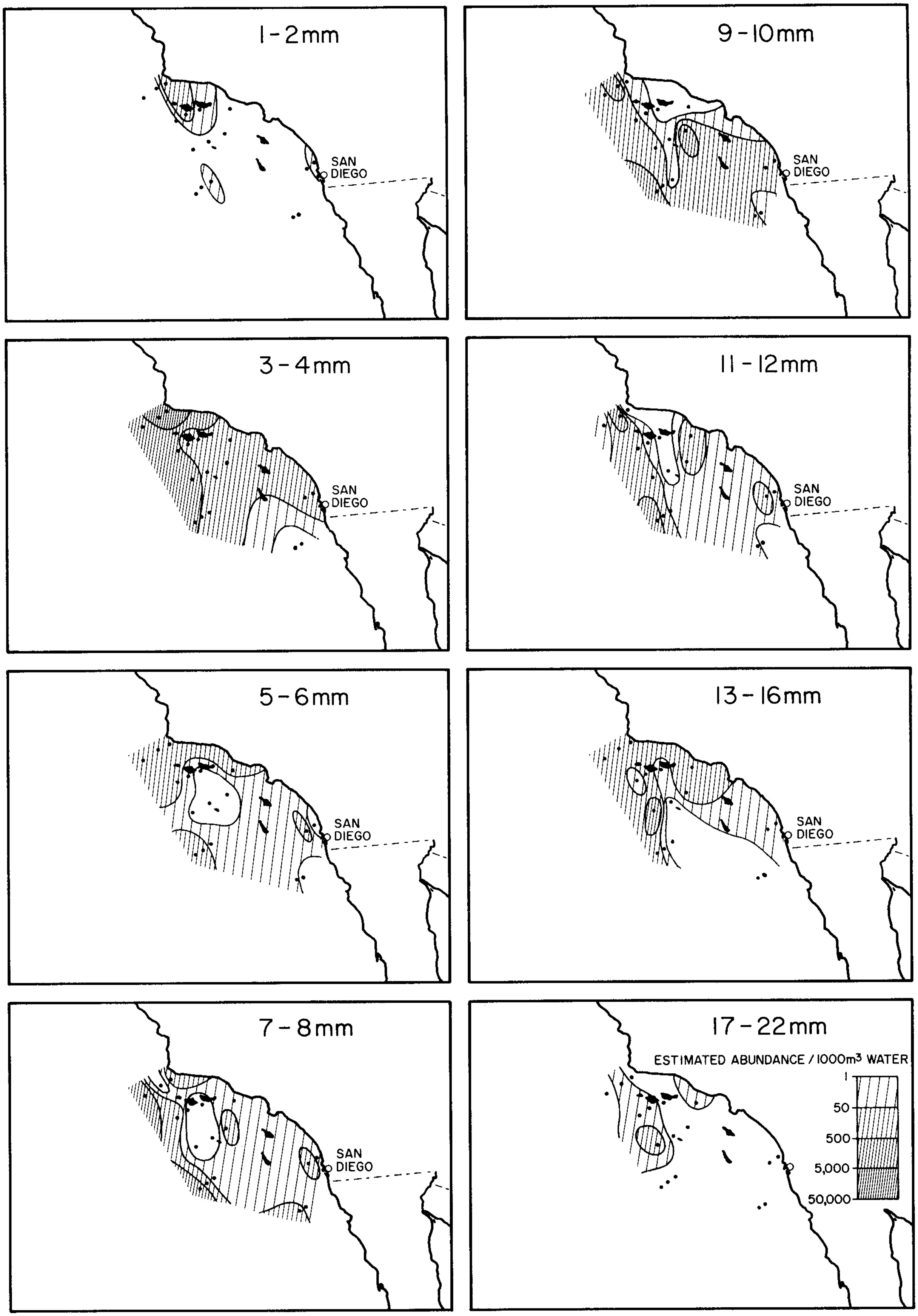
Euphausiacea

CALCOFI CRUISE 5307

14 - 26 JULY 1953

Euphausia pacifica

5307



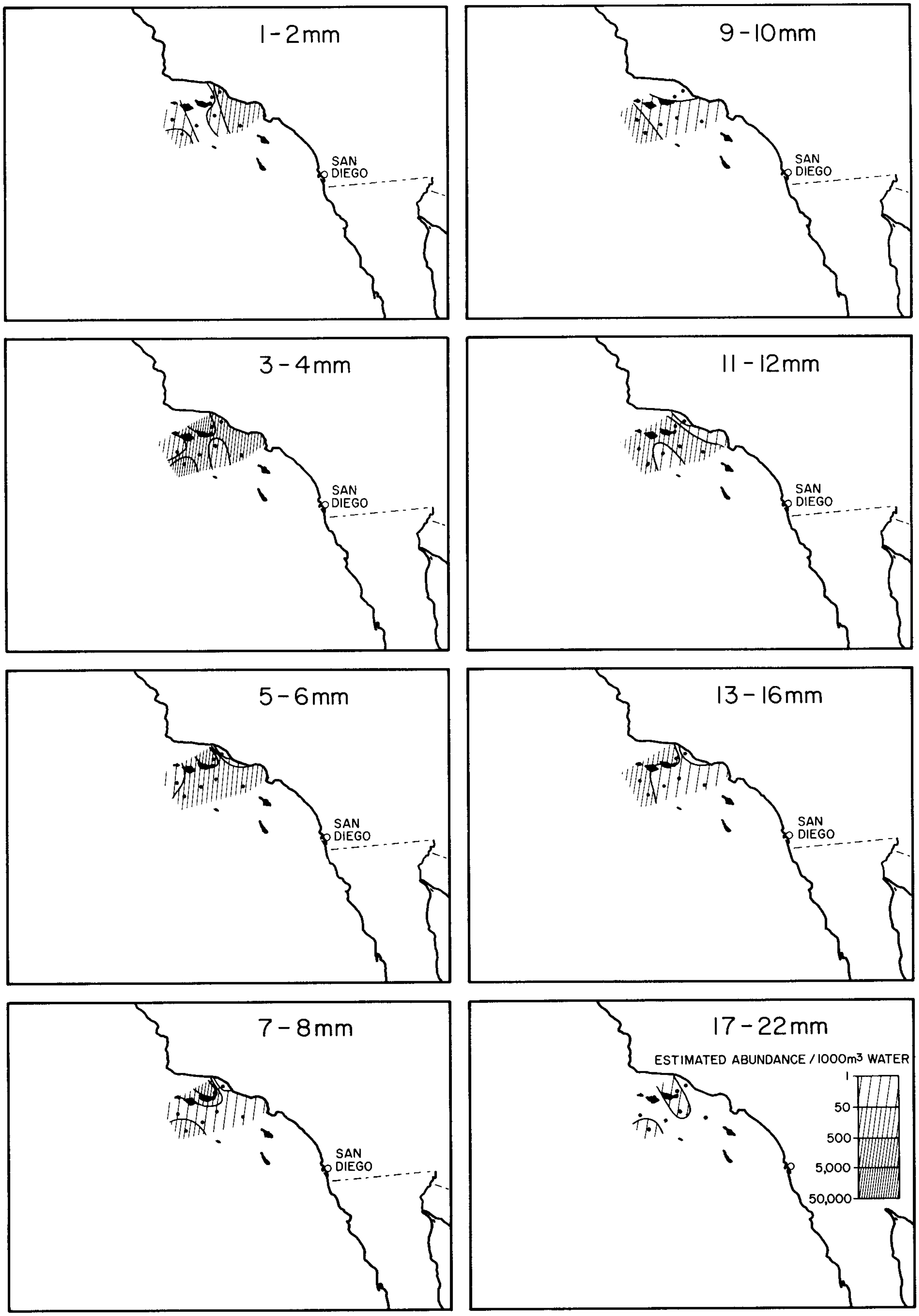
CALCOFI CRUISE 5308

18 - 29 AUGUST 1953

Euphausiacea

Euphausia pacifica

5308



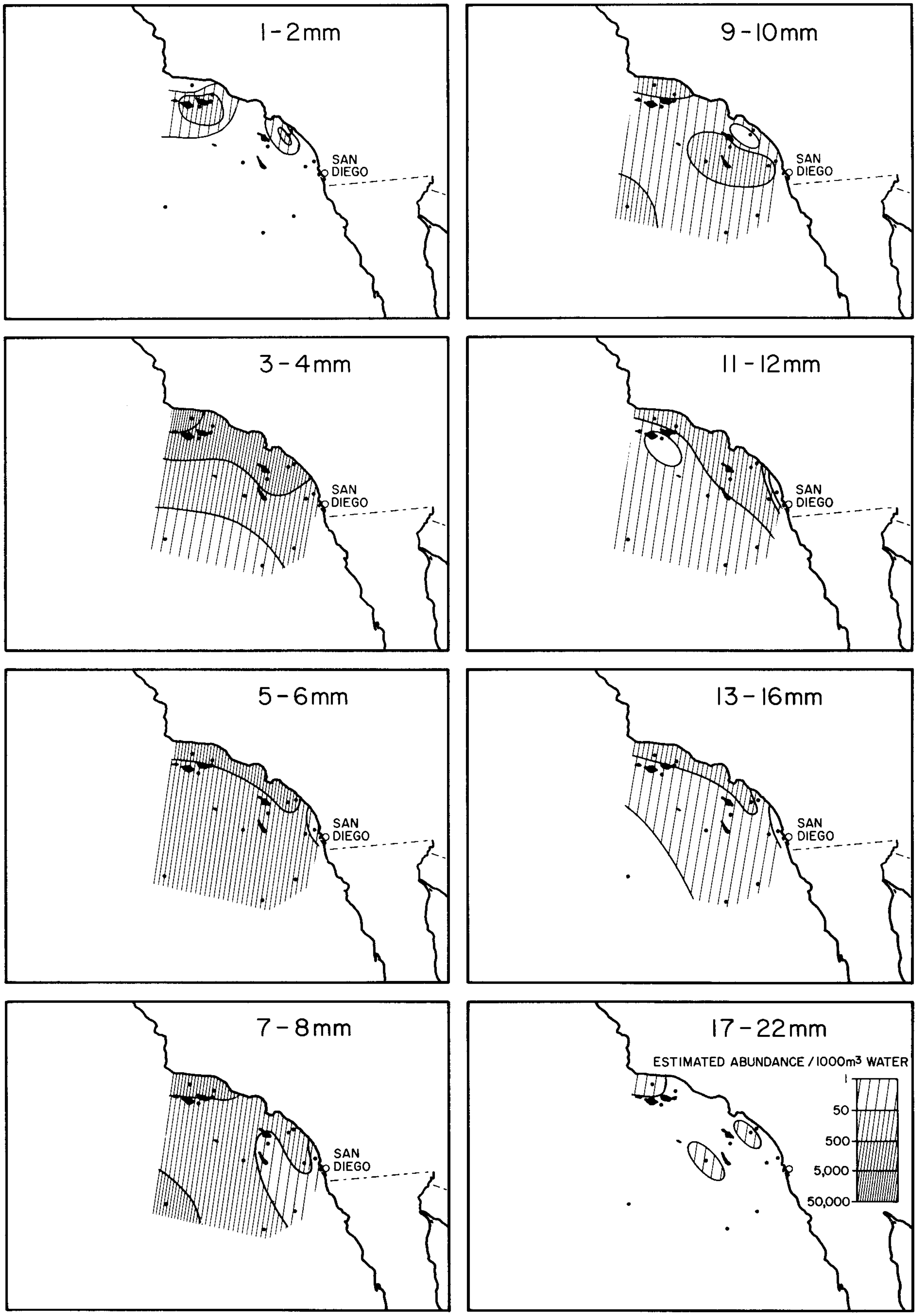
CALCOFI CRUISE 5309

15 - 17 SEPTEMBER 1953

Euphausiacea

Euphausia pacifica

5309



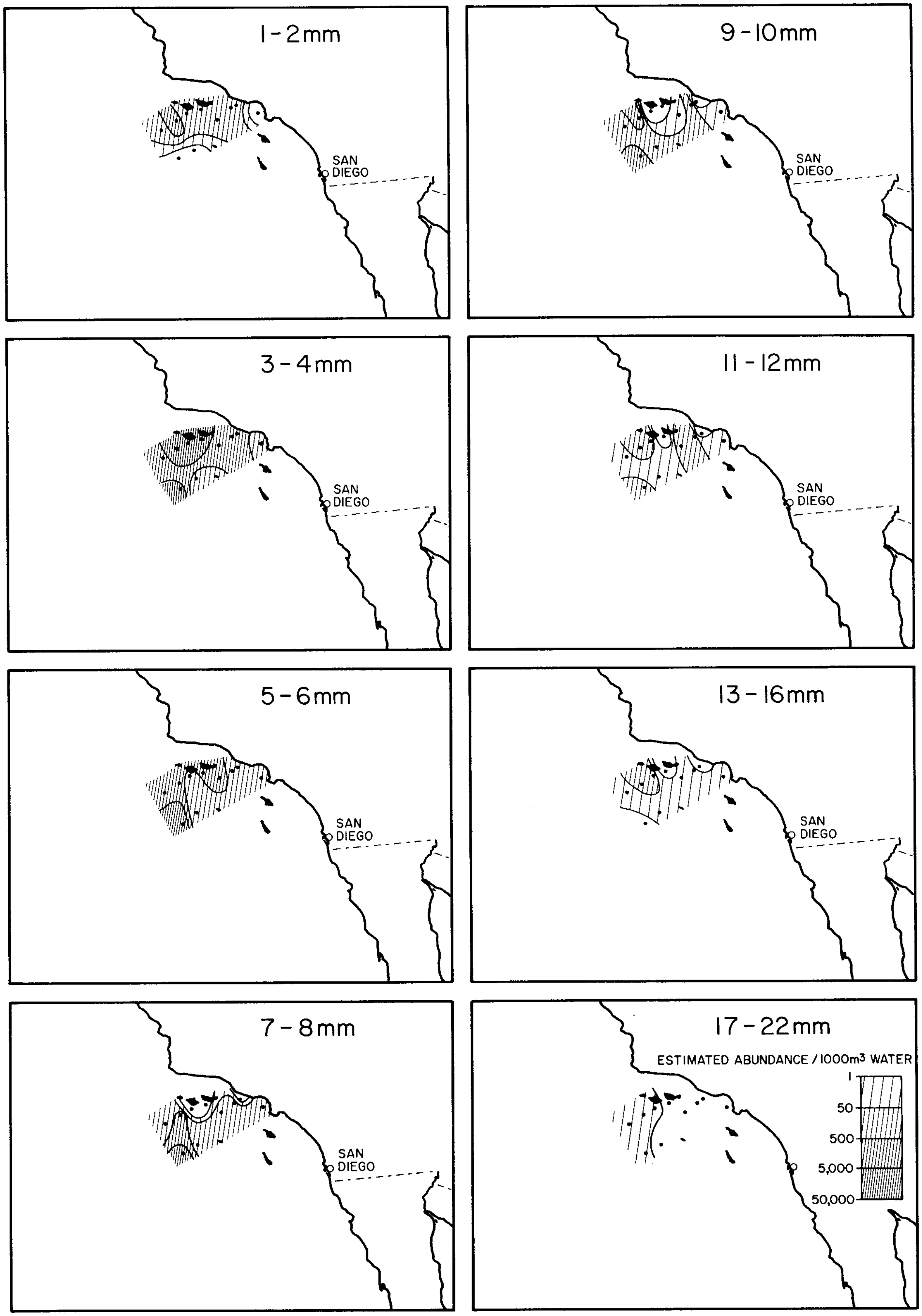
CALCOFI CRUISE 5310

19 - 22 OCTOBER 1953

Euphausiacea

Euphausia pacifica

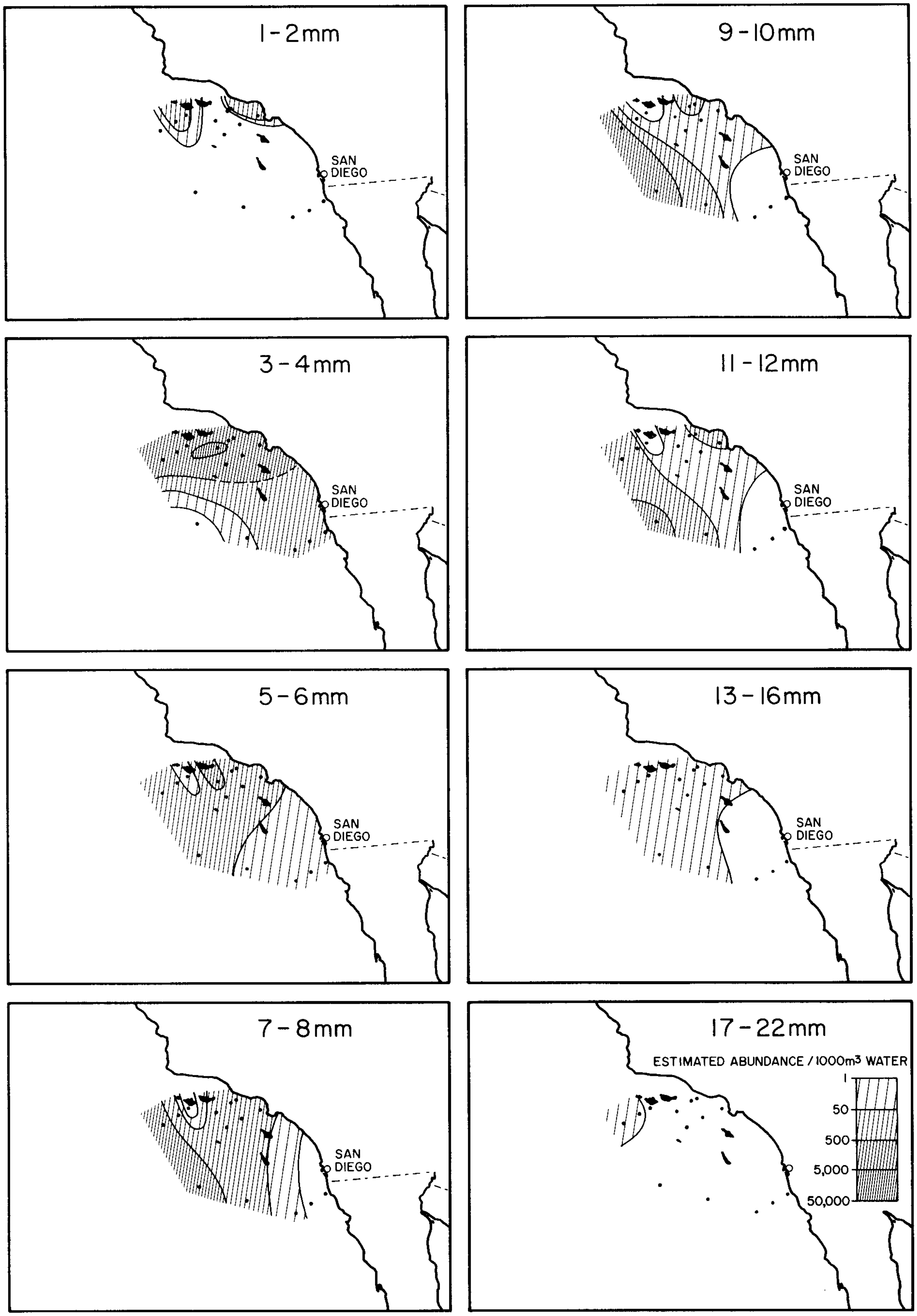
5310



Euphausiacea

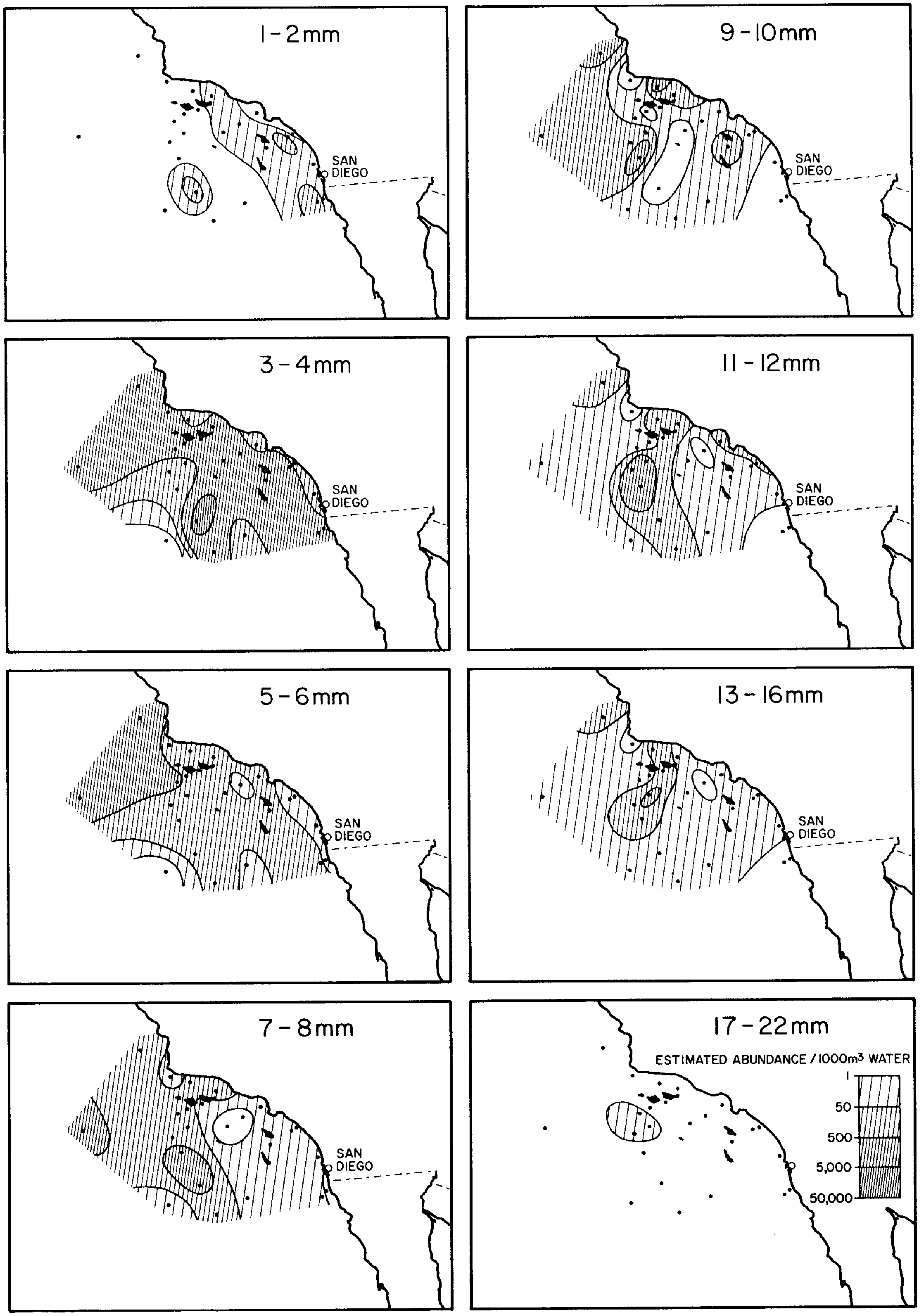
CALCOFI CRUISE 5311
10-12 NOVEMBER 1953

Euphausia pacifica
5311



CALCOFI CRUISE 5312
3 - 9 DECEMBER 1953

Euphausiacea
Euphausia pacifica
5312



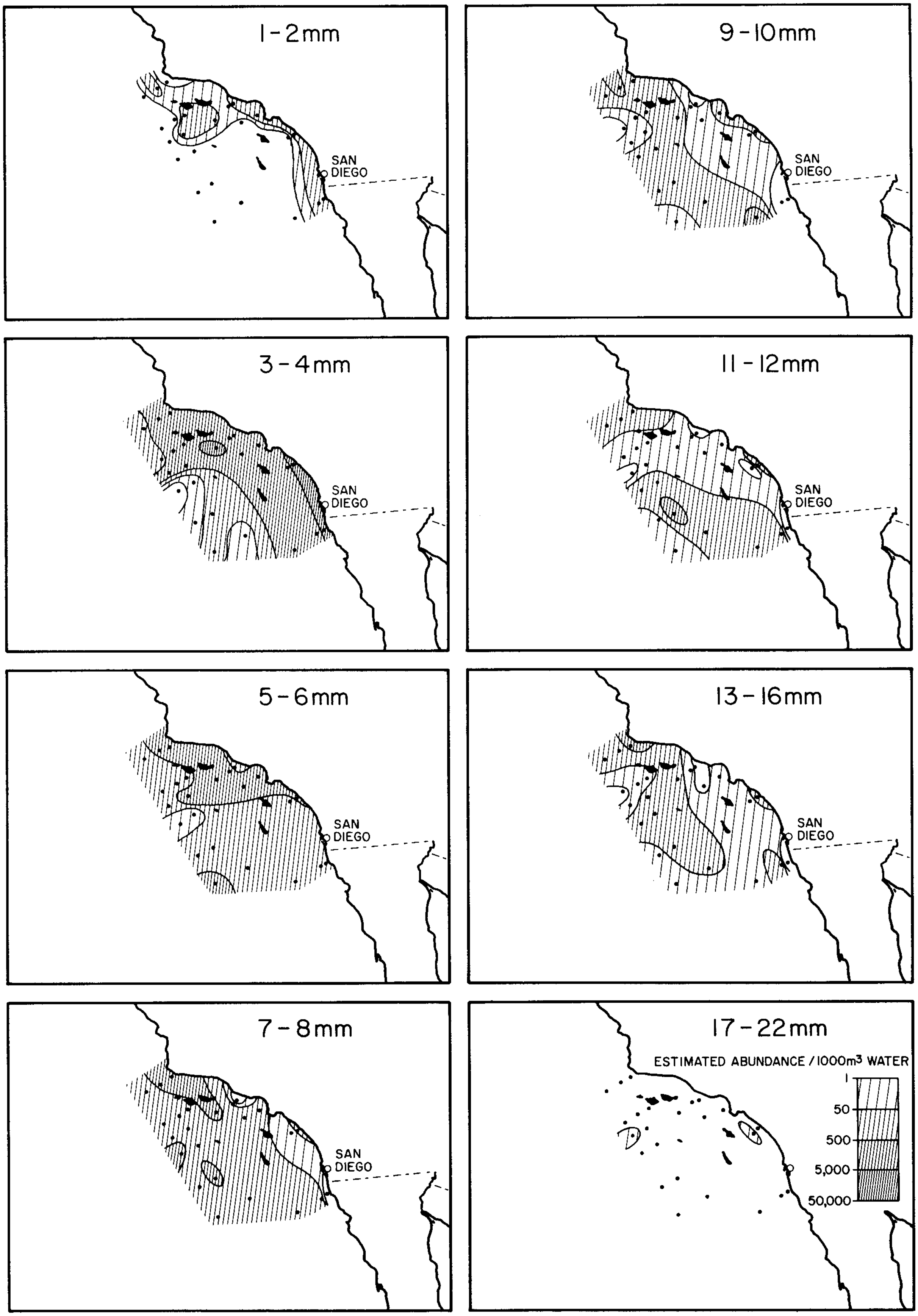
CALCOFI CRUISE 5401

5-15 JANUARY 1954

Euphausiacea

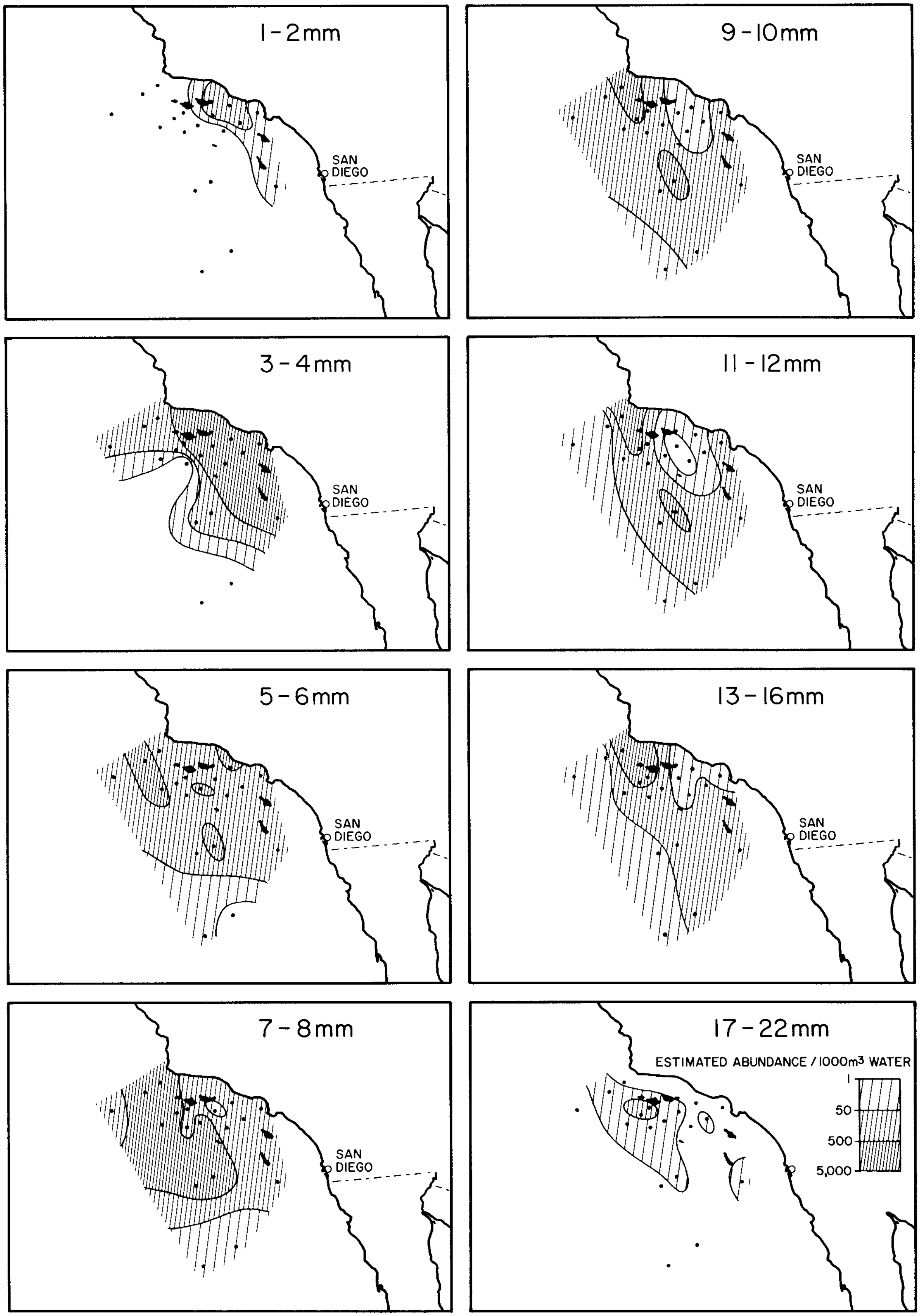
Euphausia pacifica

5401



CALCOFI CRUISE 5402
3 - 12 FEBRUARY 1954

Euphausiacea
Euphausia pacifica
5402



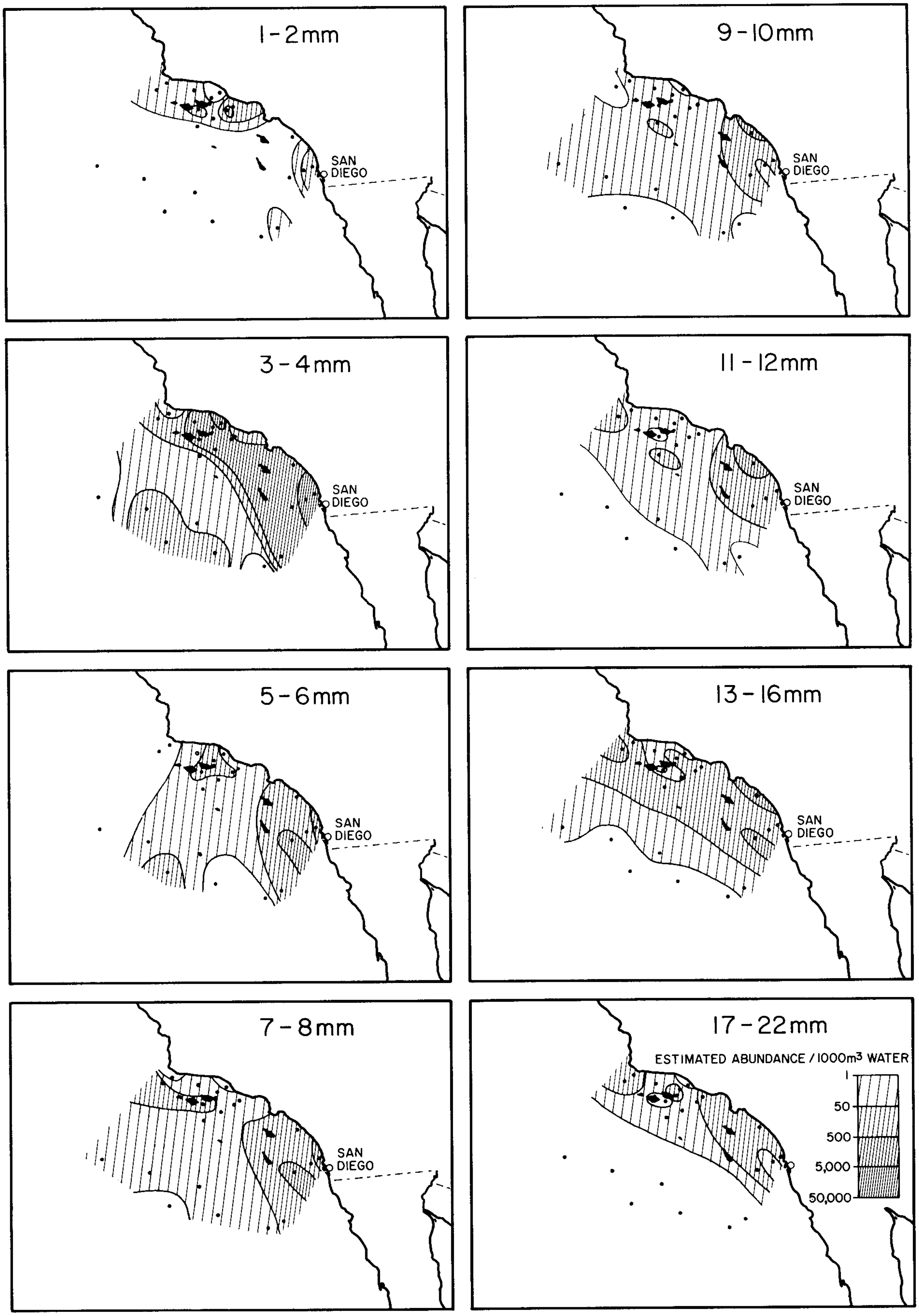
CALCOFI CRUISE 5403

5-18 MARCH 1954

Euphausiacea

Euphausia pacifica

5403



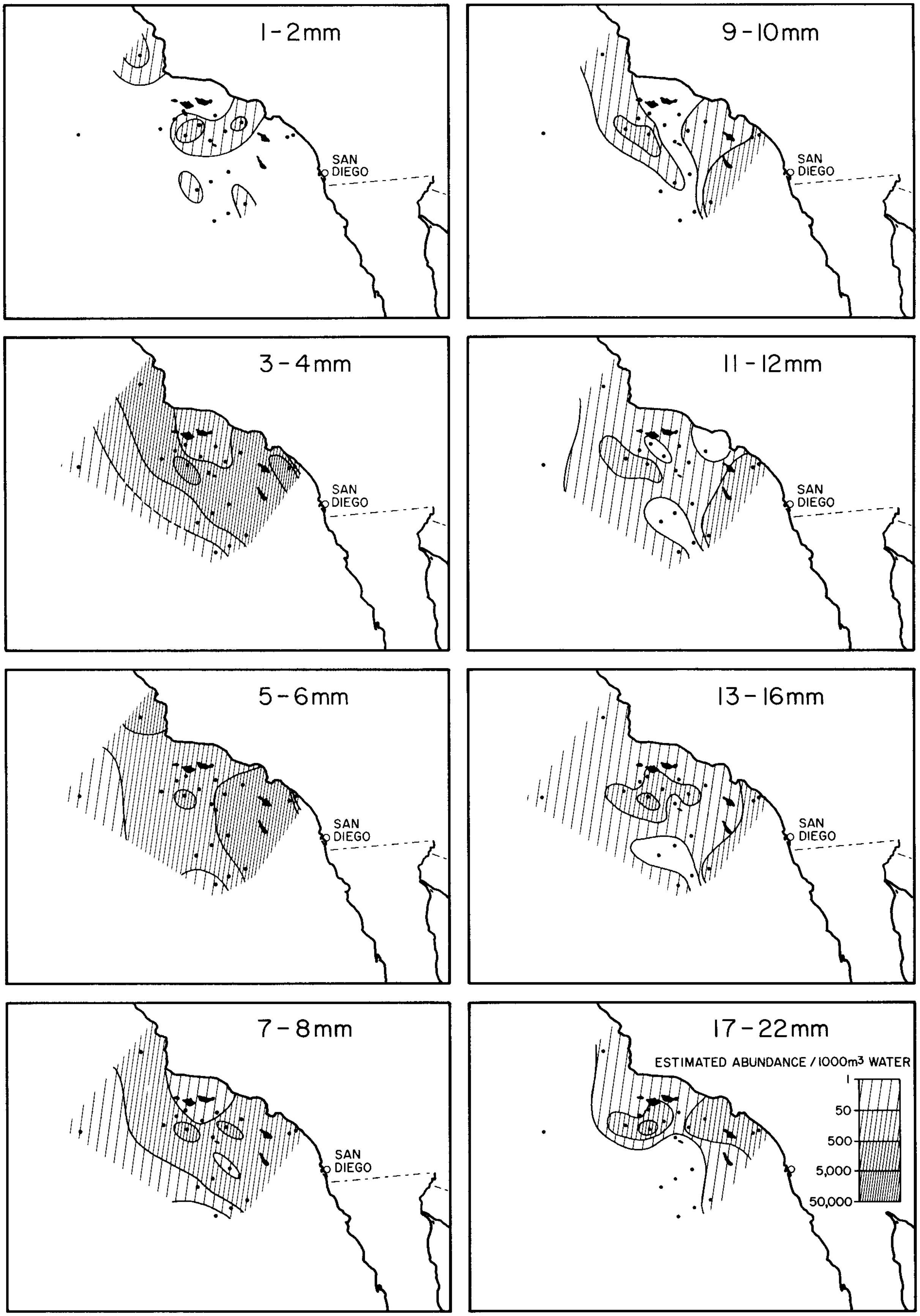
Euphausiacea

CALCOFI CRUISE 5404

7- 19 APRIL 1954

Euphausia pacifica

5404



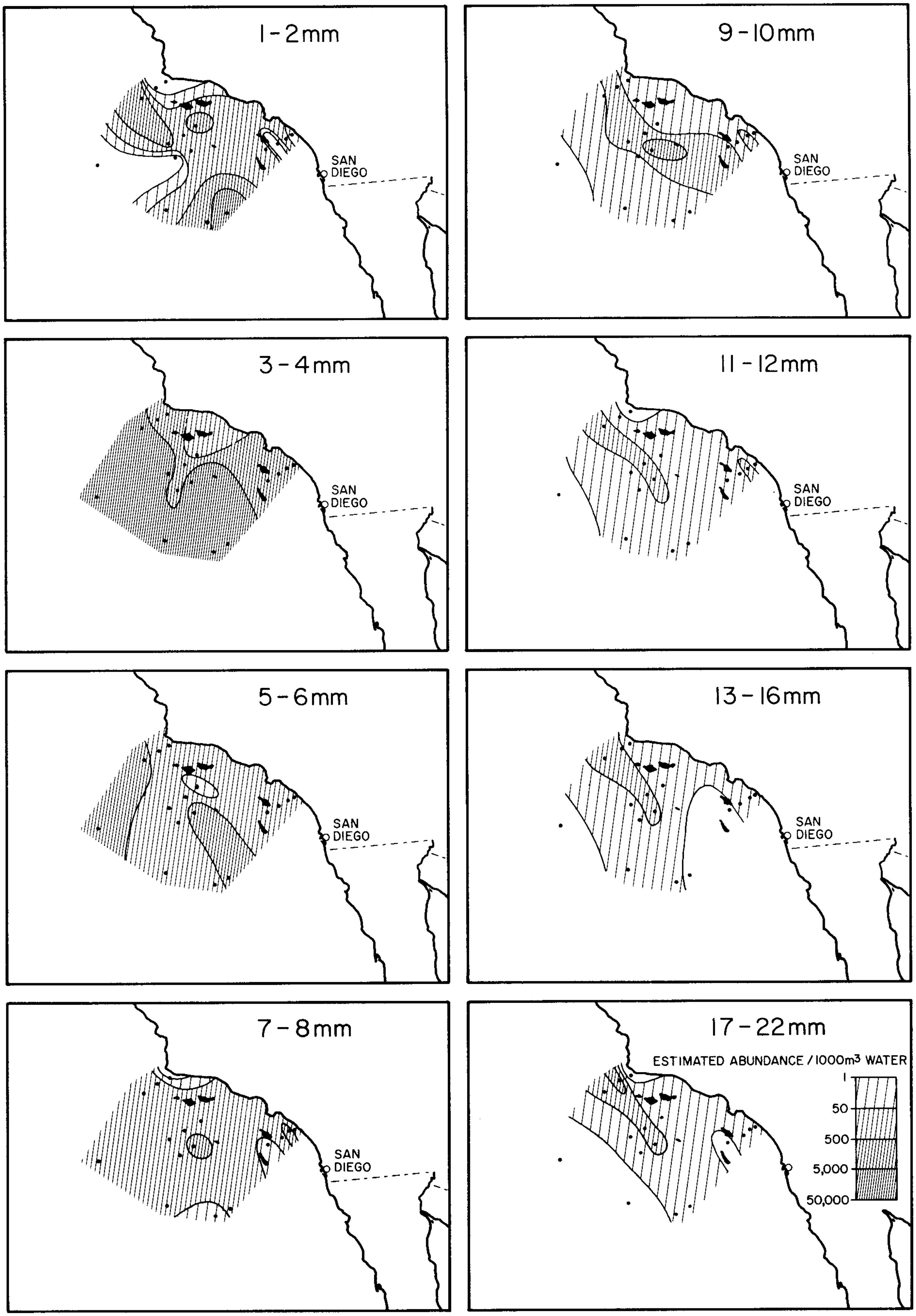
CALCOFI CRUISE 5405

13 - 22 MAY 1954

Euphausiacea

Euphausia pacifica

5405



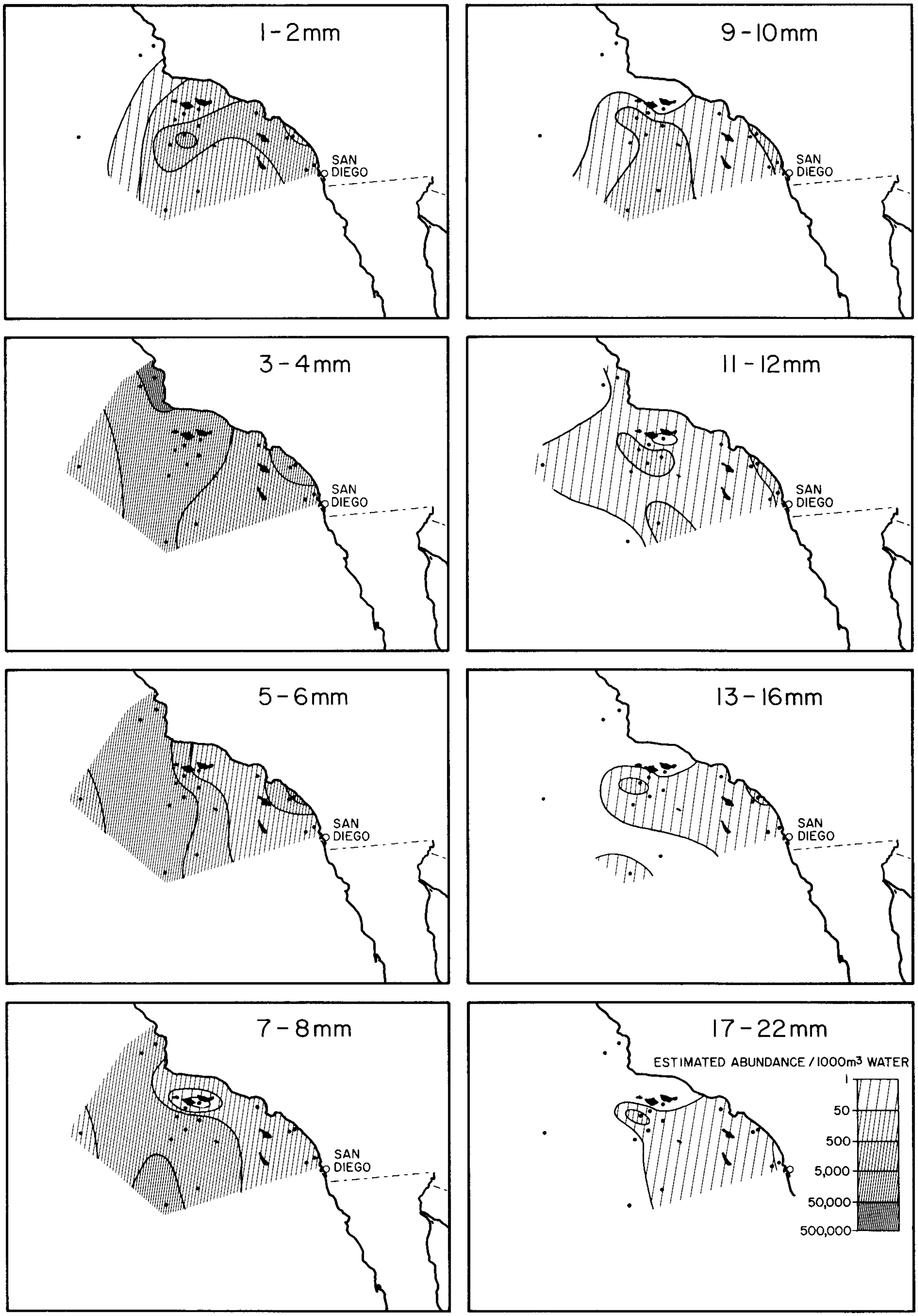
CALCOFI CRUISE 5406

13 - 20 JUNE 1954

Euphausiacea

Euphausia pacifica

5406



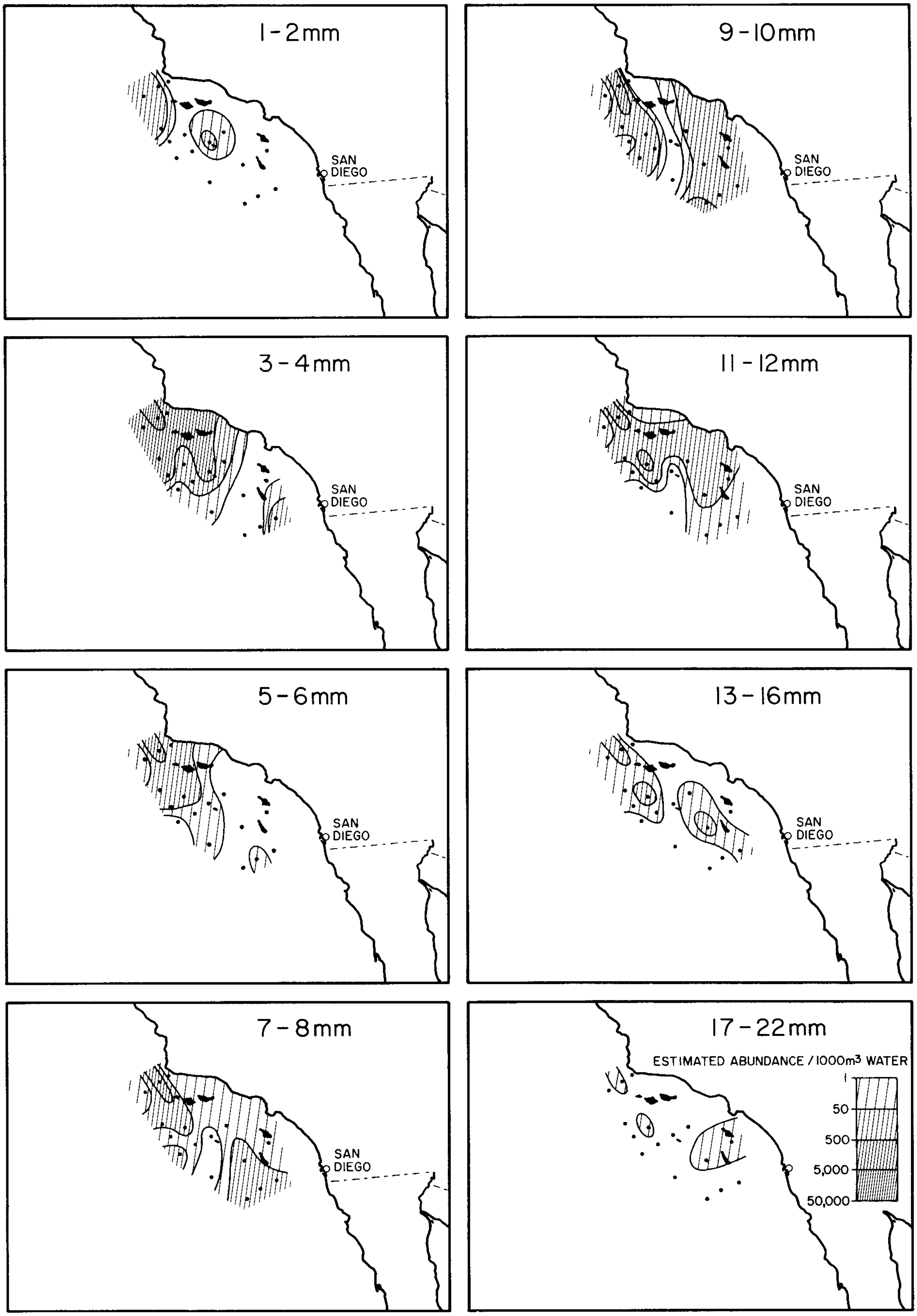
Euphausiacea

CALCOFI CRUISE 5407

13 - 21 JULY 1954

Euphausia pacifica

5407



CALCOFI CRUISE 5408

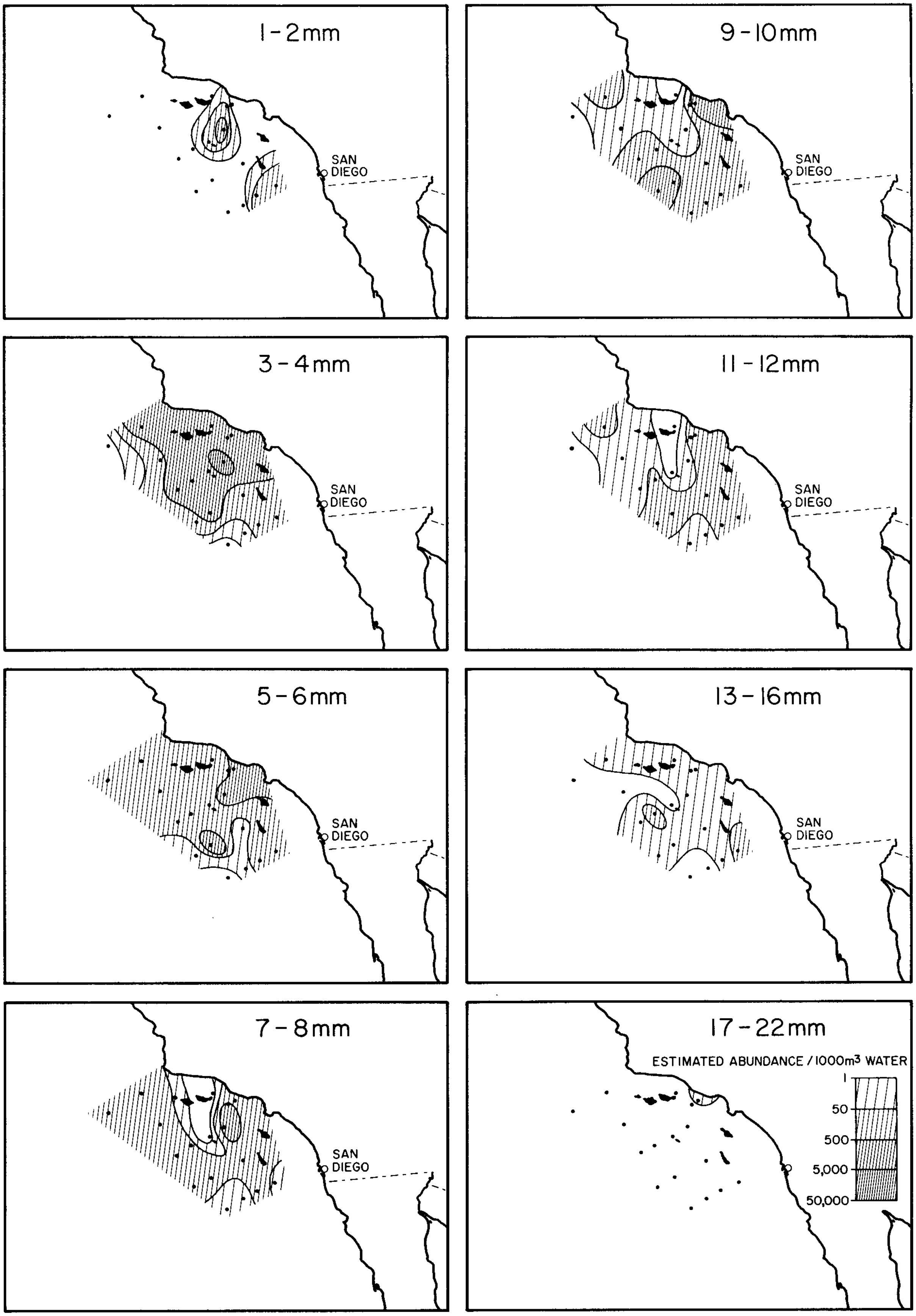
4 - 9 SEPTEMBER 1954

MAIN PORTION OF CRUISE OCCUPIED IN AUGUST

Euphausiacea

Euphausia pacifica

5408



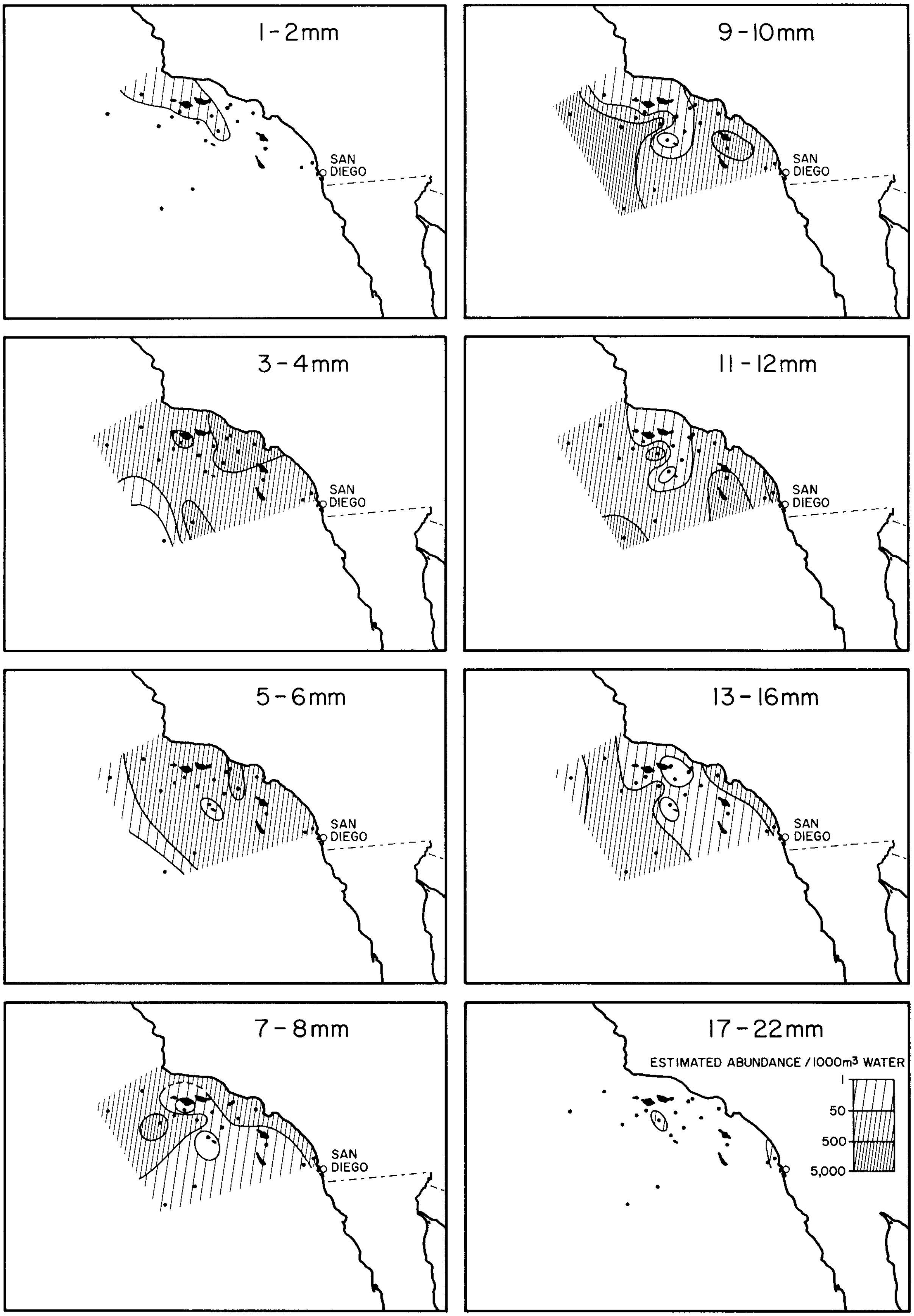
CALCOFI CRUISE 5410

7-14 OCTOBER 1954

Euphausiacea

Euphausia pacifica

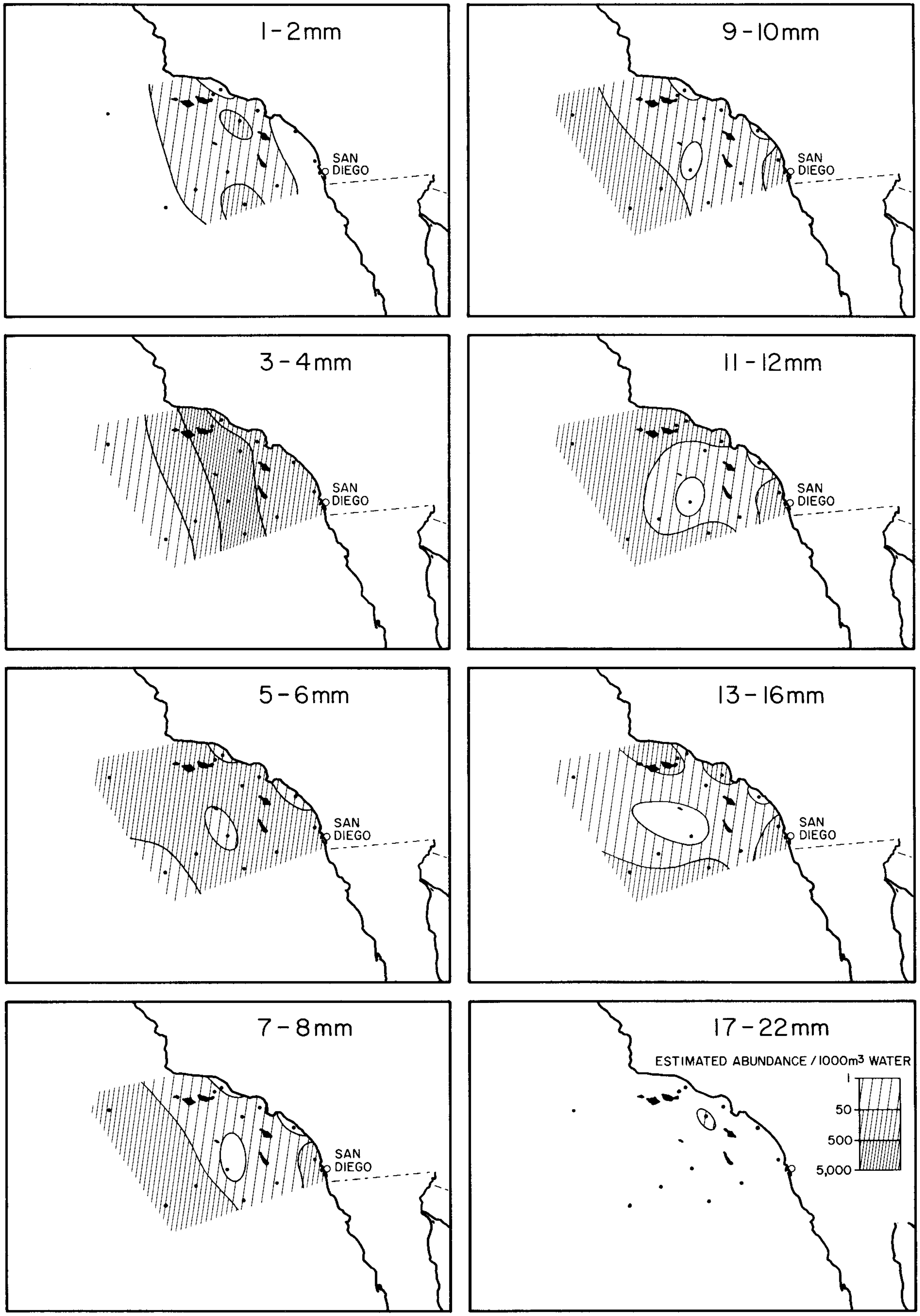
5410



Euphausiacea

CALCOFI CRUISE 5412
2-9 DECEMBER 1954

Euphausia pacifica
5412



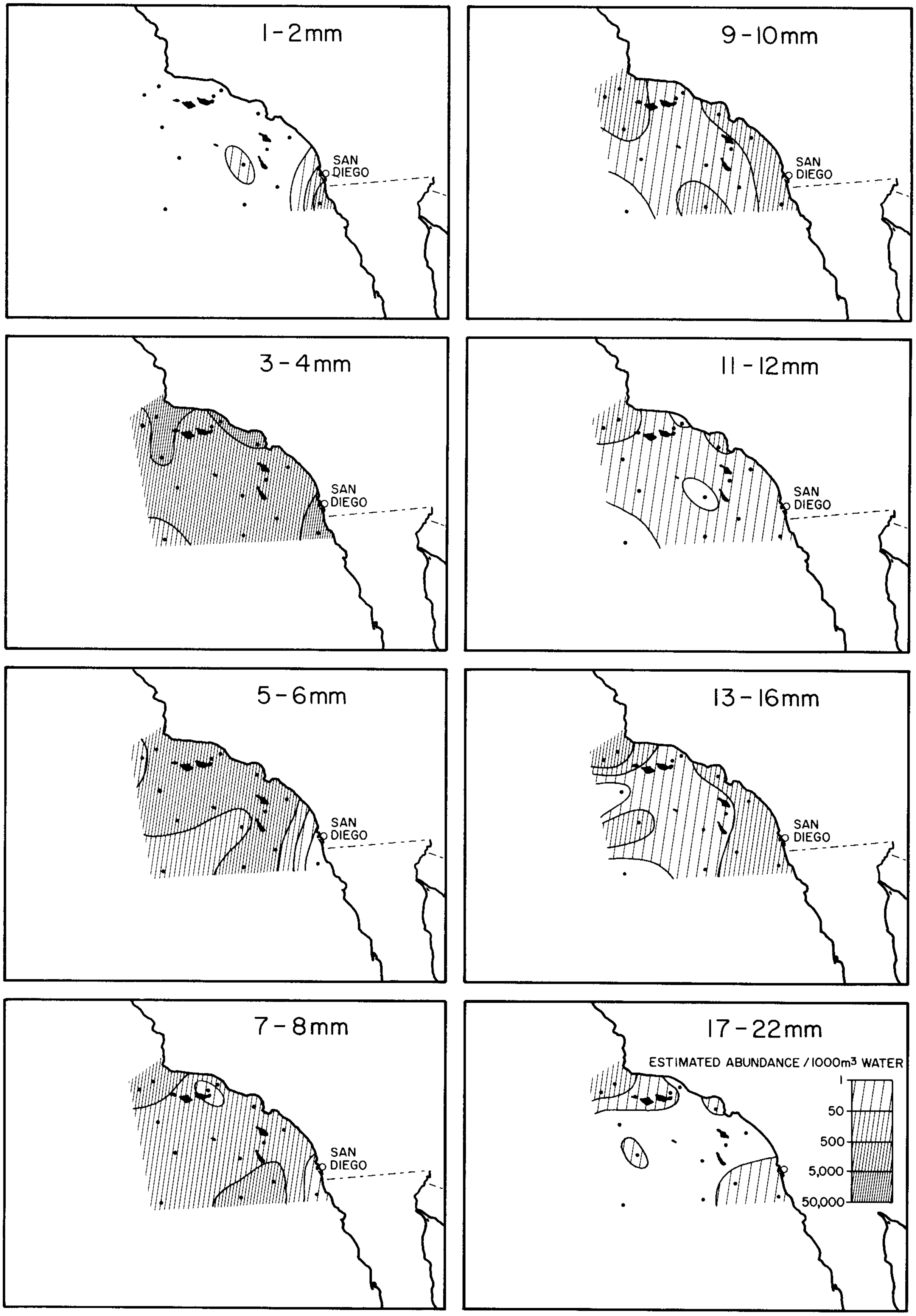
CALCOFI CRUISE 5501

13 - 19 JANUARY 1955

Euphausiacea

Euphausia pacifica

5501



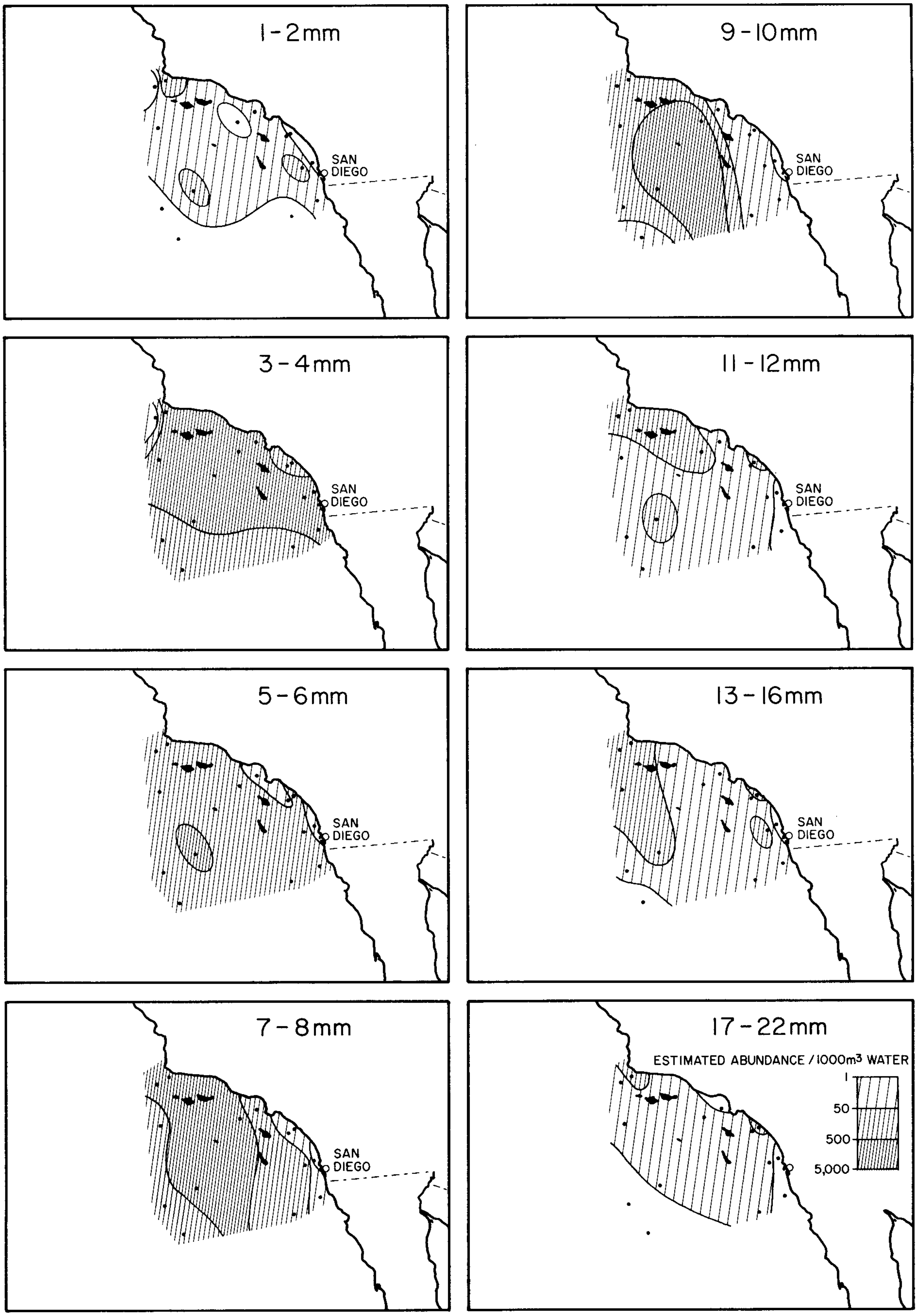
CALCOFI CRUISE 5502

11-17 FEBRUARY 1955

Euphausiacea

Euphausia pacifica

5502



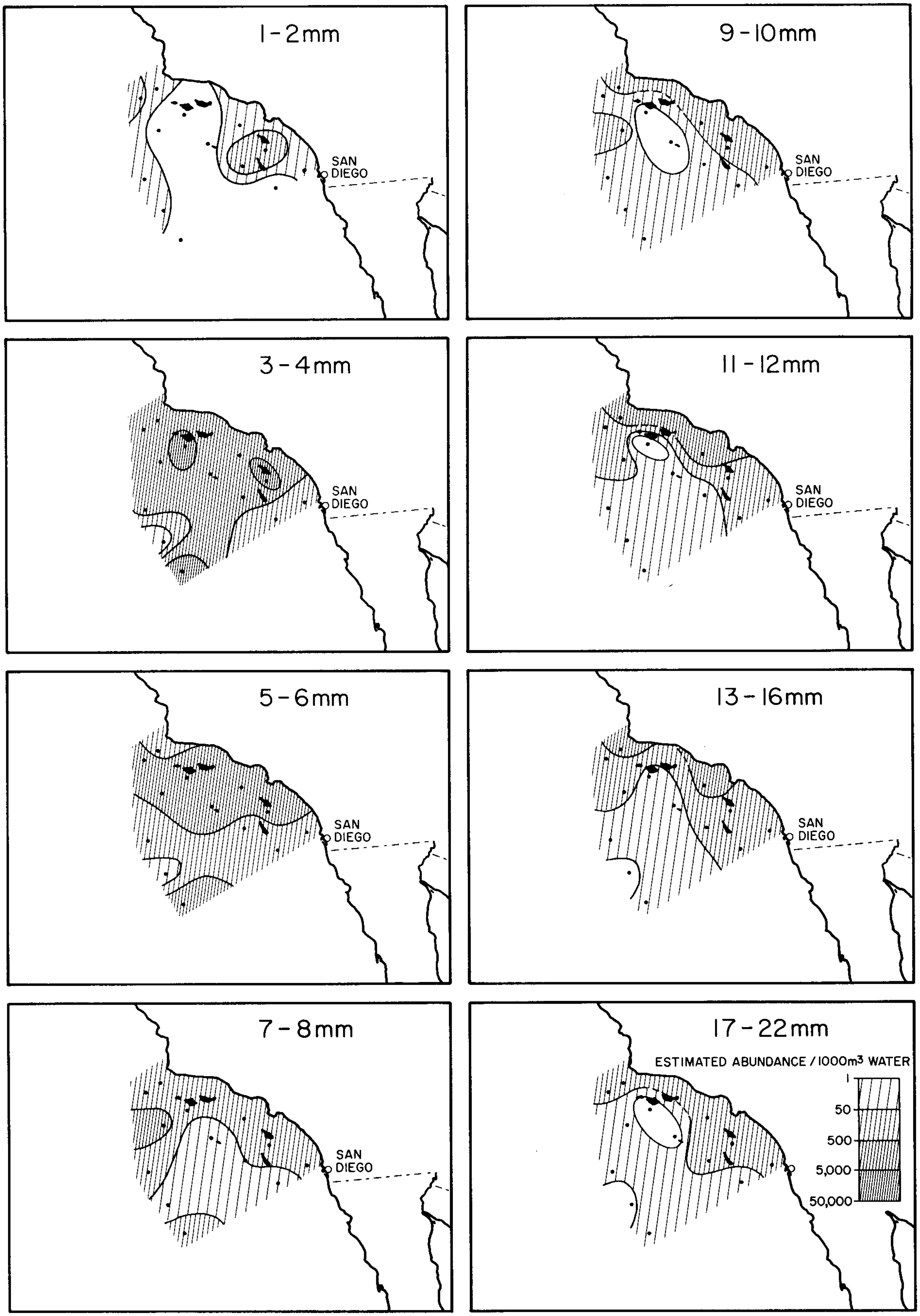
Euphausiacea

CALCOFI CRUISE 5503

8-16 MARCH 1955

Euphausia pacifica

5503



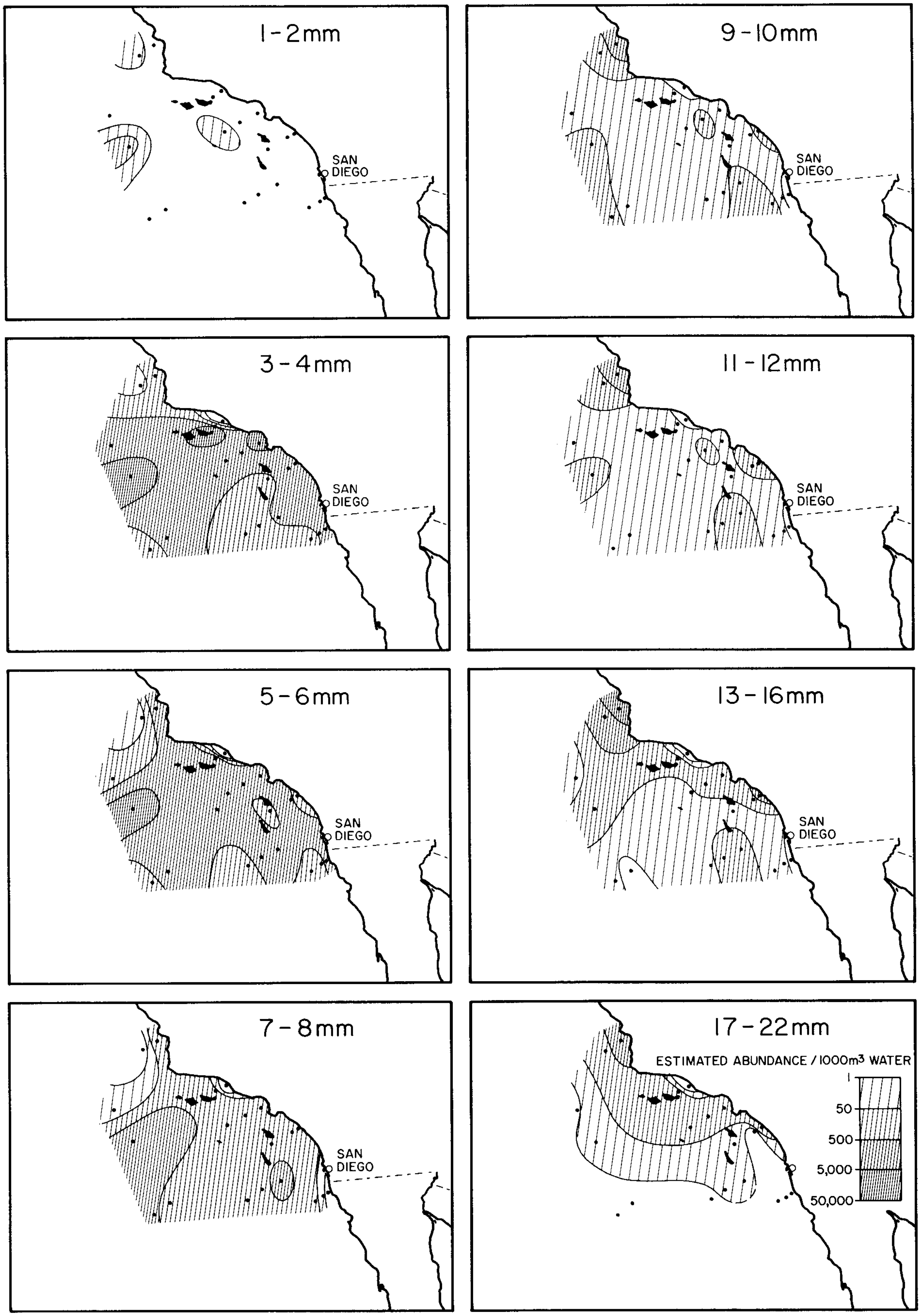
CALCOFI CRUISE 5504

7 - 16 APRIL 1955

Euphausiacea

Euphausia pacifica

5504



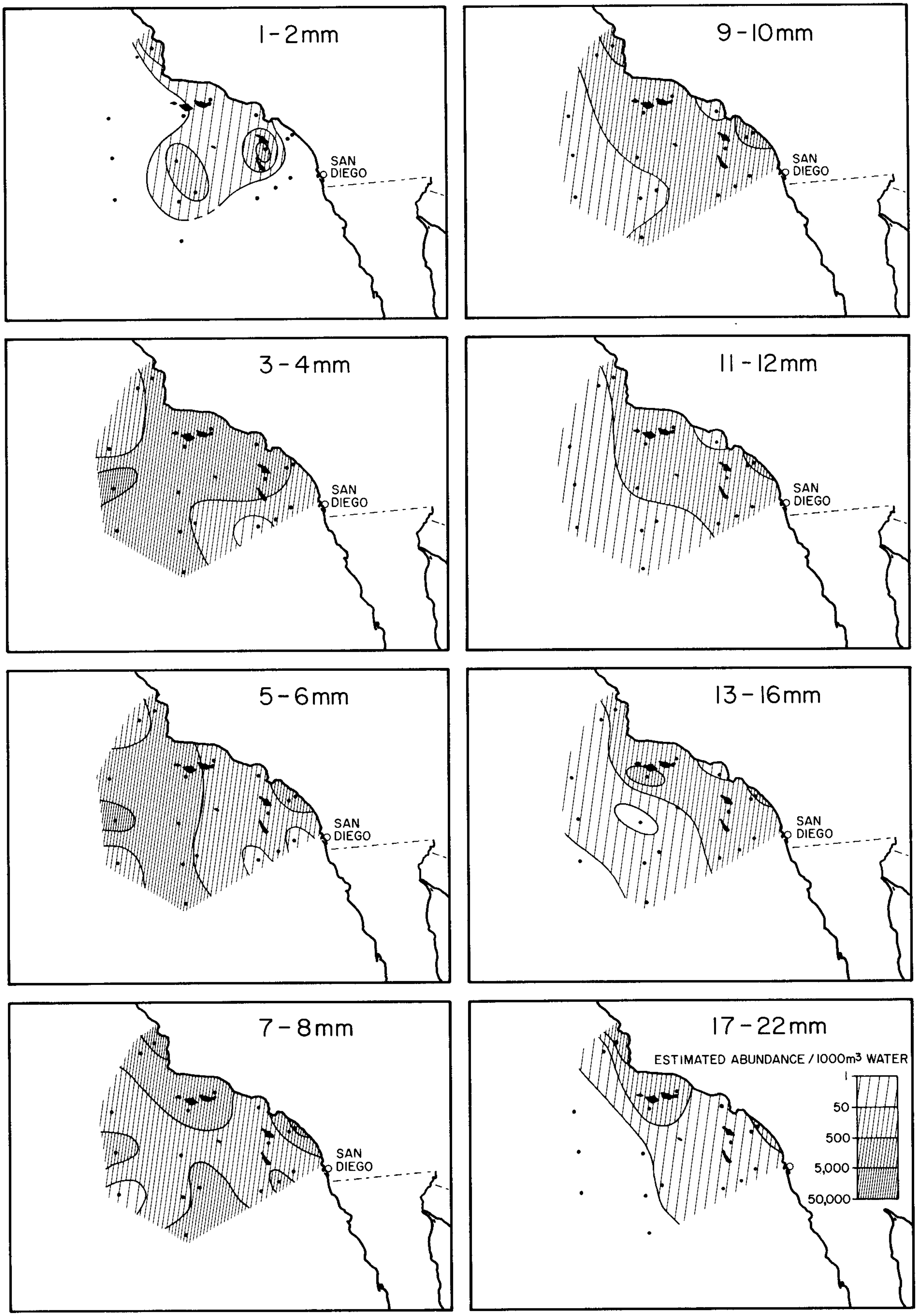
CALCOFI CRUISE 5505

21 MAY - 6 JUNE 1955

Euphausiacea

Euphausia pacifica

5505



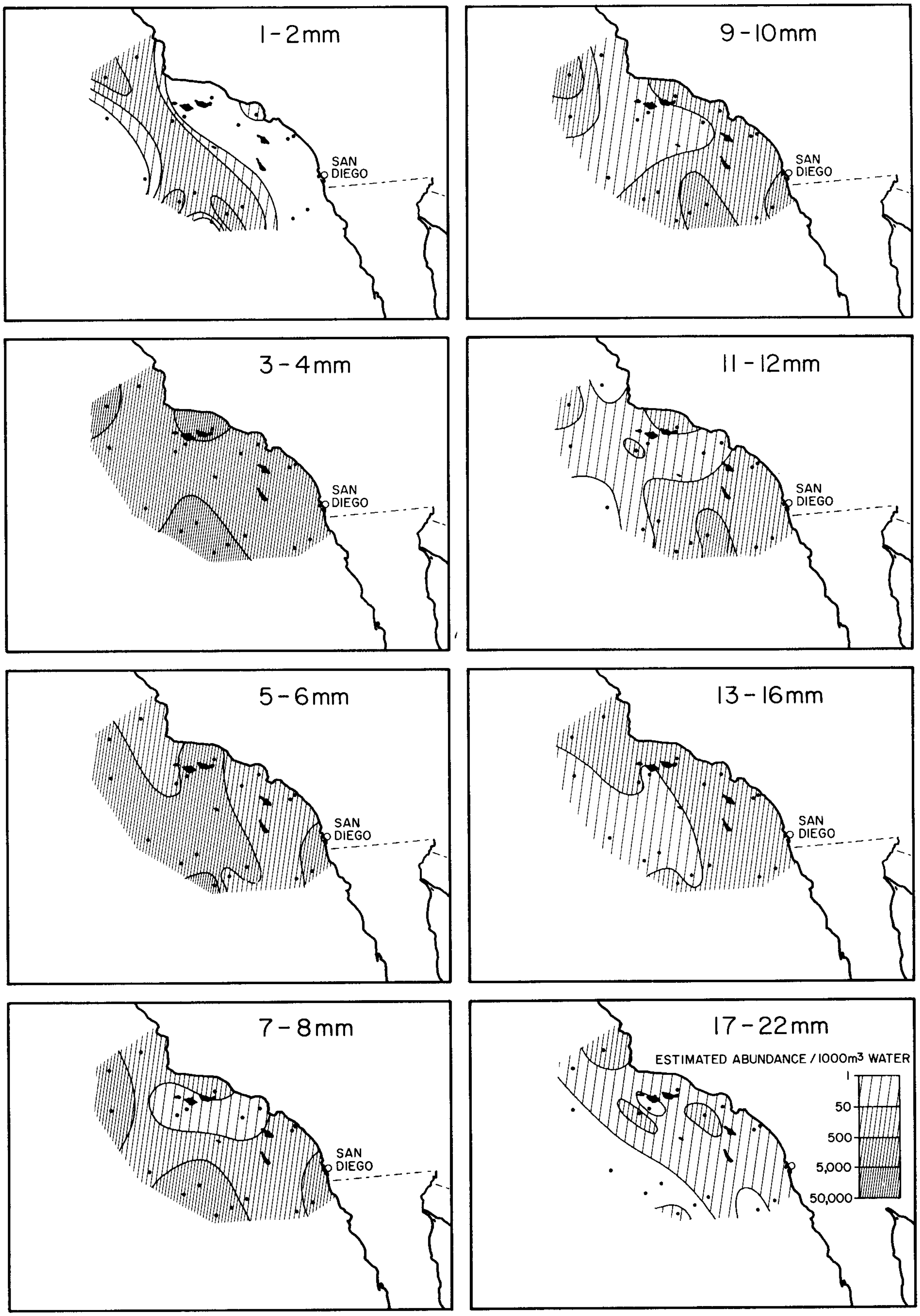
CALCOFI CRUISE 5506

11 - 20 JUNE 1955

Euphausiacea

Euphausia pacifica

5506



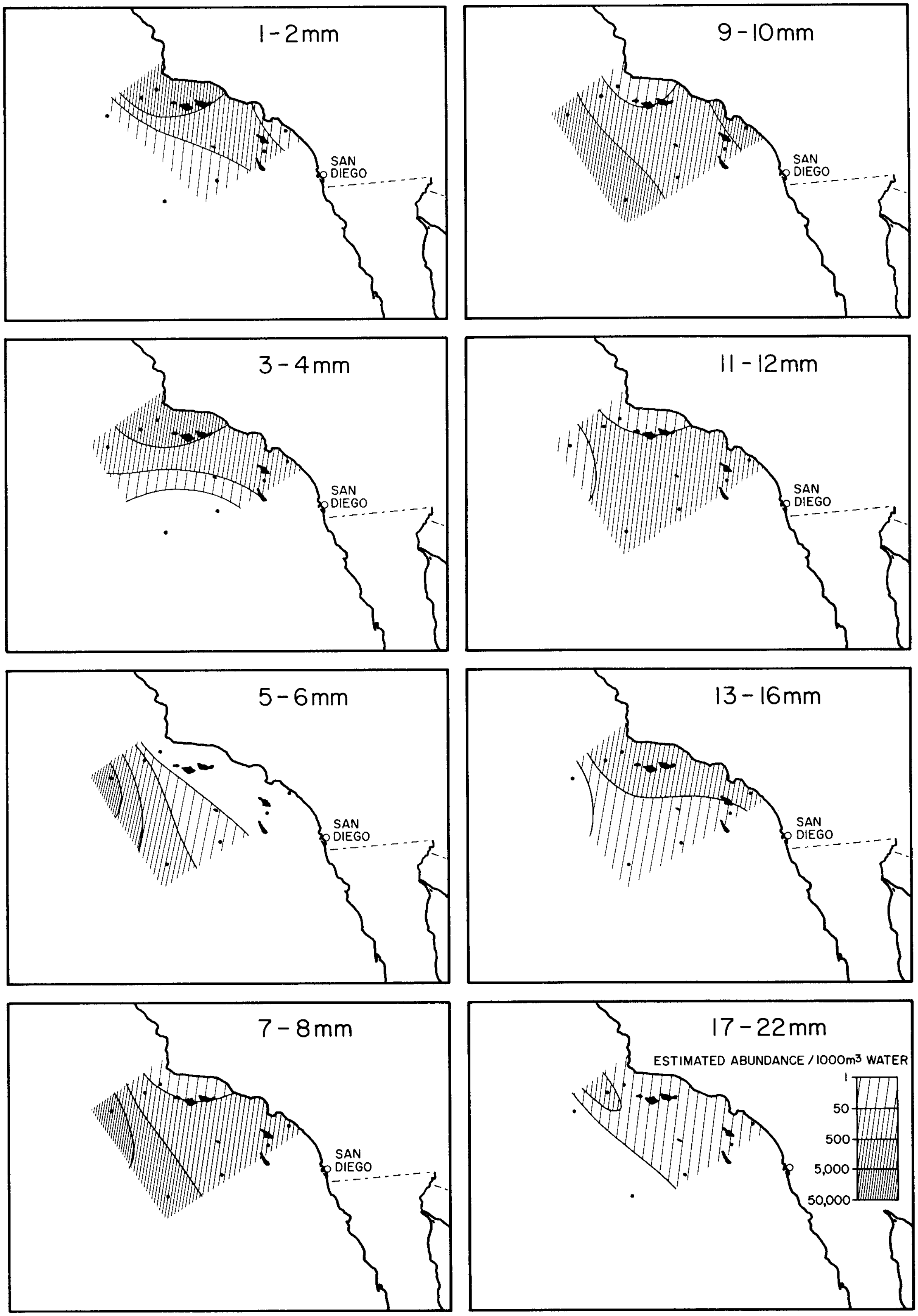
Euphausiacea

Euphausia pacifica

5507

CALCOFI CRUISE 5507

7-13 JULY 1955



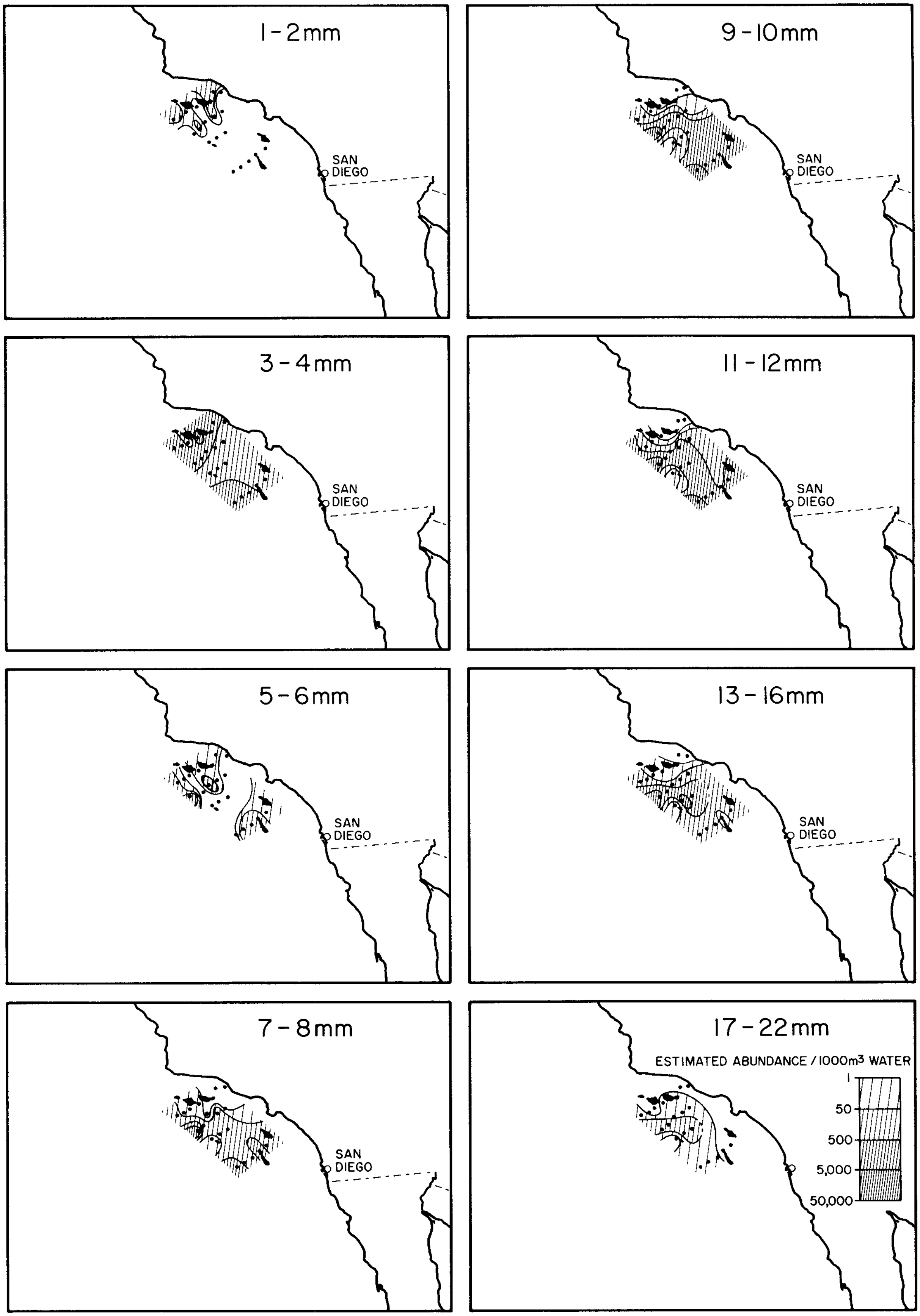
CALCOFI CRUISE 5508 'NORPAC'

4 - 6 SEPTEMBER 1955
MAIN PORTION OF CRUISE OCCUPIED IN AUGUST

Euphausiacea

Euphausia pacifica

5508 'NORPAC'



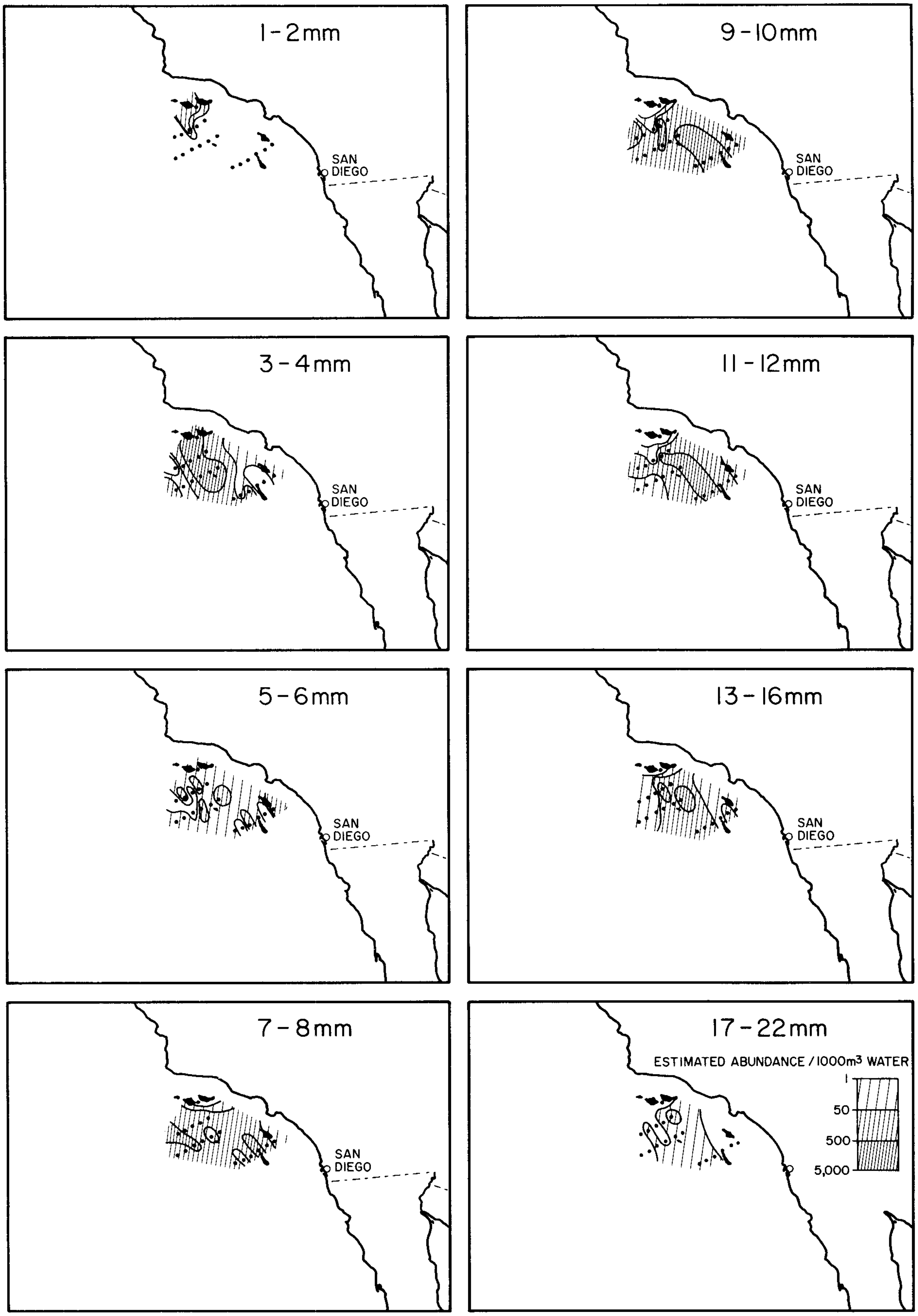
CALCOFI CRUISE 5509 - I

12 - 17 SEPTEMBER 1955

Euphausiacea

Euphausia pacifica

5509-I



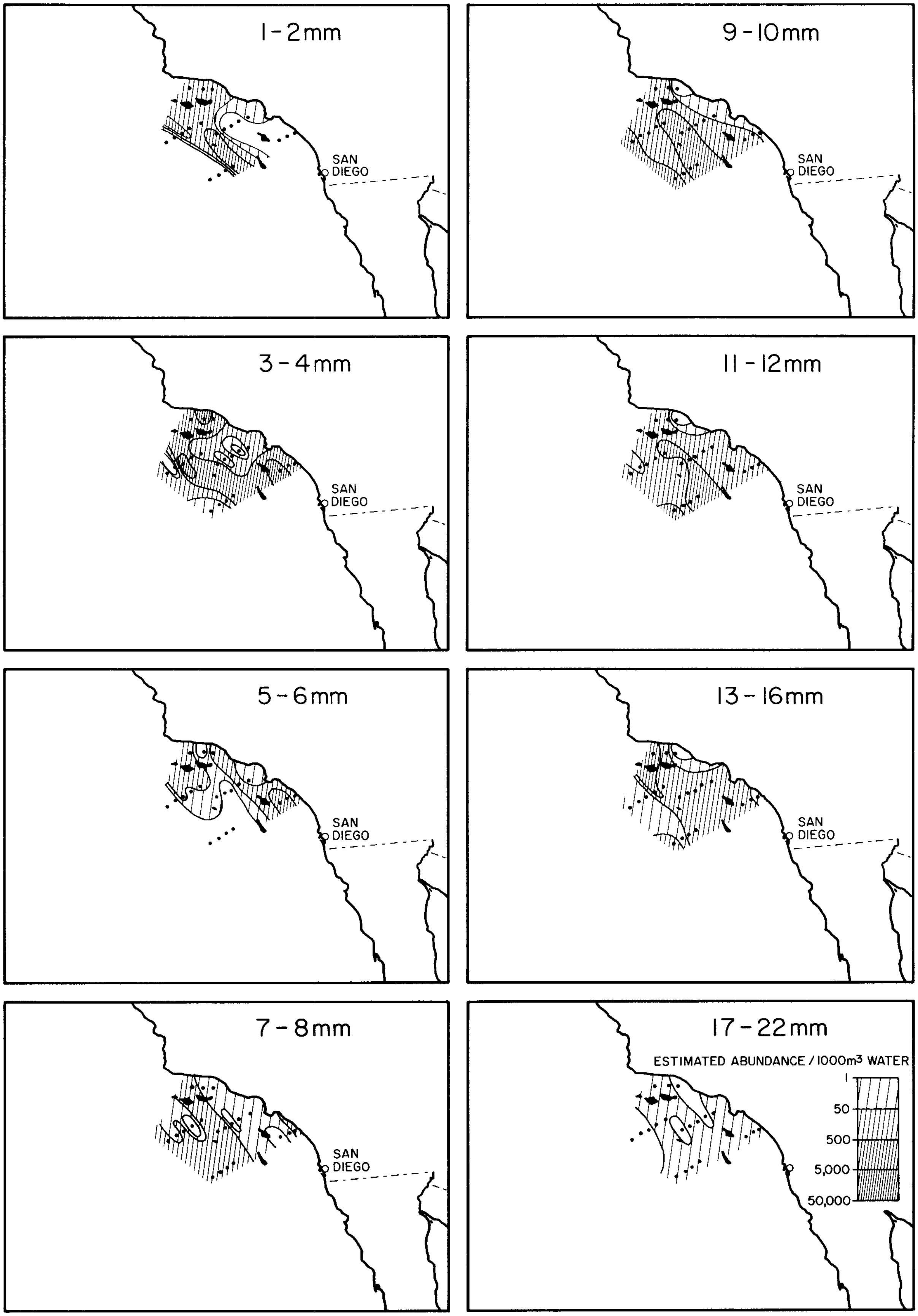
CALCOFI CRUISE 5509-II

15 - 19 SEPTEMBER 1955

Euphausiacea

Euphausia pacifica

5509-II



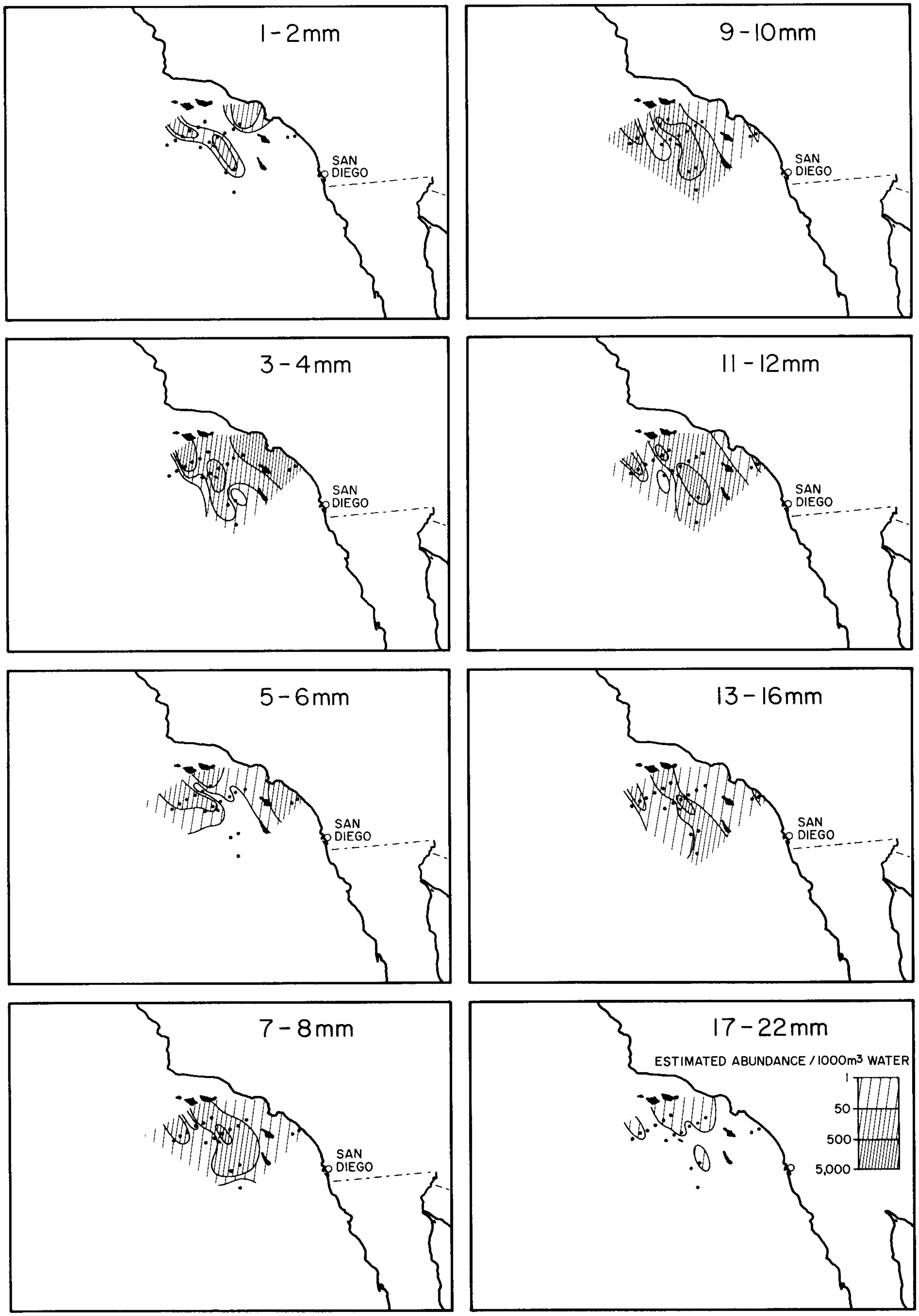
CALCOFI CRUISE 5509-III

18-23 SEPTEMBER 1955

Euphausiacea

Euphausia pacifica

5509-III



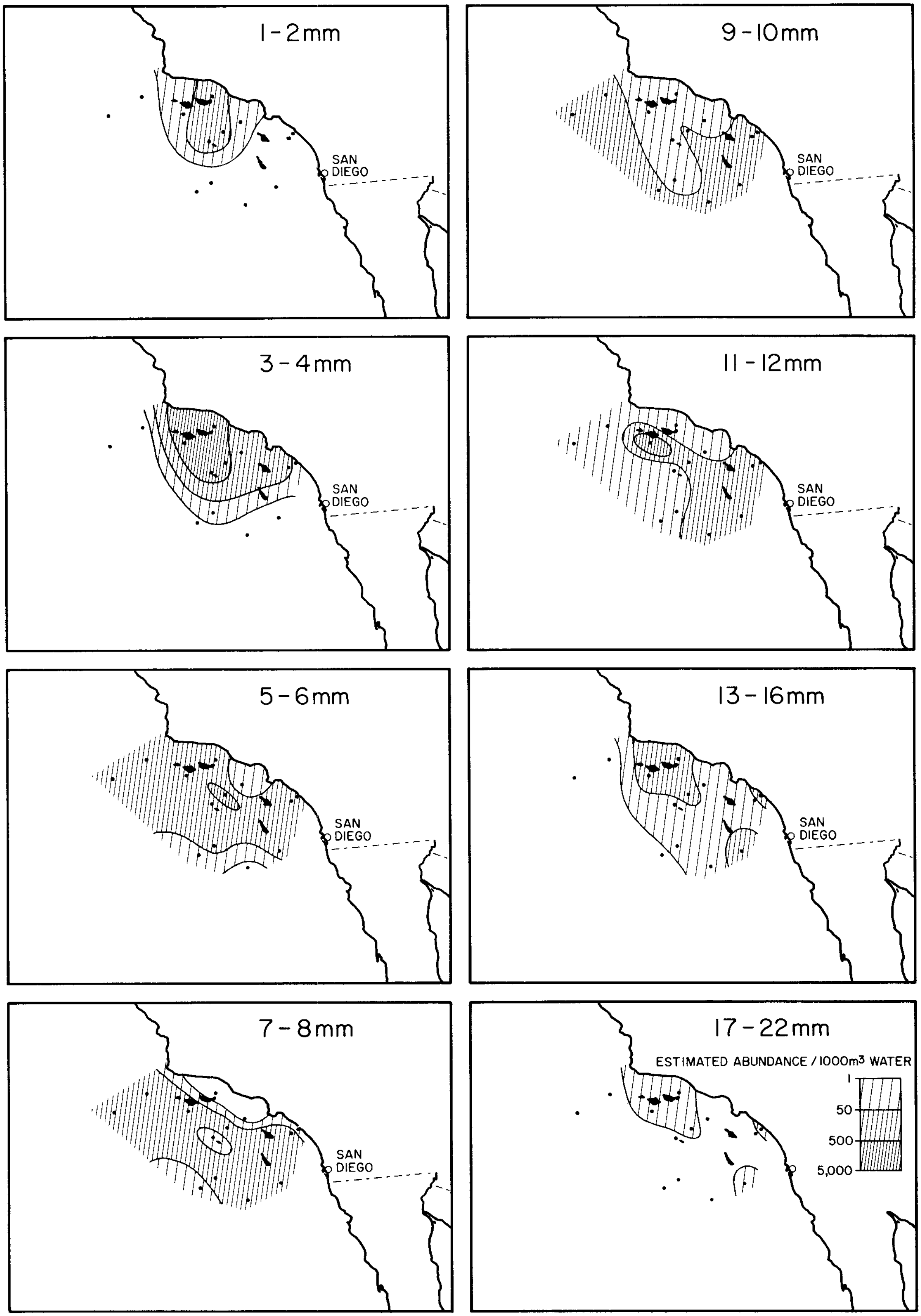
CALCOFI CRUISE 5509-IV

21-24 SEPTEMBER 1955

Euphausiacea

Euphausia pacifica

5509-IV



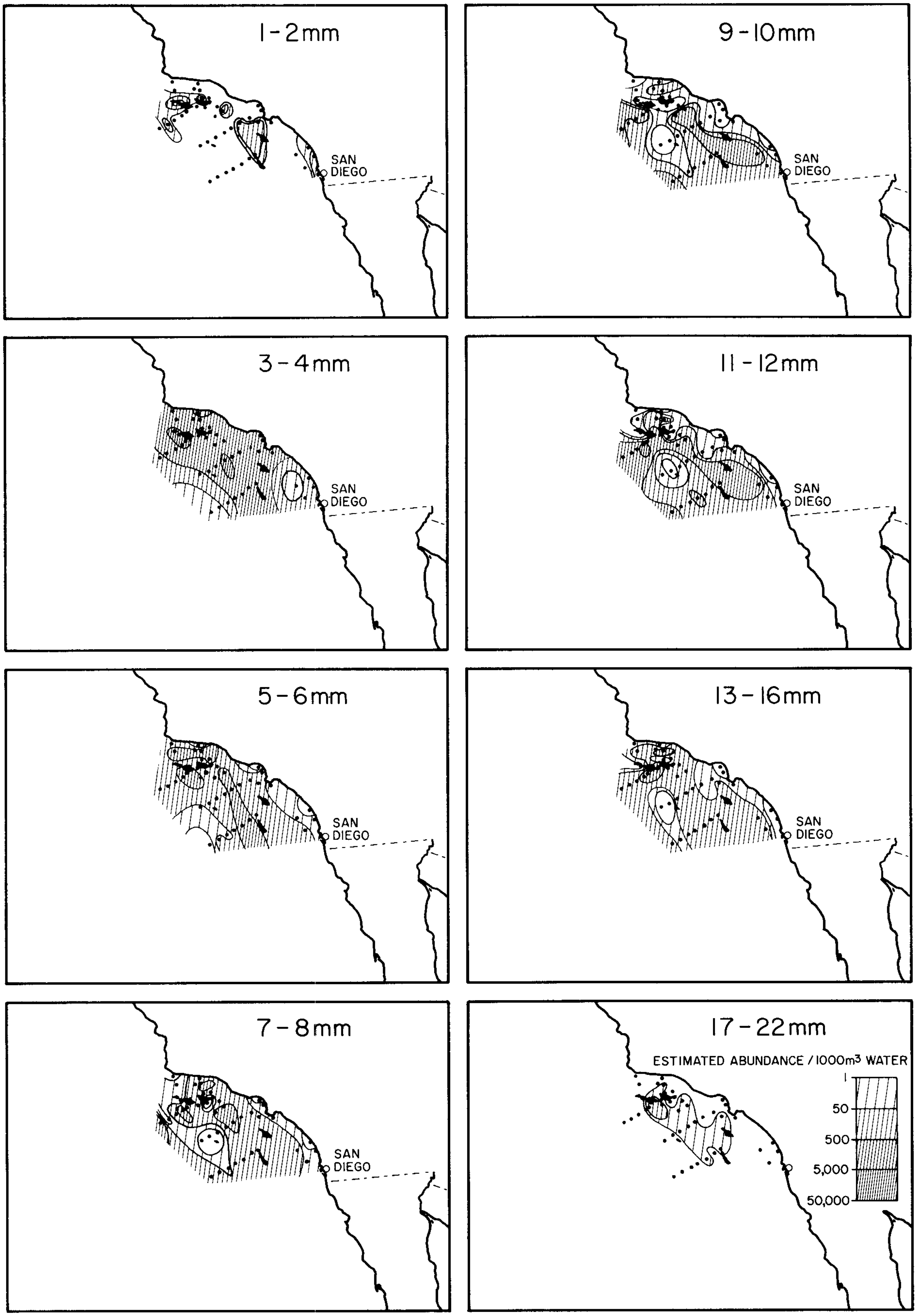
CALCOFI CRUISE 5510

21-29 OCTOBER 1955

Euphausiacea

Euphausia pacifica

5510



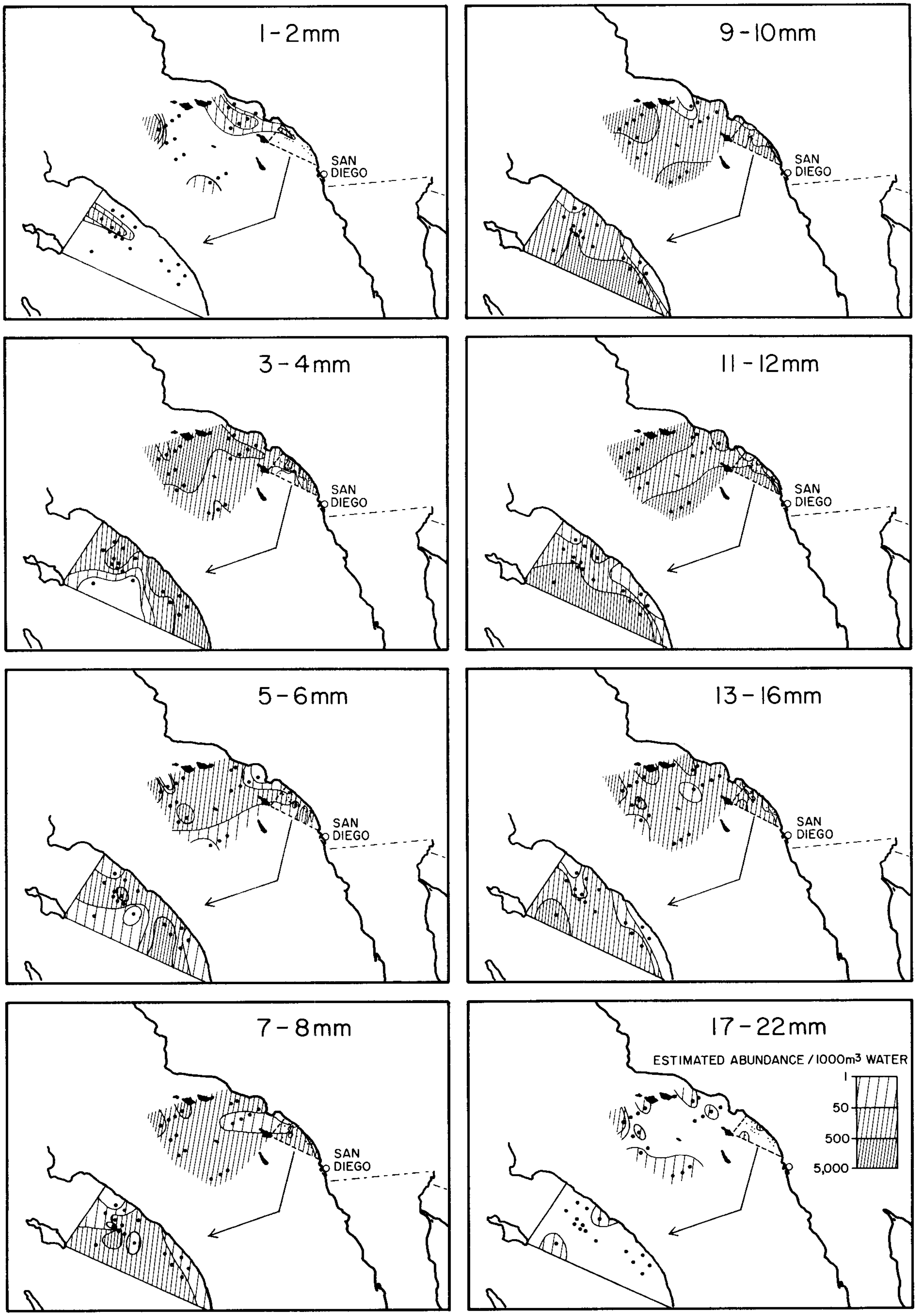
CALCOFI CRUISE 5511-I

8-13 NOVEMBER 1955

Euphausiacea

Euphausia pacifica

5511-I



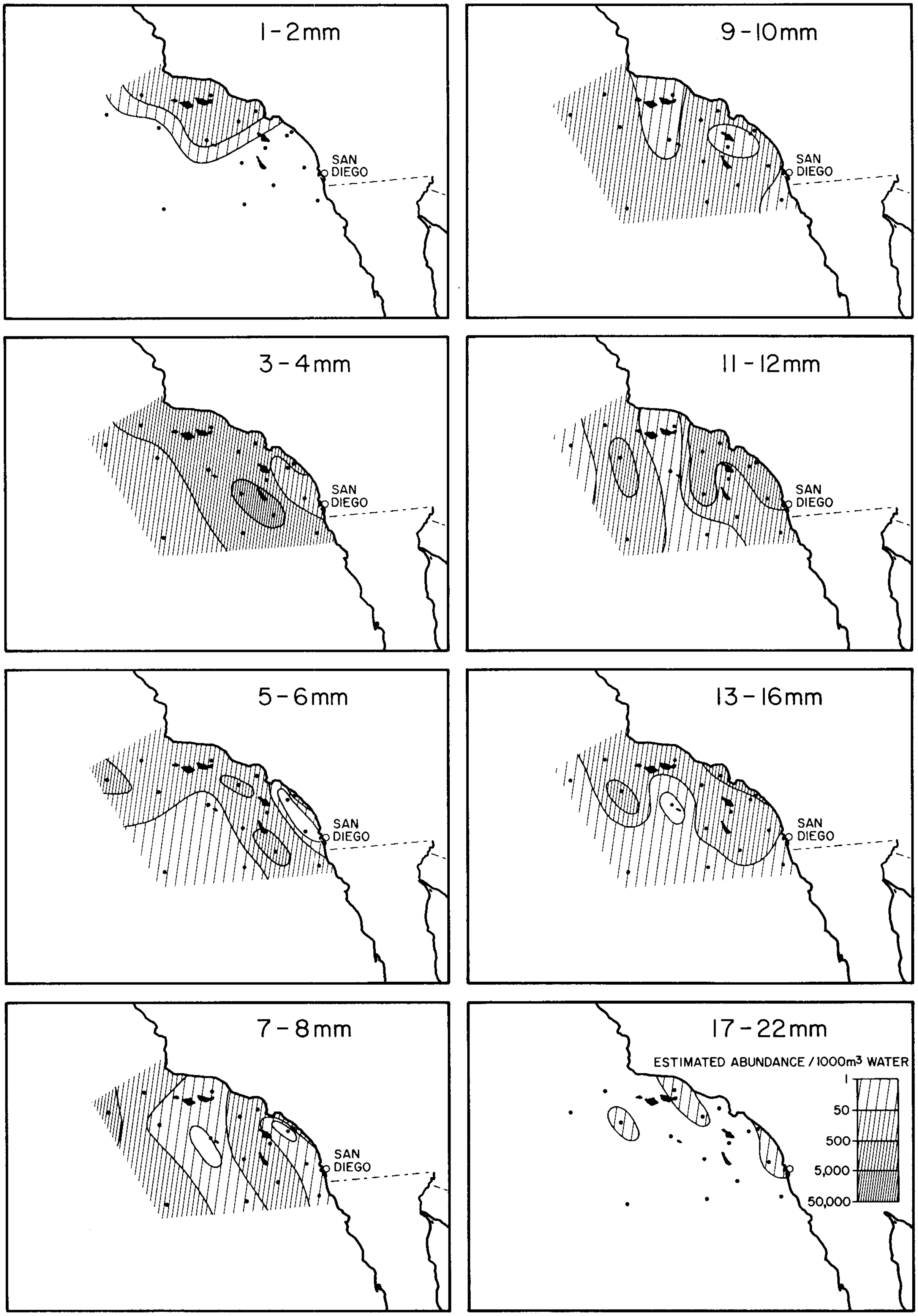
CALCOFI CRUISE 5511-II

16-19 NOVEMBER 1955

Euphausiacea

Euphausia pacifica

5511-II



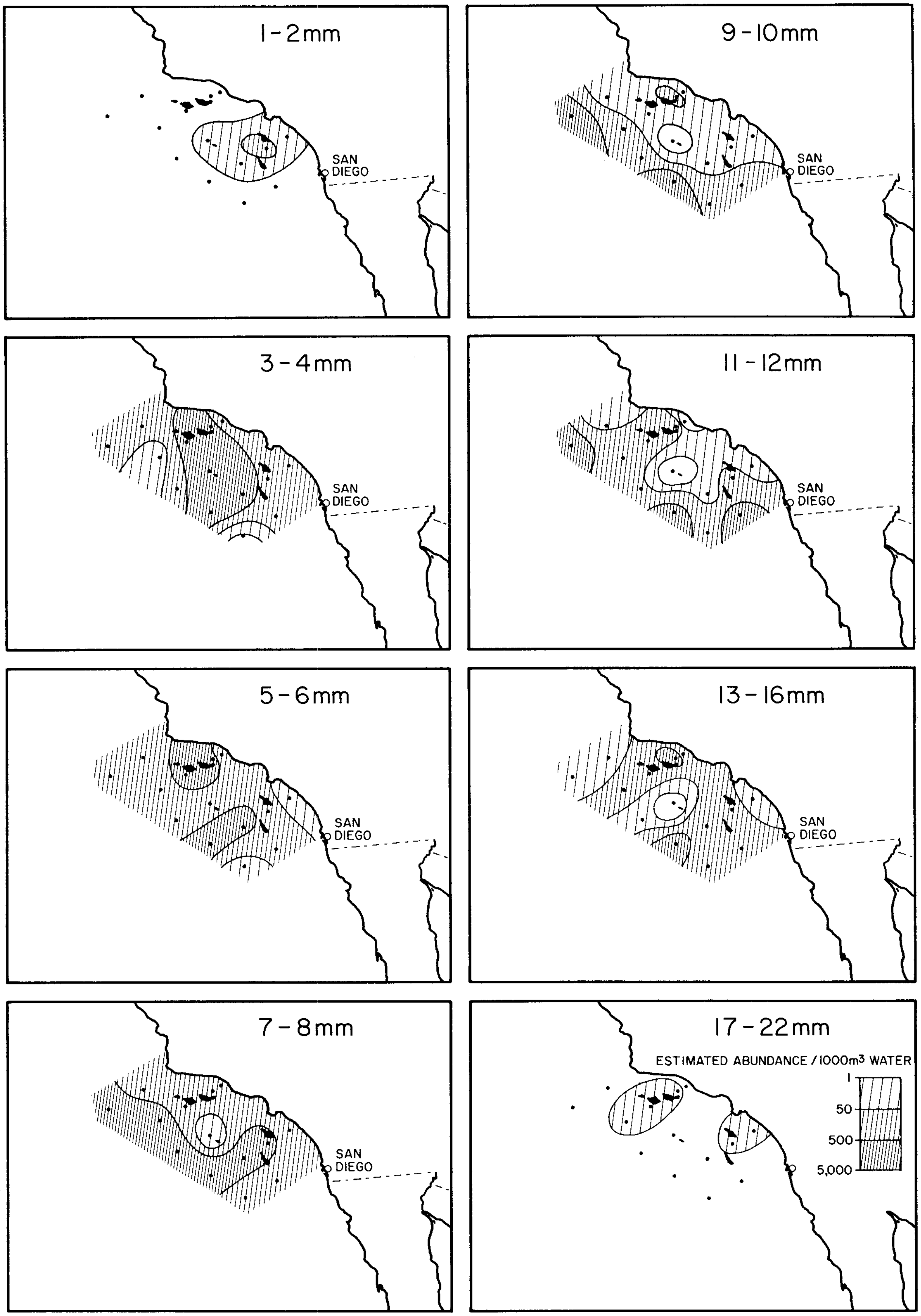
CALCOFI CRUISE 5512

30 NOVEMBER - 7 DECEMBER 1955

Euphausiacea

Euphausia pacifica

5512



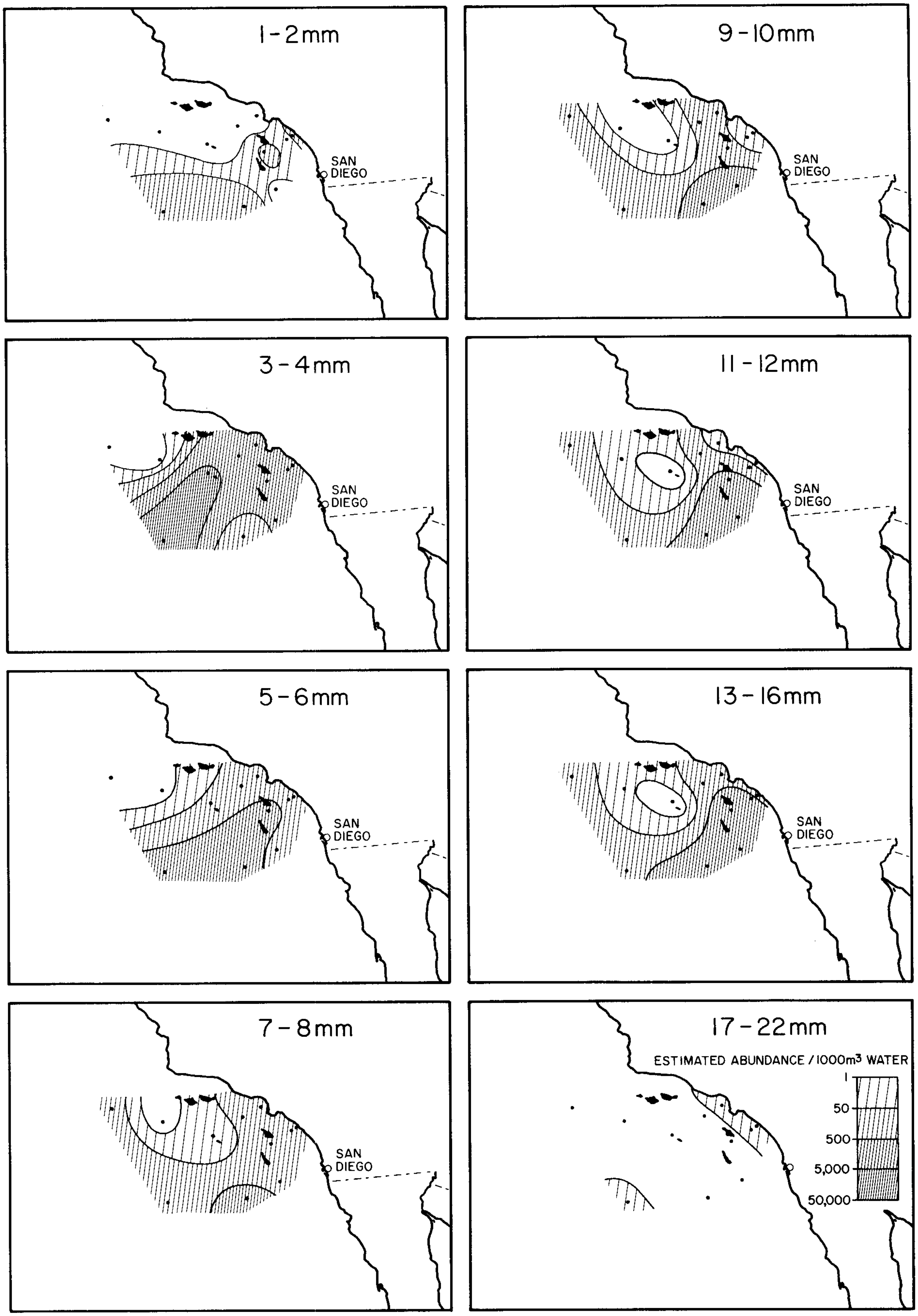
Euphausiacea

Euphausia pacifica

5601

CALCOFI CRUISE 5601

6-10 JANUARY 1956



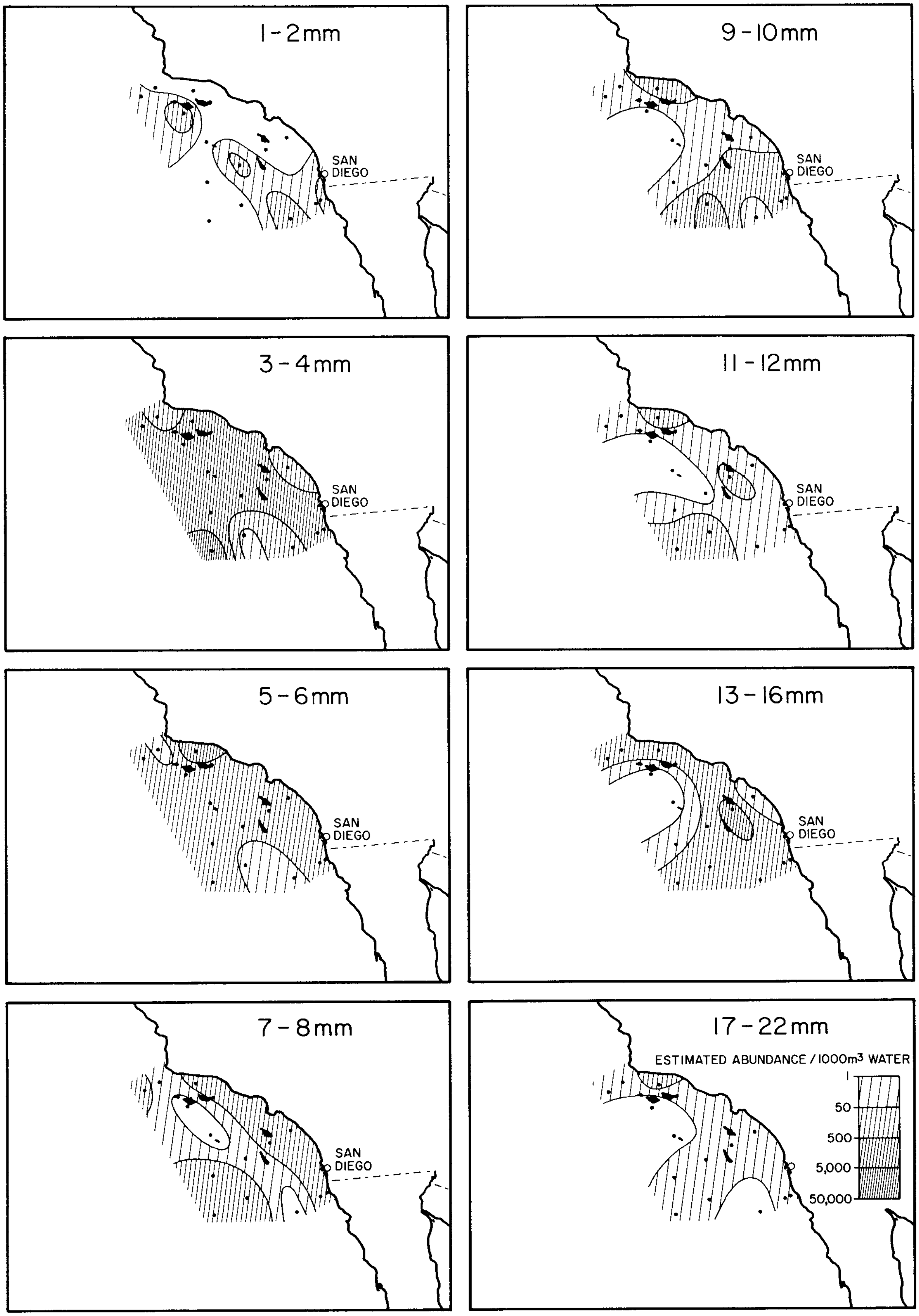
Euphausiacea

CALCOFI CRUISE 5602

3-10 FEBRUARY 1956

Euphausia pacifica

5602



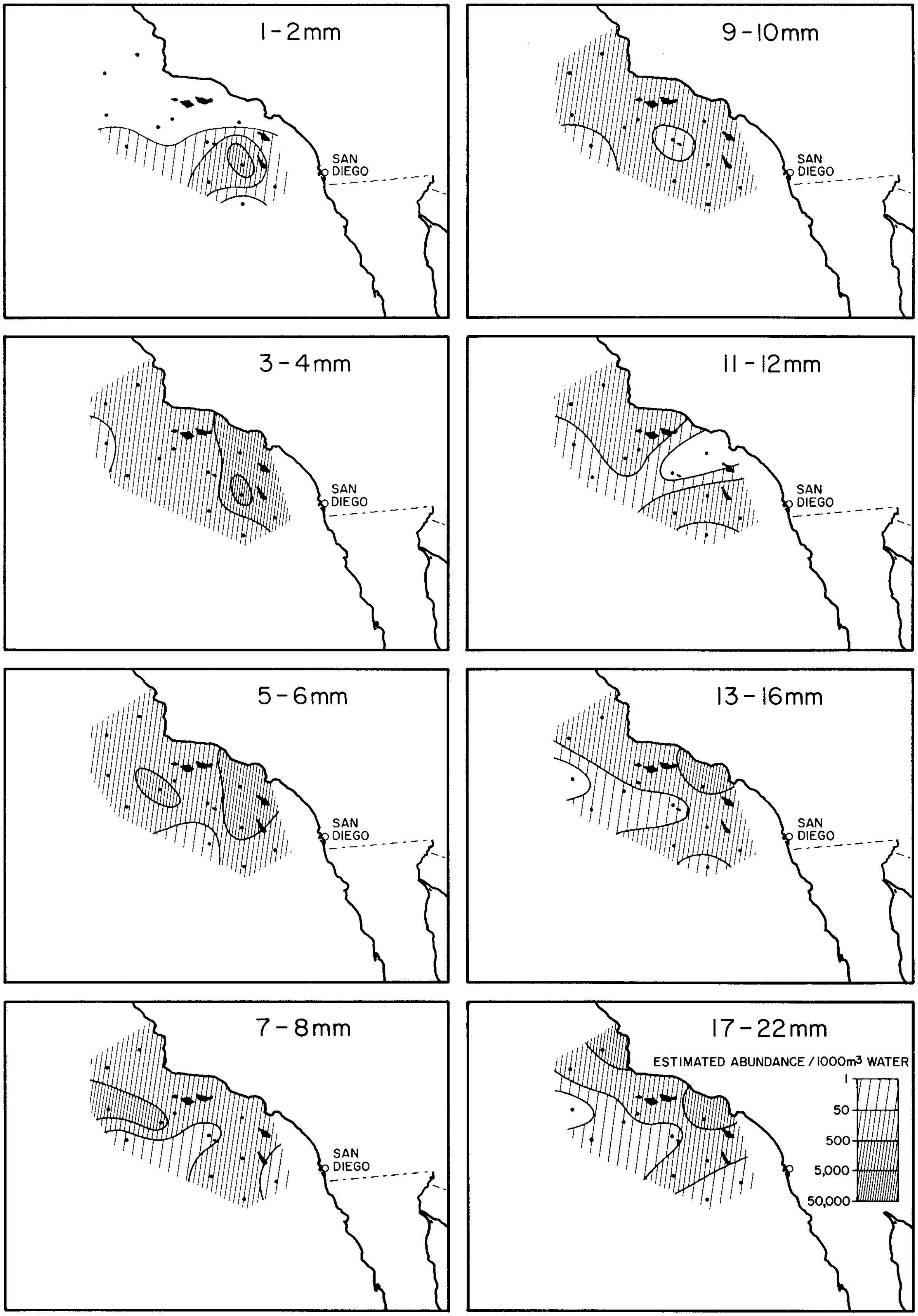
CALCOFI CRUISE 5603

8-17 MARCH 1956

Euphausiacea

Euphausia pacifica

5603



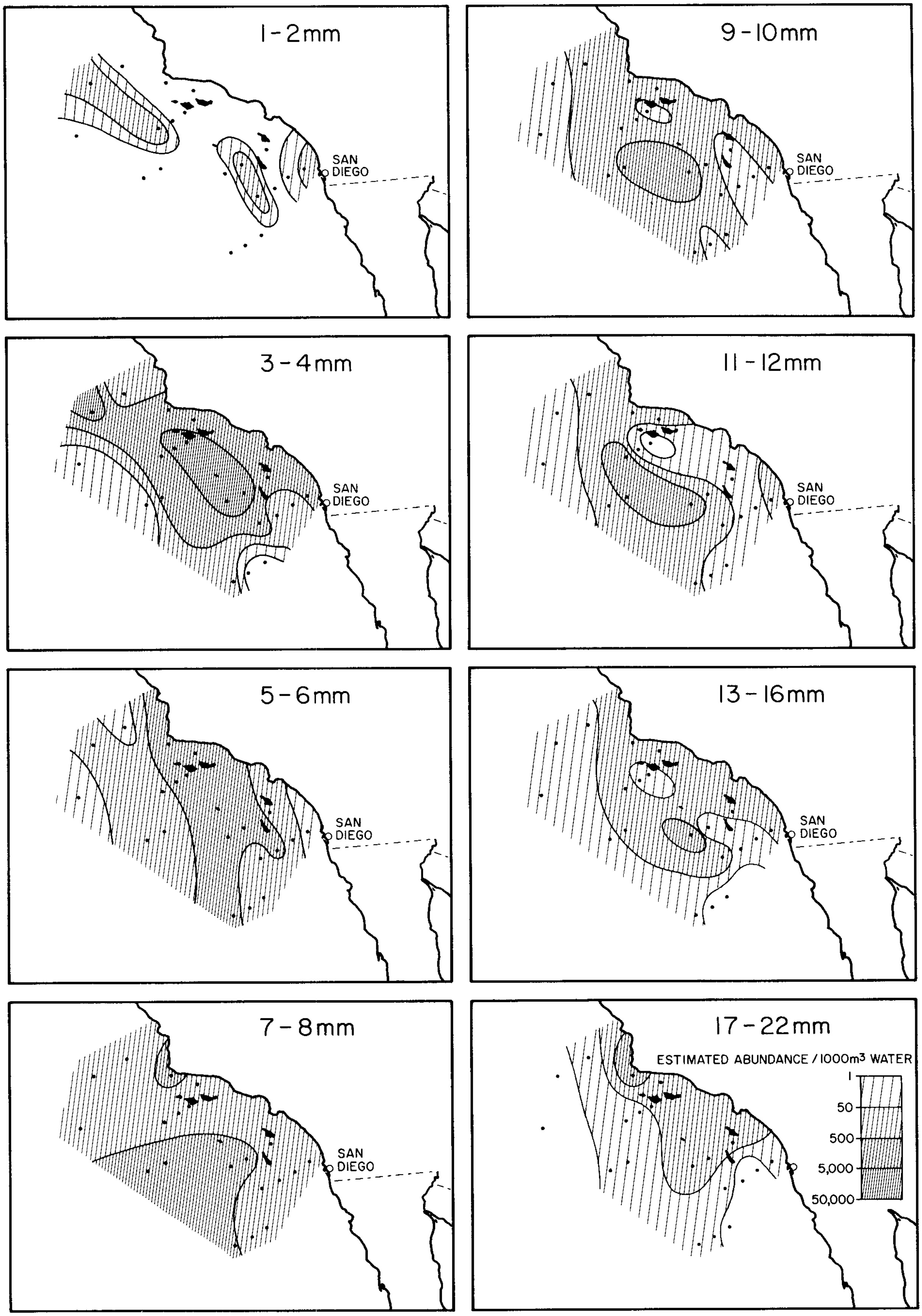
CALCOFI CRUISE 5604

14 - 21 APRIL 1956

Euphausiacea

Euphausia pacifica

5604



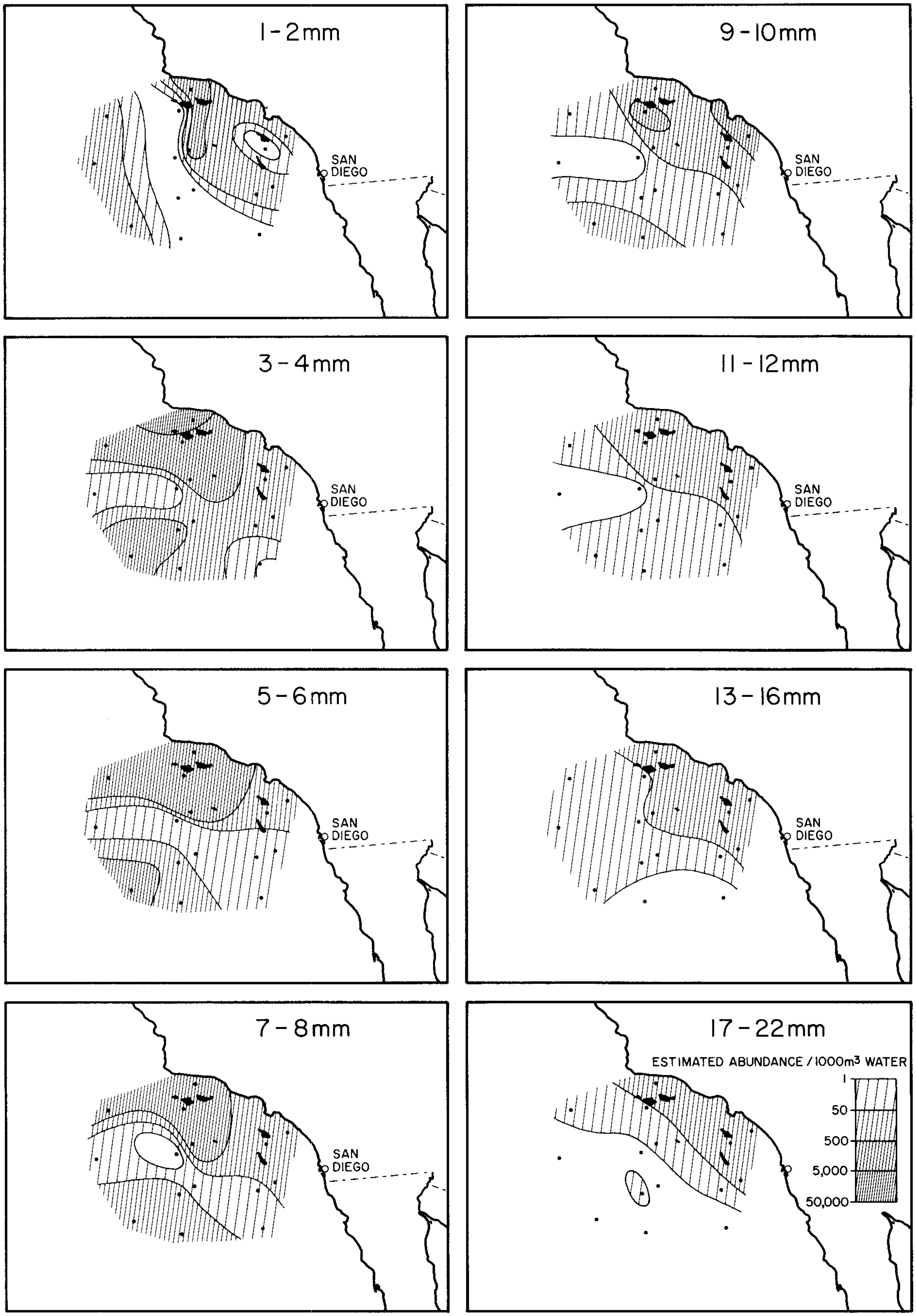
CALCOFI CRUISE 5605

6-18 MAY 1956

Euphausiacea

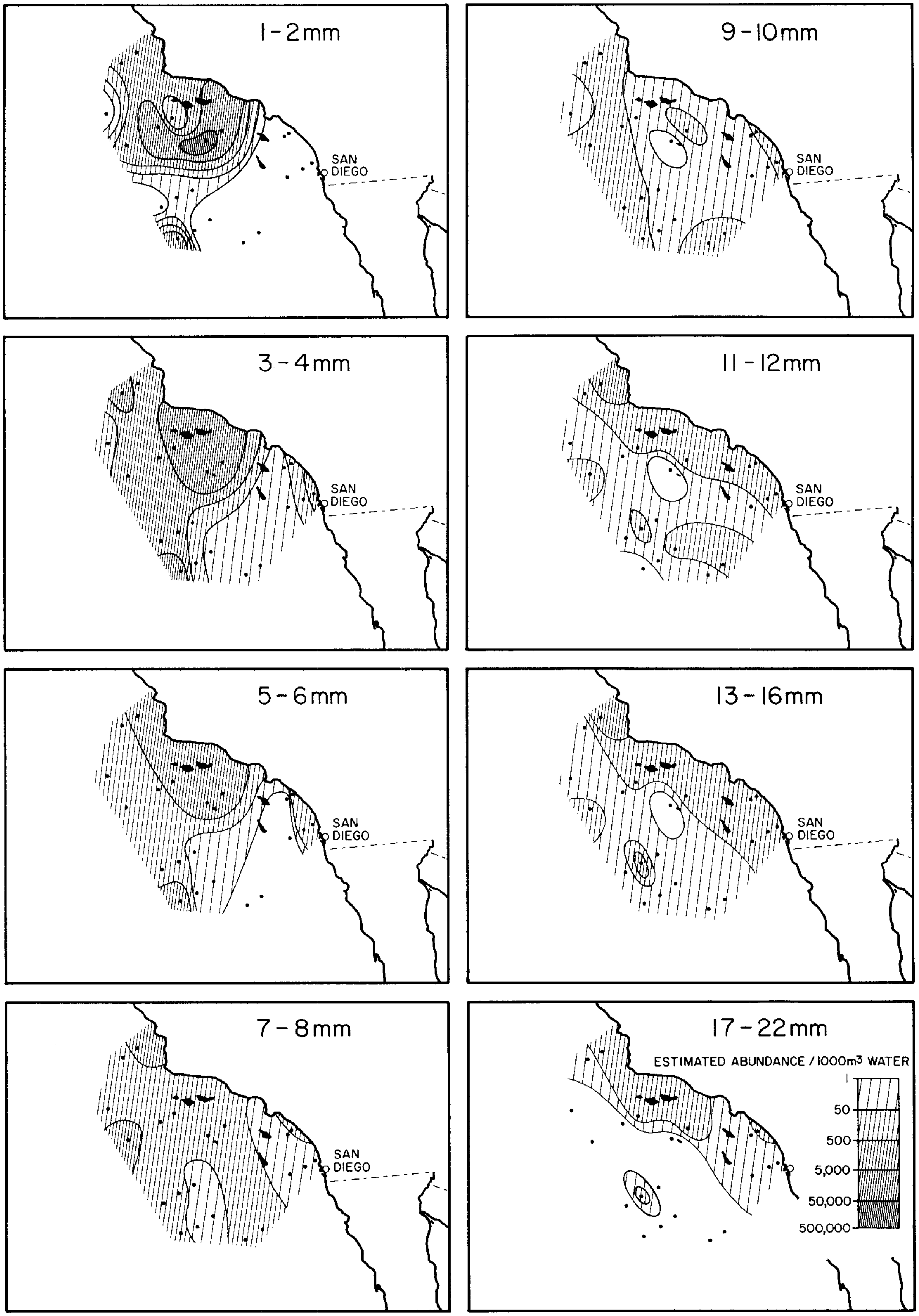
Euphausia pacifica

5605



CALCOFI CRUISE 5606
30 MAY - 13 JUNE 1956

Euphausiacea
Euphausia pacifica
5606



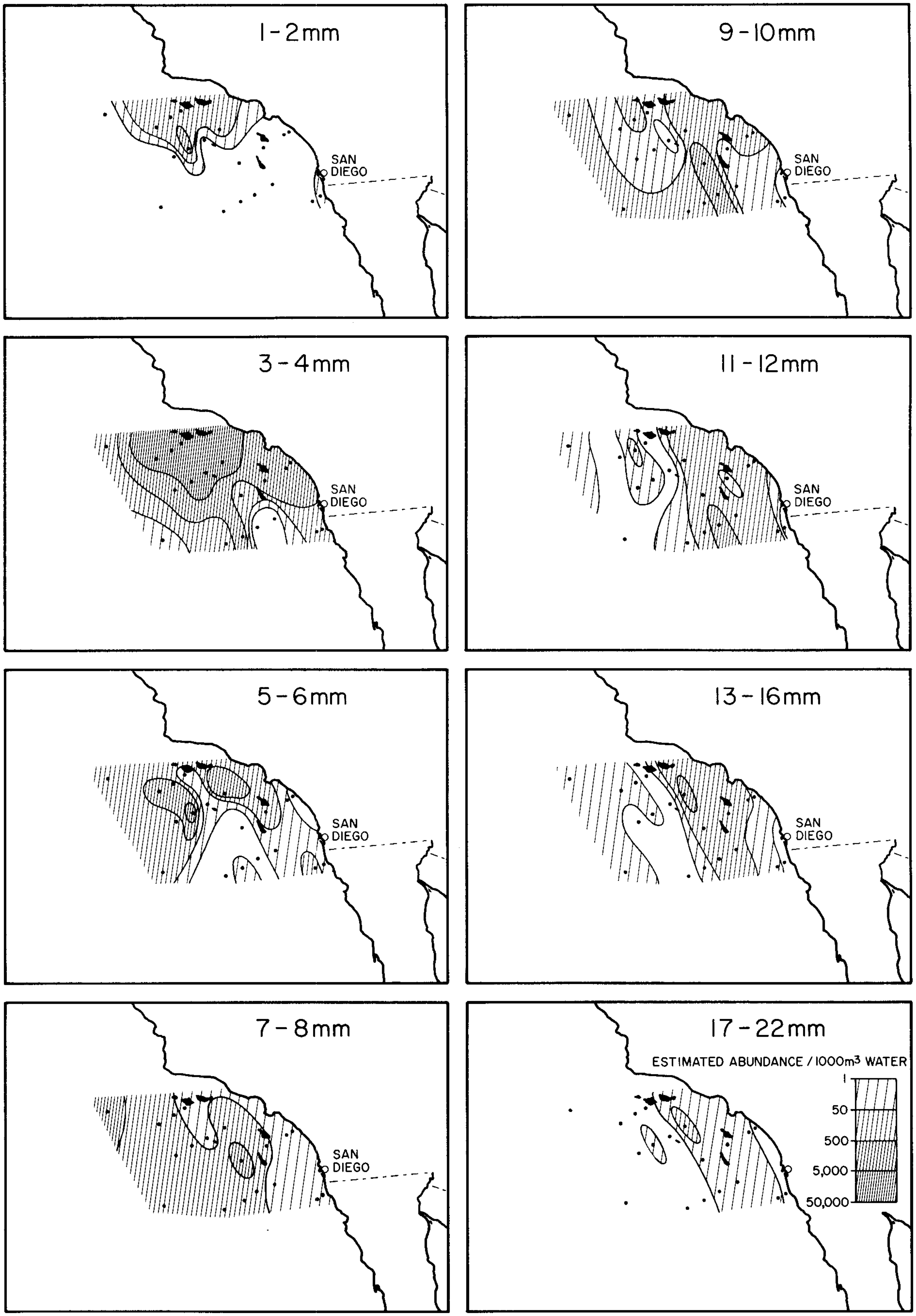
CALCOFI CRUISE 5607

7-15 JULY 1956

Euphausiacea

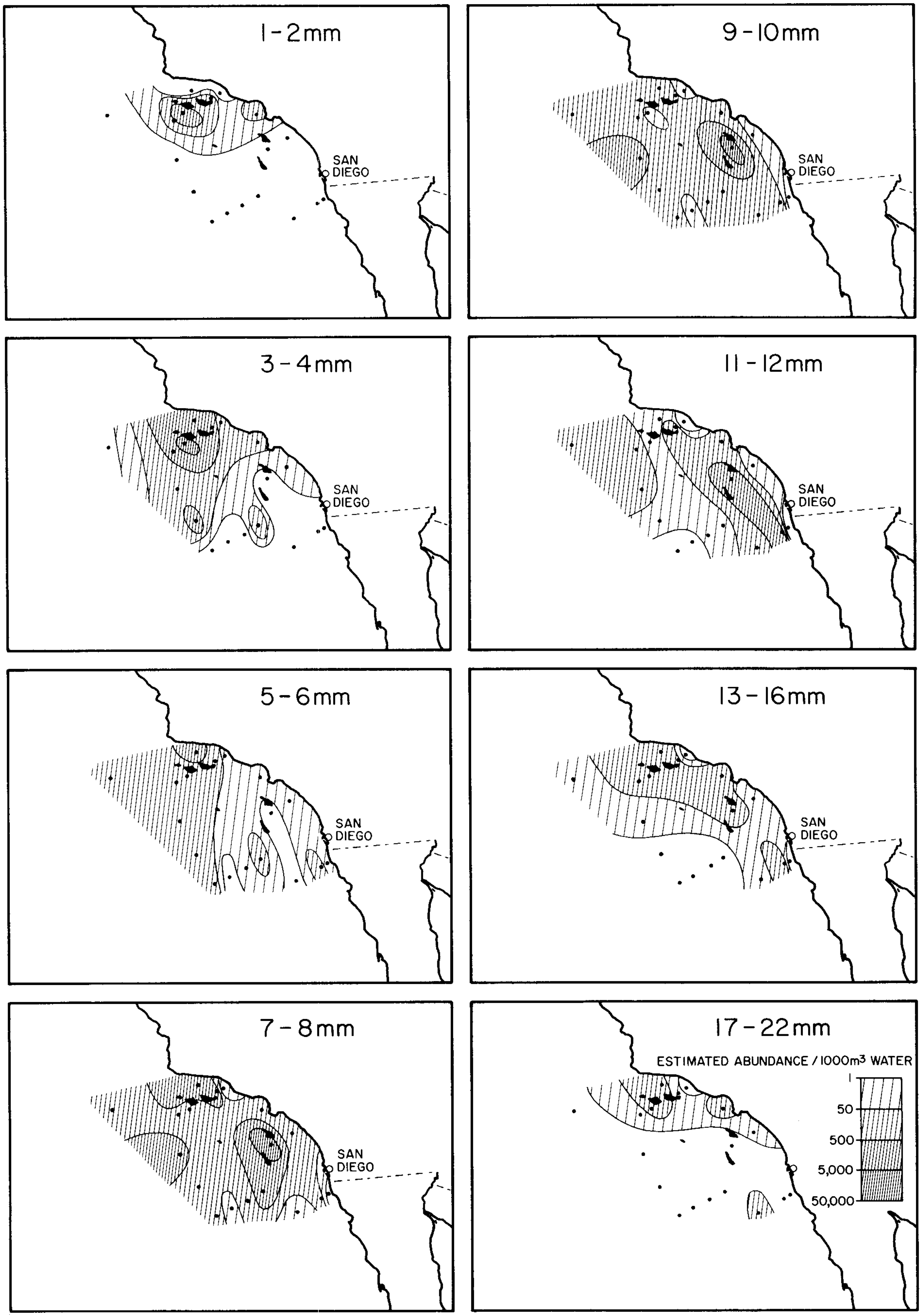
Euphausia pacifica

5607



CALCOFI CRUISE 5610
29 SEPTEMBER - 5 OCTOBER 1956

Euphausiacea
Euphausia pacifica
5610



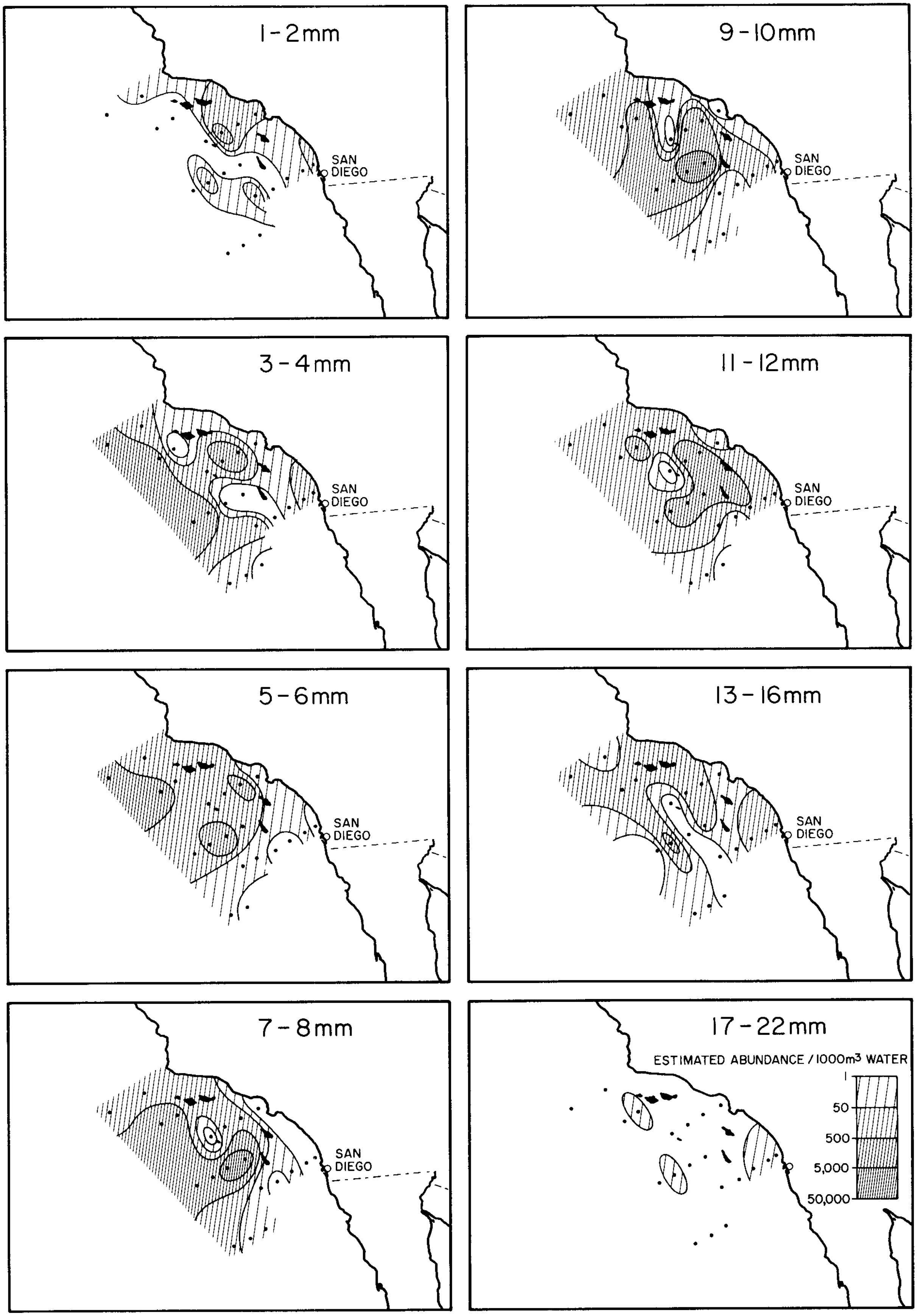
CALCOFI CRUISE 5611

30 OCTOBER - 5 NOVEMBER 1956

Euphausiacea

Euphausia pacifica

5611



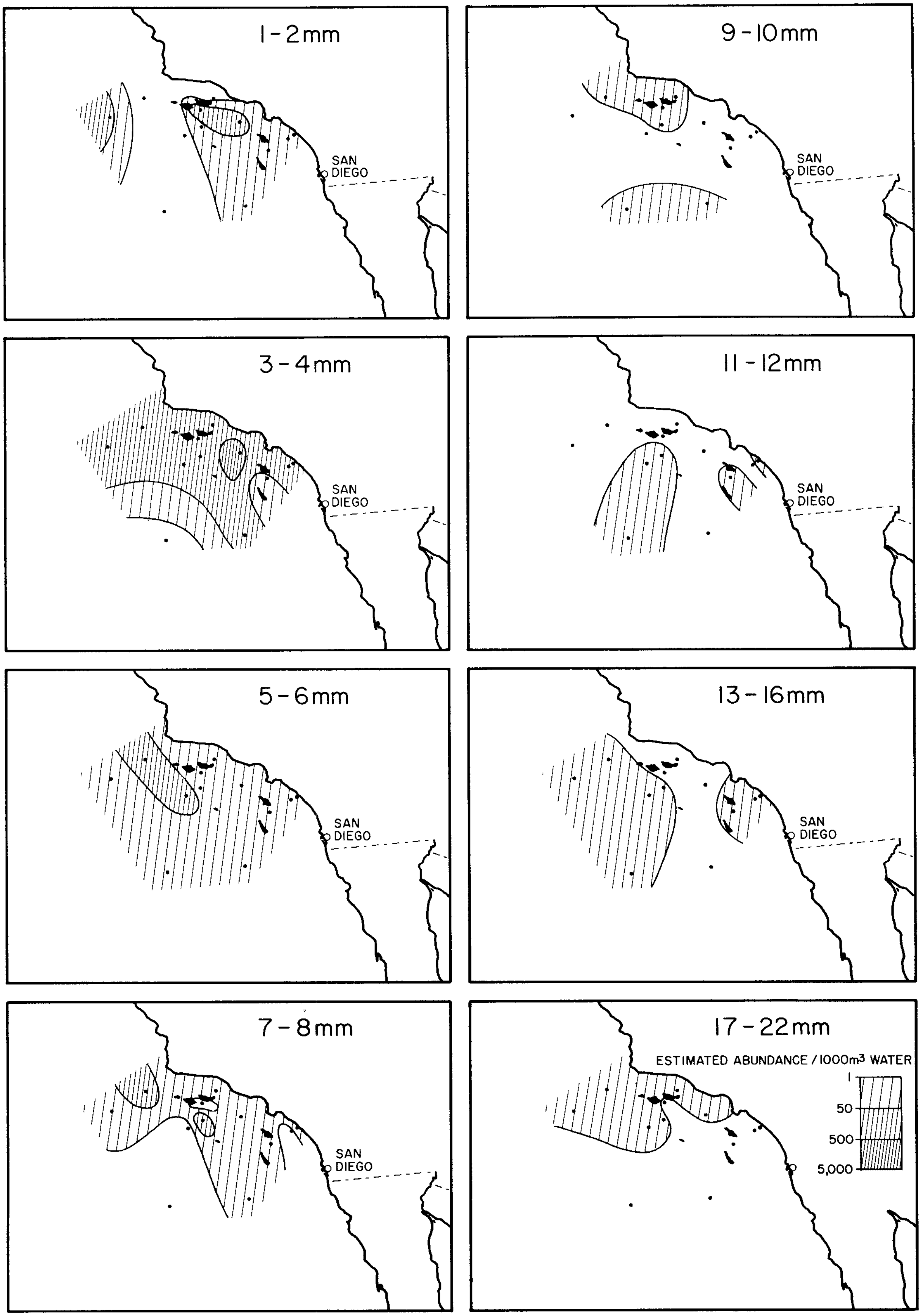
CALCOFI CRUISE 5612

6 - 12 DECEMBER 1956

Euphausiacea

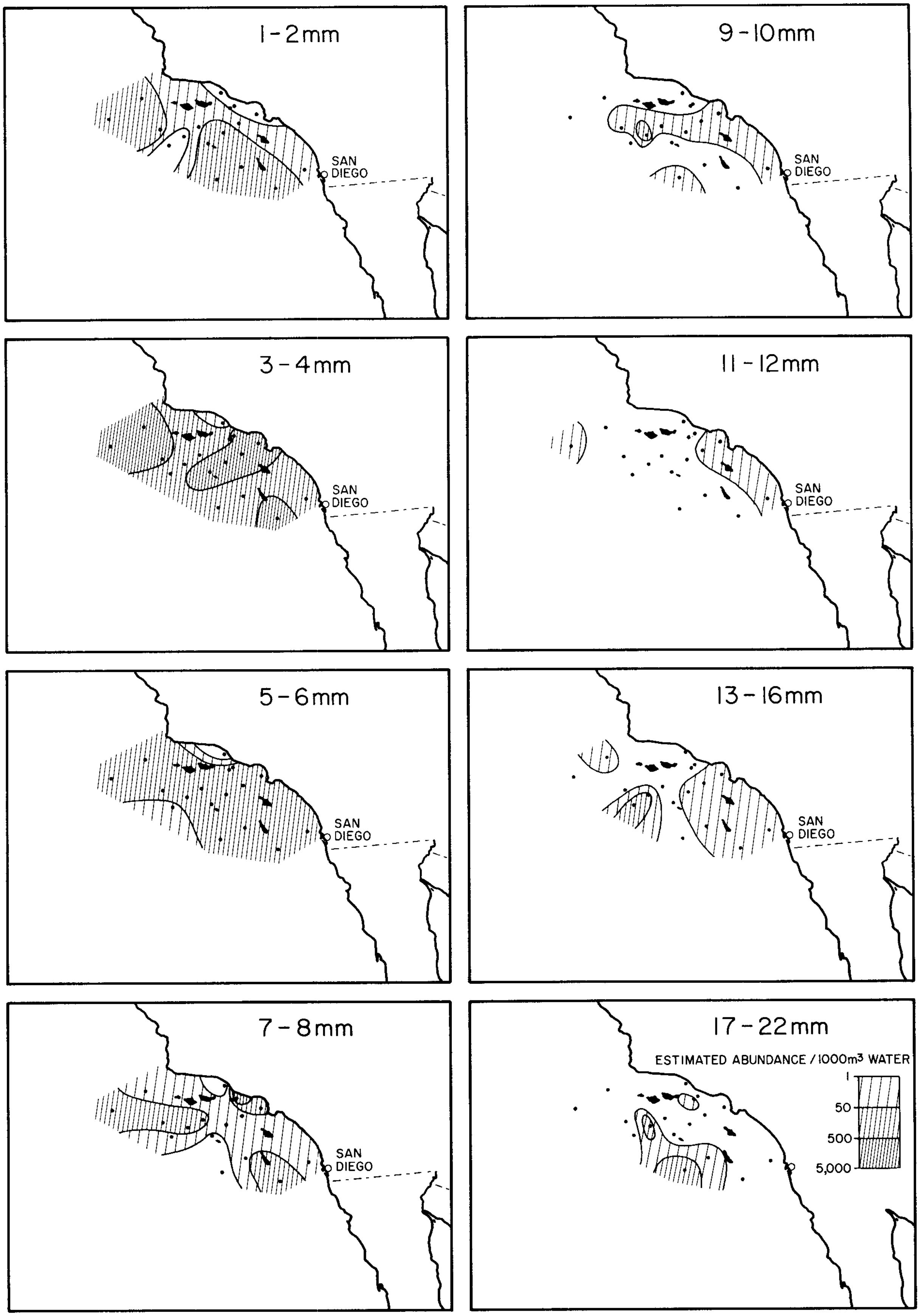
Euphausia pacifica

5612



CALCOFI CRUISE 5301
9 - 17 JANUARY 1953

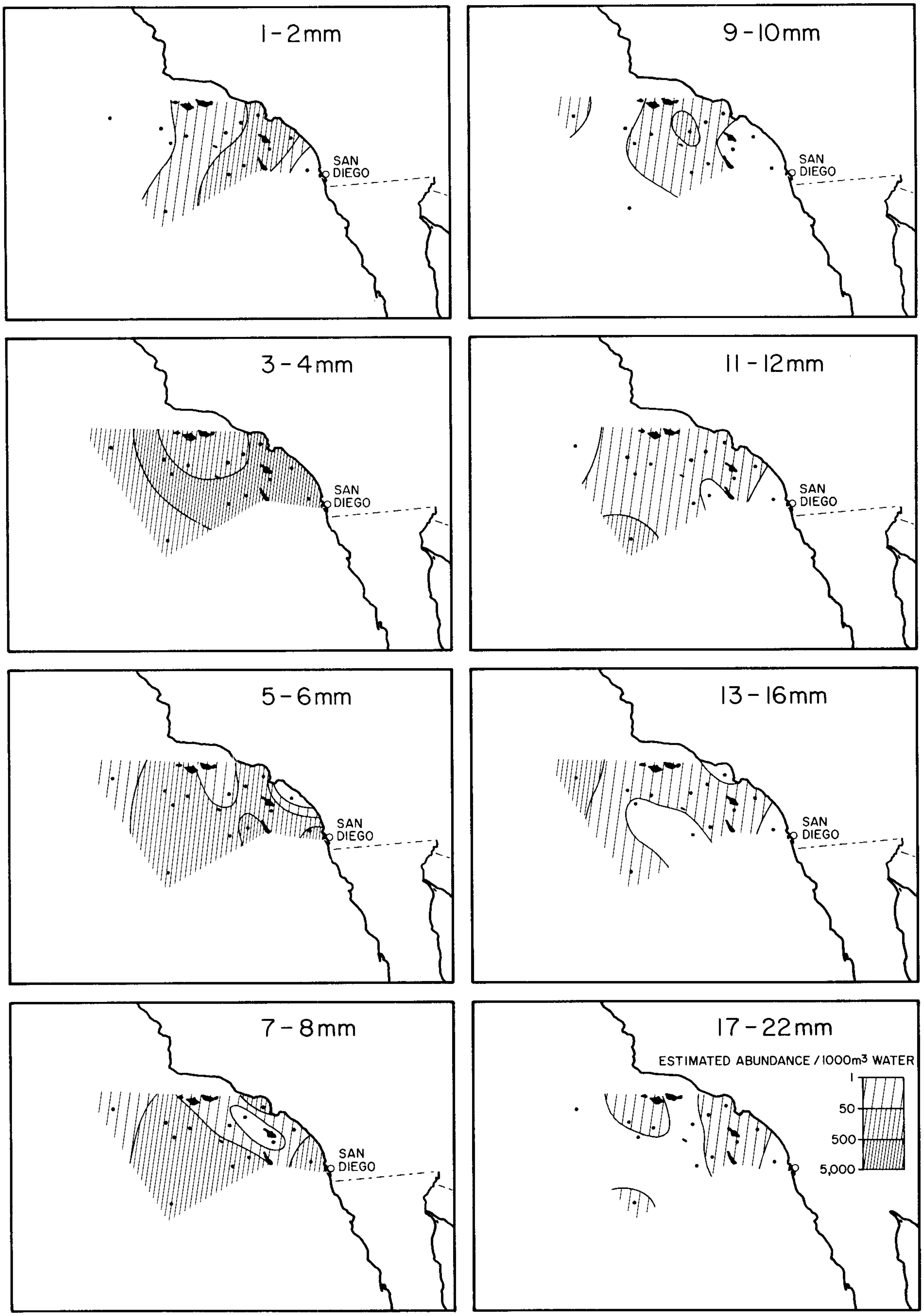
Euphausiacea
Nematoscelis difficilis
5301



Euphausiacea

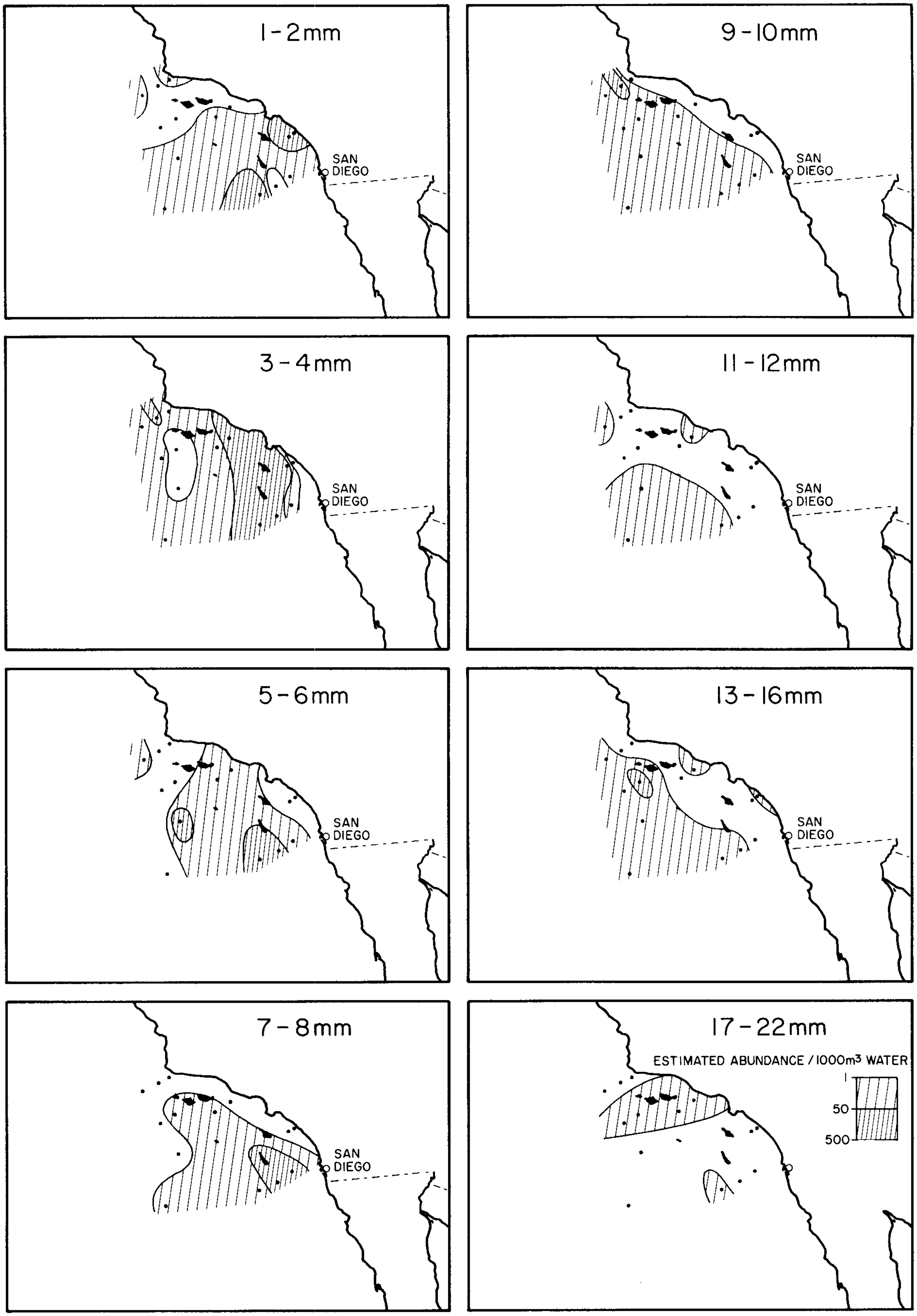
CALCOFI CRUISE 5302
4 - 14 FEBRUARY 1953

Nematoscelis difficilis
5302



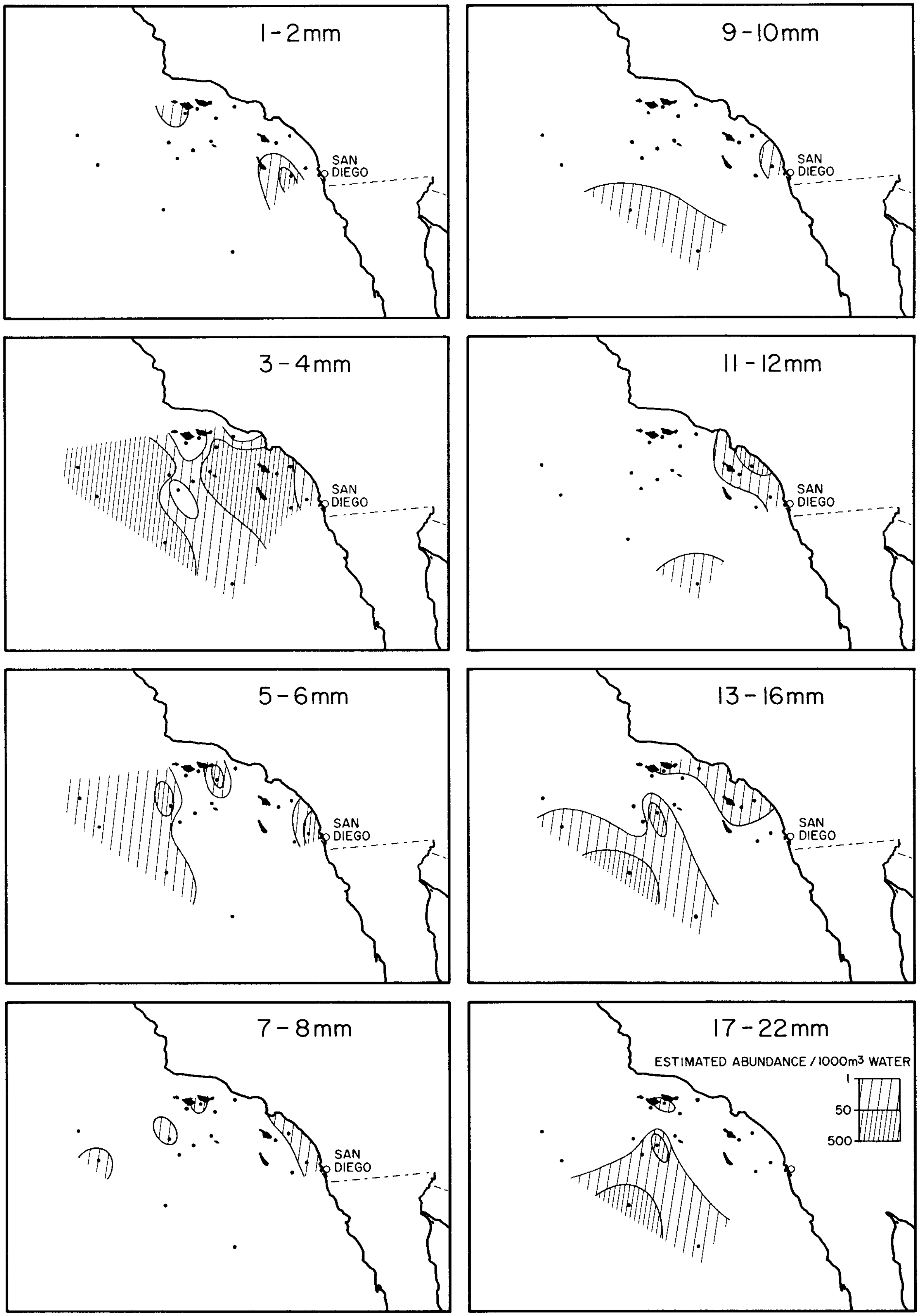
CALCOFI CRUISE 5303
6 - 20 MARCH 1953

Euphausiacea
Nematoscelis difficilis
5303



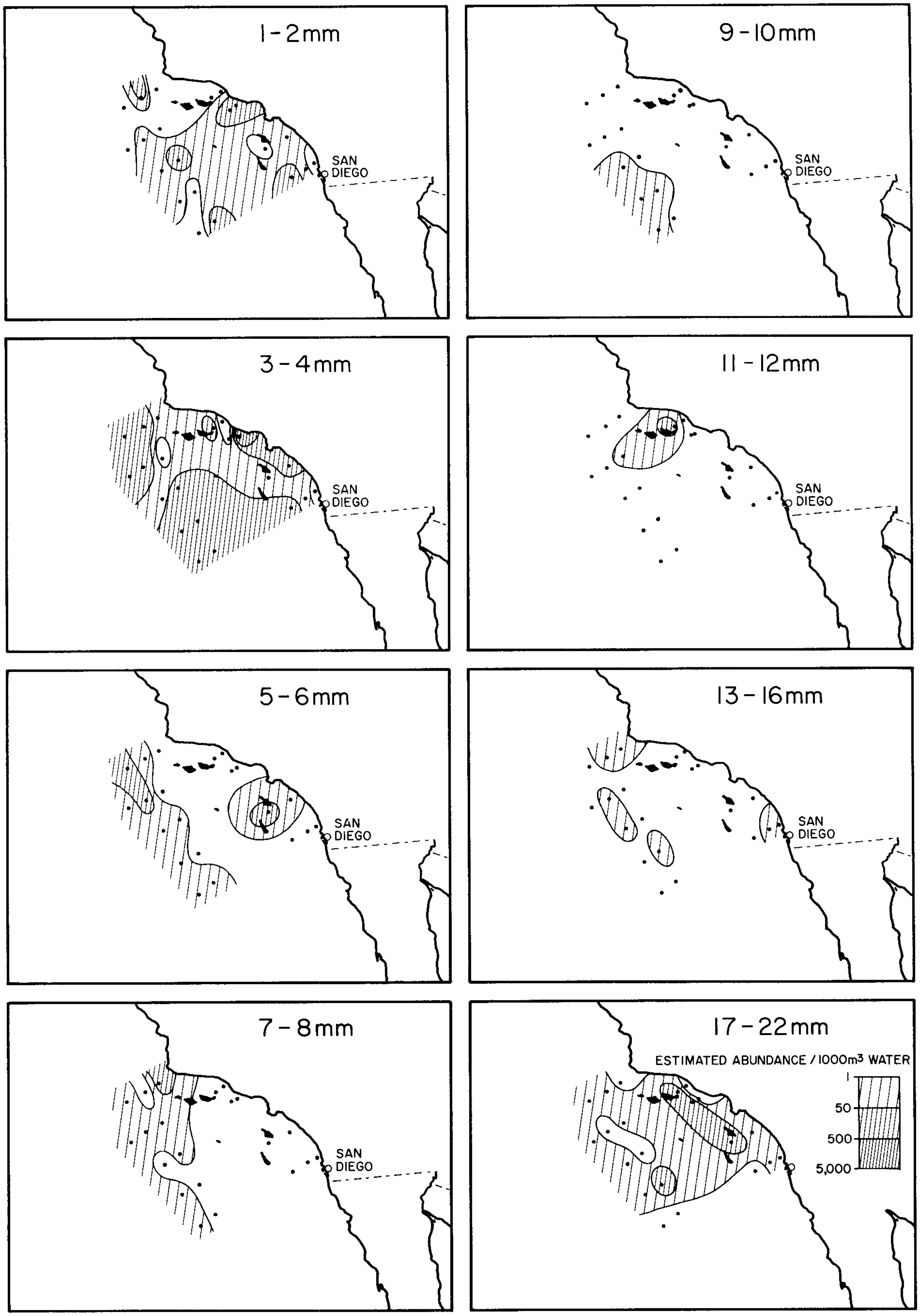
CALCOFI CRUISE 5304
7-17 APRIL 1953

Euphausiacea
Nematoscelis difficilis
5304



CALCOFI CRUISE 5305
5 - 18 MAY 1953

Euphausiacea
Nematoscelis difficilis
5305



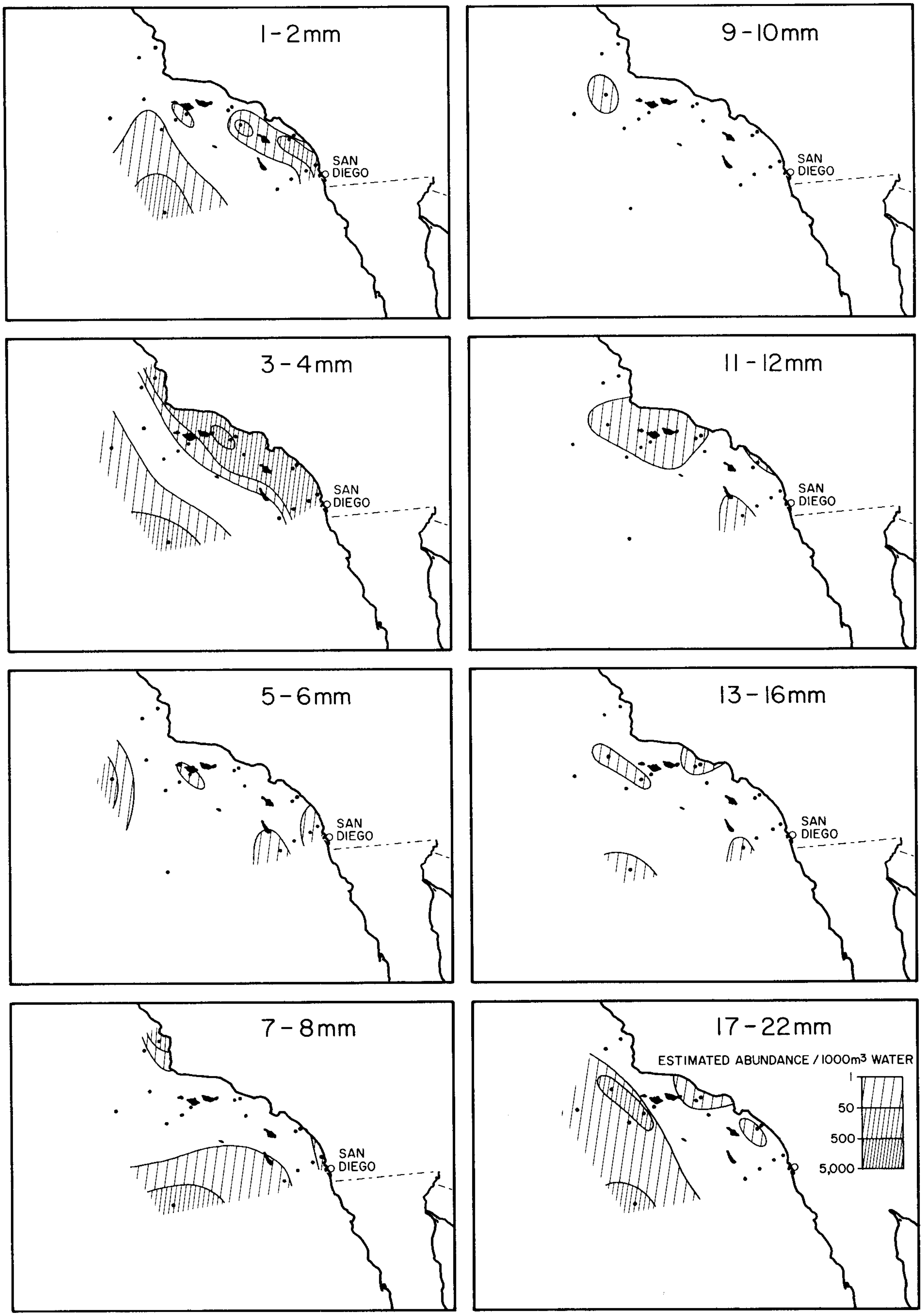
CALCOFI CRUISE 5306

5 - 12 JUNE 1953

Euphausiacea

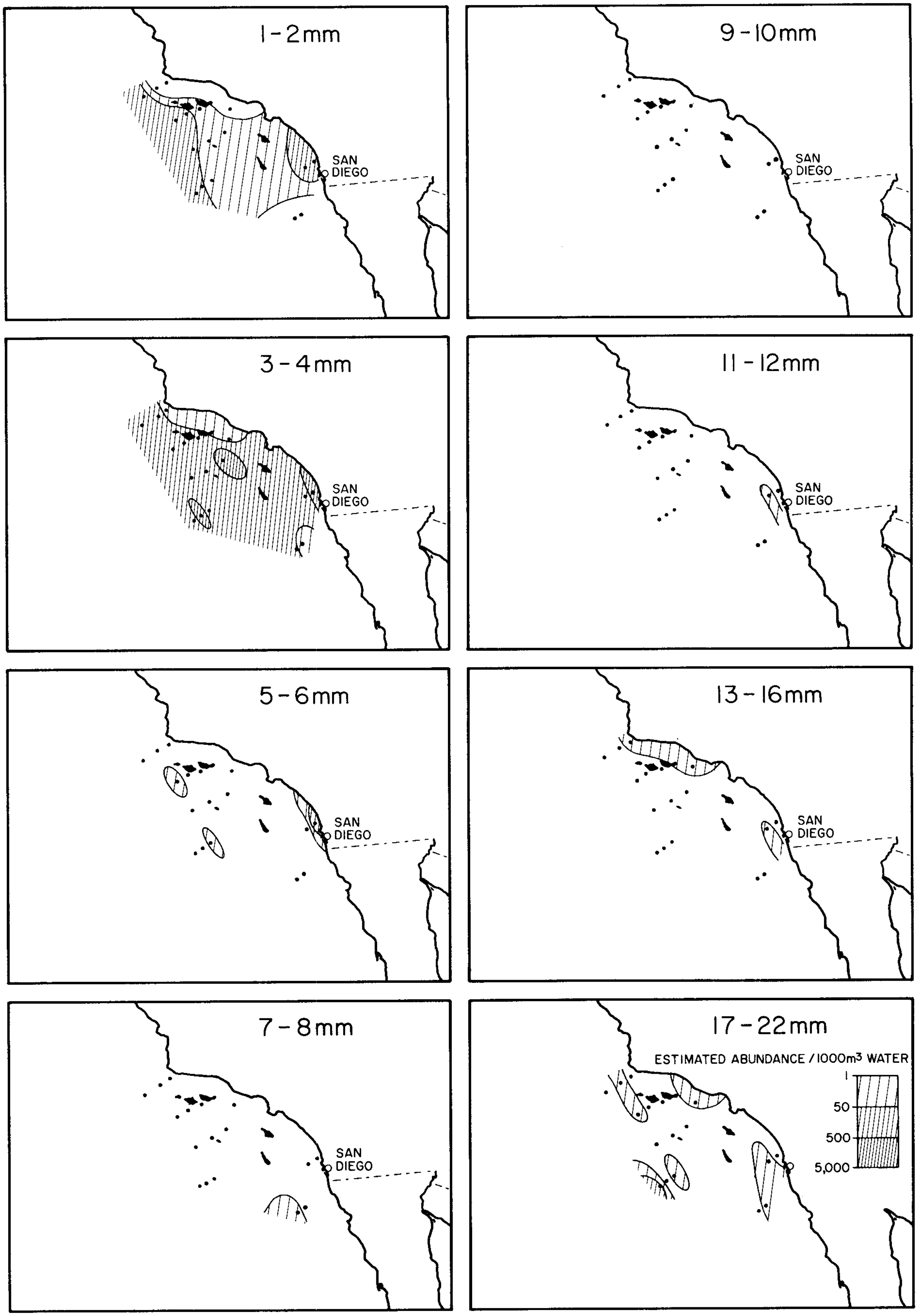
Nematoscelis difficilis

5306



CALCOFI CRUISE 5307
14 - 26 JULY 1953

Euphausiacea
Nematoscelis difficilis
5307



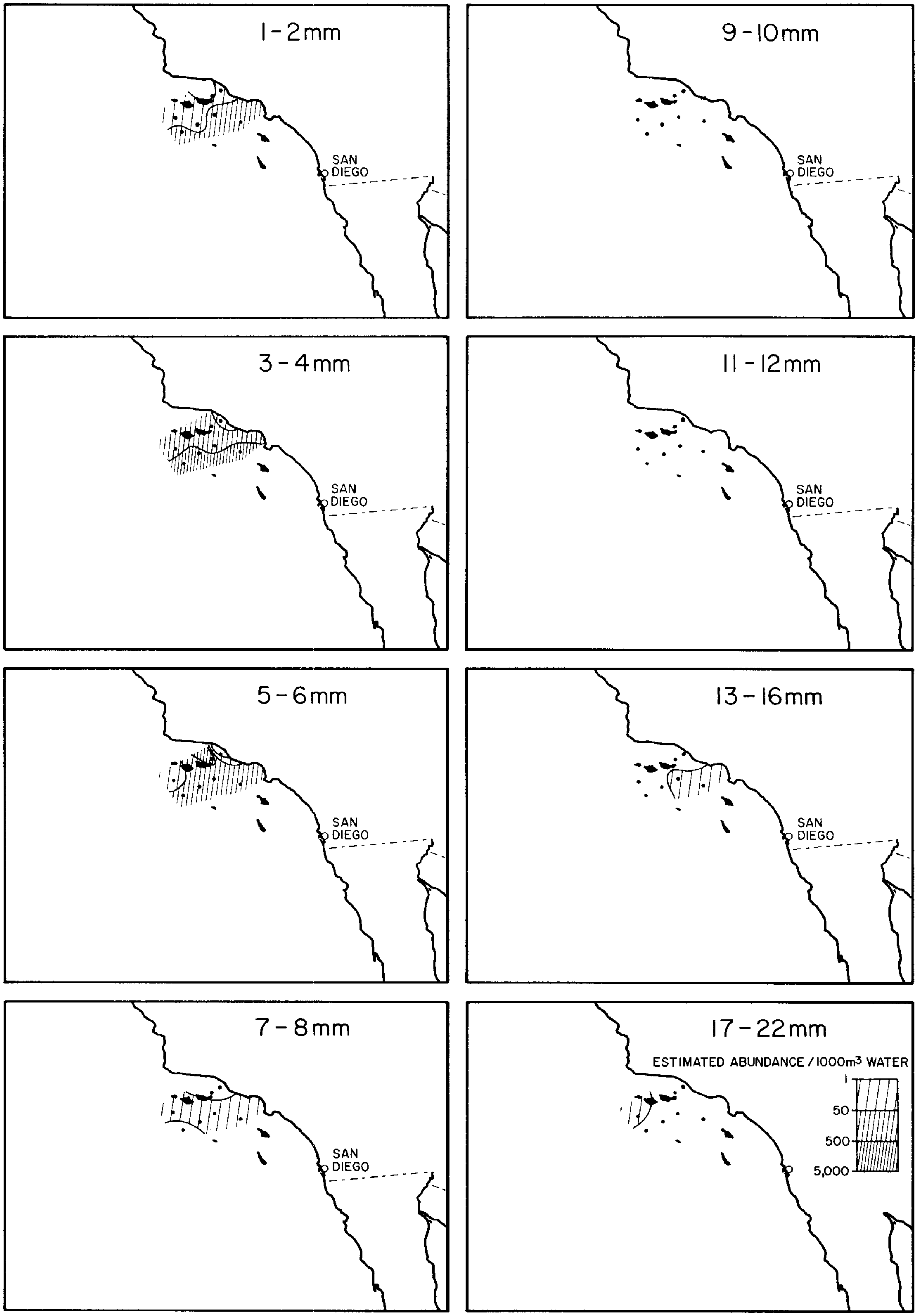
CALCOFI CRUISE 5308

18 - 29 AUGUST 1953

Euphausiacea

Nematoscelis difficilis

5308



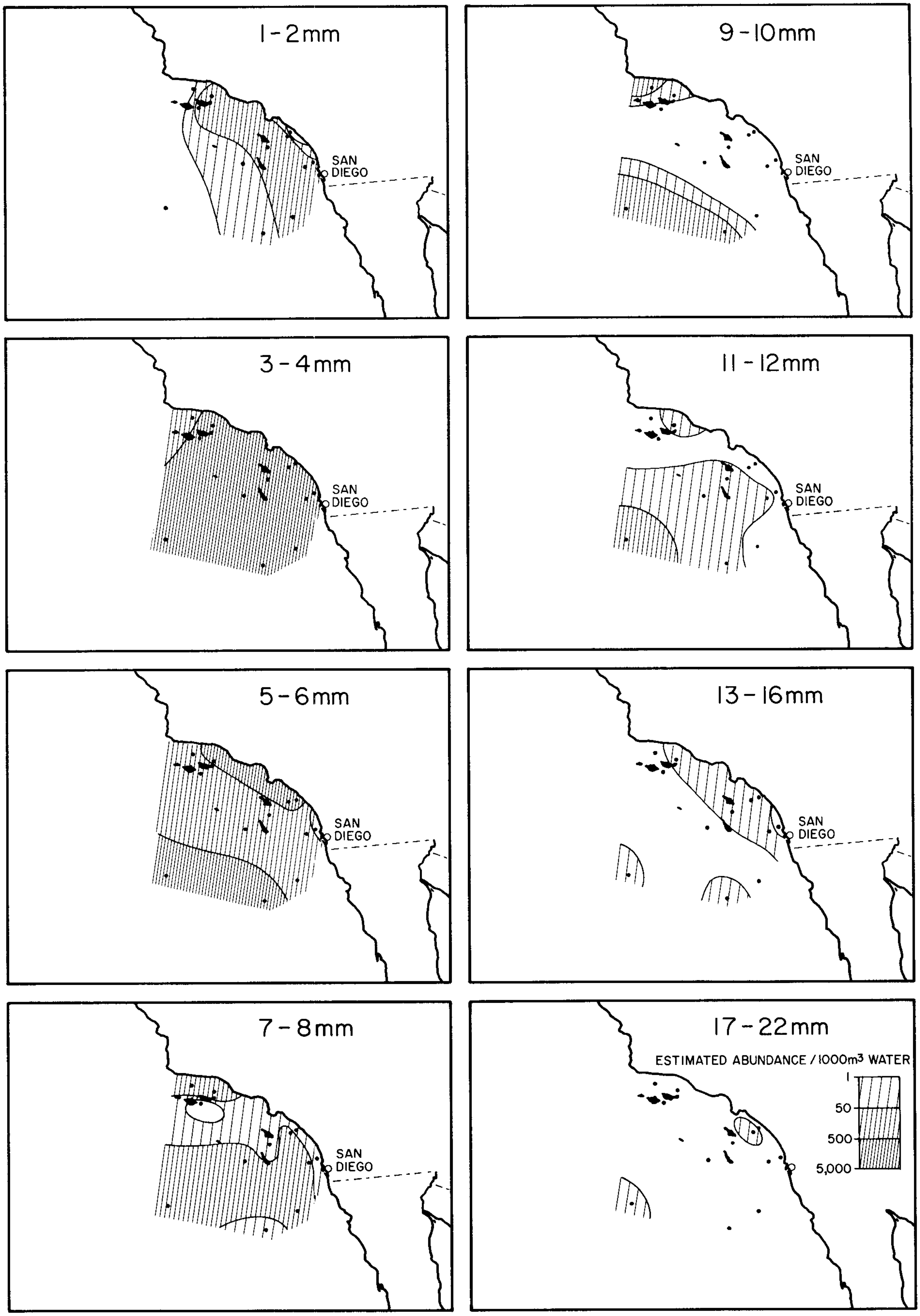
CALCOFI CRUISE 5309

15 - 17 SEPTEMBER 1953

Euphausiacea

Nematoscelis difficilis

5309



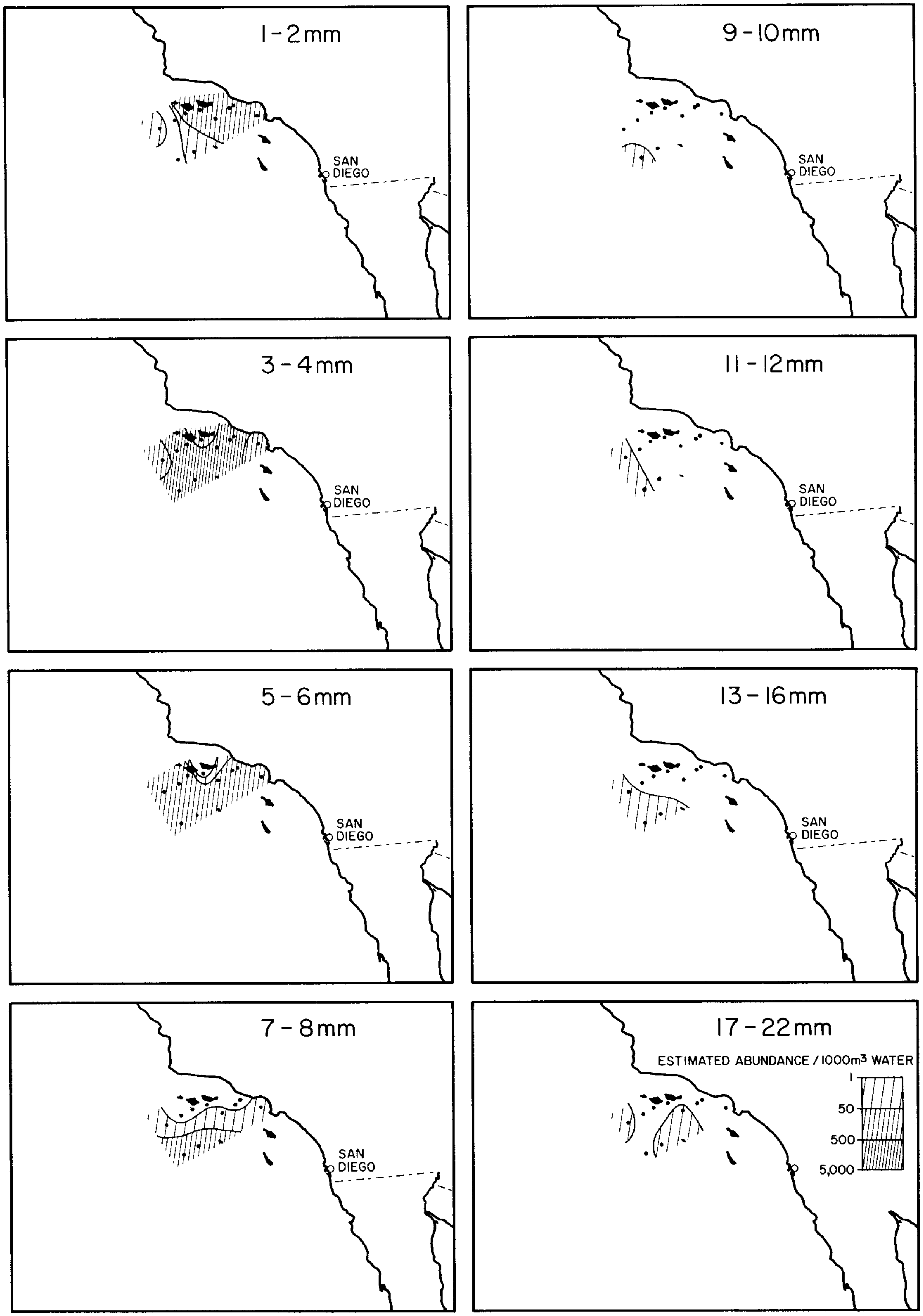
Euphausiacea

CALCOFI CRUISE 5310

19 - 22 OCTOBER 1953

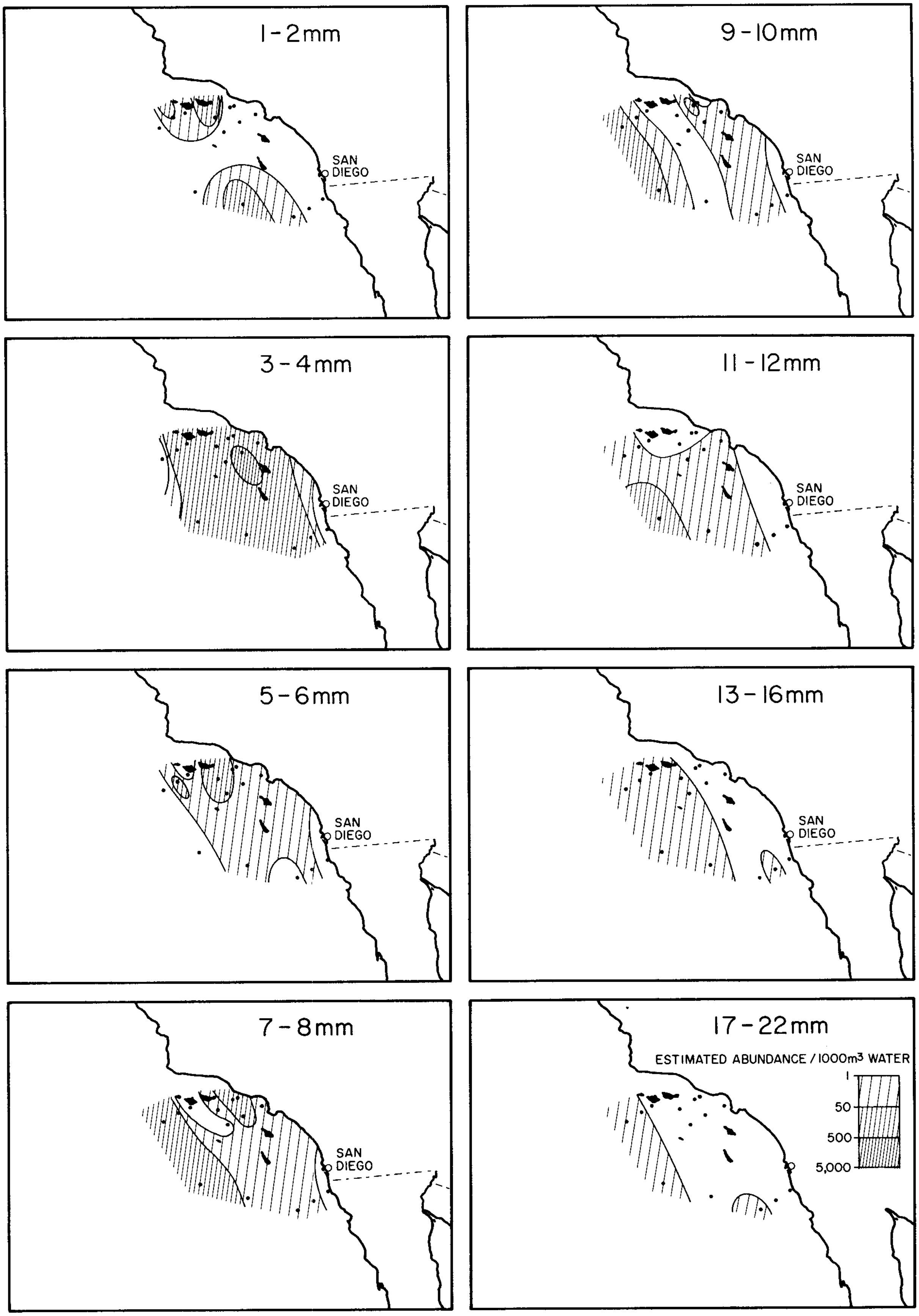
Nematoscelis difficilis

5310



CALCOFI CRUISE 5311
10 - 12 NOVEMBER 1953

Euphausiacea
Nematoscelis difficilis
5311



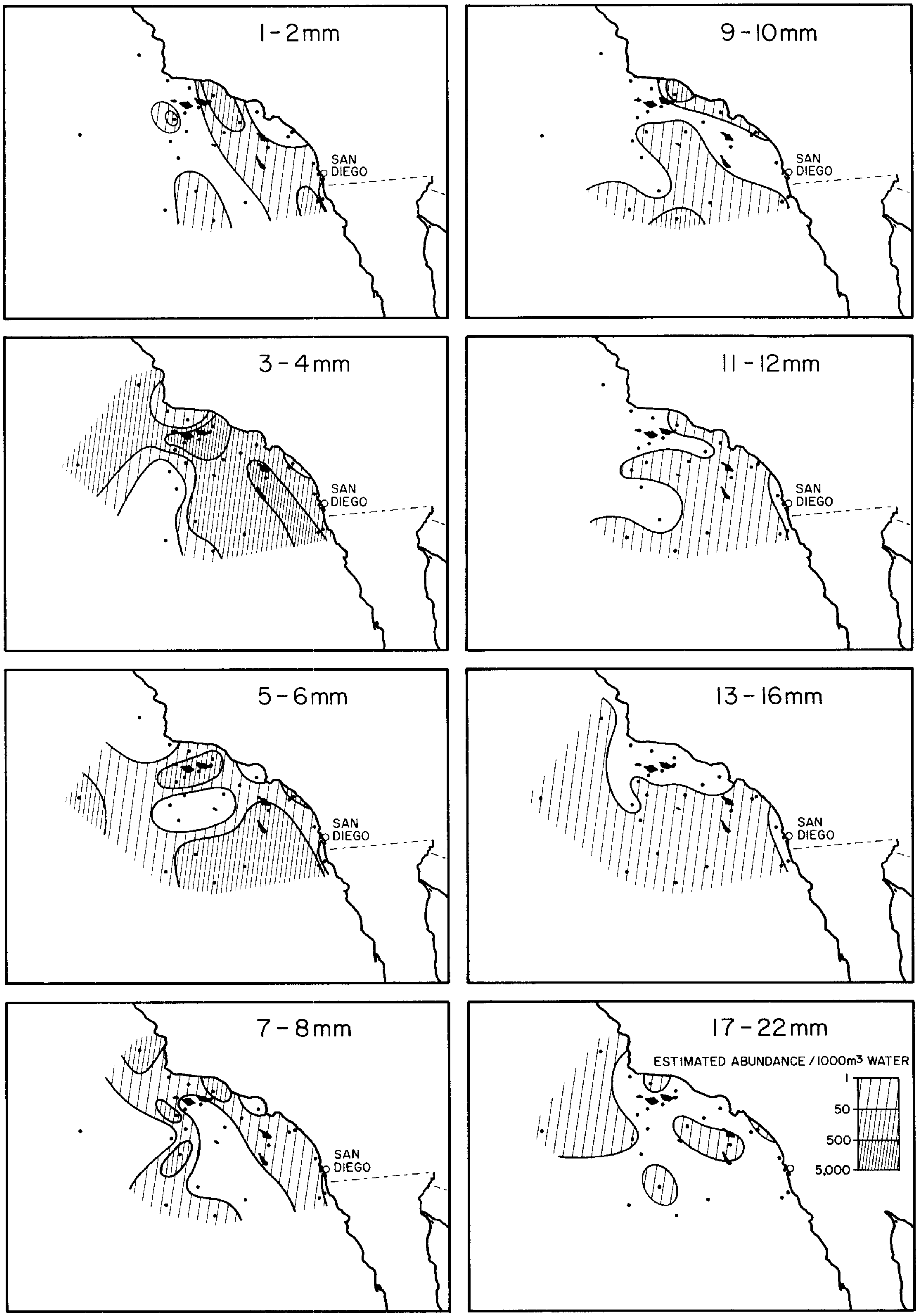
CALCOFI CRUISE 5312

3-9 DECEMBER 1953

Euphausiacea

Nematoscelis difficilis

5312



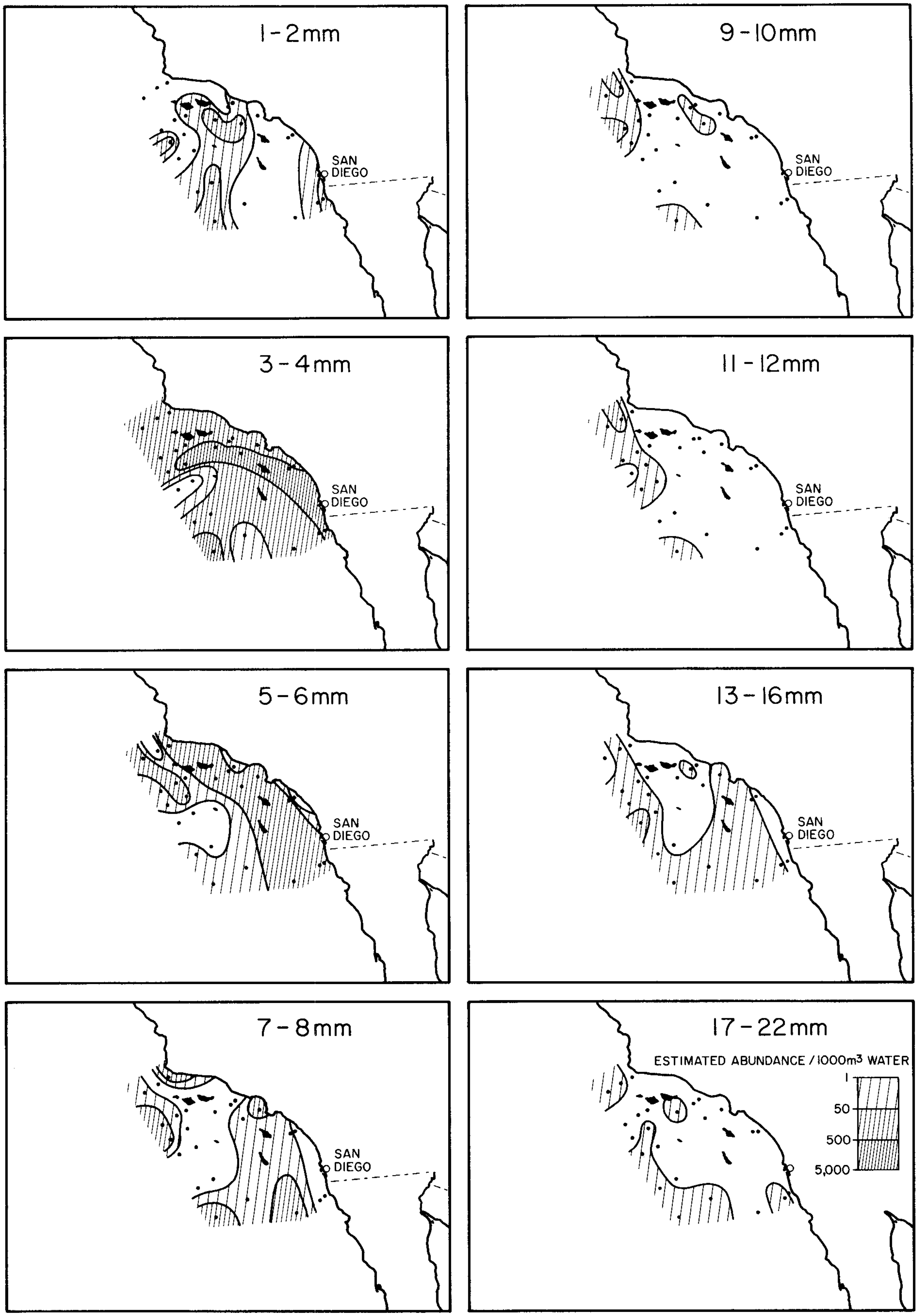
CALCOFI CRUISE 5401

5 - 15 JANUARY 1954

Euphausiacea

Nematoscelis difficilis

5401



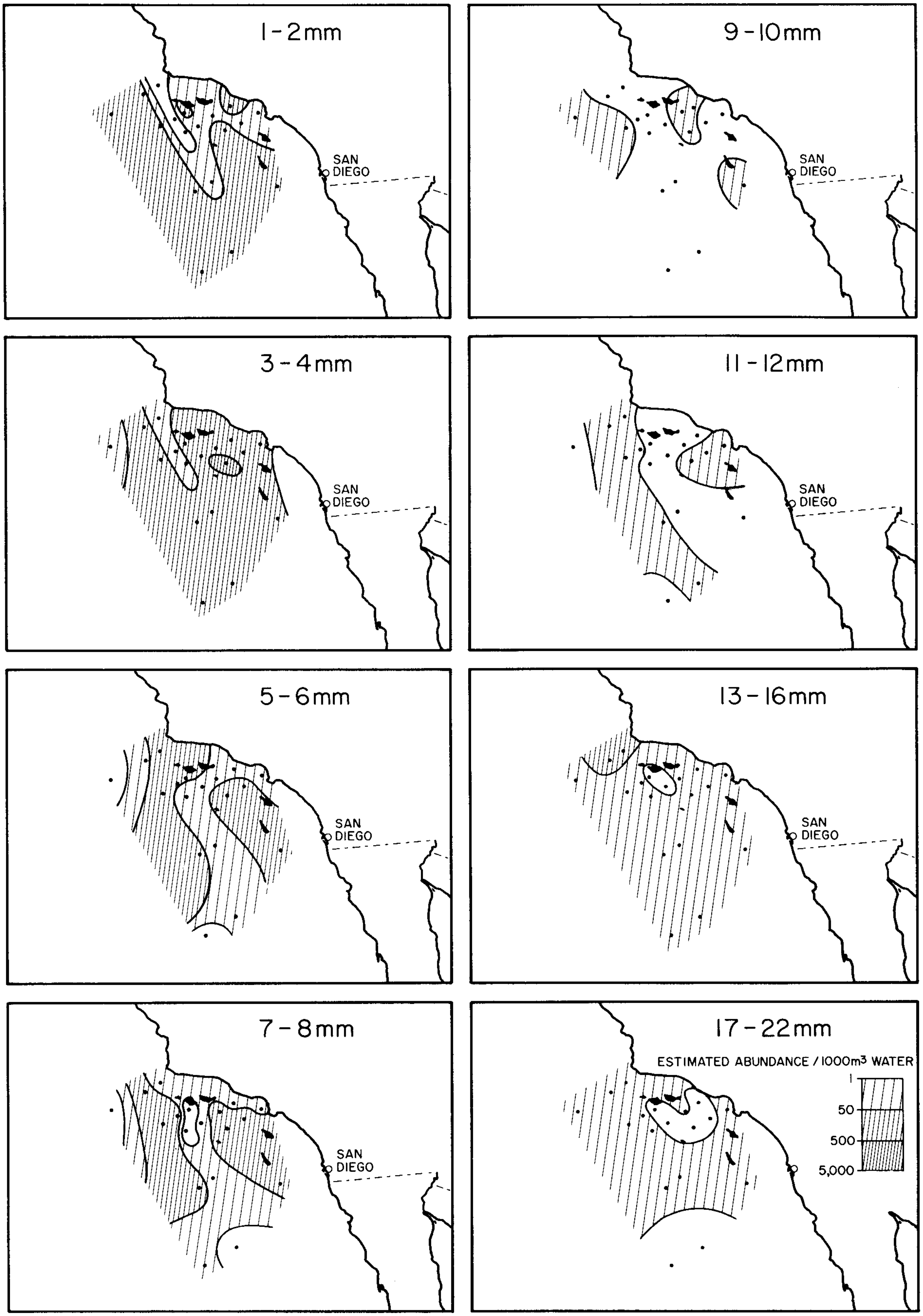
CALCOFI CRUISE 5402

3 - 12 FEBRUARY 1954

Euphausiacea

Nematoscelis difficilis

5402



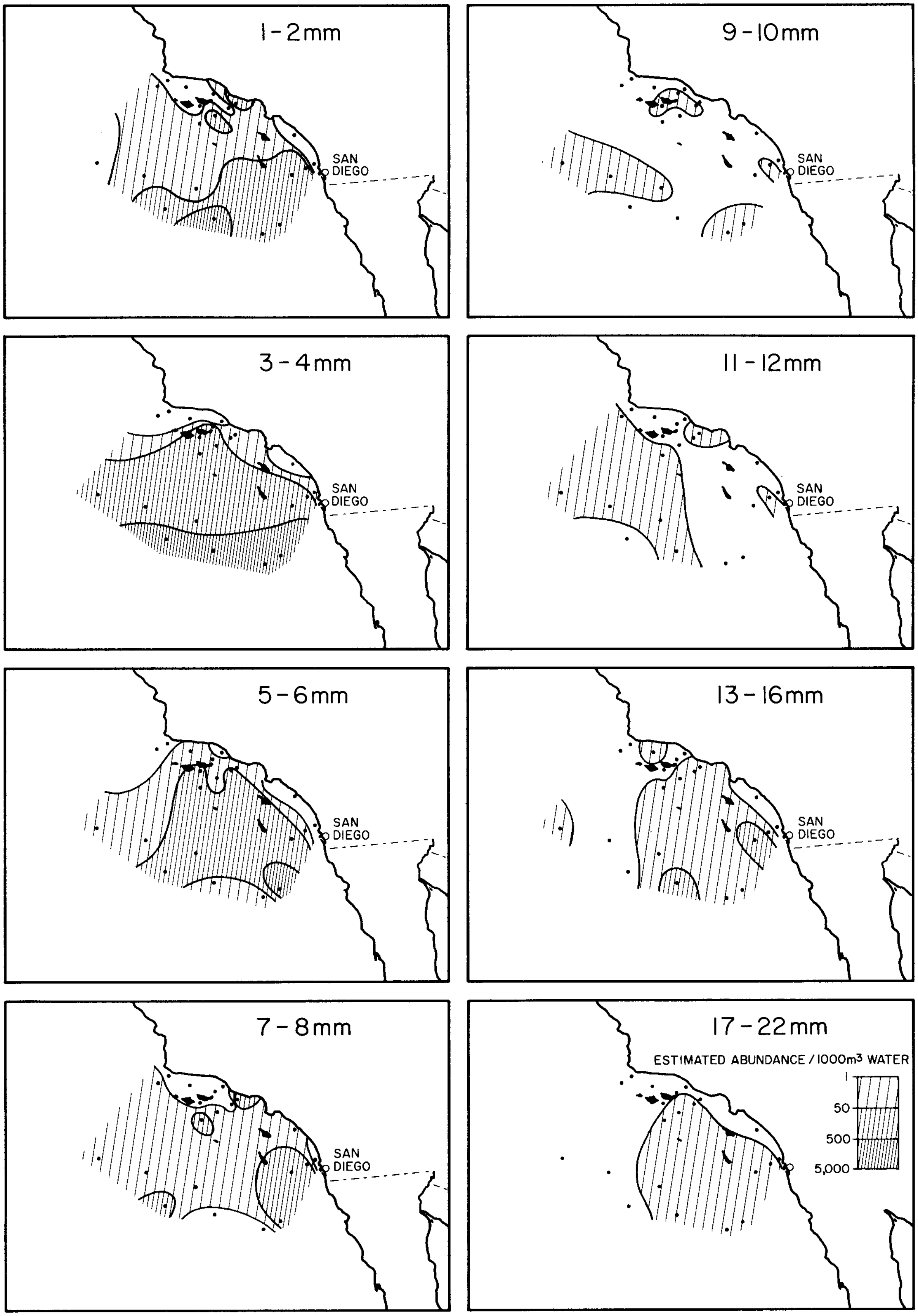
CALCOFI CRUISE 5403

5 - 18 MARCH 1954

Euphausiacea

Nematoscelis difficilis

5403



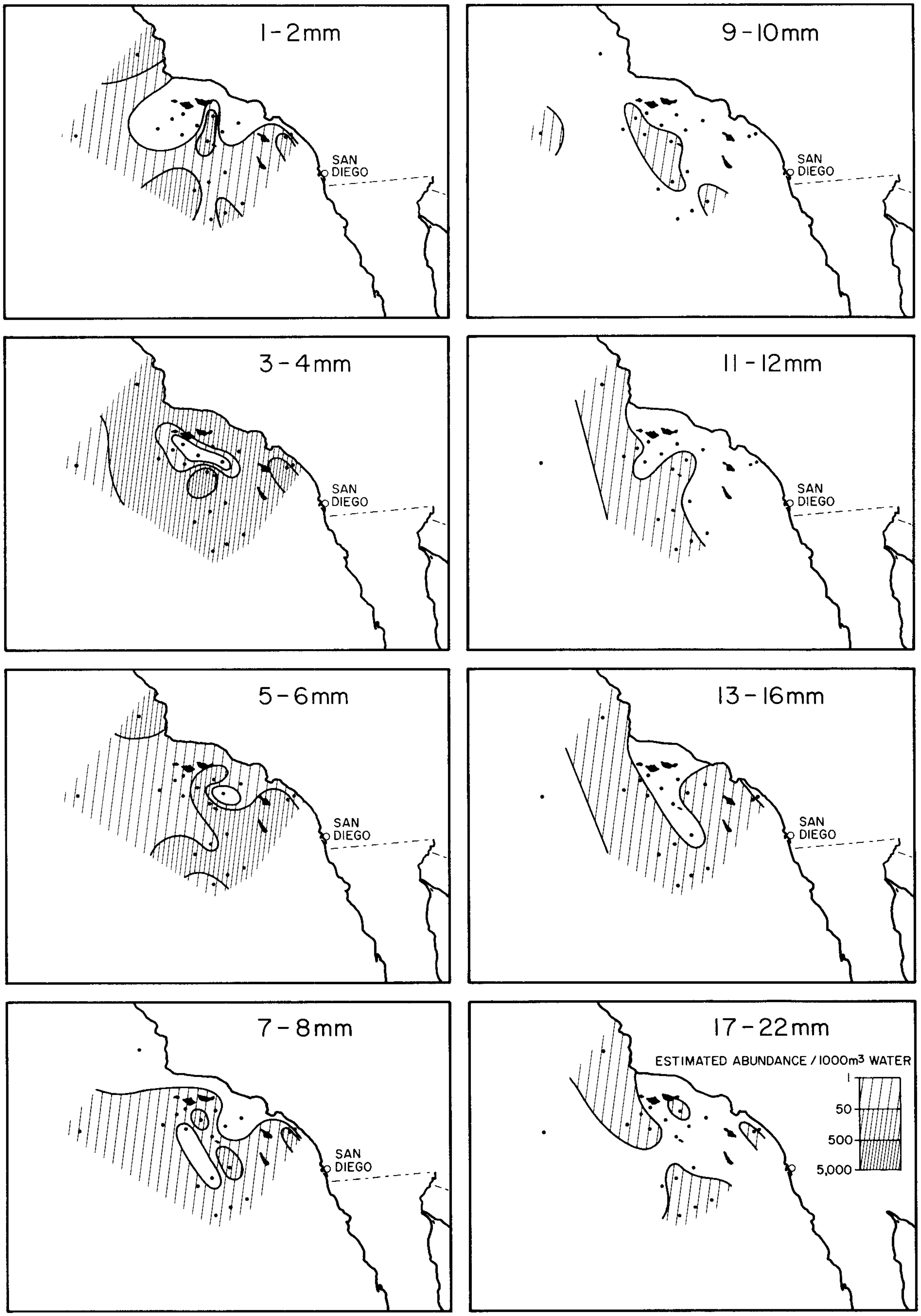
CALCOFI CRUISE 5404

7- 19 APRIL 1954

Euphausiacea

Nematoscelis difficilis

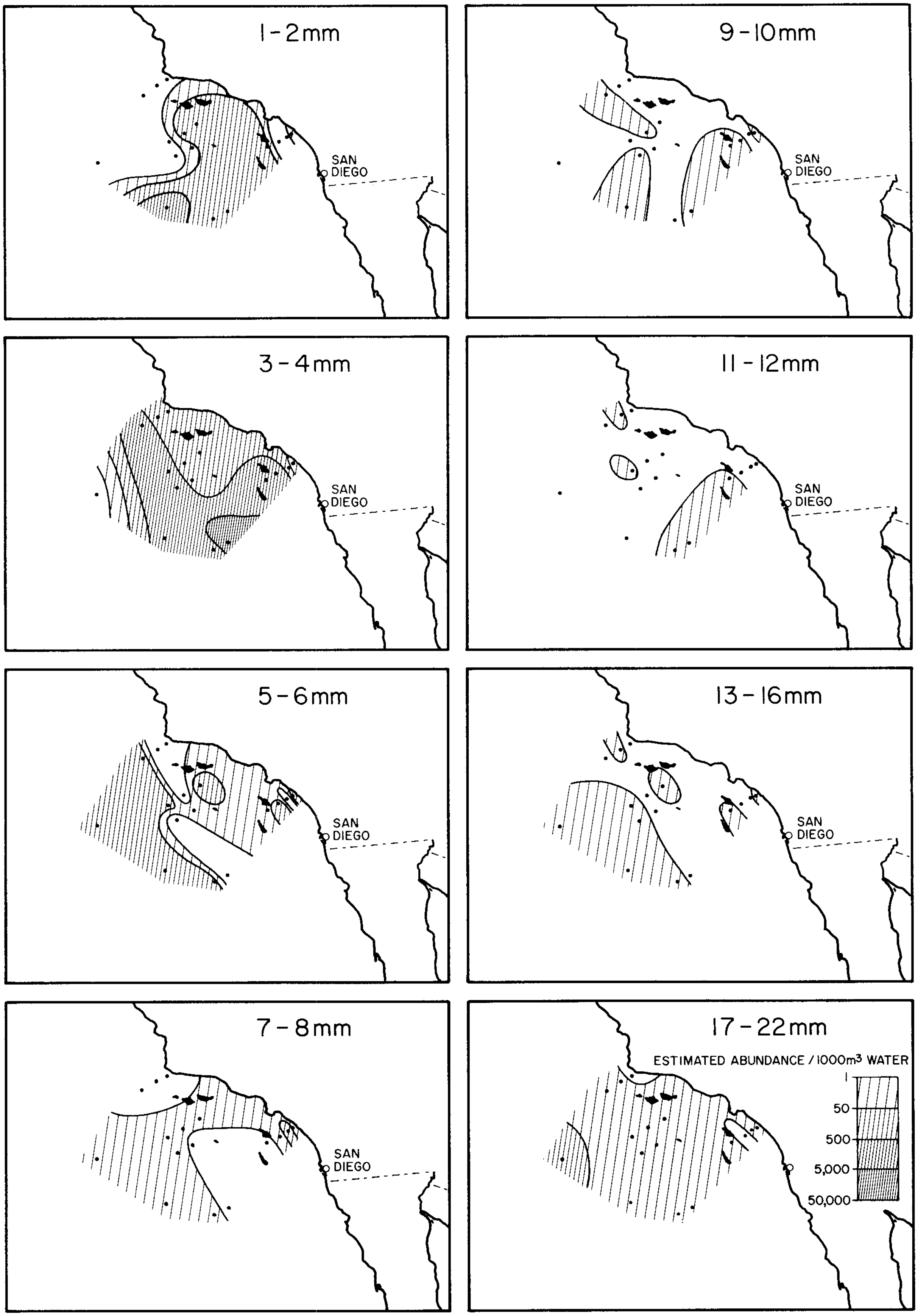
5404



Euphausiacea

CALCOFI CRUISE 5405 *Nematoscelis difficilis*

13 - 22 MAY 1954 5405



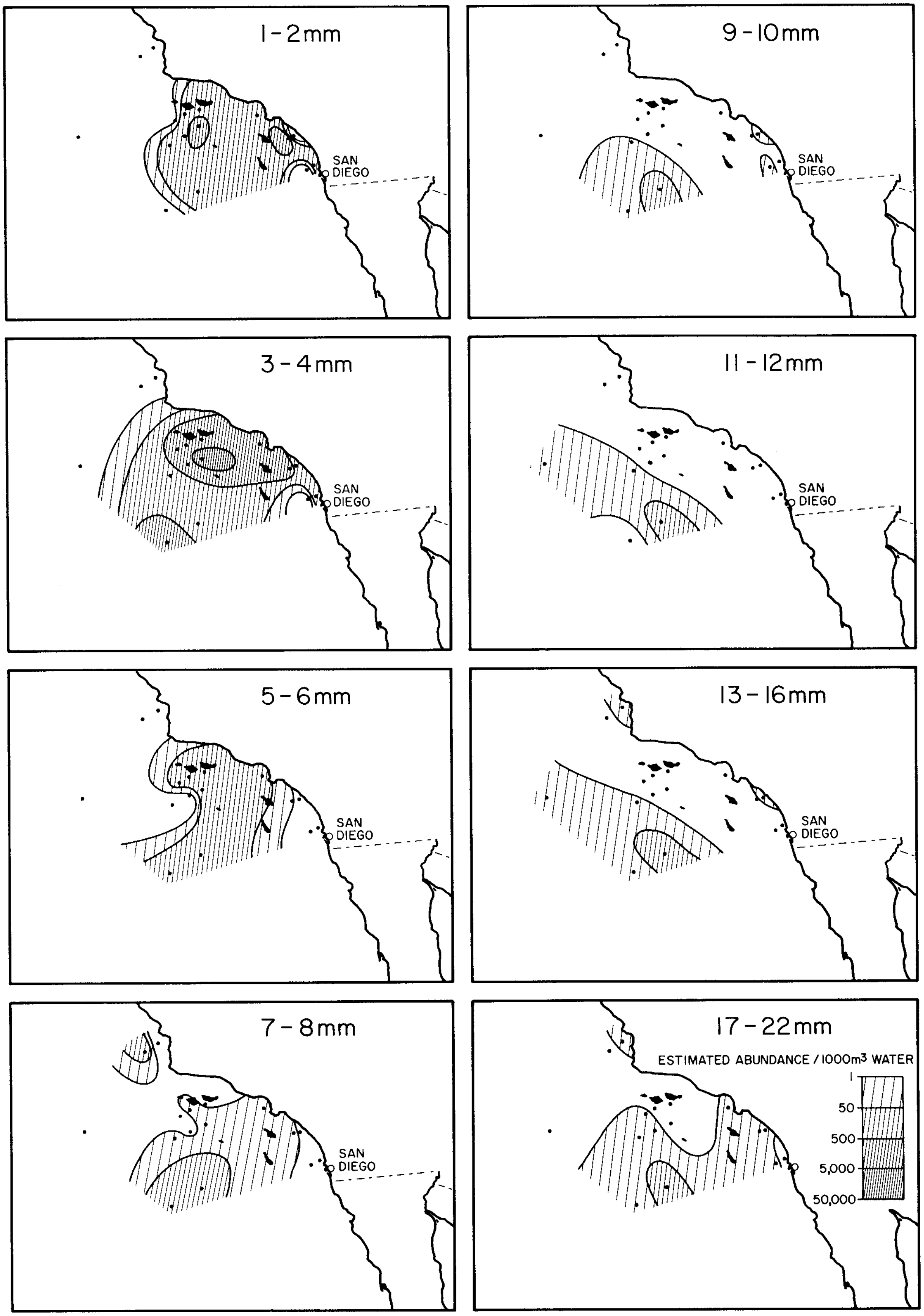
CALCOFI CRUISE 5406

13 - 20 JUNE 1954

Euphausiacea

Nematoscelis difficilis

5406



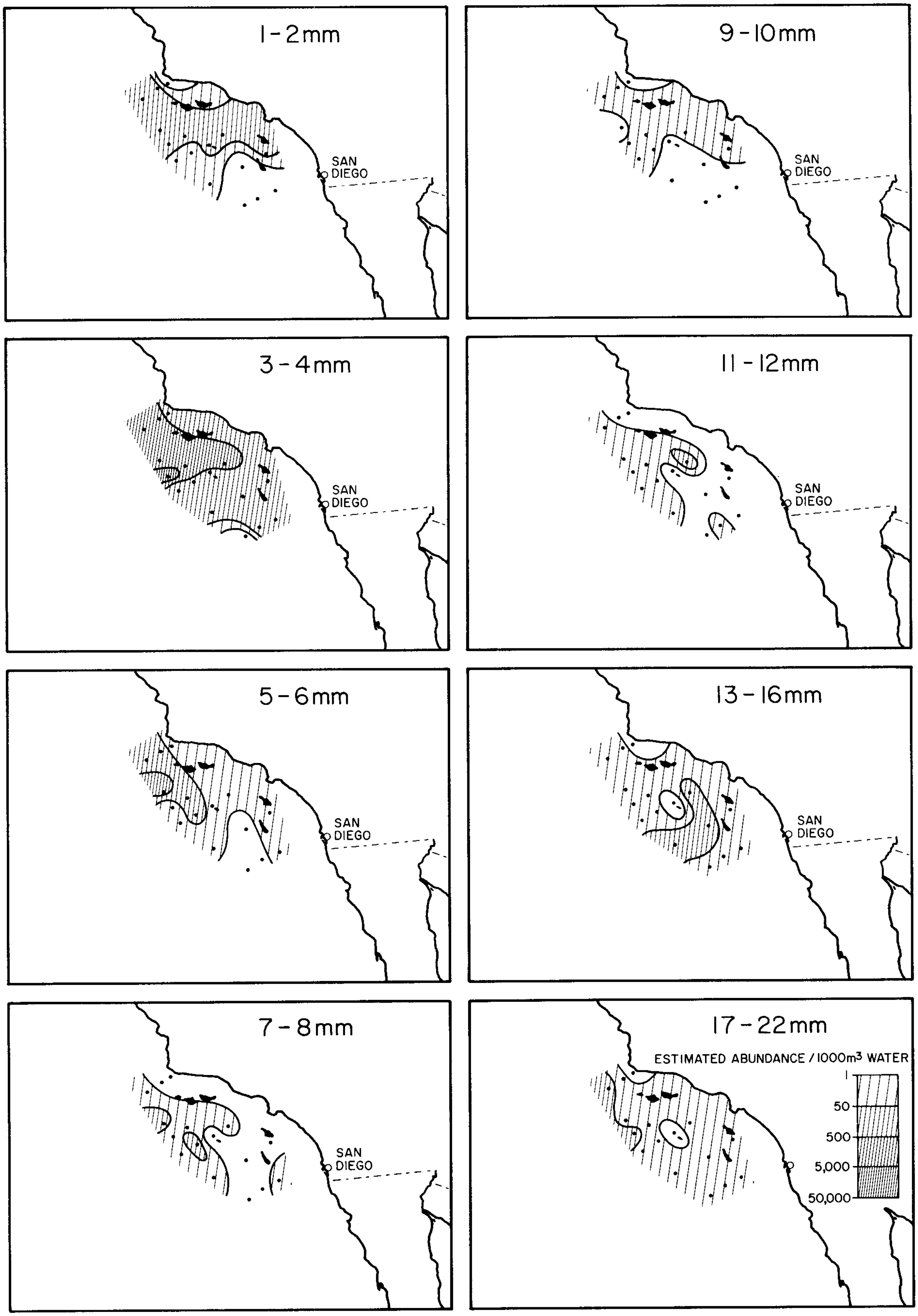
CALCOFI CRUISE 5407

13 - 21 JULY 1954

Euphausiacea

Nematoscelis difficilis

5407



CALCOFI CRUISE 5408

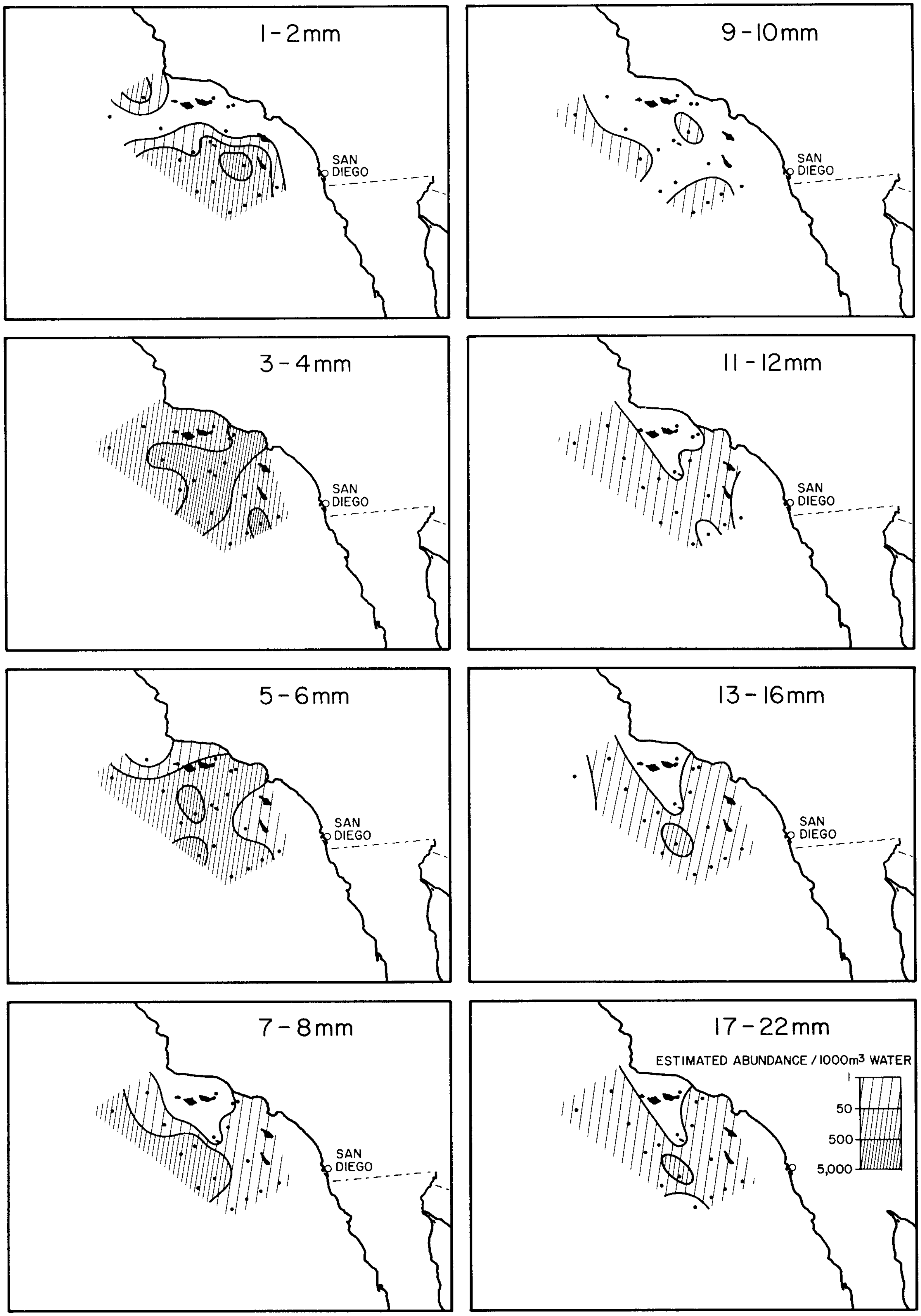
4-9 SEPTEMBER 1954

MAIN PORTION OF CRUISE OCCUPIED IN AUGUST

Euphausiacea

Nematoscelis difficilis

5408



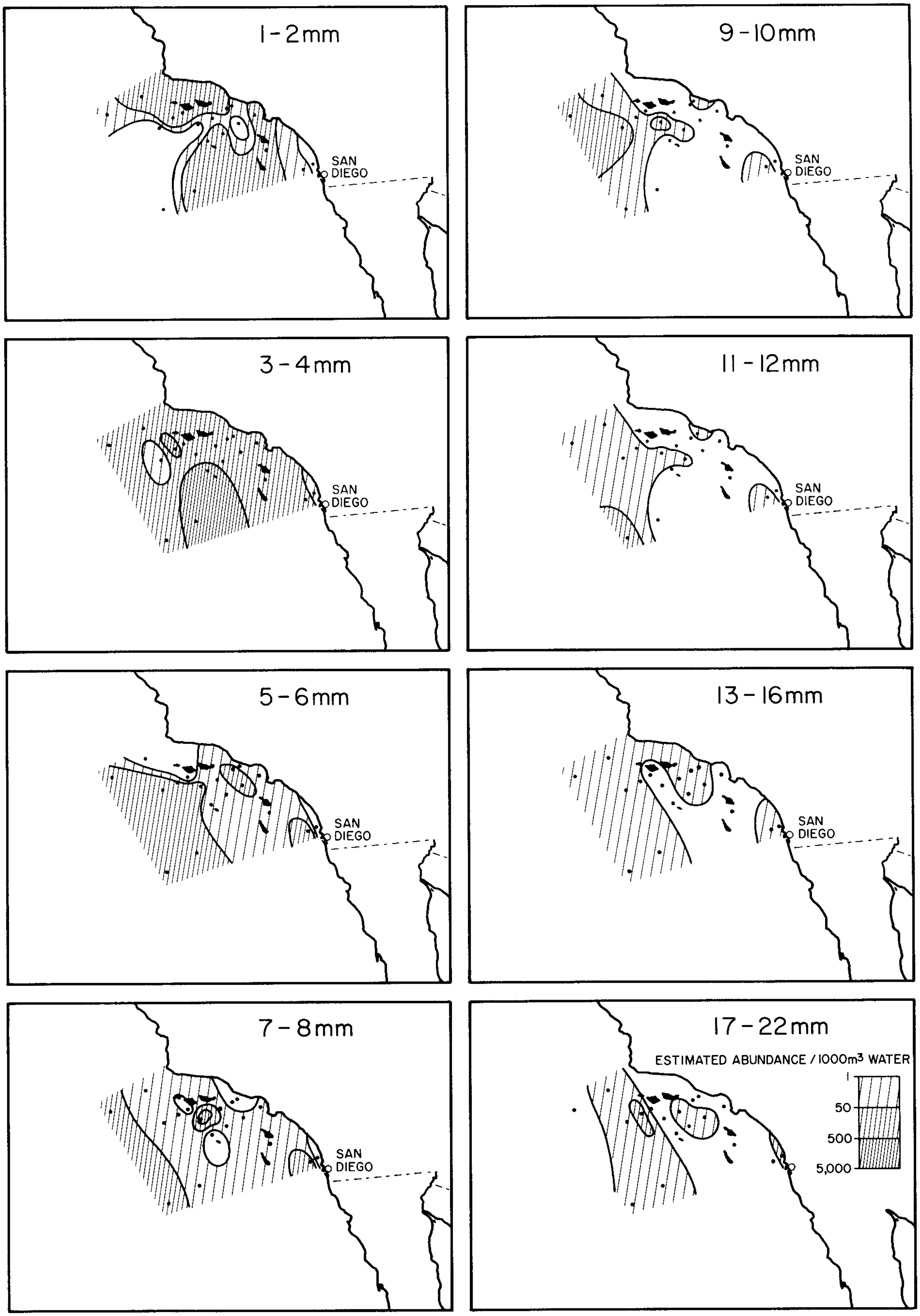
CALCOFI CRUISE 5410

7 - 14 OCTOBER 1954

Euphausiacea

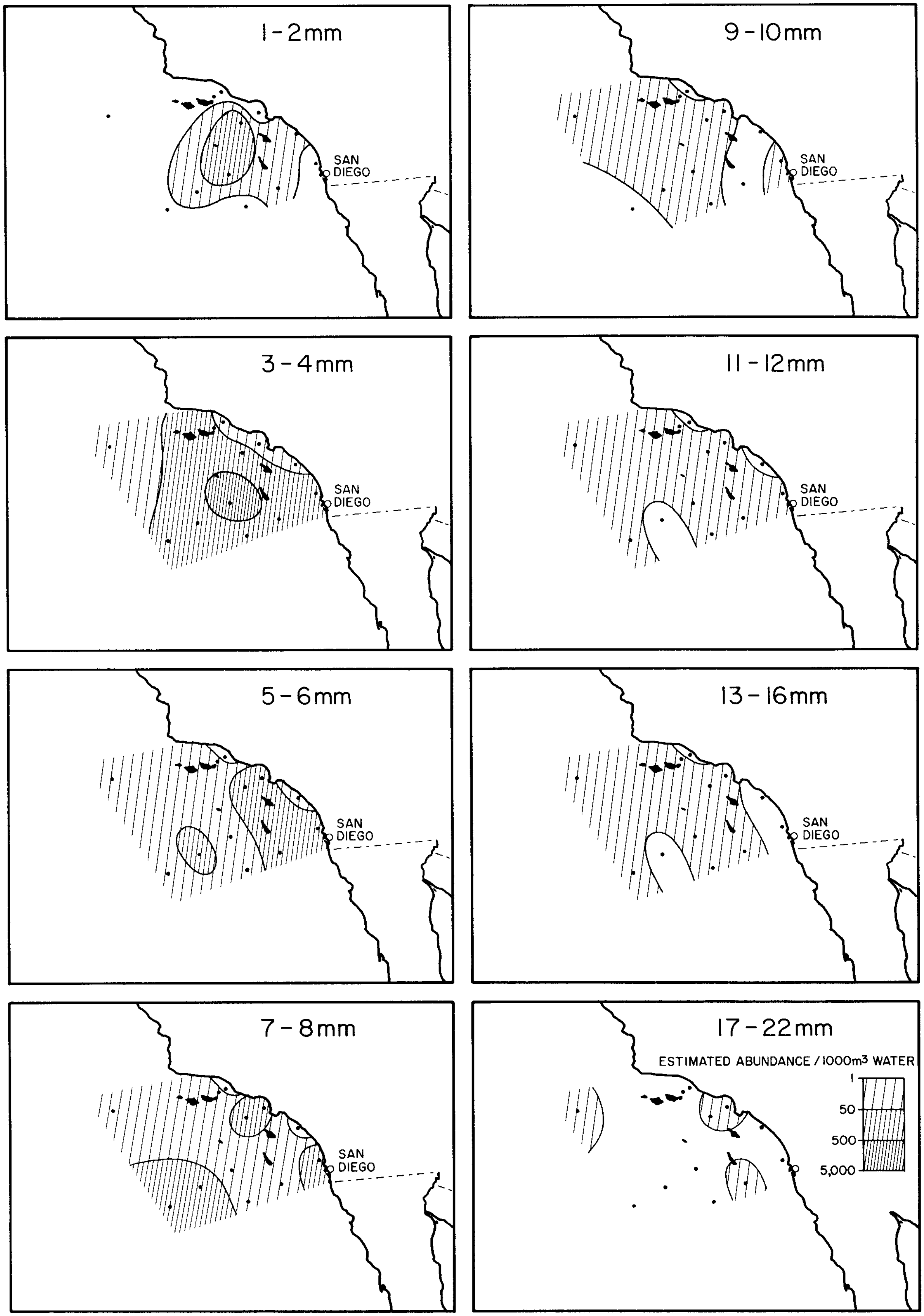
Nematoscelis difficilis

5410



CALCOFI CRUISE 5412
2-9 DECEMBER 1954

Euphausiacea
Nematoscelis difficilis
5412



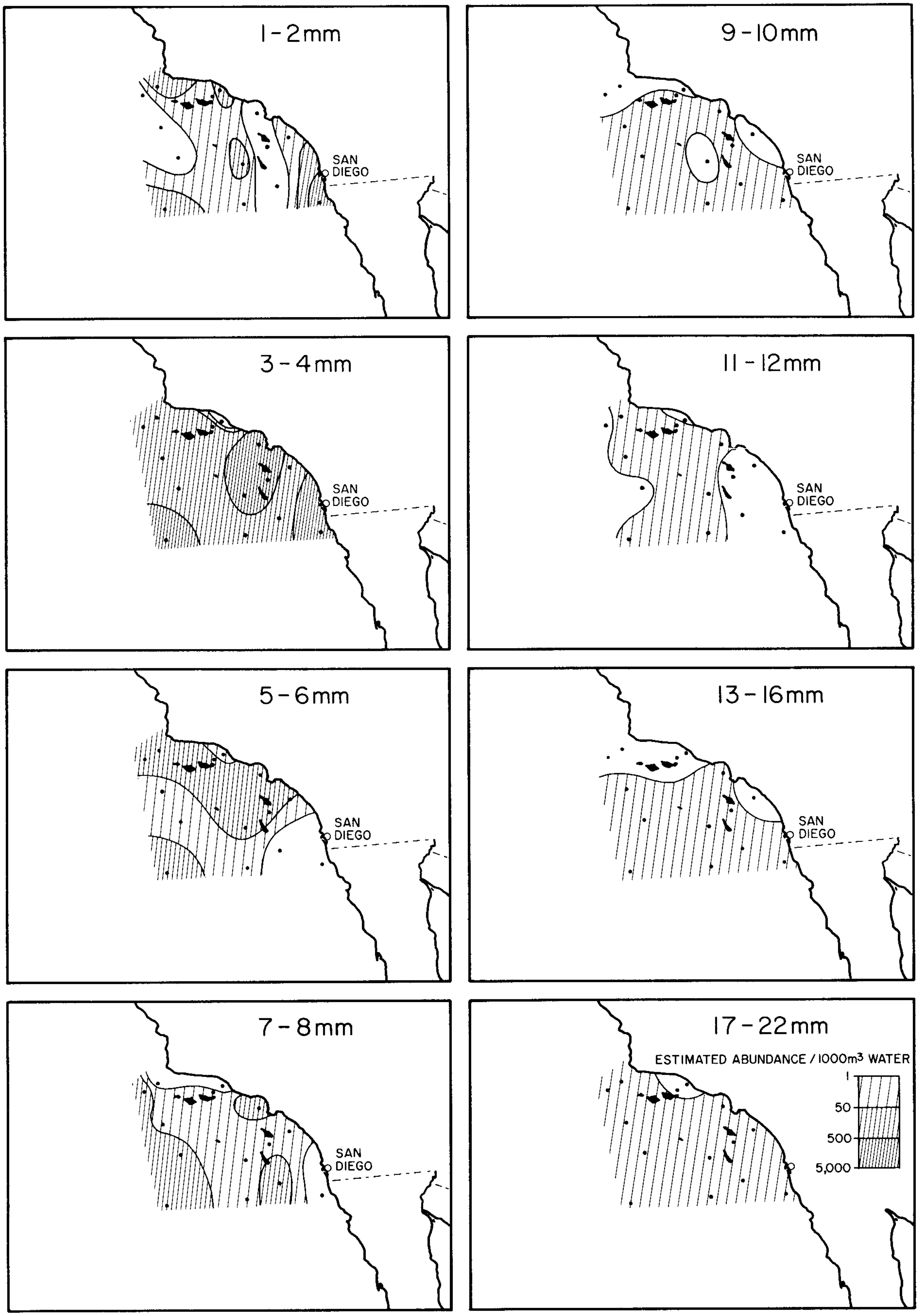
CALCOFI CRUISE 5501

13– 19 JANUARY 1955

Euphausiacea

Nematoscelis difficilis

5501



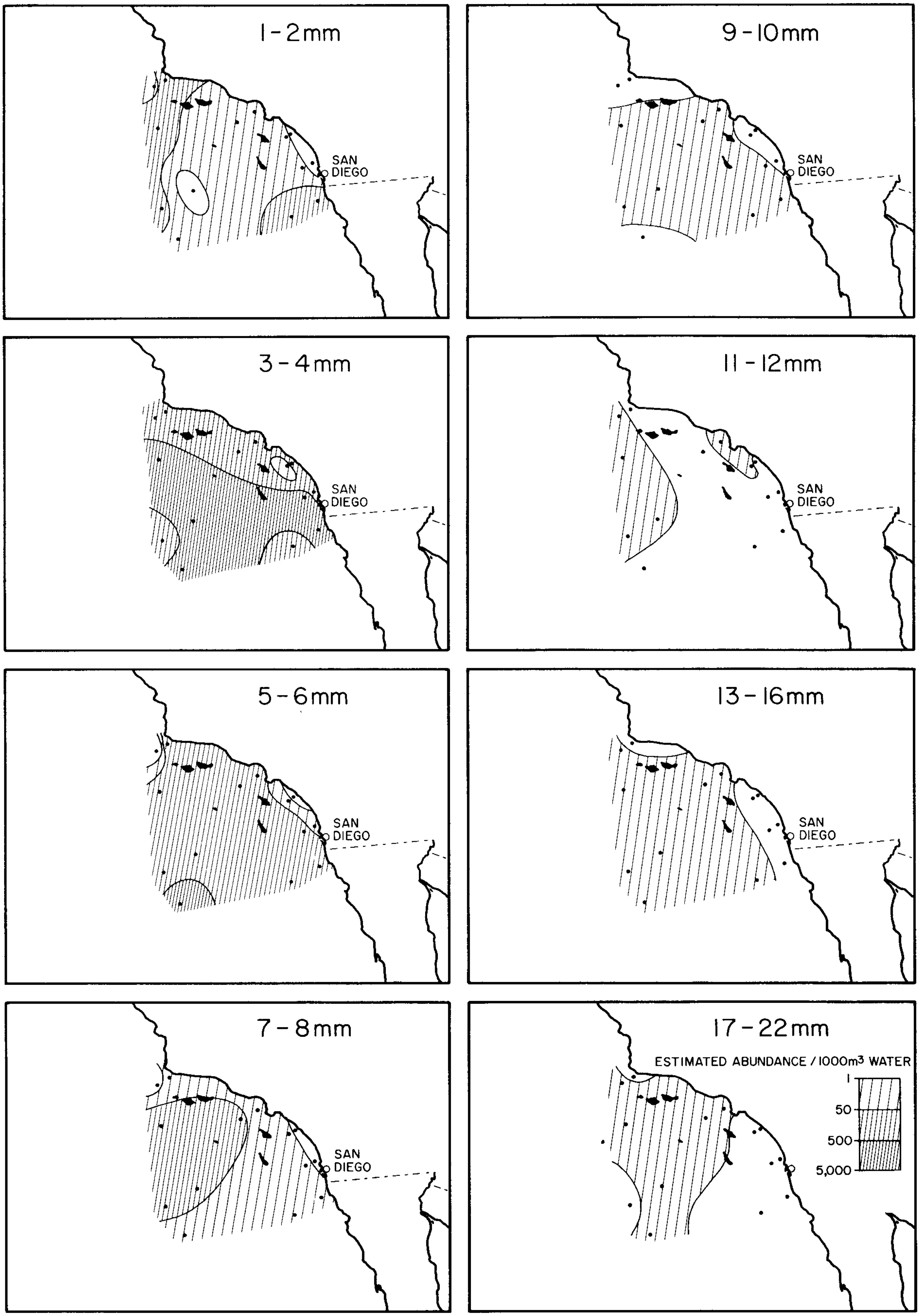
CALCOFI CRUISE 5502

11-17 FEBRUARY 1955

Euphausiacea

Nematoscelis difficilis

5502



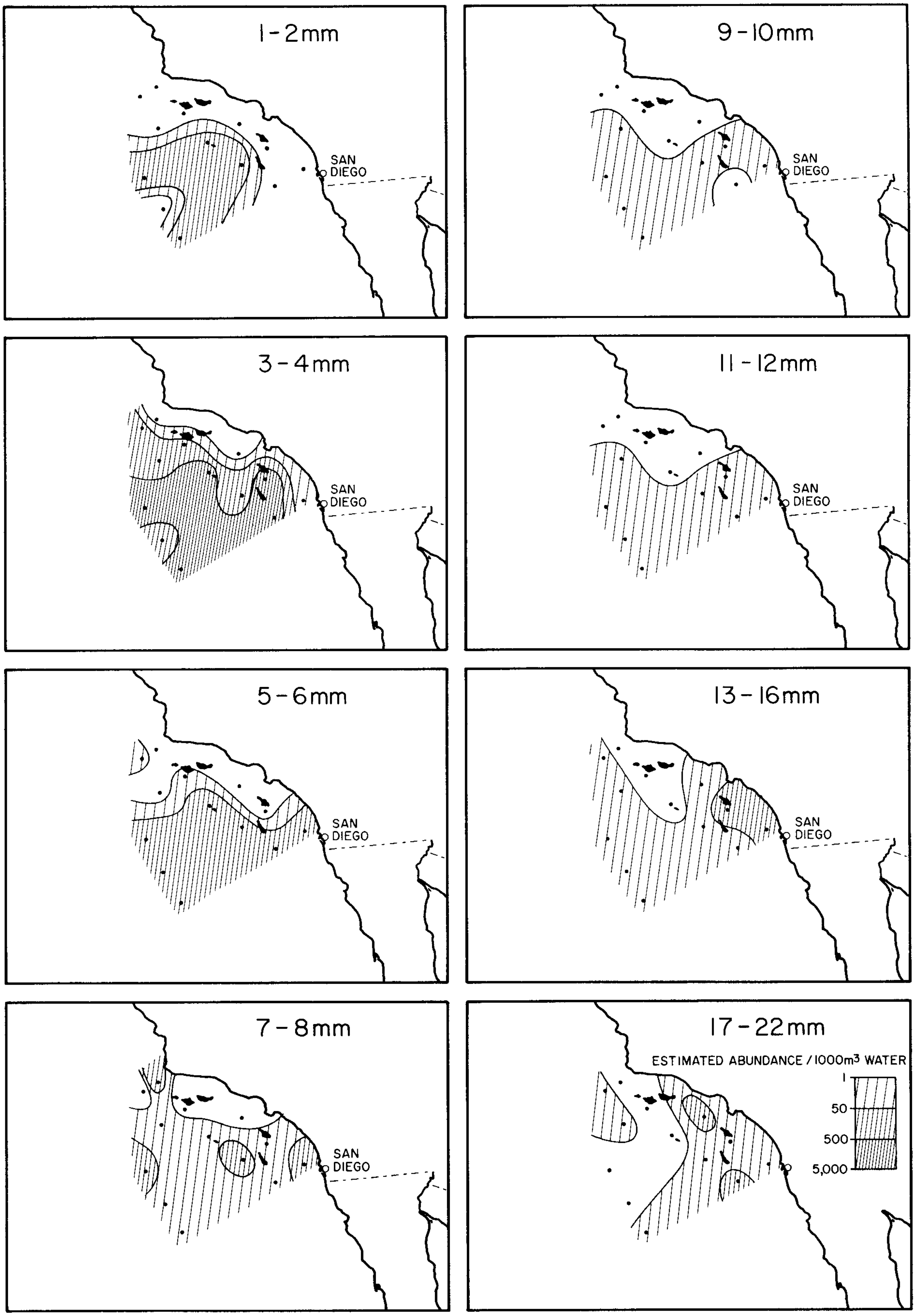
CALCOFI CRUISE 5503

8-16 MARCH 1955

Euphausiacea

Nematoscelis difficilis

5503



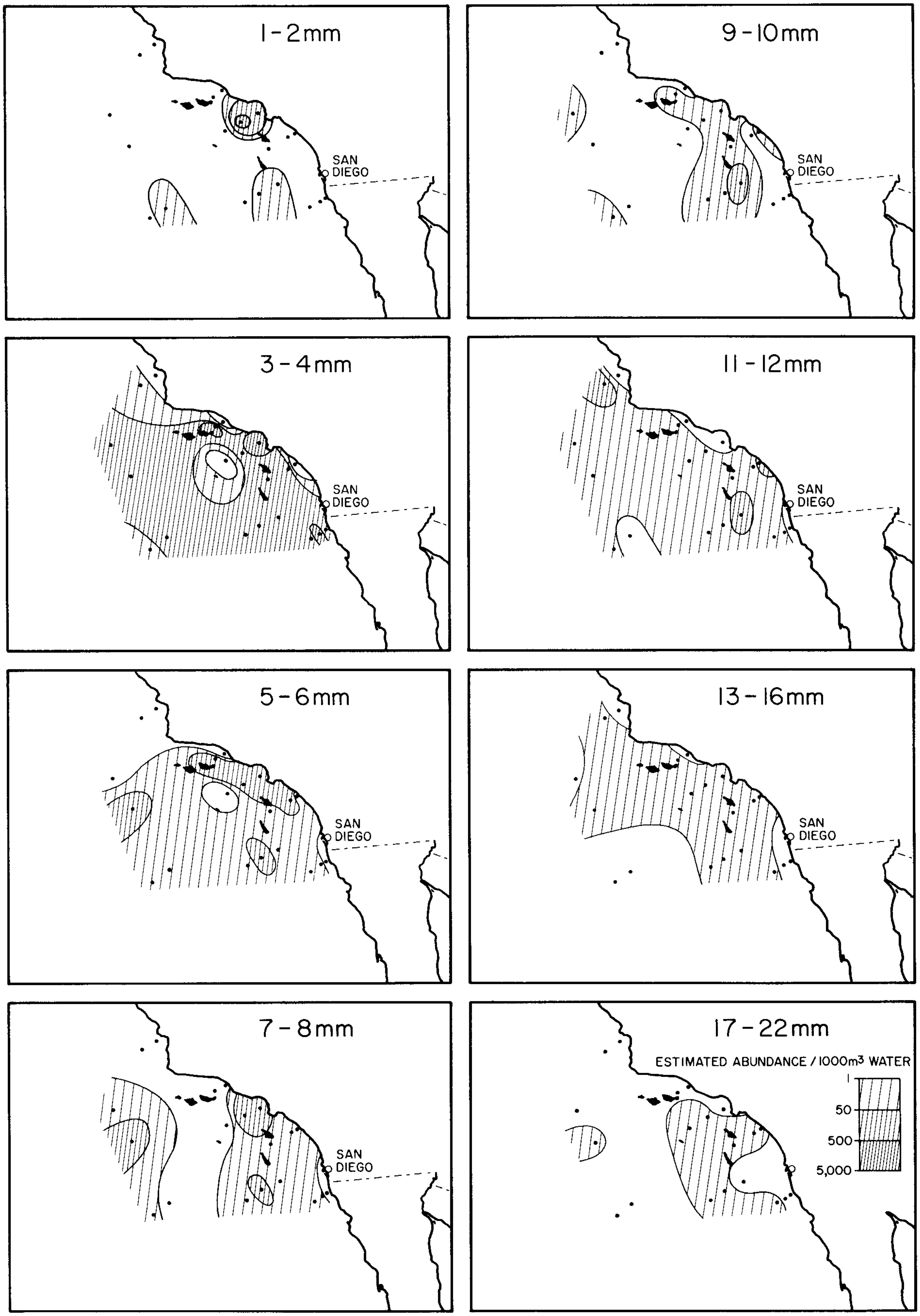
CALCOFI CRUISE 5504

7-16 APRIL 1955

Euphausiacea

Nematoscelis difficilis

5504



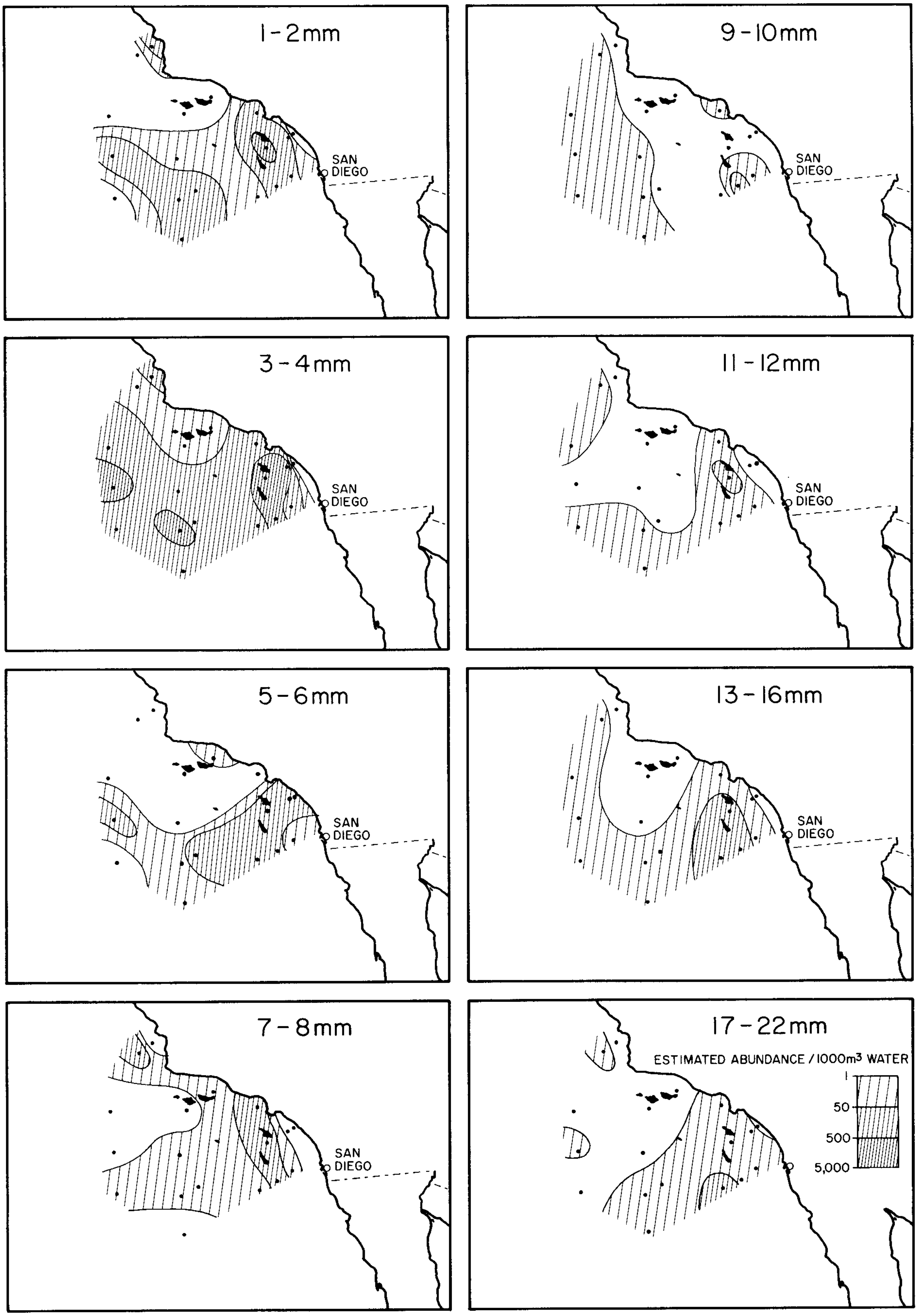
CALCOFI CRUISE 5505

21 MAY - 6 JUNE 19

Euphausiacea

Nematoscelis difficilis

5505



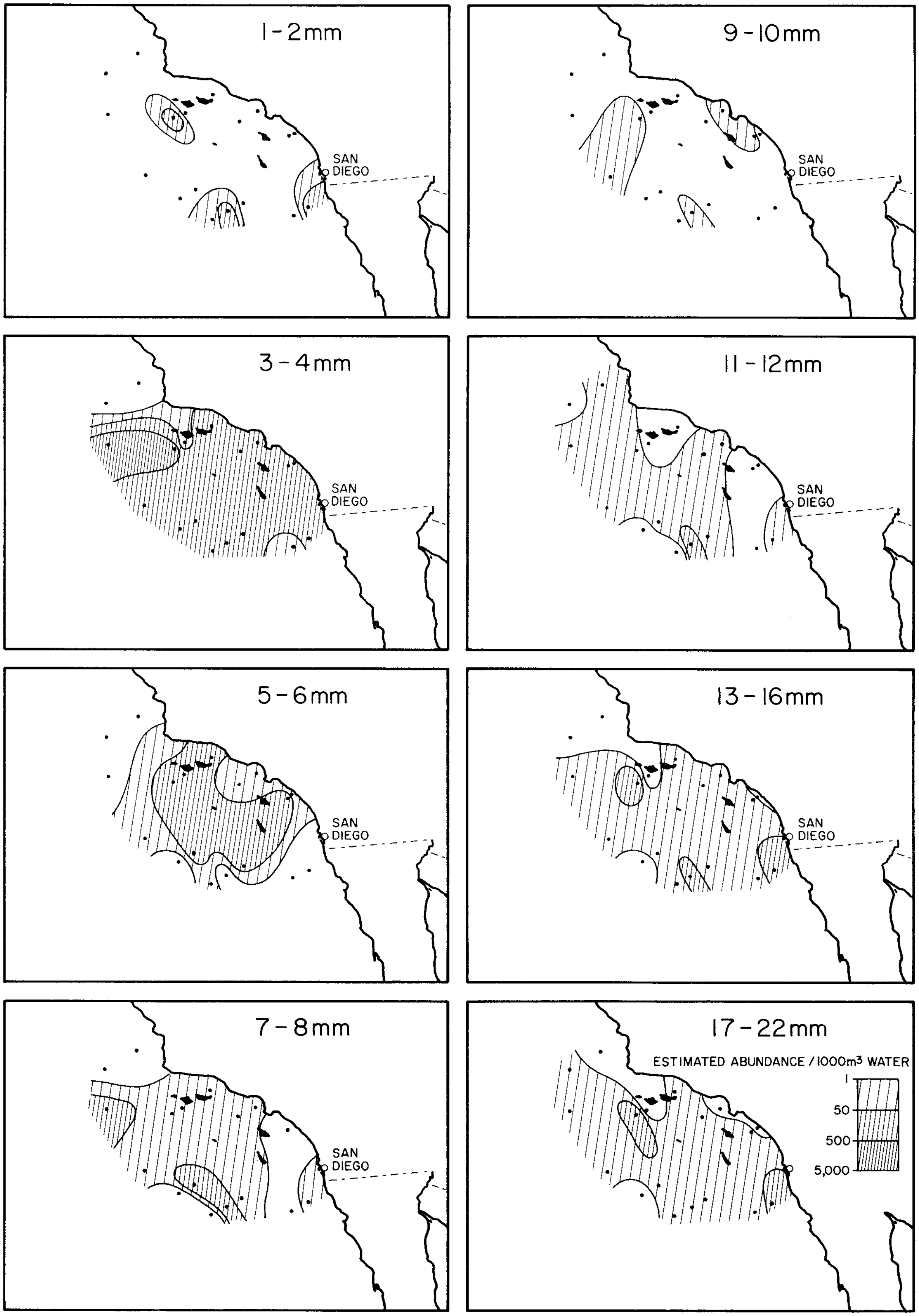
CALCOFI CRUISE 5506

11 - 20 JUNE 1955

Euphausiacea

Nematoscelis difficilis

5506



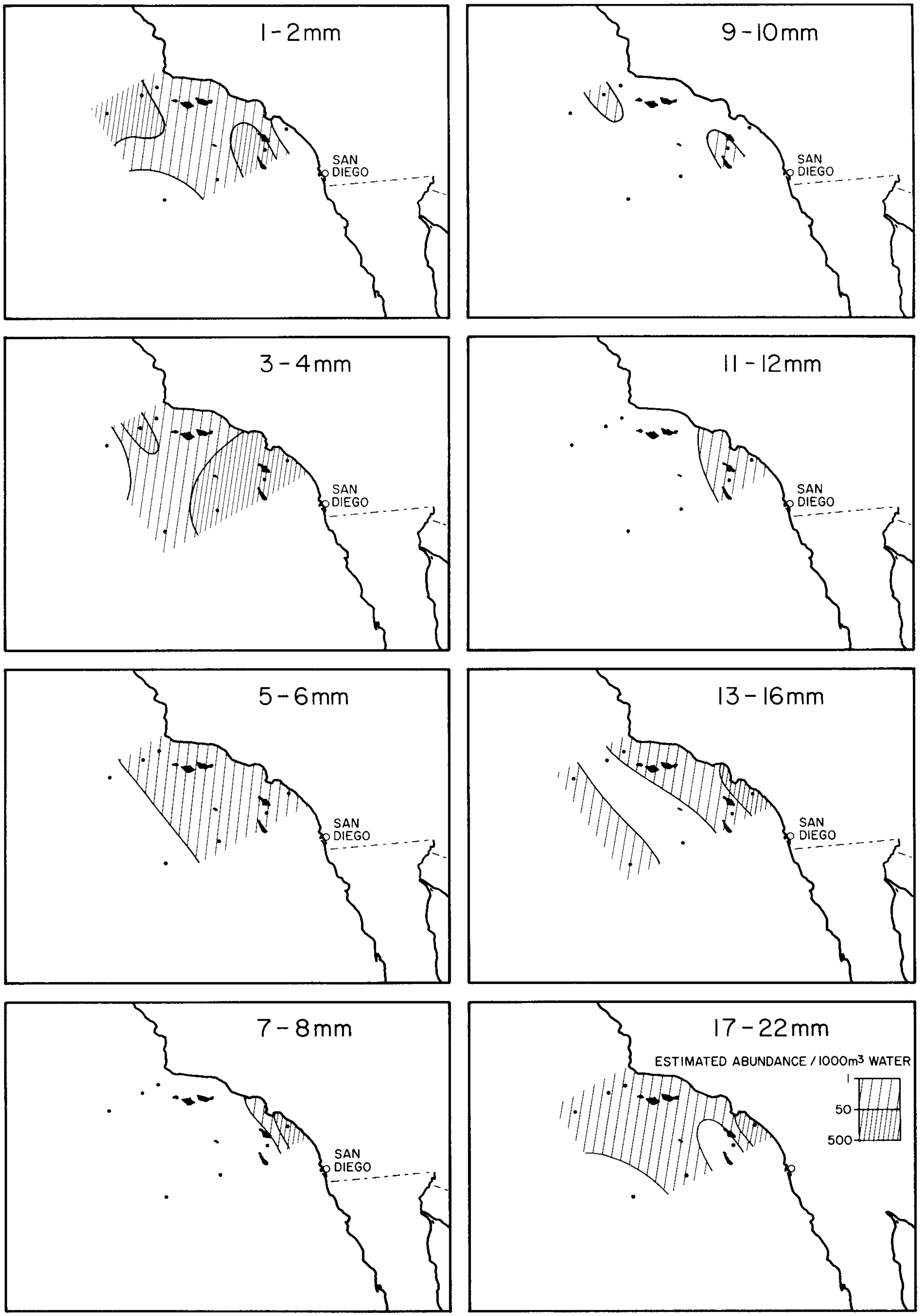
Euphausiacea

CALCOFI CRUISE 5507

7-13 JULY 1955

Nematoscelis difficilis

5507



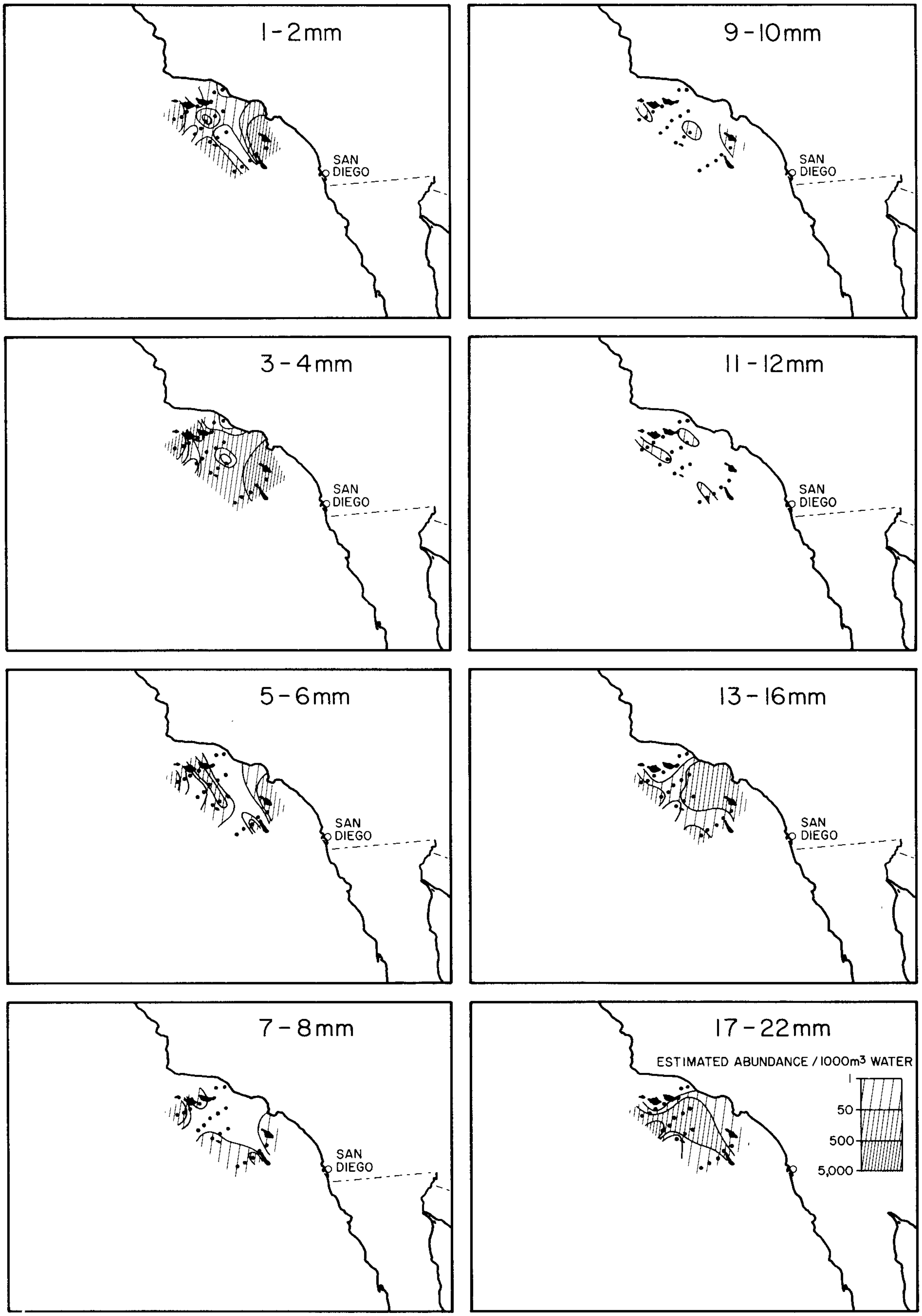
CALCOFI CRUISE 5508 'NORPAC'

4 - 6 SEPTEMBER 1955
MAIN PORTION OF CRUISE OCCUPIED IN AUGUST

Euphausiacea

Nematoscelis difficilis

5508 'NORPAC'



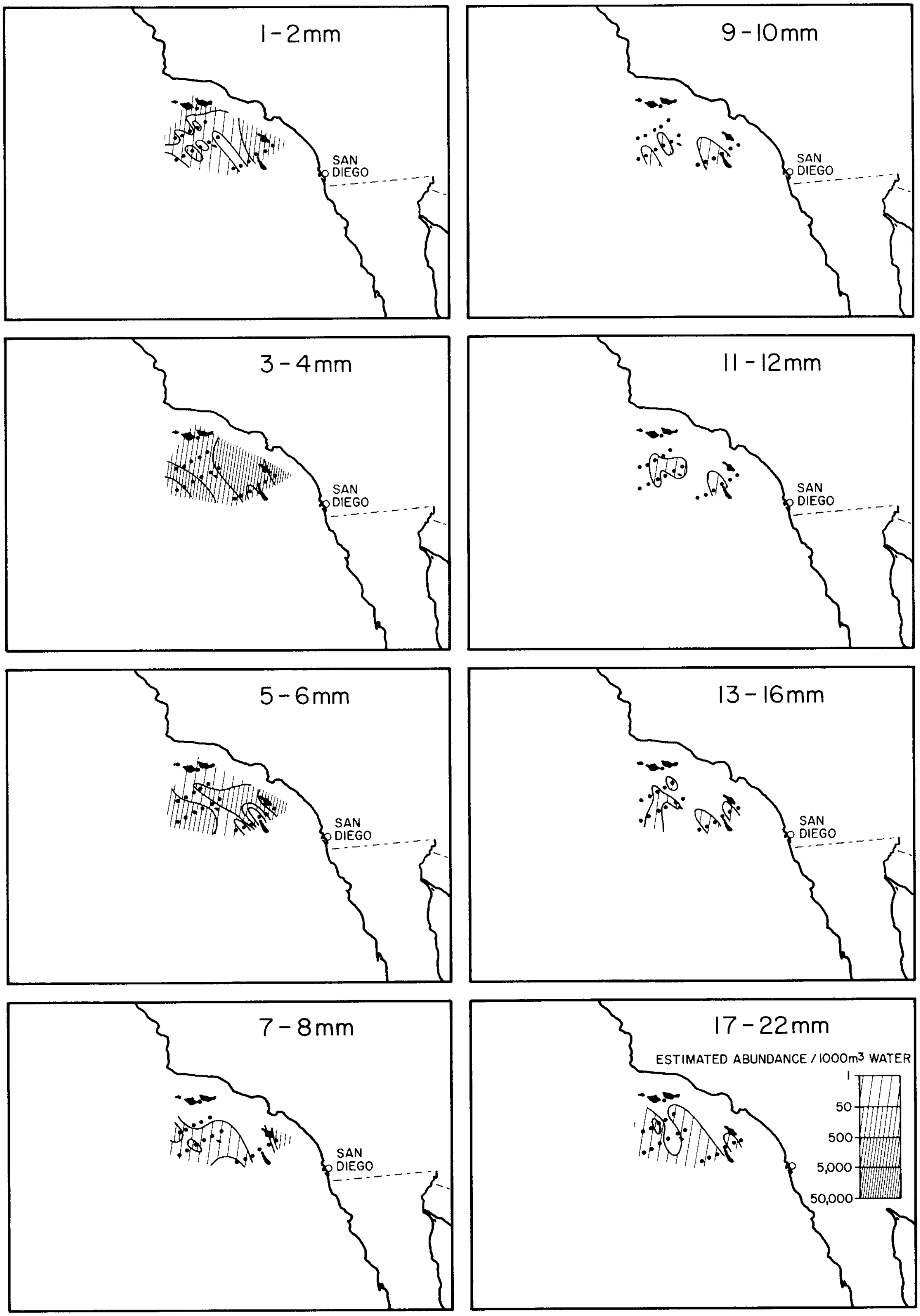
Euphausiacea

CALCOFI CRUISE 5509-I

Nematoscelis difficilis

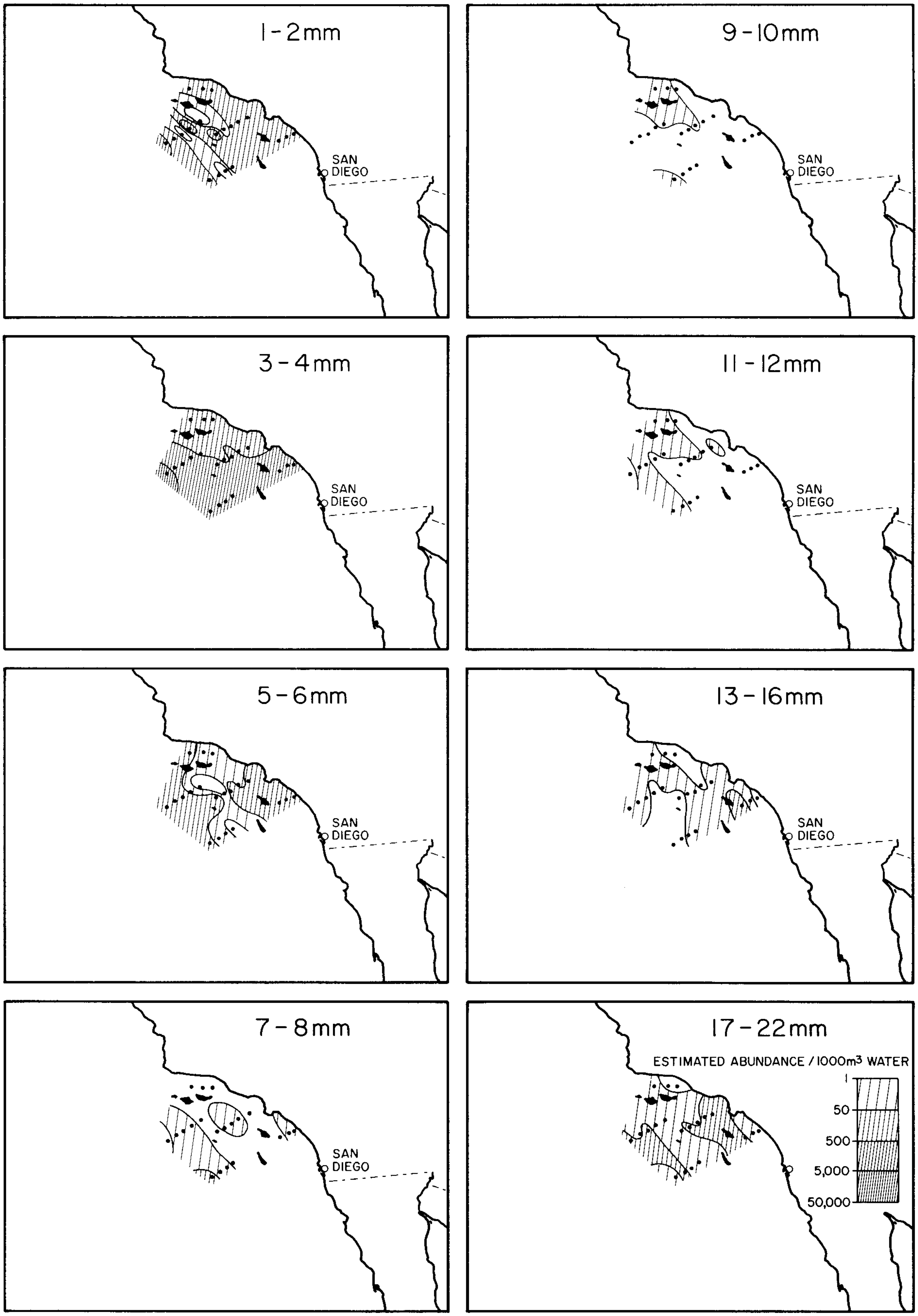
12-17 SEPTEMBER 1955

5509-I



CALCOFI CRUISE 5509 - II
15 - 19 SEPTEMBER 1955

Euphausiacea
Nematoscelis difficilis
5509 - II



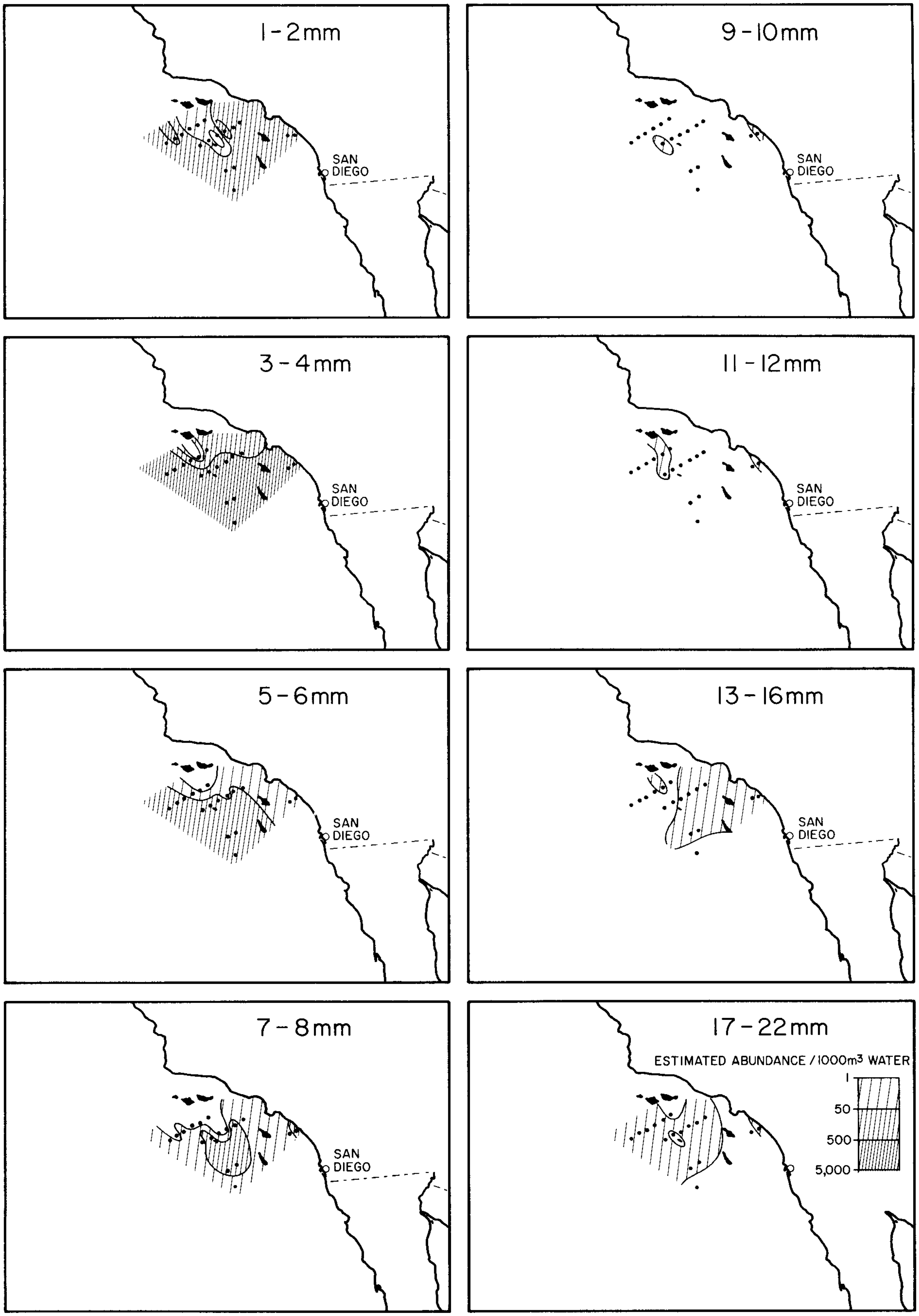
CALCOFI CRUISE 5509-III

18-23 SEPTEMBER 1955

Euphausiacea

Nematoscelis difficilis

5509-III



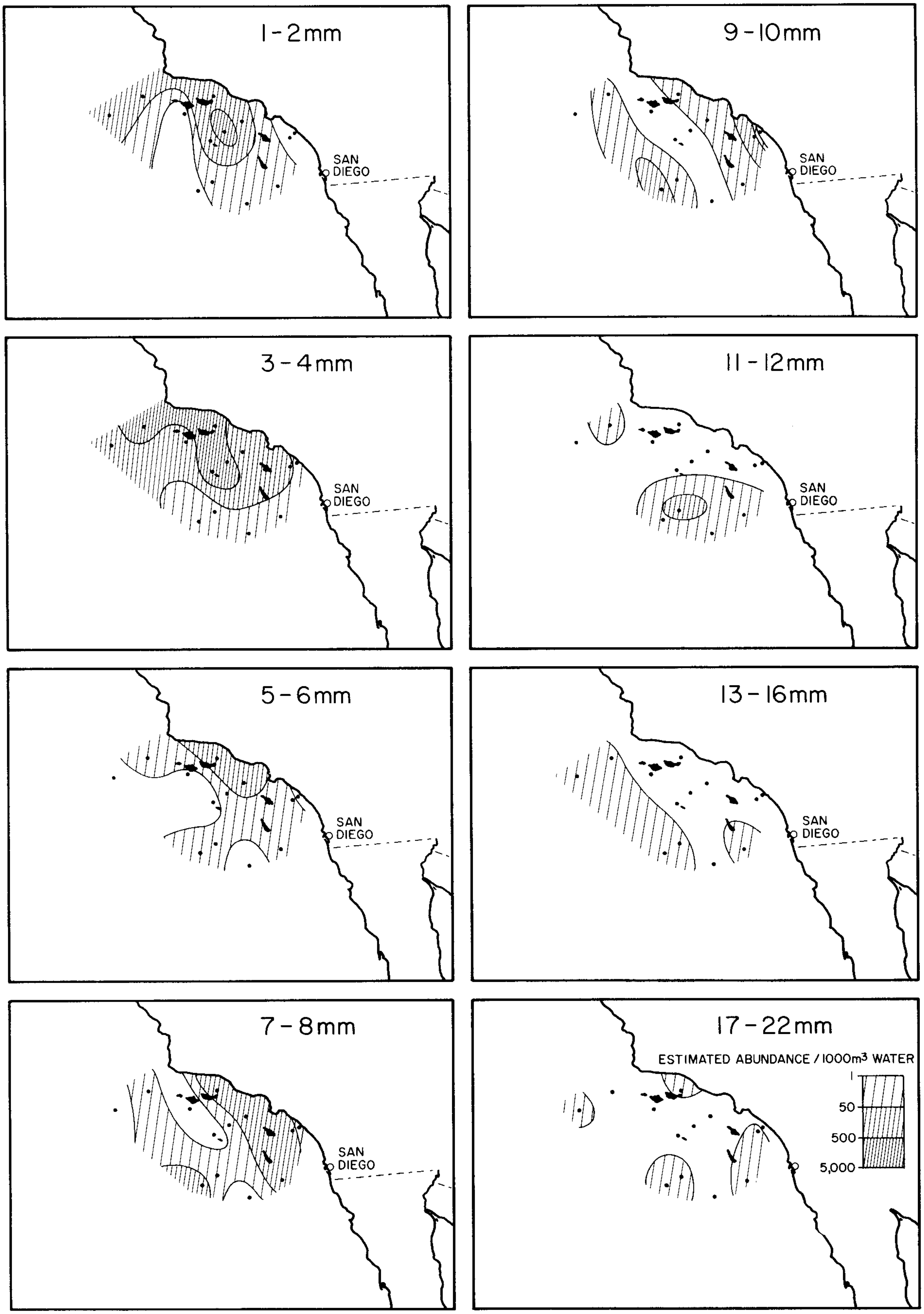
CALCOFI CRUISE 5509-IV

21-24 SEPTEMBER 1955

Euphausiacea

Nematoscelis difficilis

5509-IV



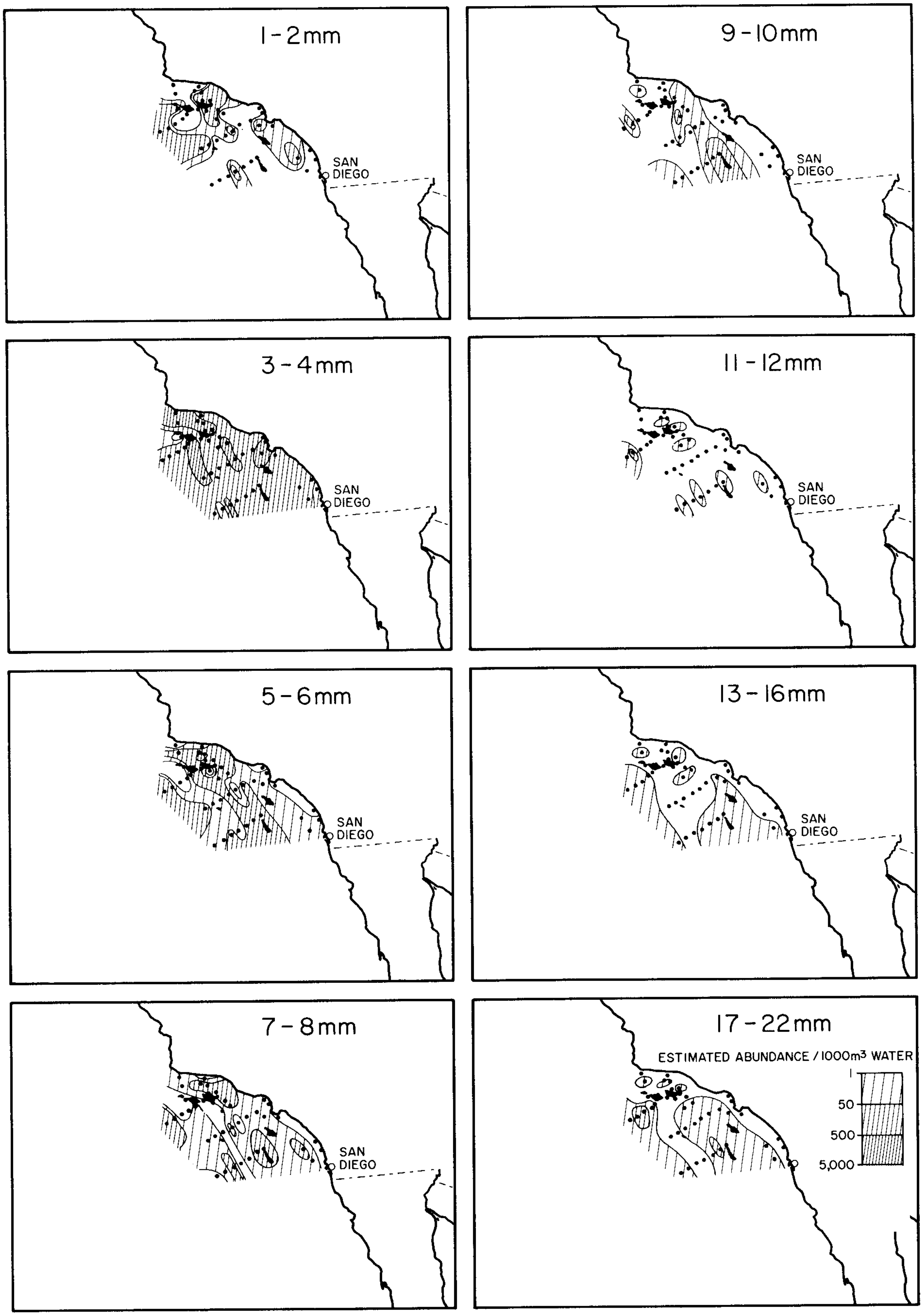
Euphausiacea

CALCOFI CRUISE 5510

21-29 OCTOBER 1955

Nematoscelis difficilis

5510



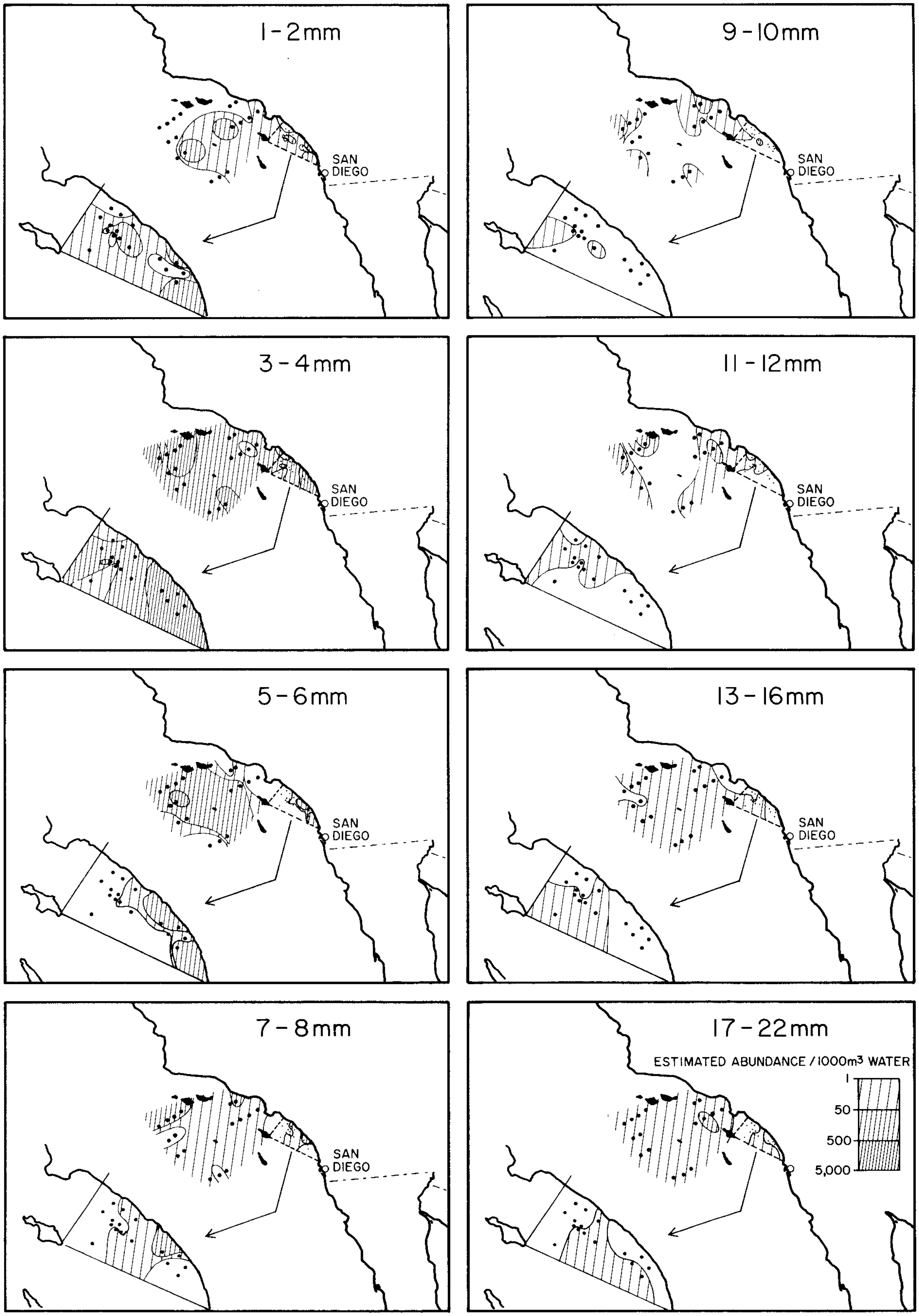
Euphausiacea

CALCOFI CRUISE 5511-I

8-13 NOVEMBER 1955

Nematoscelis difficilis

5511-I



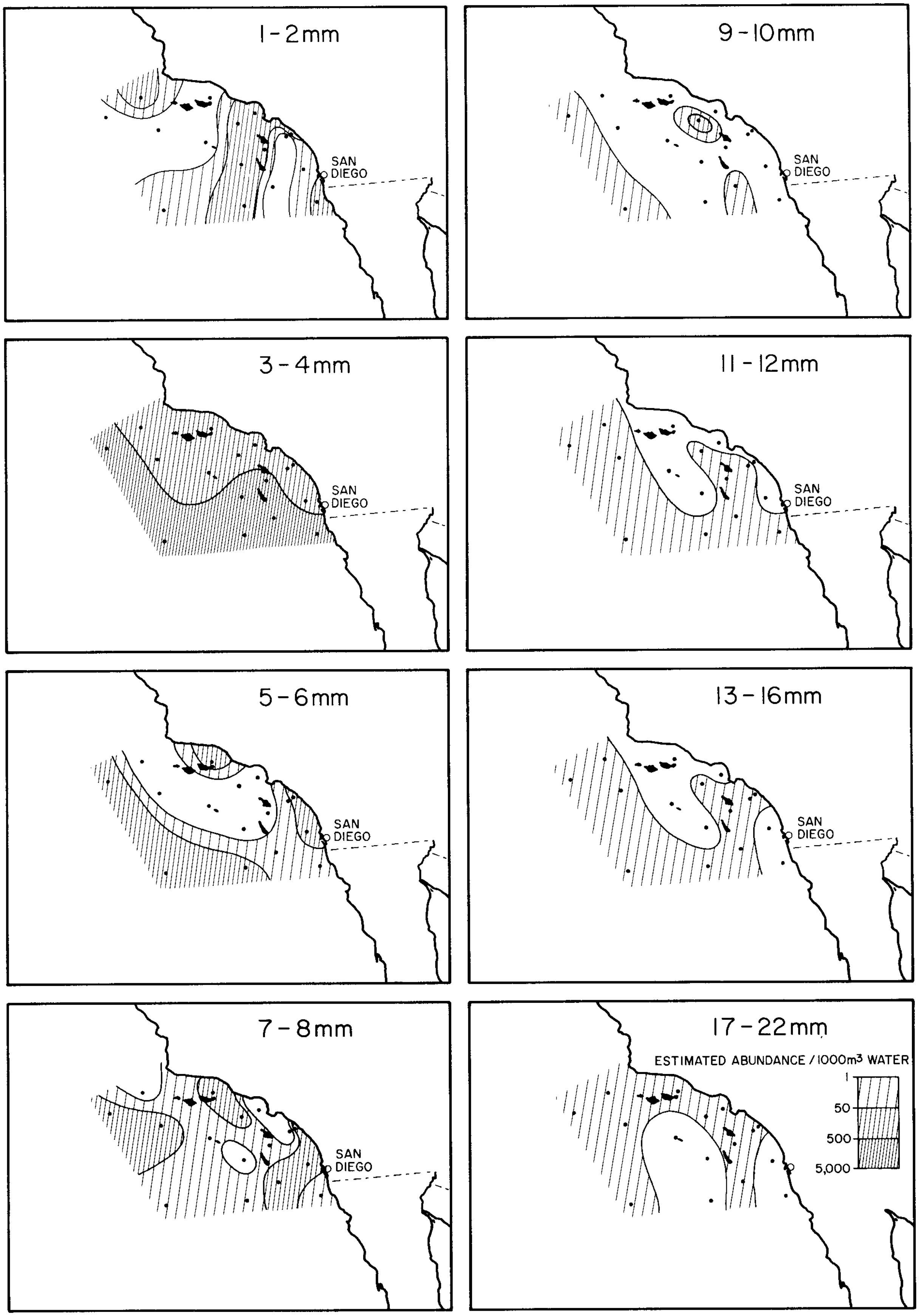
CALCOFI CRUISE 5511-II

16-19 NOVEMBER 1955

Euphausiacea

Nematoscelis difficilis

5511-II



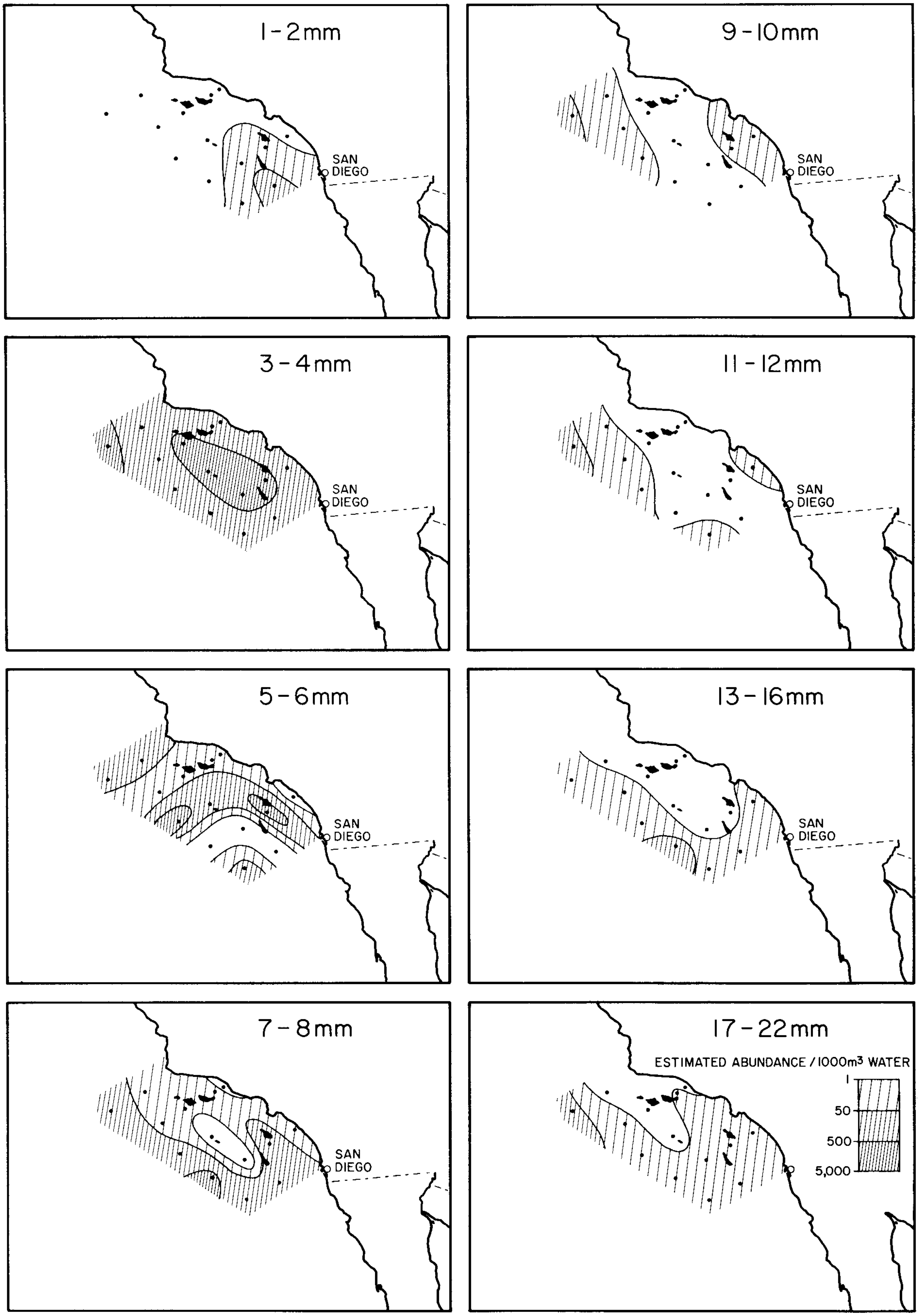
Euphausiacea

CALCOFI CRUISE 5512

30 NOVEMBER – 7 DECEMBER 1955

Nematoscelis difficilis

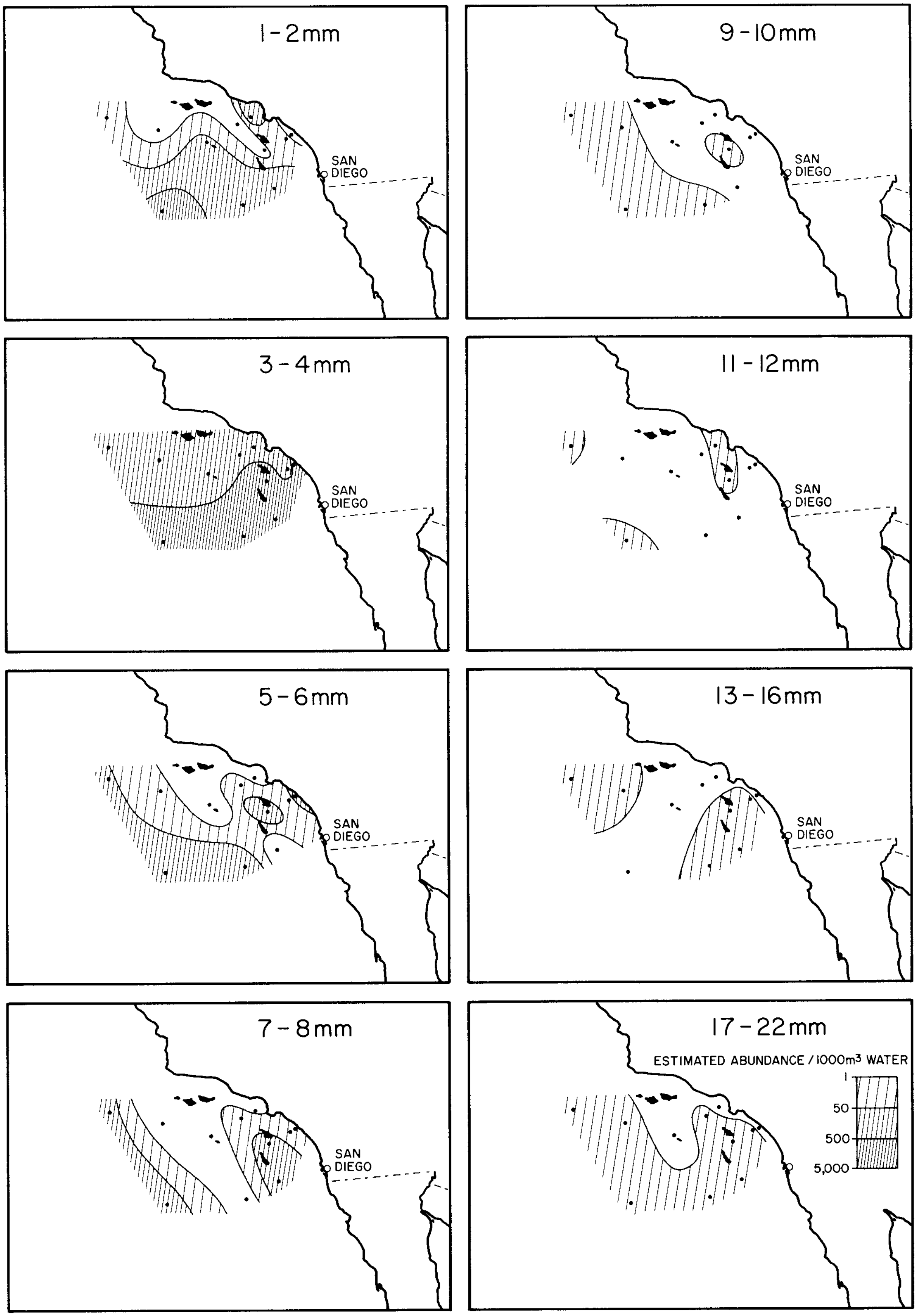
5512



Euphausiacea

CALCOFI CRUISE 5601
6 - 10 JANUARY 1956

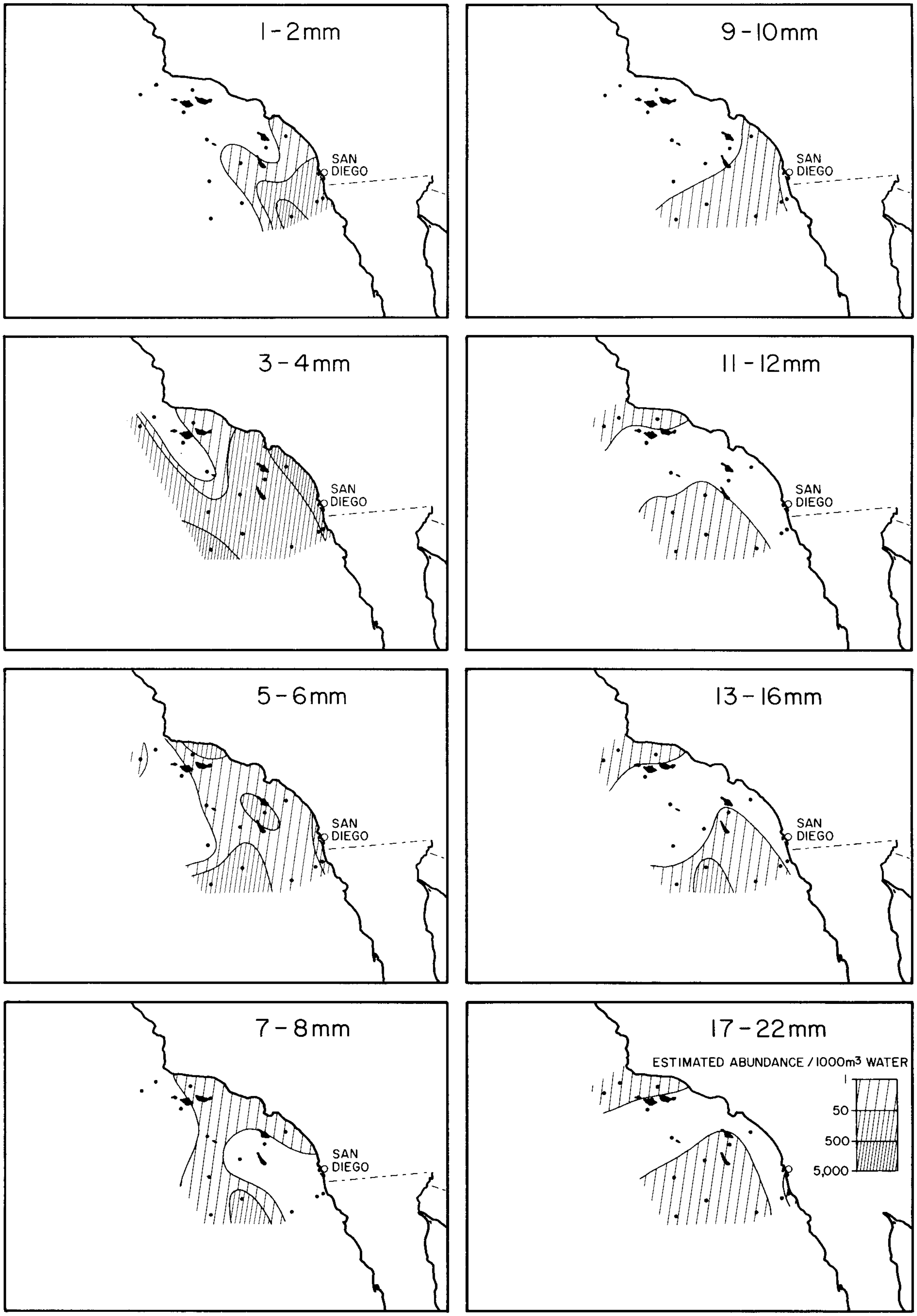
Nematoscelis difficilis
5601



Euphausiacea

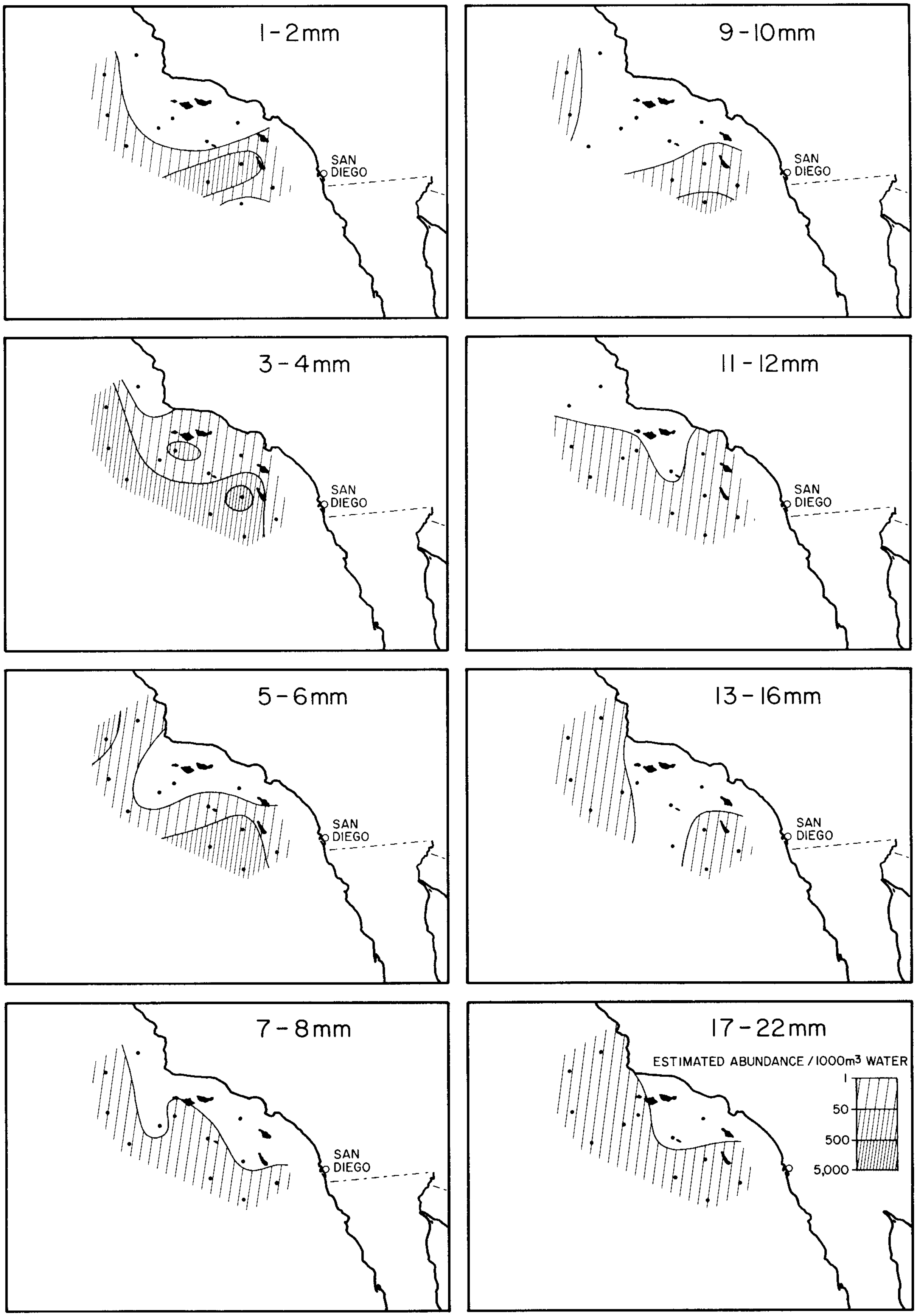
CALCOFI CRUISE 5602
3-10 FEBRUARY 1956

Nematoscelis difficilis
5602



CALCOFI CRUISE 5603
8-17 MARCH 1956

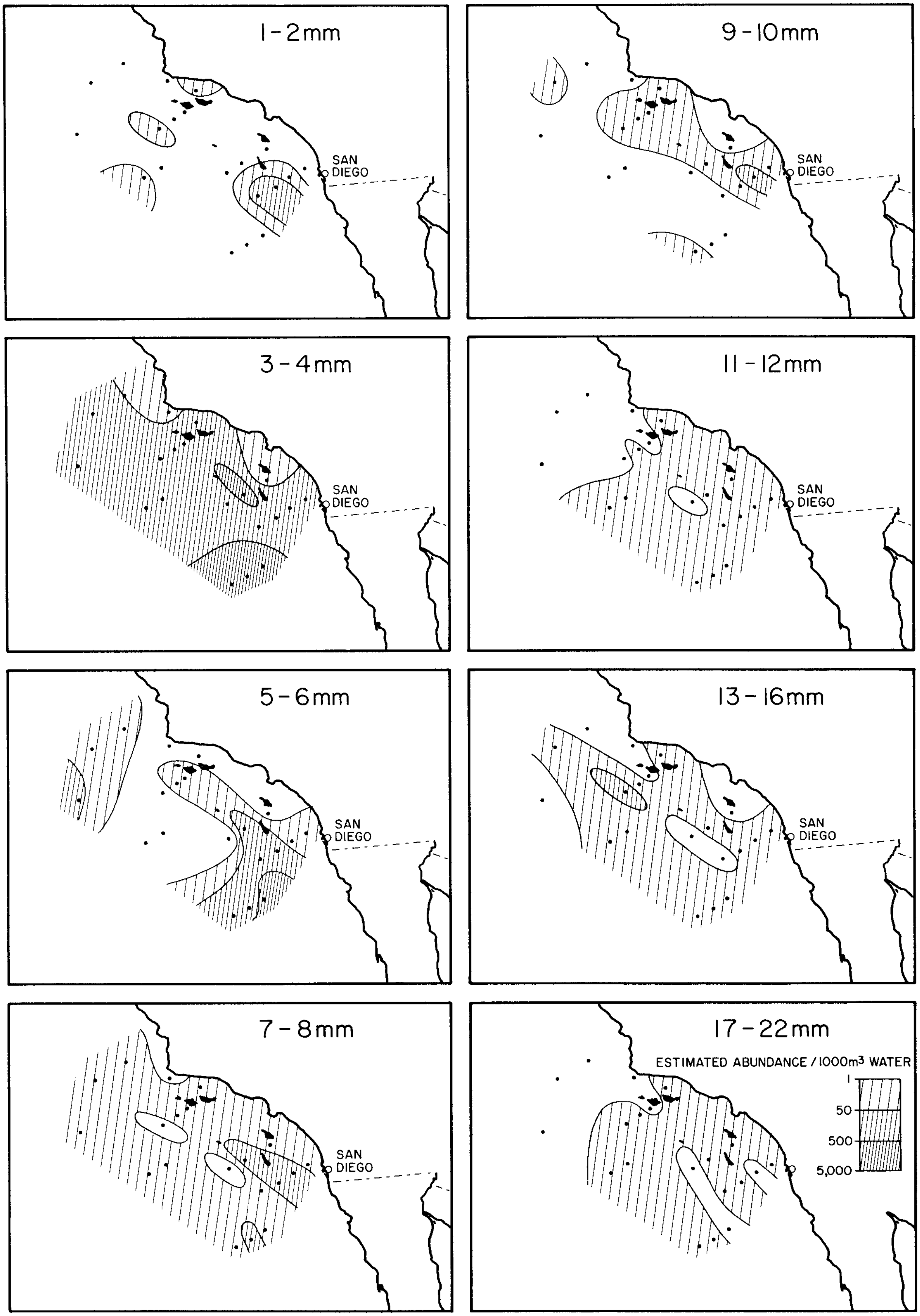
Euphausiacea
Nematoscelis difficilis
5603



Euphausiacea

CALCOFI CRUISE 5604
14 - 21 APRIL 1956

Nematoscelis difficilis
5604



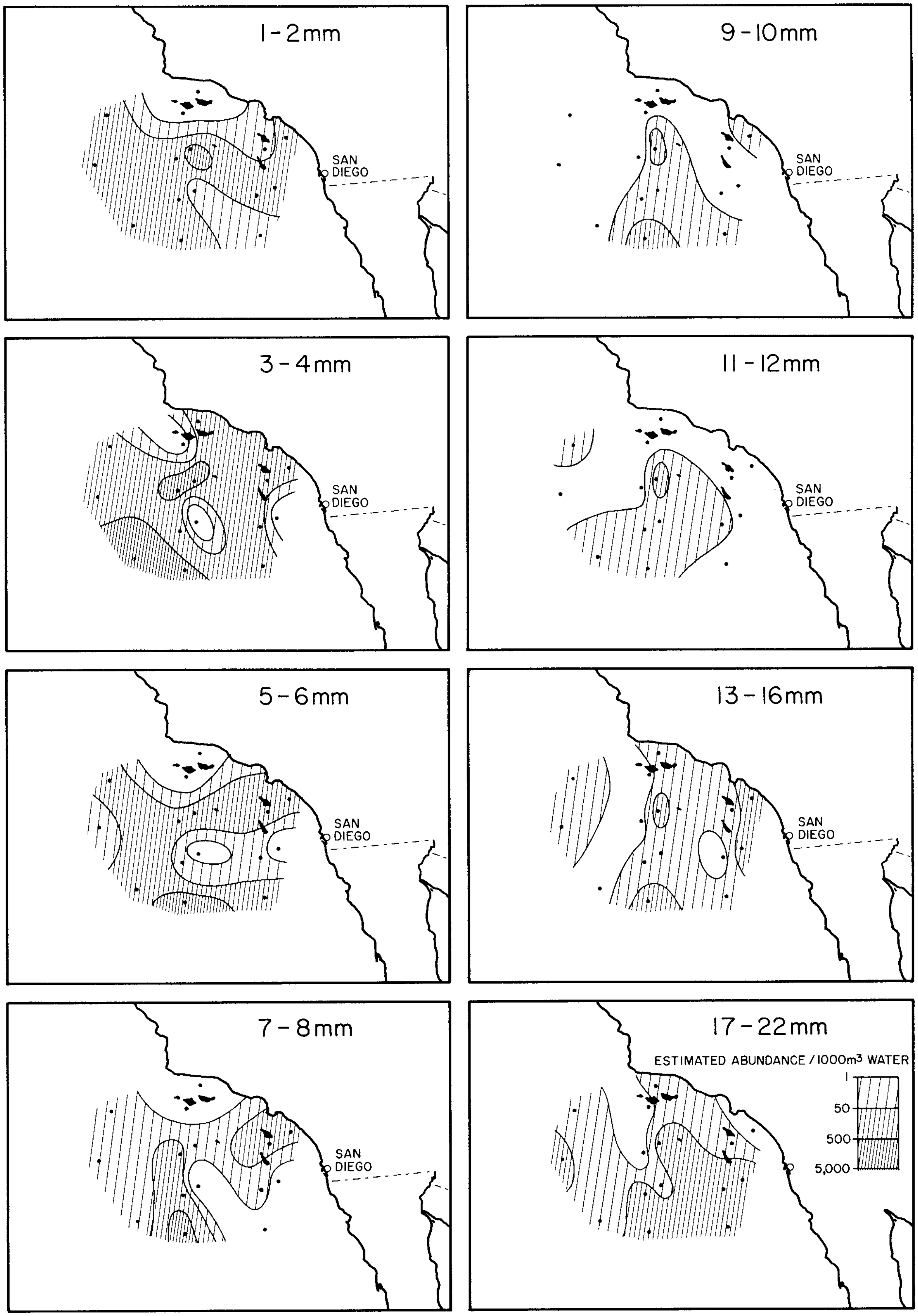
CALCOFI CRUISE 5605

6 - 18 MAY 1956

Euphausiacea

Nematoscelis difficilis

5605



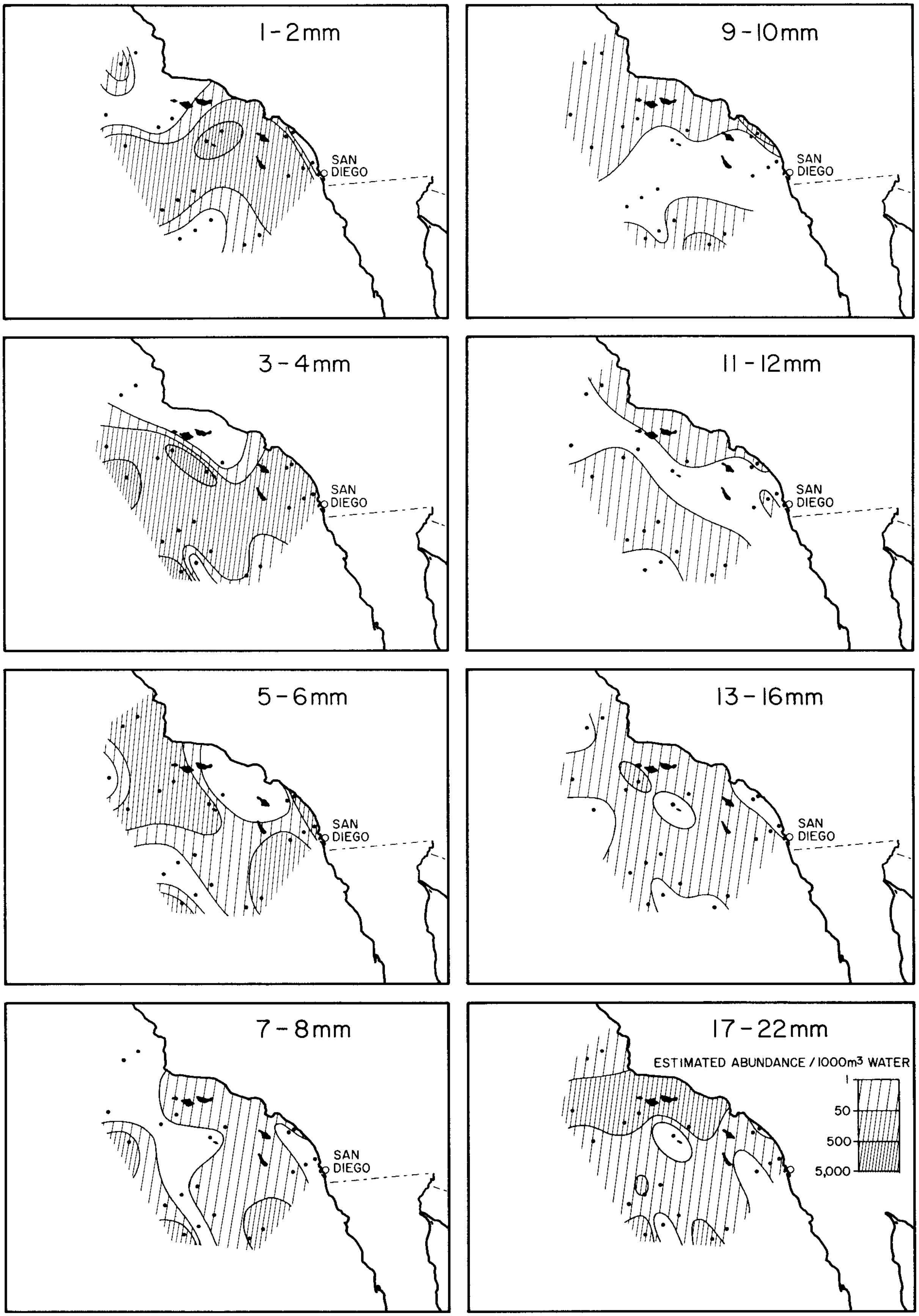
Euphausiacea

CALCOFI CRUISE 5606

30 MAY - 13 JUNE 1956

Nematoscelis difficilis

5606



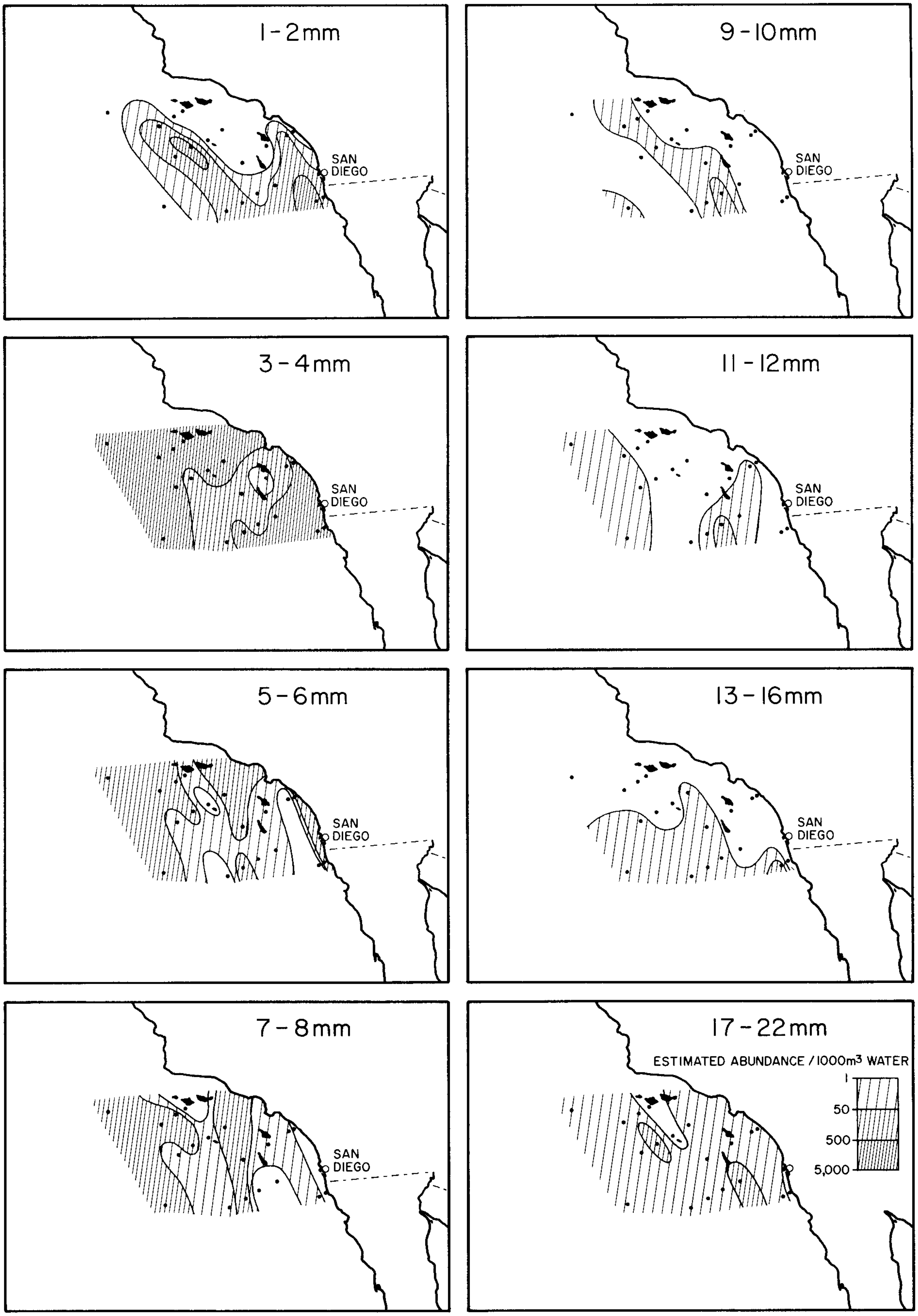
CALCOFI CRUISE 5607

7 - 15 JULY 1956

Euphausiacea

Nematoscelis difficilis

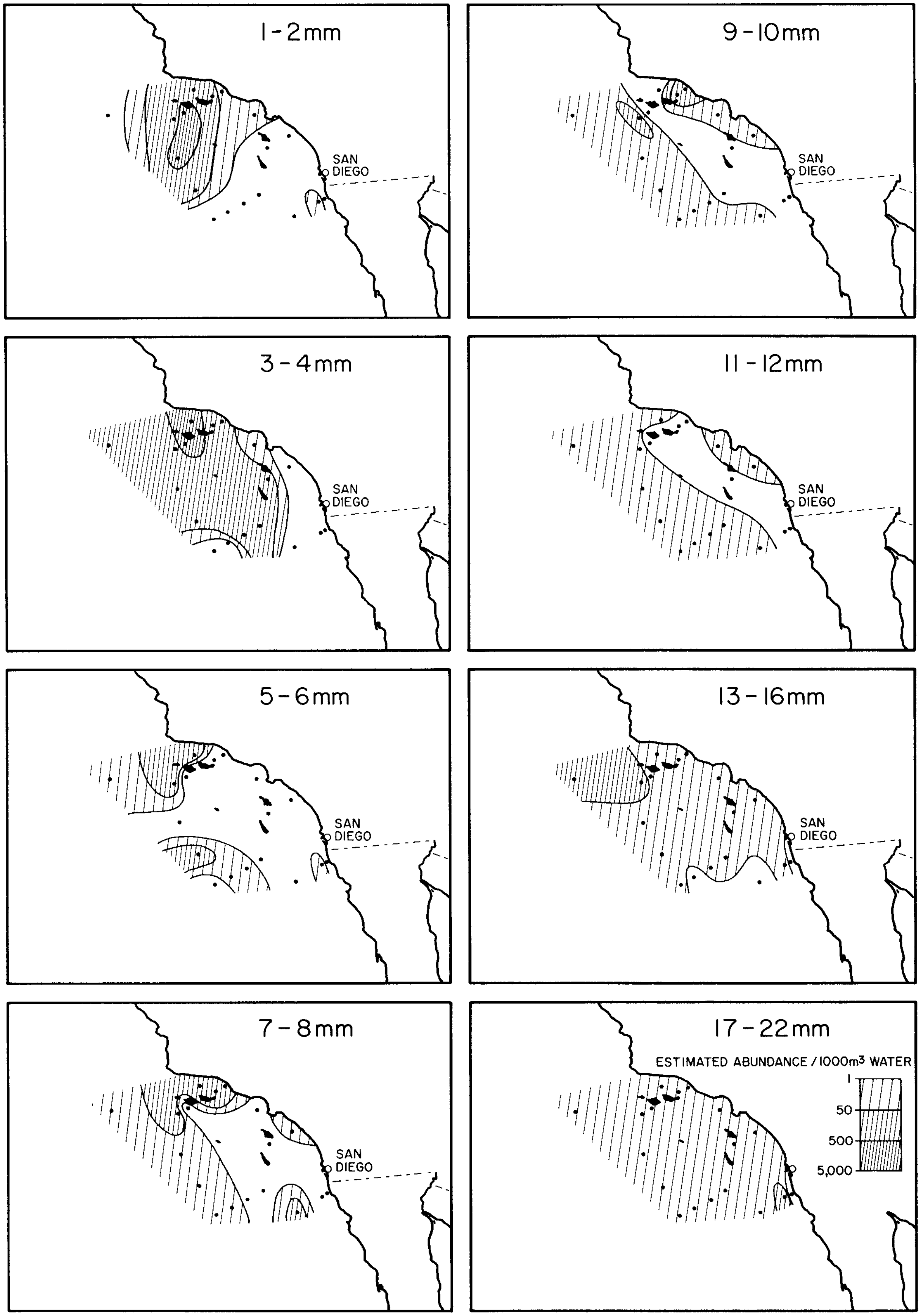
5607



Euphausiacea

CALCOFI CRUISE 5610
29 SEPTEMBER - 5 OCTOBER 1956

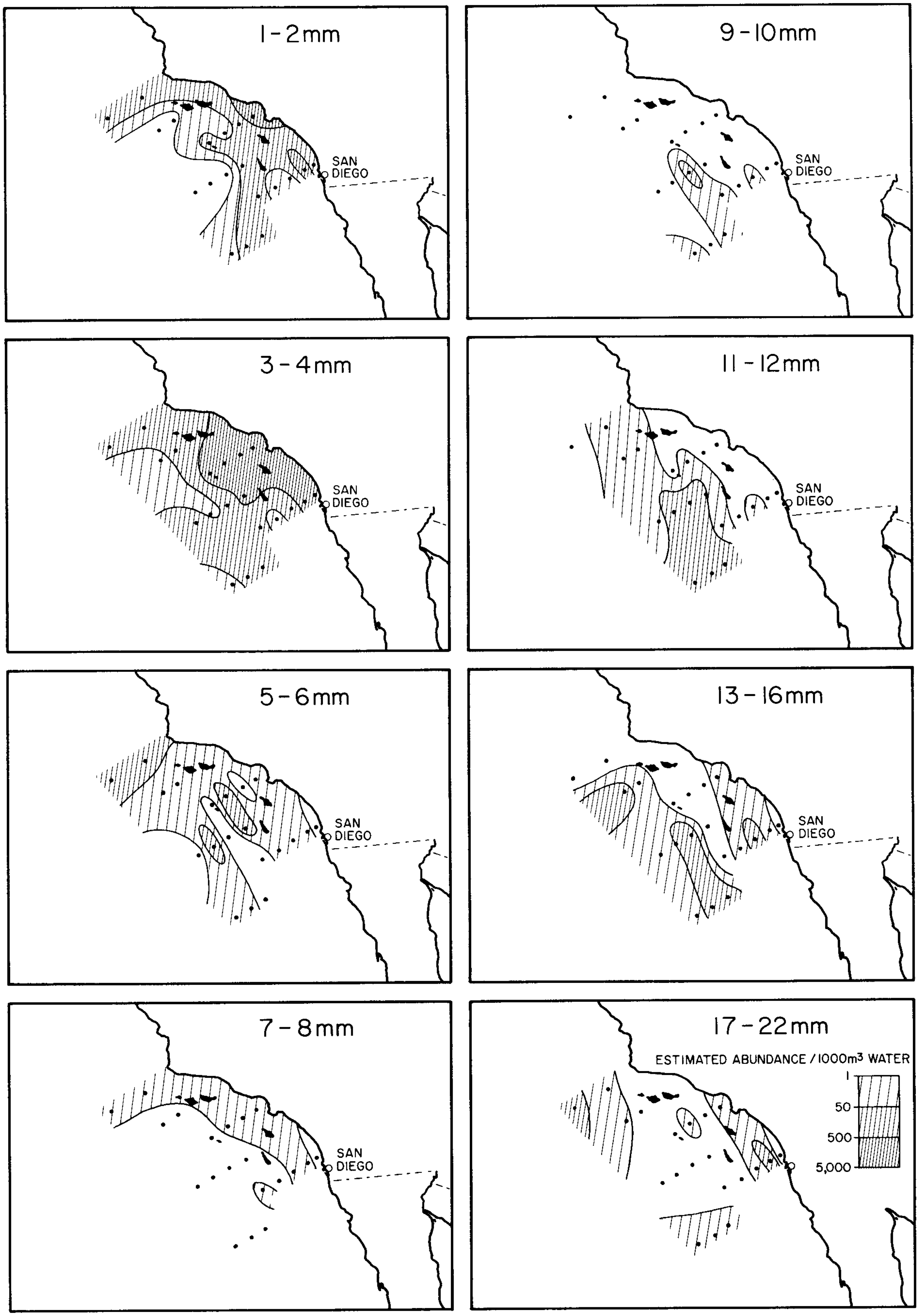
Nematoscelis difficilis
5610



Euphausiacea

CALCOFI CRUISE 5611
30 OCTOBER - 5 NOVEMBER 1956

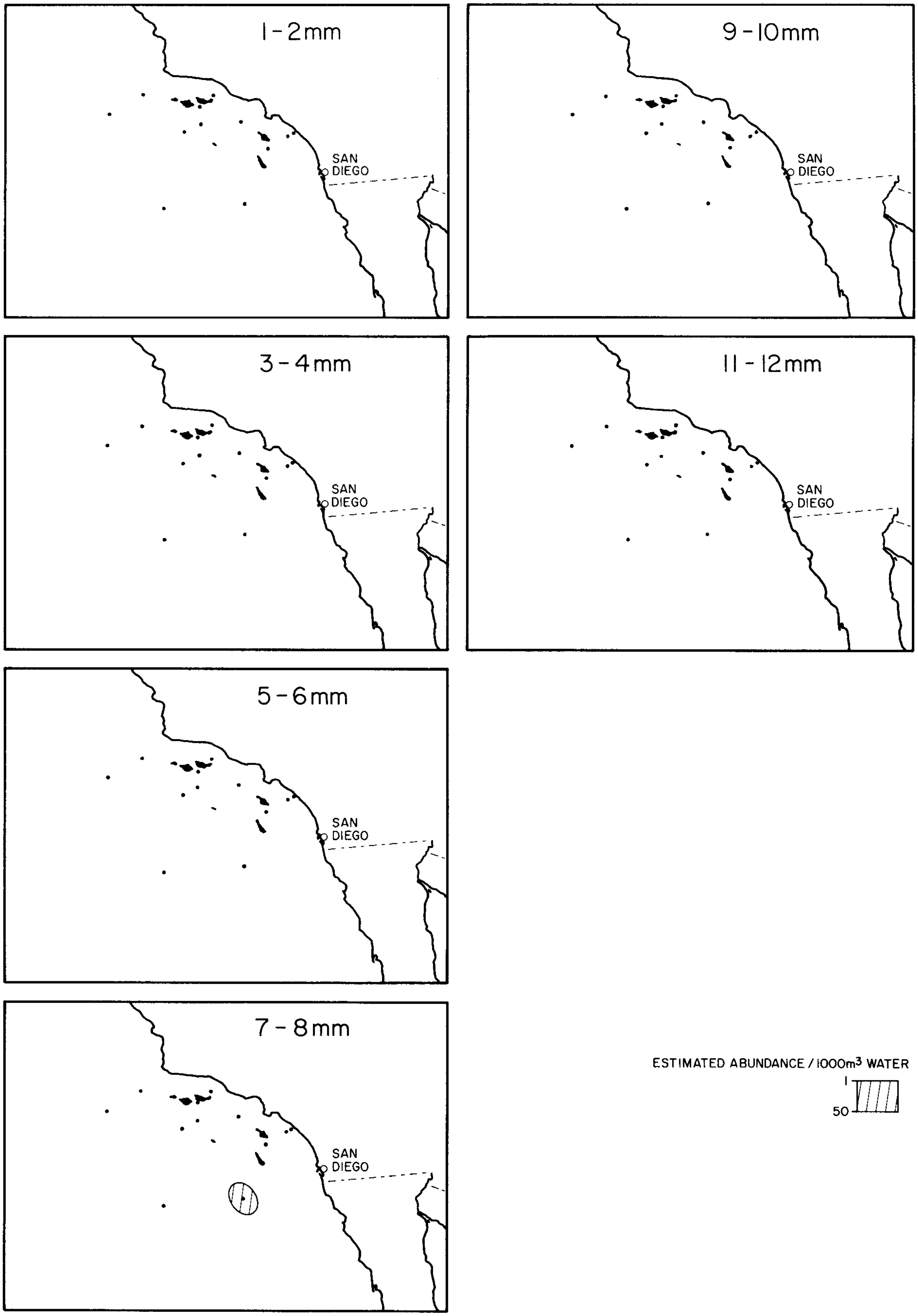
Nematoscelis difficilis
5611



Euphausiacea

CALCOFI CRUISE 5612
6 - 12 DECEMBER 1956

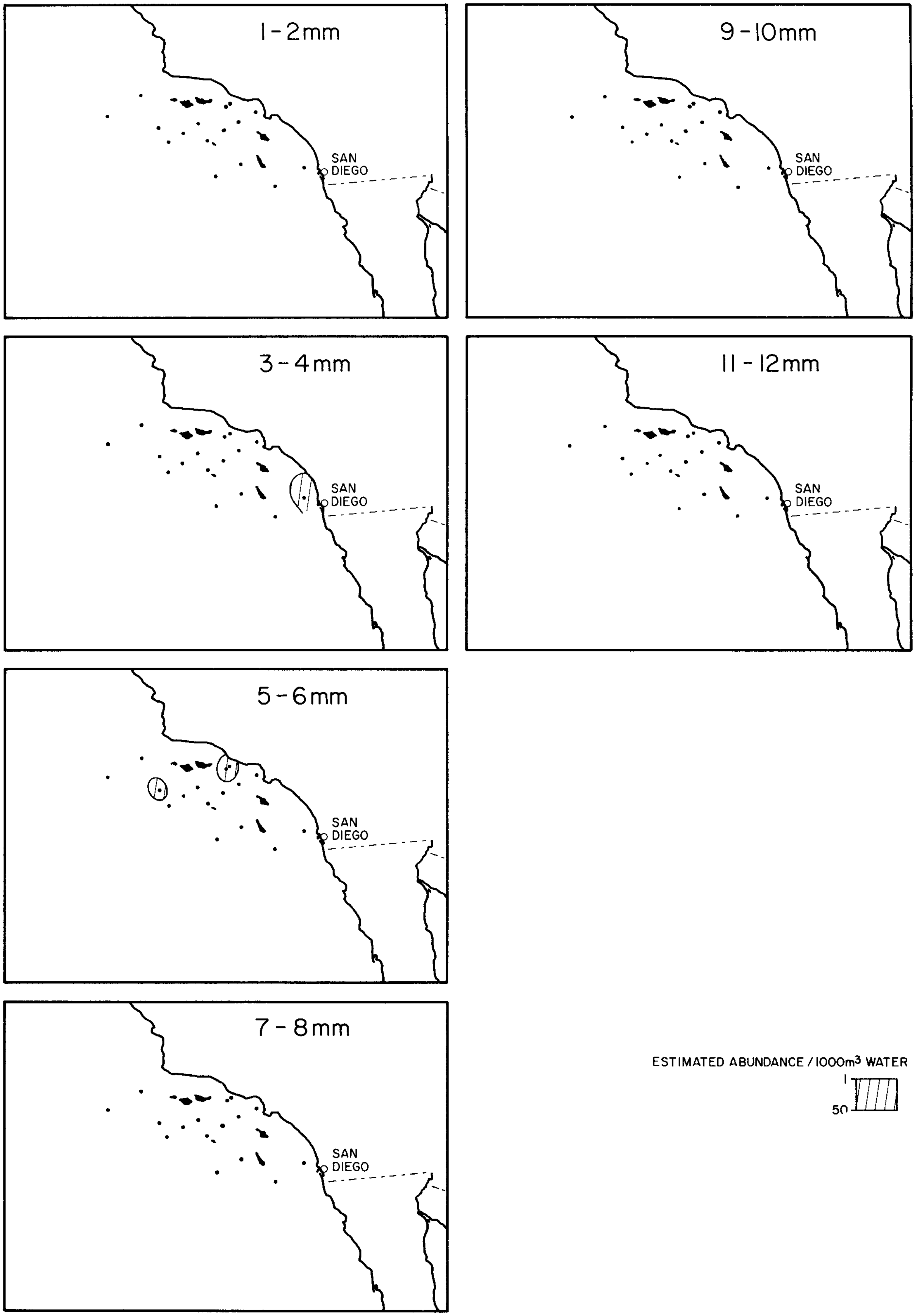
Nematoscelis difficilis
5612



Euphausiacea

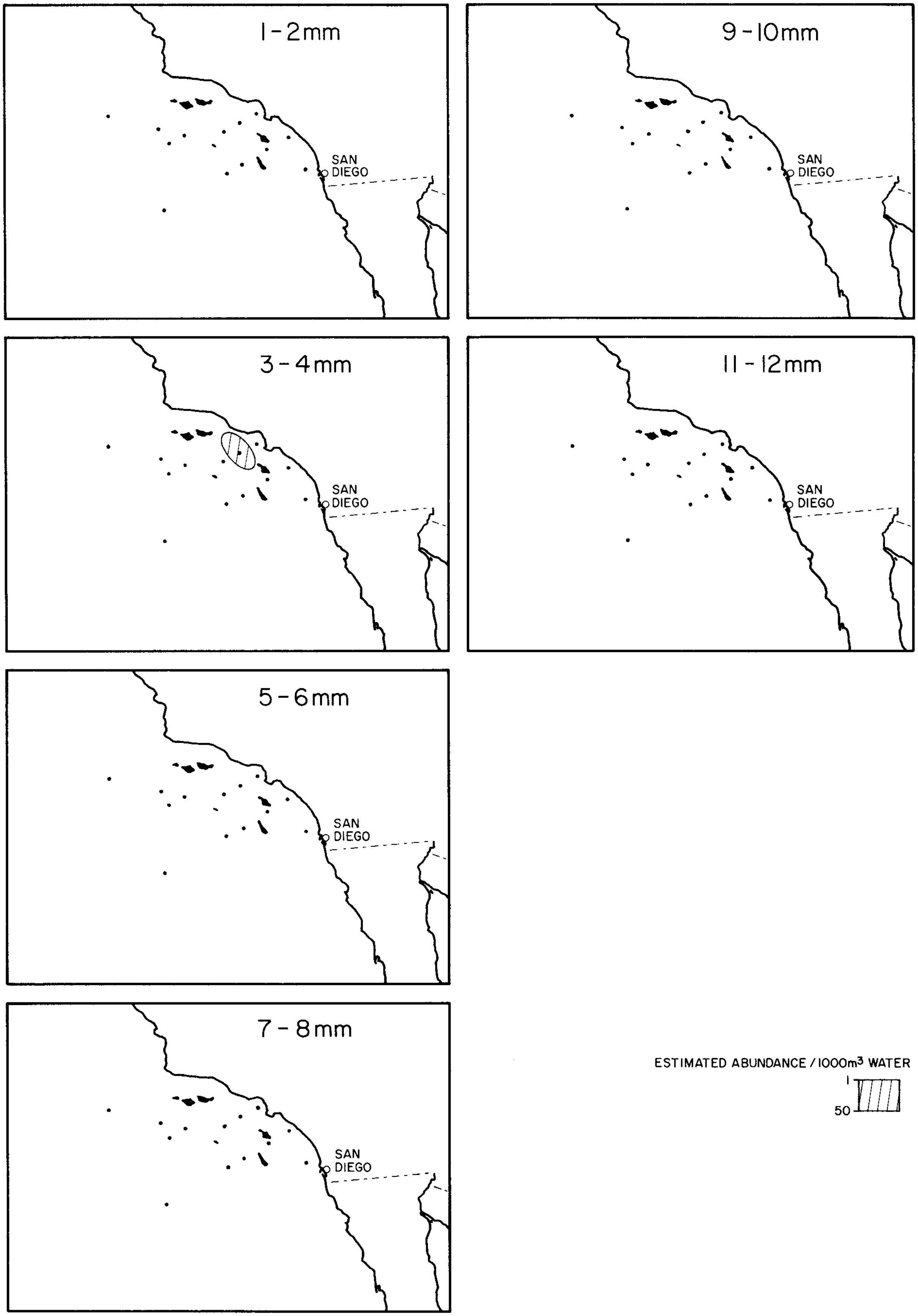
CALCOFI CRUISE 5301
9 - 17 JANUARY 1953

Nyctiphanes simplex
5301



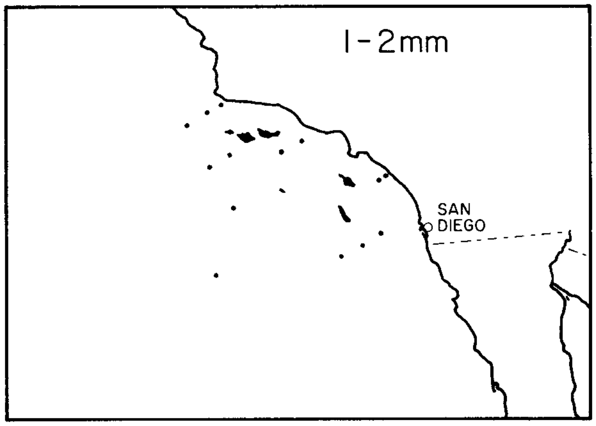
CALCOFI CRUISE 5302
4 - 14 FEBRUARY 1953

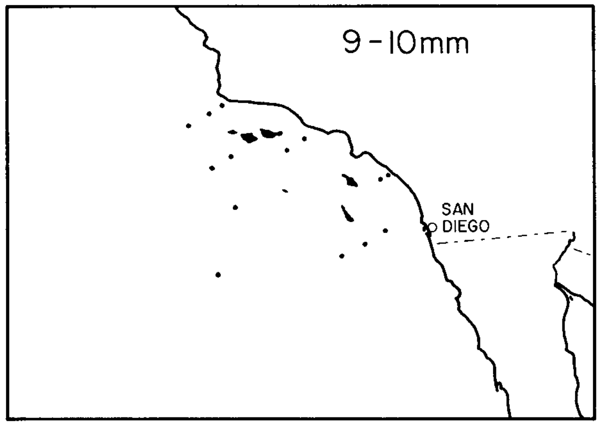
Euphausiacea
Nyctiphanes simplex
5302

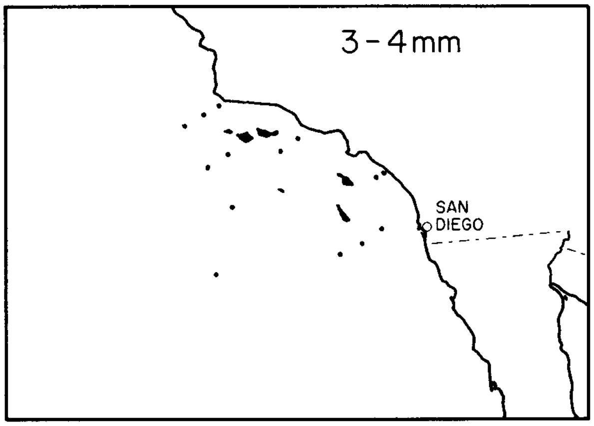


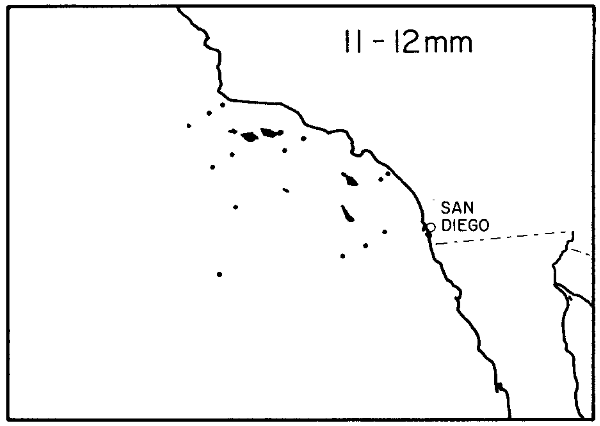
CALCOFI CRUISE 5303
6 - 20 MARCH 1953

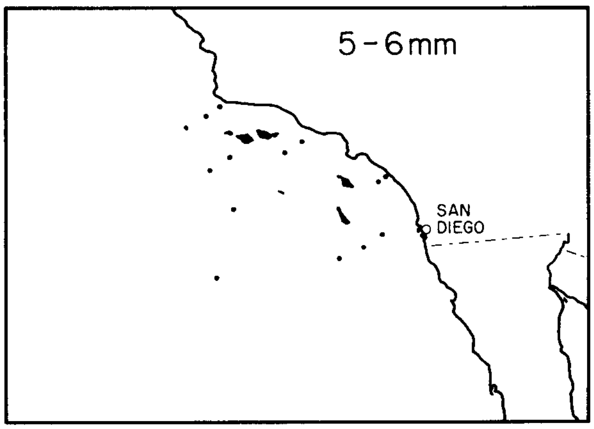
Euphausiacea
Nyctiphanes simplex
5303



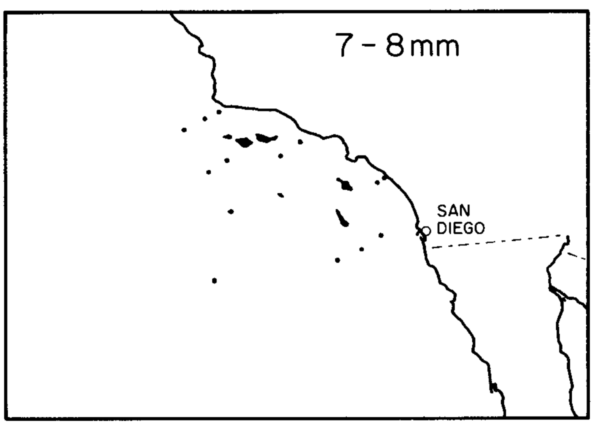






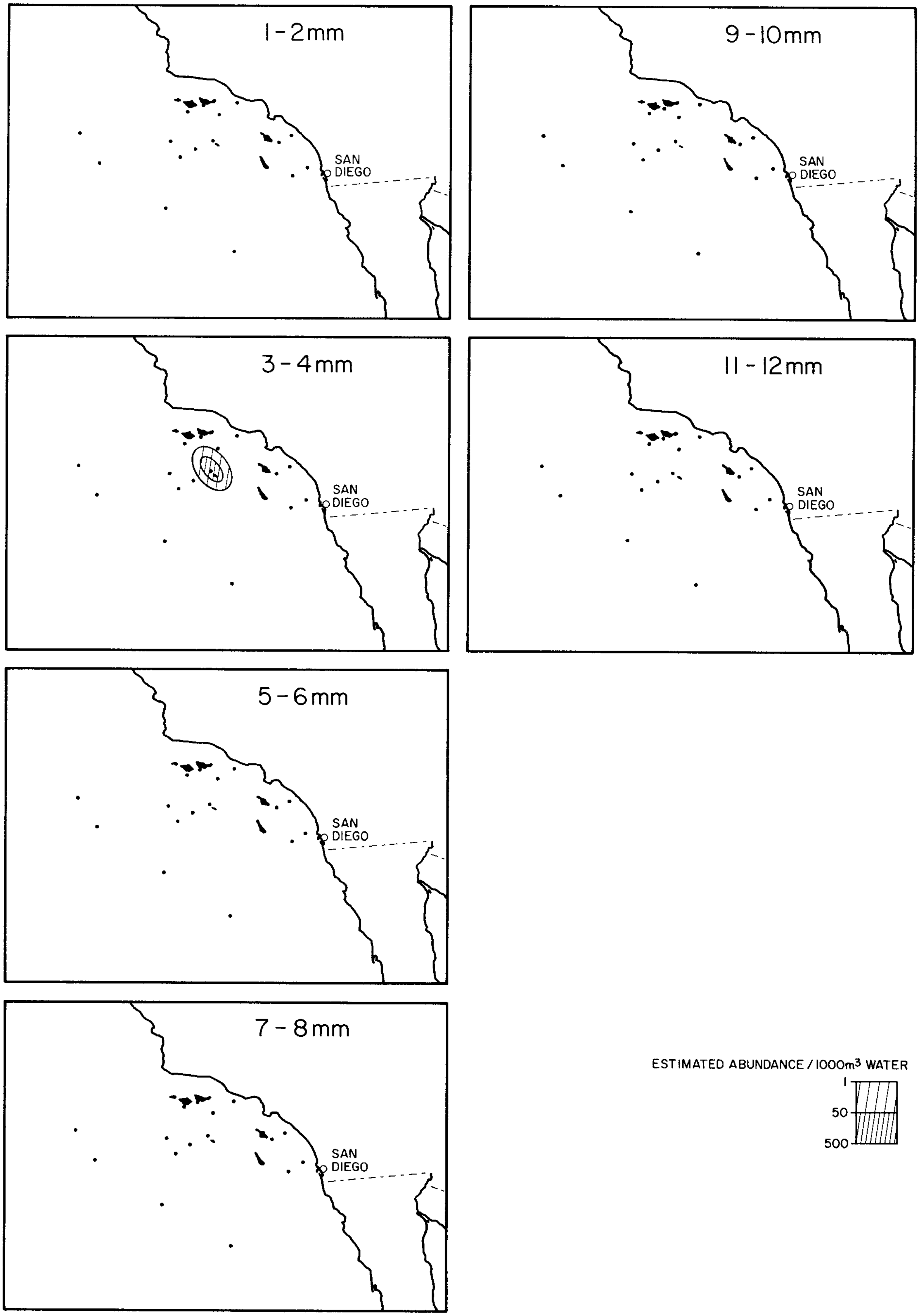


NO POSITIVE RECORDS



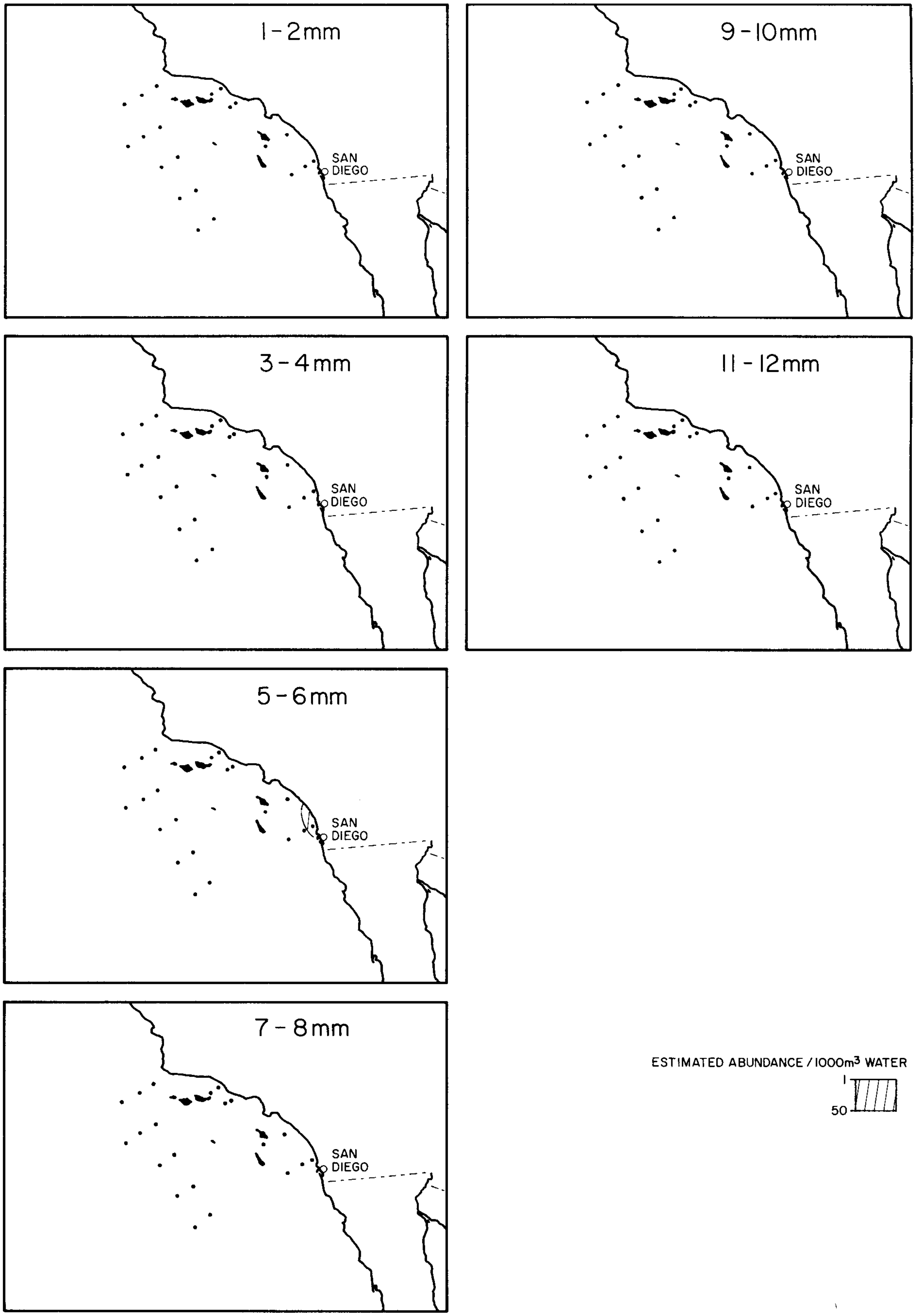
CALCOFI CRUISE 5304
7-17 APRIL 1953

Euphausiacea
Nyctiphanes simplex
5304



CALCOFI CRUISE 5305
5 - 18 MAY 1953

Euphausiacea
Nyctiphanes simplex
5305



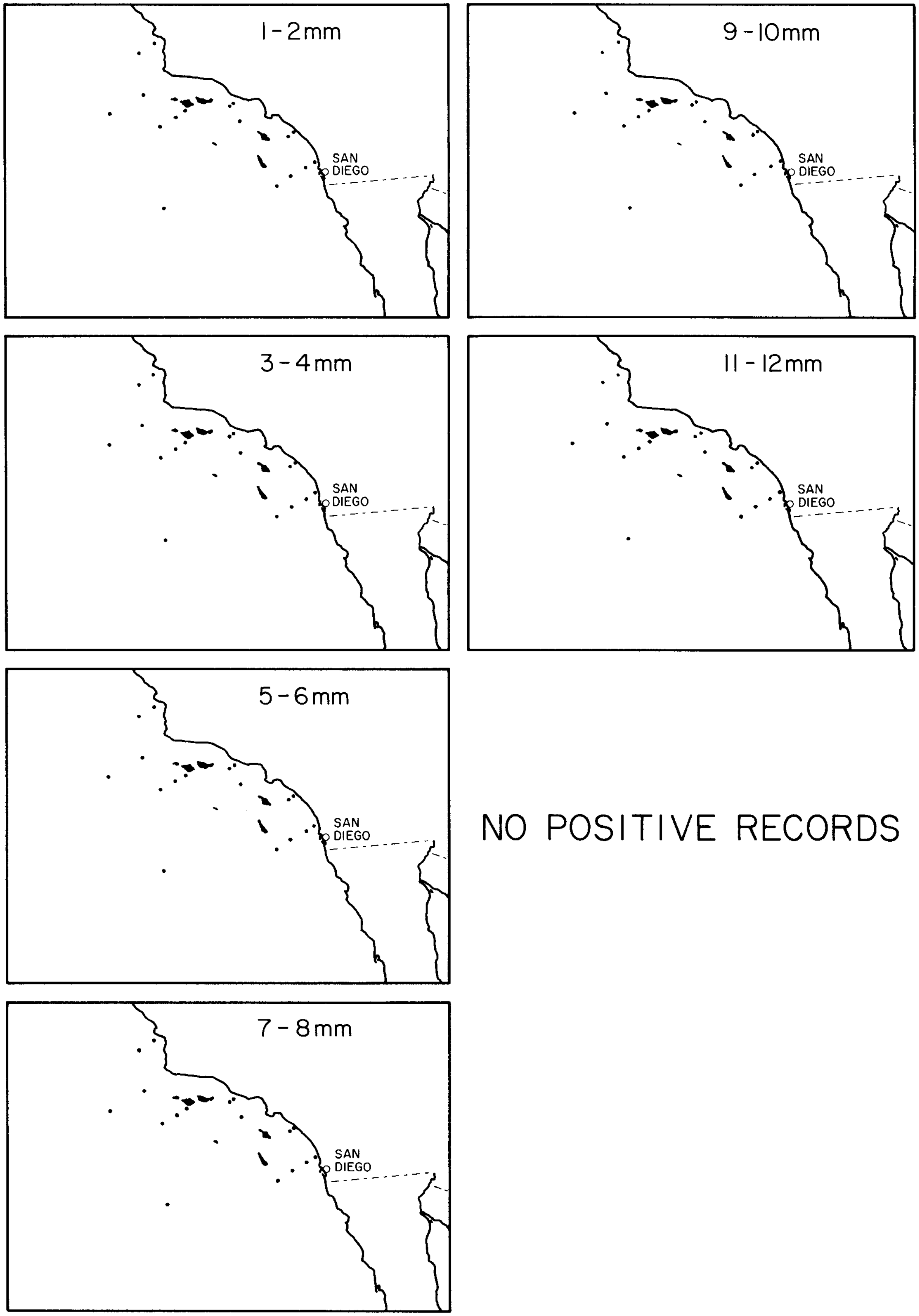
CALCOFI CRUISE 5306

5 - 12 JUNE 1953

Euphausiacea

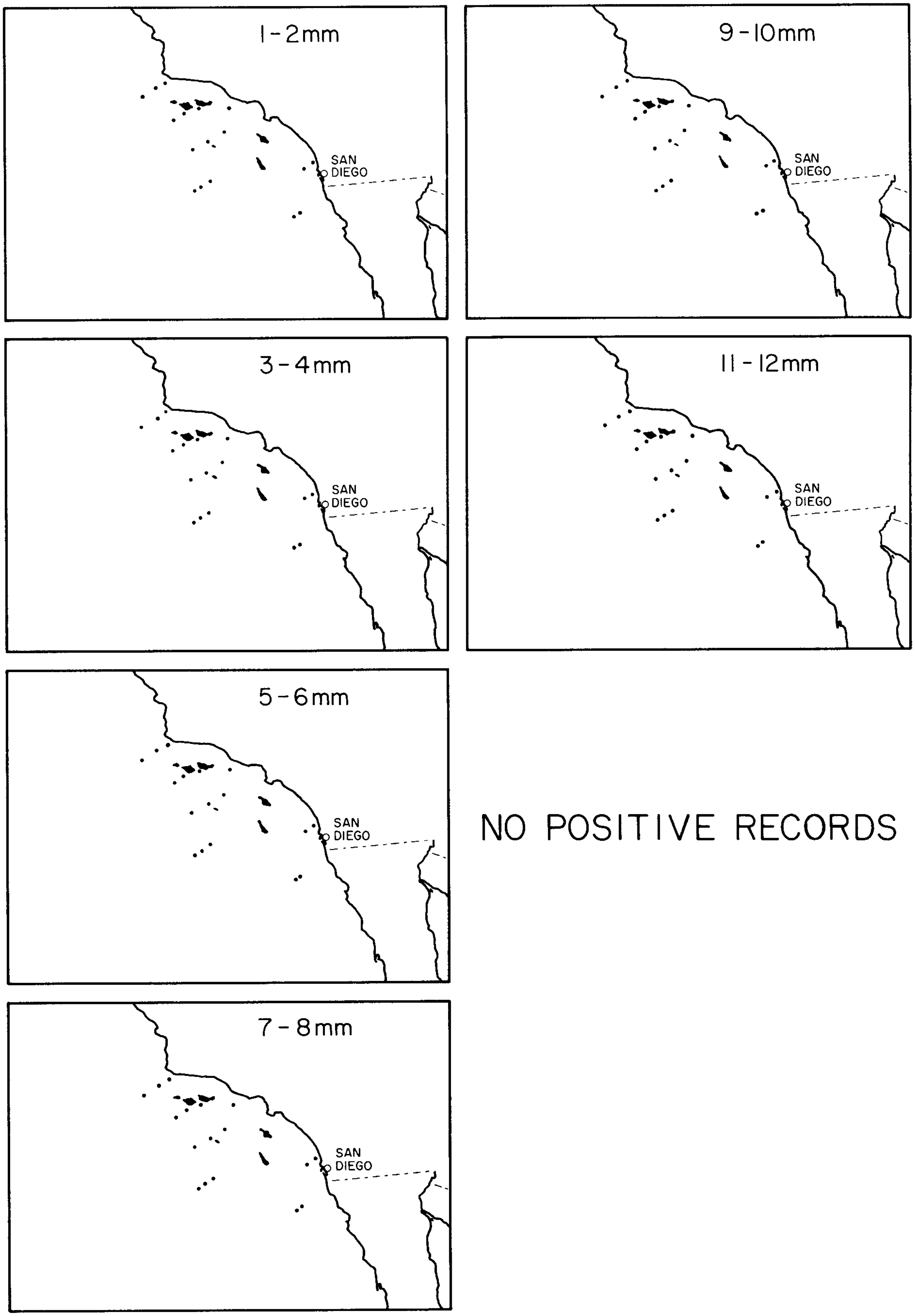
Nyctiphanes simplex

5306



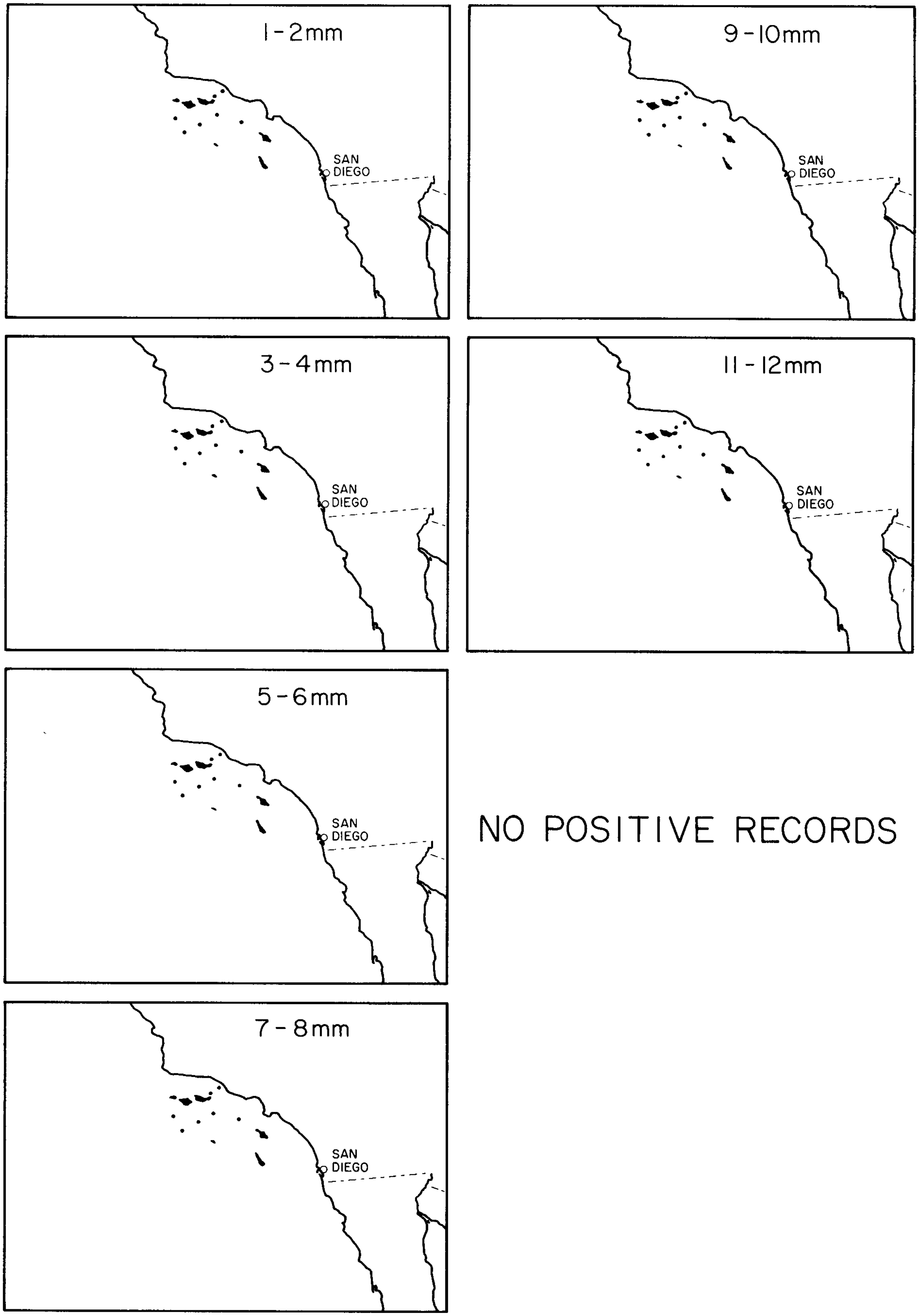
CALCOFI CRUISE 5307
14 - 26 JULY 1953

Euphausiacea
Nyctiphanes simplex
5307



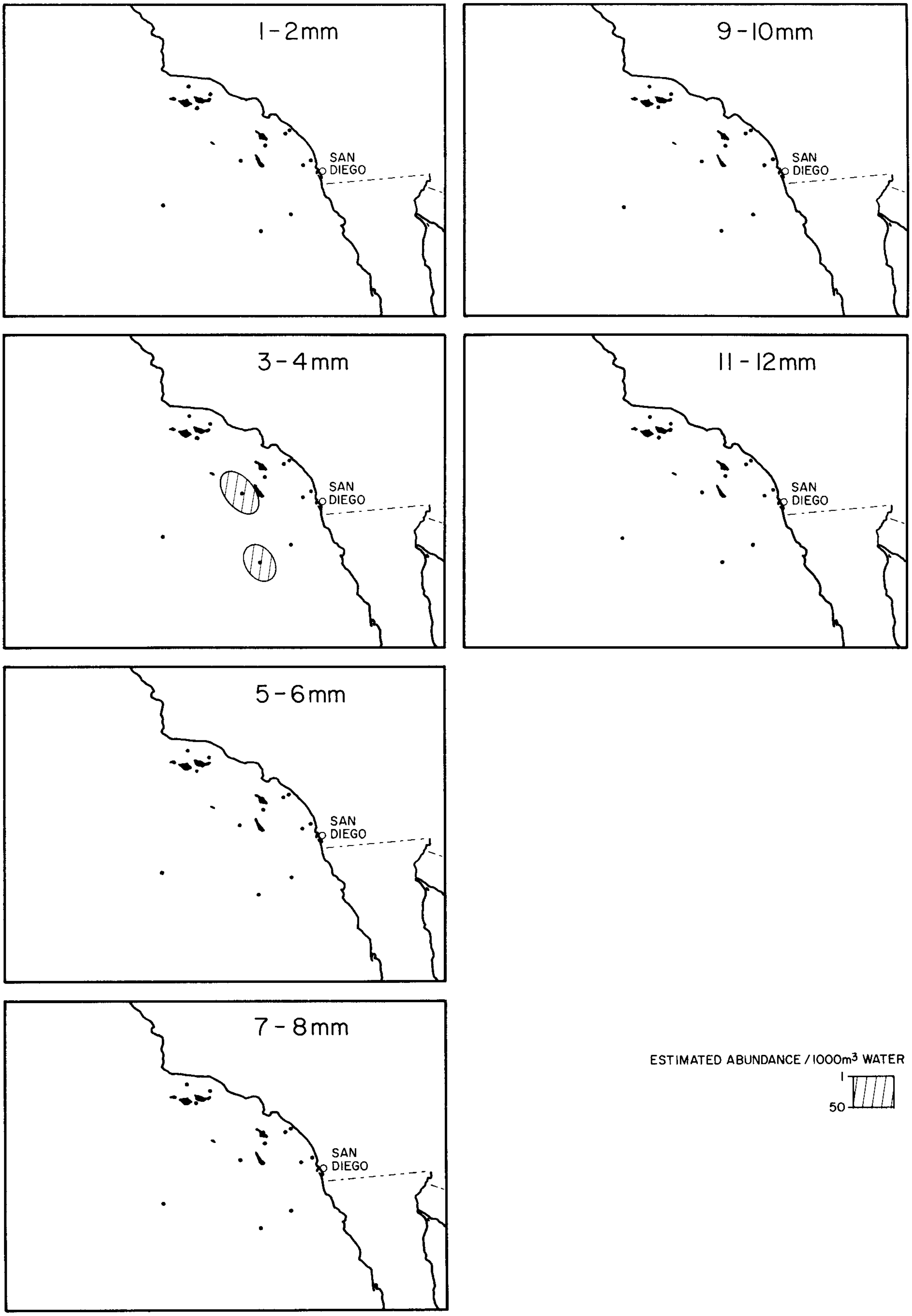
CALCOFI CRUISE 5308
18 - 29 AUGUST 1953

Euphausiacea
Nyctiphanes simplex
5308



CALCOFI CRUISE 5309
15-17 SEPTEMBER 1953

Euphausiacea
Nyctiphanes simplex
5309



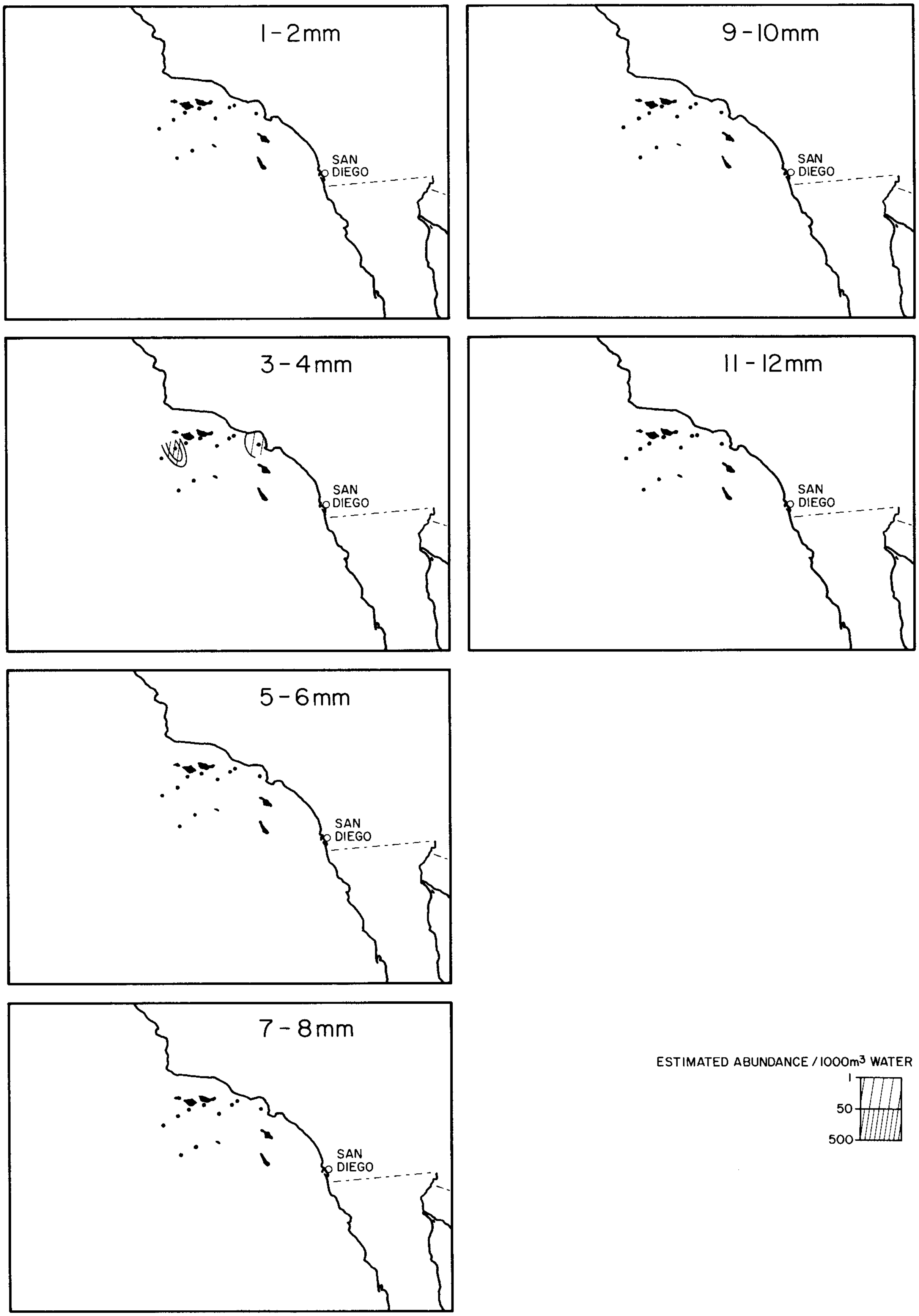
Euphausiacea

CALCOFI CRUISE 5310

19 - 22 OCTOBER 1953

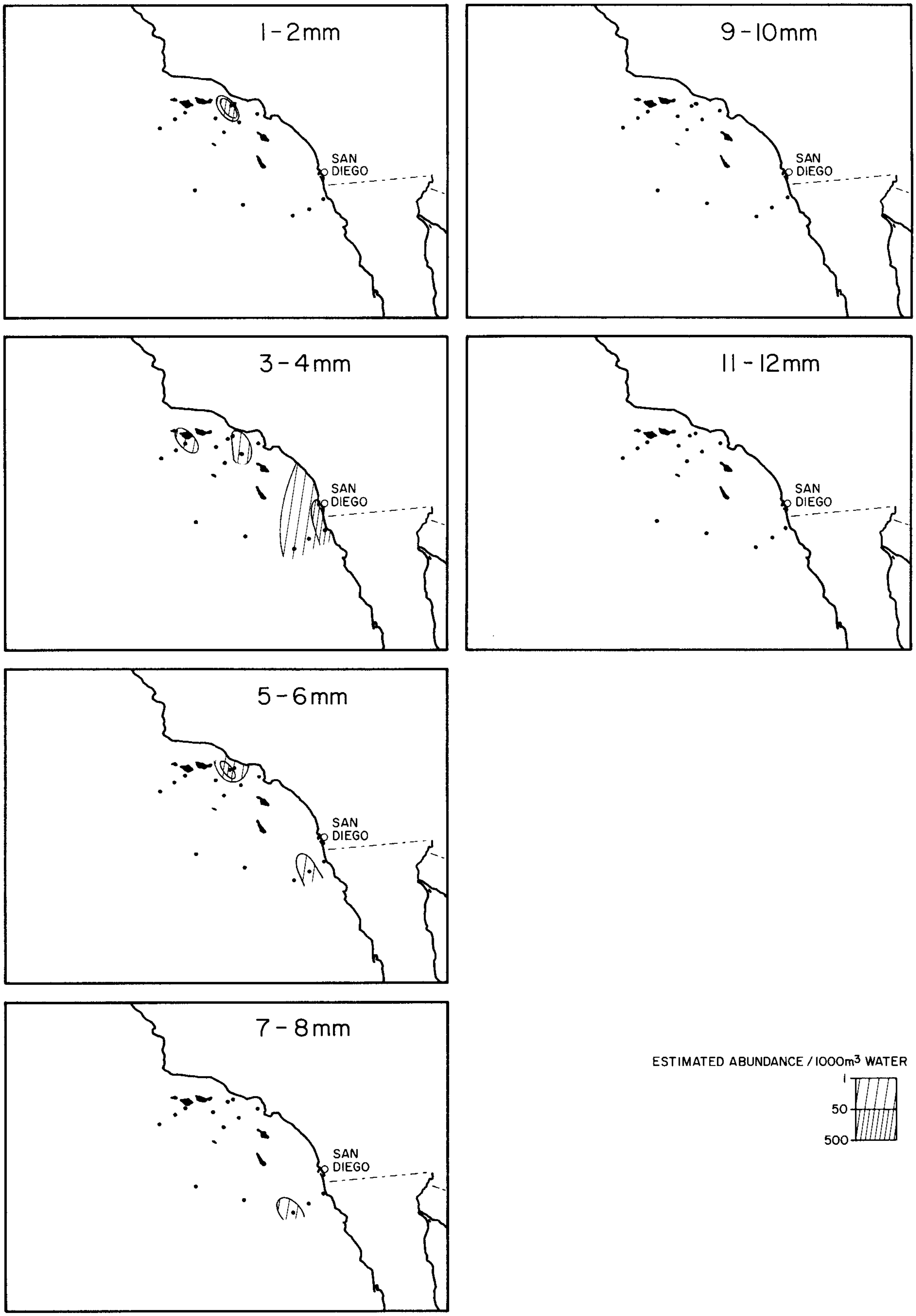
Nyctiphanes simplex

5310



CALCOFI CRUISE 5311
10 - 12 NOVEMBER 1953

Euphausiacea
Nyctiphanes simplex
5311



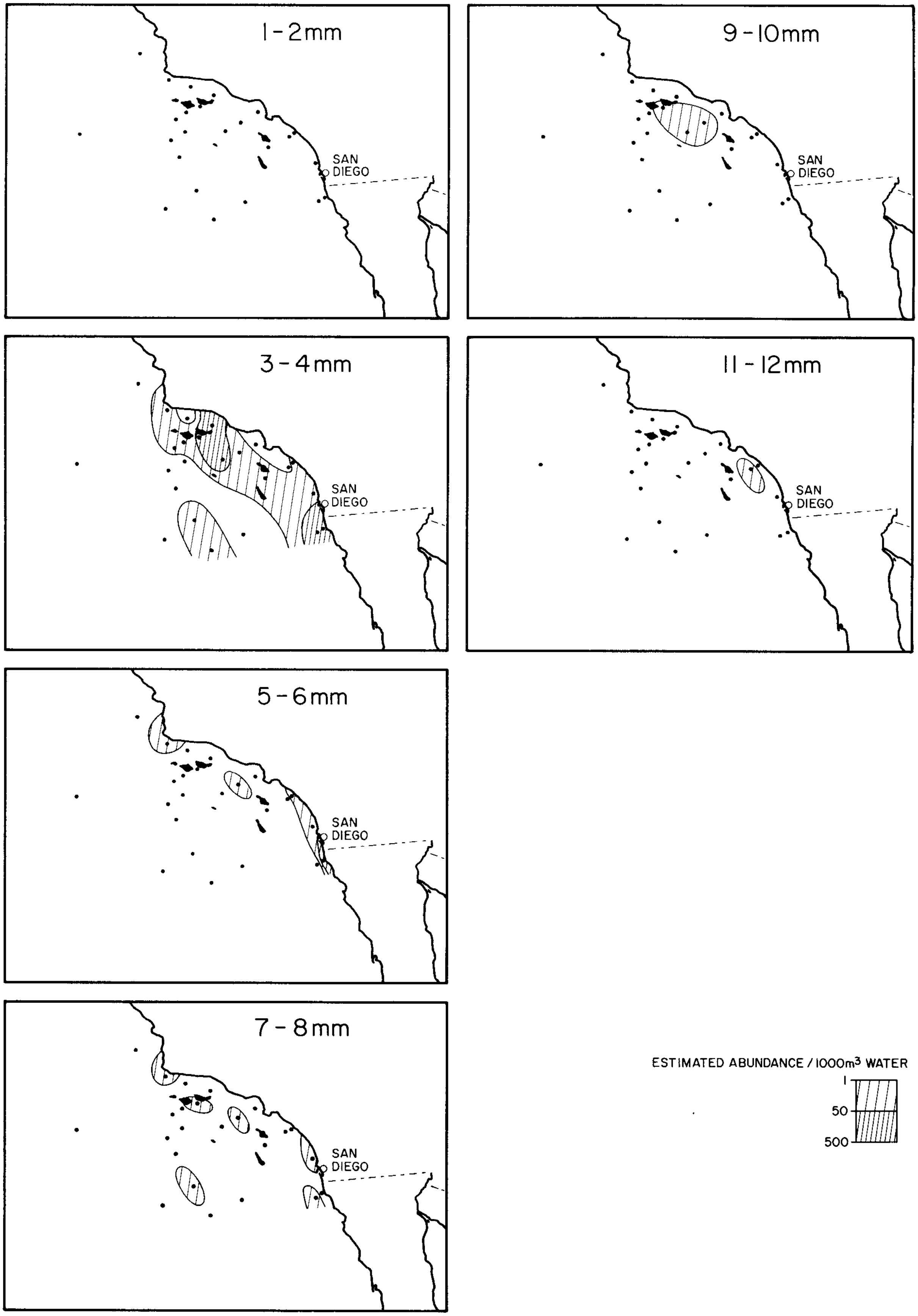
CALCOFI CRUISE 5312

3 - 9 DECEMBER 1953

Euphausiacea

Nyctiphanes simplex

5312



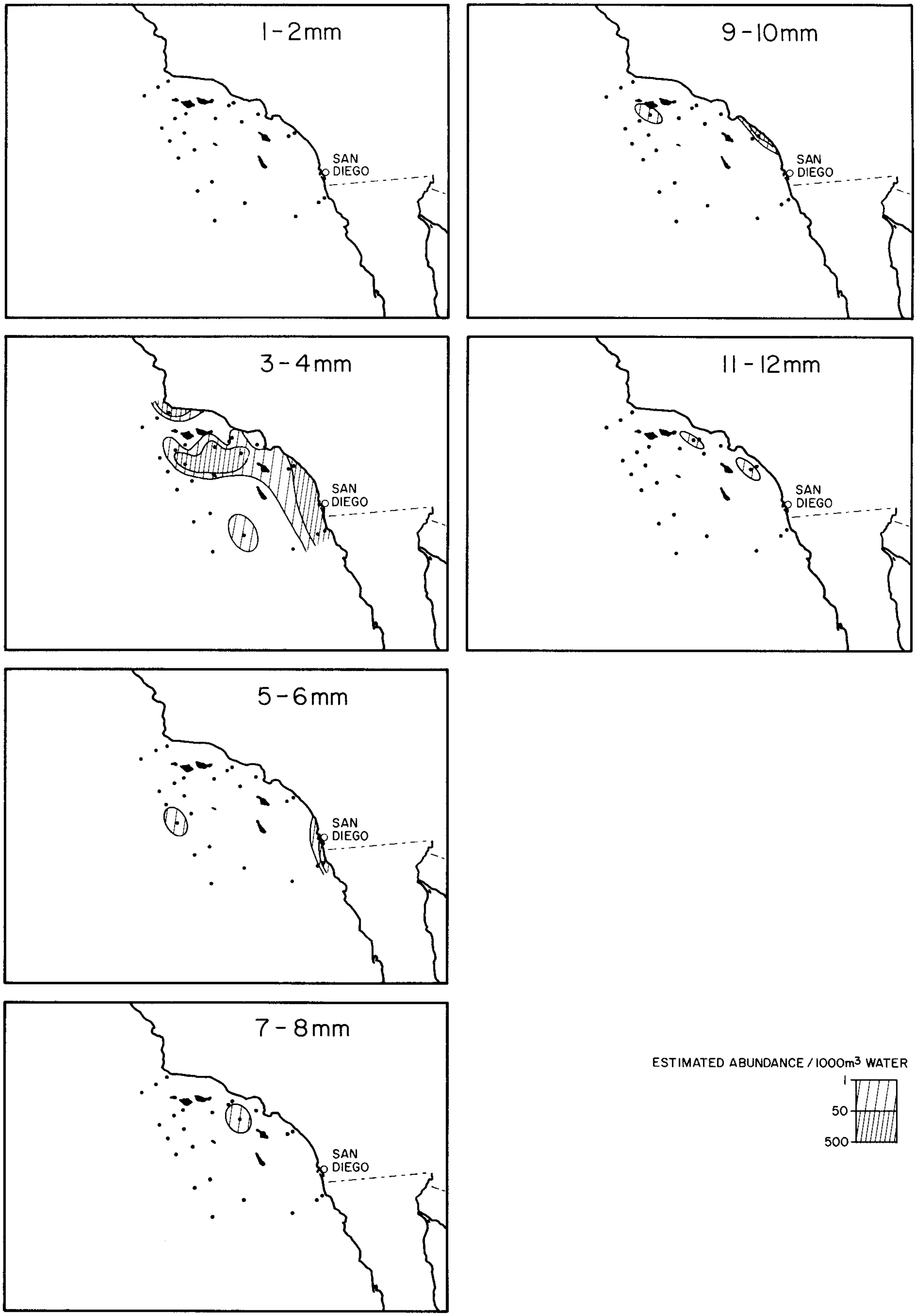
CALCOFI CRUISE 5401

5-15 JANUARY 1954

Euphausiacea

Nyctiphanes simplex

5401



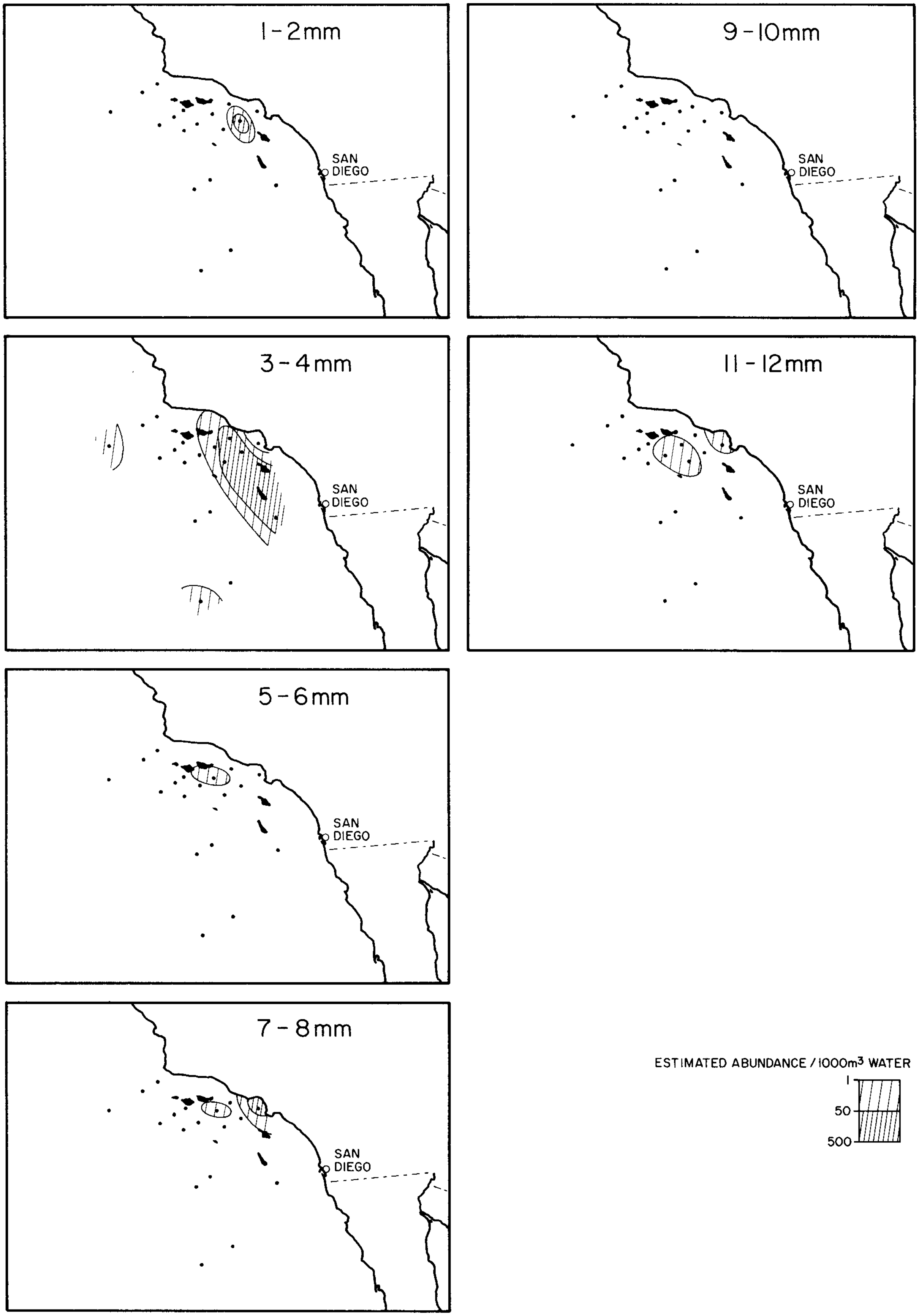
CALCOFI CRUISE 5402

3 - 12 FEBRUARY 1954

Euphausiacea

Nyctiphanes simplex

5402



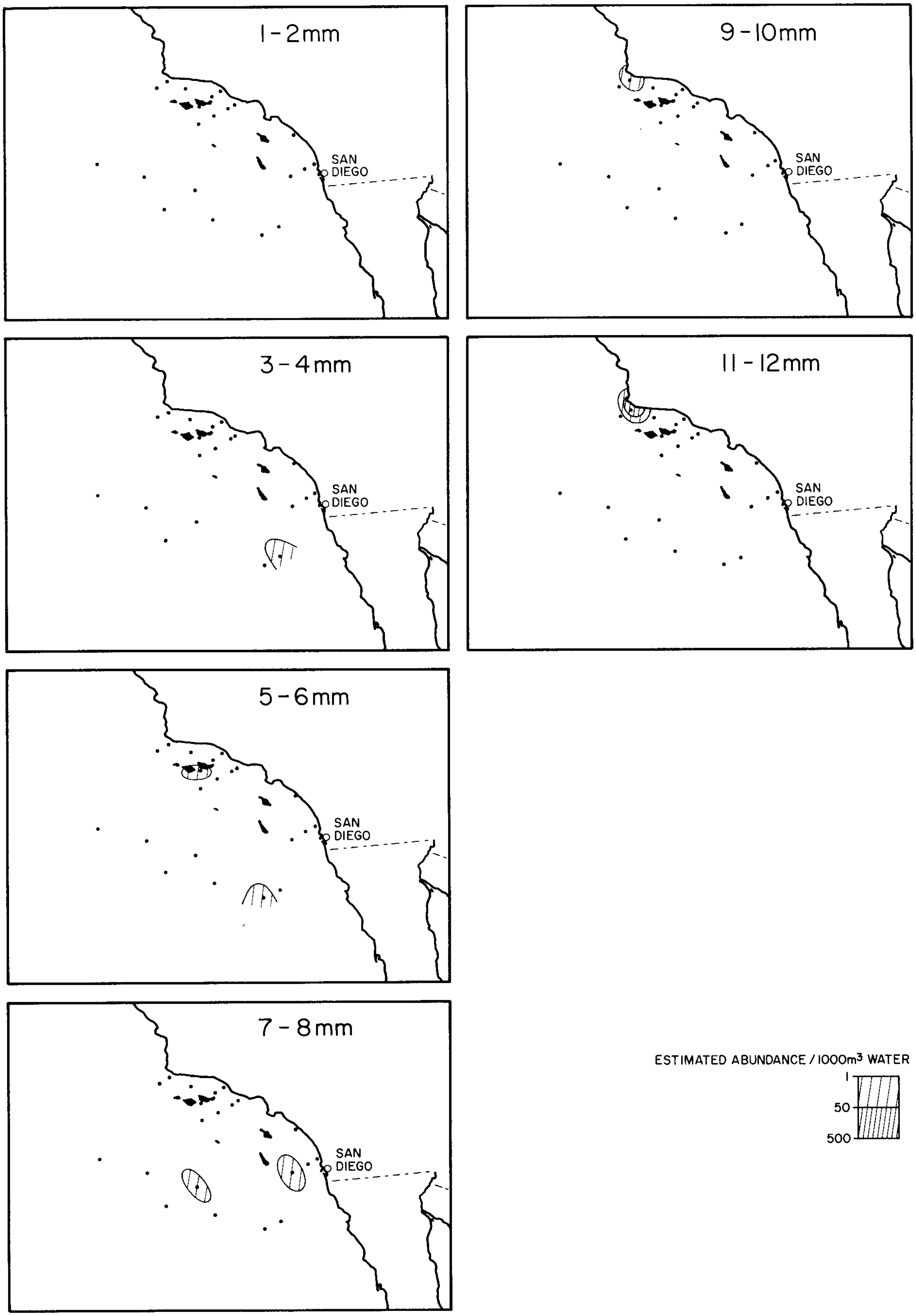
CALCOFI CRUISE 5403

5-18 MARCH 1954

Euphausiacea

Nyctiphanes simplex

5403



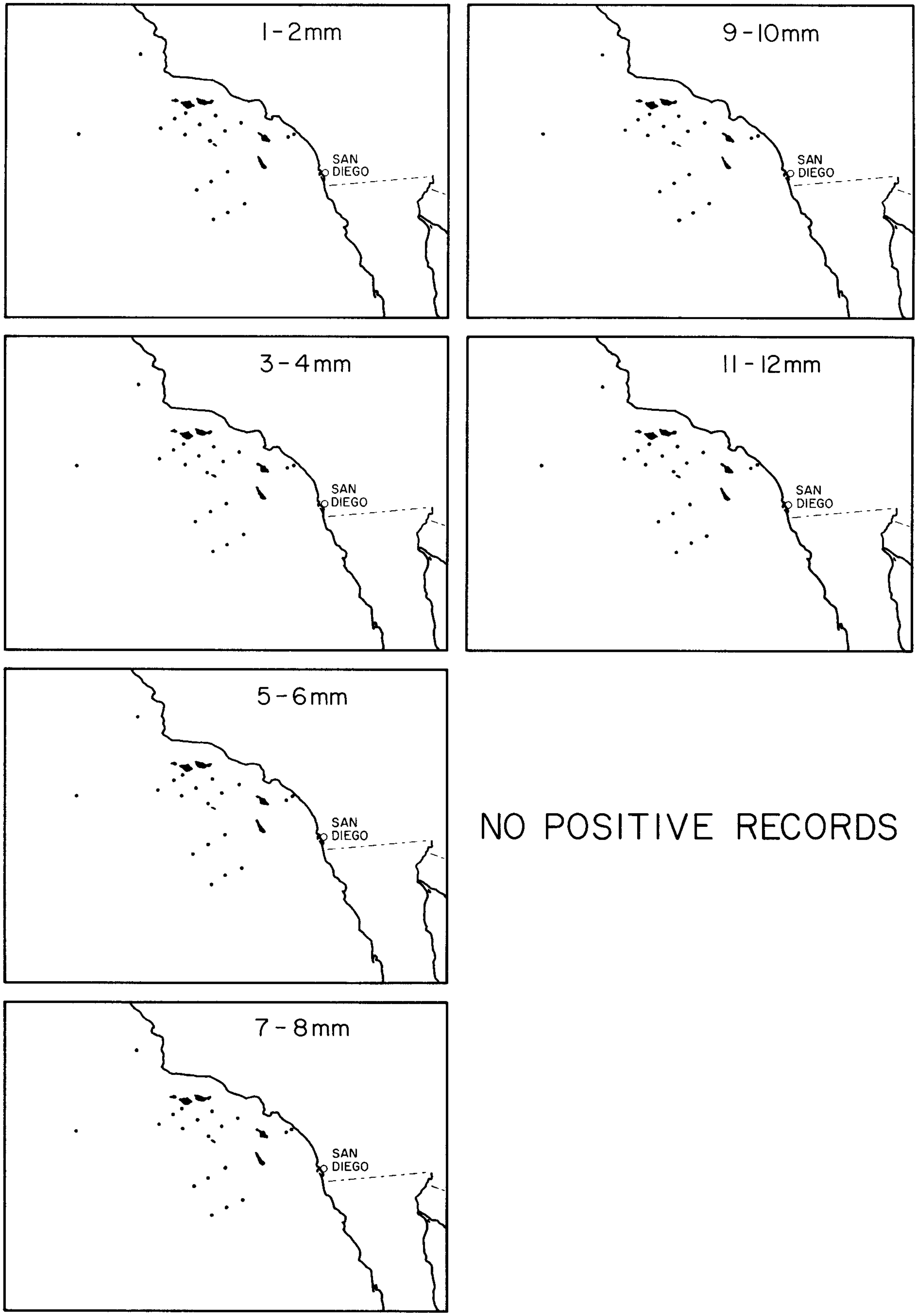
CALCOFI CRUISE 5404

7-19 APRIL 1954

Euphausiacea

Nyctiphanes simplex

5404



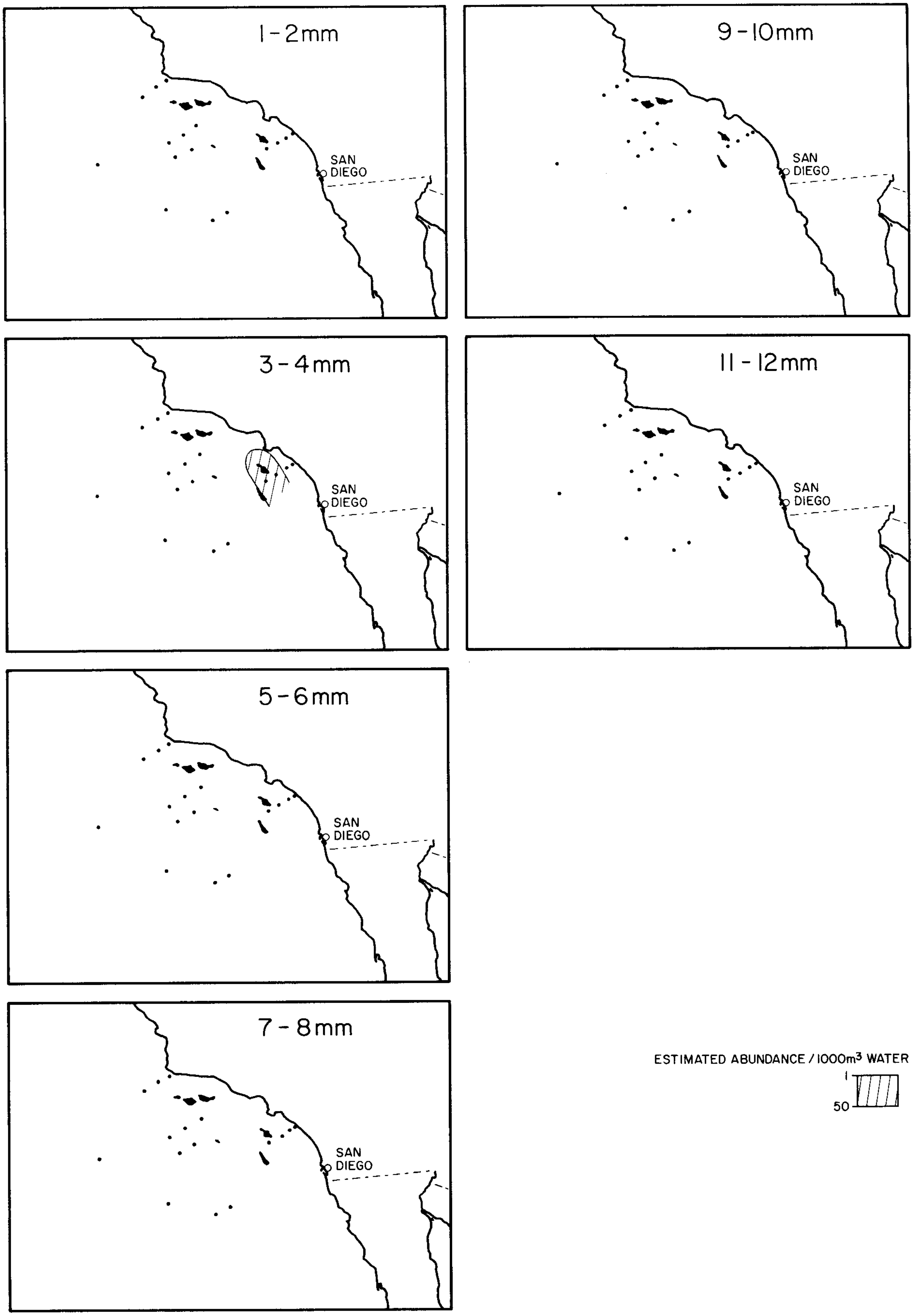
CALCOFI CRUISE 5405

13 - 22 MAY 1954

Euphausiacea

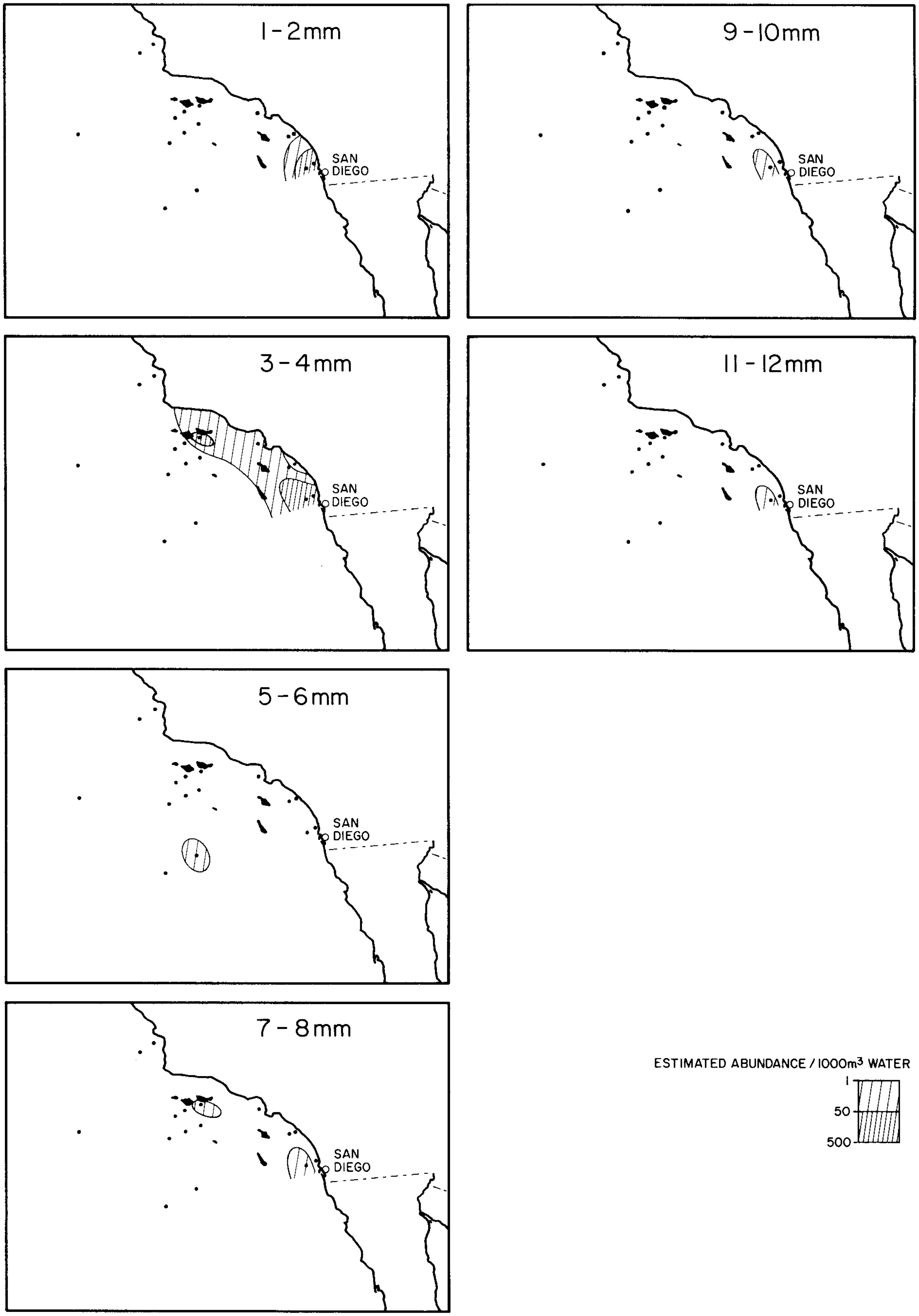
Nyctiphanes simplex

5405



CALCOFI CRUISE 5406
13 - 20 JUNE 1954

Euphausiacea
Nyctiphanes simplex
5406



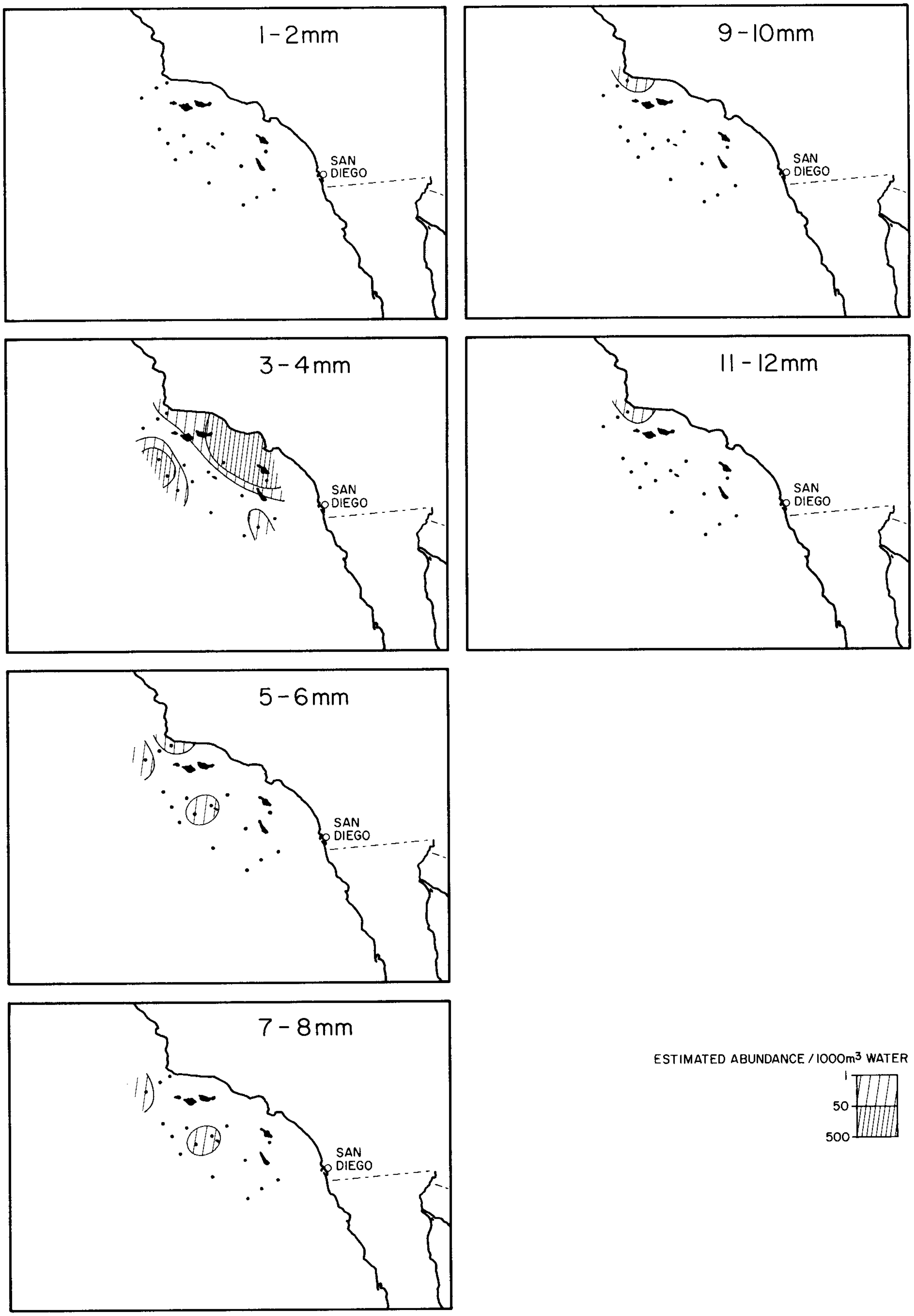
CALCOFI CRUISE 5407

13 - 21 JULY 1954

Euphausiacea

Nyctiphanes simplex

5407



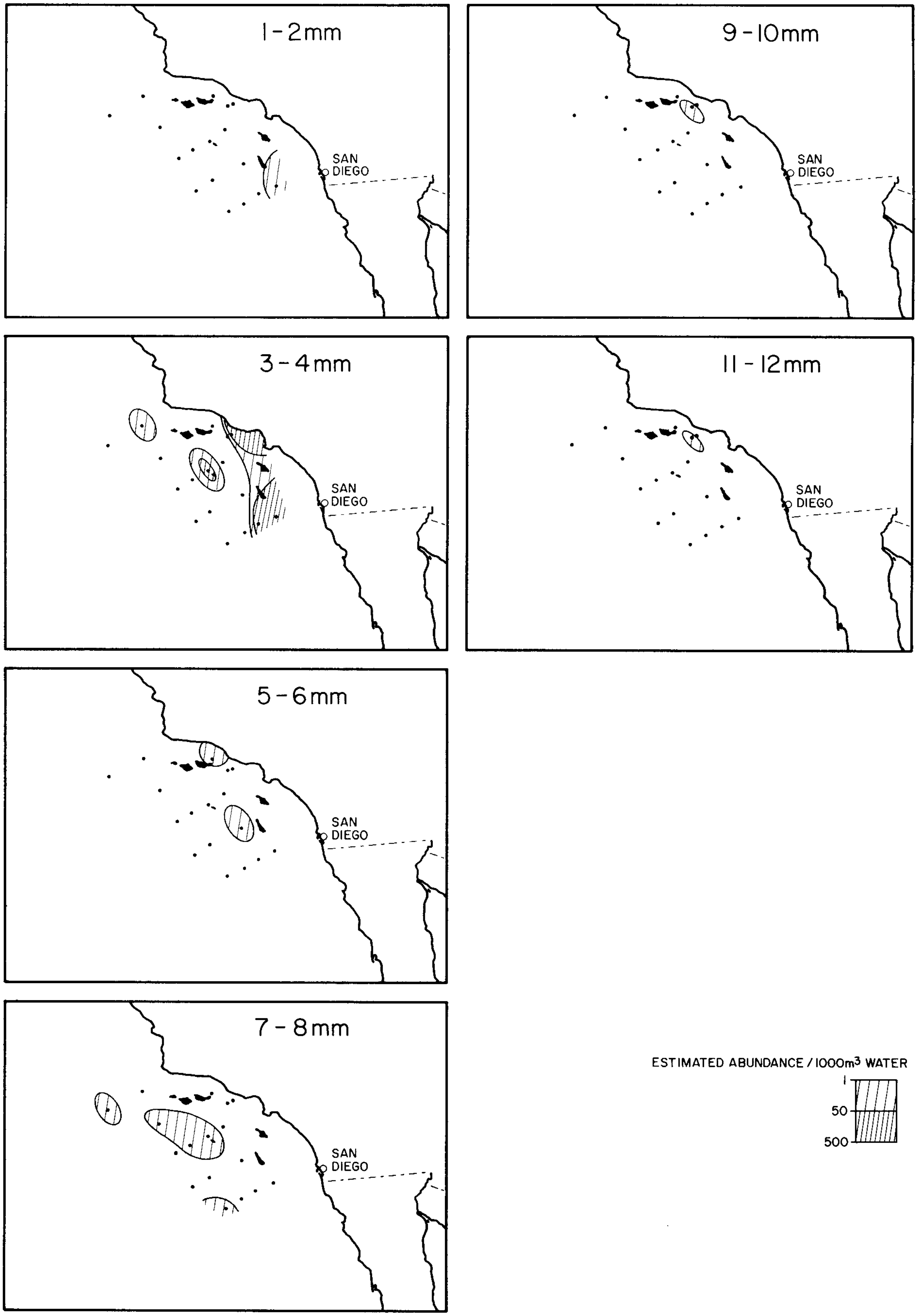
CALCOFI CRUISE 5408

4-9 SEPTEMBER 1954
MAIN PORTION OF CRUISE OCCUPIED IN AUGUST

Euphausiacea

Nyctiphanes simplex

5408



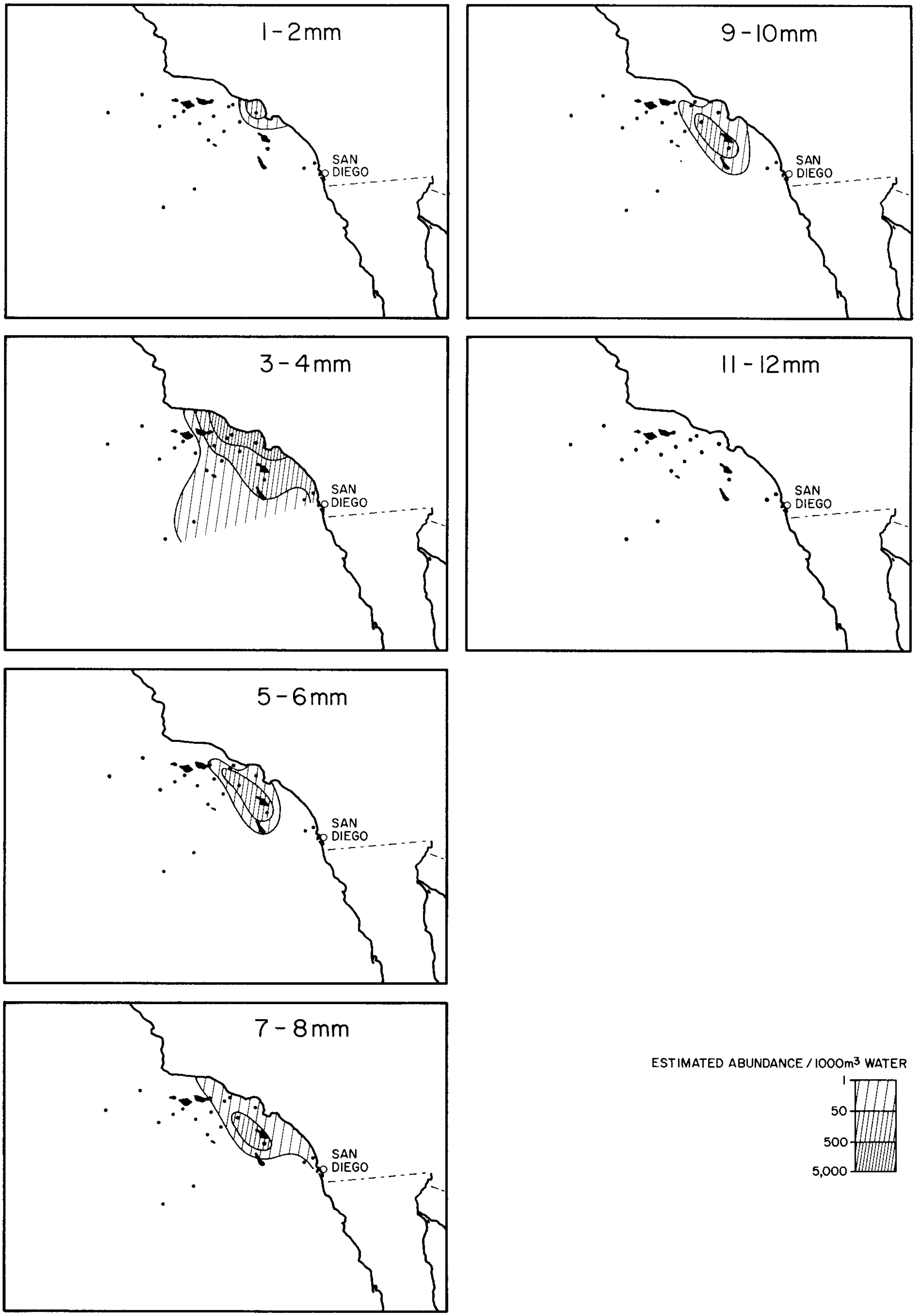
CALCOFI CRUISE 5410

7 - 14 OCTOBER 1954

Euphausiacea

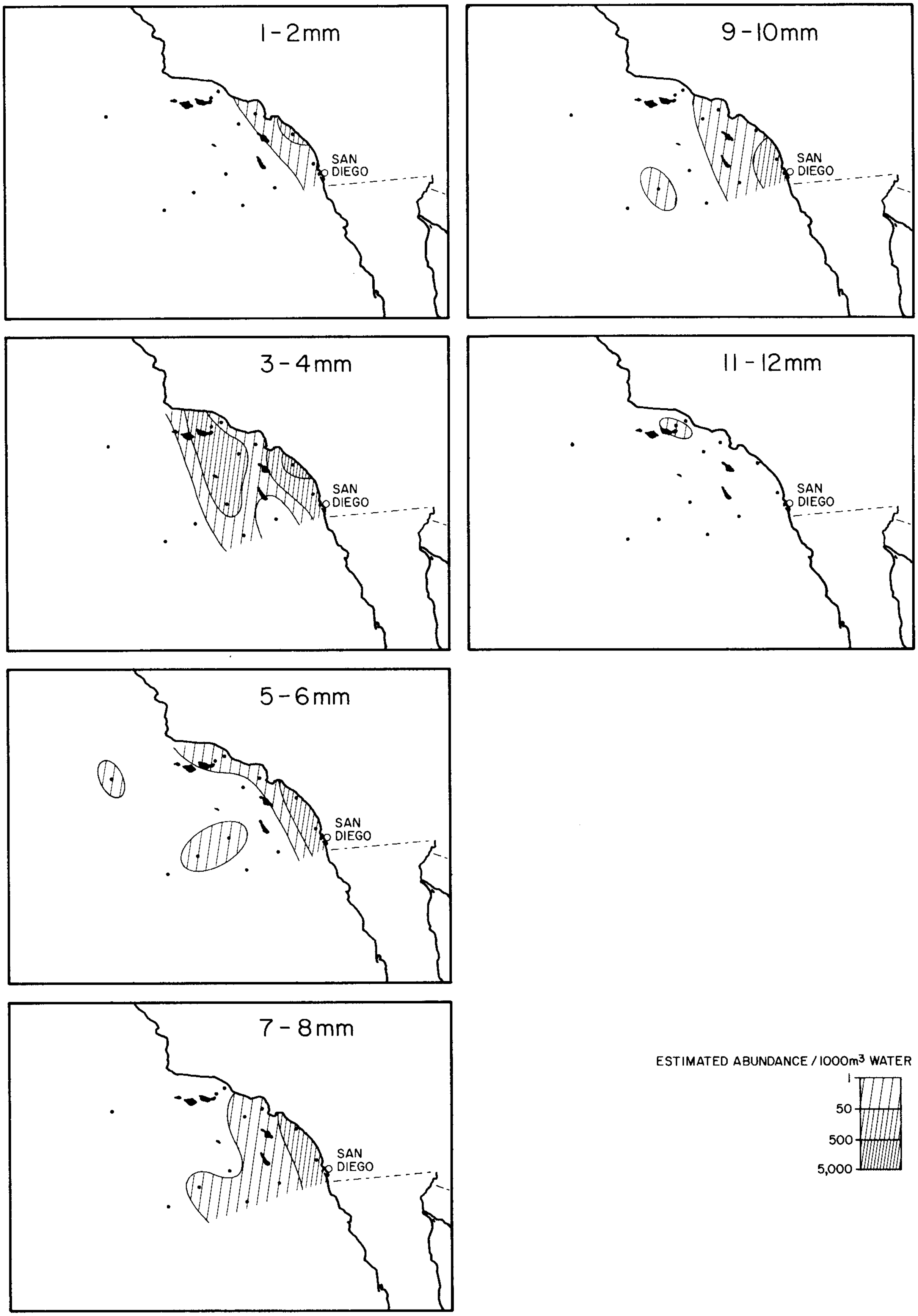
Nyctiphanes simplex

5410



CALCOFI CRUISE 5412
2 - 9 DECEMBER 1954

Euphausiacea
Nyctiphanes simplex
5412



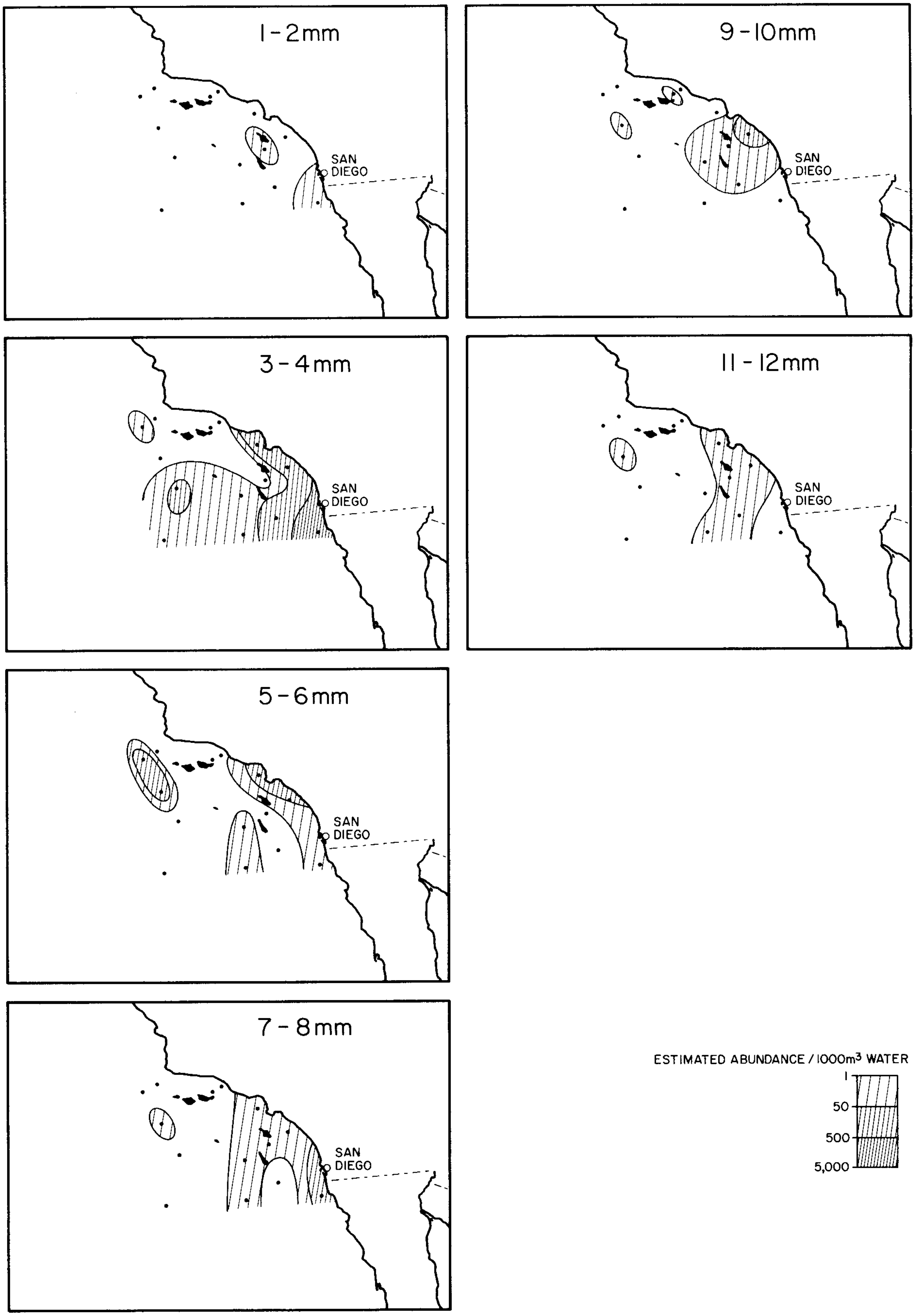
CALCOFI CRUISE 5501

13 - 19 JANUARY 1955

Euphausiacea

Nyctiphanes simplex

5501



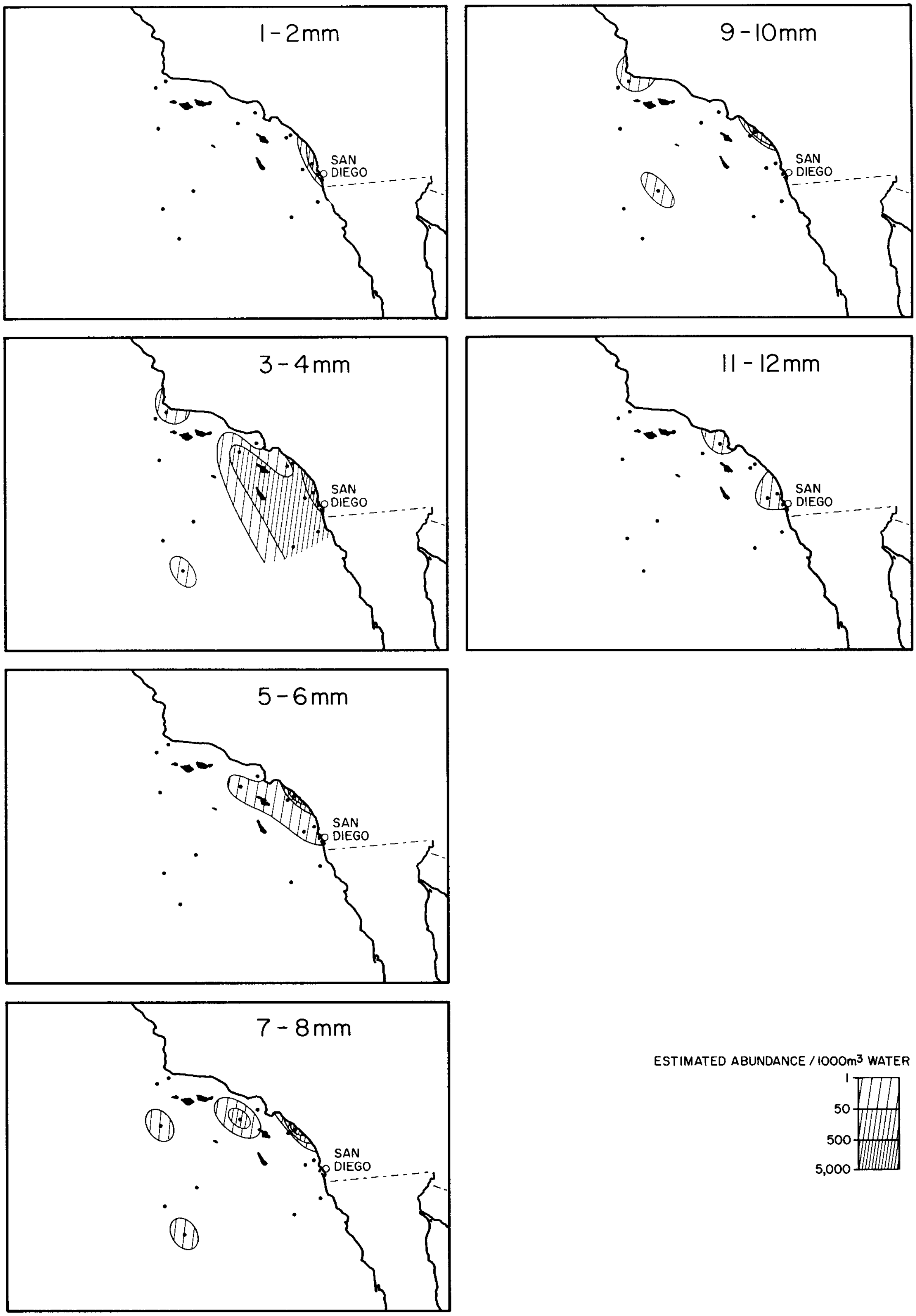
Euphausiacea

Nyctiphanes simplex

5502

CALCOFI CRUISE 5502

11-17 FEBRUARY 1955



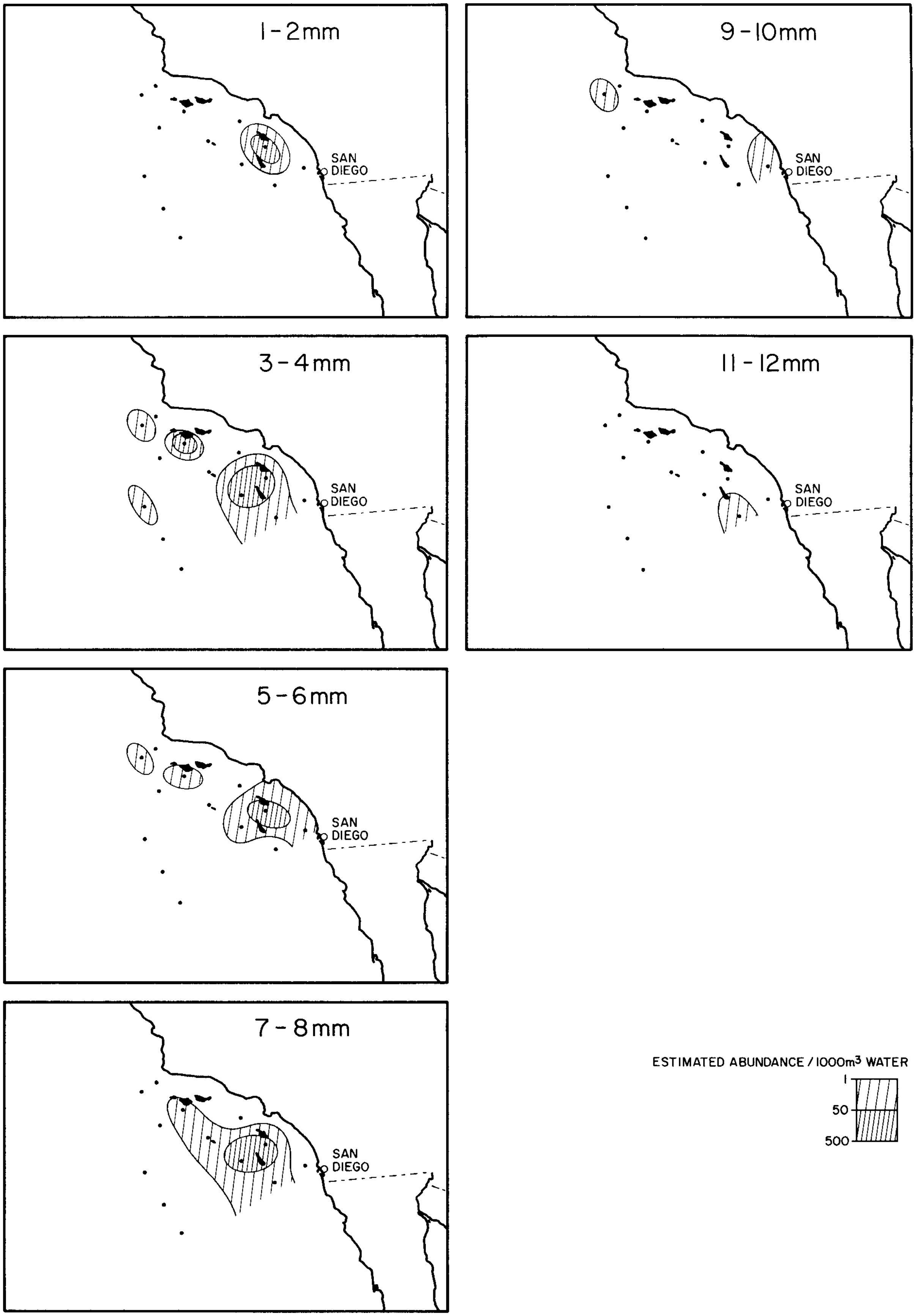
CALCOFI CRUISE 5503

8-16 MARCH 1955

Euphausiacea

Nyctiphanes simplex

5503



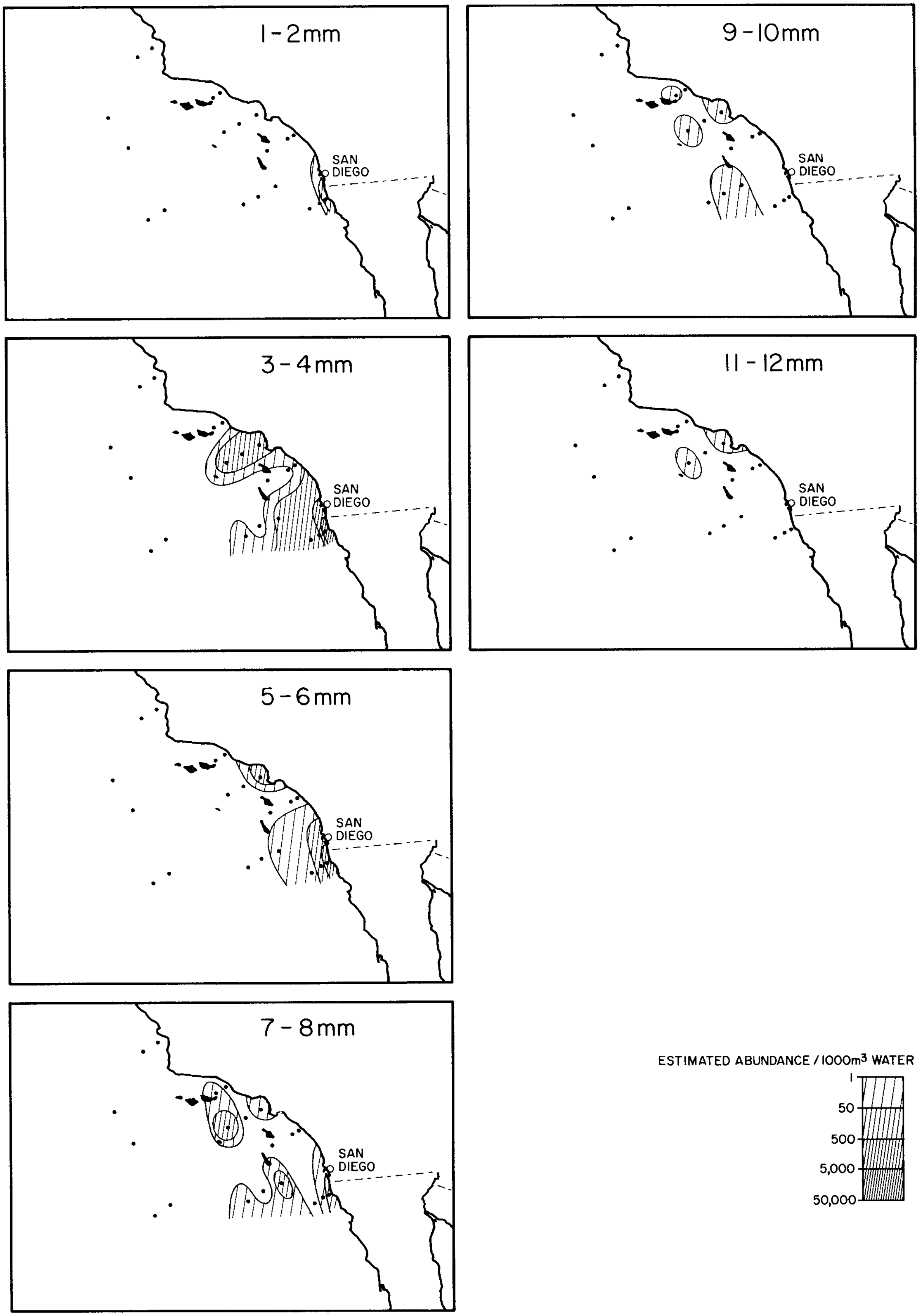
CALCOFI CRUISE 5504

7-16 APRIL 1955

Euphausiacea

Nyctiphanes simplex

5504



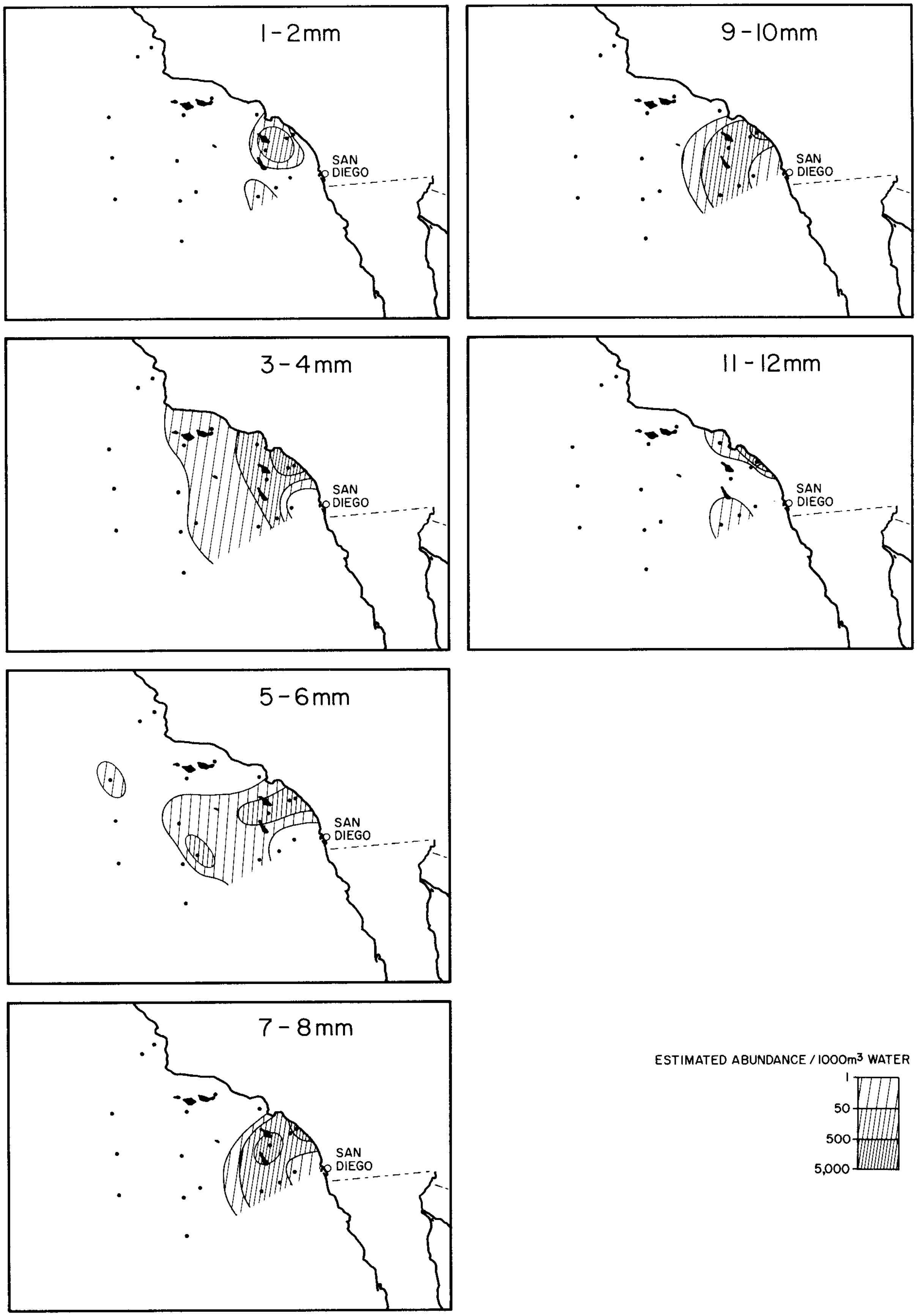
CALCOFI CRUISE 5505

21 MAY - 6 JUNE 19

Euphausiacea

Nyctiphanes simplex

5505



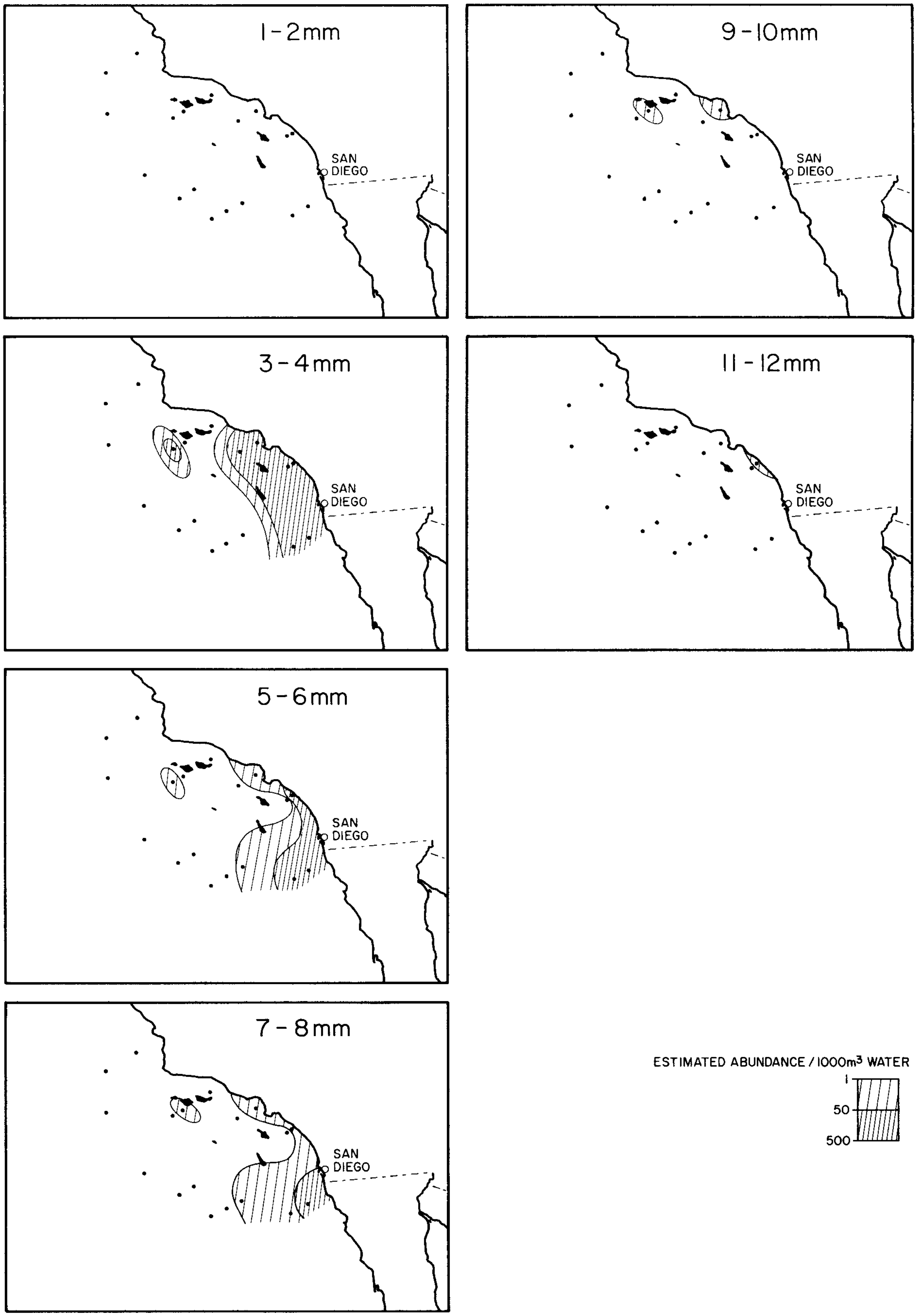
CALCOFI CRUISE 5506

11 - 20 JUNE 1955

Euphausiacea

Nyctiphanes simplex

5506



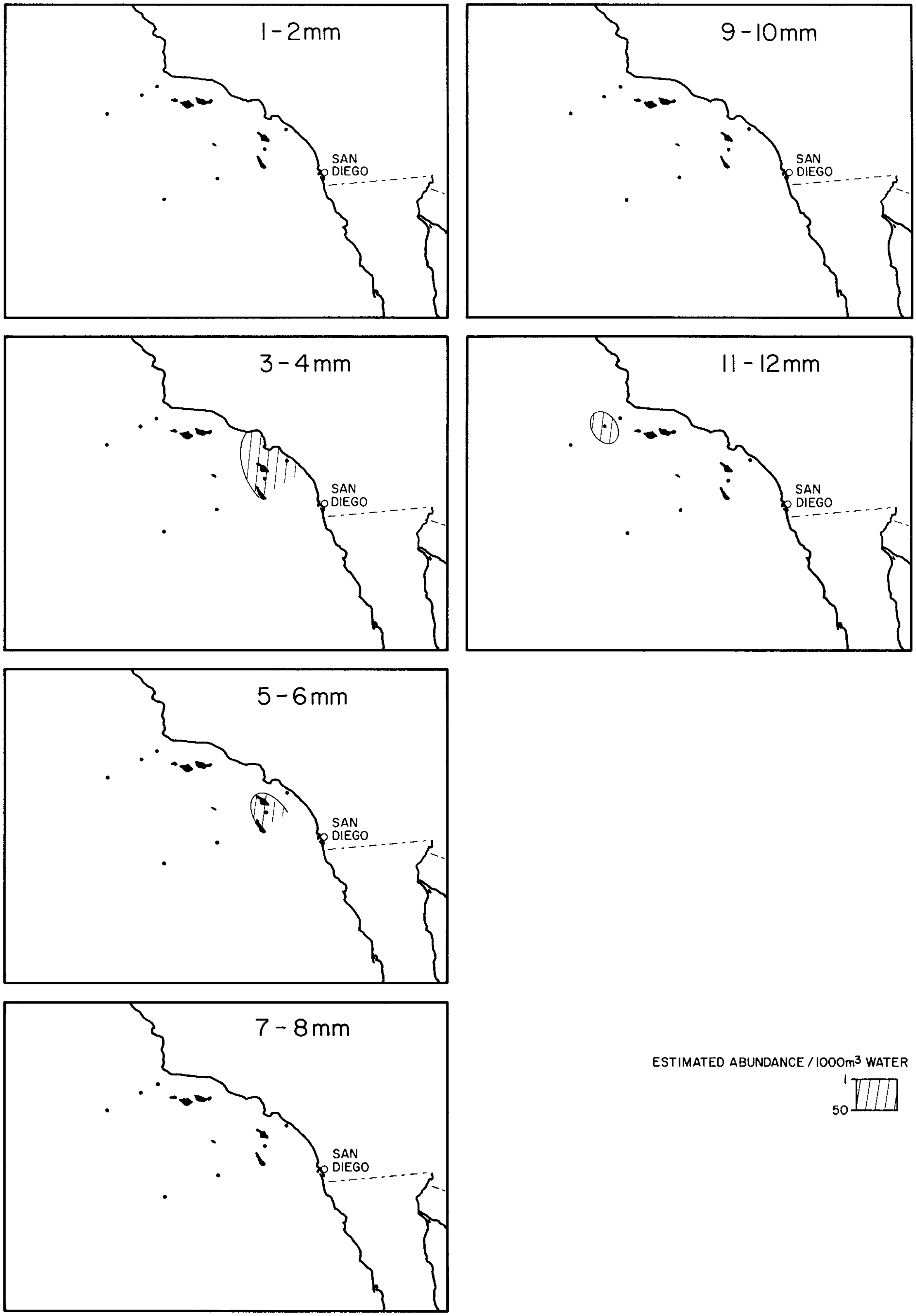
CALCOFI CRUISE 5507

7-13 JULY 1955

Euphausiacea

Nyctiphanes simplex

5507



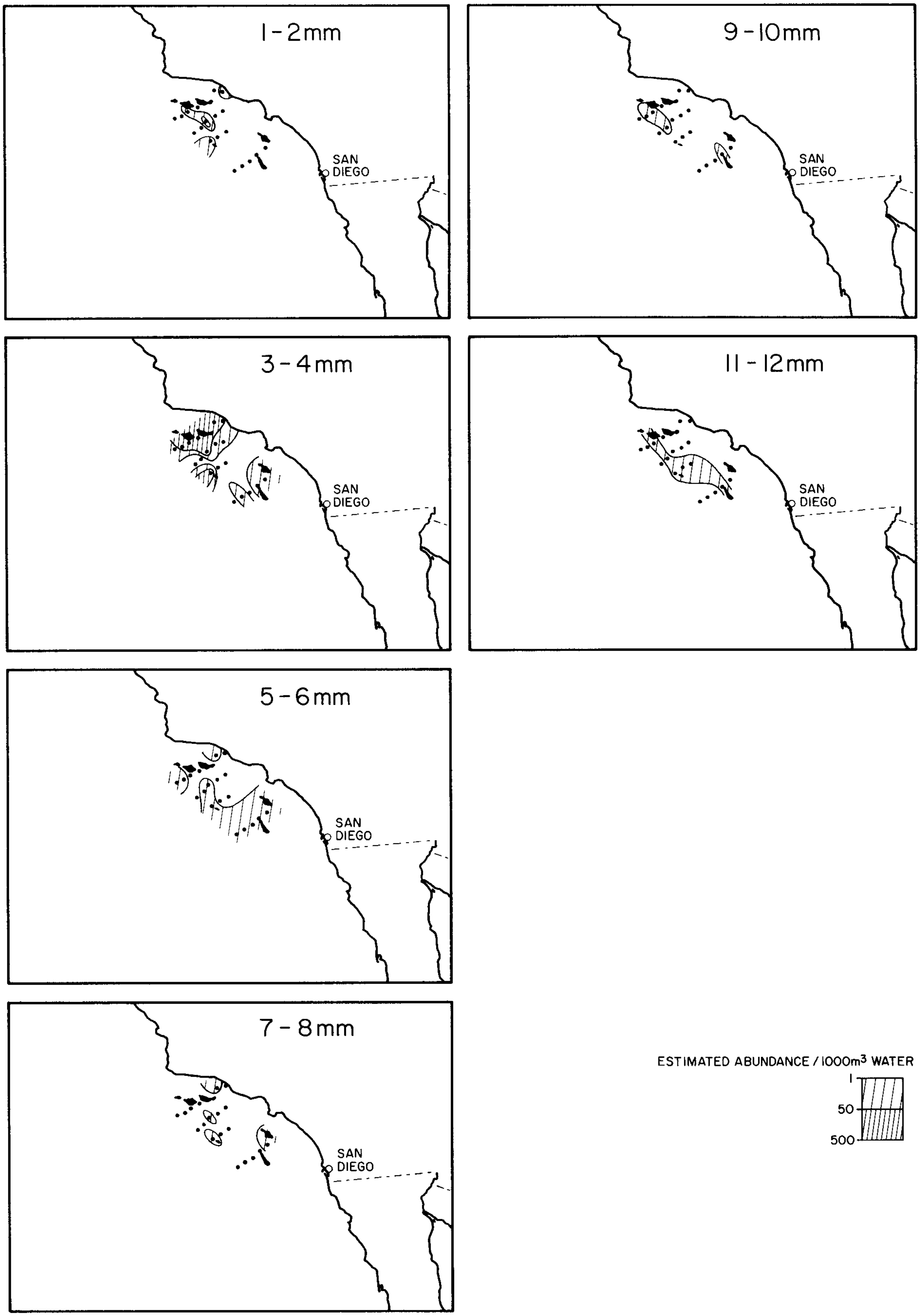
CALCOFI CRUISE 5508 'NORPAC'

4-6 SEPTEMBER 1955
MAIN PORTION OF CRUISE OCCUPIED IN AUGUST

Euphausiacea

Nyctiphanes simplex

5508 'NORPAC'



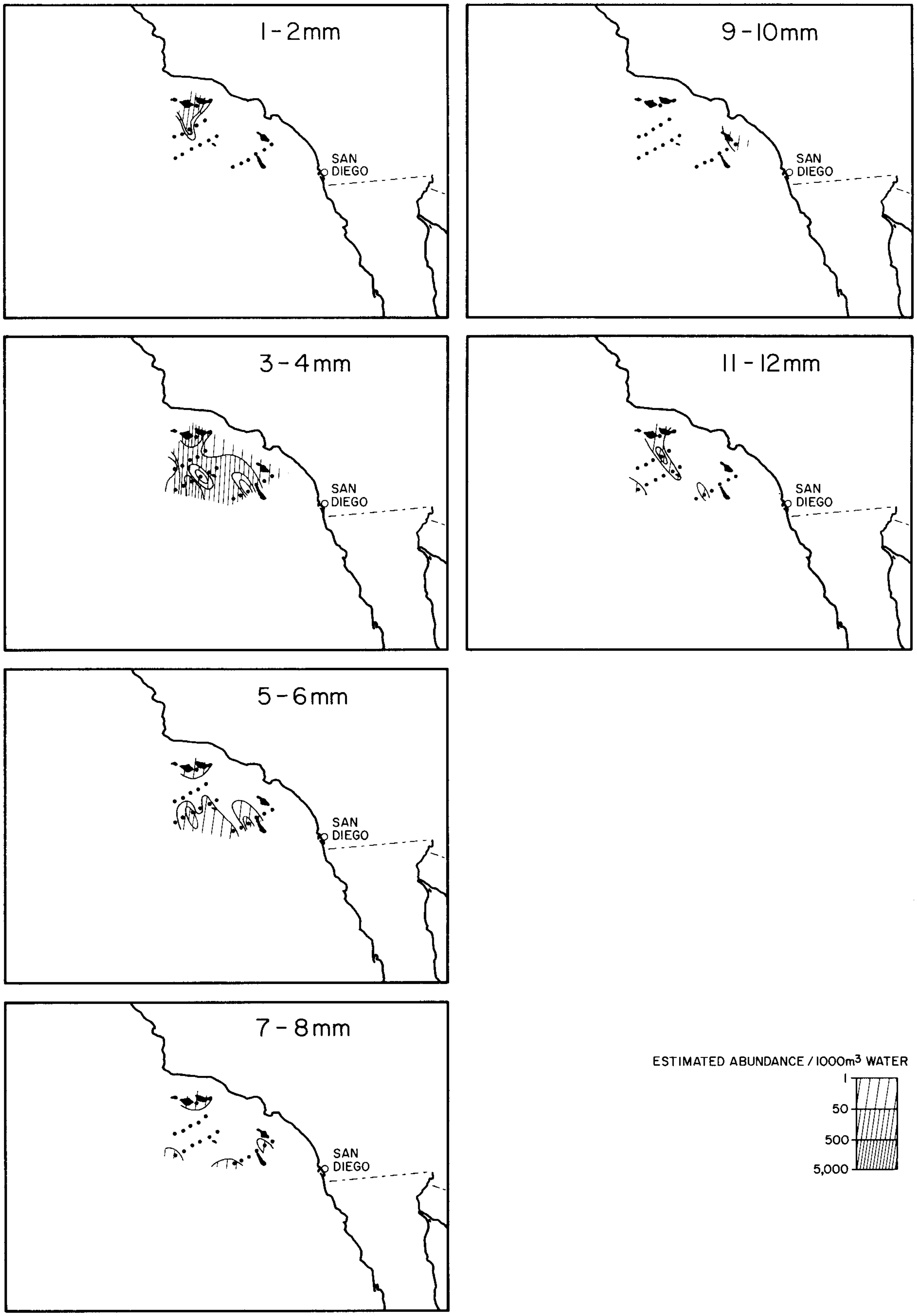
CALCOFI CRUISE 5509-I

12-17 SEPTEMBER 1955

Euphausiacea

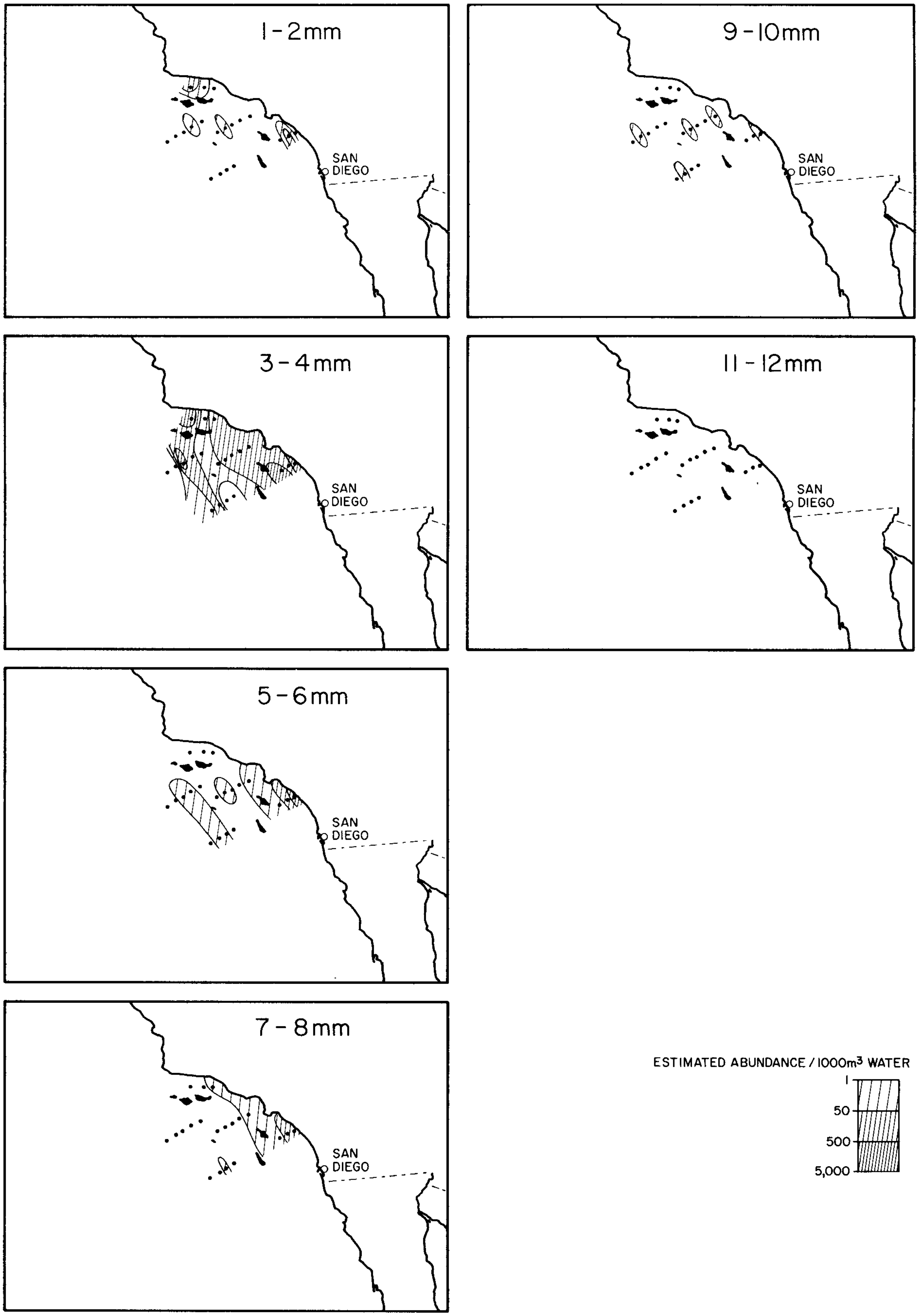
Nyctiphanes simplex

5509-I



CALCOFI CRUISE 5509-II
15-19 SEPTEMBER 1955

Euphausiacea
Nyctiphanes simplex
5509-II



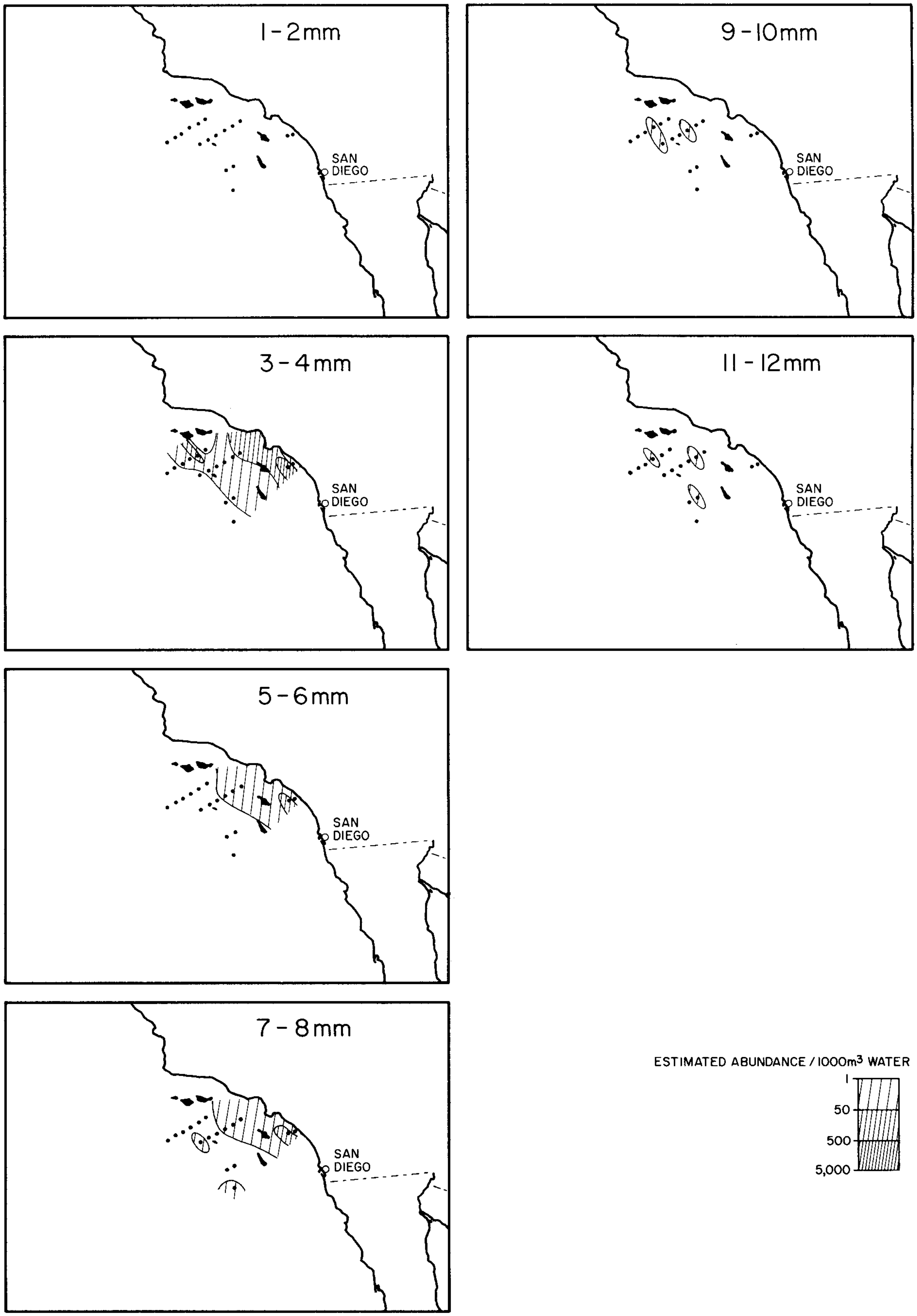
CALCOFI CRUISE 5509-III

18-23 SEPTEMBER 1955

Euphausiacea

Nyctiphanes simplex

5509-III



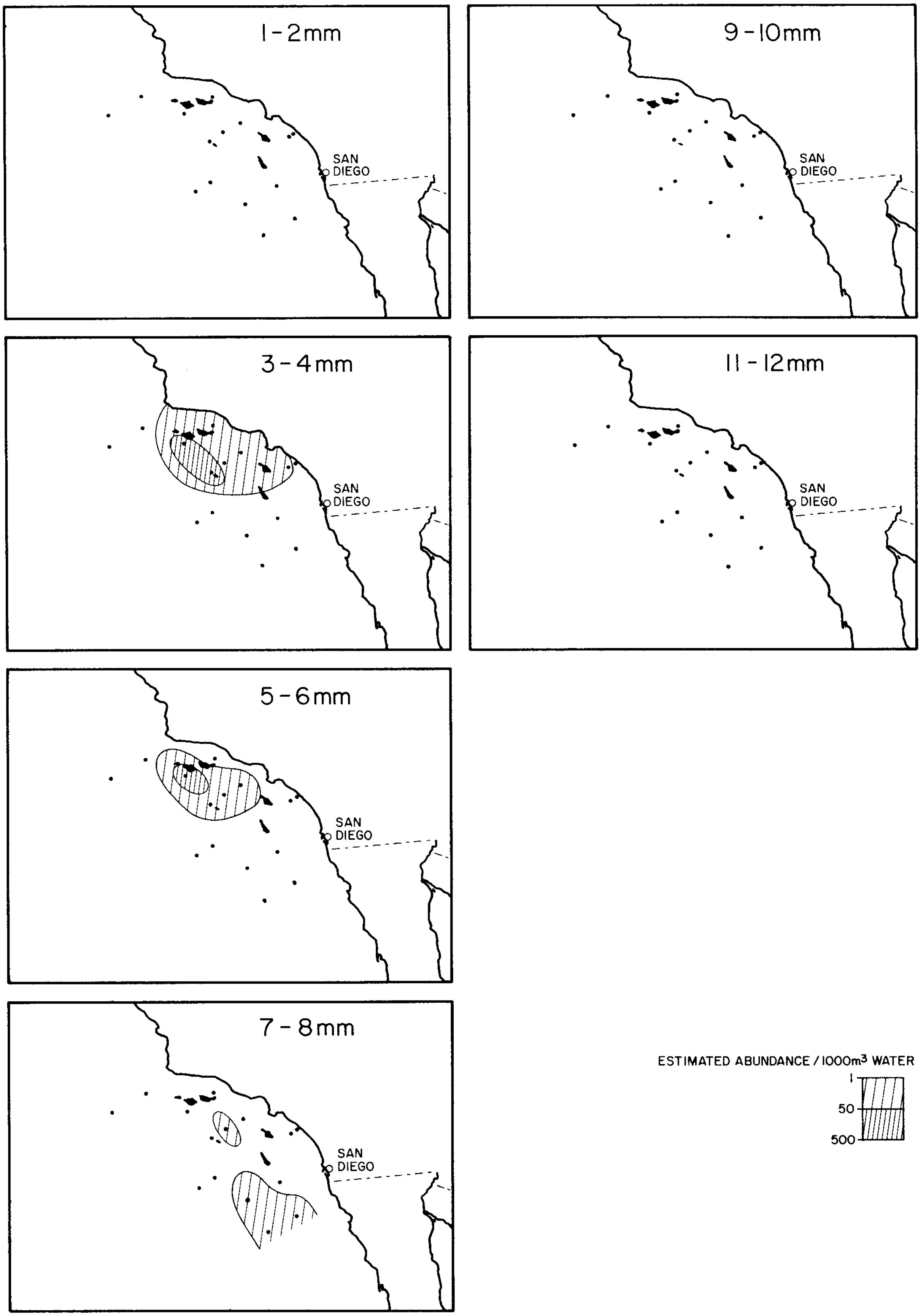
CALCOFI CRUISE 5509-IV

21 - 24 SEPTEMBER 1955

Euphausiacea

Nyctiphanes simplex

5509 - IV



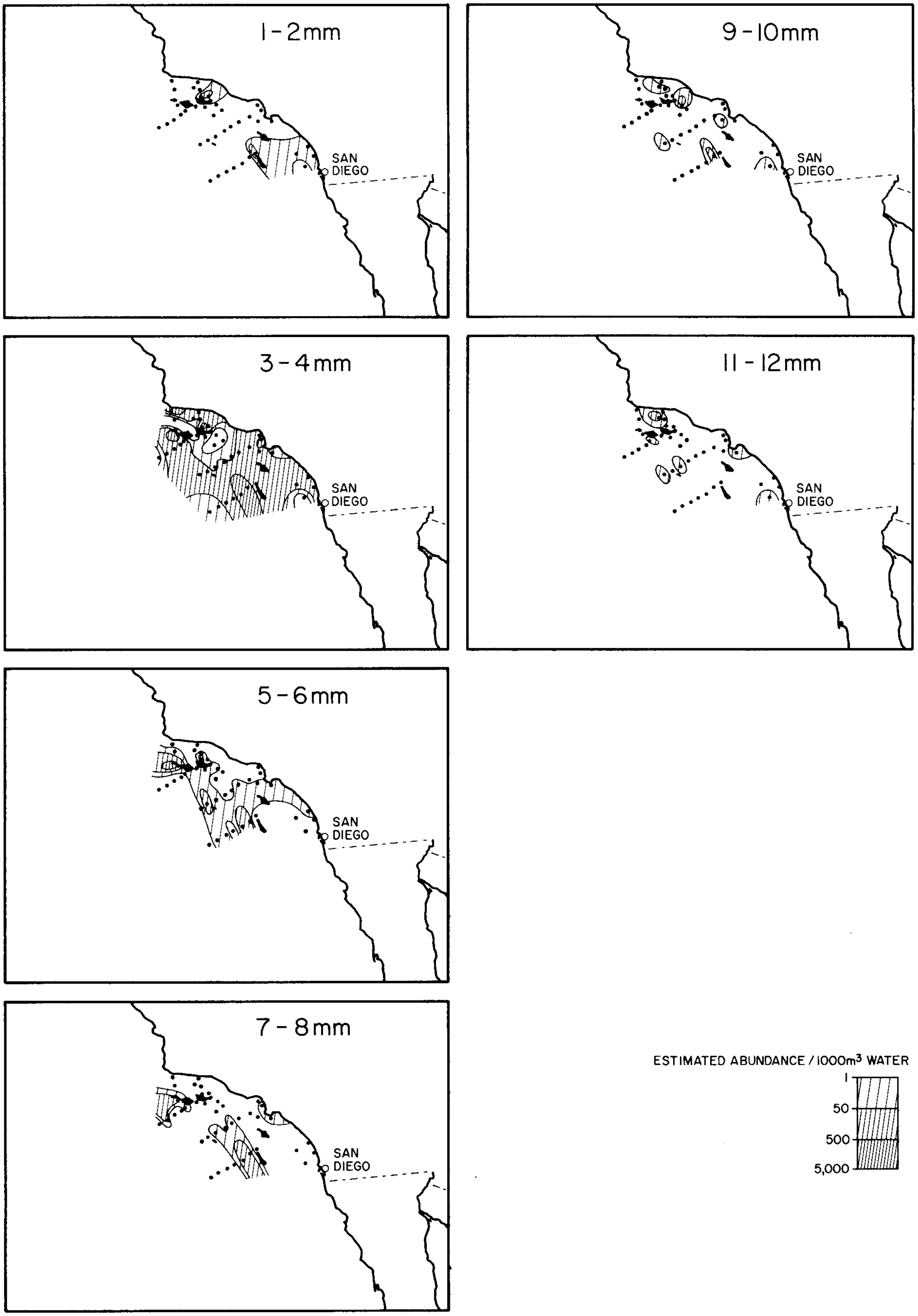
Euphausiacea

CALCOFI CRUISE 5510

21-29 OCTOBER 1955

Nyctiphanes simplex

5510



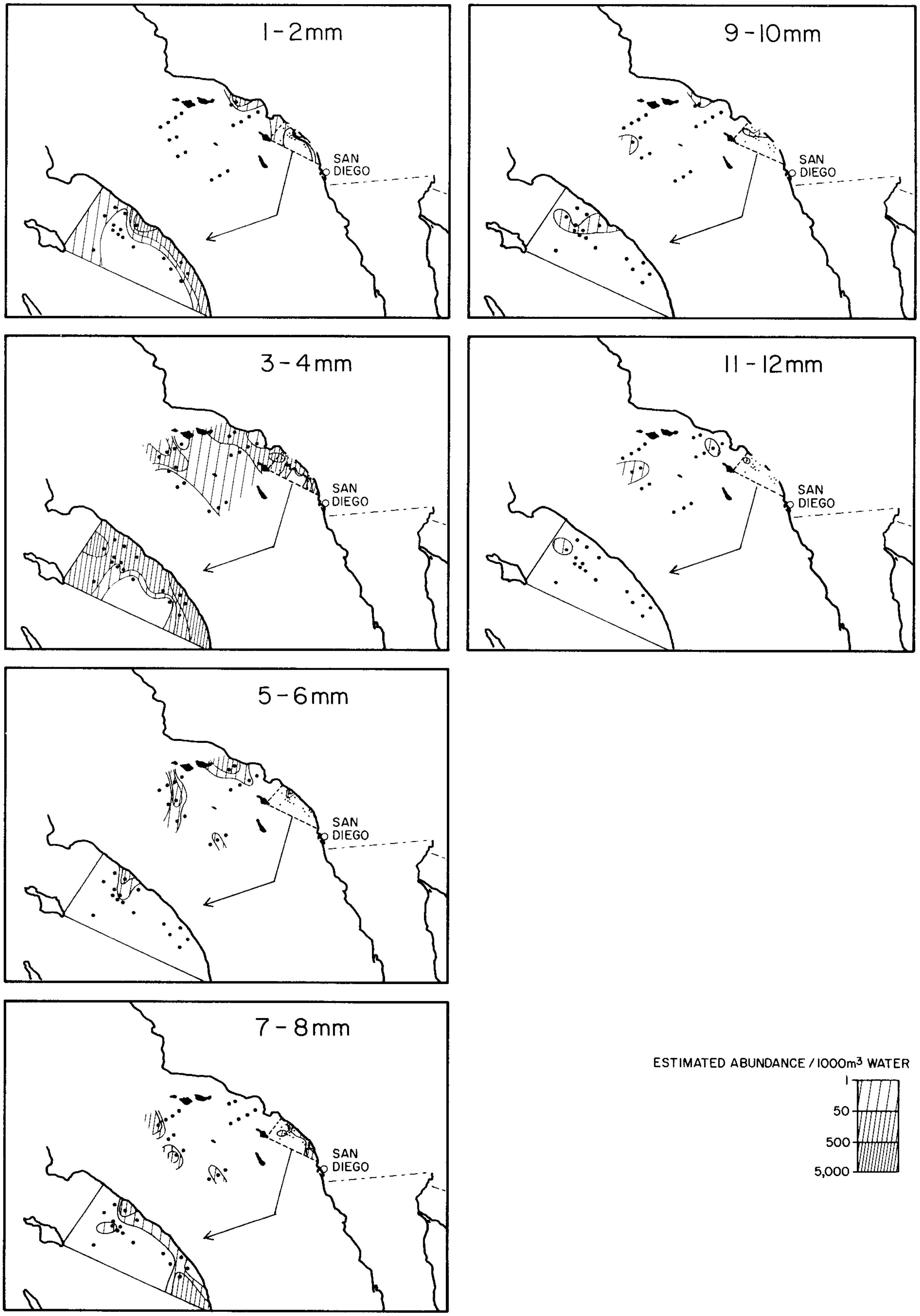
CALCOFI CRUISE 5511-I

8-13 NOVEMBER 1955

Euphausiacea

Nyctiphanes simplex

5511-I



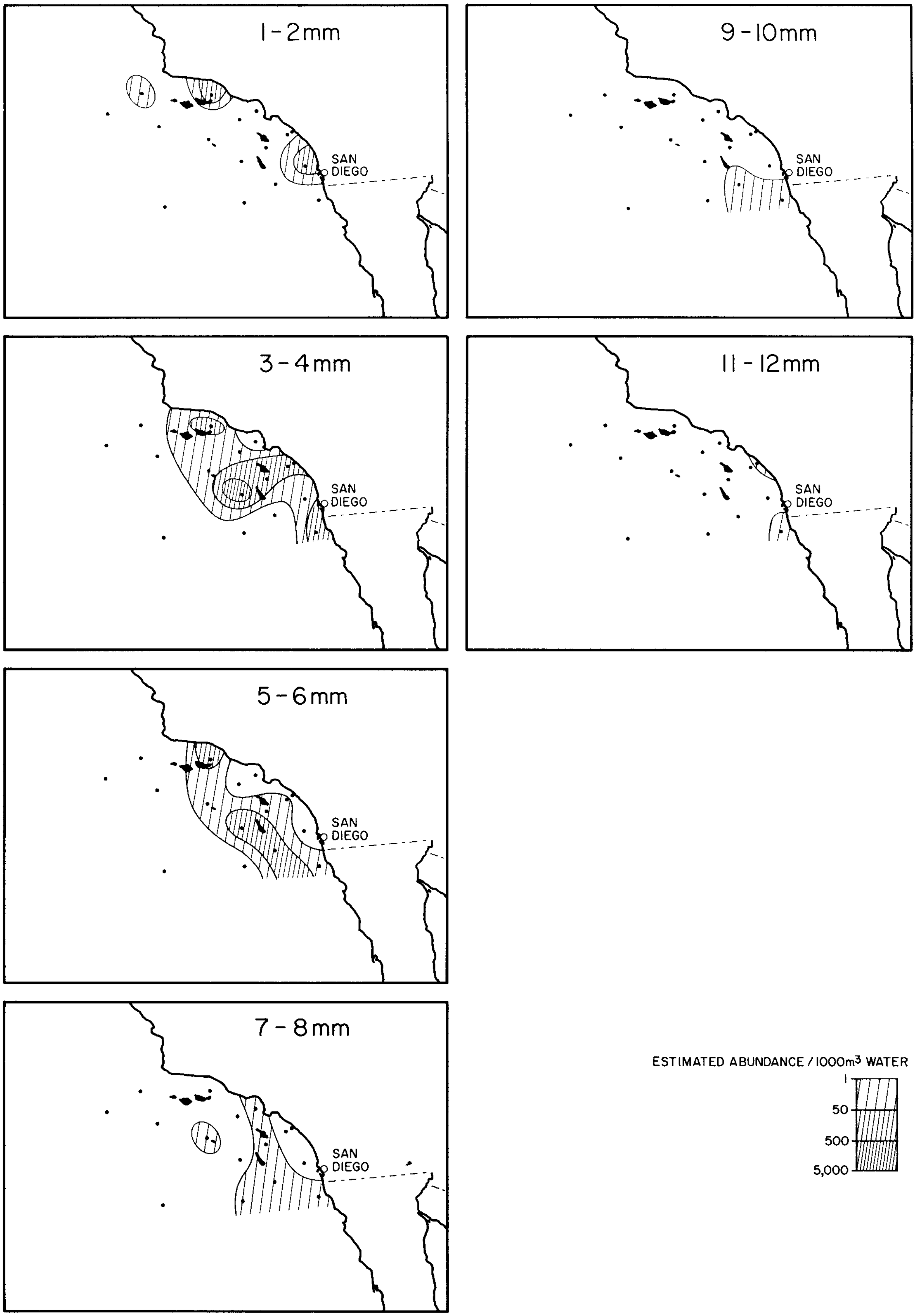
CALCOFI CRUISE 5511-II

16-19 NOVEMBER 1955

Euphausiacea

Nyctiphanes simplex

5511-II



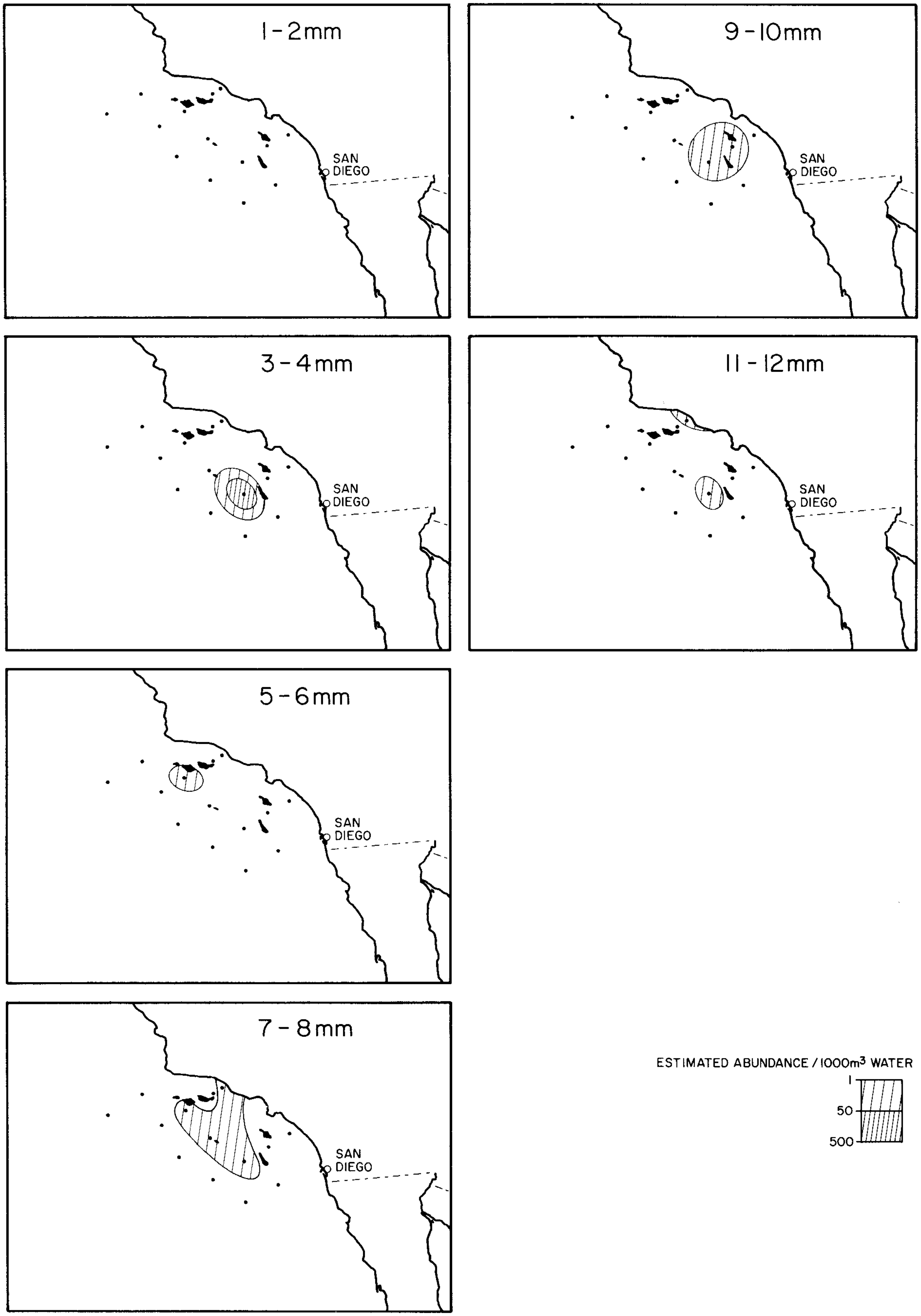
CALCOFI CRUISE 5512

30 NOVEMBER - 7 DECEMBER 1955

Euphausiacea

Nyctiphanes simplex

5512



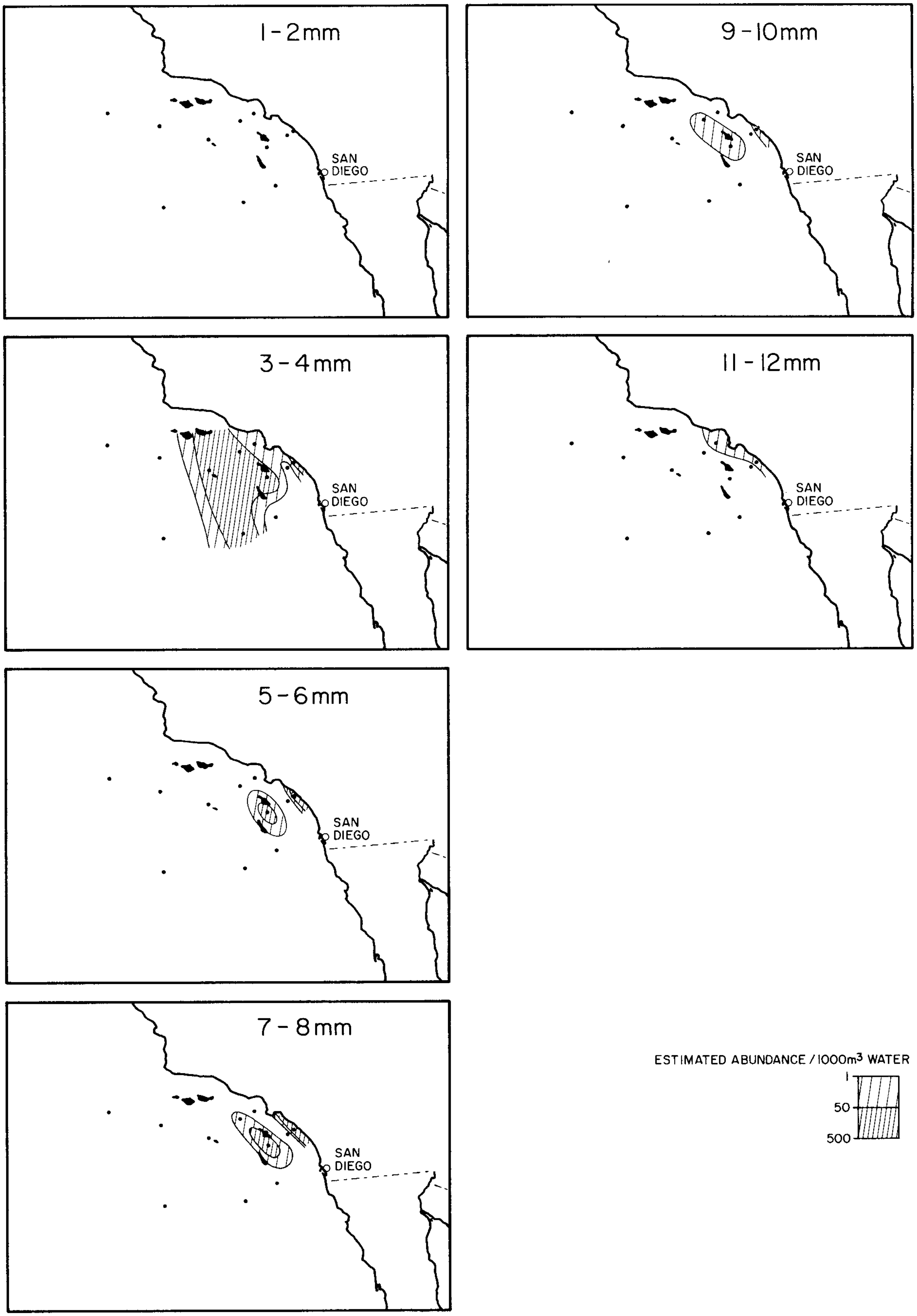
CALCOFI CRUISE 5601

6-10 JANUARY 1956

Euphausiacea

Nyctiphanes simplex

5601



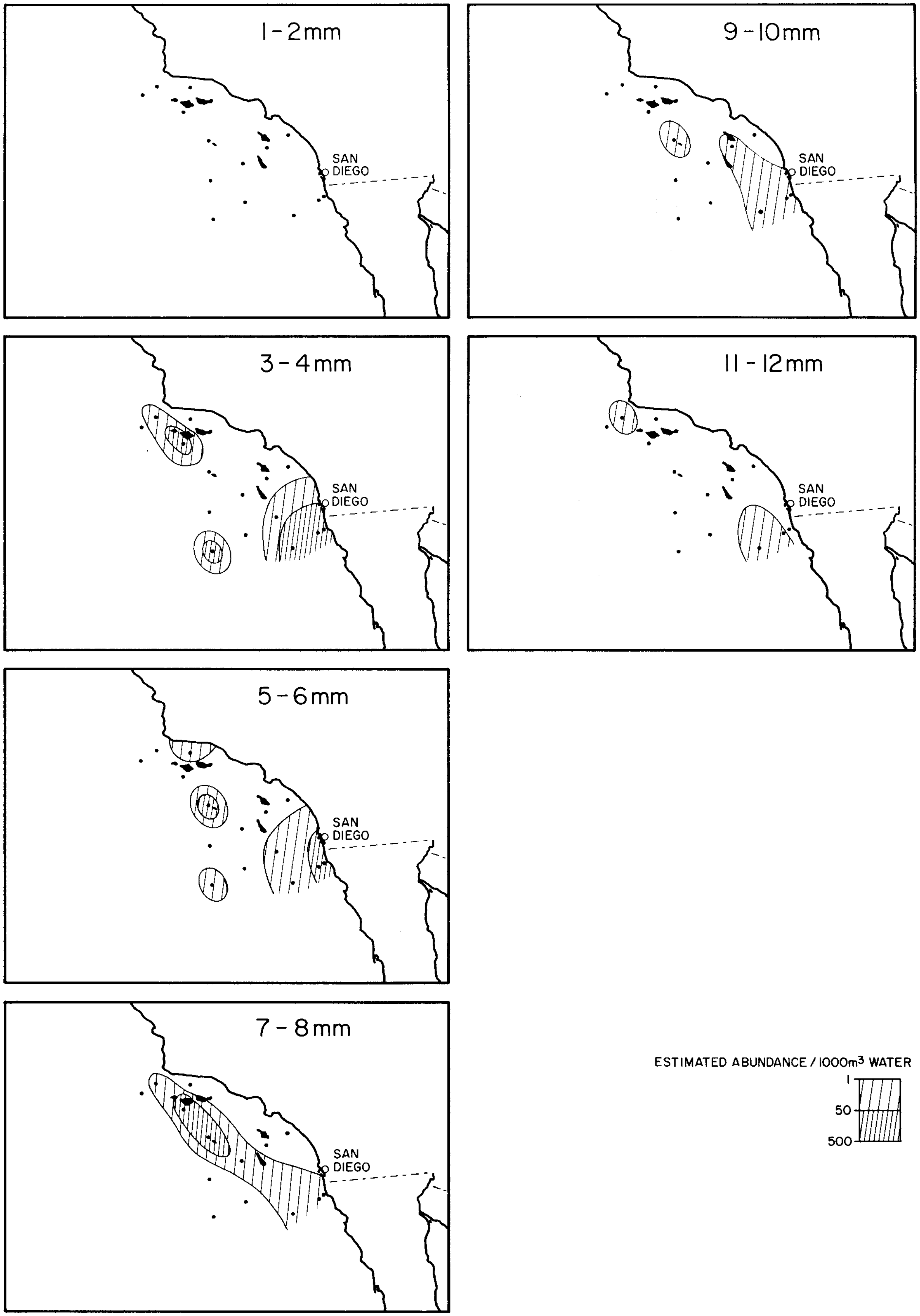
CALCOFI CRUISE 5602

3 - 10 FEBRUARY 1956

Euphausiacea

Nyctiphanes simplex

5602



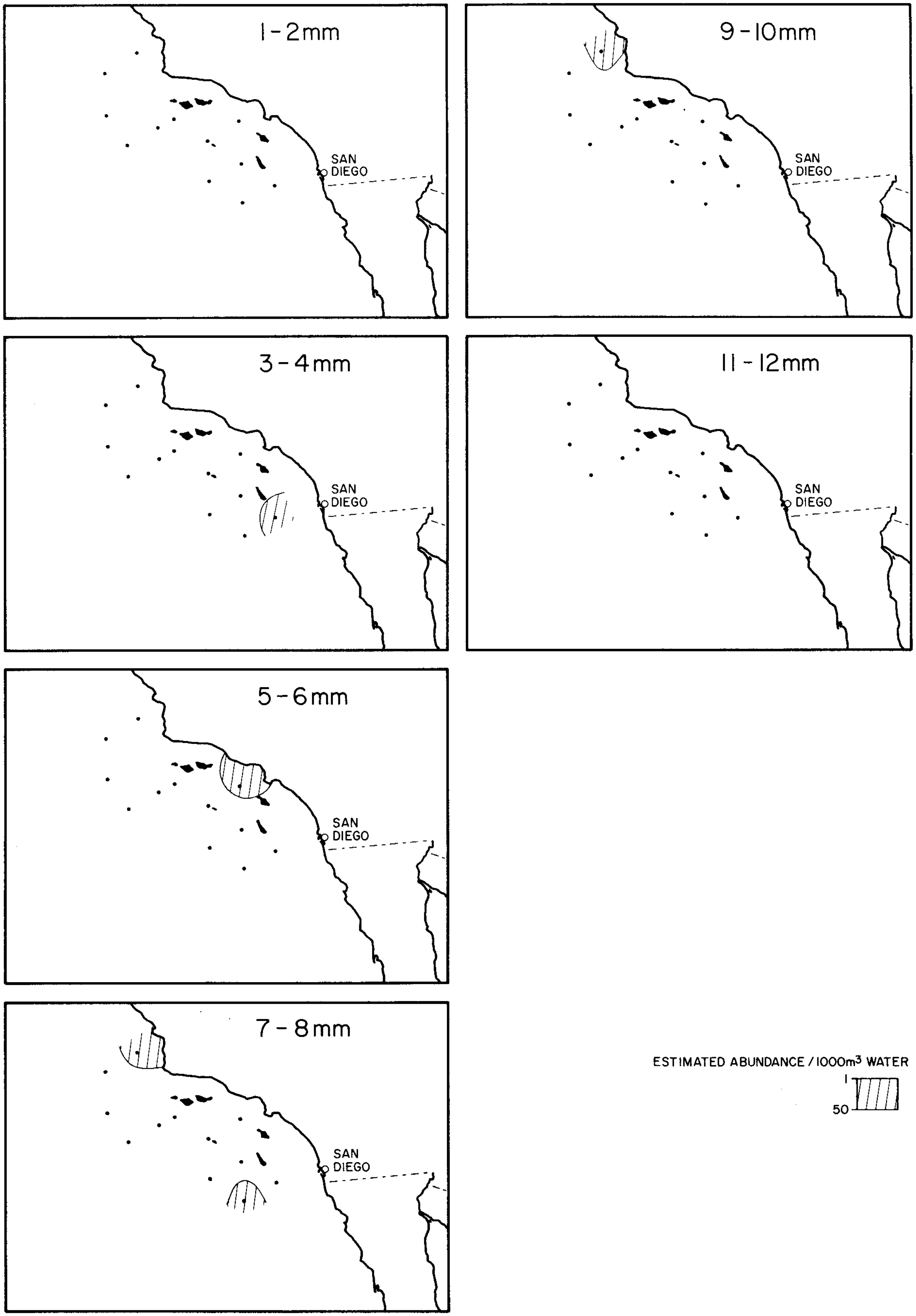
CALCOFI CRUISE 5603

8-17 MARCH 1956

Euphausiacea

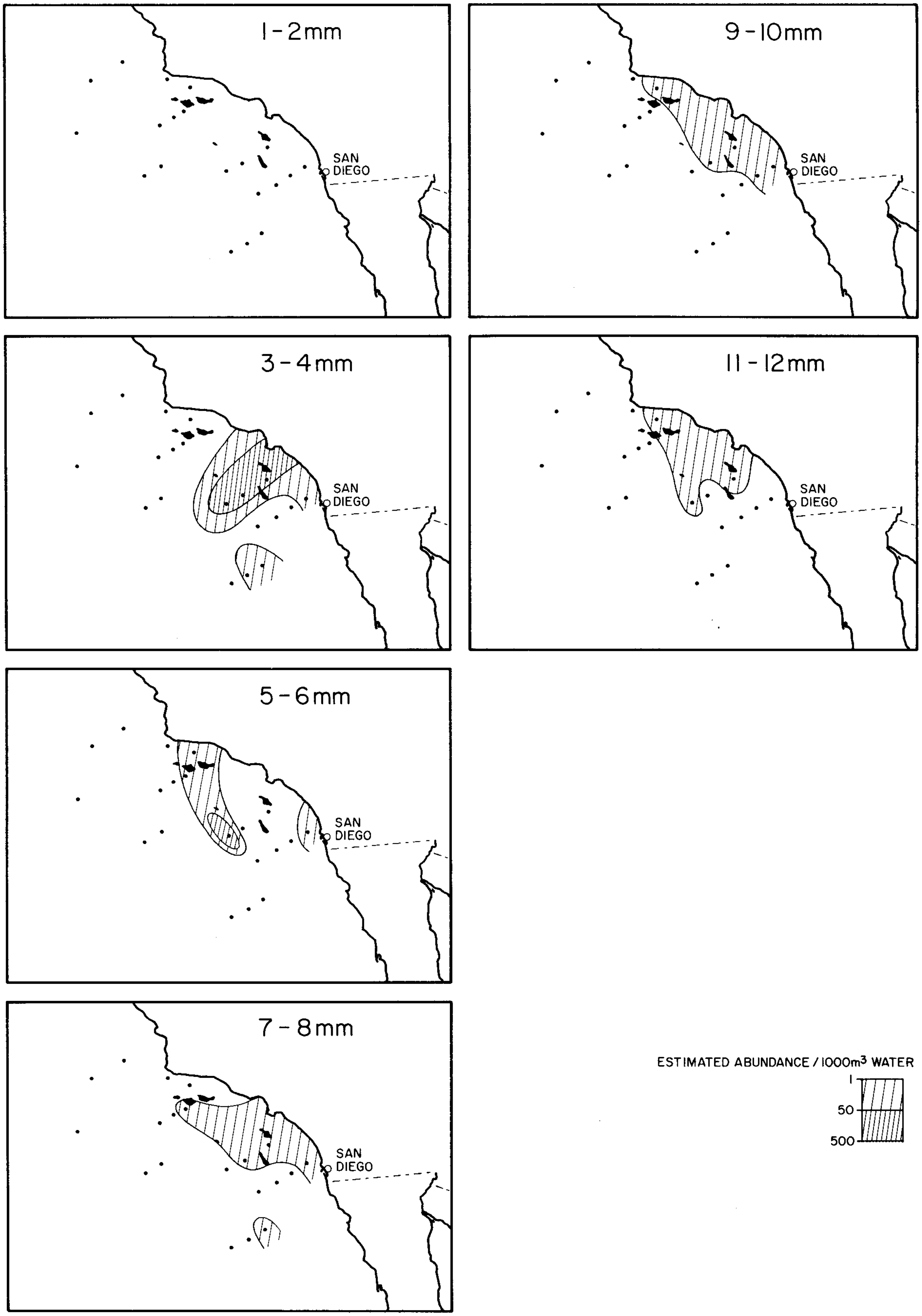
Nyctiphanes simplex

5603



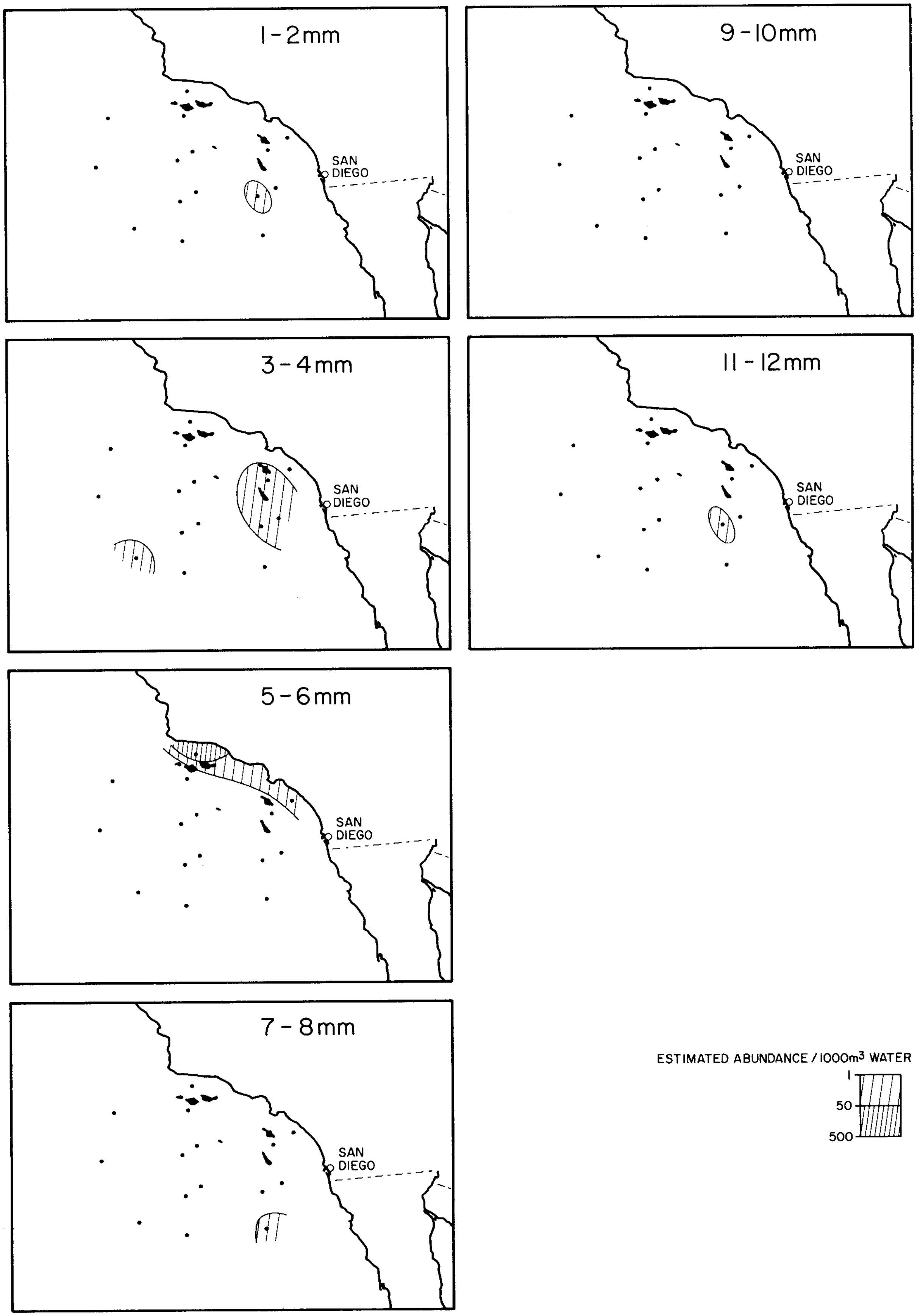
CALCOFI CRUISE 5604
14-21 APRIL 1956

Euphausiacea
Nyctiphanes simplex
5604



CALCOFI CRUISE 5605
6-18 MAY 1956

Euphausiacea
Nyctiphanes simplex
5605



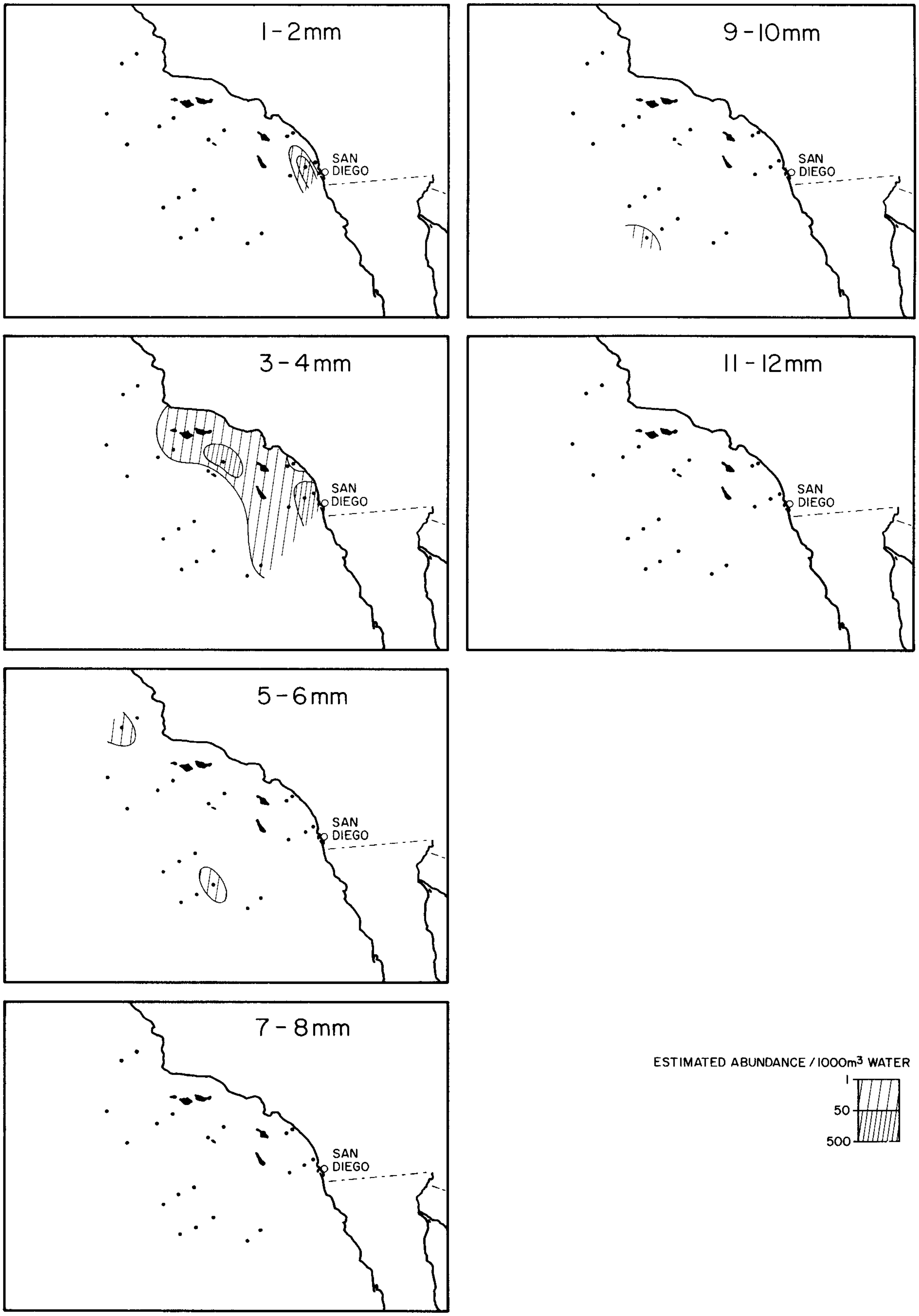
CALCOFI CRUISE 5606

30 MAY – 13 JUNE 1956

Euphausiacea

Nyctiphanes simplex

5606



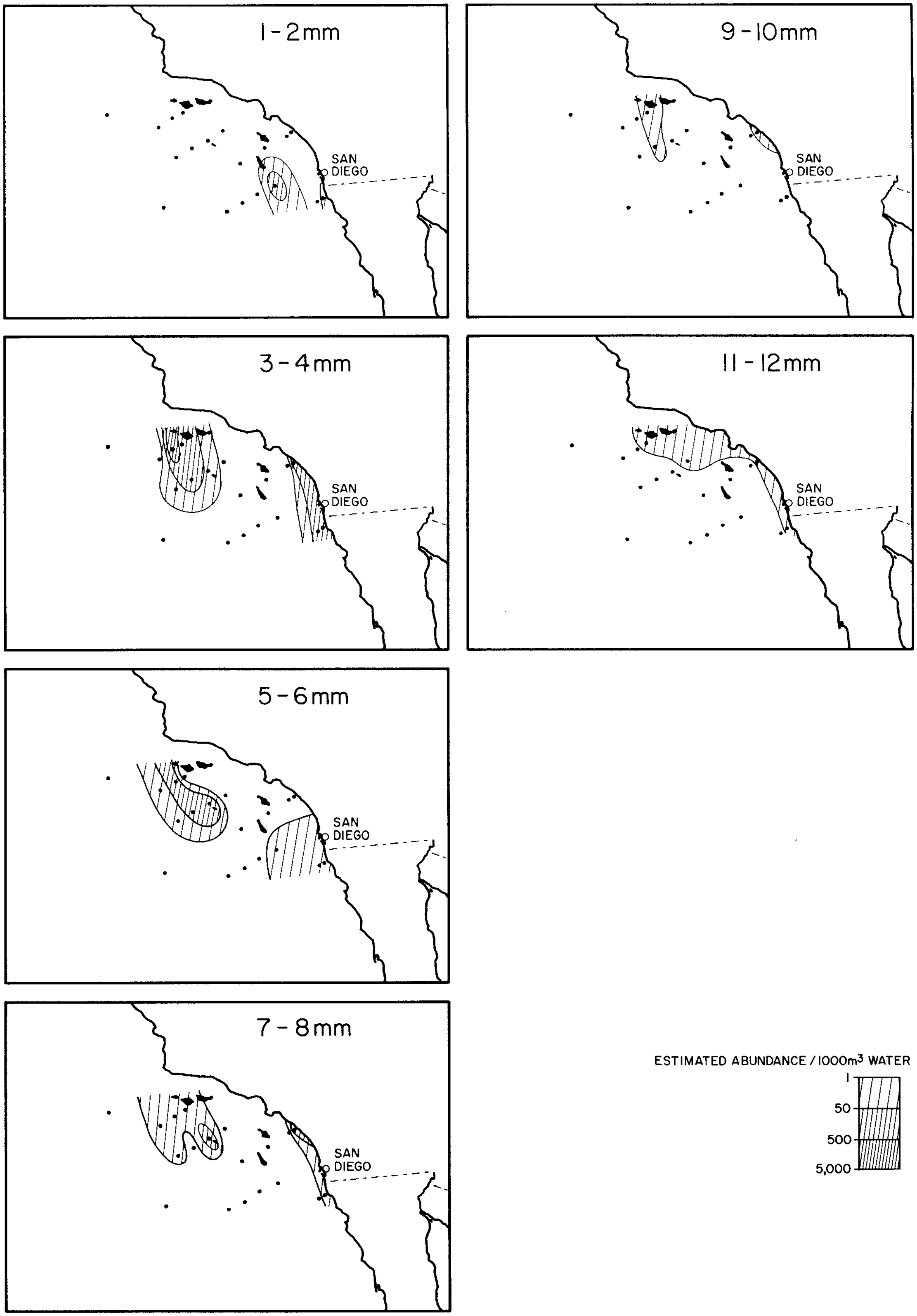
CALCOFI CRUISE 5607

7-15 JULY 1956

Euphausiacea

Nyctiphanes simplex

5607



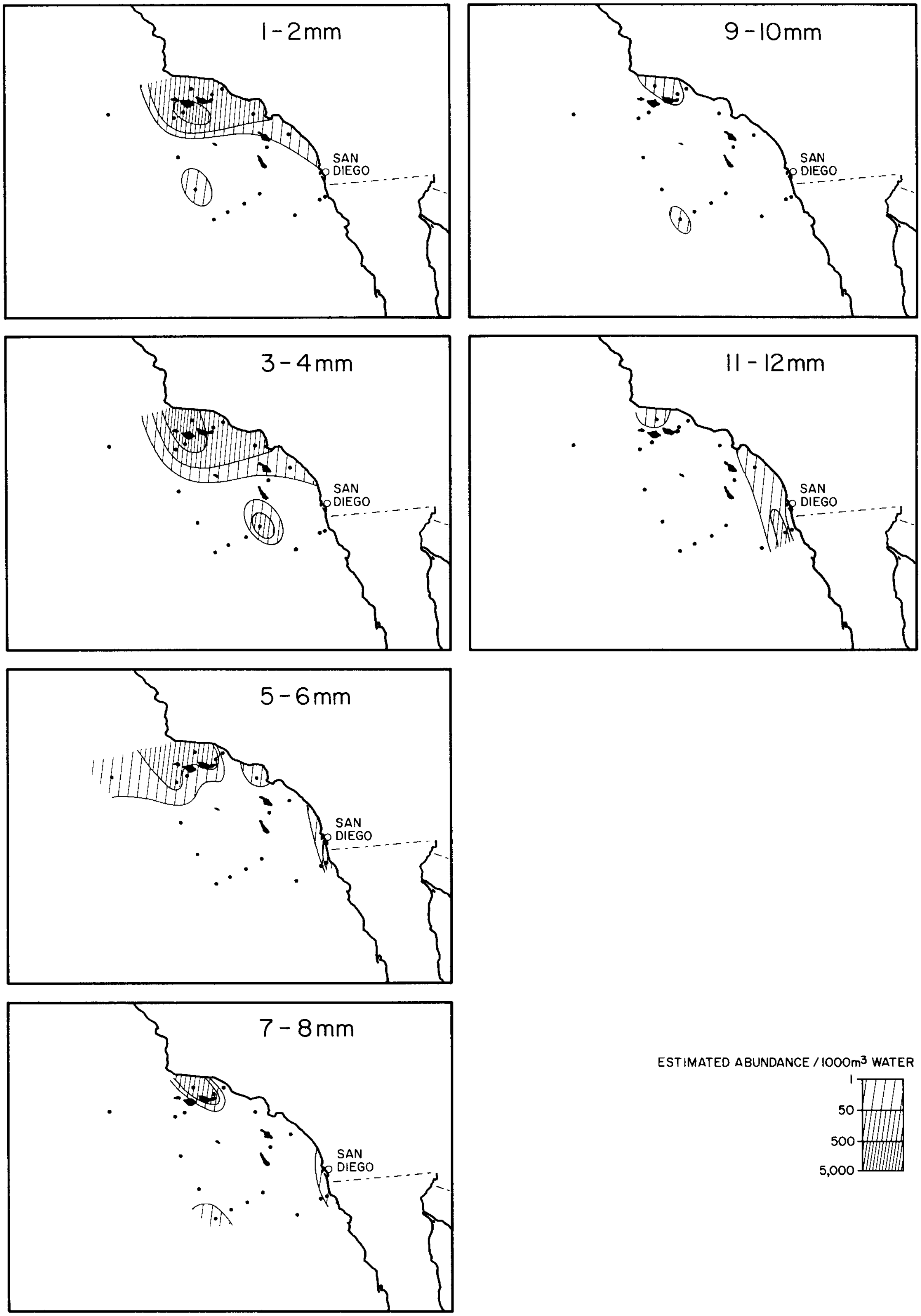
Euphausiacea

CALCOFI CRUISE 5610

29 SEPTEMBER – 5 OCTOBER 1956

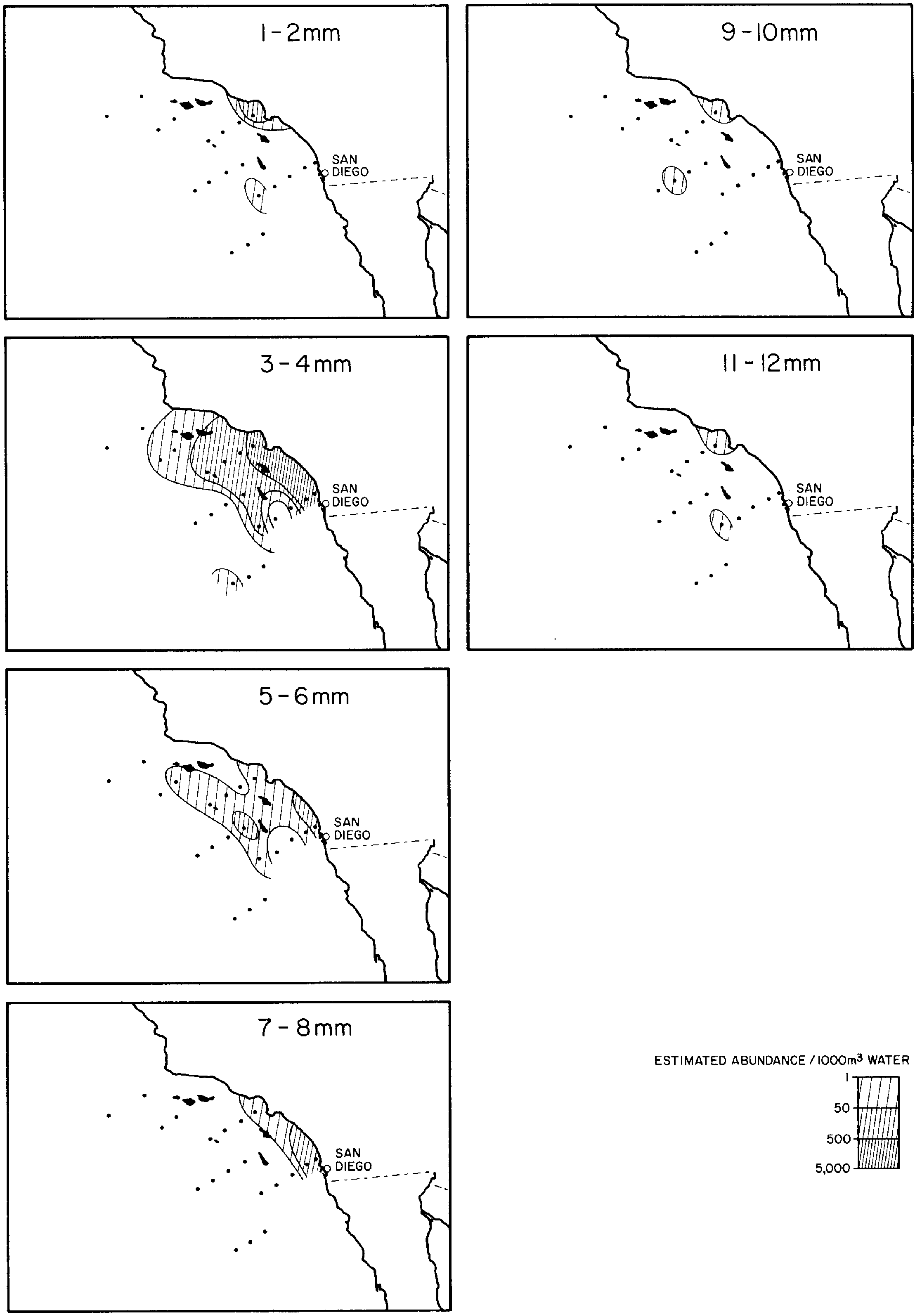
Nyctiphanes simplex

5610



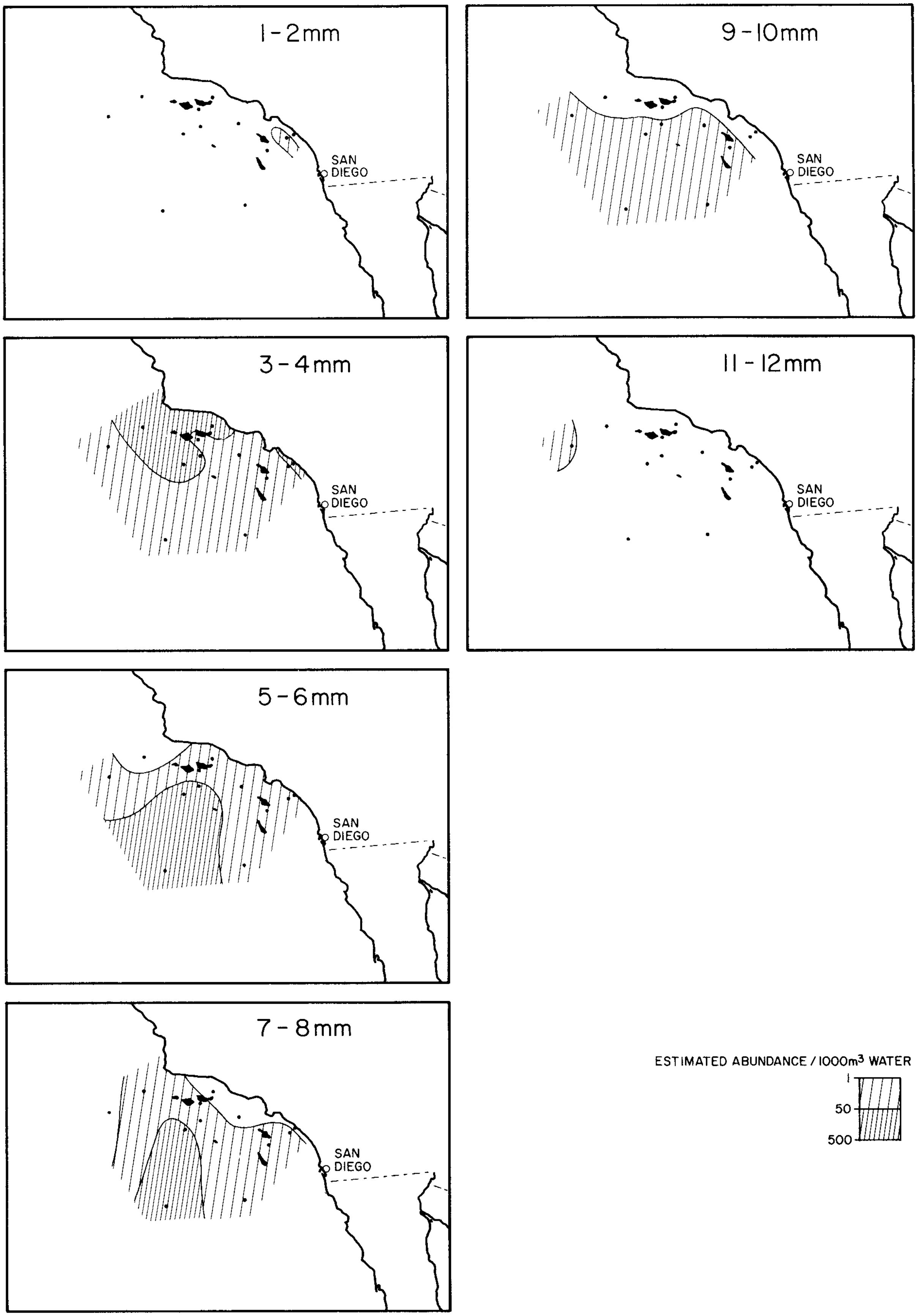
CALCOFI CRUISE 5611
30 OCTOBER - 5 NOVEMBER 1956

Euphausiacea
Nyctiphanes simplex
5611



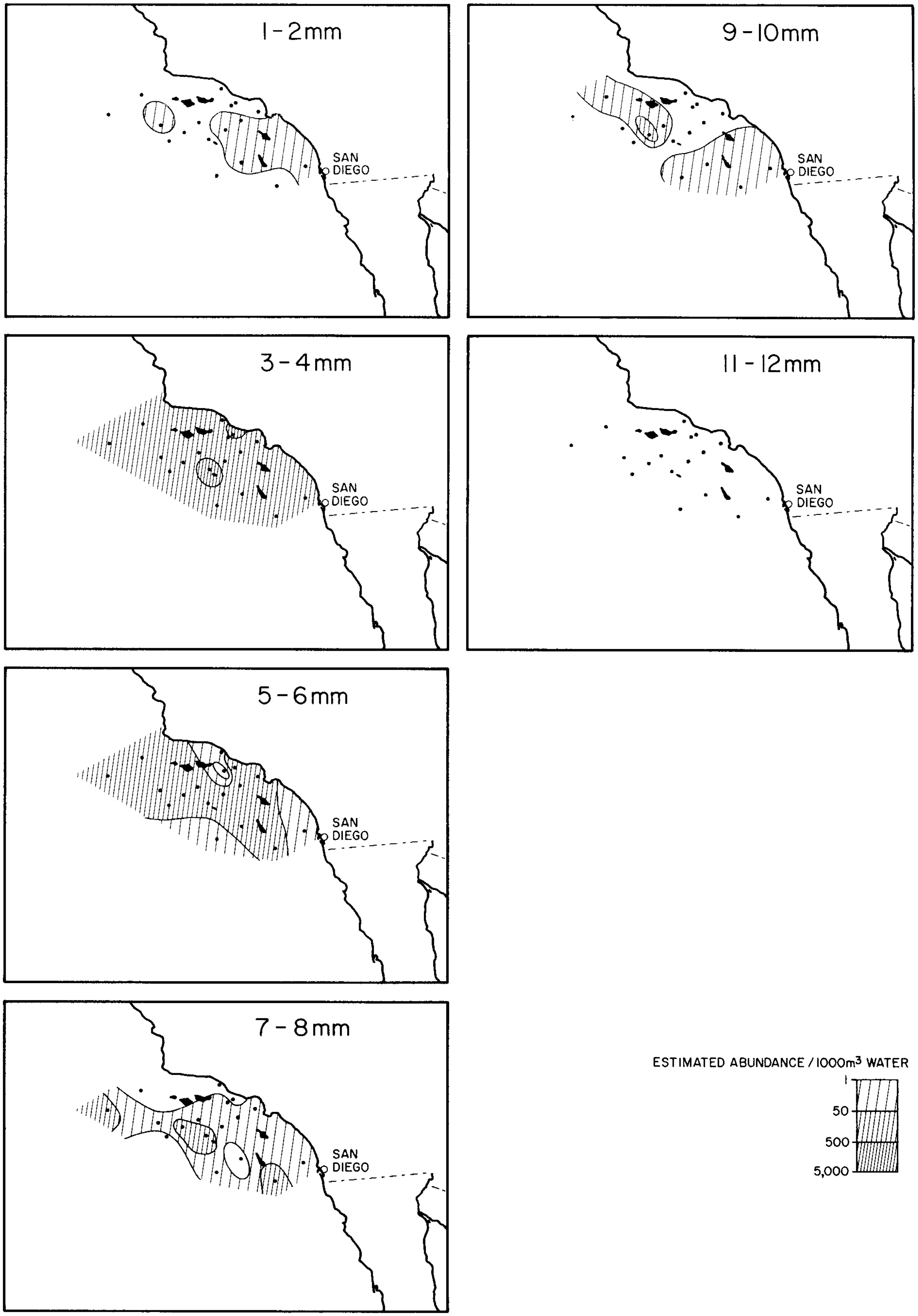
CALCOFI CRUISE 5612
6-12 DECEMBER 1956

Euphausiacea
Nyctiphanes simplex
5612



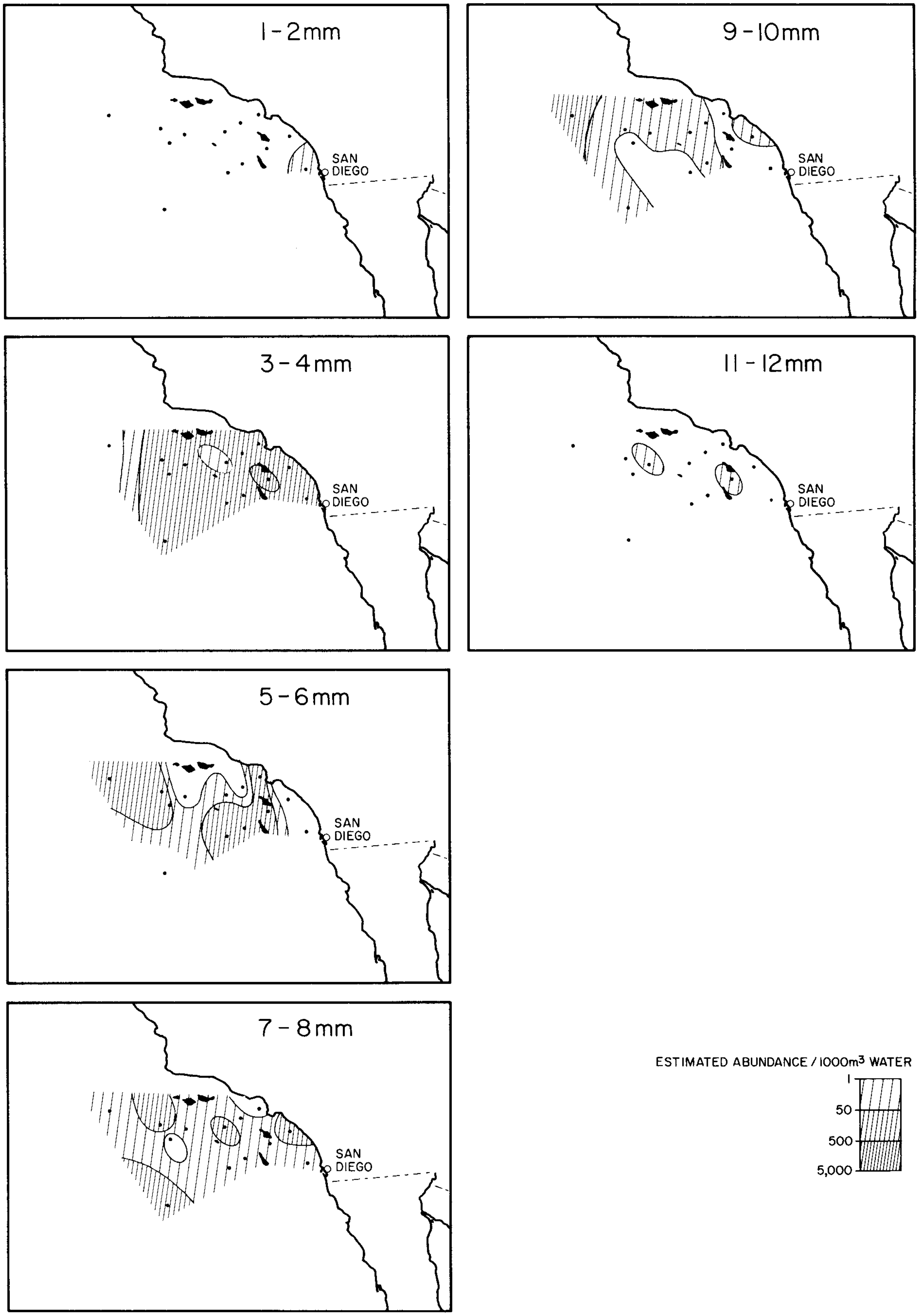
CALCOFI CRUISE 5301
9 - 17 JANUARY 1953

Euphausiacea
Thysanoessa gregaria
5301



CALCOFI CRUISE 5302
4 - 14 FEBRUARY 1953

Euphausiacea
Thysanoessa gregaria
5302



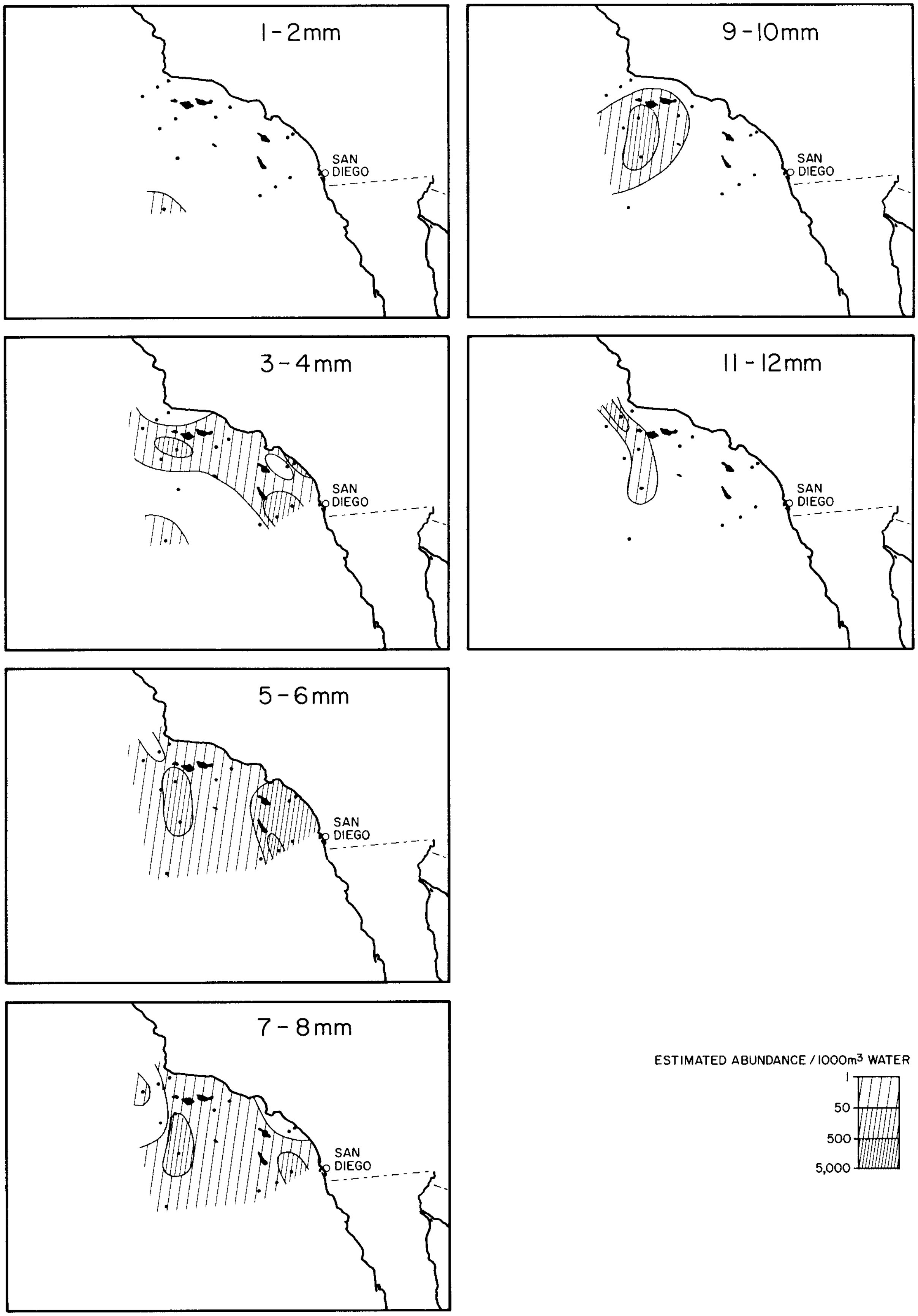
CALCOFI CRUISE 5303

6 - 20 MARCH 1953

Euphausiacea

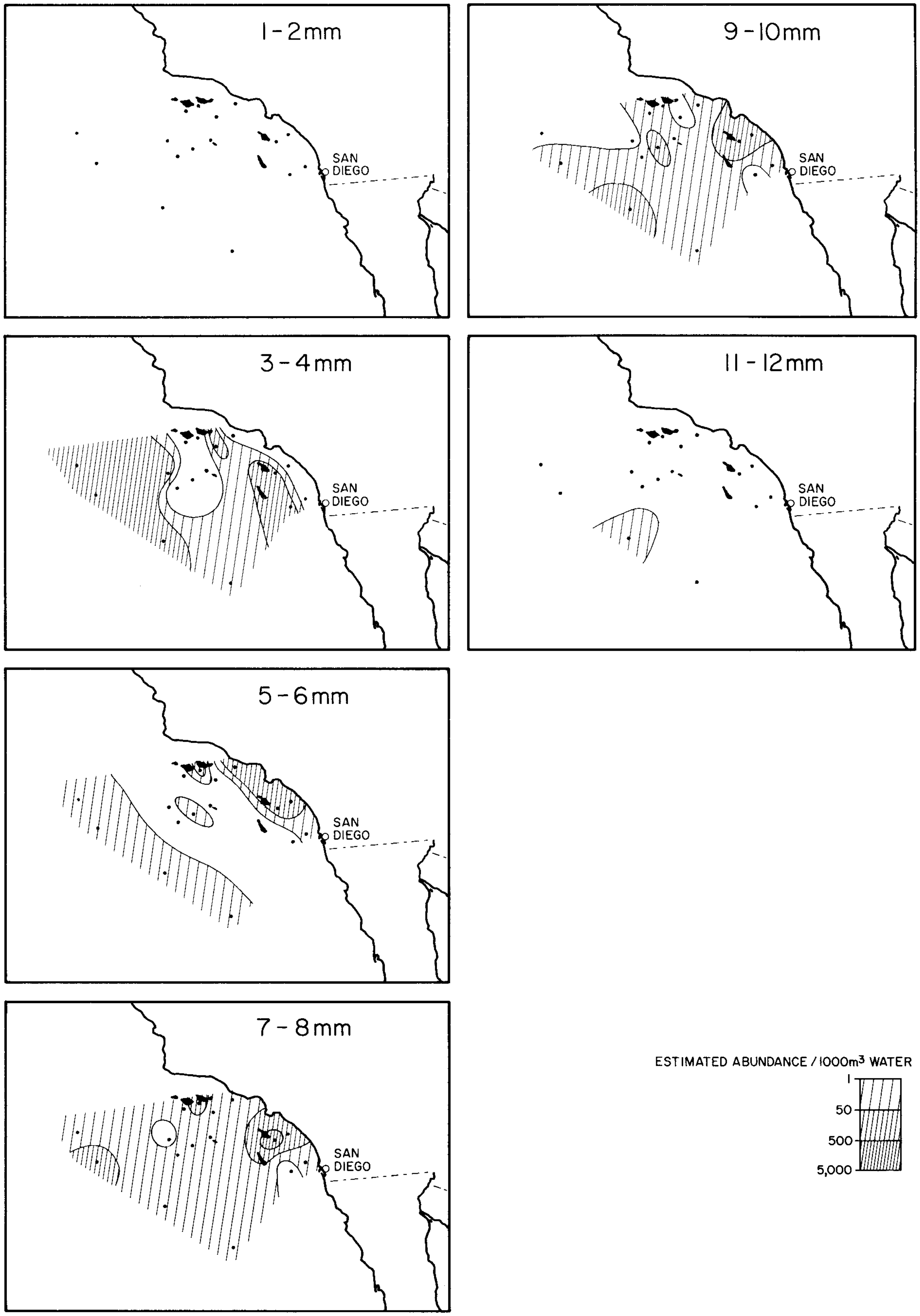
Thysanoessa gregaria

5303



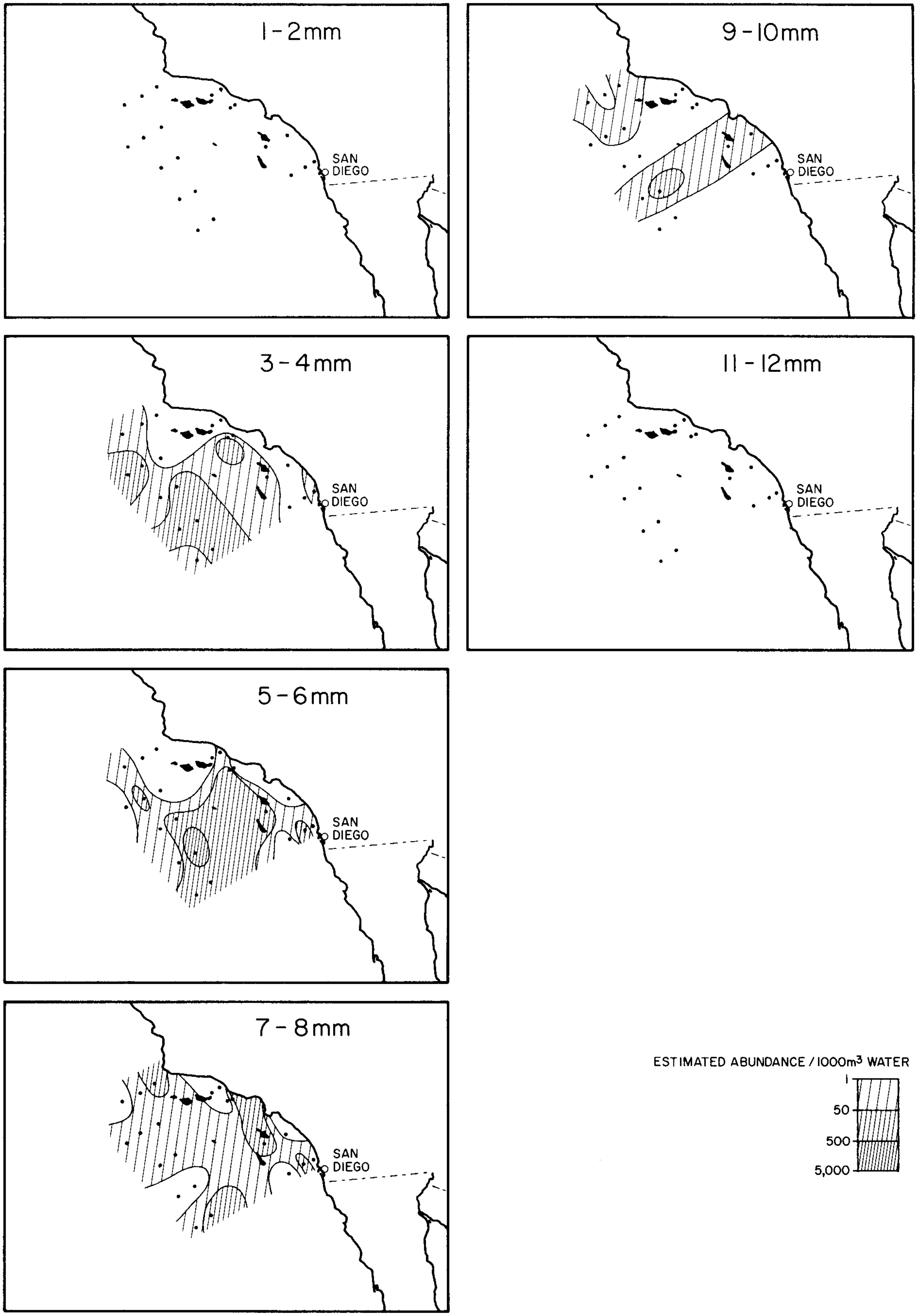
CALCOFI CRUISE 5304
7 - 17 APRIL 1953

Euphausiacea
Thysanoessa gregaria
5304



CALCOFI CRUISE 5305
5 - 18 MAY 1953

Euphausiacea
Thysanoessa gregaria
5305



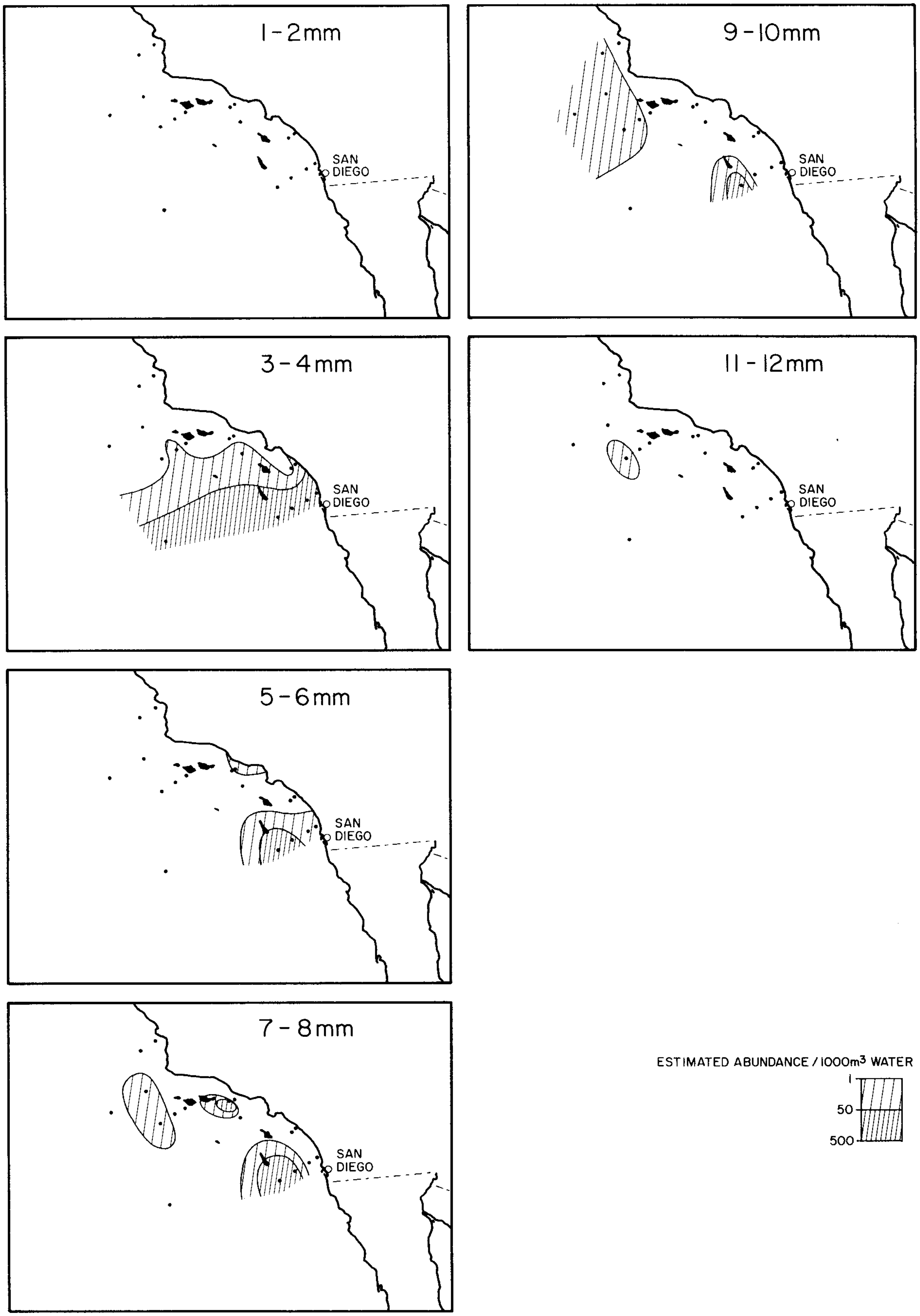
CALCOFI CRUISE 5306

5 - 12 JUNE 1953

Euphausiacea

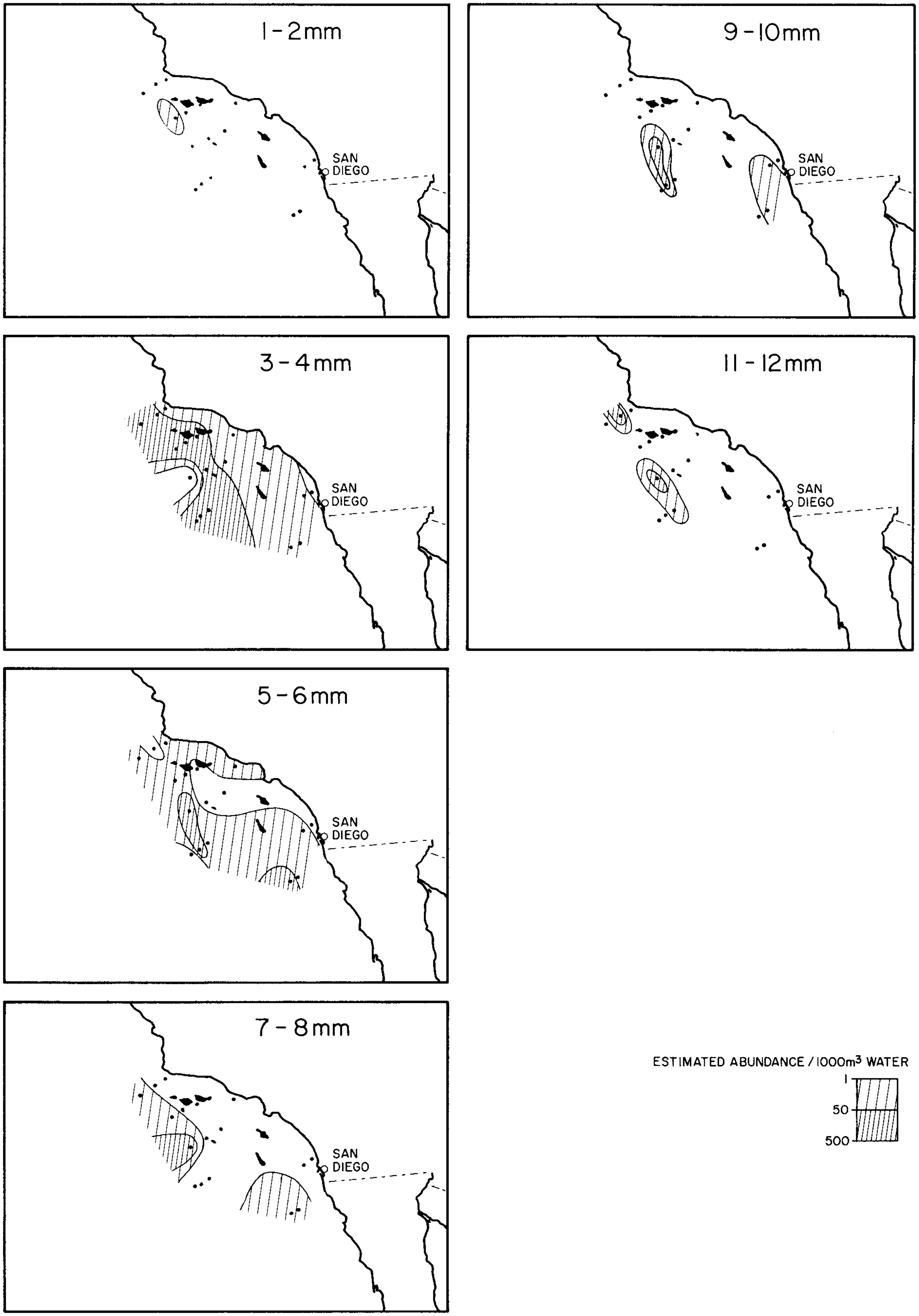
Thysanoessa gregaria

5306



CALCOFI CRUISE 5307
14 - 26 JULY 1953

Euphausiacea
Thysanoessa gregaria
5307



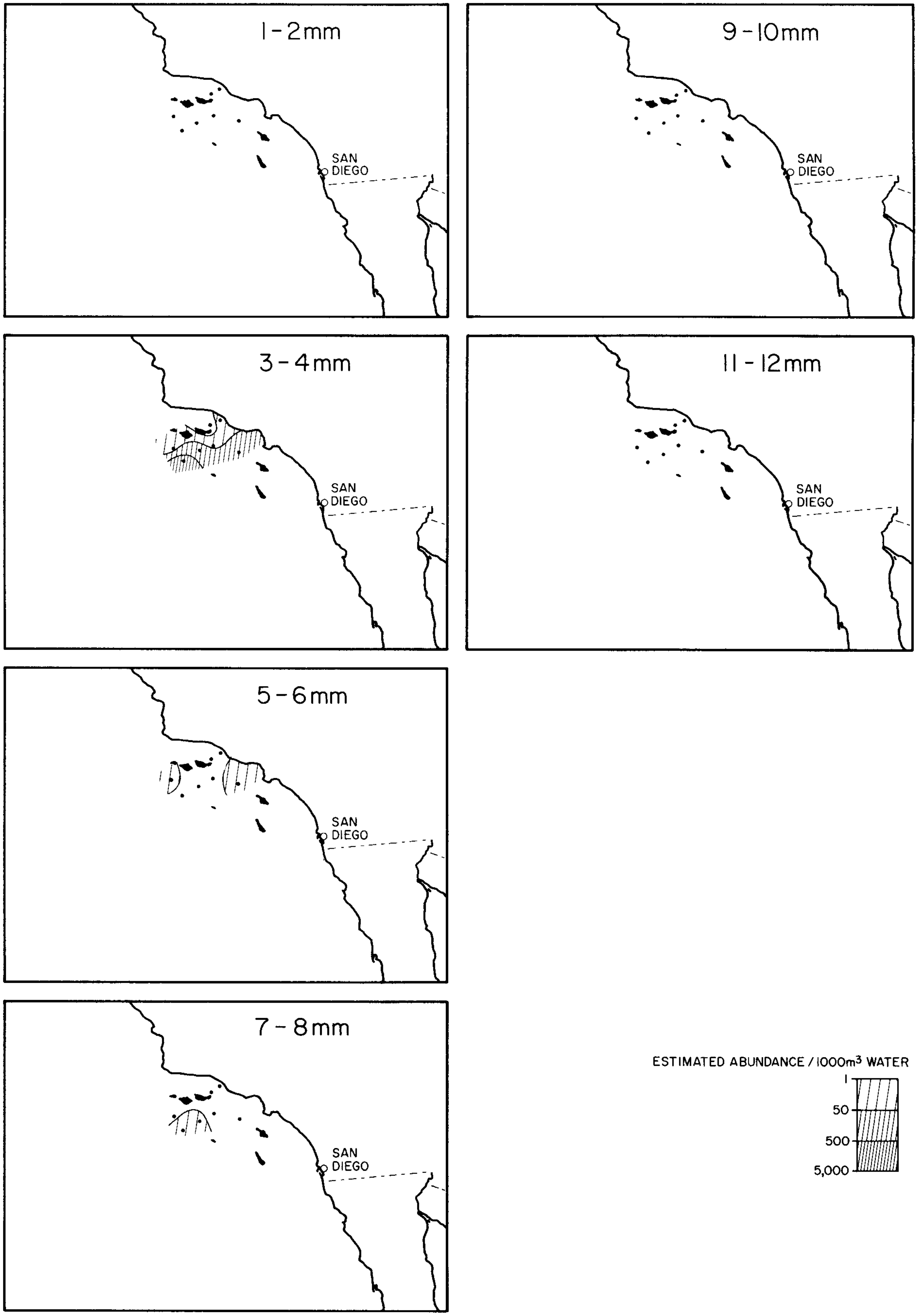
CALCOFI CRUISE 5308

18 - 29 AUGUST 1953

Euphausiacea

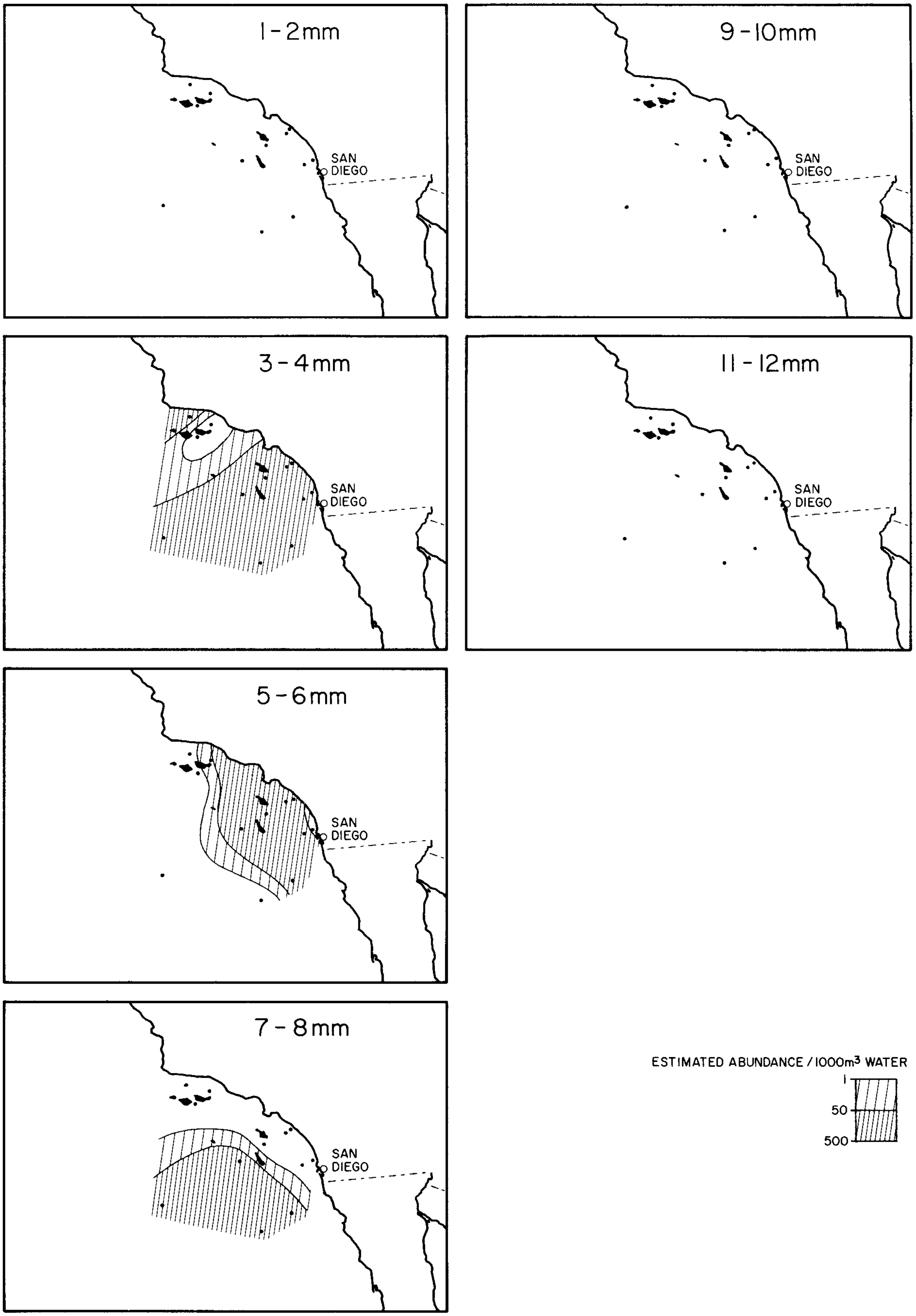
Thysanoessa gregaria

5308



CALCOFI CRUISE 5309
15 - 17 SEPTEMBER 1953

Euphausiacea
Thysanoessa gregaria
5309



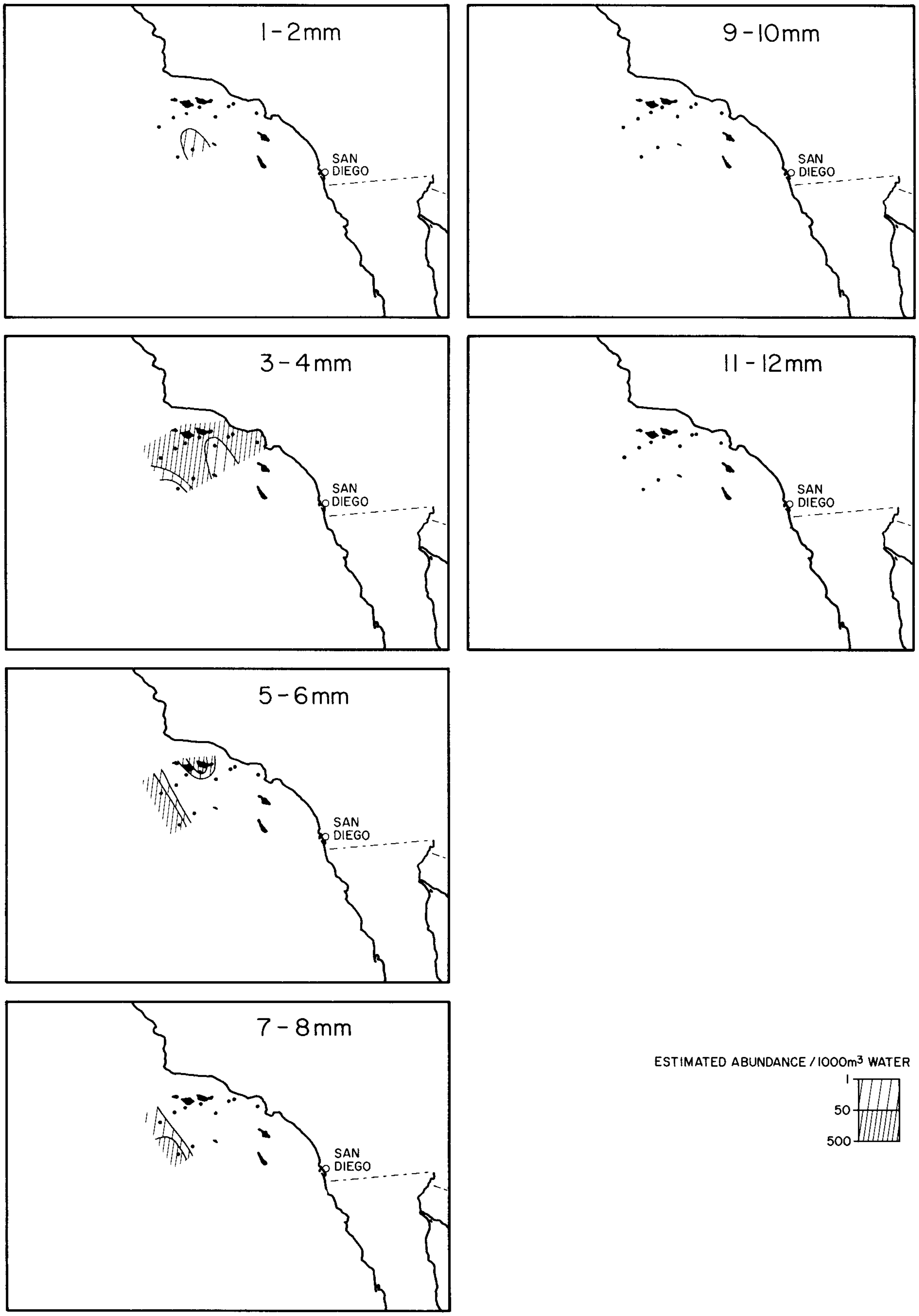
CALCOFI CRUISE 5310

19 - 22 OCTOBER 1953

Euphausiacea

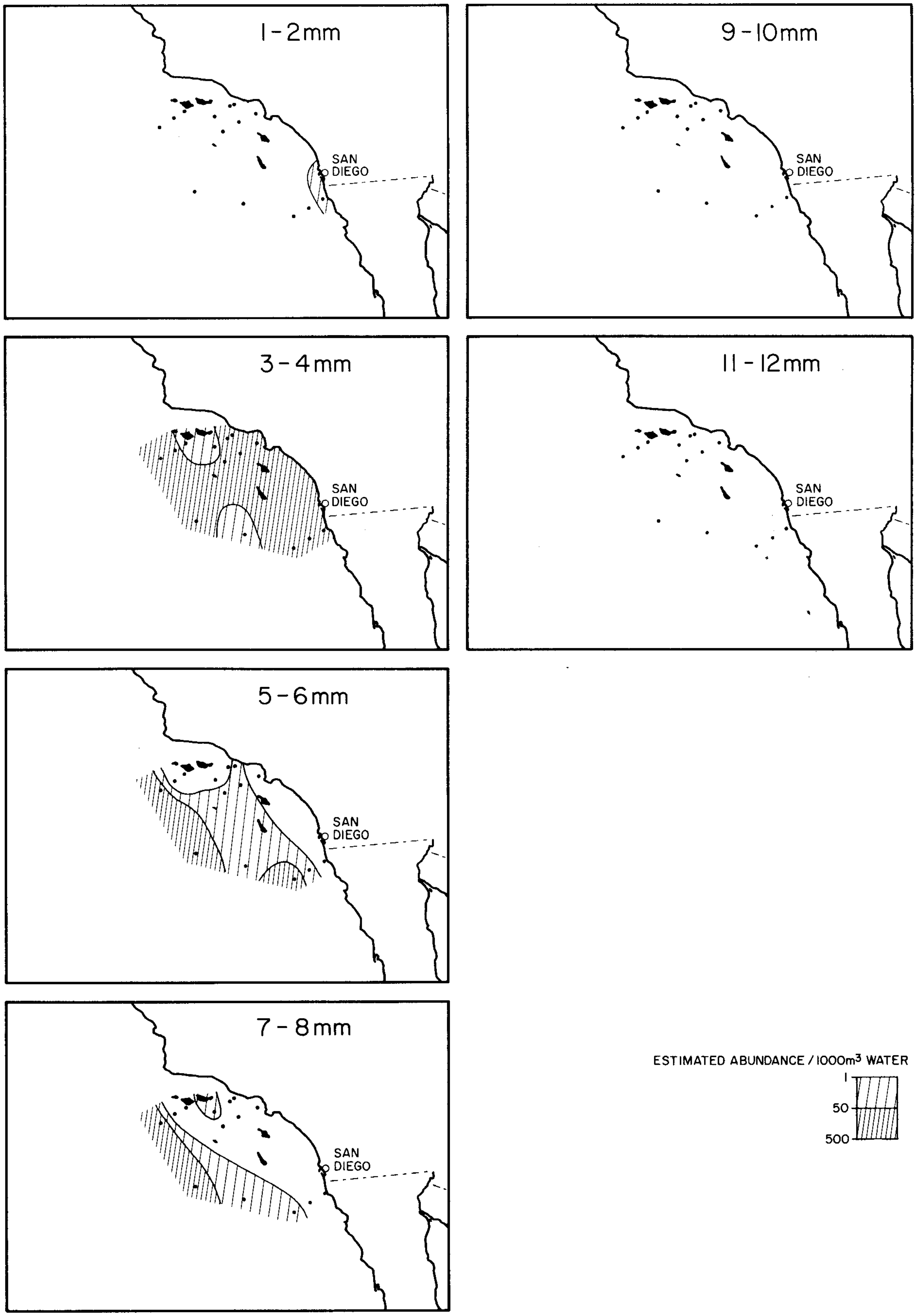
Thysanoessa gregaria

5310



CALCOFI CRUISE 5311
10-12 NOVEMBER 1953

Euphausiacea
Thysanoessa gregaria
5311



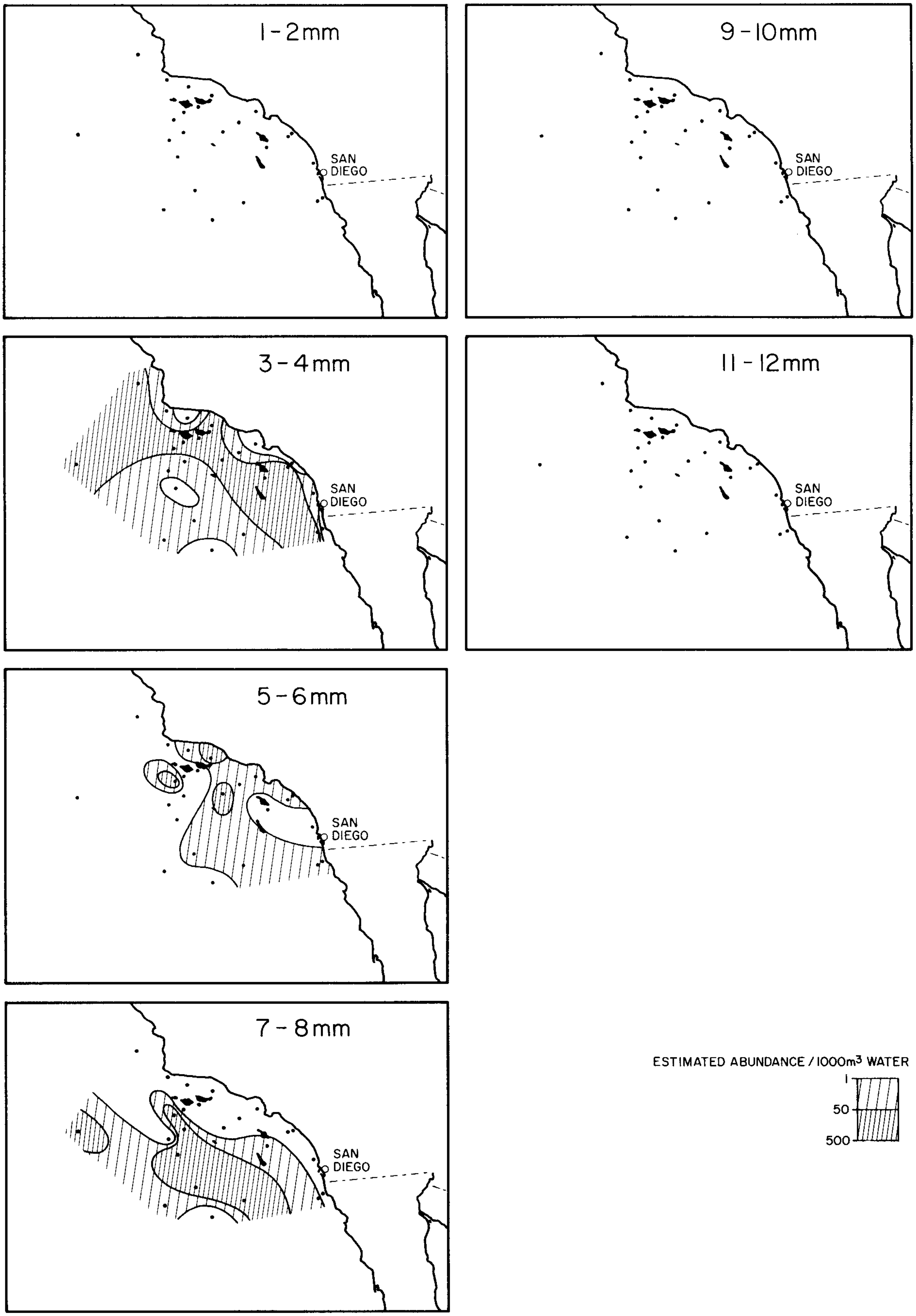
CALCOFI CRUISE 5312

3 - 9 DECEMBER 1953

Euphausiacea

Thysanoessa gregaria

5312



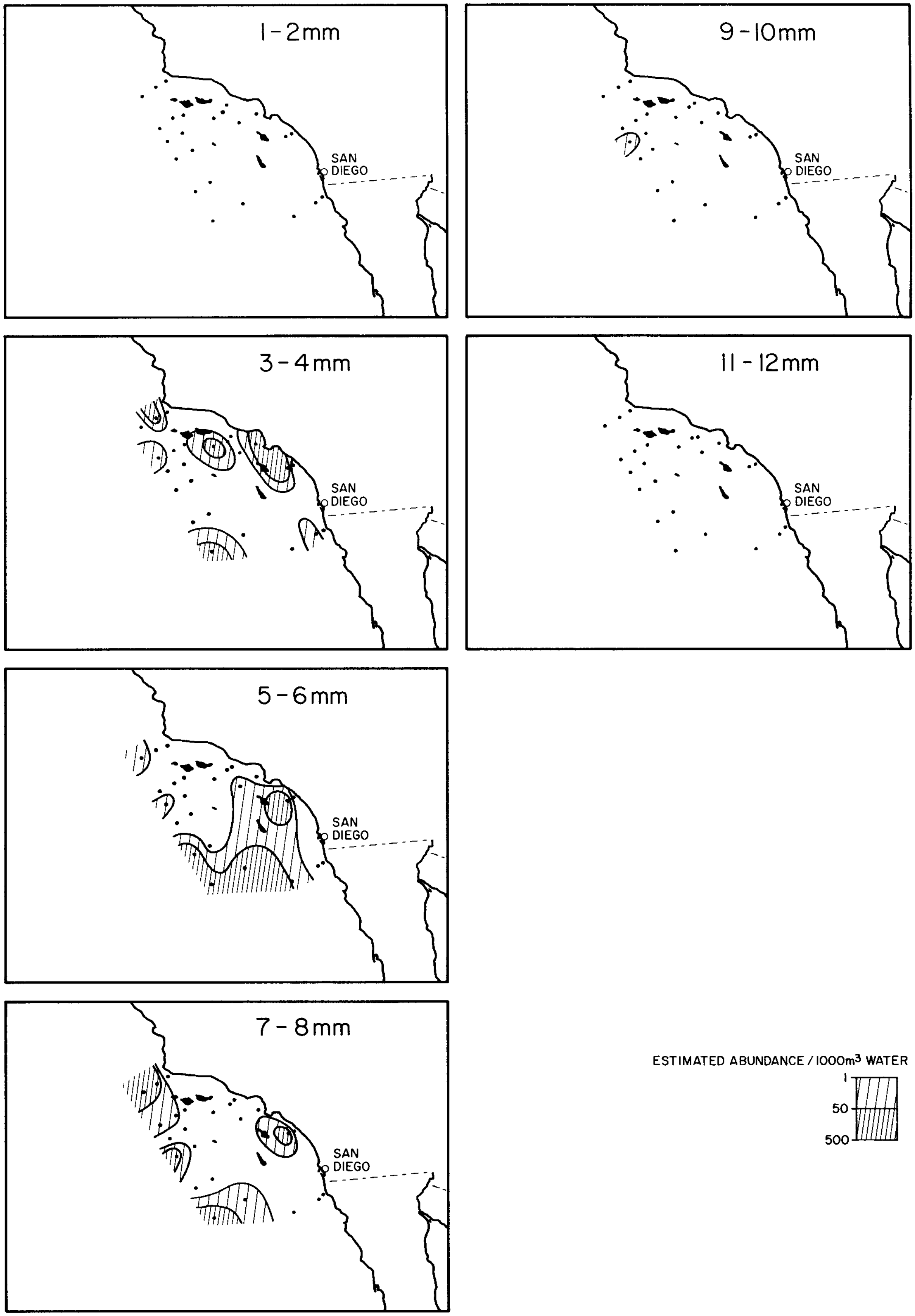
CALCOFI CRUISE 5401

5 - 15 JANUARY 1954

Euphausiacea

Thysanoessa gregaria

5401



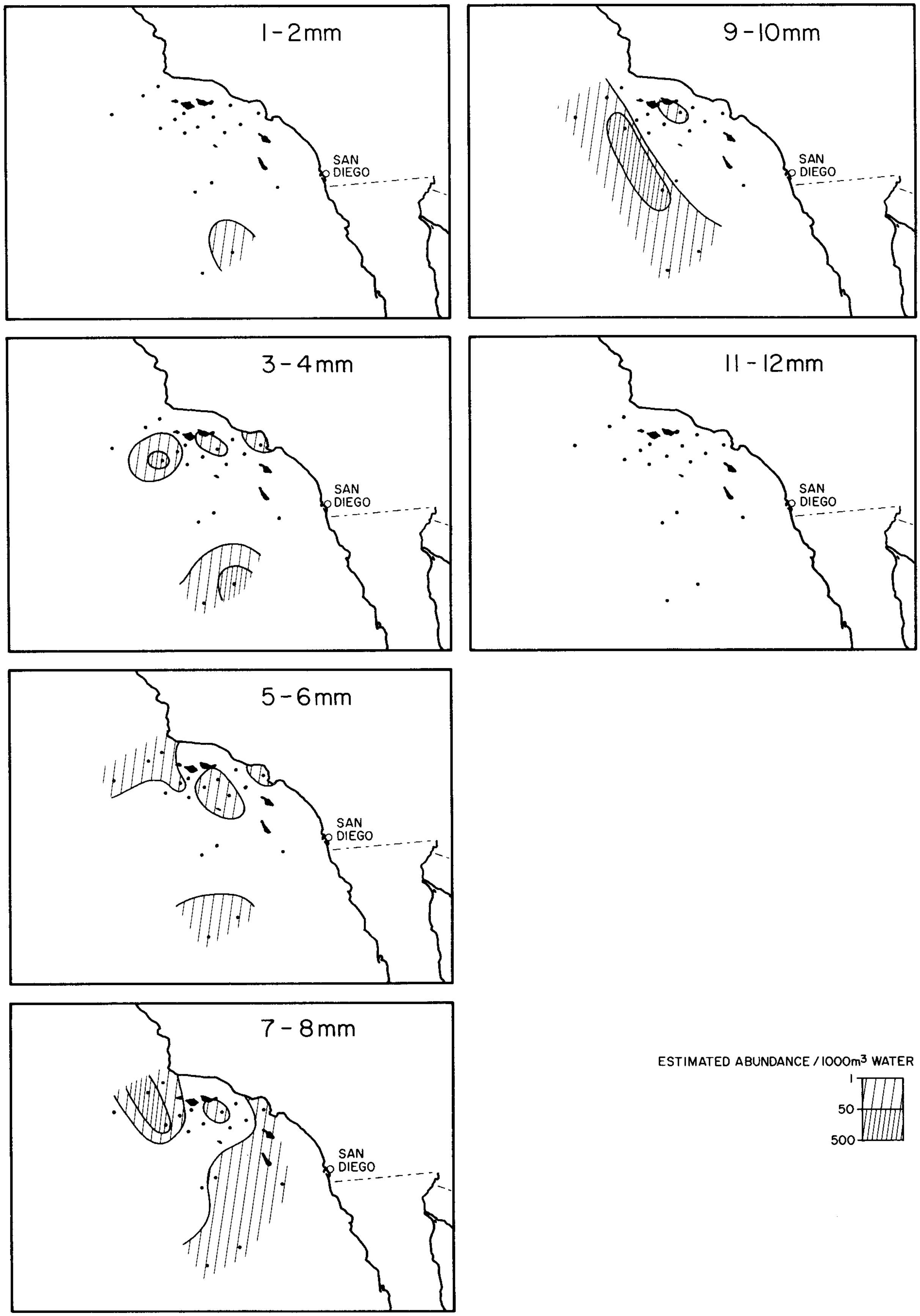
Euphausiacea

Thysanoessa gregaria

5402

CALCOFI CRUISE 5402

3 - 12 FEBRUARY 1954



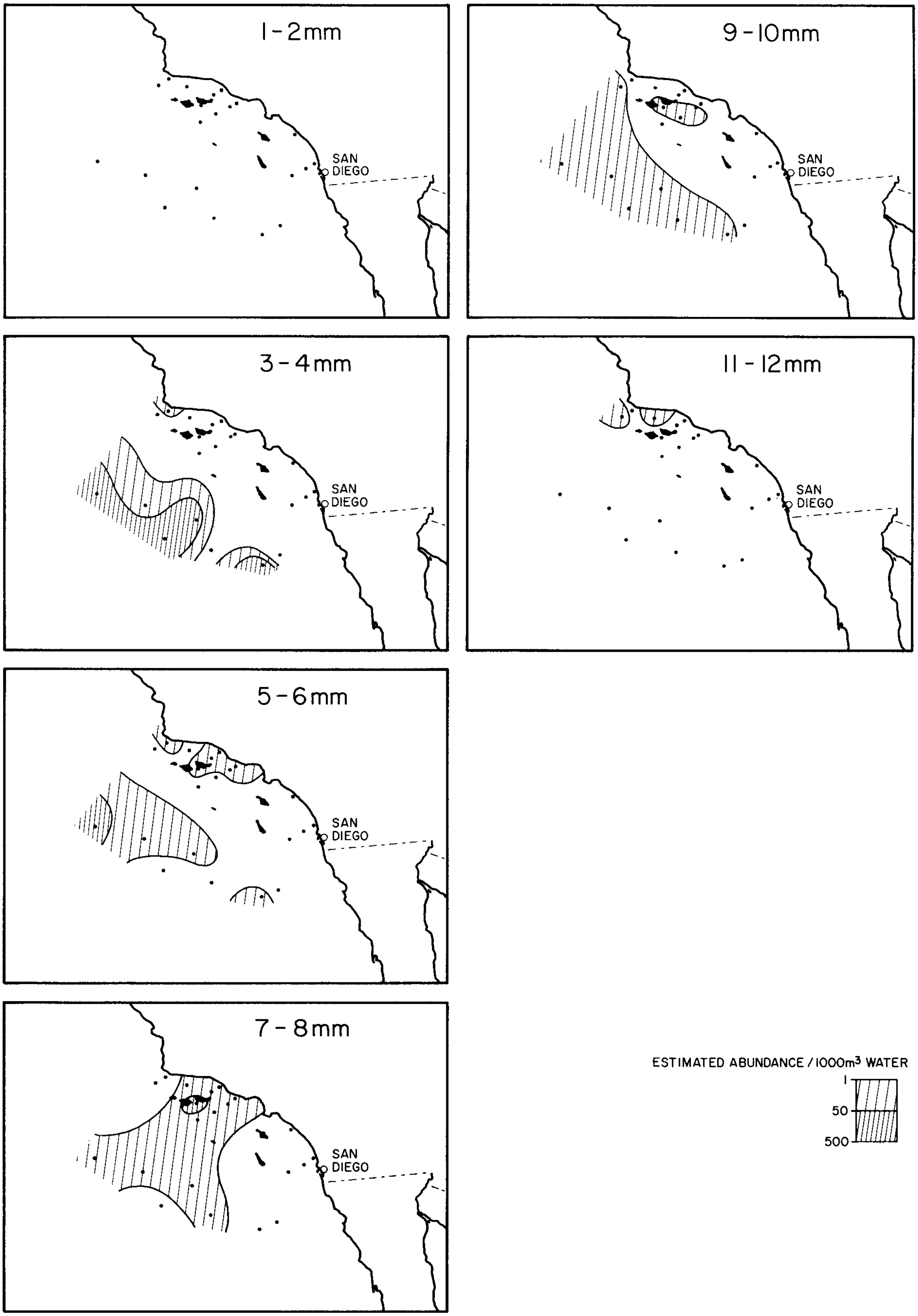
CALCOFI CRUISE 5403

5 - 18 MARCH 1954

Euphausiacea

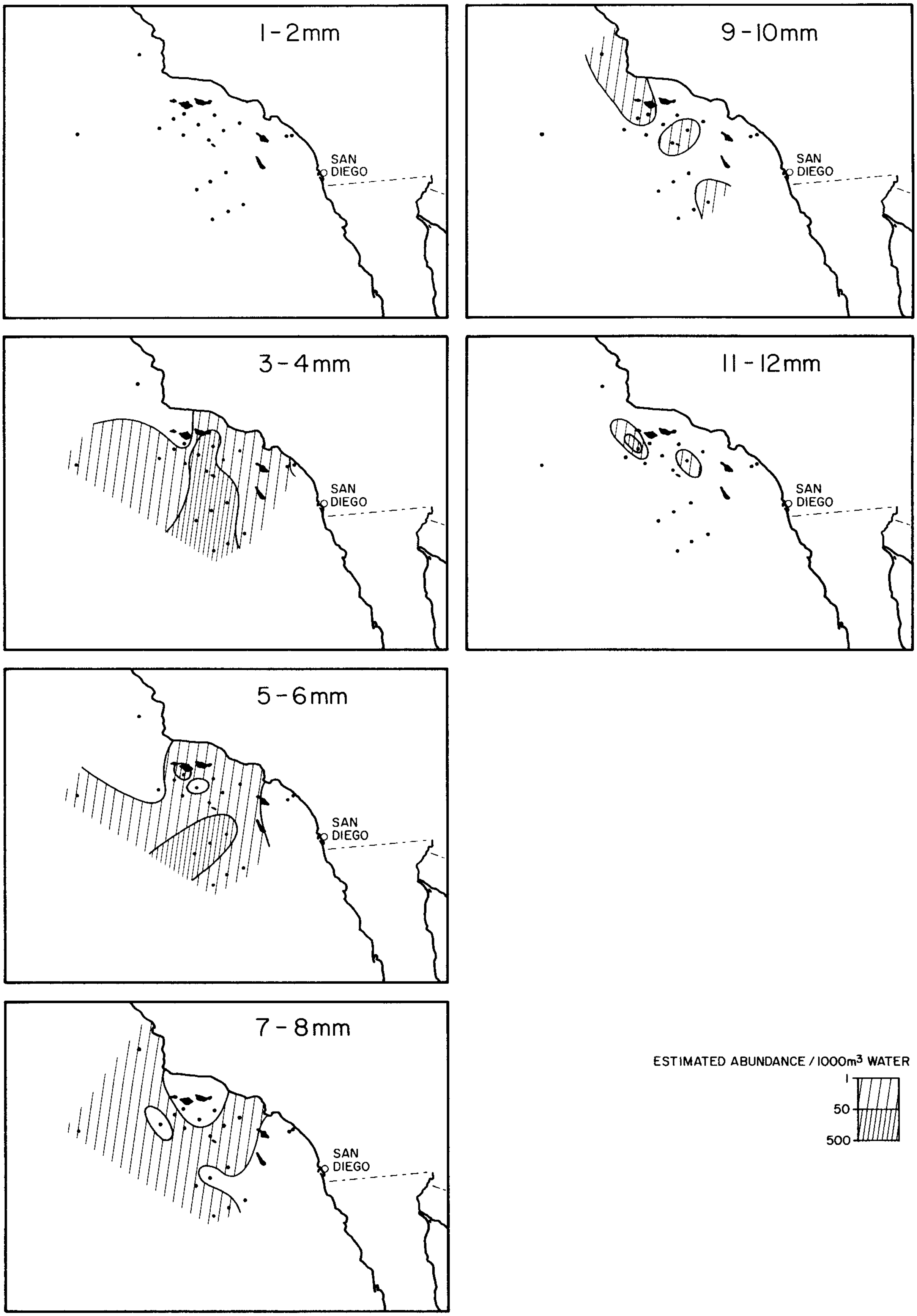
Thysanoessa gregaria

5403



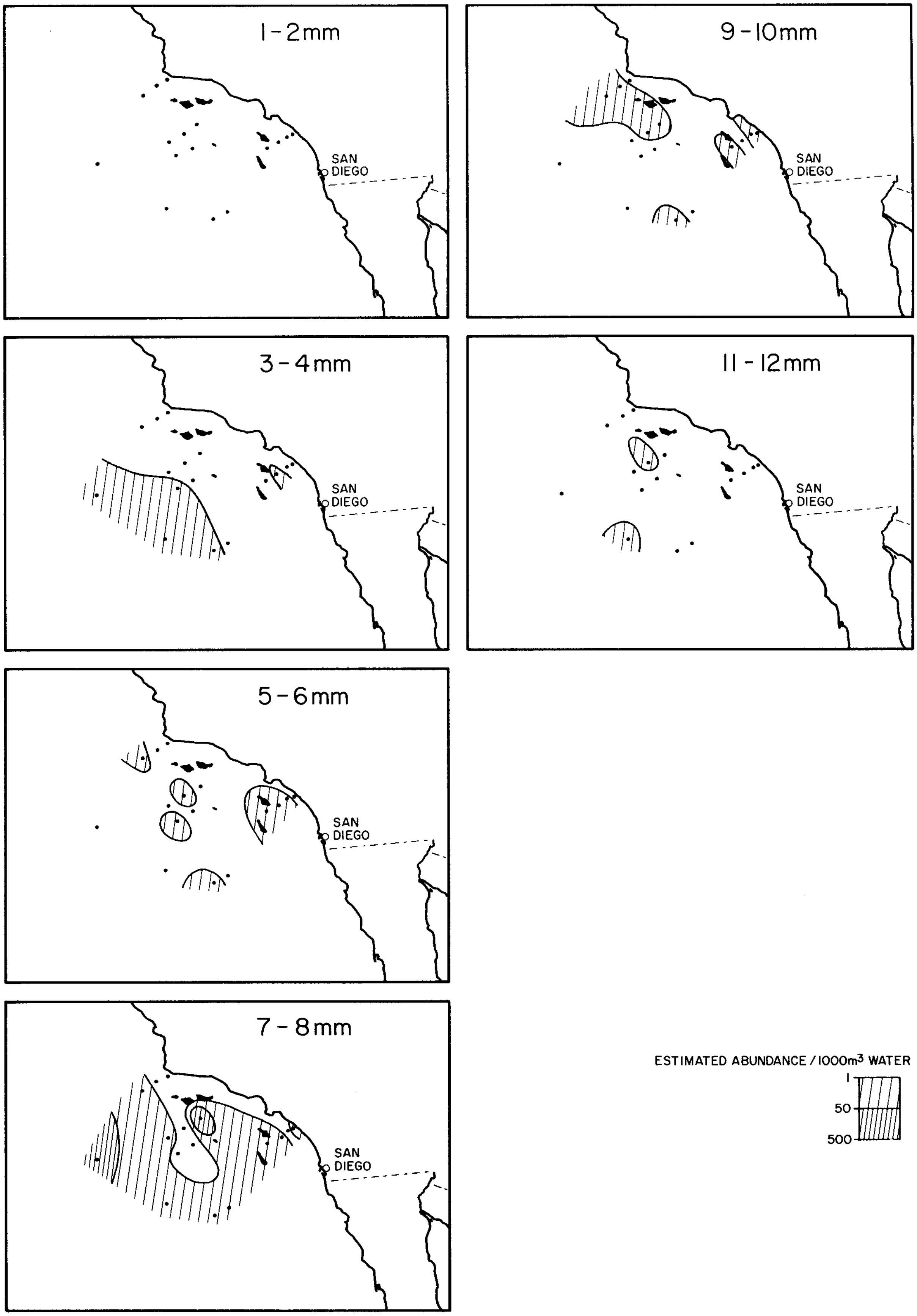
CALCOFI CRUISE 5404
7-19 APRIL 1954

Euphausiacea
Thysanoessa gregaria
5404



CALCOFI CRUISE 5405
13 – 22 MAY 1954

Euphausiacea
Thysanoessa gregaria
5405



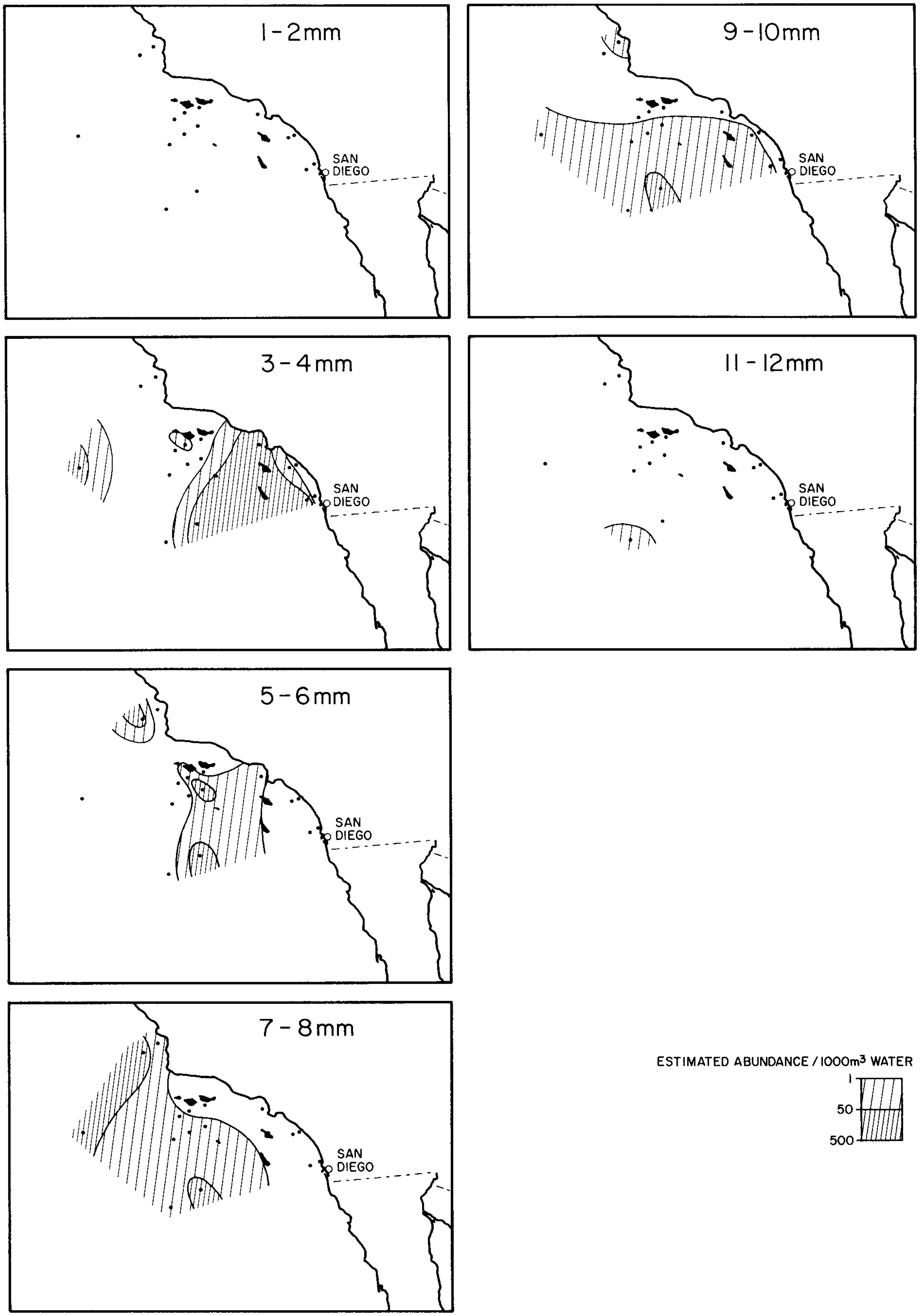
CALCOFI CRUISE 5406

13 – 20 JUNE 1954

Euphausiacea

Thysanoessa gregaria

5406



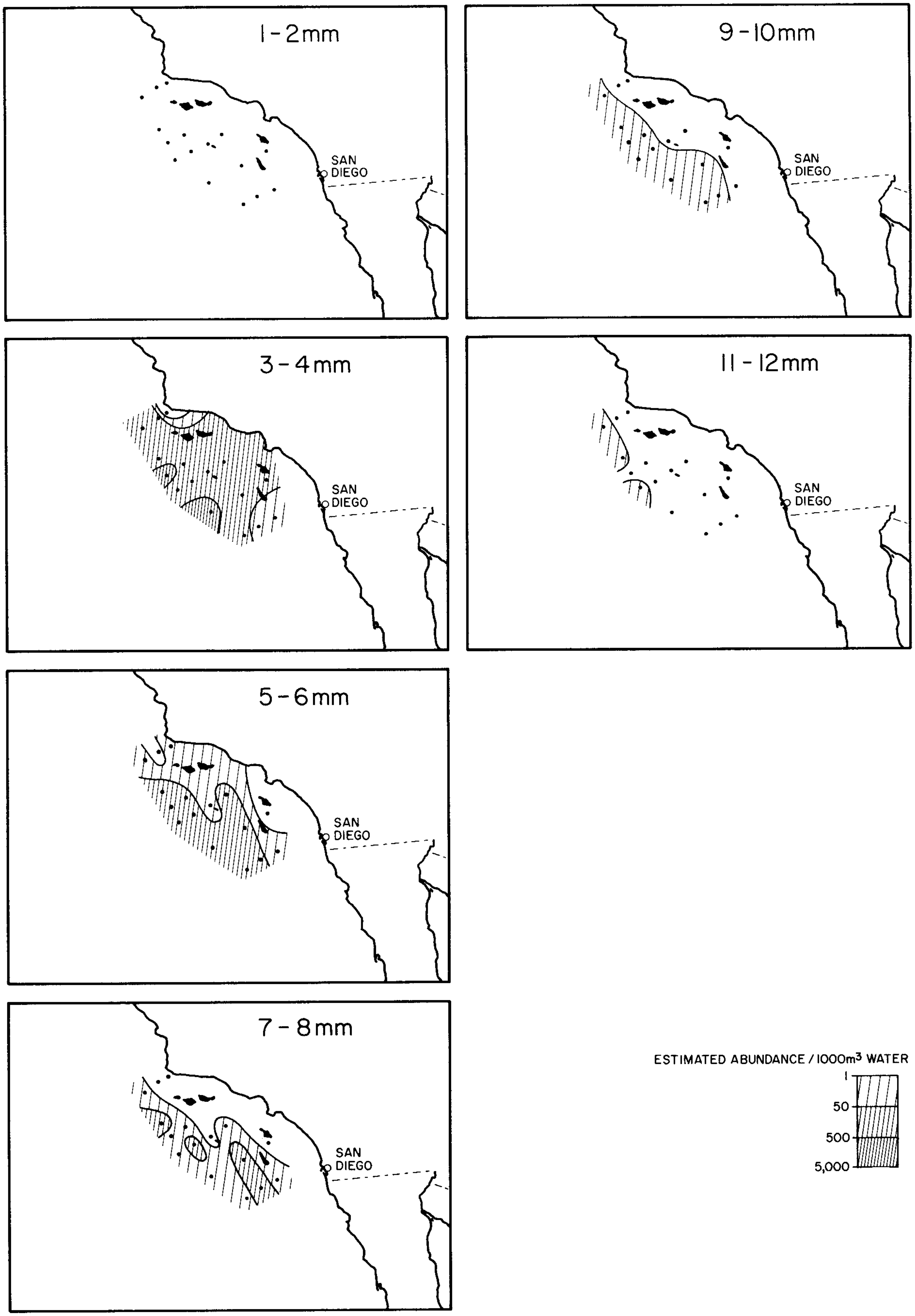
CALCOFI CRUISE 5407

13 - 21 JULY 1954

Euphausiacea

Thysanoessa gregaria

5407



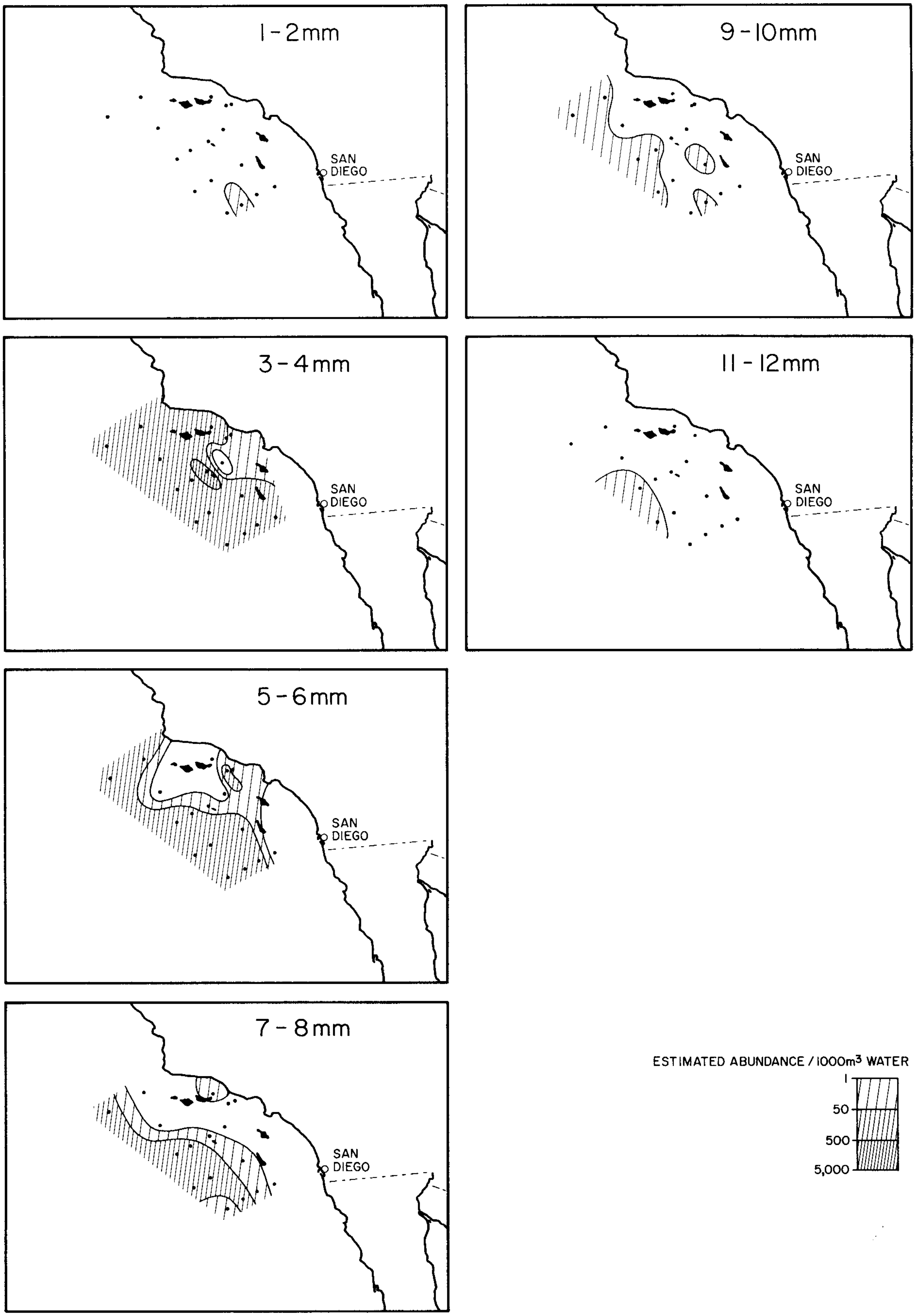
CALCOFI CRUISE 5408

4-9 SEPTEMBER 1954

Euphausiacea

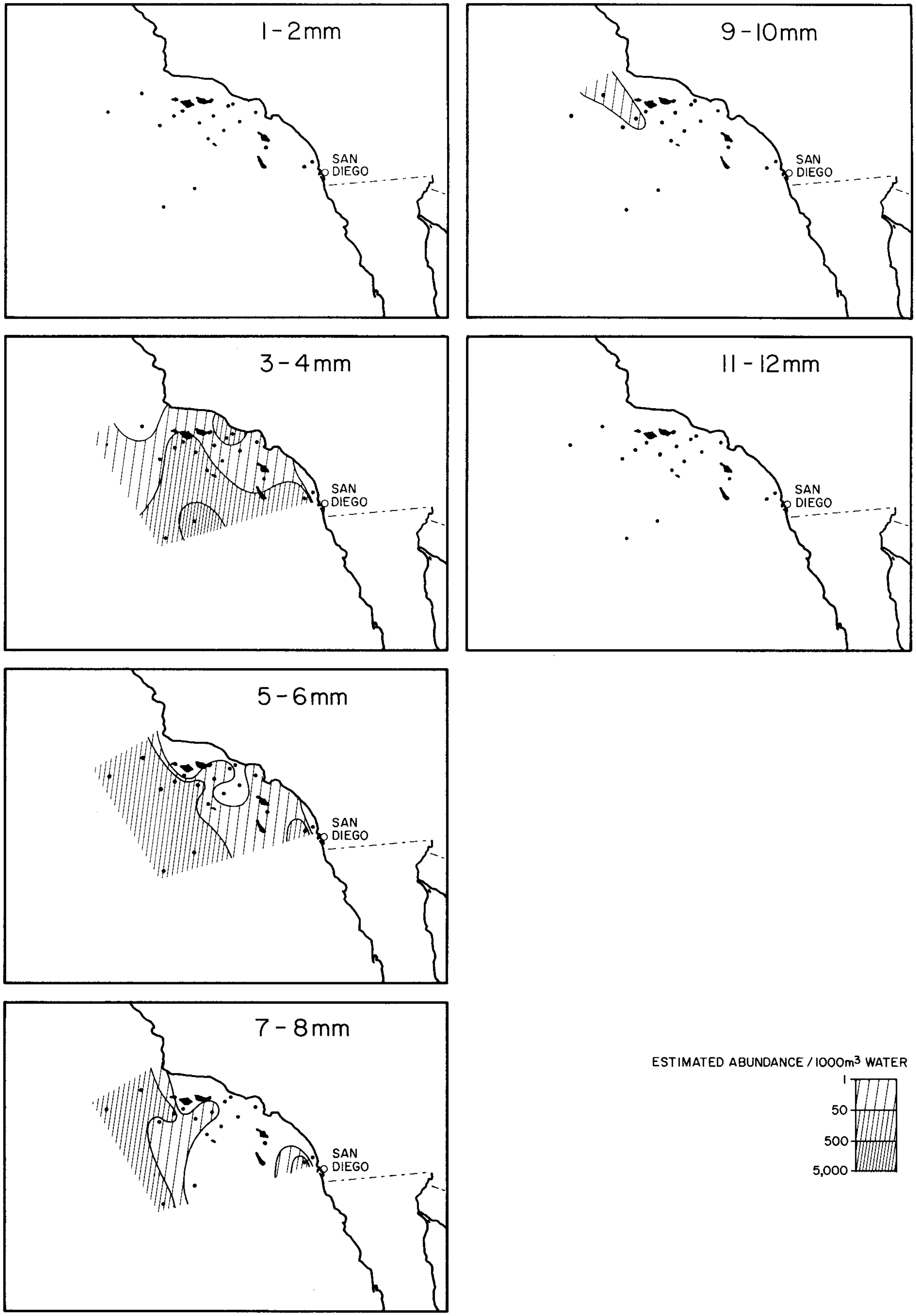
Thysanoessa gregaria

5408



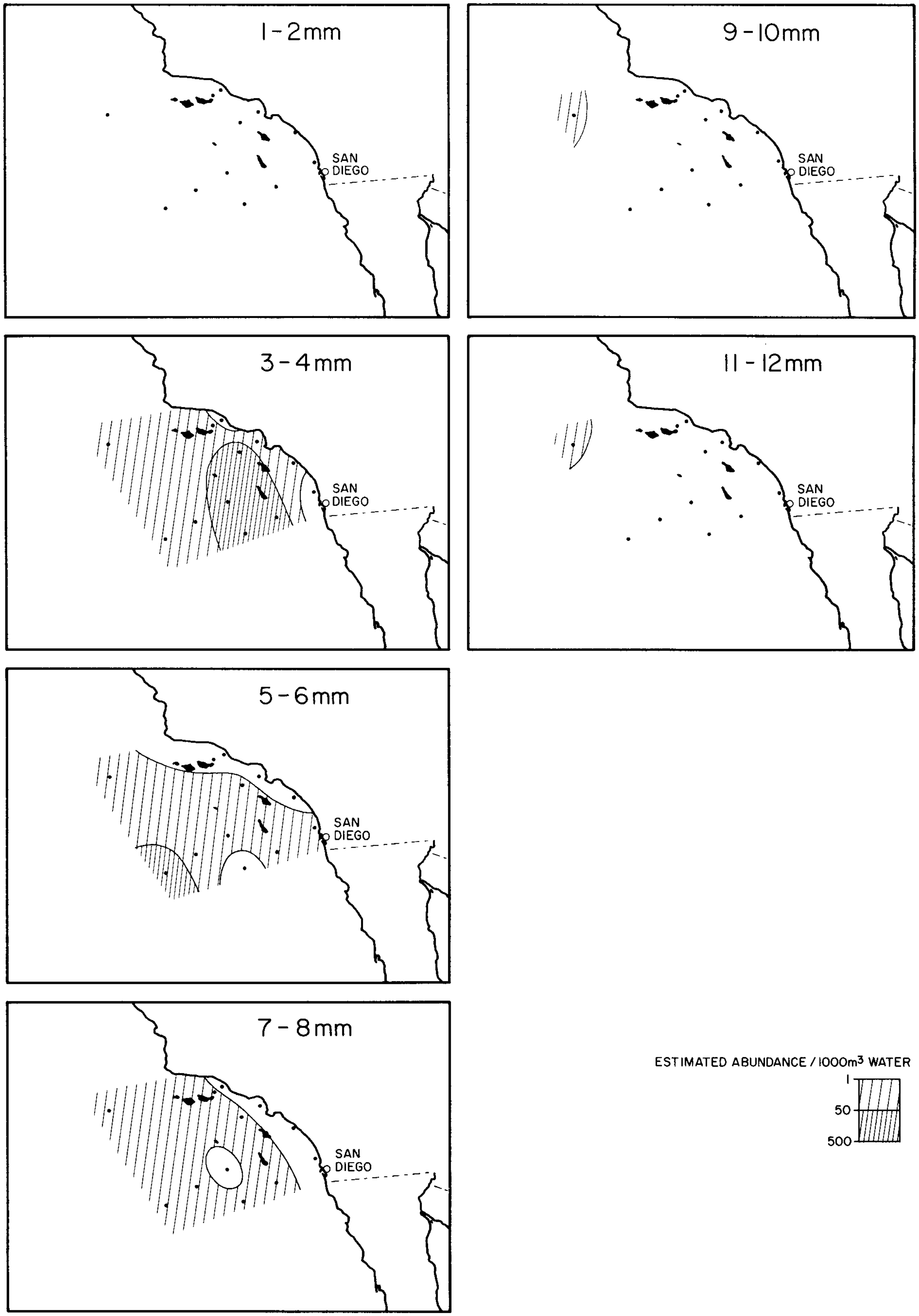
CALCOFI CRUISE 5410
7-14 OCTOBER 1954

Euphausiacea
Thysanoessa gregaria
5410



CALCOFI CRUISE 5412
2-9 DECEMBER 1954

Euphausiacea
Thysanoessa gregaria
5412



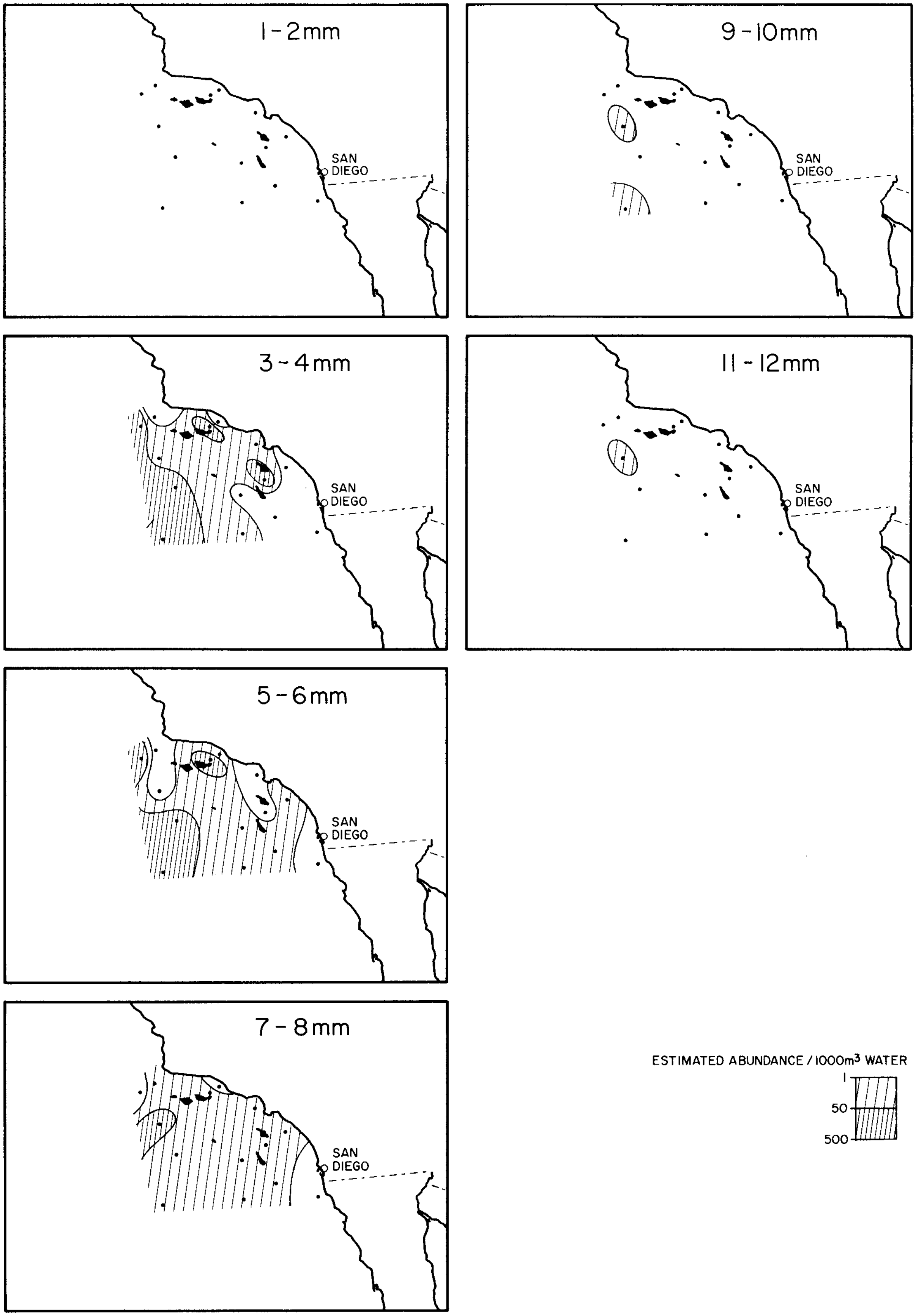
CALCOFI CRUISE 5501

13 - 19 JANUARY 1955

Euphausiacea

Thysanoessa gregaria

5501



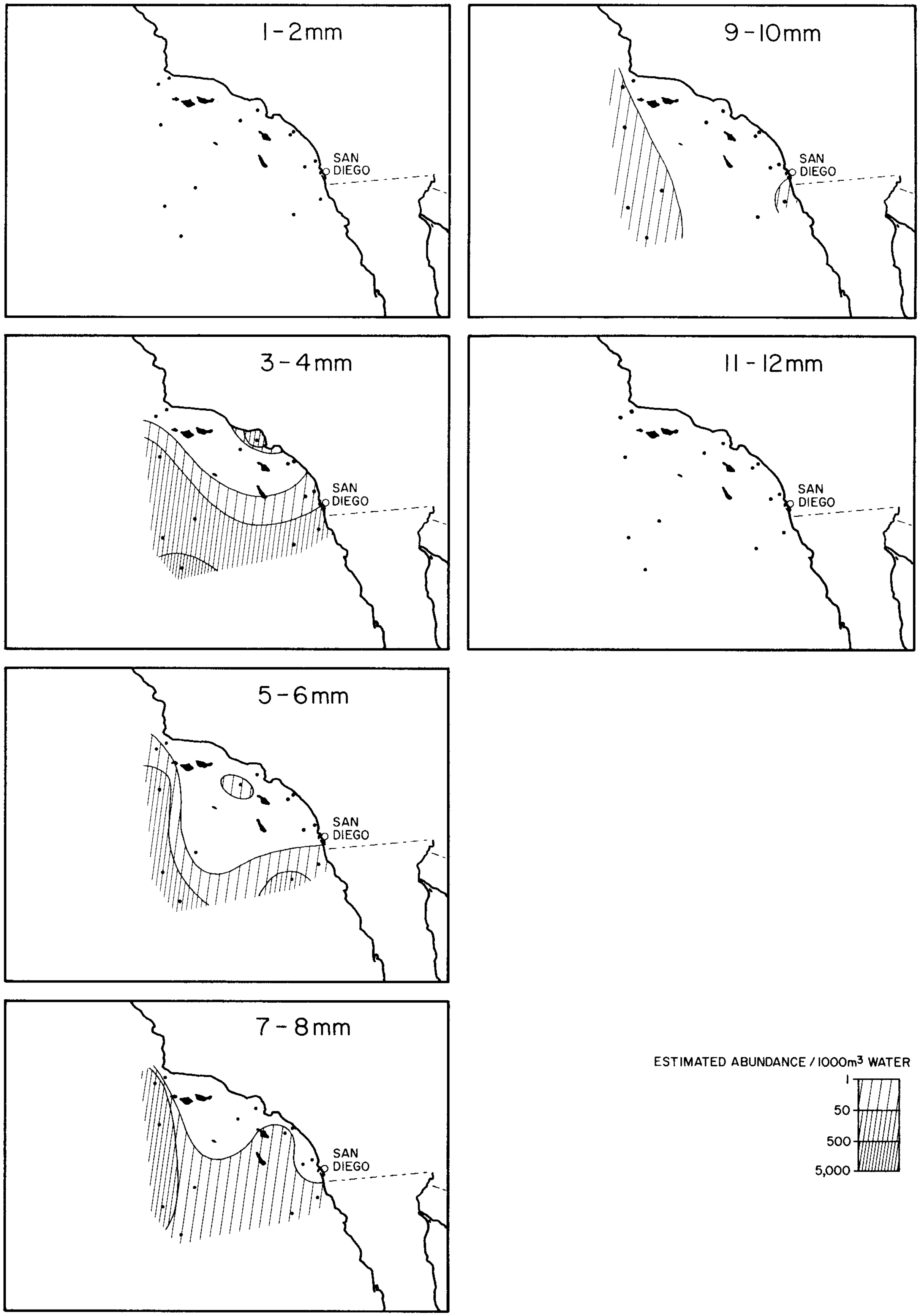
CALCOFI CRUISE 5502

11-17 FEBRUARY 1955

Euphausiacea

Thysanoessa gregaria

5502



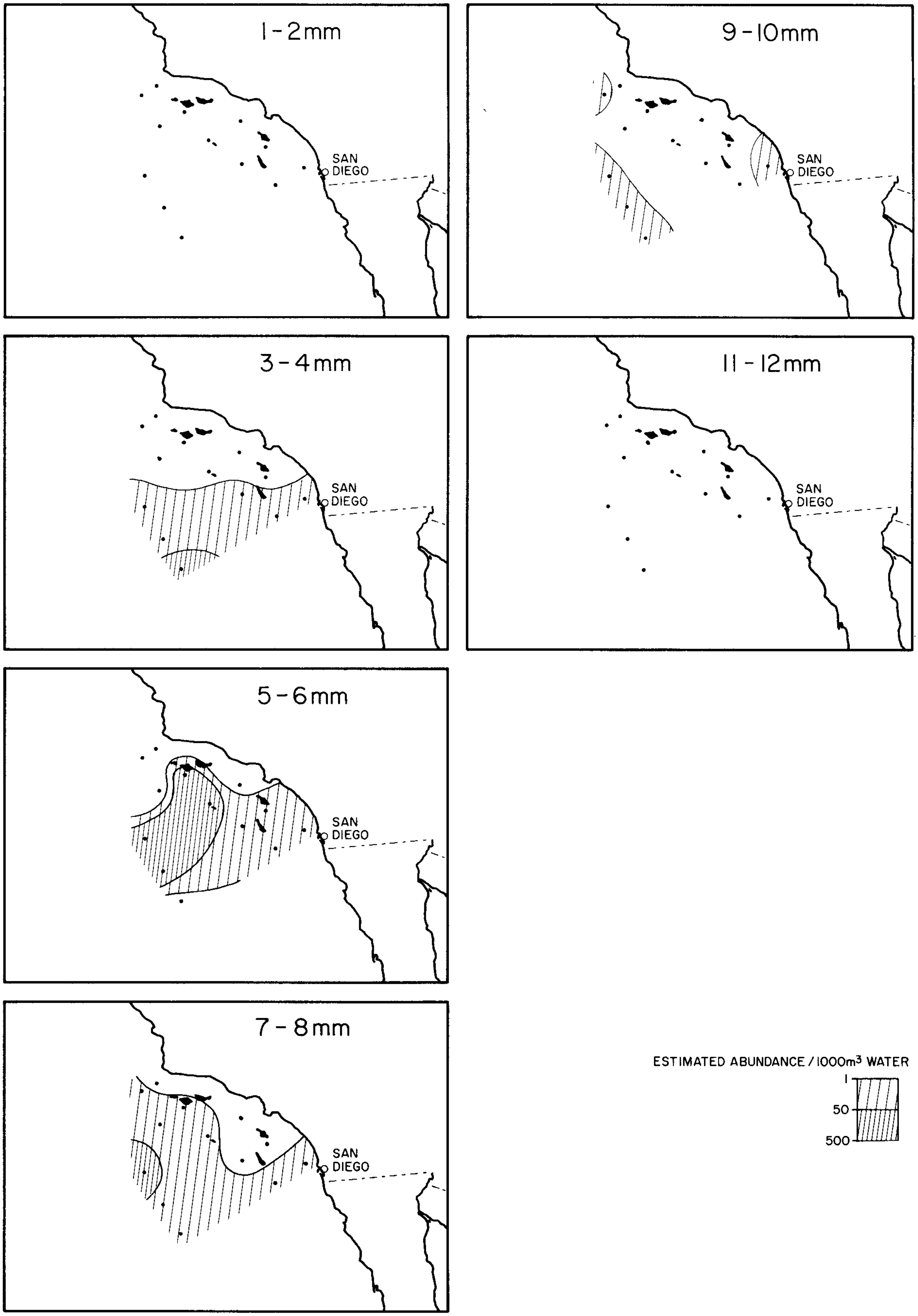
CALCOFI CRUISE 5503

8-16 MARCH 1955

Euphausiacea

Thysanoessa gregaria

5503



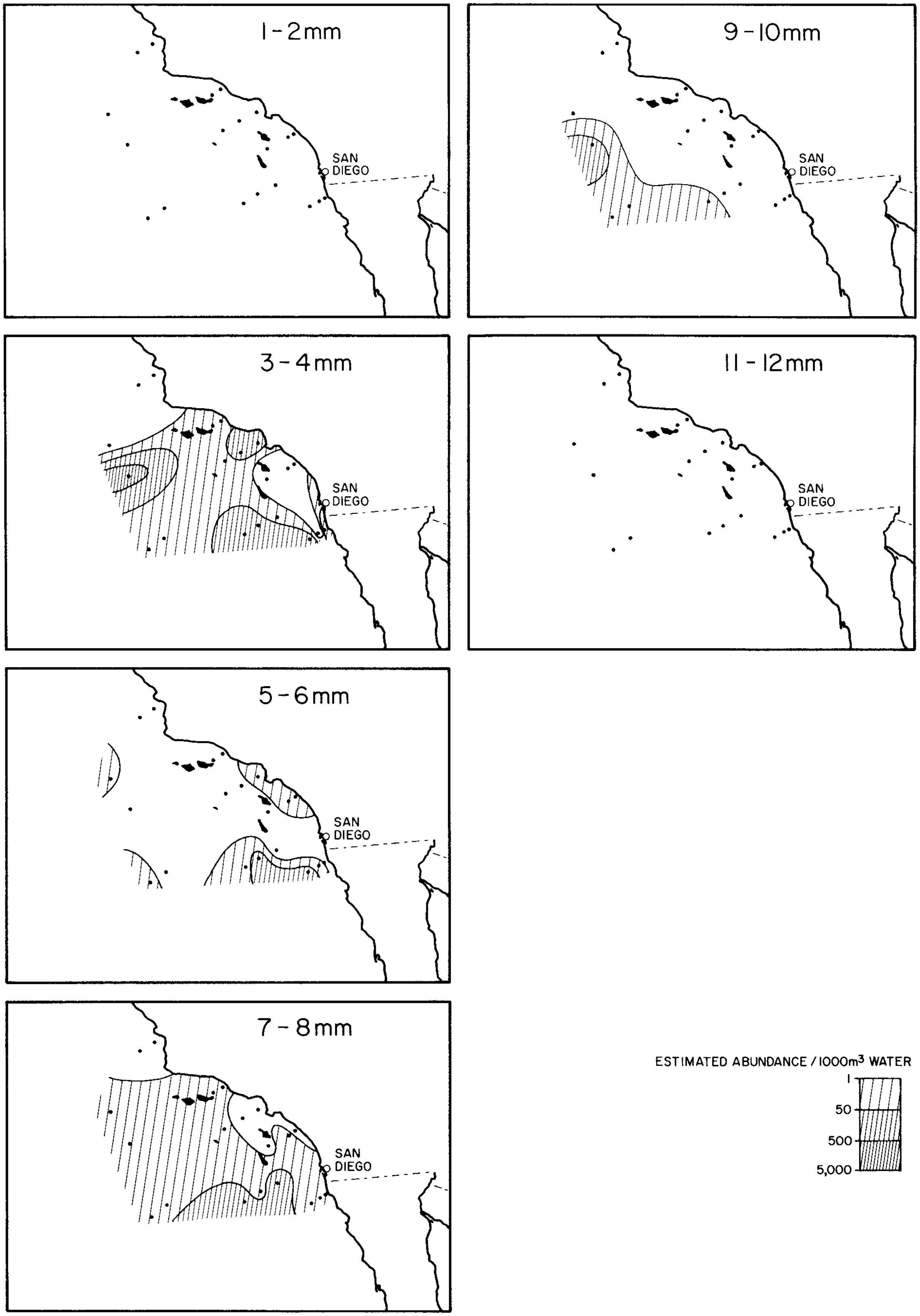
CALCOFI CRUISE 5504

7-16 APRIL 1955

Euphausiacea

Thysanoessa gregaria

5504



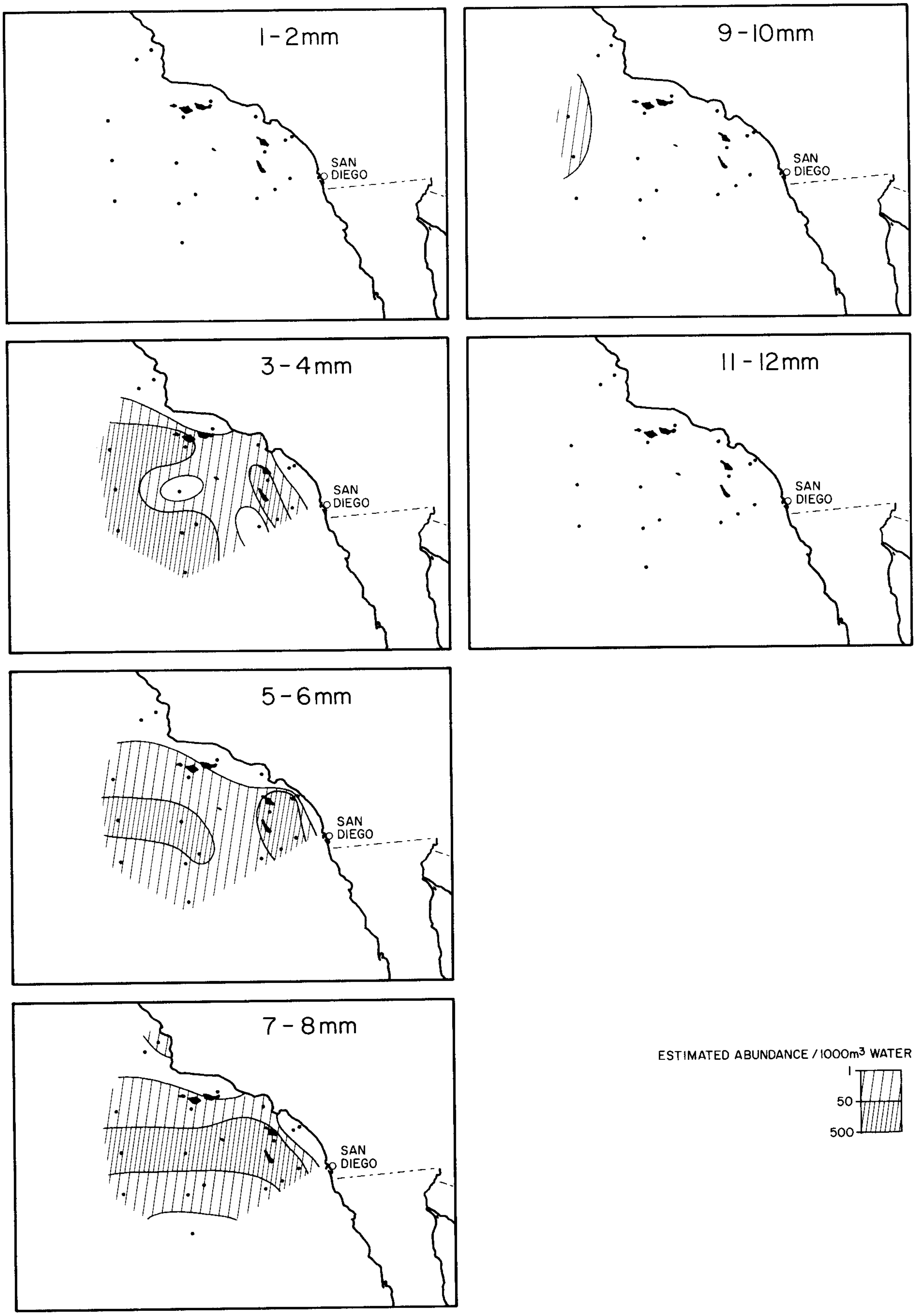
CALCOFI CRUISE 5505

21 MAY - 6 JUNE 1955

Euphausiacea

Thysanoessa gregaria

5505



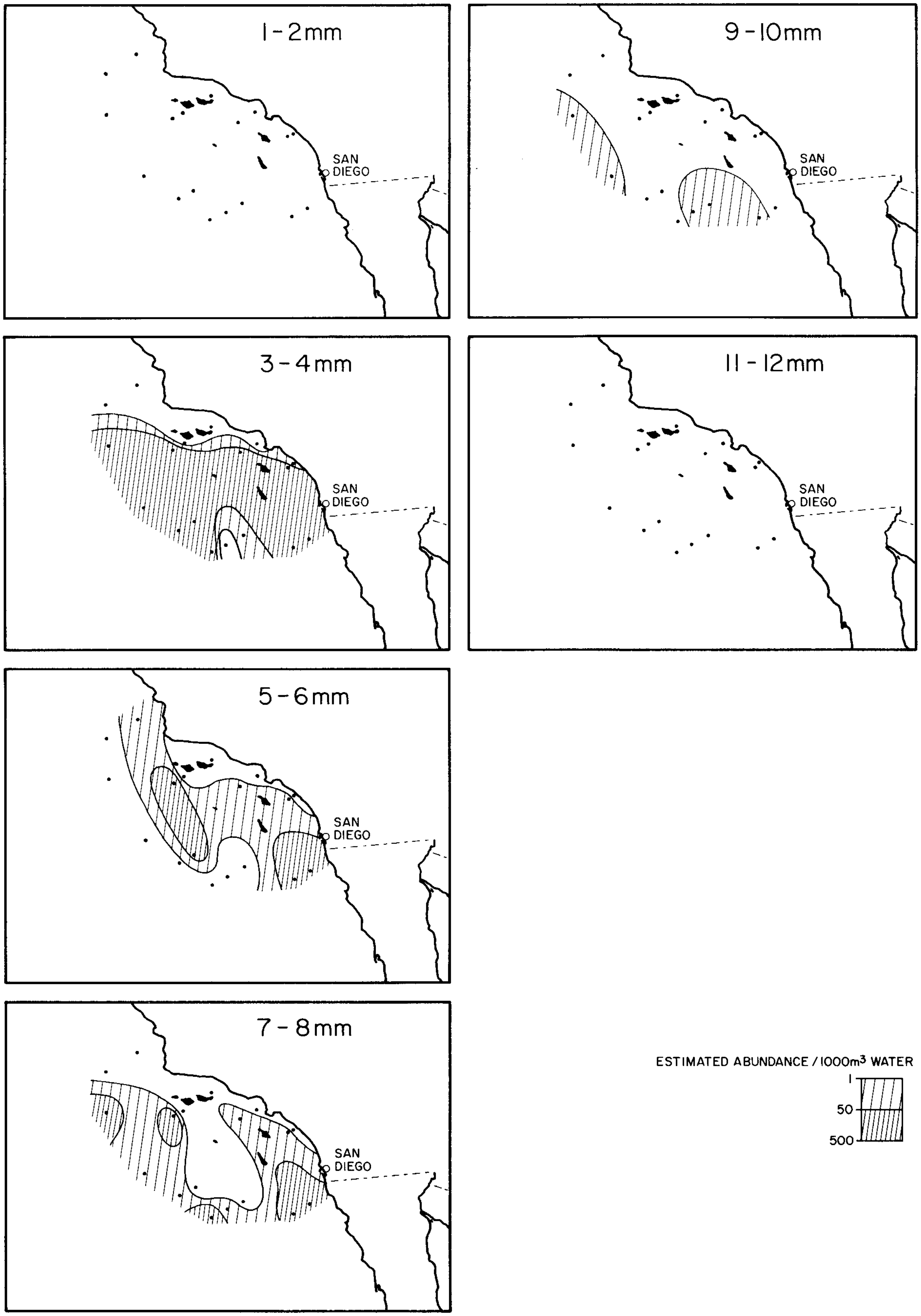
CALCOFI CRUISE 5506

11- 20 JUNE 1955

Euphausiacea

Thysanoessa gregaria

5506



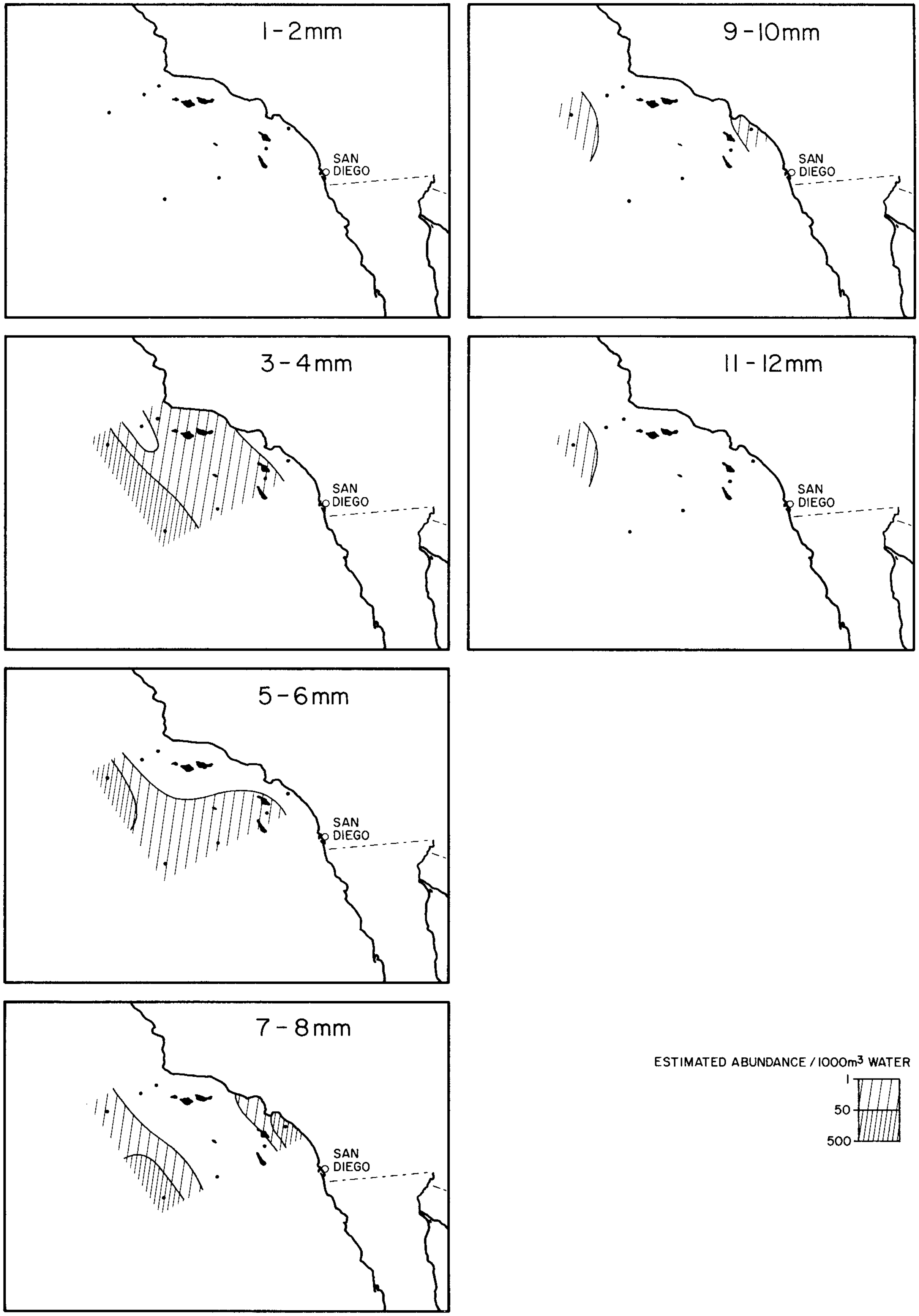
CALCOFI CRUISE 5507

7-13 JULY 1955

Euphausiacea

Thysanoessa gregaria

5507

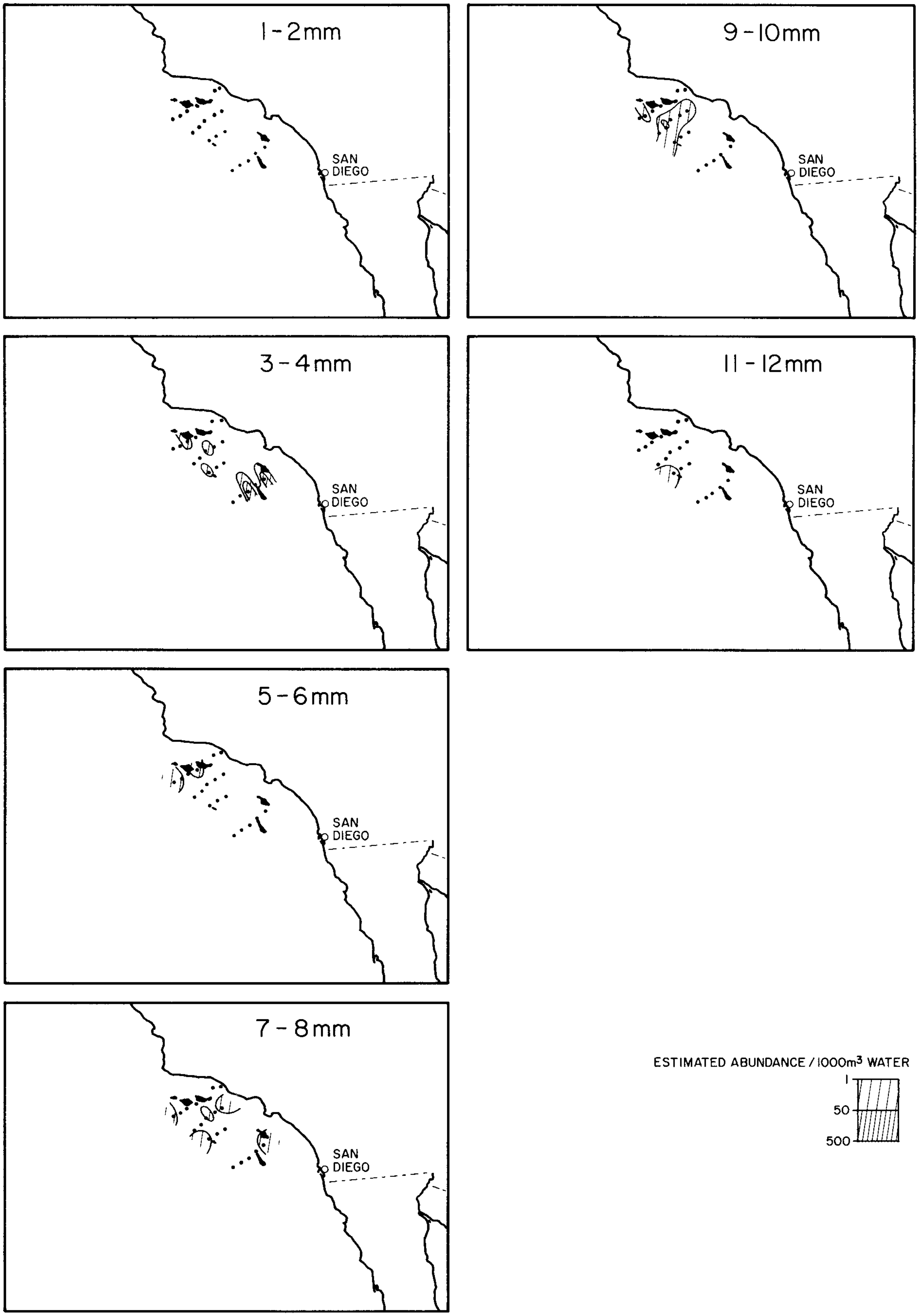


CALCOFI CRUISE 5508 'NORPAC'

4-6 SEPTEMBER 1955
MAIN PORTION OF CRUISE OCCUPIED IN AUGUST

Euphausiacea

Thysanoessa gregaria
5508 'NORPAC'



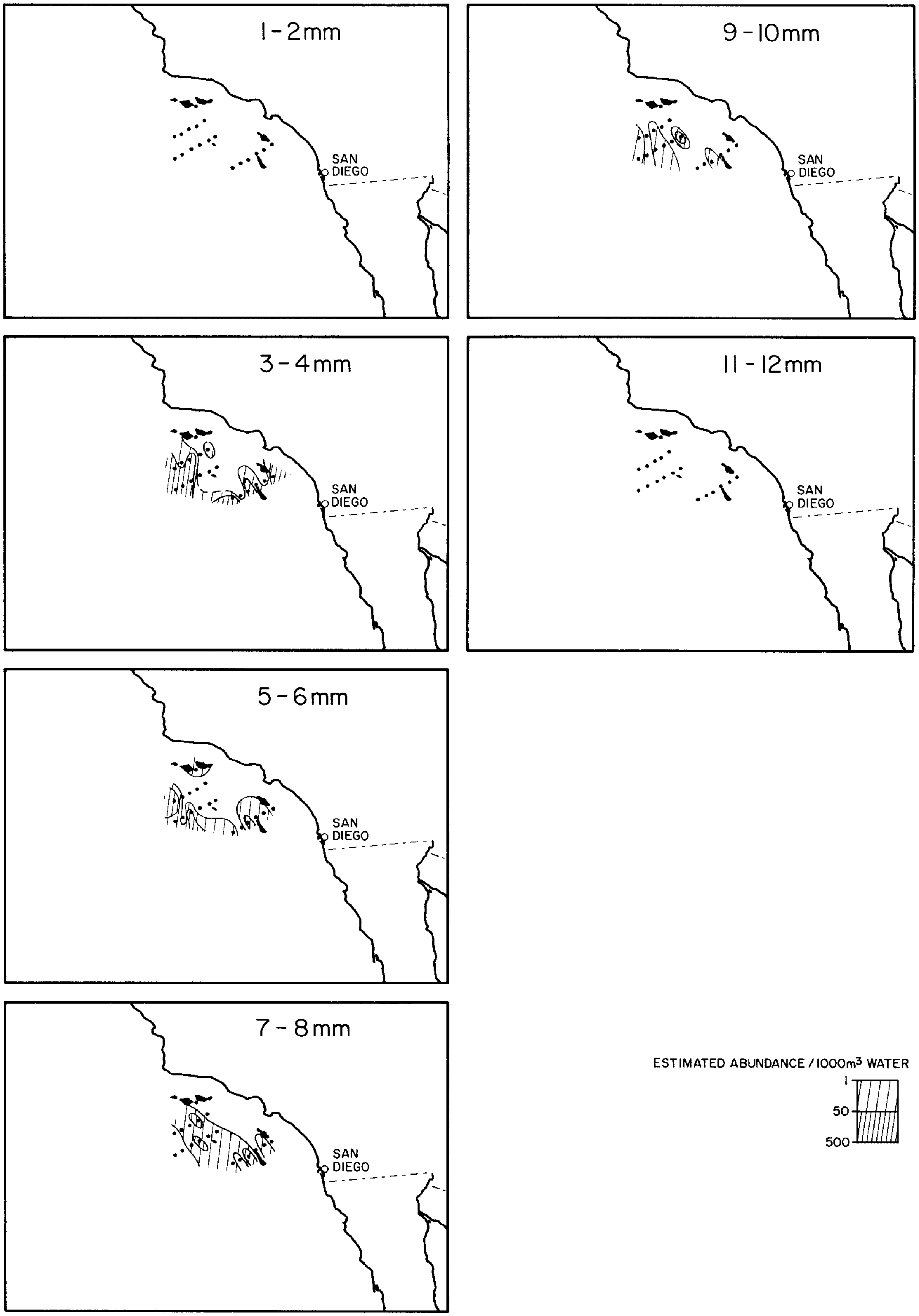
CALCOFI CRUISE 5509-I

12-17 SEPTEMBER 1955

Euphausiacea

Thysanoessa gregaria

5509-I



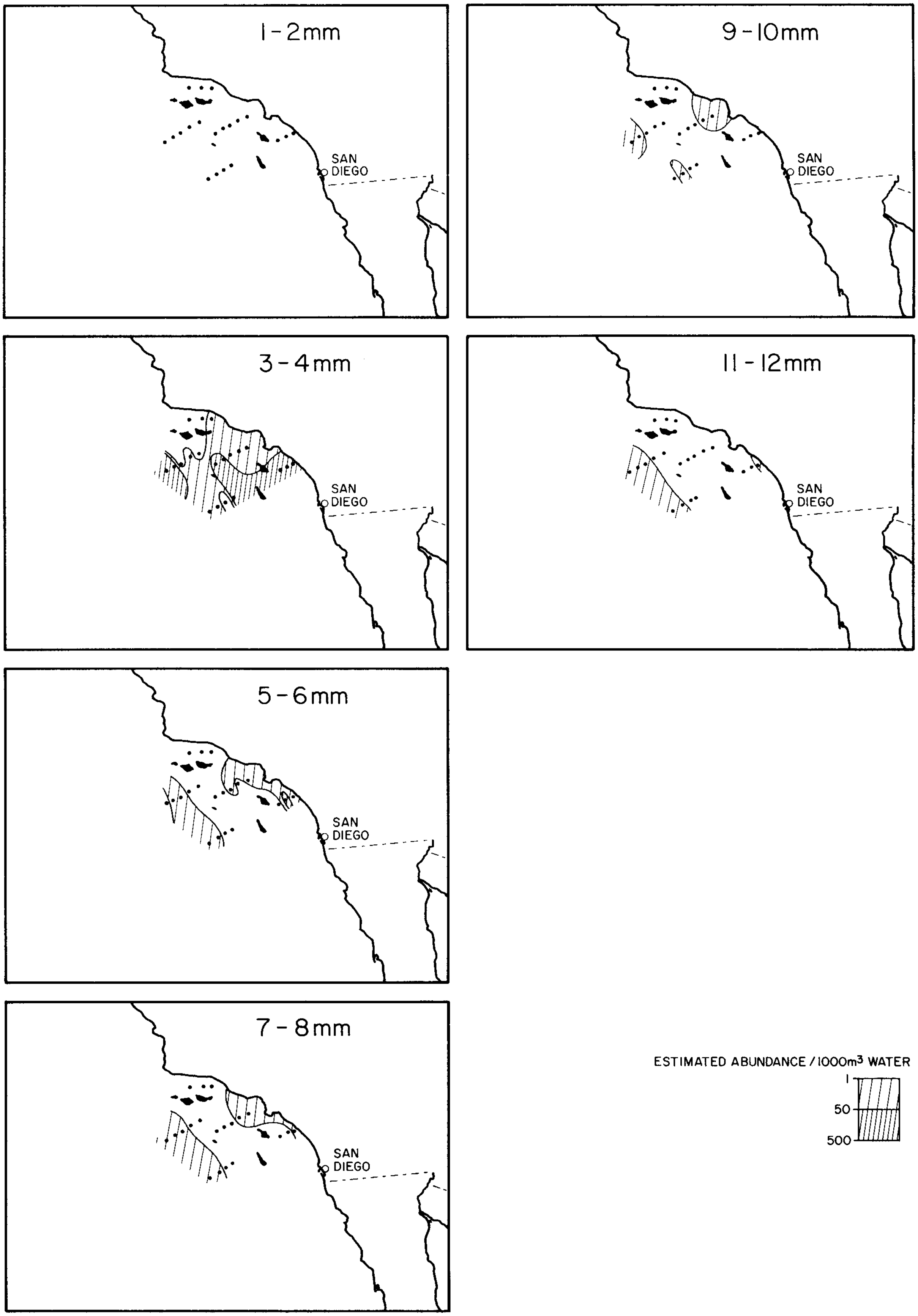
CALCOFI CRUISE 5509-II

15 - 19 SEPTEMBER 1955

Euphausiacea

Thysanoessa gregaria

5509-II



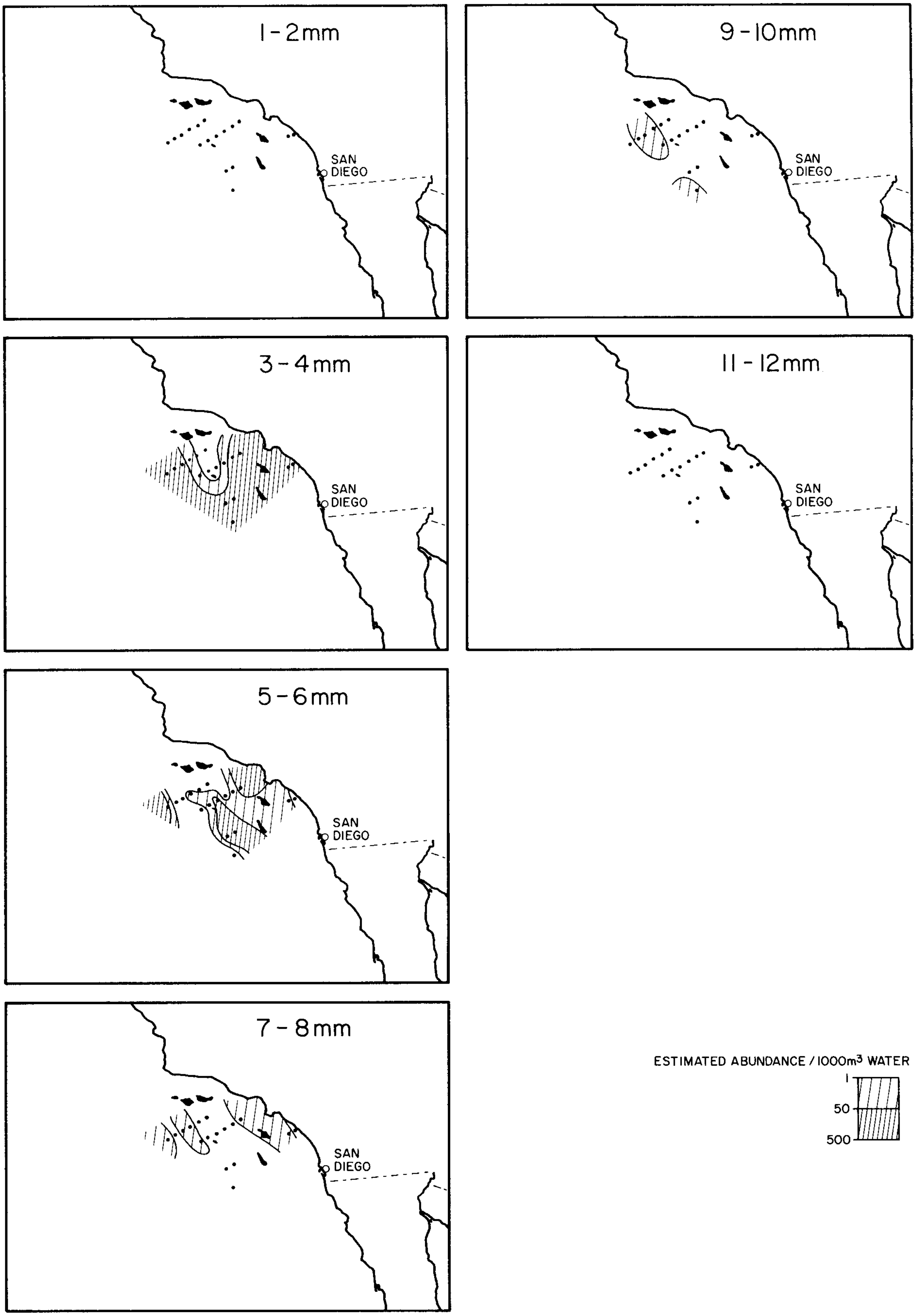
CALCOFI CRUISE 5509-III

18-23 SEPTEMBER 1955

Euphausiacea

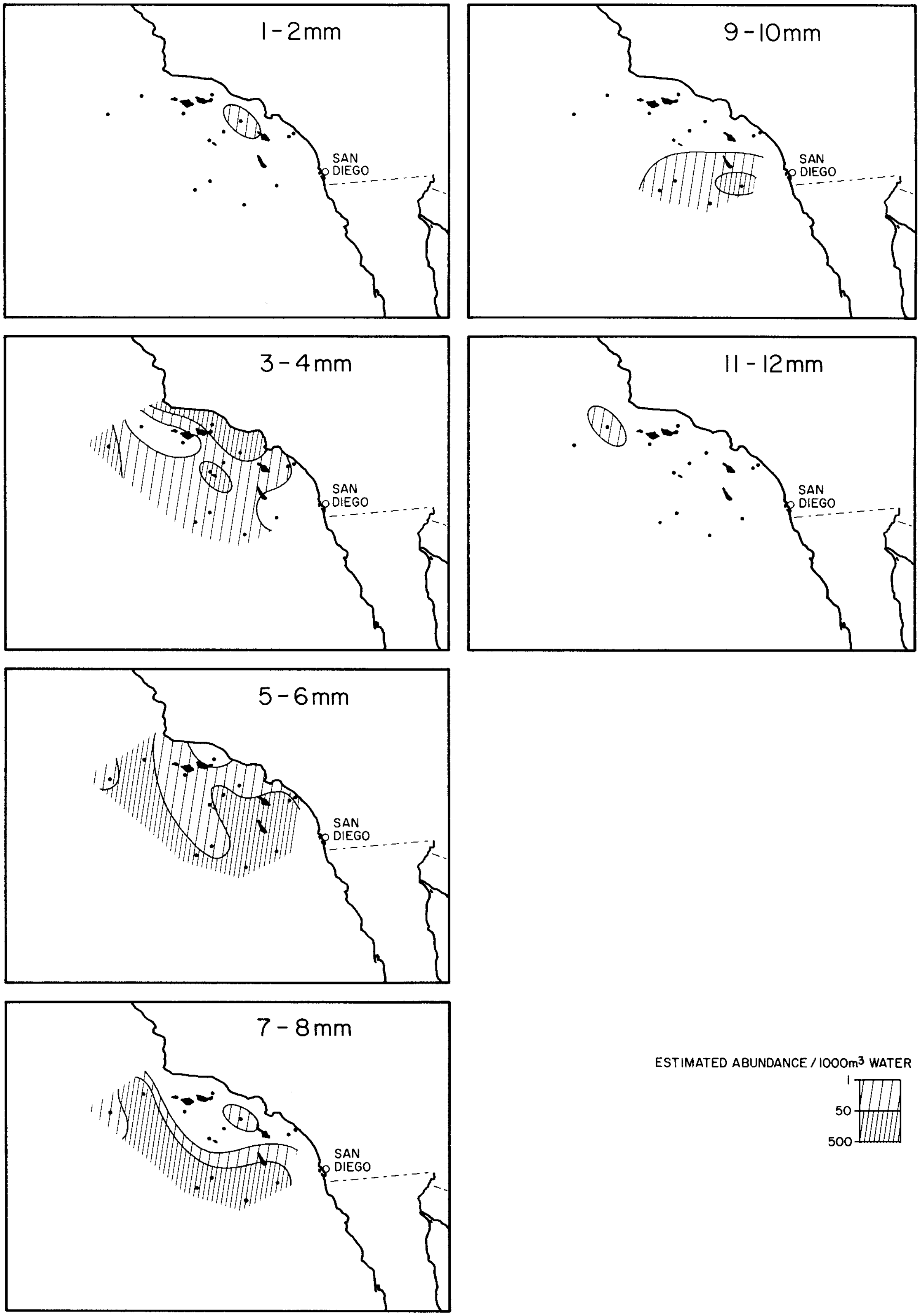
Thysanoessa gregaria

5509-III



CALCOFI CRUISE 5509-IV
21-24 SEPTEMBER 1955

Euphausiacea
Thysanoessa gregaria
5509-IV



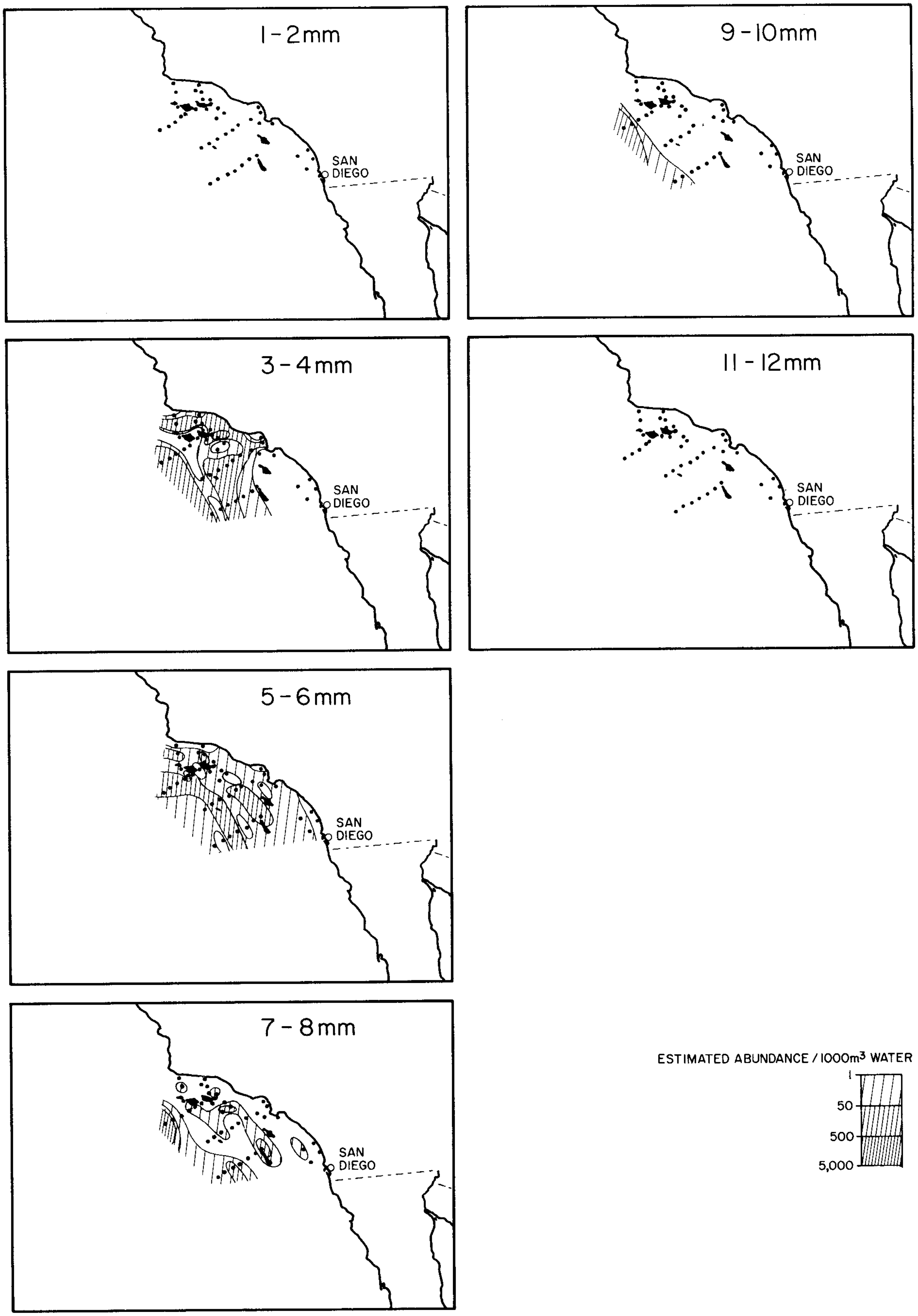
CALCOFI CRUISE 5510

21-29 OCTOBER 1955

Euphausiacea

Thysanoessa gregaria

5510



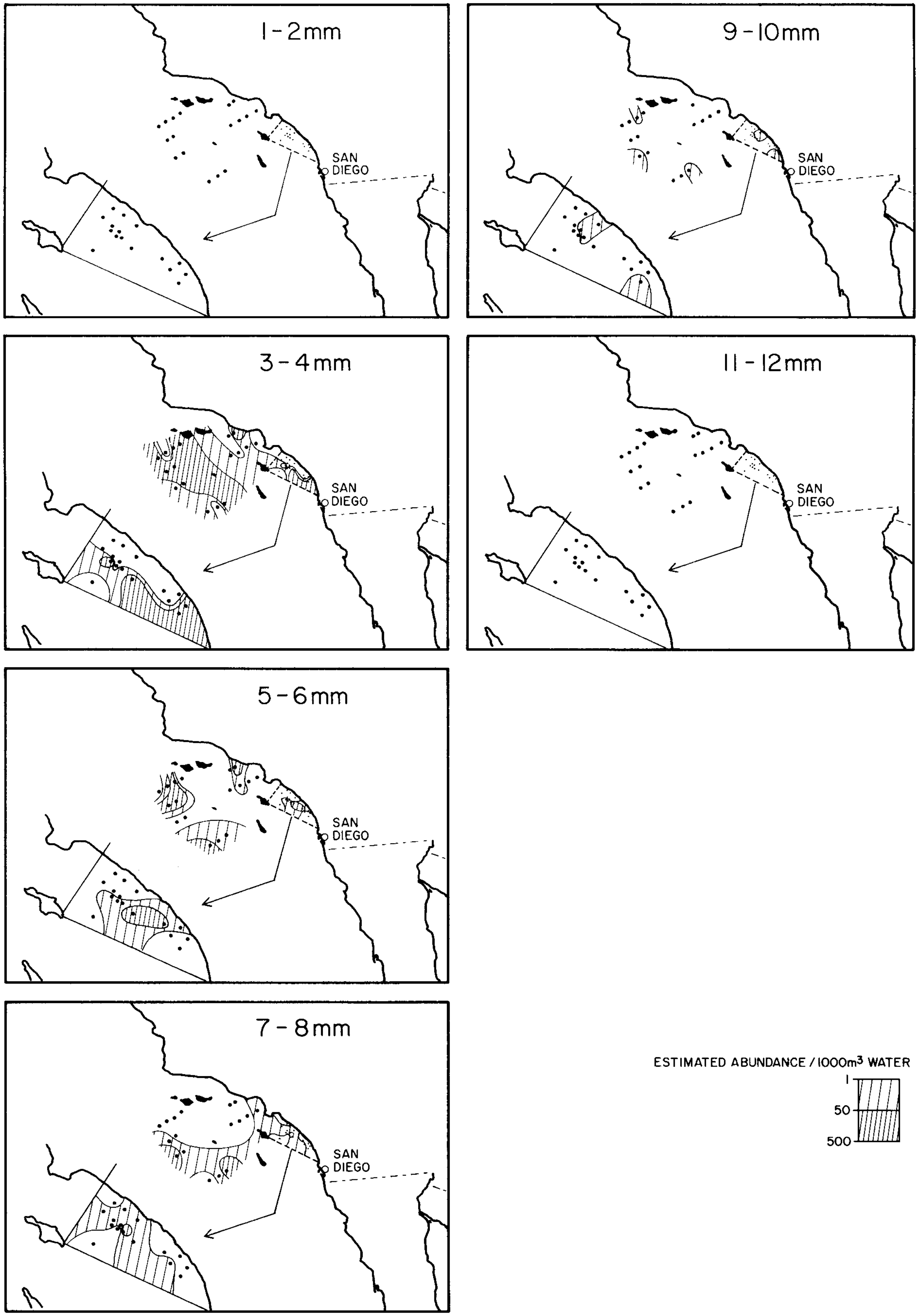
CALCOFI CRUISE 5511-I

8-13 NOVEMBER 1955

Euphausiacea

Thysanoessa gregaria

5511-I



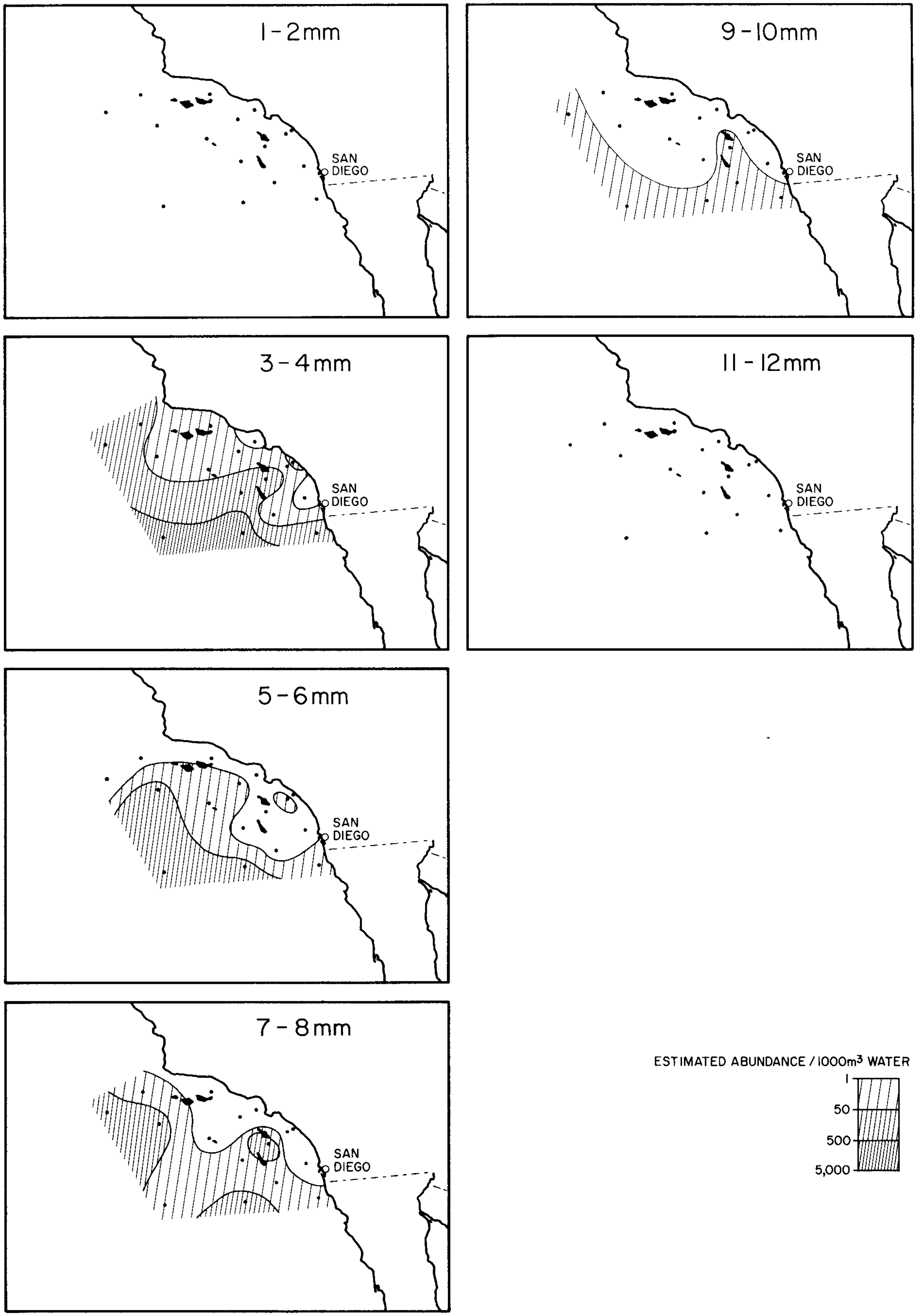
CALCOFI CRUISE 5511-II

16-19 NOVEMBER 1955

Euphausiacea

Thysanoessa gregaria

5511-II



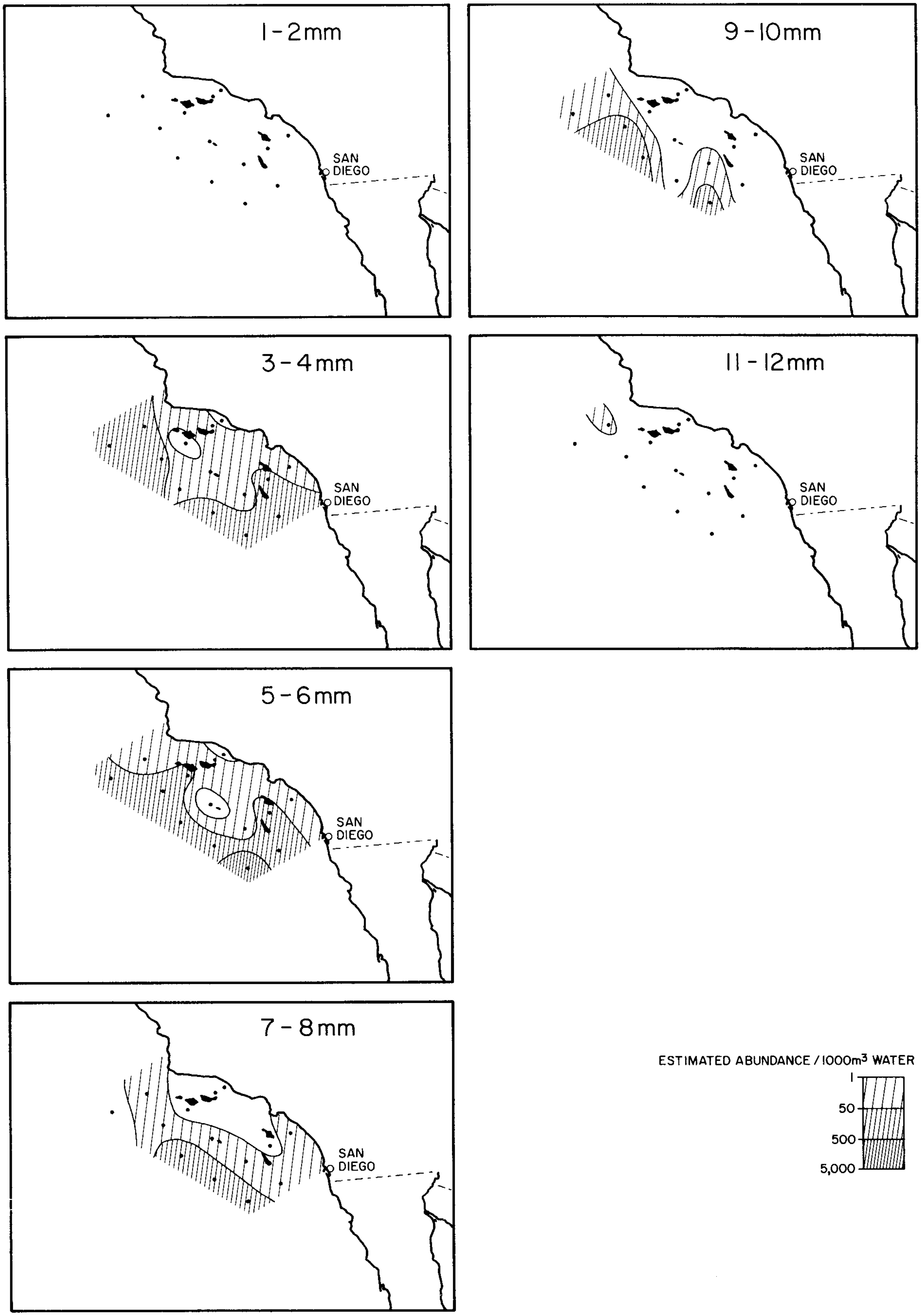
Euphausiacea

CALCOFI CRUISE 5512

30 NOVEMBER - 7 DECEMBER 1955

Thysanoessa gregaria

5512



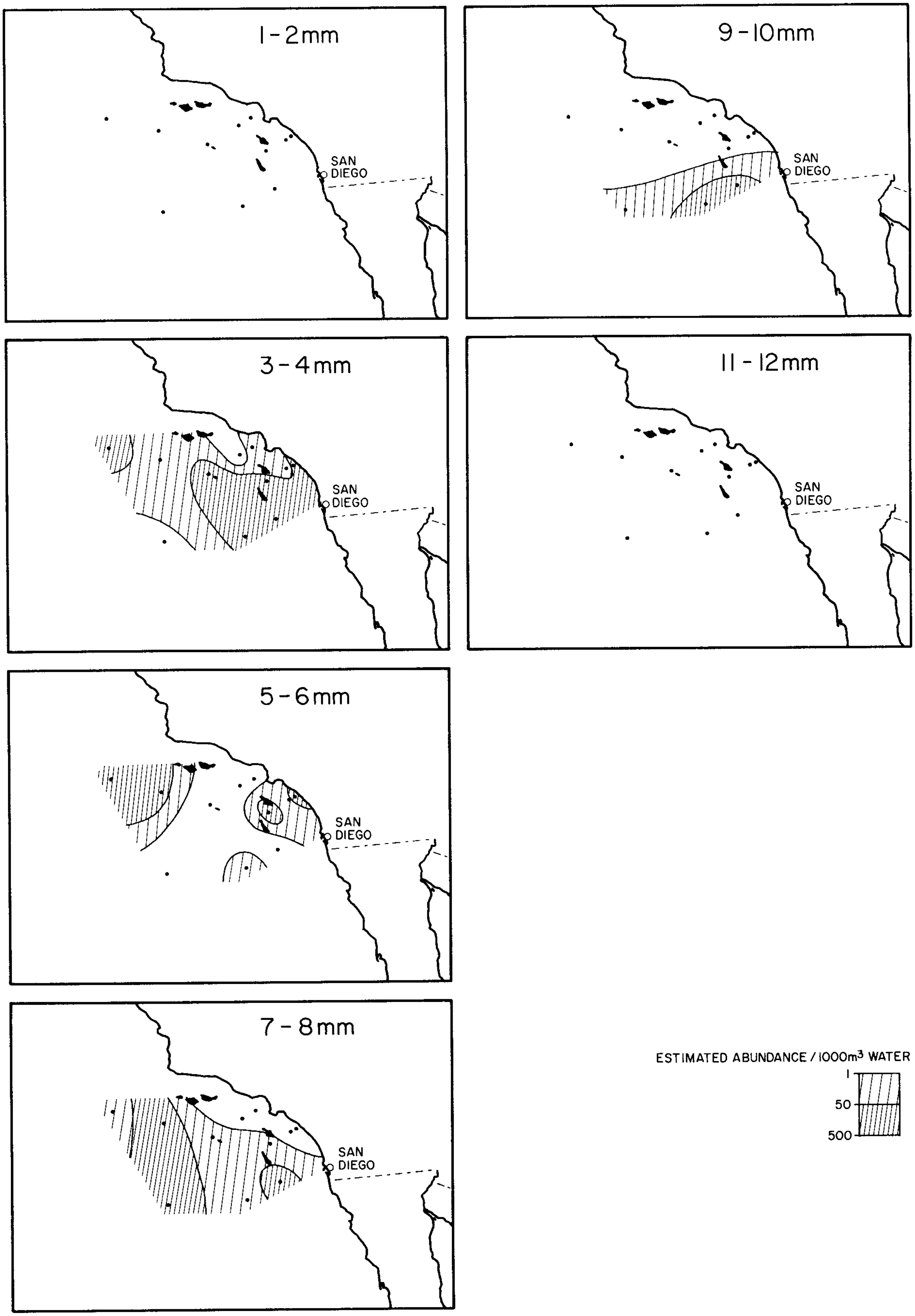
Euphausiacea

Thysanoessa gregaria

5601

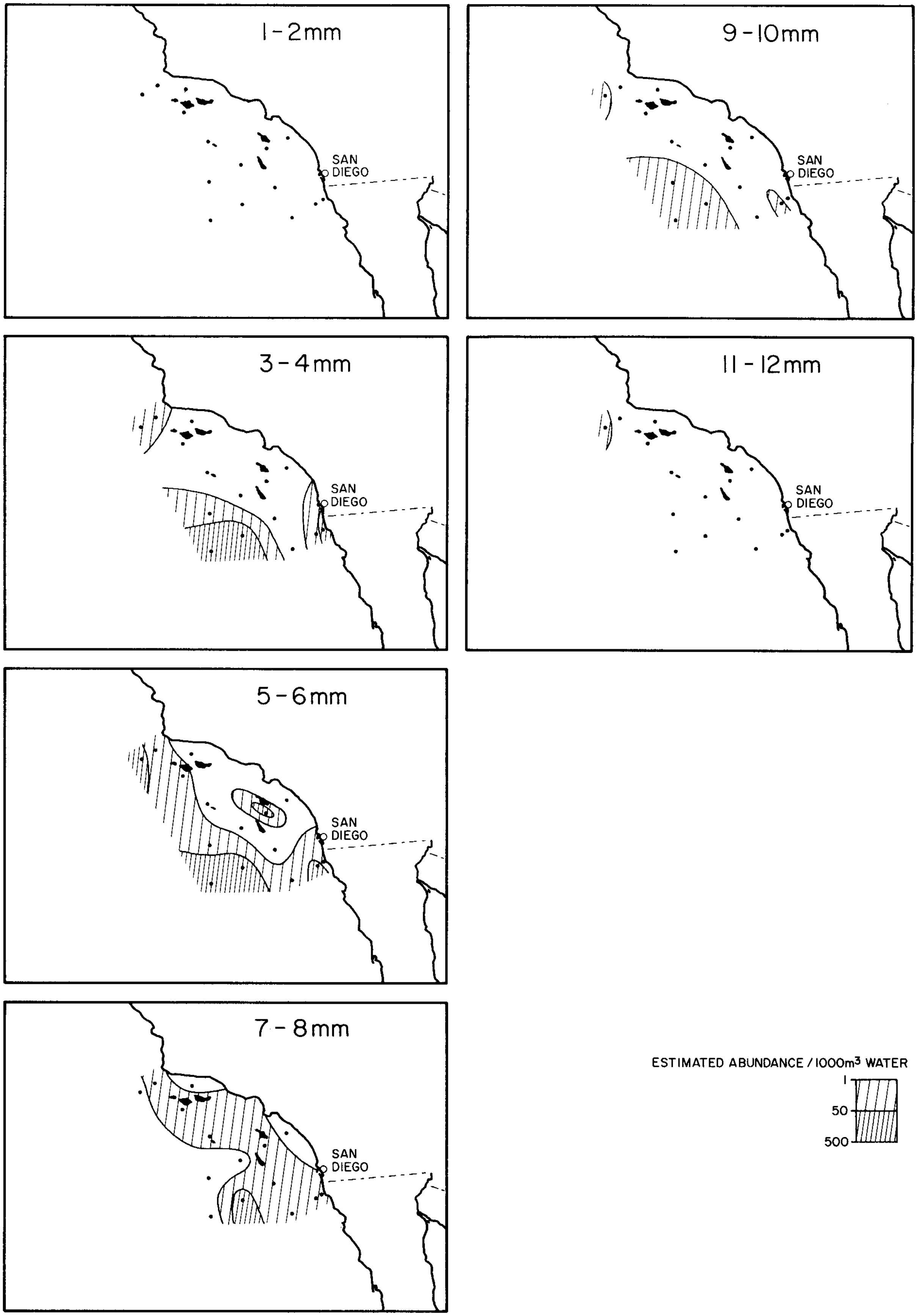
CALCOFI CRUISE 5601

6 - 10 JANUARY 1956



CALCOFI CRUISE 5602
3-10 FEBRUARY 1956

Euphausiacea
Thysanoessa gregaria
5602



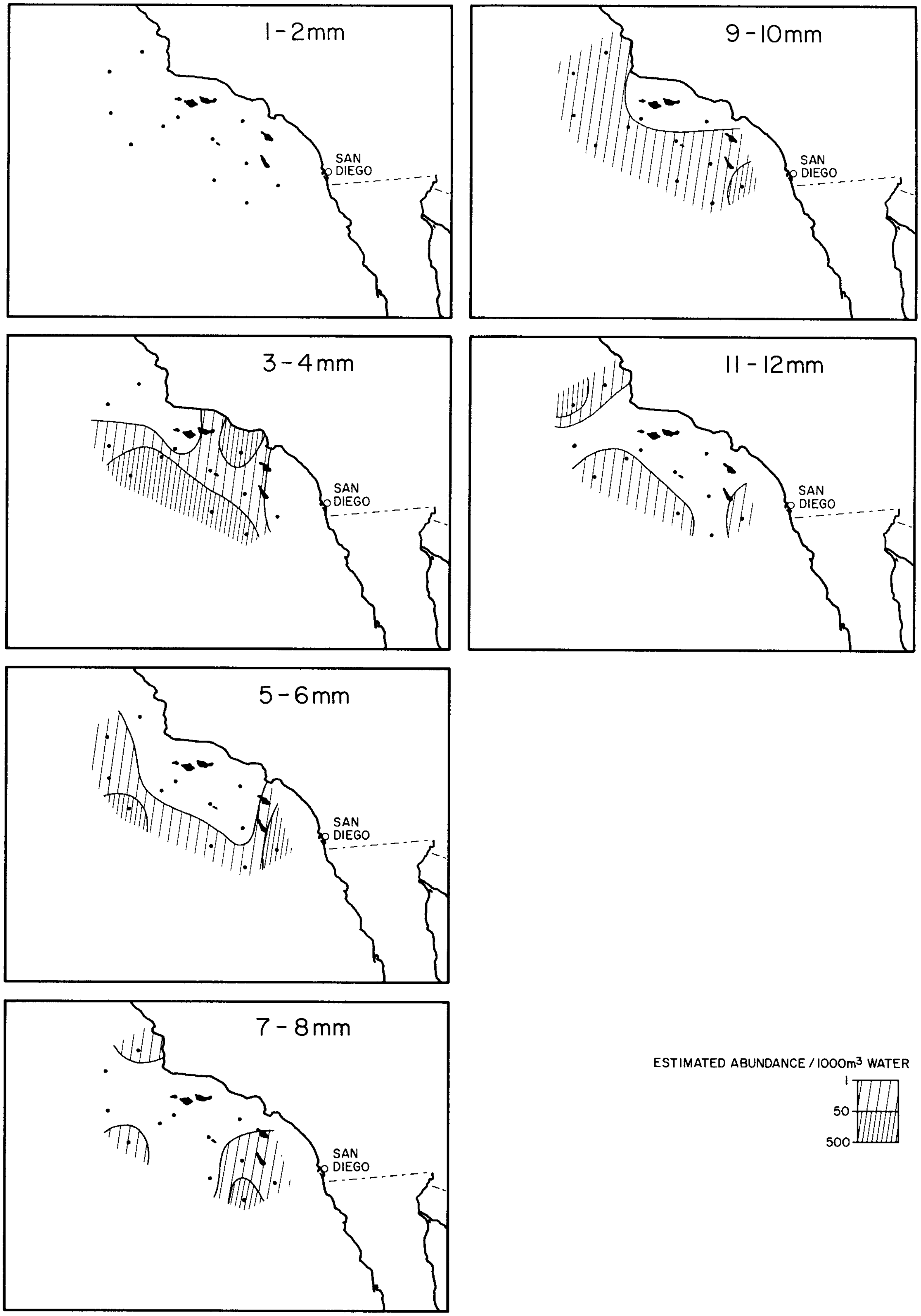
CALCOFI CRUISE 5603

8-17 MARCH 1956

Euphausiacea

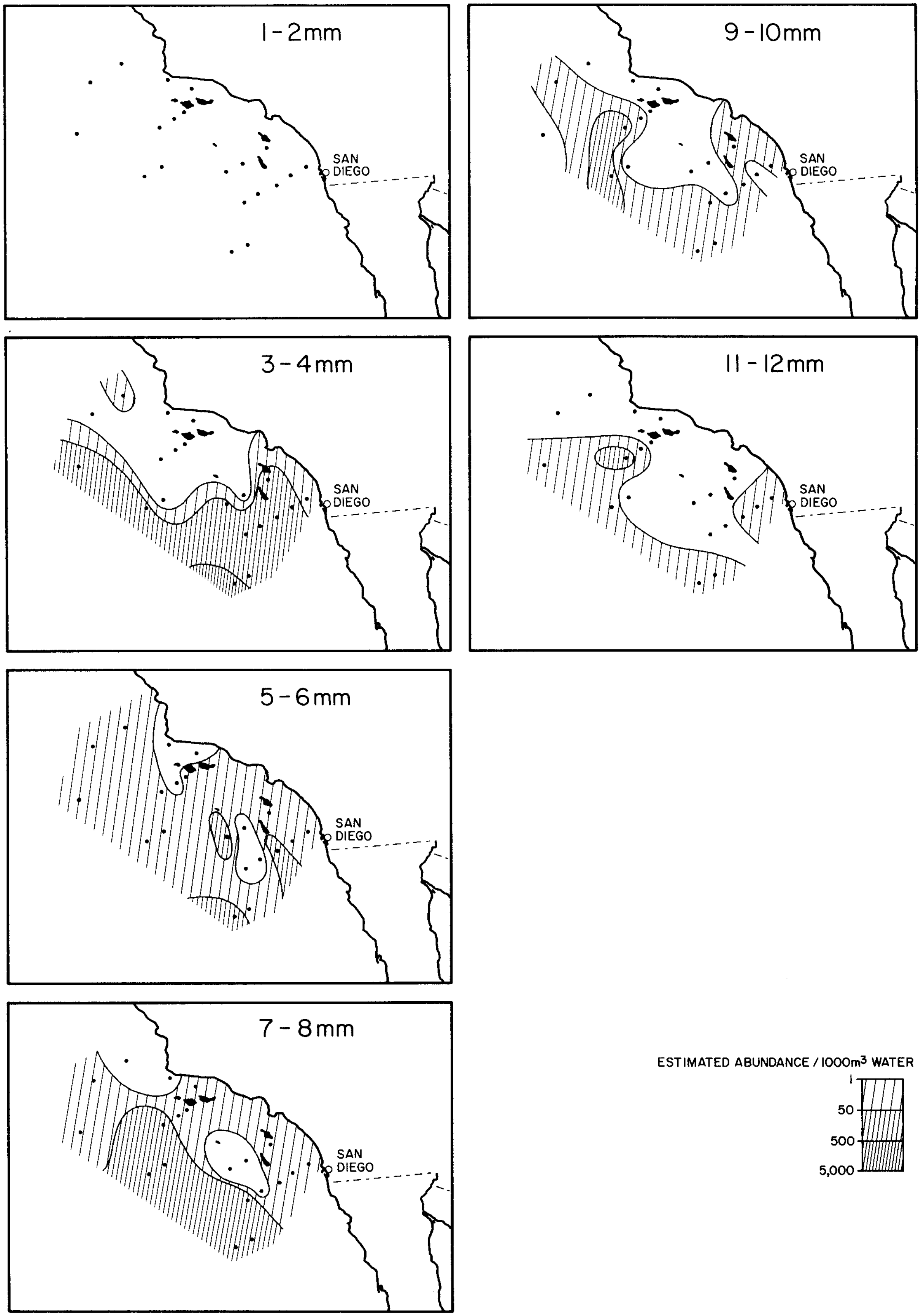
Thysanoessa gregaria

5603



CALCOFI CRUISE 5604
14 - 21 APRIL 1956

Euphausiacea
Thysanoessa gregaria
5604



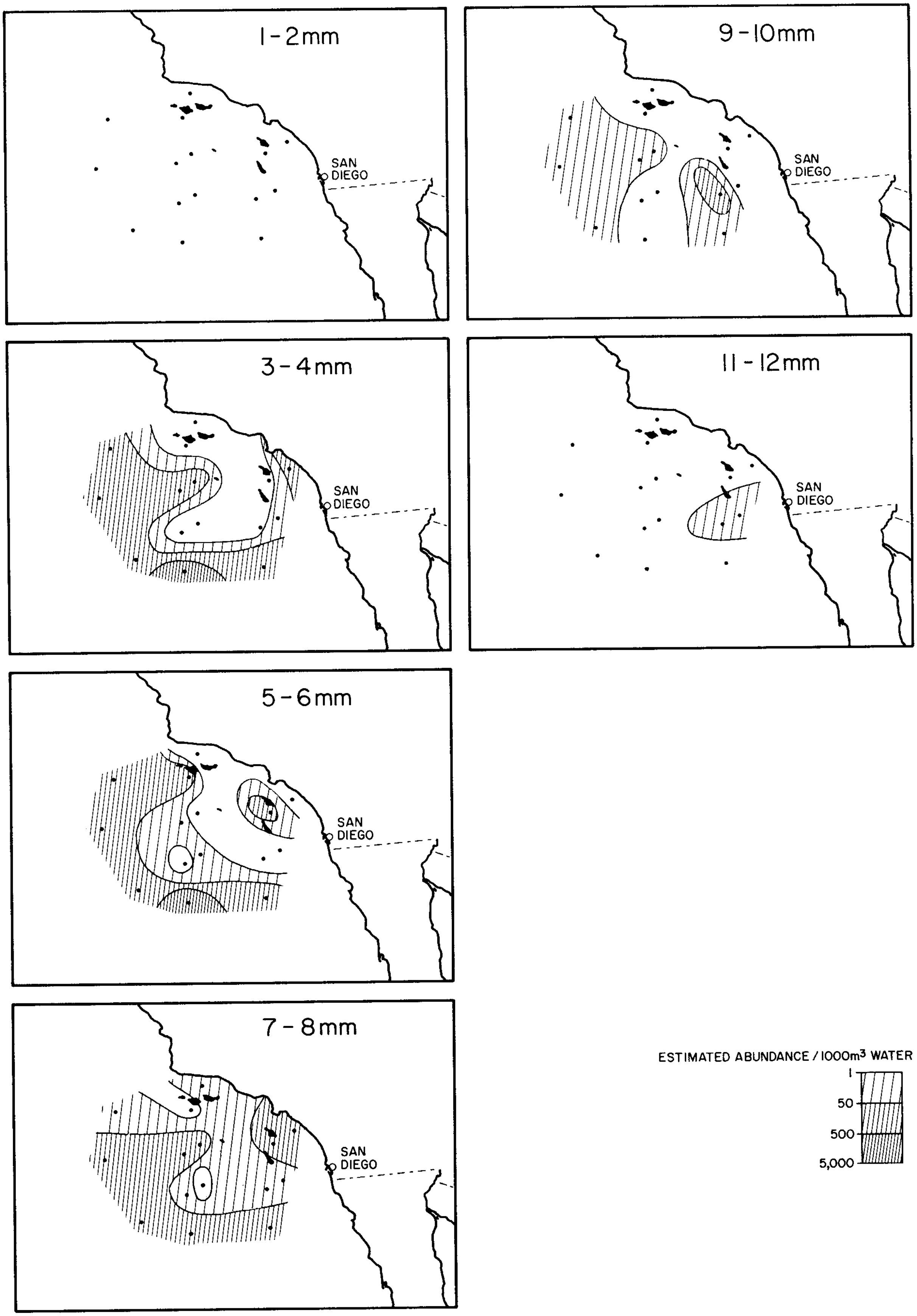
Euphausiacea

Thysanoessa gregaria

5605

CALCOFI CRUISE 5605

6-18 MAY 1956



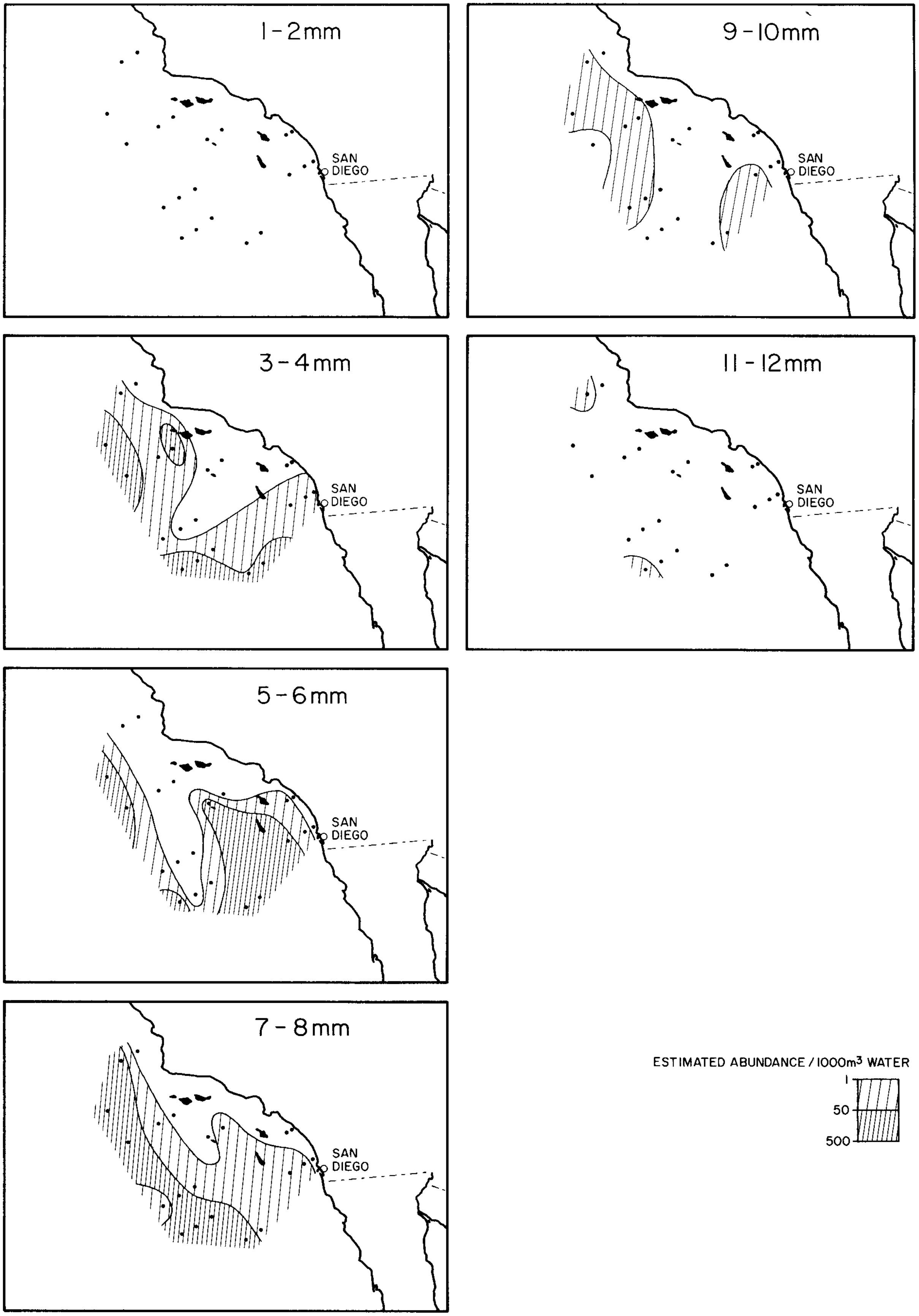
Euphausiacea

CALCOFI CRUISE 5606

30 MAY - 13 JUNE 1956

Thysanoessa gregaria

5606



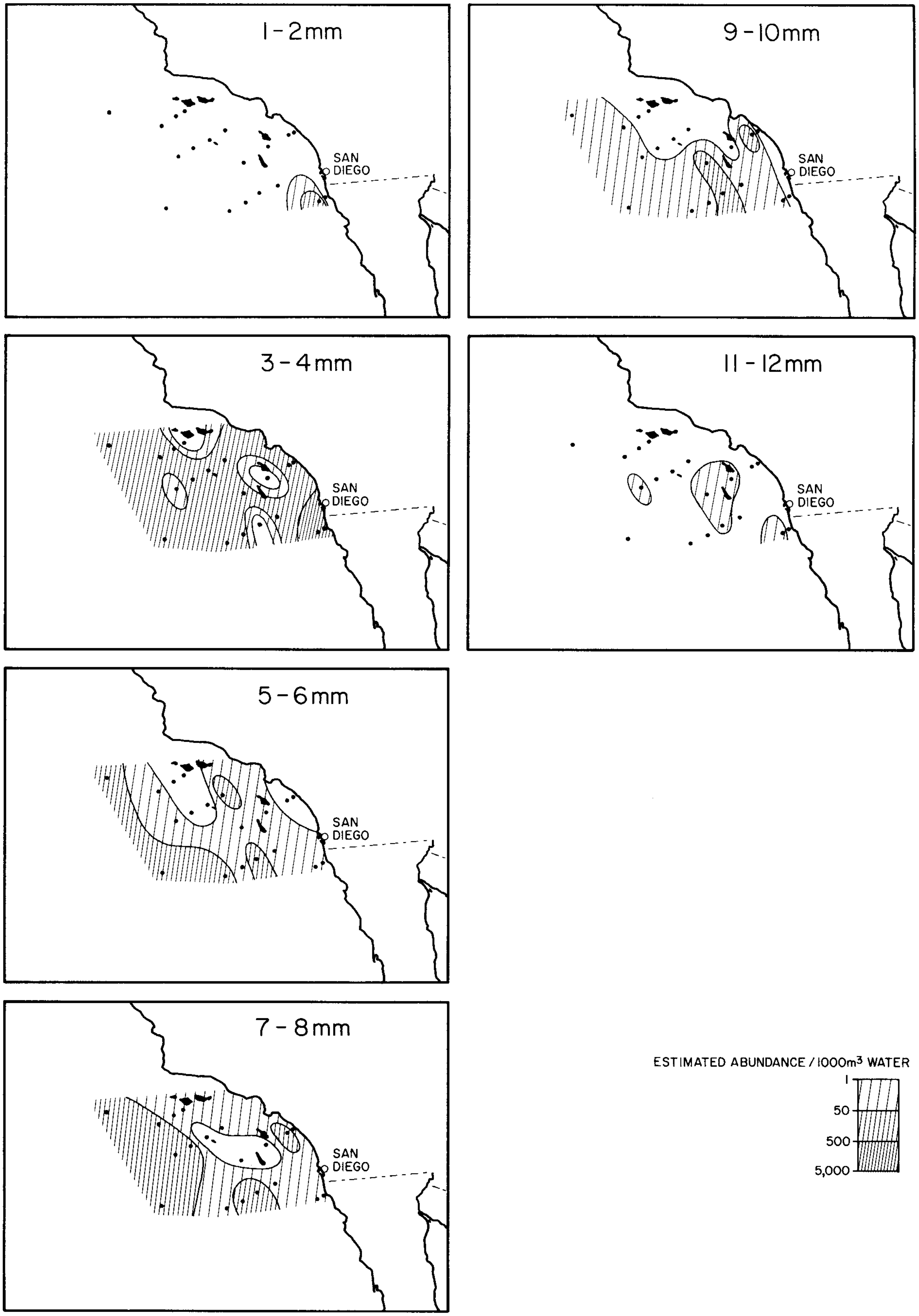
CALCOFI CRUISE 5607

7-15 JULY 1956

Euphausiacea

Thysanoessa gregaria

5607



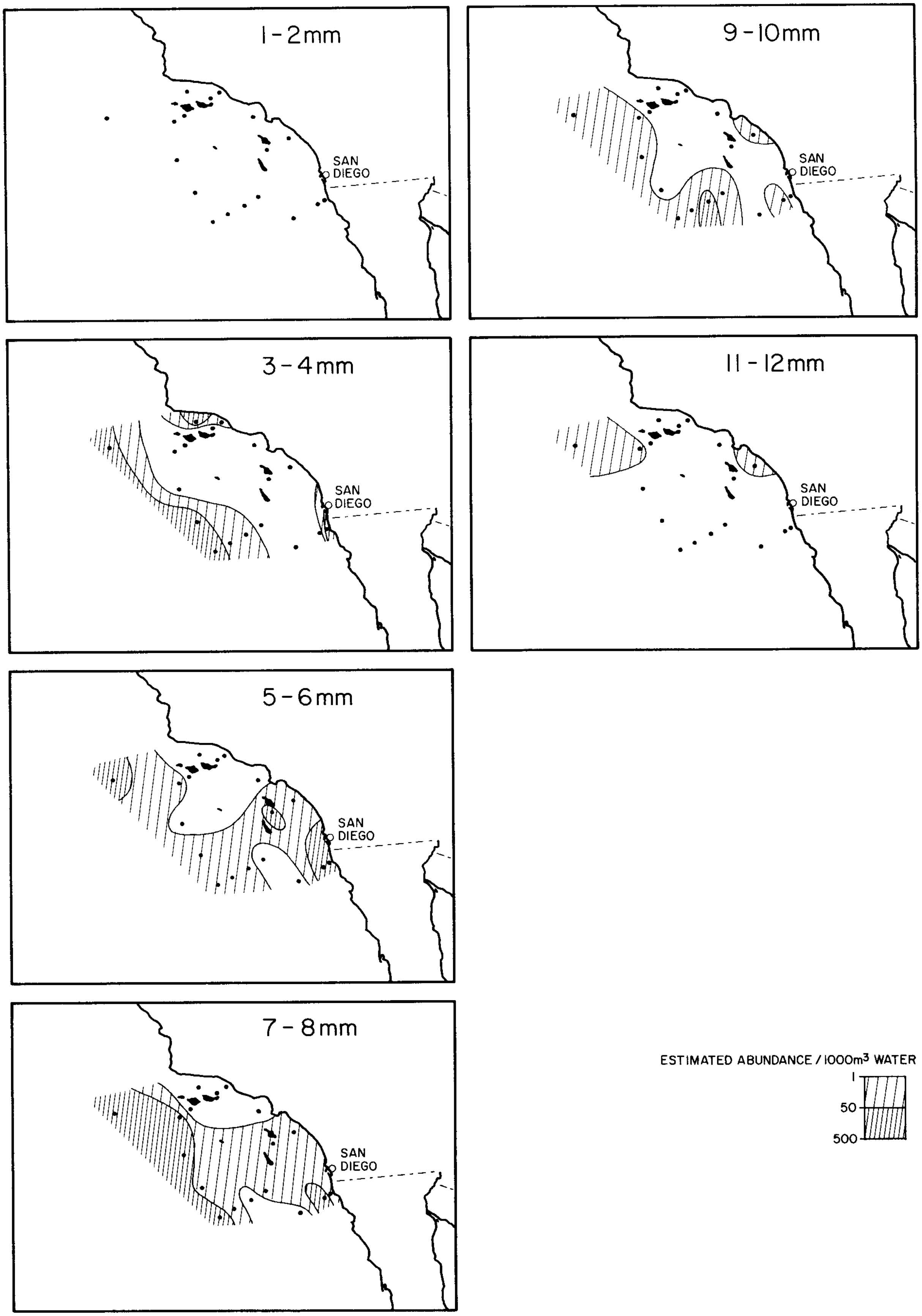
Euphausiacea

CALCOFI CRUISE 5610

29 SEPTEMBER - 5 OCTOBER 1956

Thysanoessa gregaria

5610



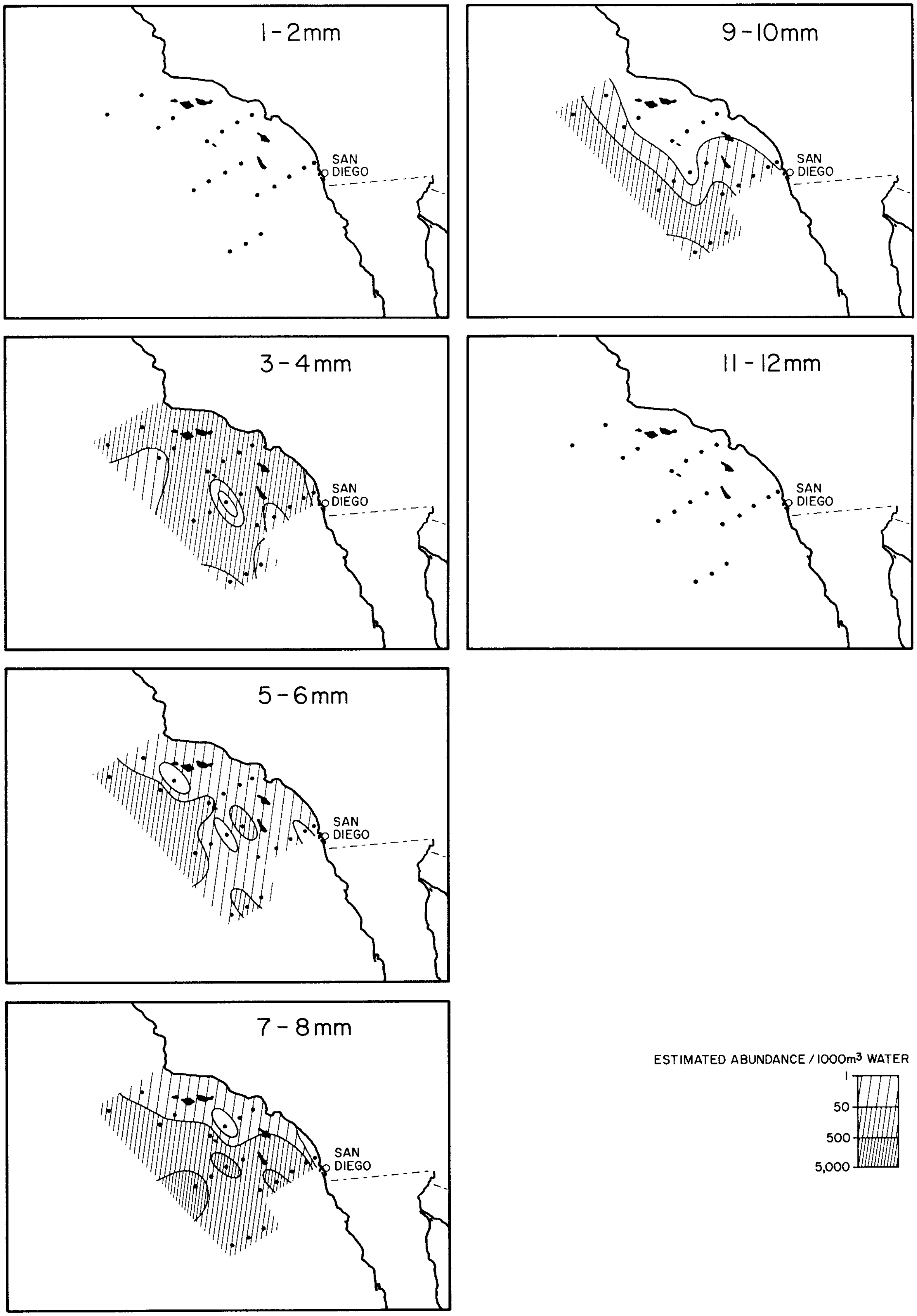
Euphausiacea

Thysanoessa gregaria

5611

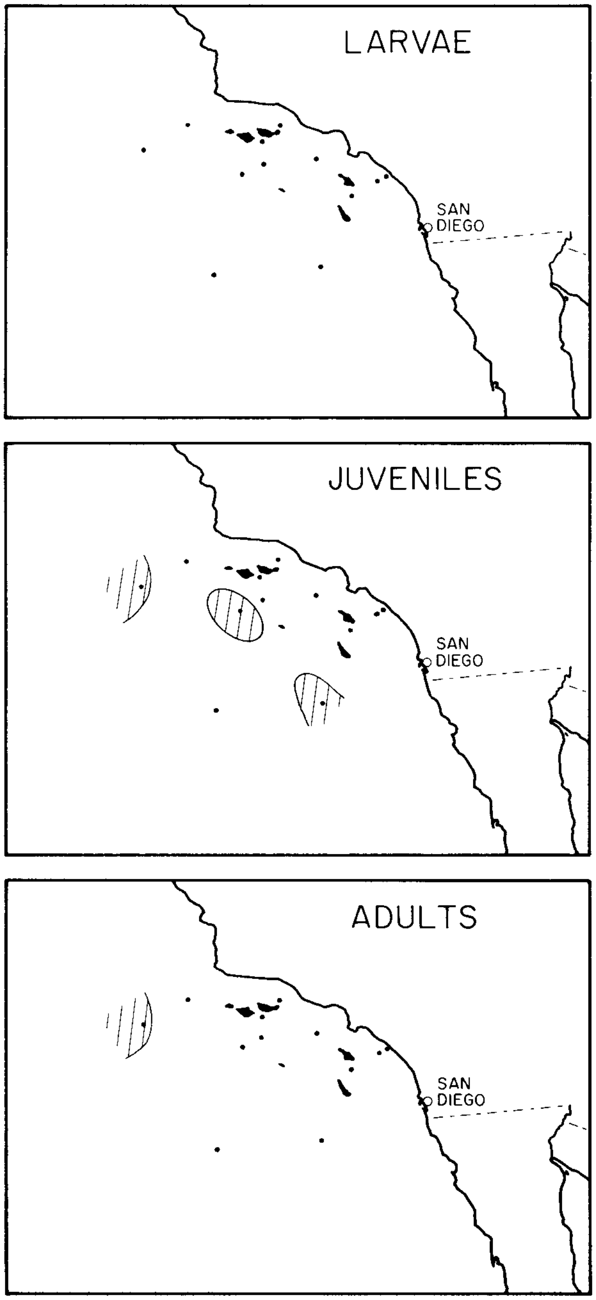
CALCOFI CRUISE 5611

30 OCTOBER - 5 NOVEMBER 1956

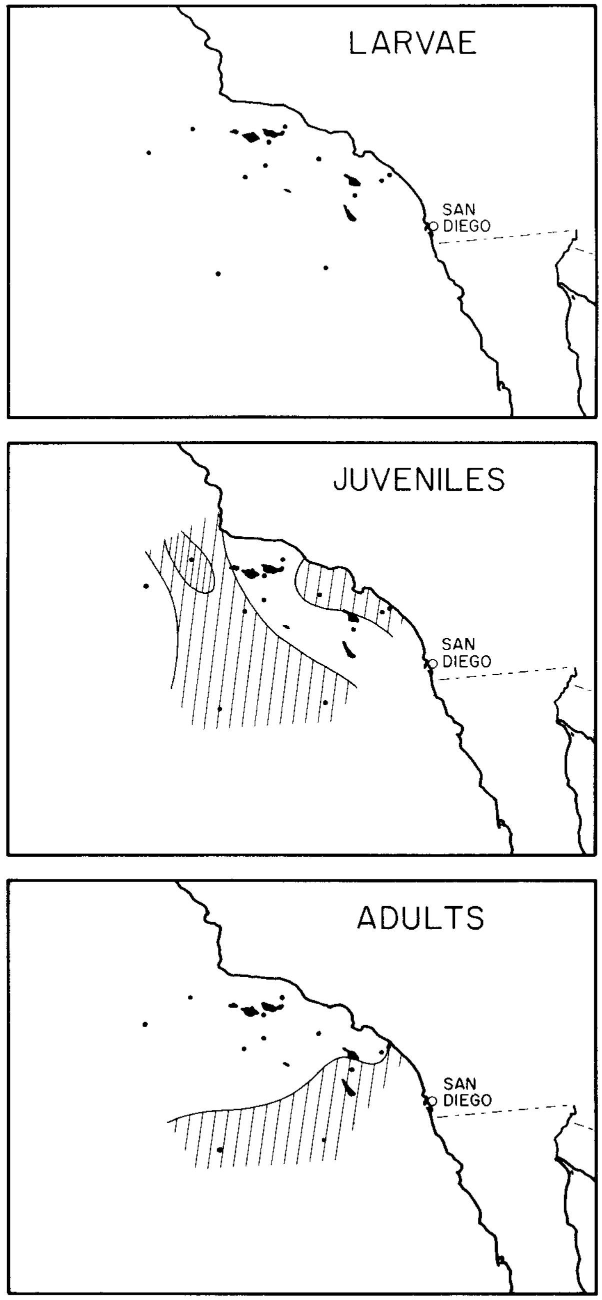


CALCOFI CRUISE 5612
6 - 12 DECEMBER 1956

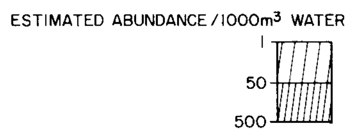
Euphausiacea
Thysanoessa gregaria
5612



Euphausia gibboides



Stylocheiron affine



Euphausiacea

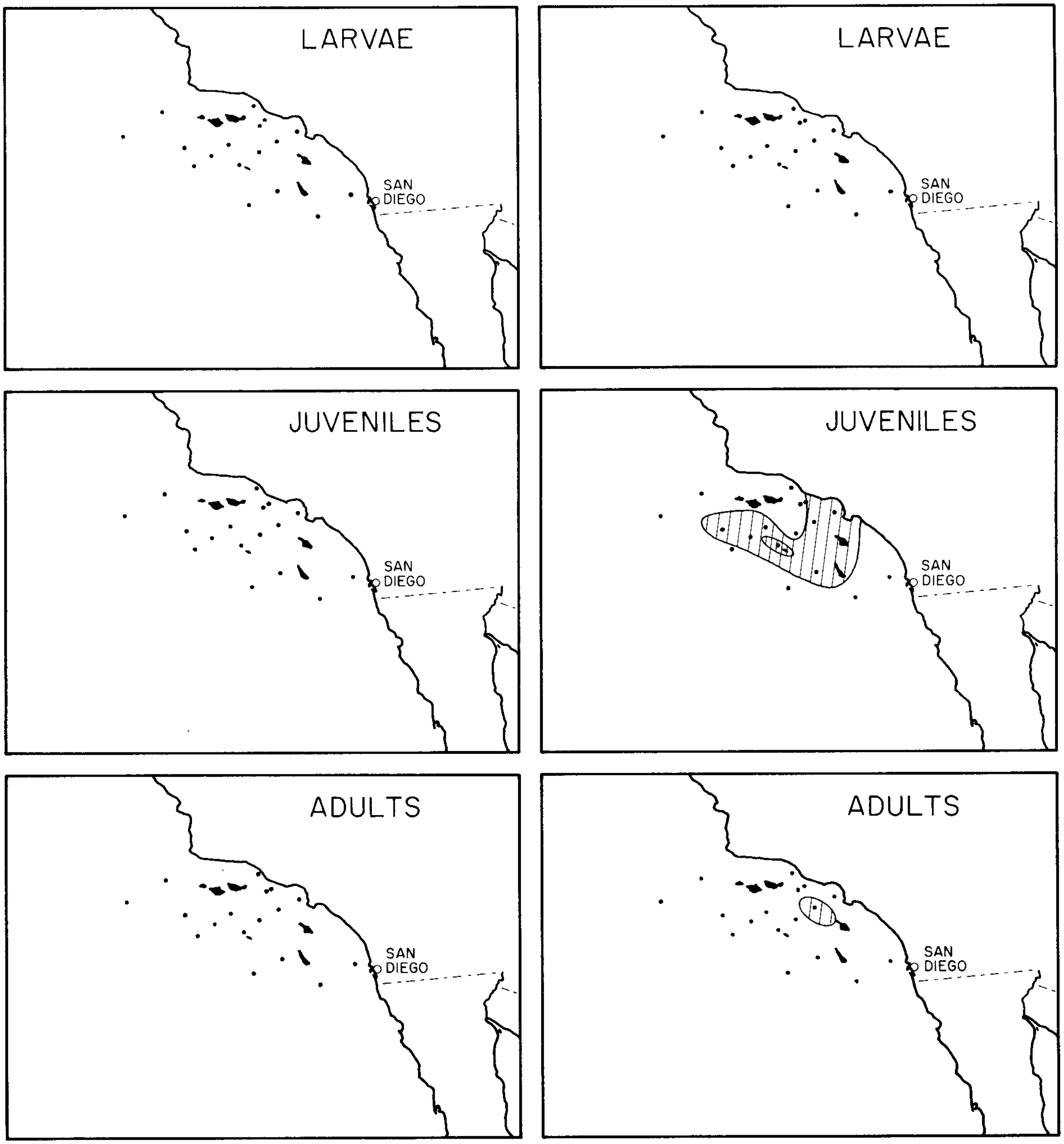
Euphausia gibboides

Stylocheiron affine

5301

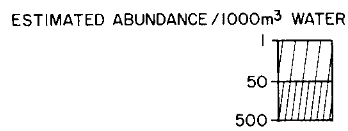
CALCOFI CRUISE 5301

9 - 17 JANUARY 1953



Euphausia gibboides
NO POSITIVE RECORDS

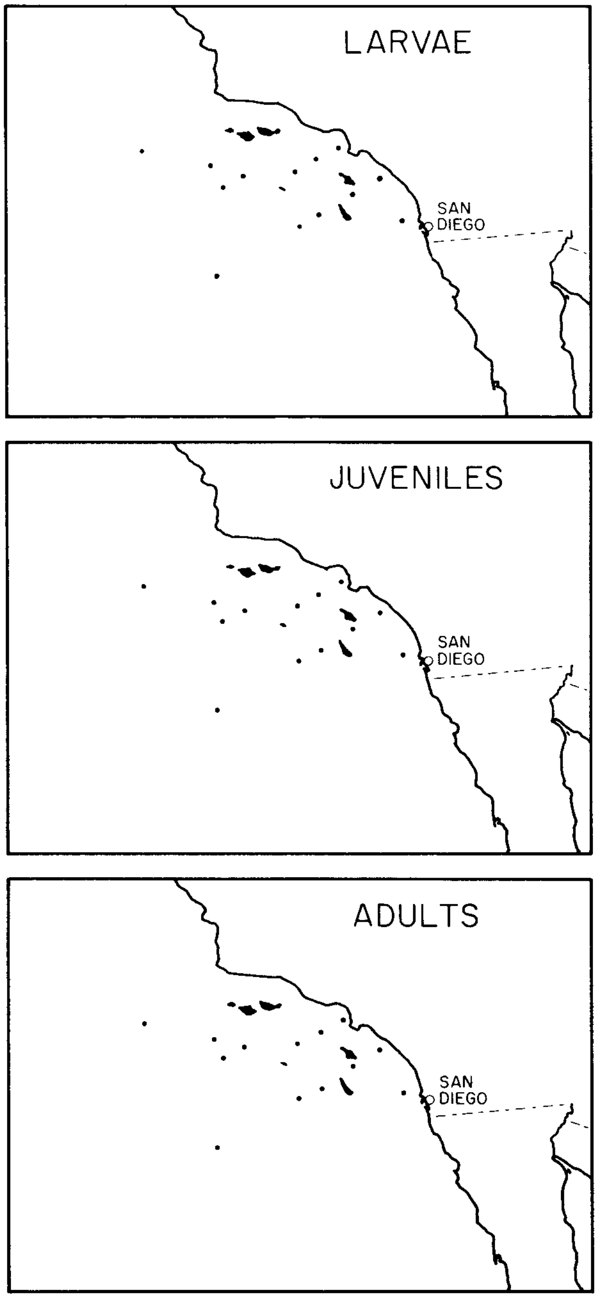
Stylocheiron affine



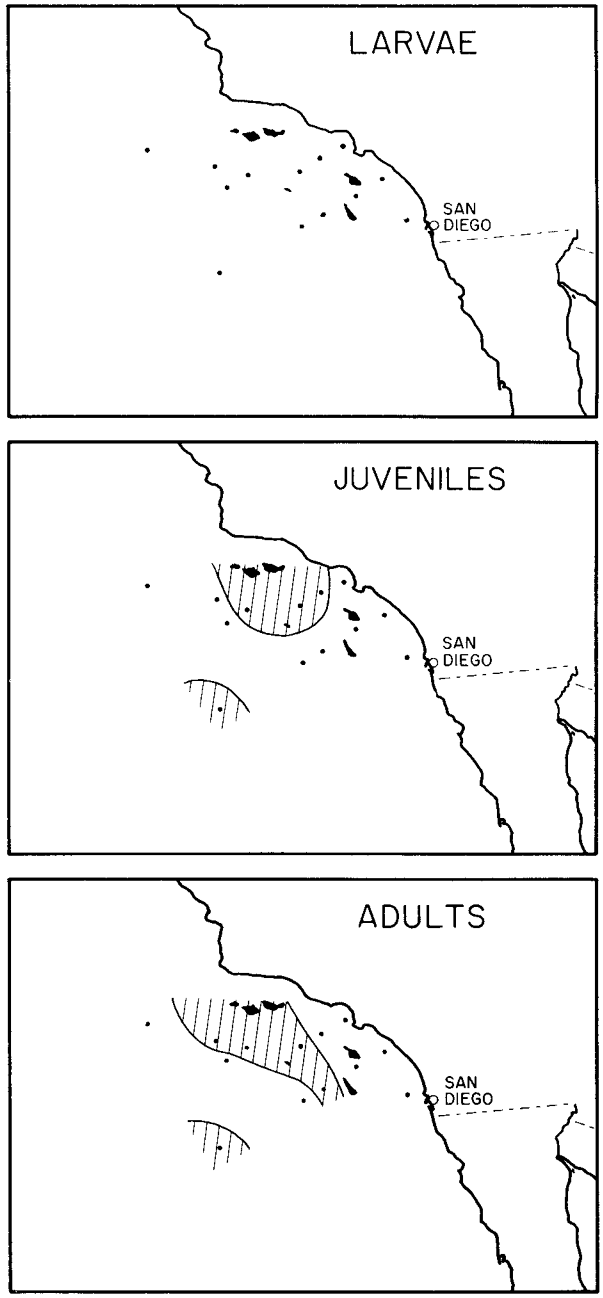
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5302

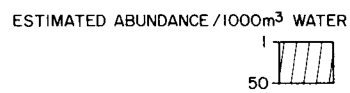
CALCOFI CRUISE 5302
4 - 14 FEBRUARY 1953



Euphausia gibboides
NO POSITIVE RECORDS



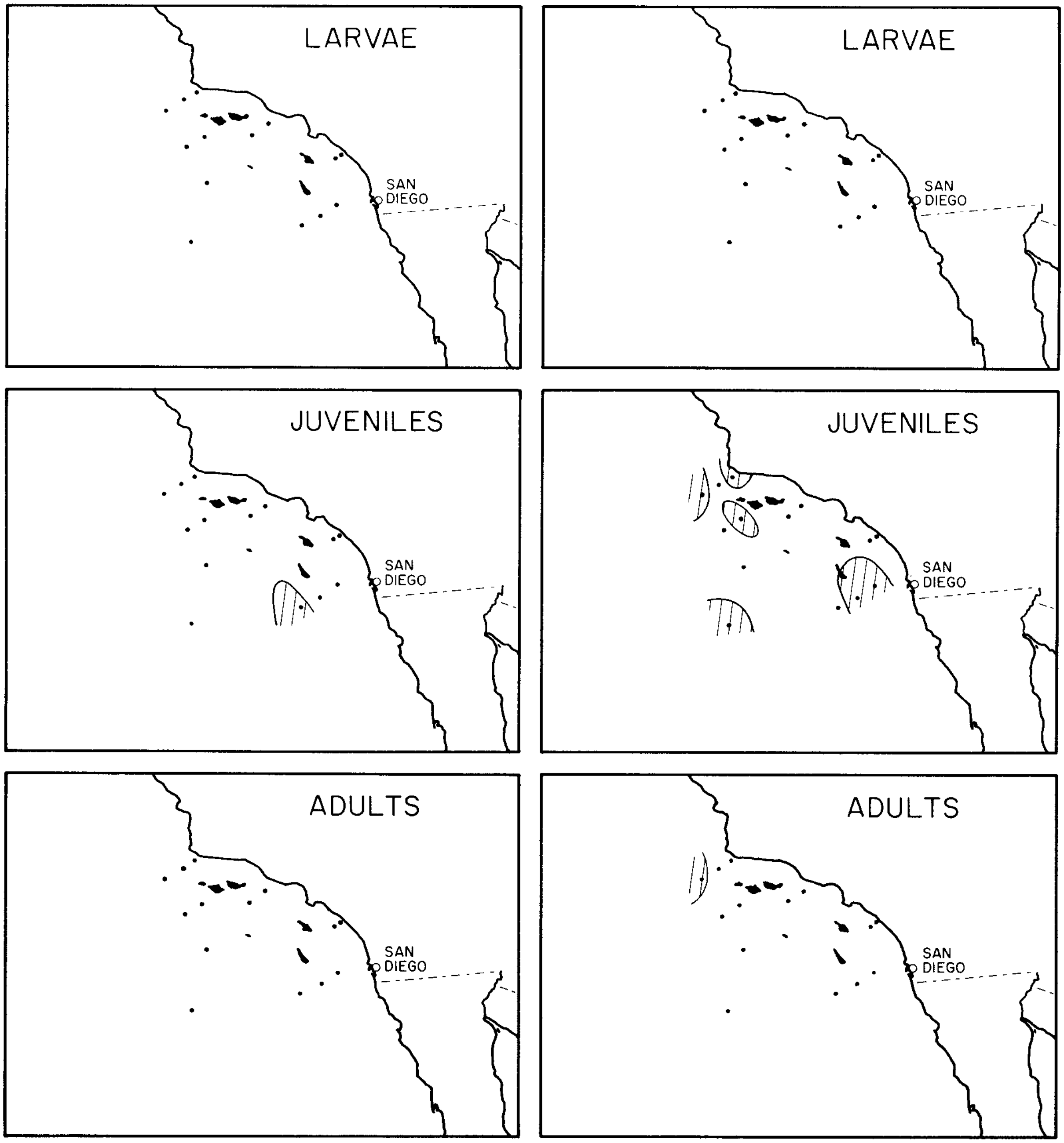
Stylocheiron affine



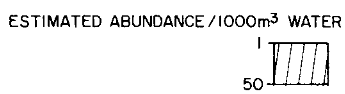
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5303

CALCOFI CRUISE 5303
6 - 20 MARCH 1953



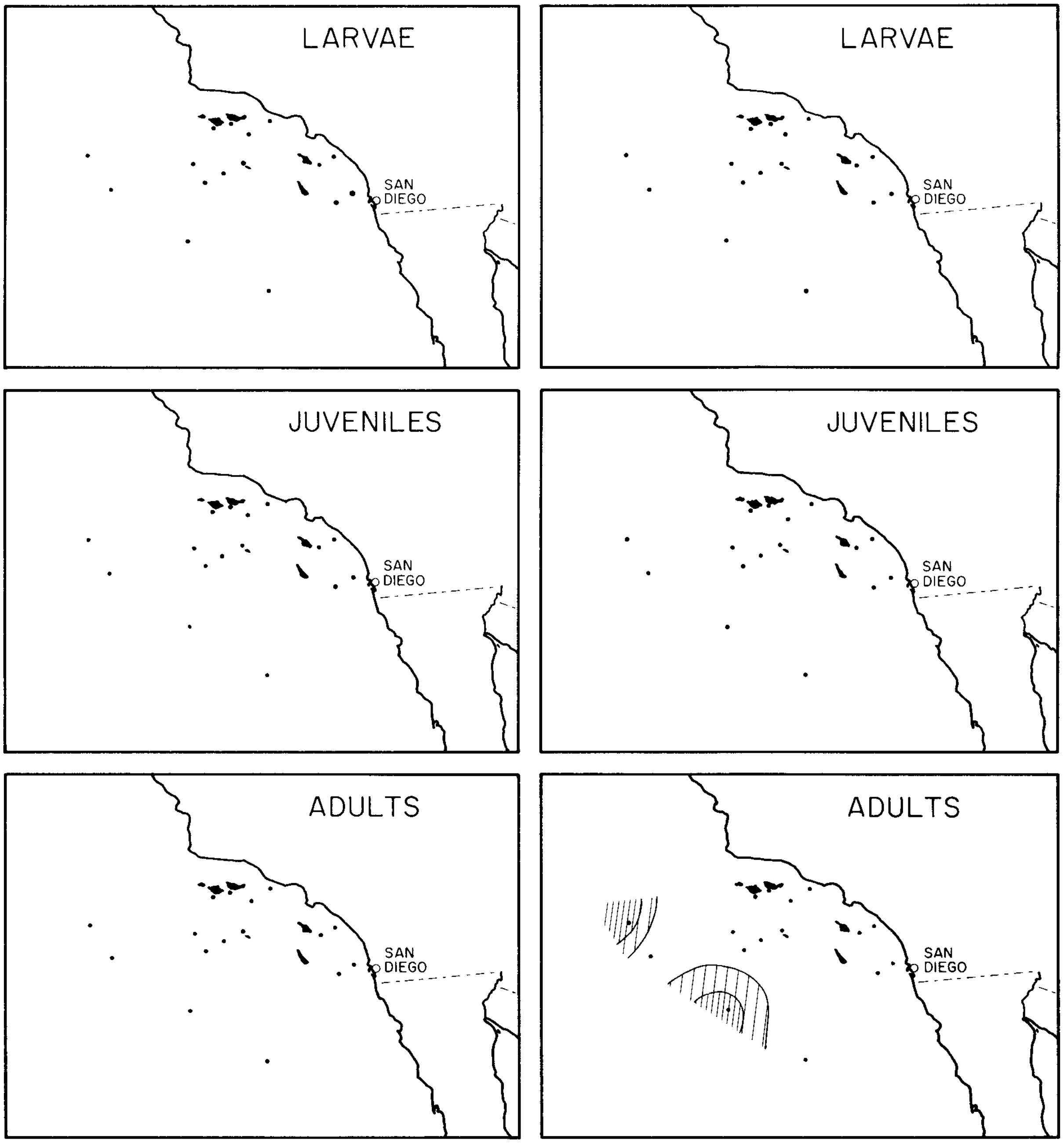
Euphausia gibboides *Stylocheiron affine*



CALCOFI CRUISE 5304
7 - 17 APRIL 1953

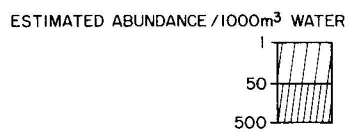
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5304



Euphausia gibboides
NO POSITIVE RECORDS

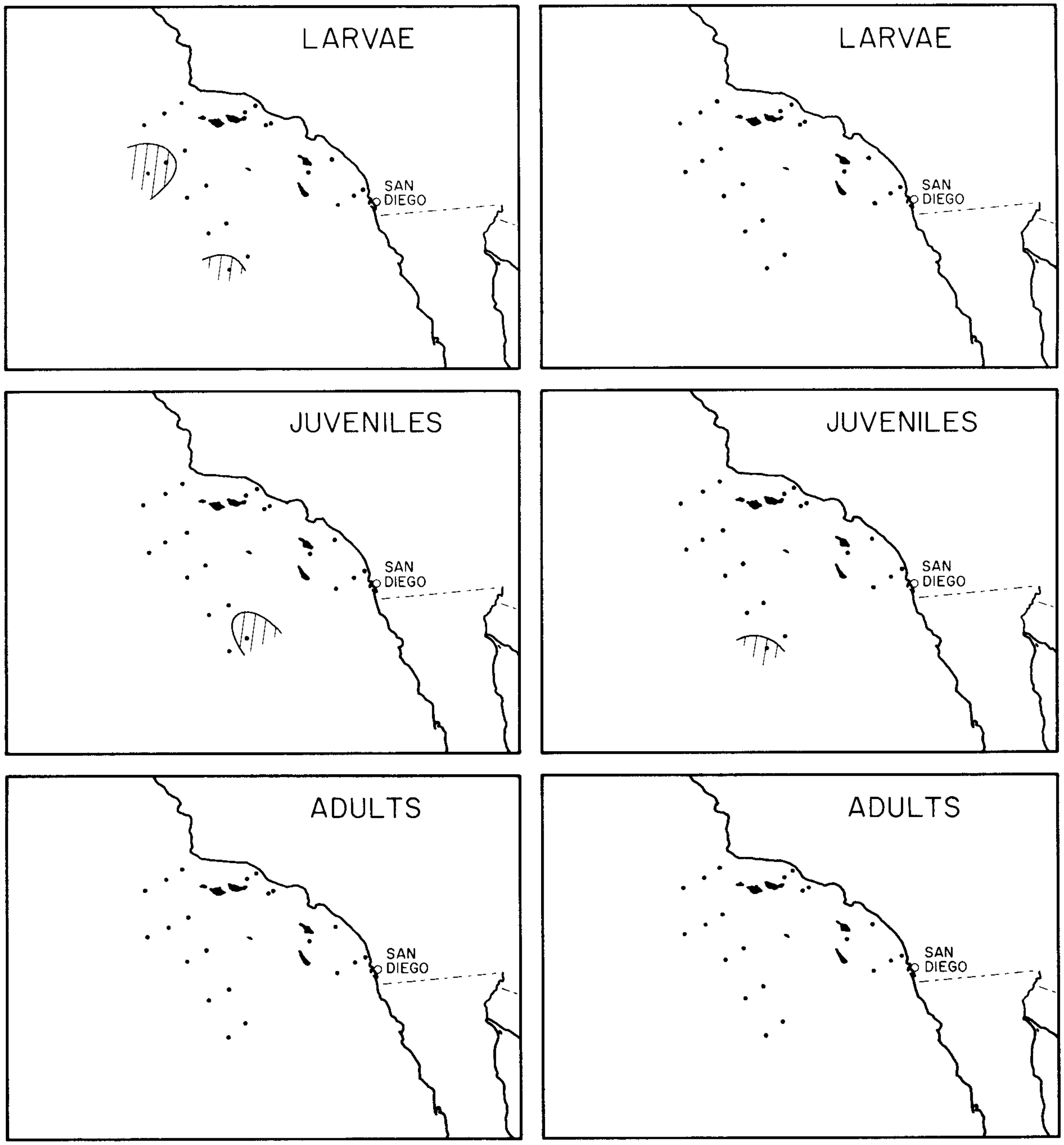
Stylocheiron affine



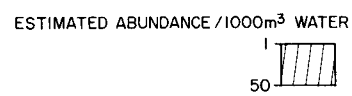
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5305

CALCOFI CRUISE 5305
5 - 18 MAY 1953



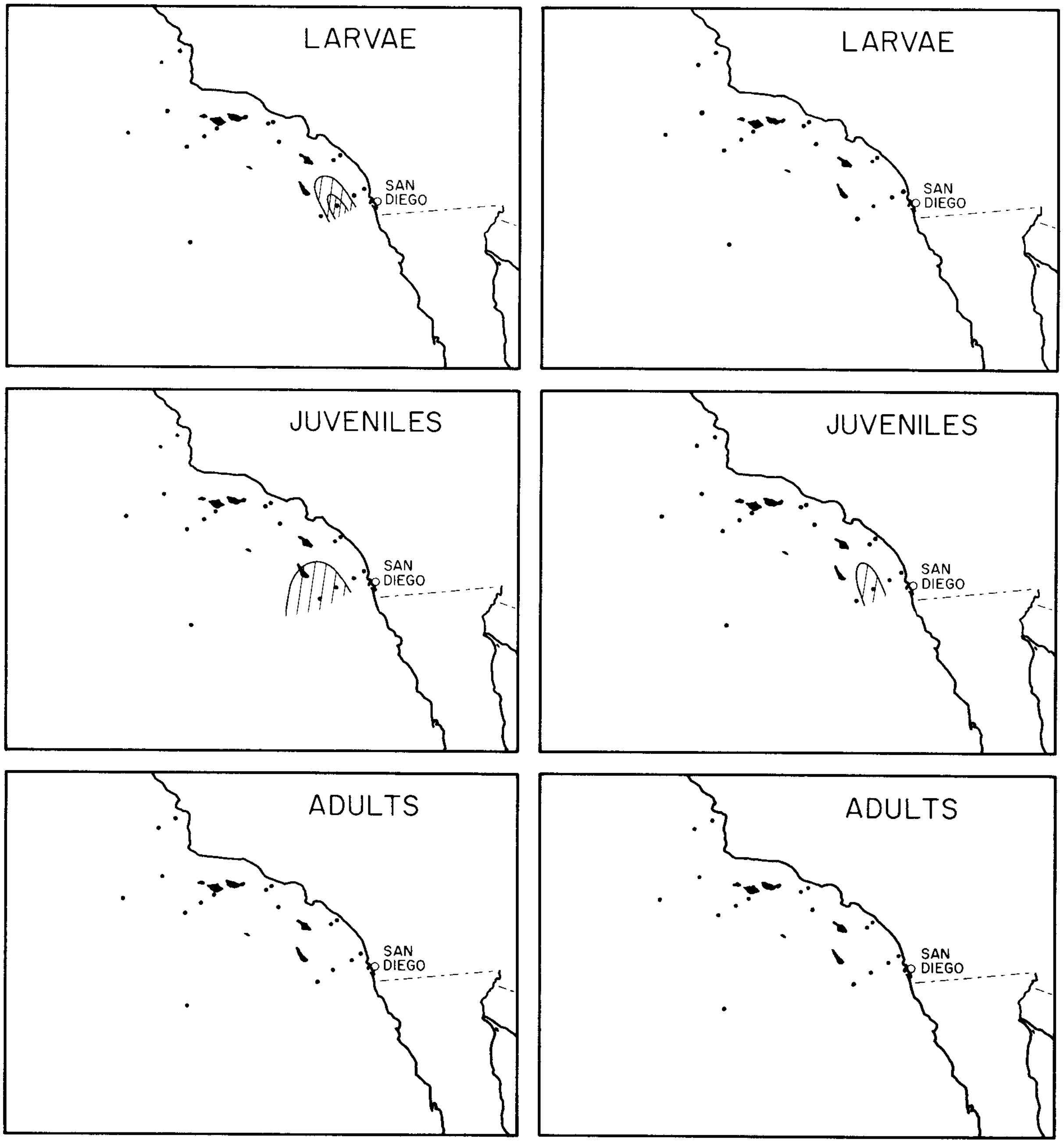
Euphausia gibboides *Stylocheiron affine*



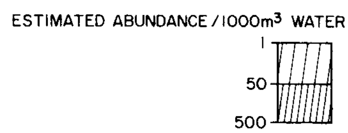
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5306

CALCOFI CRUISE 5306
5 - 12 JUNE 1953



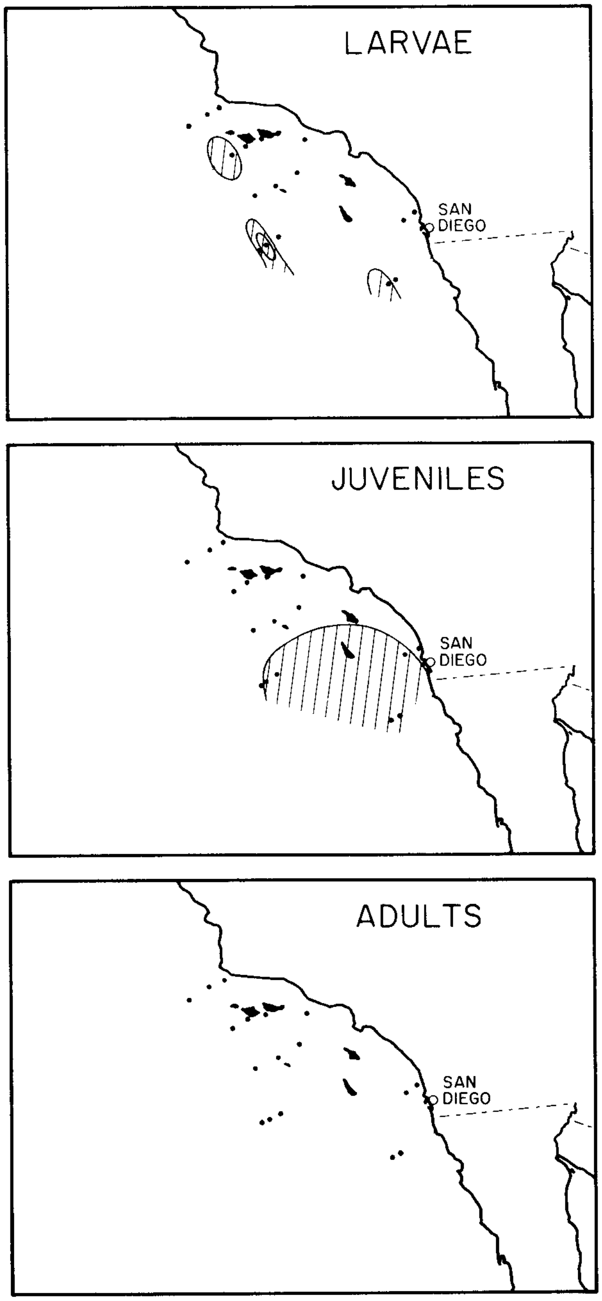
Euphausia gibboides *Stylocheiron affine*



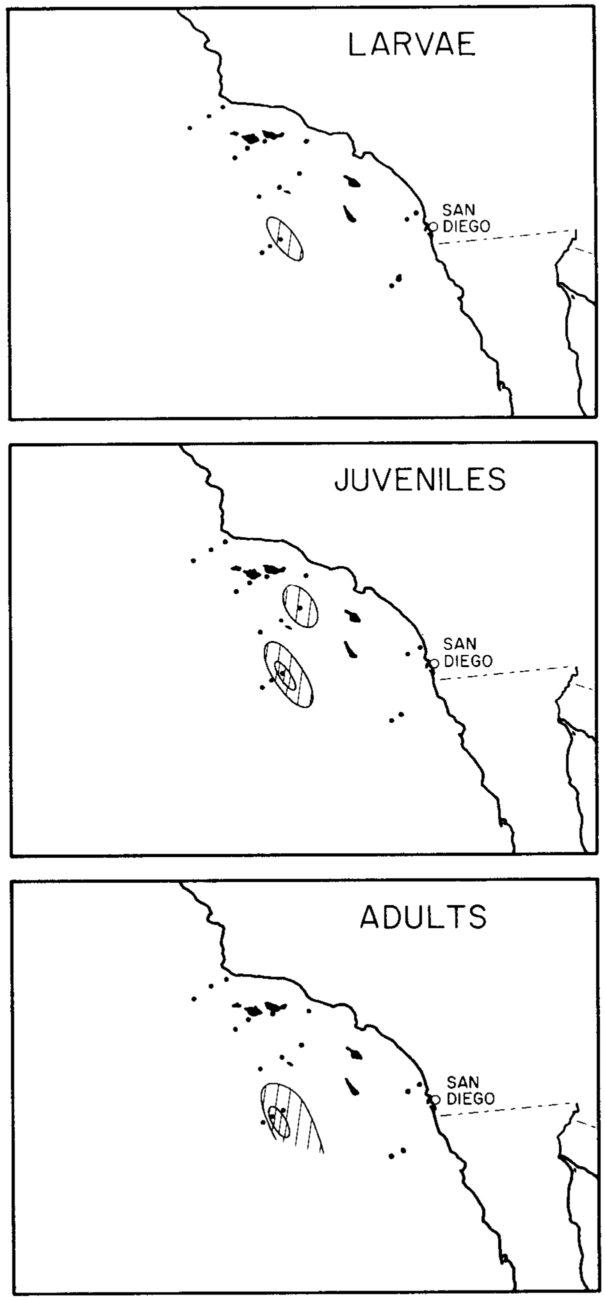
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5307

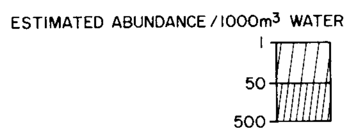
CALCOFI CRUISE 5307
14 - 26 JULY 1953



Euphausia gibboides



Stylocheiron affine



CALCOFI CRUISE 5308

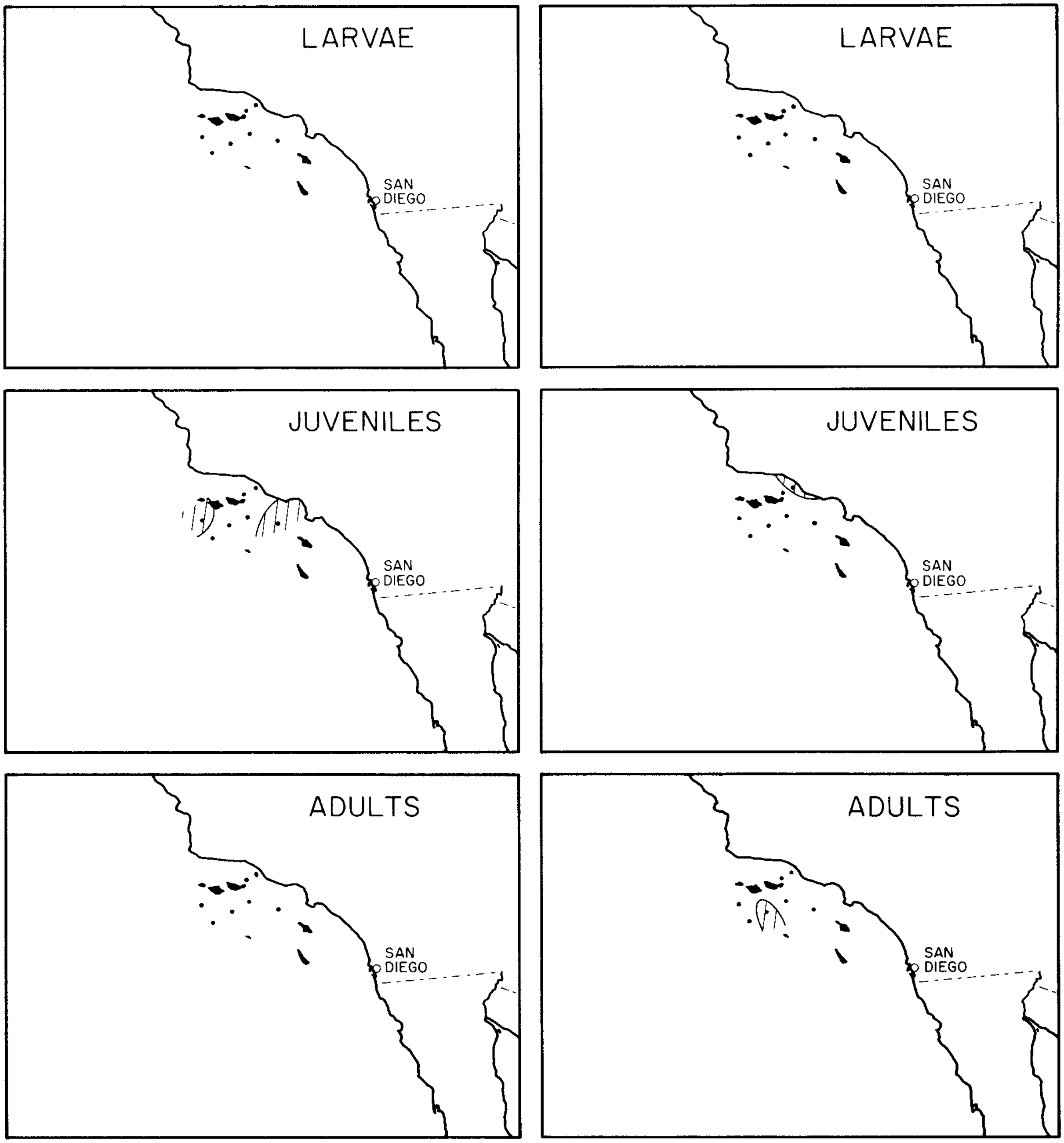
18 - 29 AUGUST 1953

Euphausiacea

Euphausia gibboides

Stylocheiron affine

5308

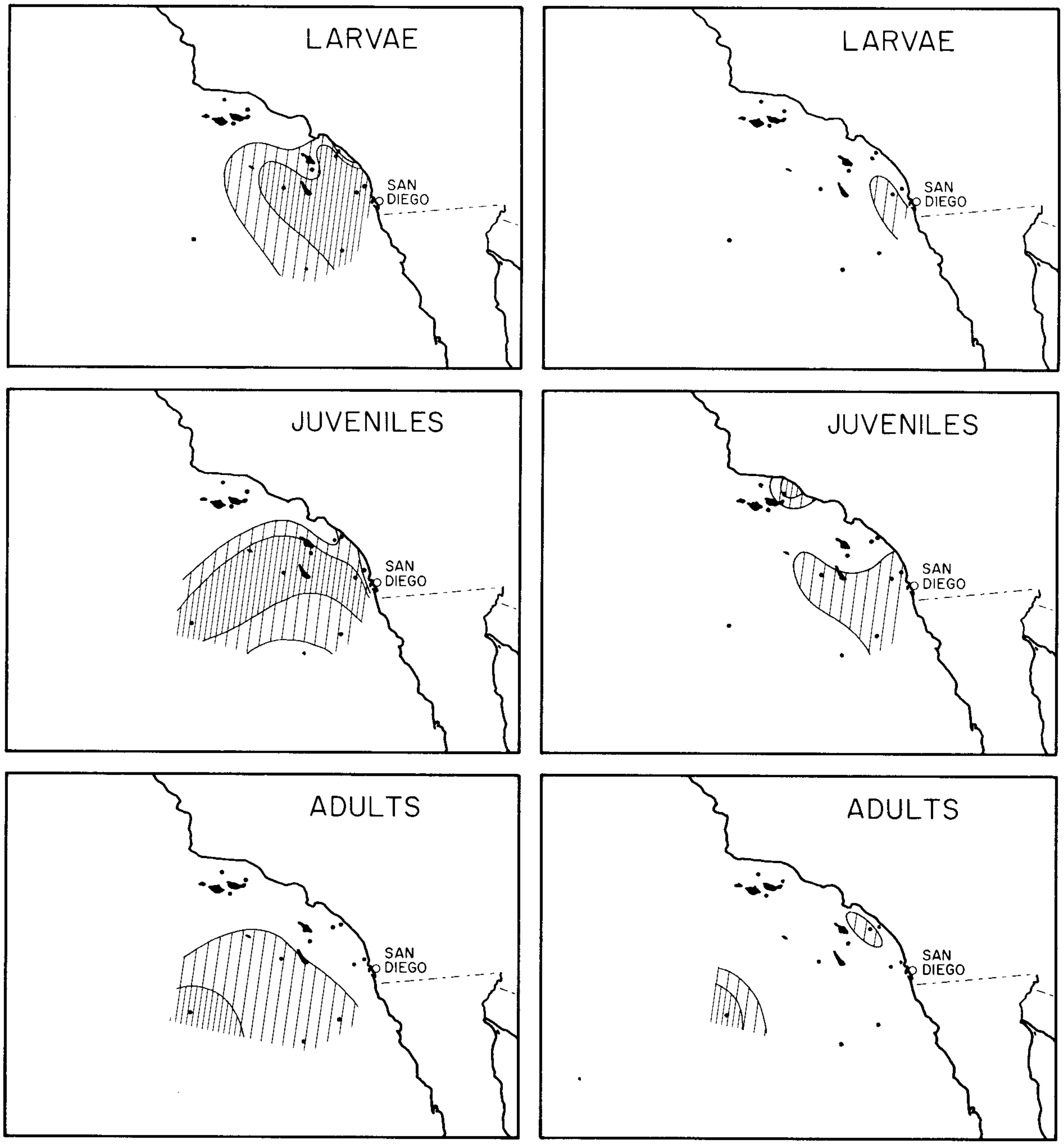


Euphausia gibboides *Stylocheiron affine*

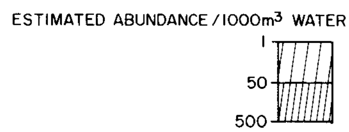
ESTIMATED ABUNDANCE / 1000m³ WATER
1
50

CALCOFI CRUISE 5309
15 - 17 SEPTEMBER 1953

Euphausiacea
Euphausia gibboides
Stylocheiron affine
5309

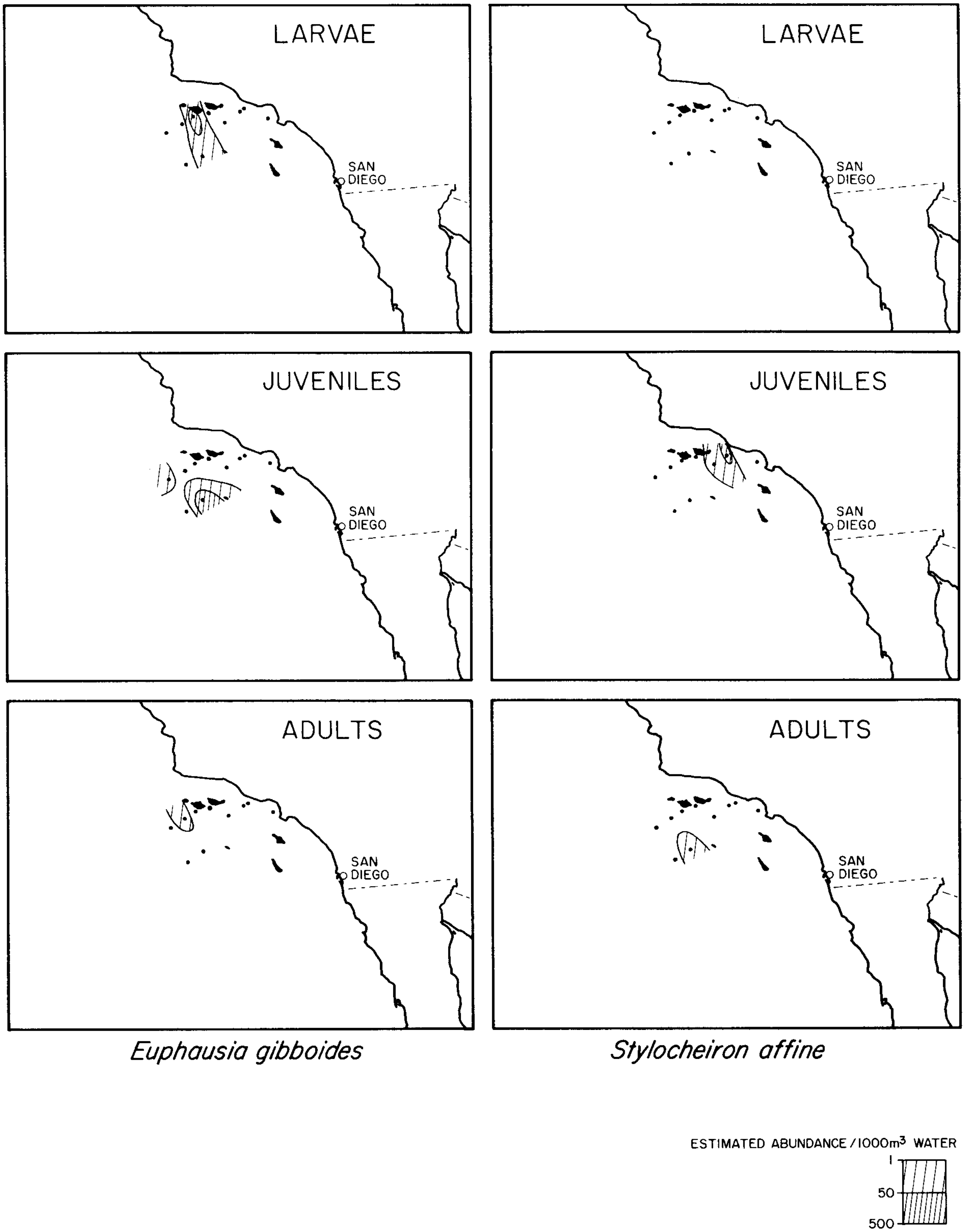


Euphausia gibboides *Stylocheiron affine*



CALCOFI CRUISE 5310
19 - 22 OCTOBER 1953

Euphausiacea
Euphausia gibboides
Stylocheiron affine
5310



Euphausiacea

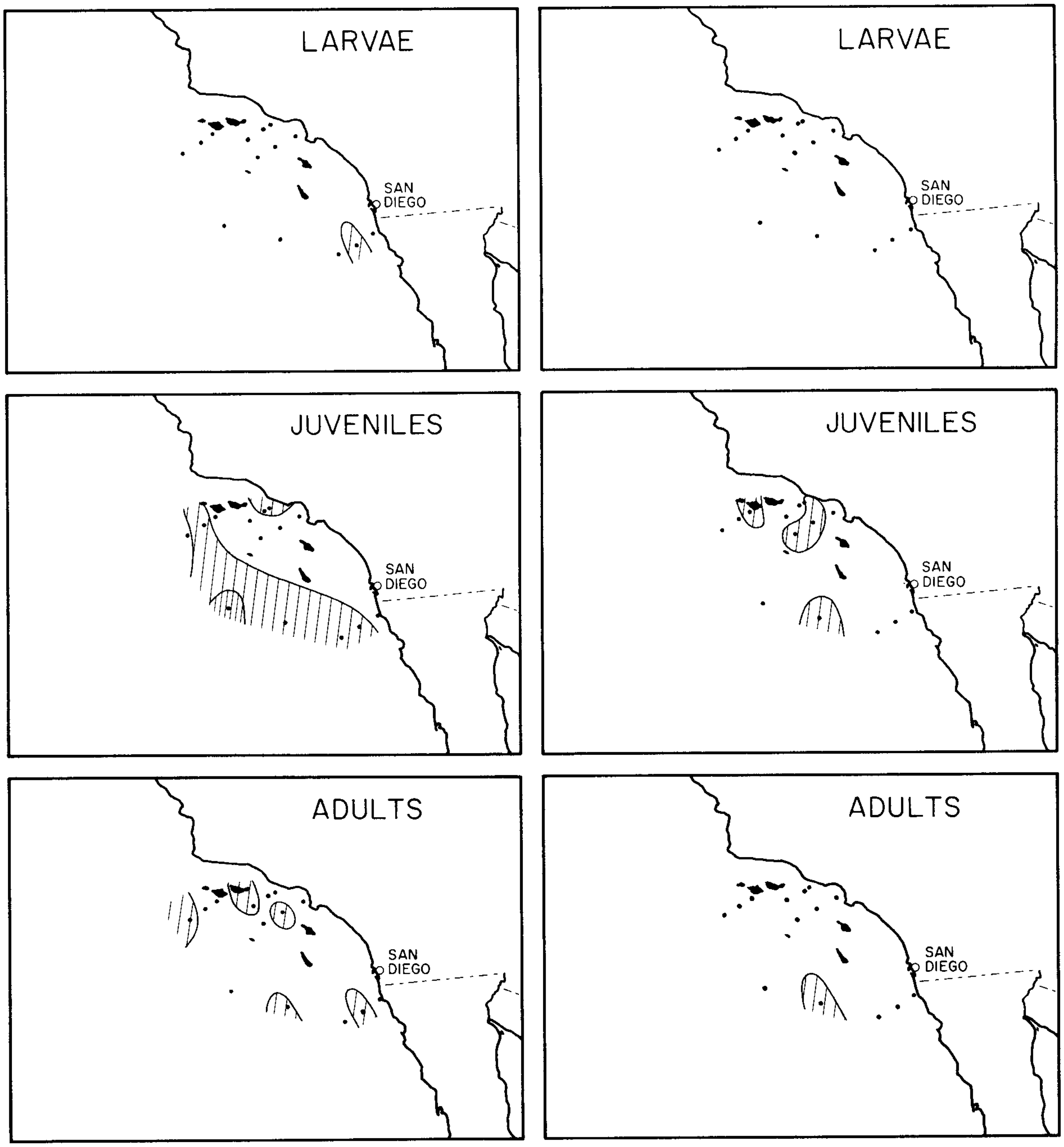
Euphausia gibboides

Stylocheiron affine

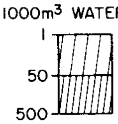
5311

CALCOFI CRUISE 5311

10 - 12 NOVEMBER 1953



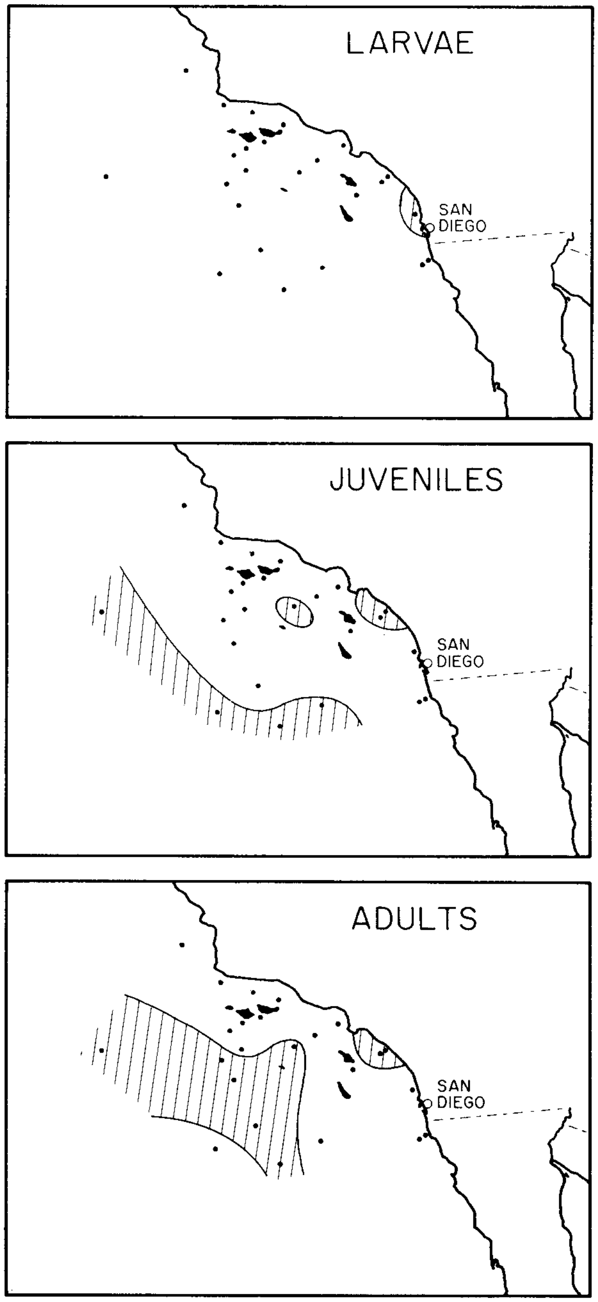
Euphausia gibboides *Stylocheiron affine*



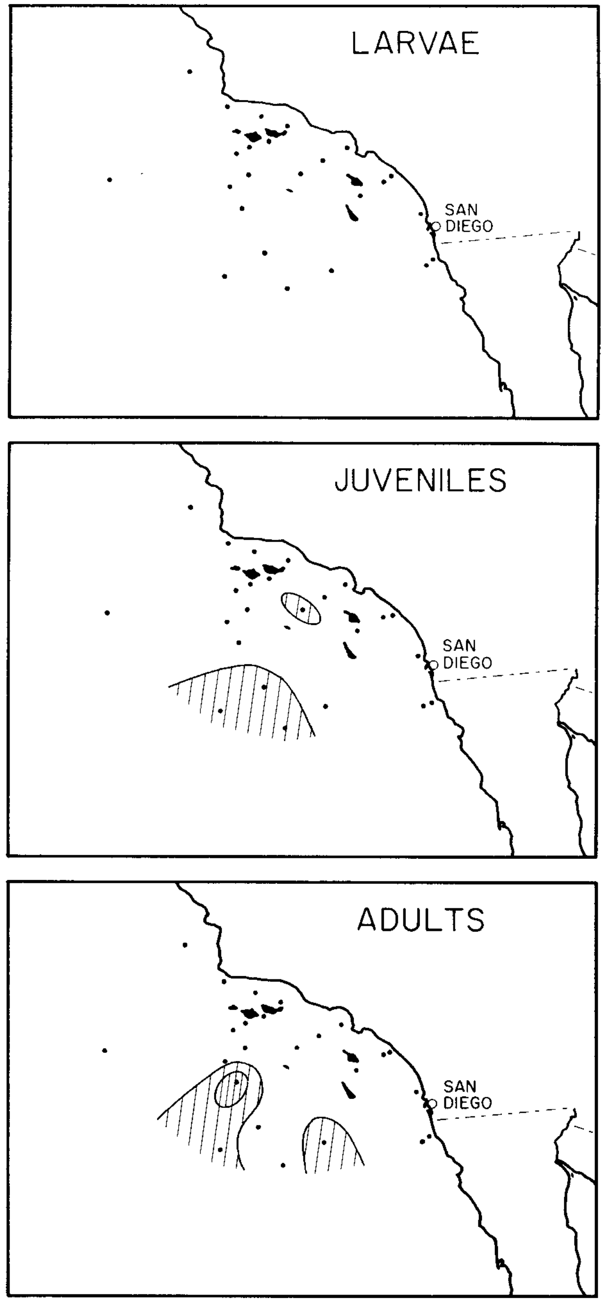
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5312

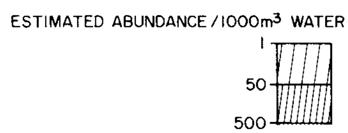
CALCOFI CRUISE 5312
3 - 9 DECEMBER 1953



Euphausia gibboides



Stylocheiron affine



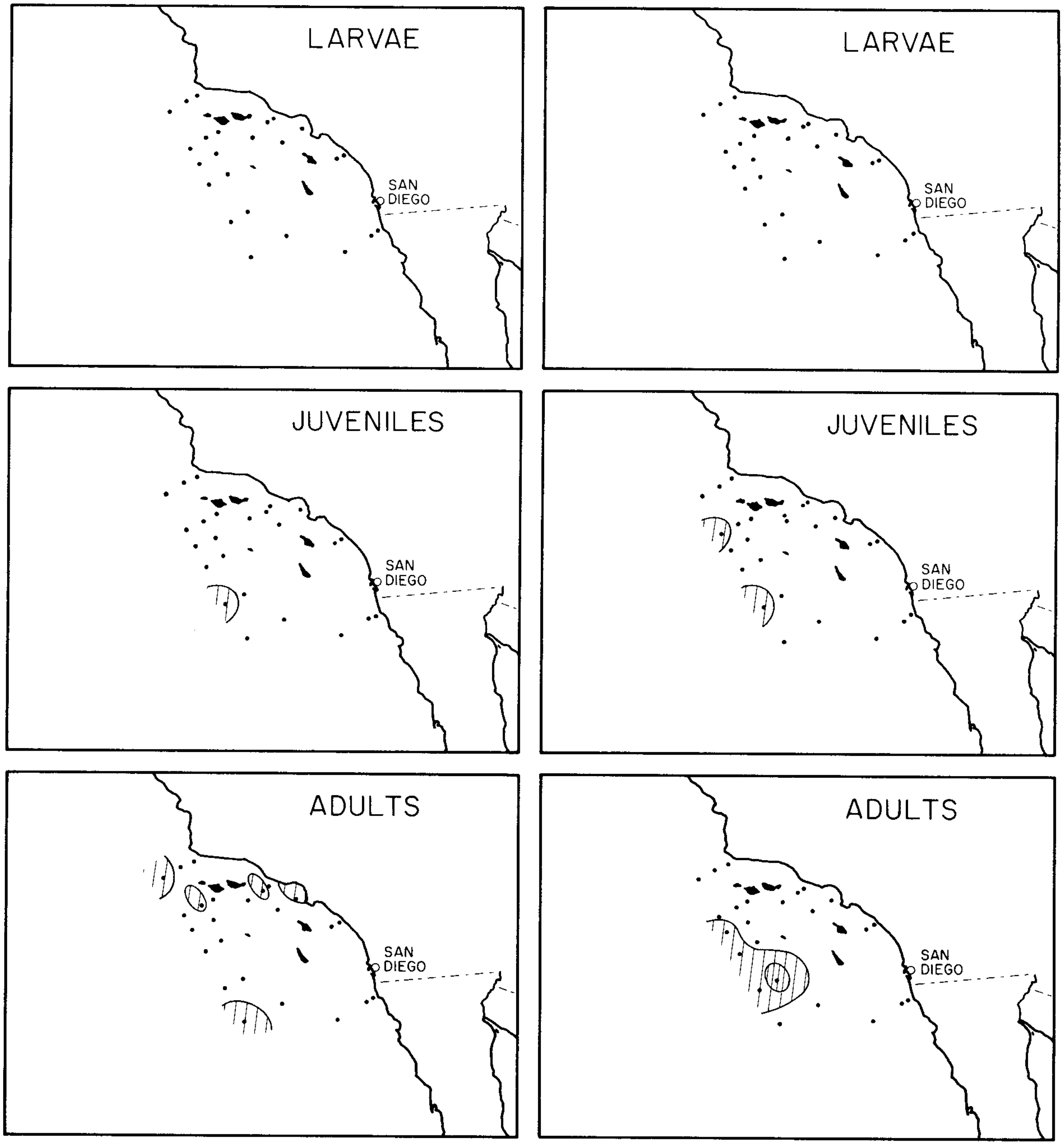
Euphausiacea

Euphausia gibboides
Stylocheiron affine

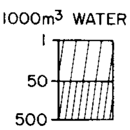
5401

CALCOFI CRUISE 5401

5 - 15 JANUARY 1954



Euphausia gibboides — *Stylocheiron affine*

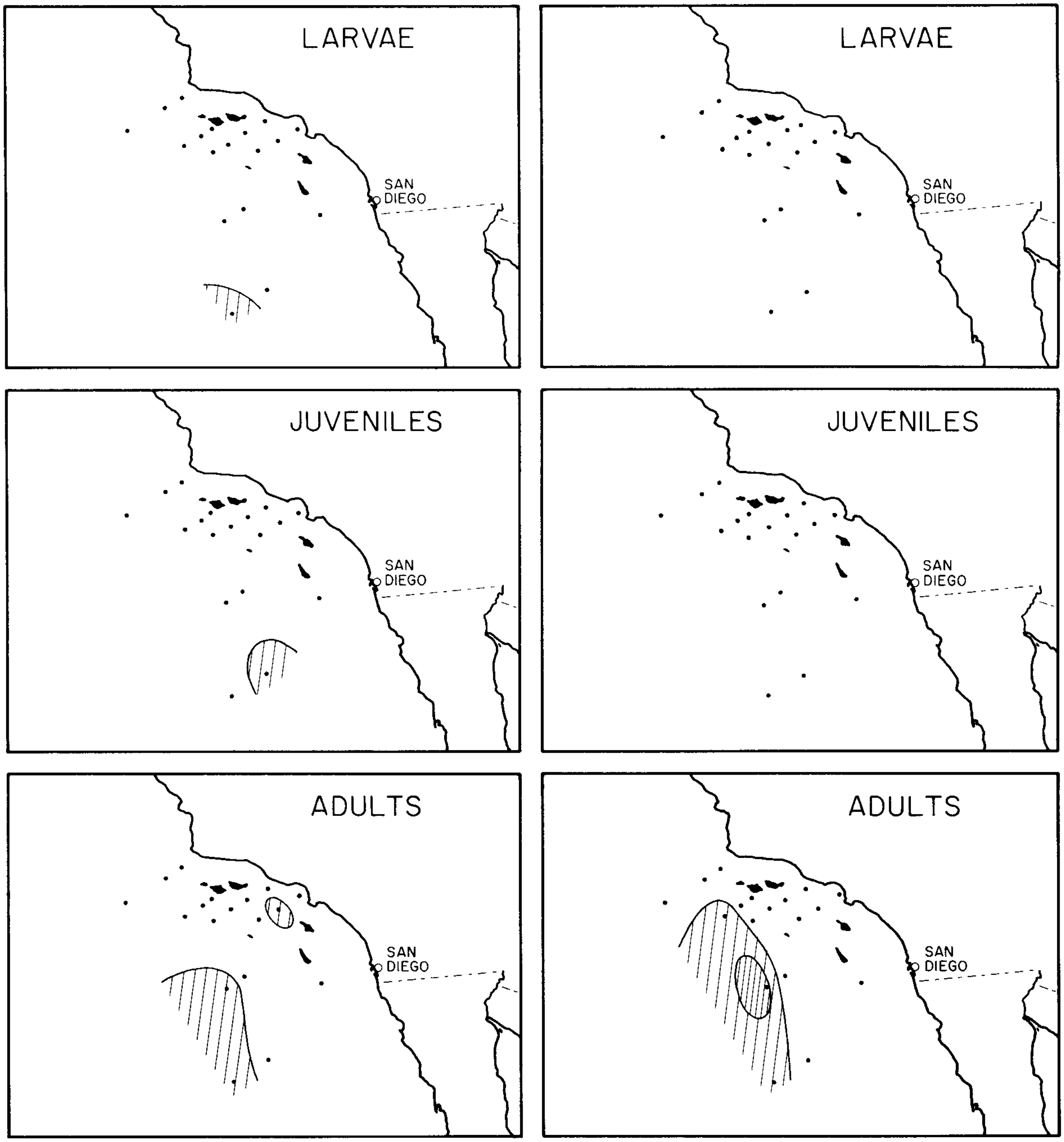


Euphausiacea

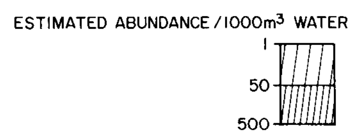
Euphausia gibboides
Stylocheiron affine
5402

CALCOFI CRUISE 5402

3 - 12 FEBRUARY 1954



Euphausia gibboides *Stylocheiron affine*



Euphausiacea

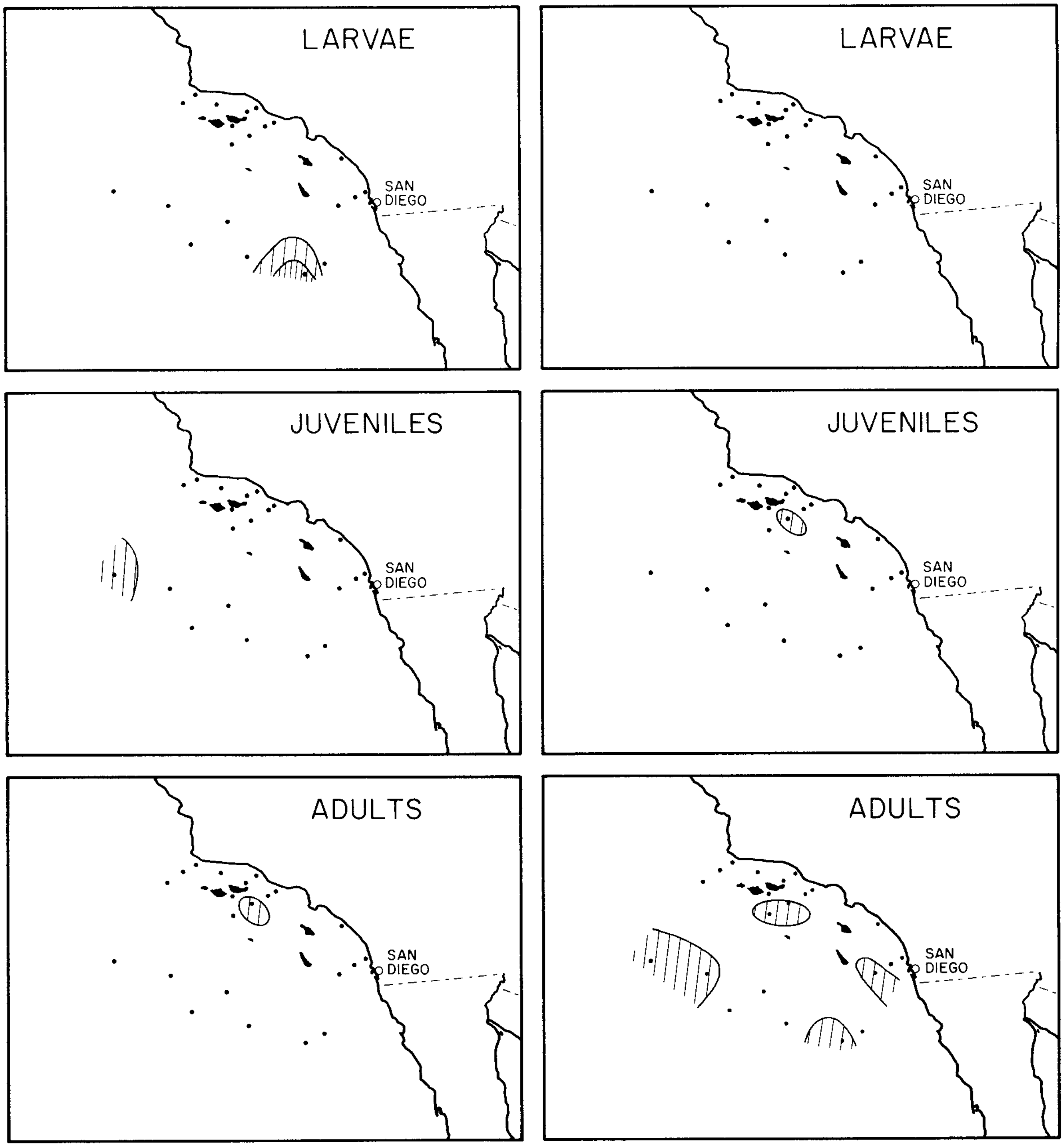
Euphausia gibboides

Stylocheiron affine

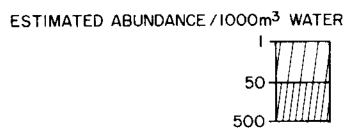
5403

CALCOFI CRUISE 5403

5 - 18 MARCH 1954



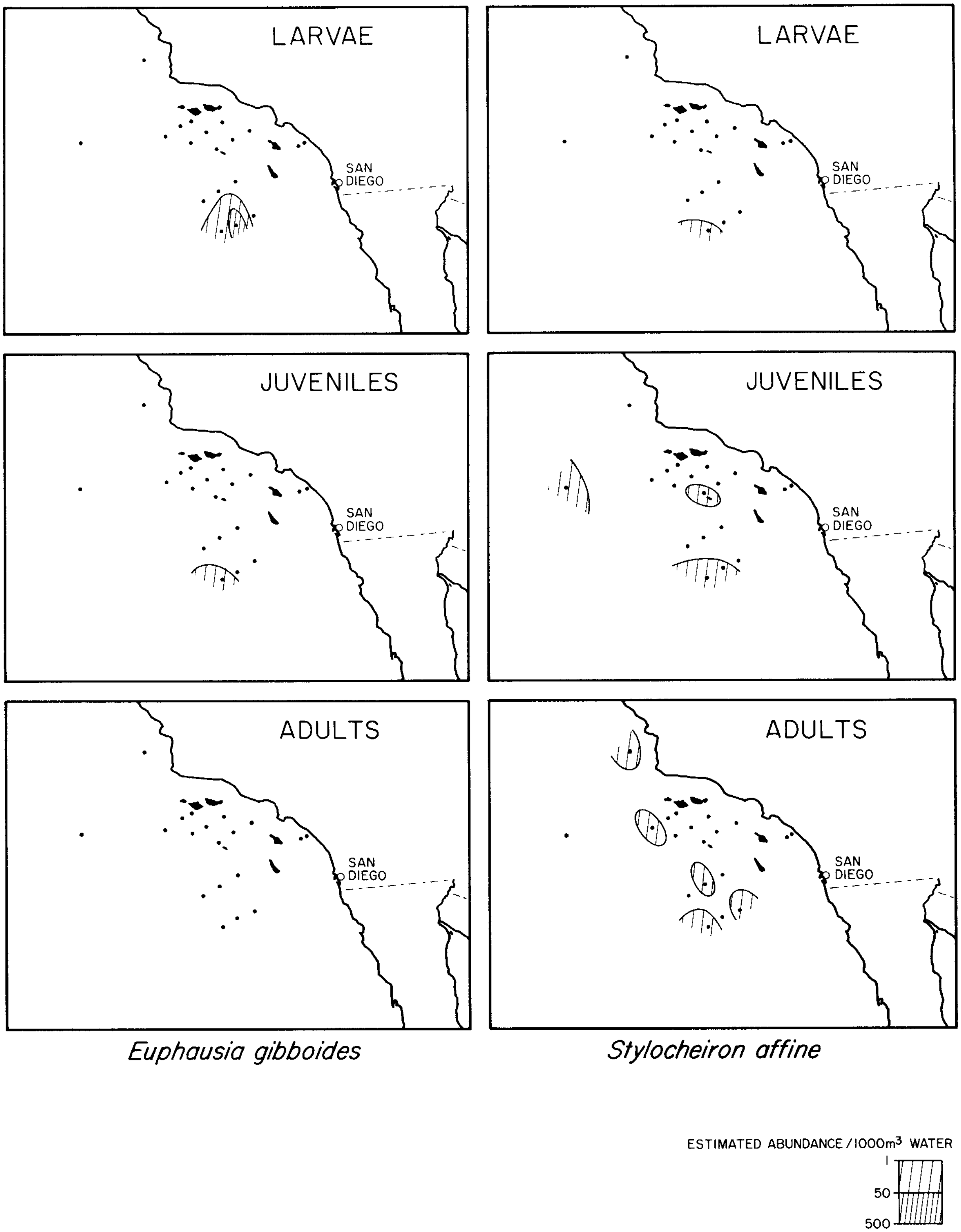
Euphausia gibboides | *Stylocheiron affine*



Euphausiacea

Euphausia gibboides
Stylocheiron affine
5404

CALCOFI CRUISE 5404
7 - 19 APRIL 1954

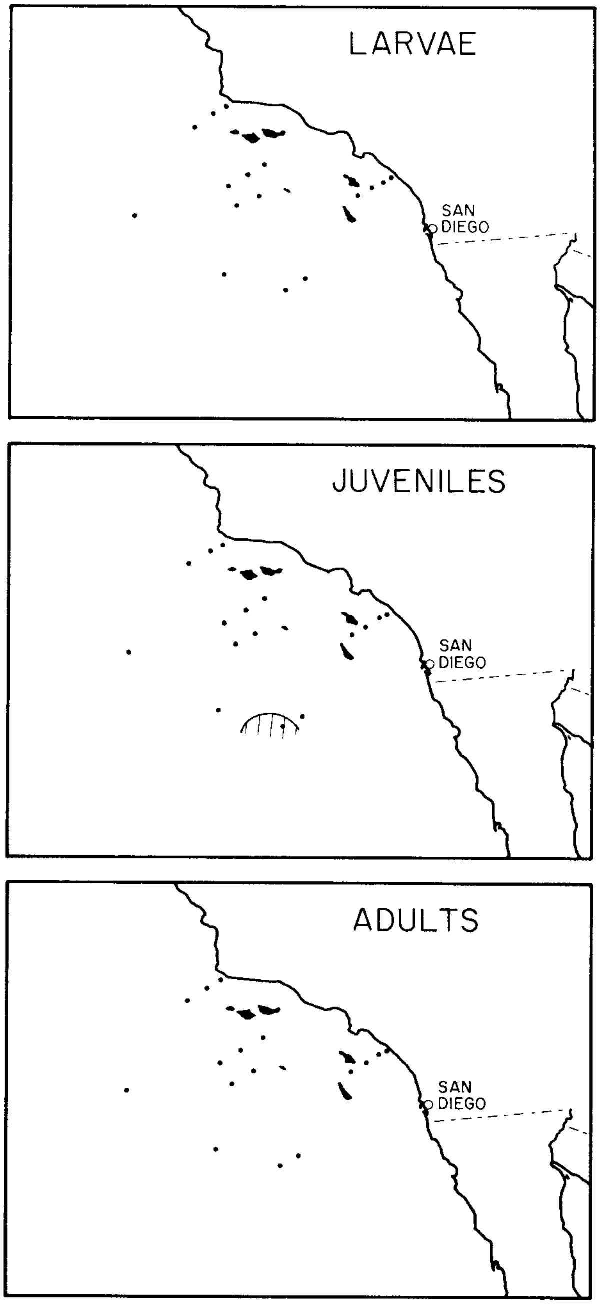


Euphausia gibboides *Stylocheiron affine*

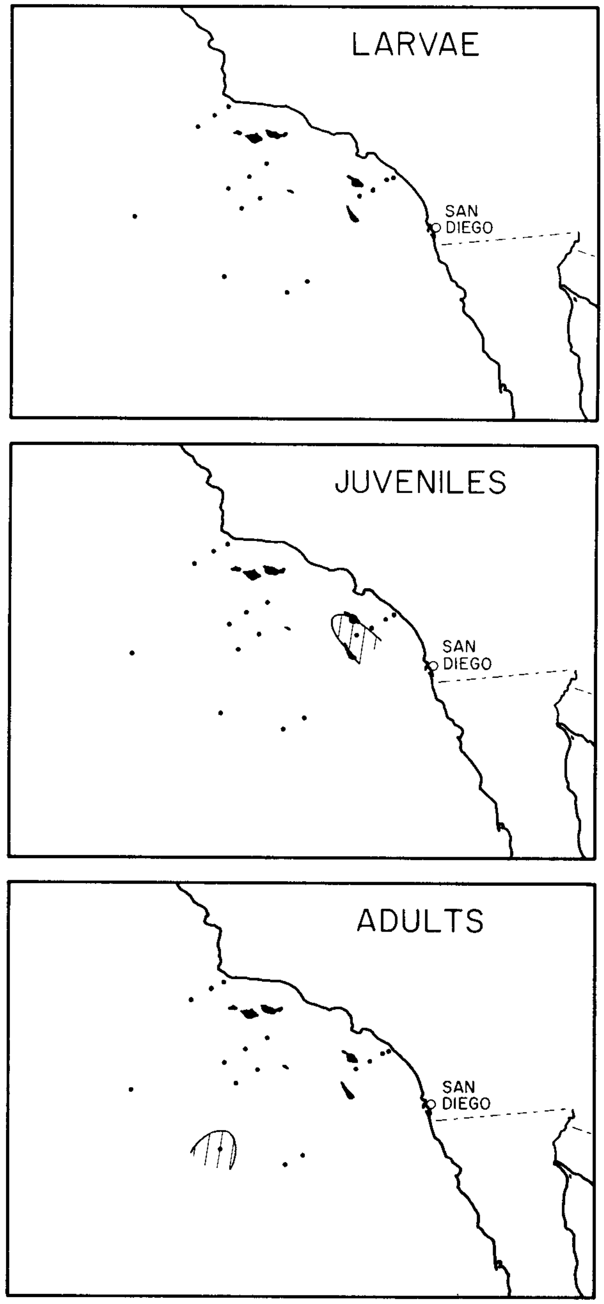
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5405

CALCOFI CRUISE 5405
13 - 22 MAY 1954



Euphausia gibboides



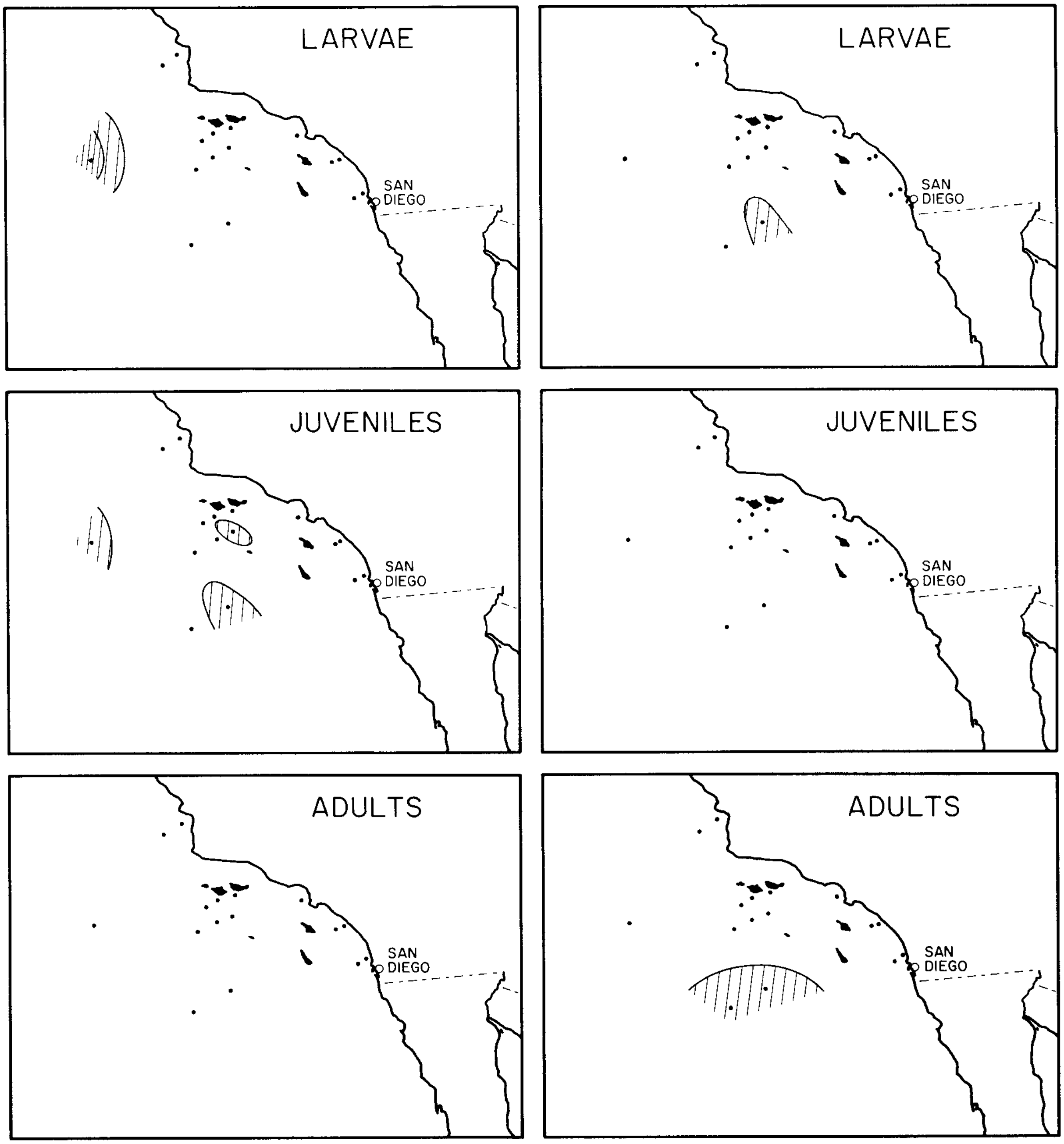
Stylocheiron affine

ESTIMATED ABUNDANCE / 1000m^3 WATER
1
50

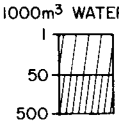
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5406

CALCOFI CRUISE 5406
13 - 20 JUNE 1954



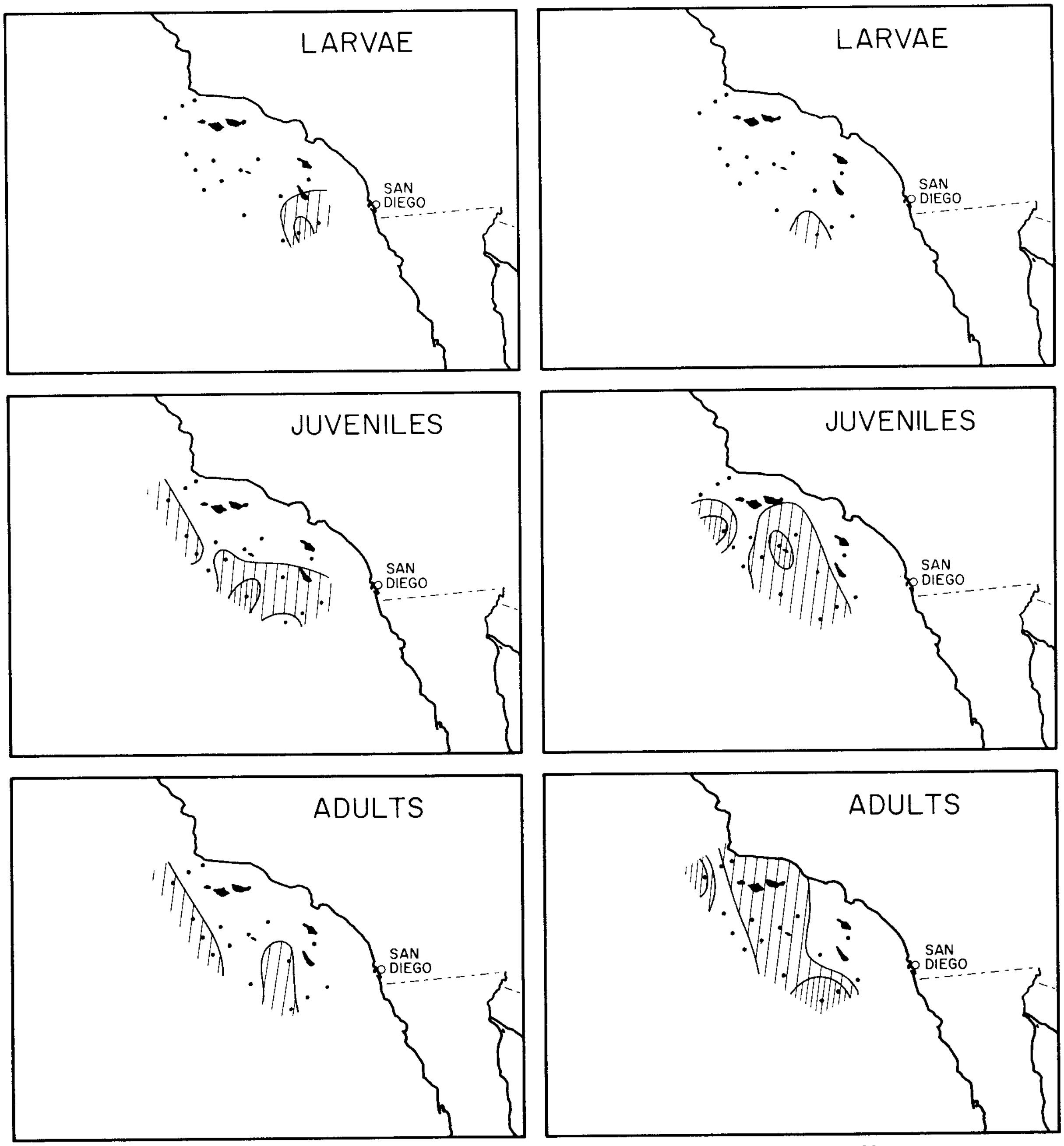
Euphausia gibboides *Stylocheiron affine*



Euphausiacea

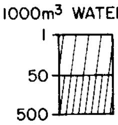
Euphausia gibboides
Stylocheiron affine
5407

CALCOFI CRUISE 5407
13 - 21 JULY 1954



Euphausia gibboides *Stylocheiron affine*

ESTIMATED ABUNDANCE / 1000m³ WATER

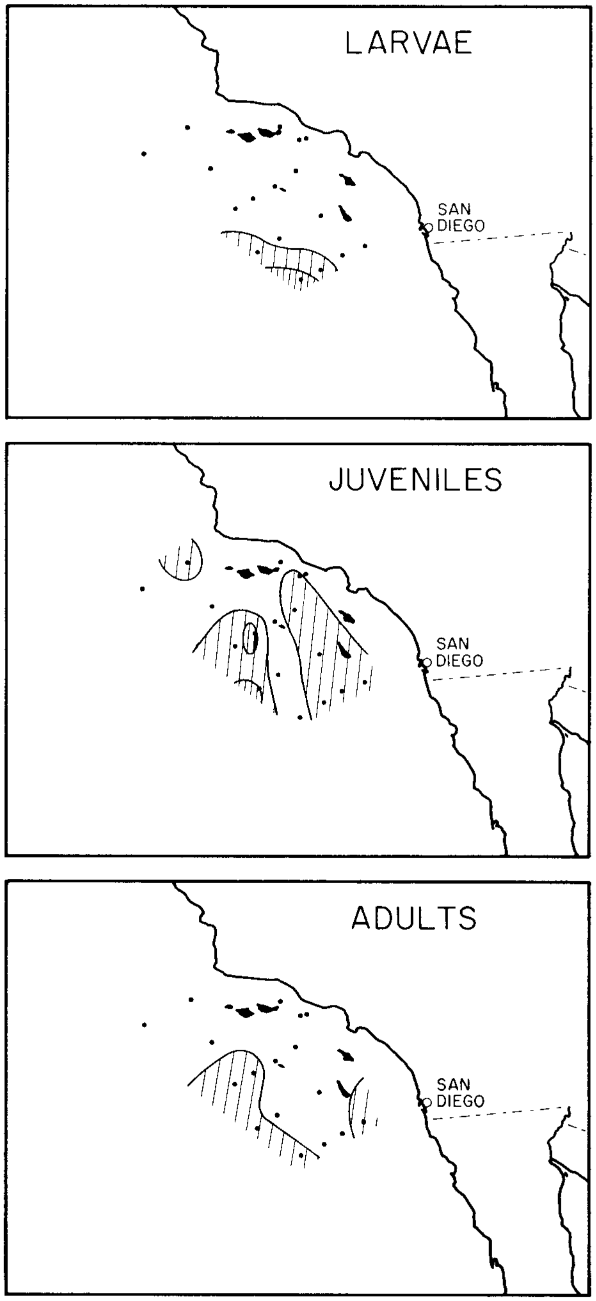


Euphausiacea

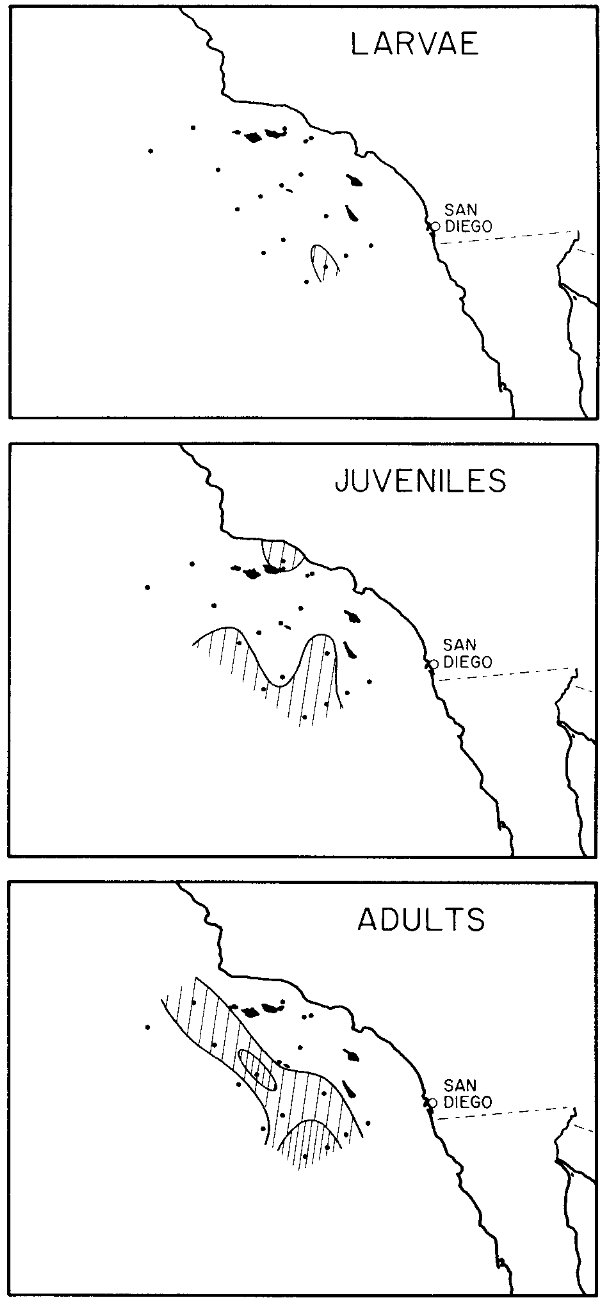
Euphausia gibboides
Stylocheiron affine
5408

CALCOFI CRUISE 5408

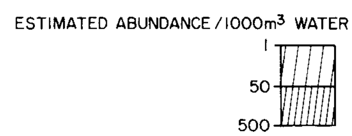
4–9 SEPTEMBER 1954
(MAIN PORTION OF CRUISE OCCUPIED IN AUGUST)



Euphausia gibboides



Stylocheiron affine

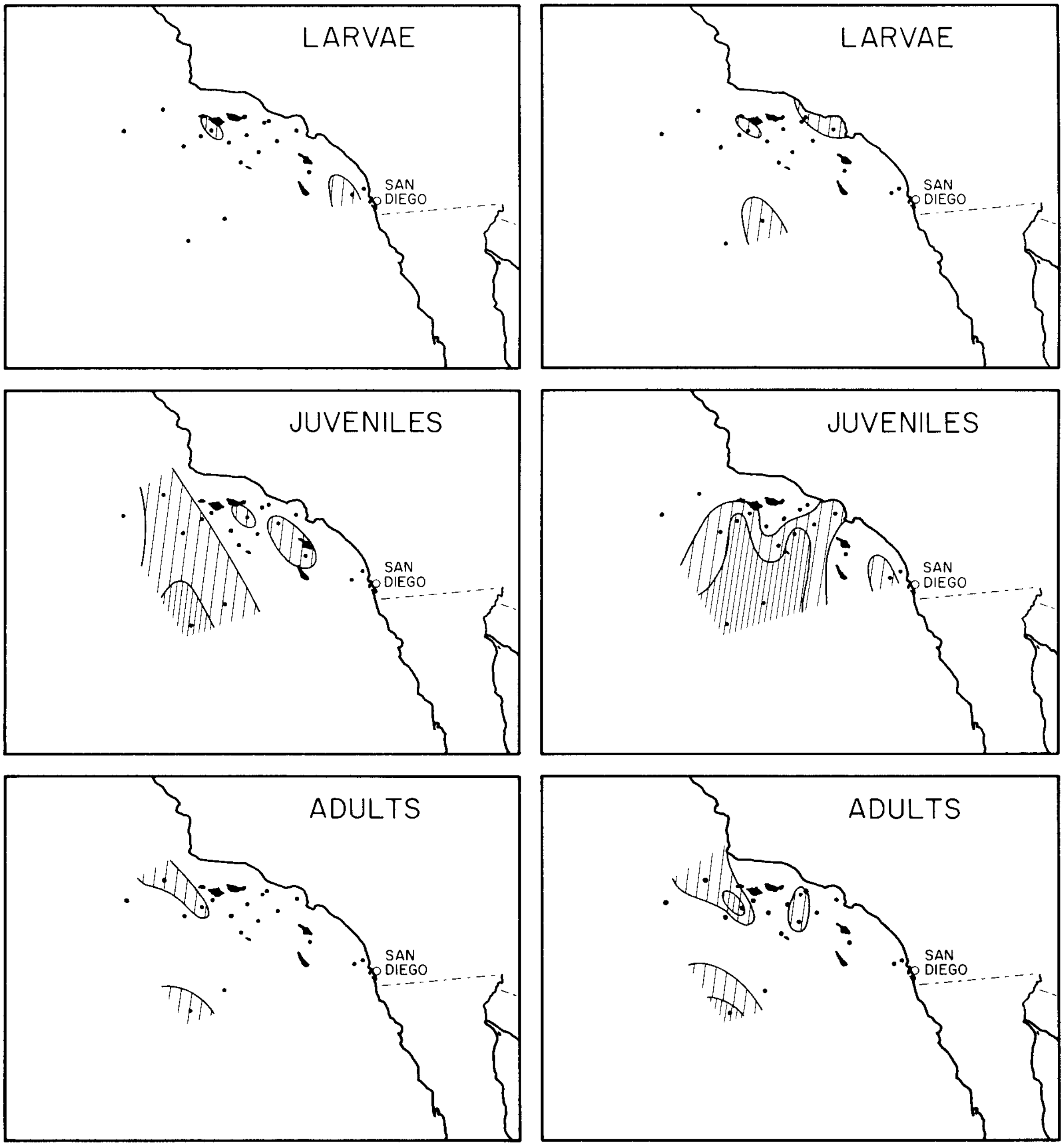


Euphausiacea

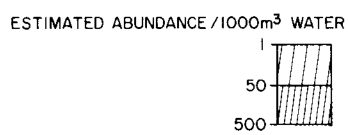
Euphausia gibboides
Stylocheiron affine
5410

CALCOFI CRUISE 5410

7-14 OCTOBER 1954



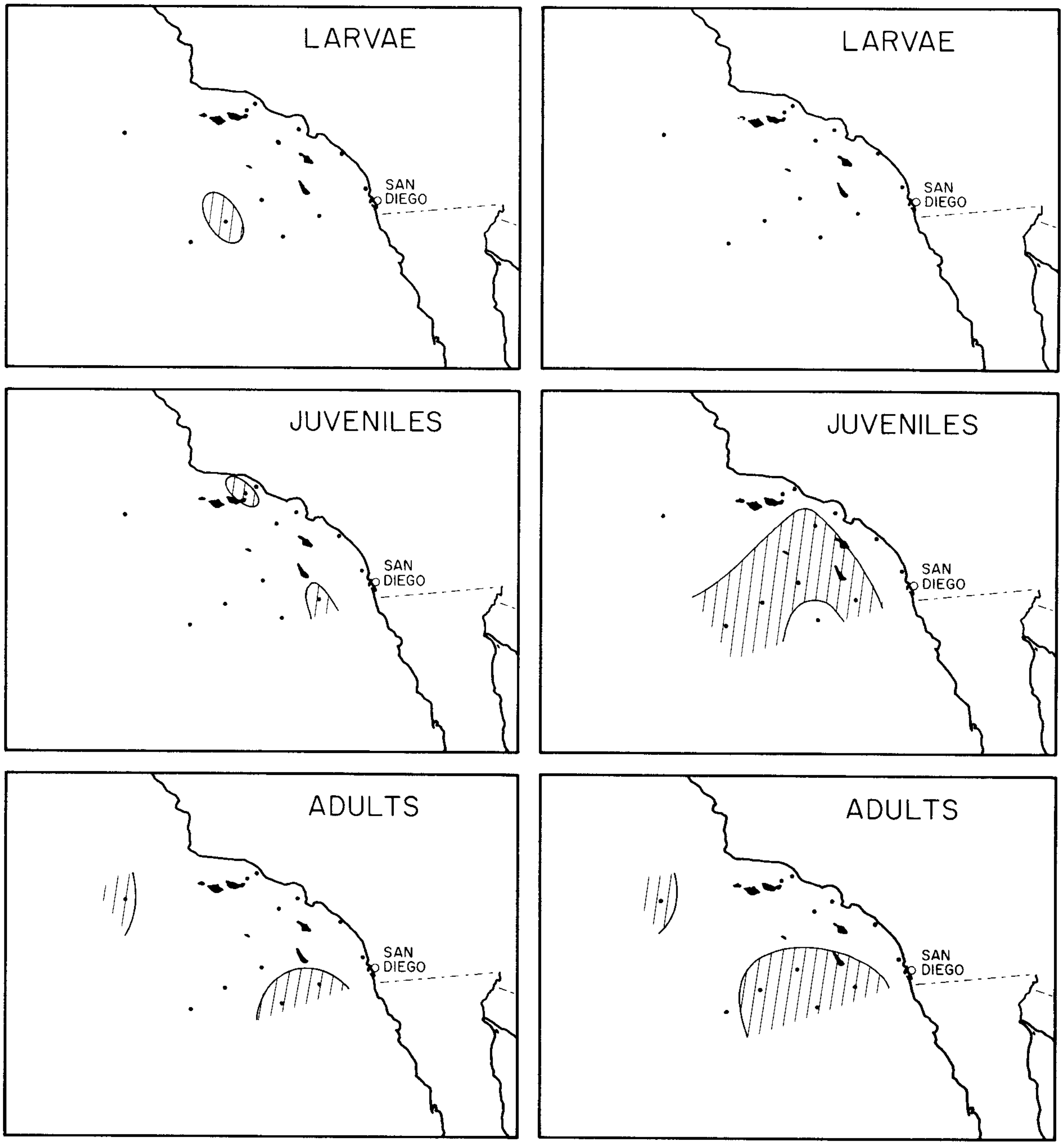
Euphausia gibboides | *Stylocheiron affine*



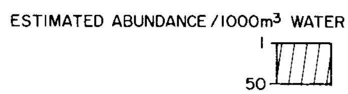
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5412

CALCOFI CRUISE 5412
2-9 DECEMBER 1954



Euphausia gibboides *Stylocheiron affine*



CALCOFI CRUISE 5501

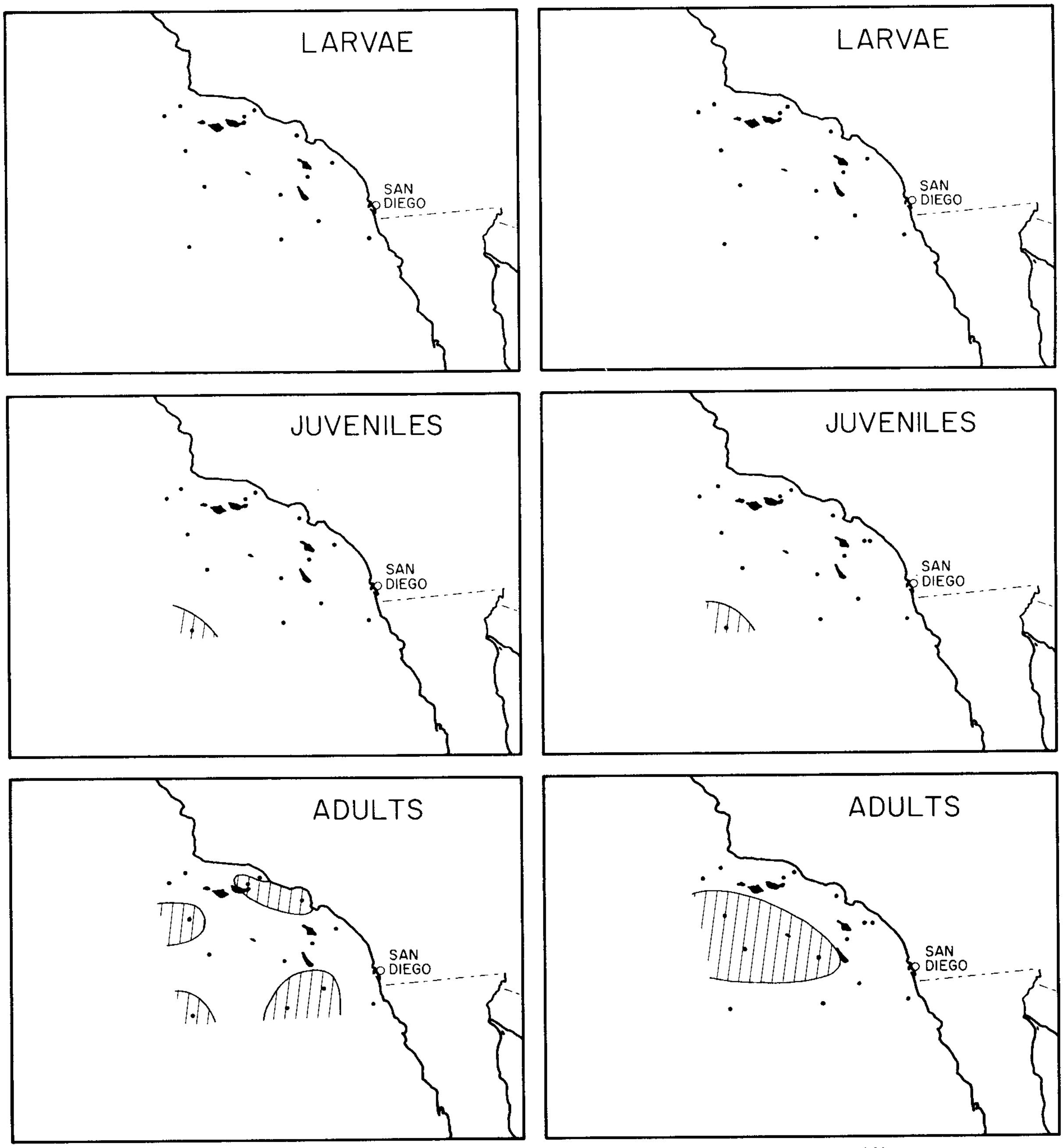
13—19 JANUARY 1955

Euphausiacea

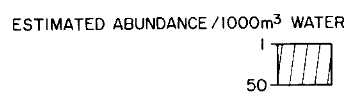
Euphausia gibboides

Stylocheiron affine

5501



Euphausia gibboides *Stylocheiron affine*



Euphausiacea

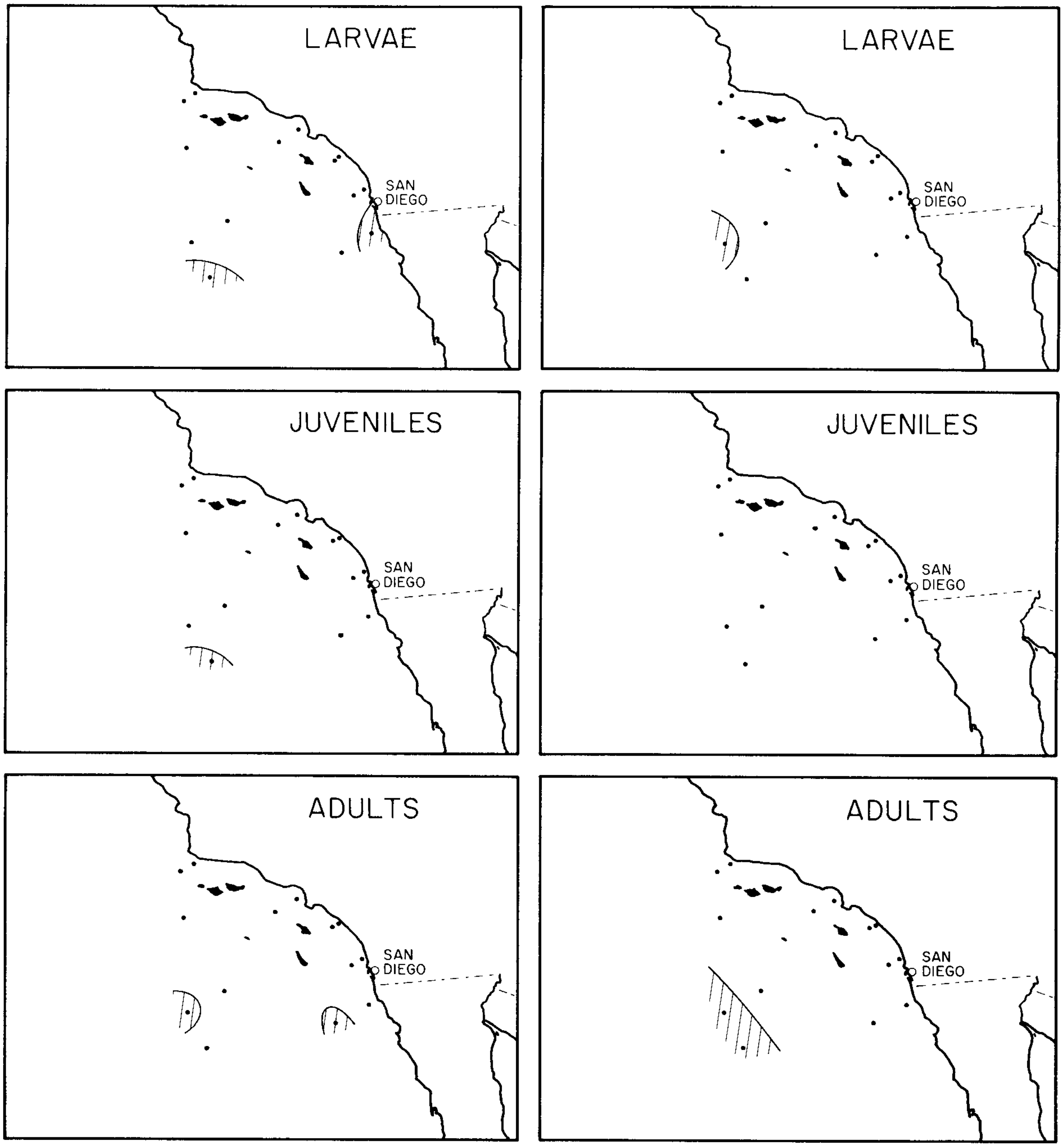
Euphausia gibboides

Stylocheiron affine

5502

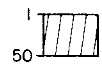
CALCOFI CRUISE 5502

11 – 17 FEBRUARY 1955



Euphausia gibboides *Stylocheiron affine*

ESTIMATED ABUNDANCE / 1000m^3 WATER



Euphausiacea

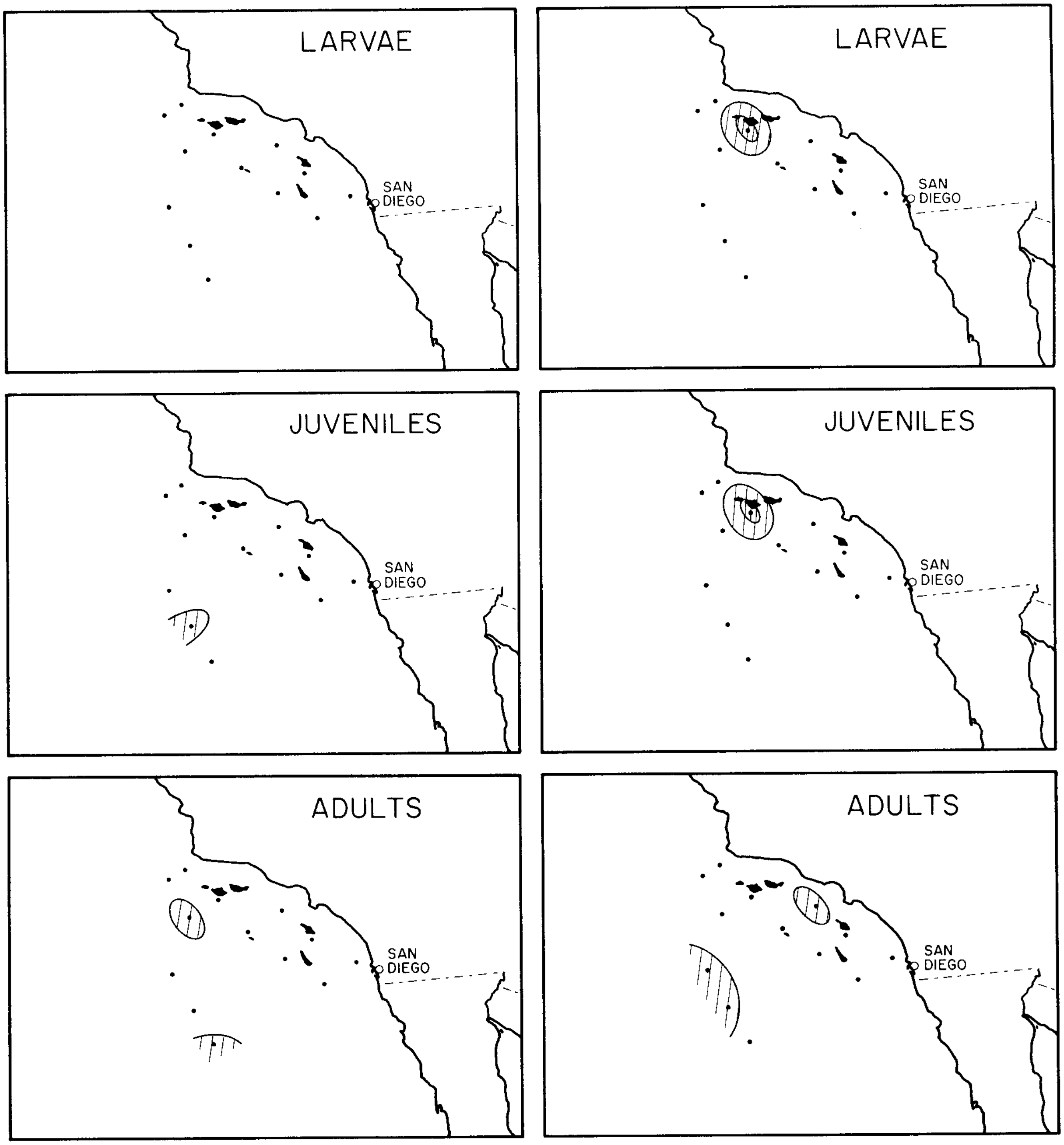
Euphausia gibboides

Stylocheiron affine

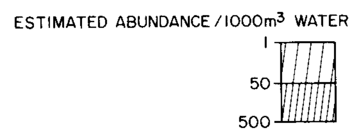
5503

CALCOFI CRUISE 5503

8-16 MARCH 1955



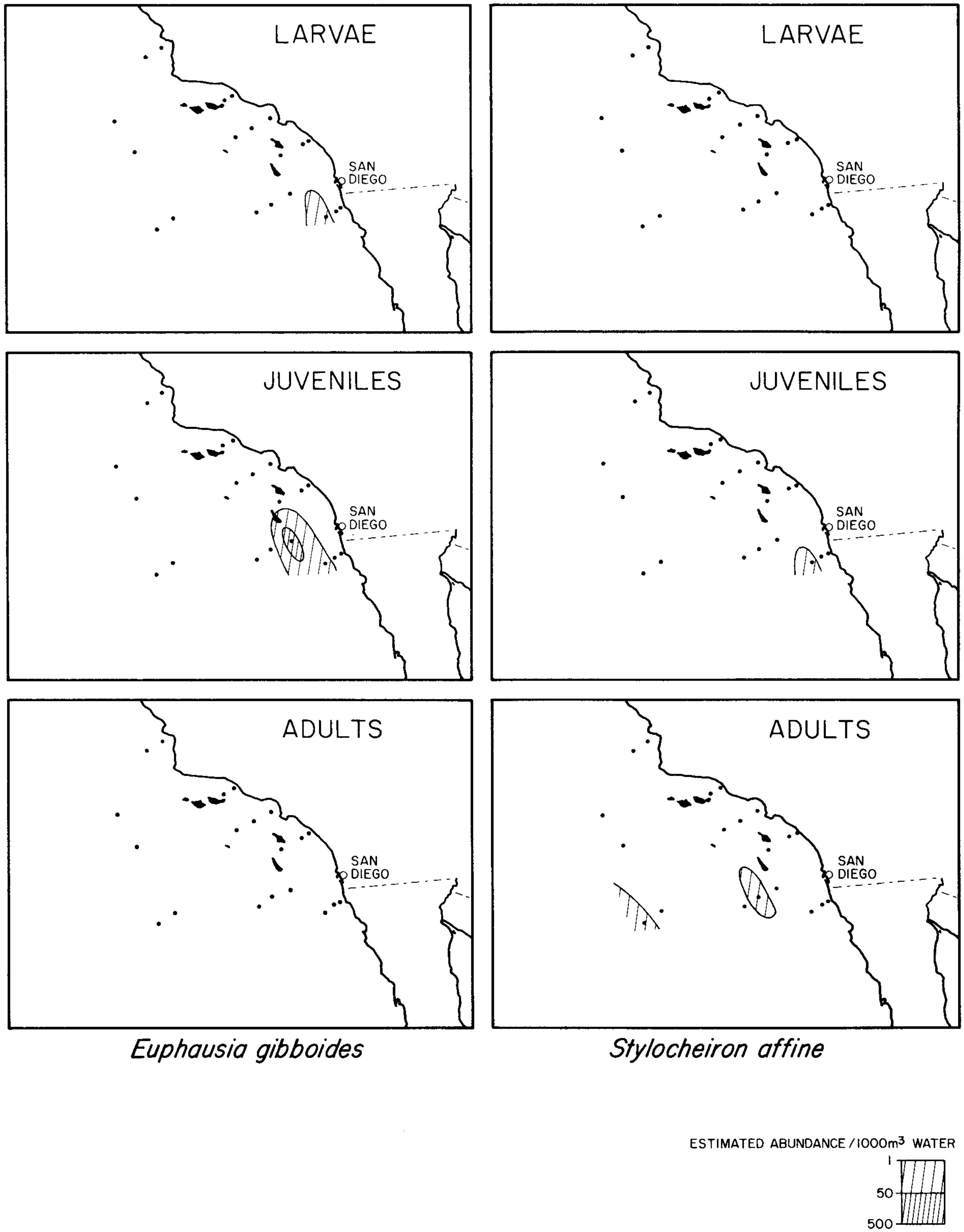
Euphausia gibboides *Stylocheiron affine*



Euphausiacea

Euphausia gibboides
Stylocheiron affine
5504

CALCOFI CRUISE 5504
7–16 APRIL 1955



CALCOFI CRUISE 5505

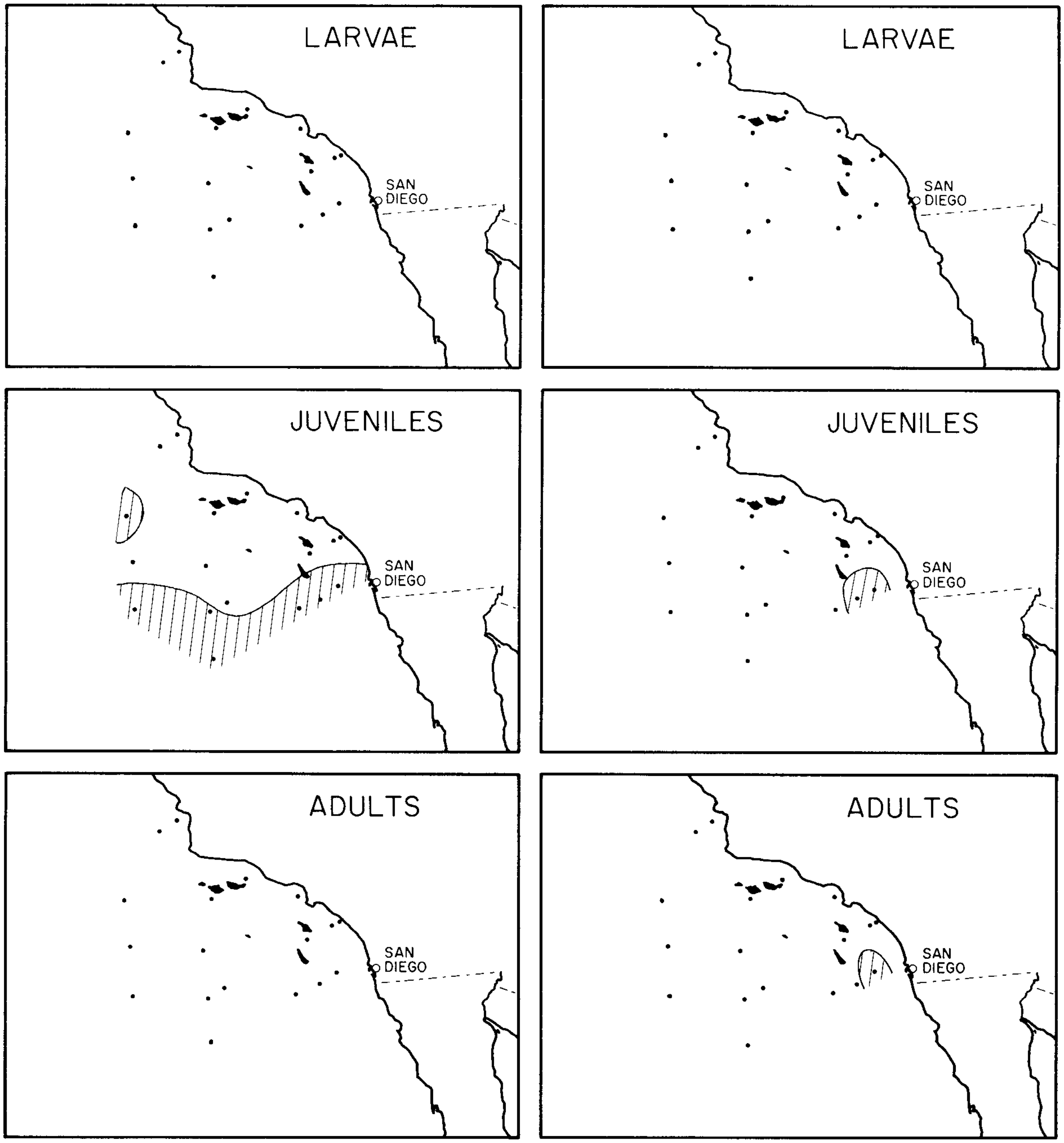
21 MAY – 6 JUNE 1955

Euphausiacea

Euphausia gibboides

Stylocheiron affine

5505



Euphausia gibboides *Stylocheiron affine*

ESTIMATED ABUNDANCE / 1000m^3 WATER

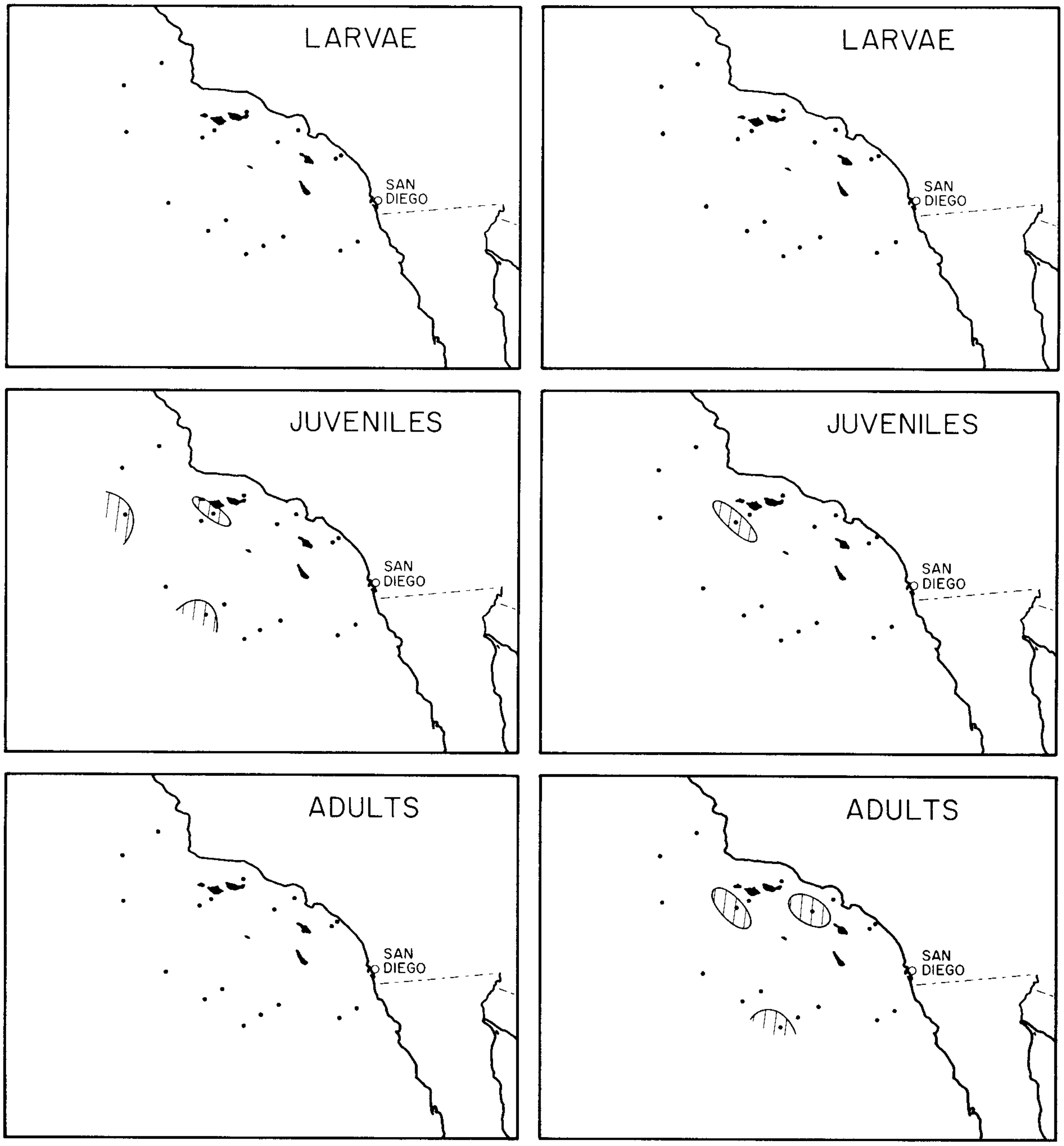
1–50

Euphausiacea

Euphausia gibboides
Stylocheiron affine
5506

CALCOFI CRUISE 5506

11 – 20 JUNE 1955



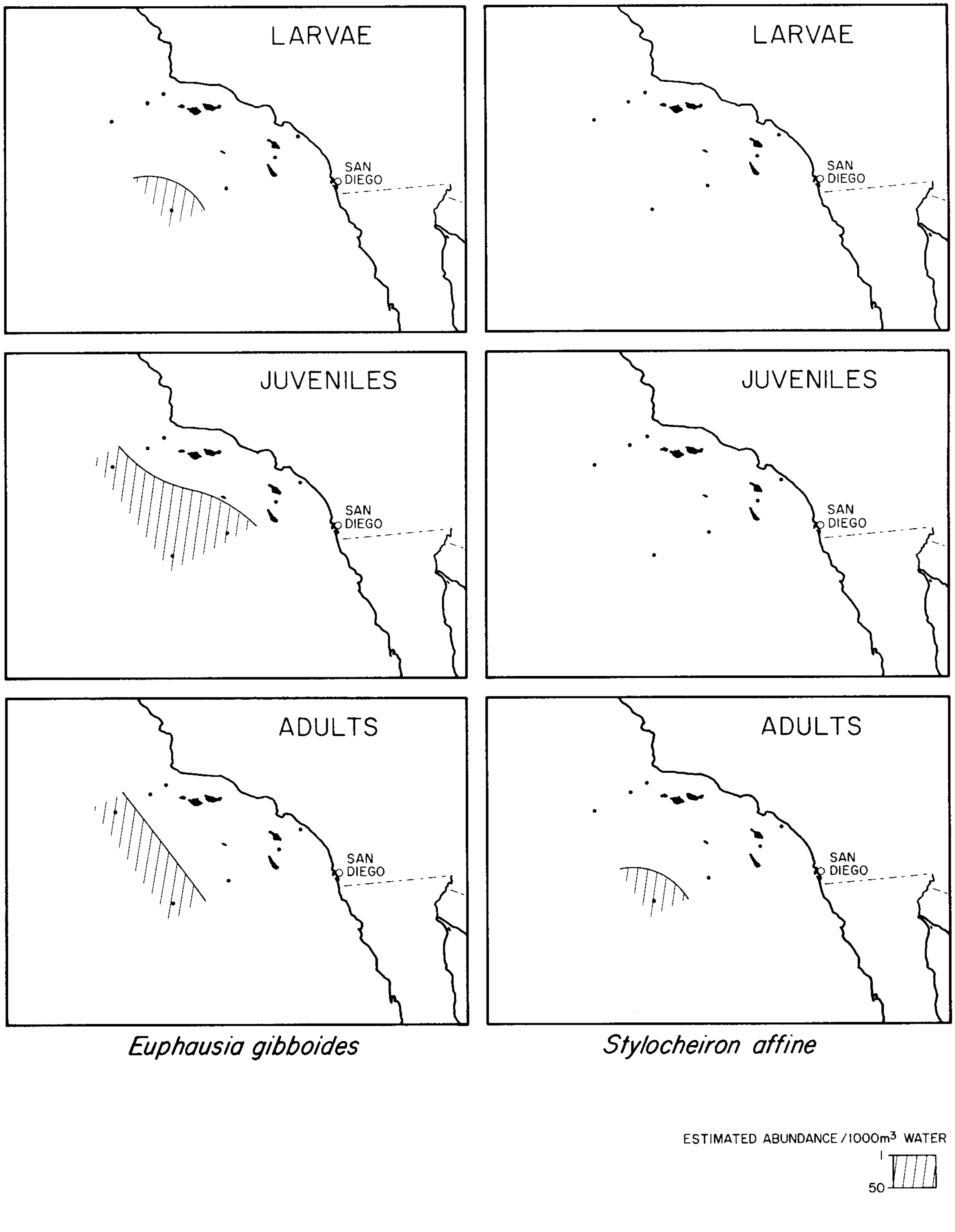
Euphausia gibboides *Stylocheiron affine*

ESTIMATED ABUNDANCE / 1000m³ WATER
1
50

Euphausiacea

Euphausia gibboides
Stylocheiron affine
5507

CALCOFI CRUISE 5507
7–13 JULY 1955

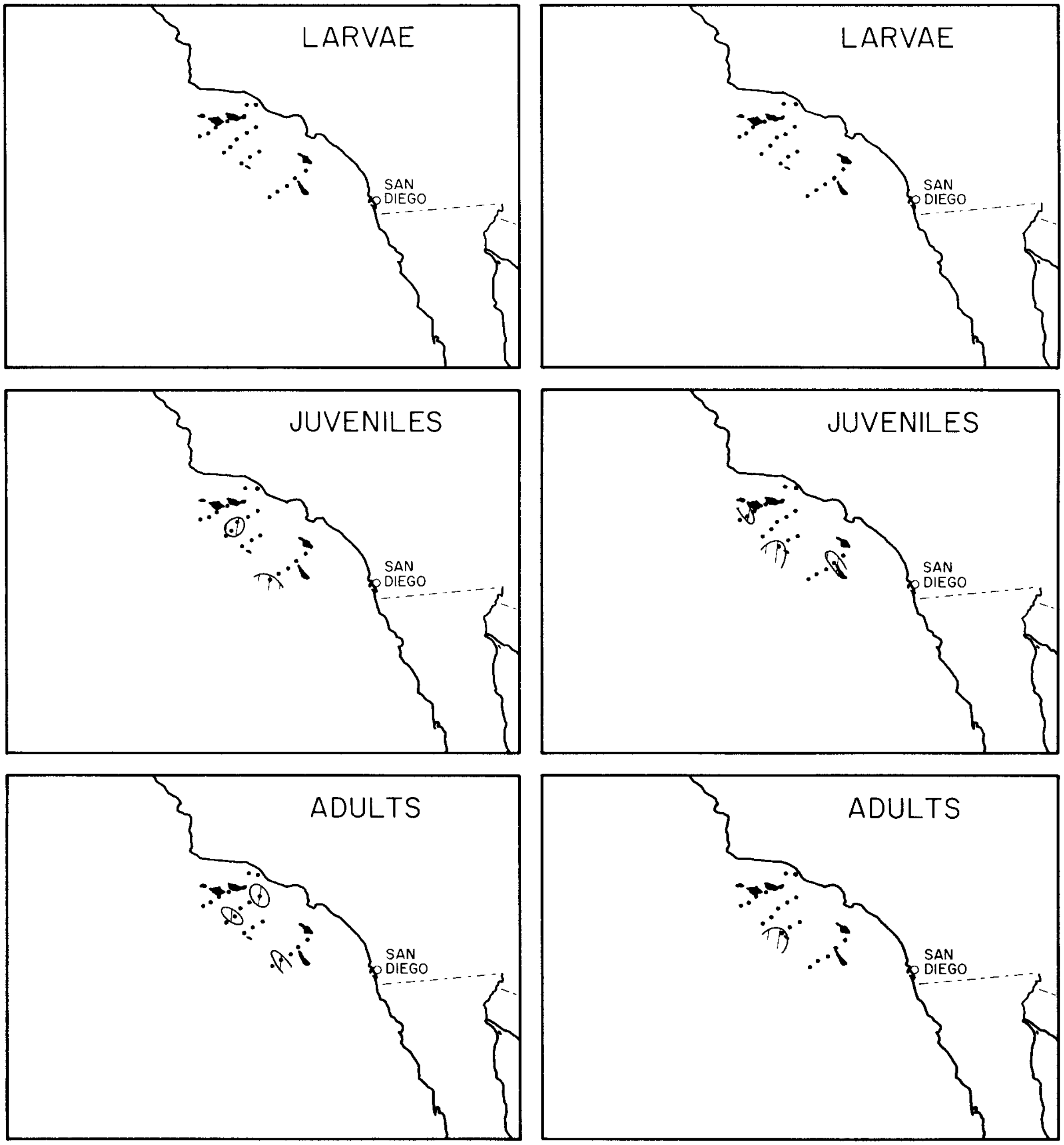


Euphausiacea

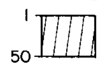
Euphausia gibboides
Stylocheiron affine
5508 'NORPAC'

CALCOFI CRUISE 5508 'NORPAC'

4 – 6 SEPTEMBER 1955
MAIN PORTION OF CRUISE OCCUPIED IN AUGUST



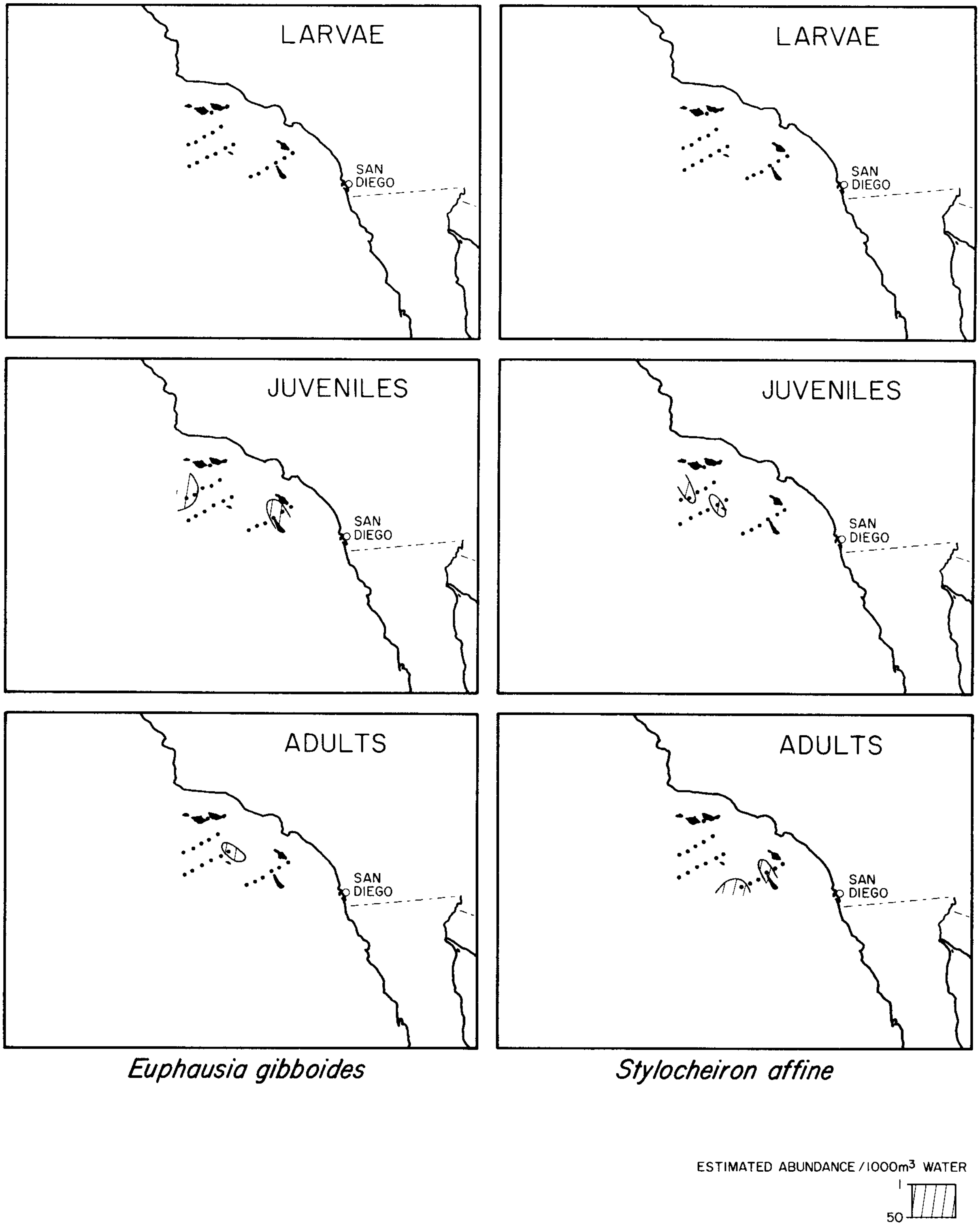
Euphausia gibboides *Stylocheiron affine*



Euphausiacea

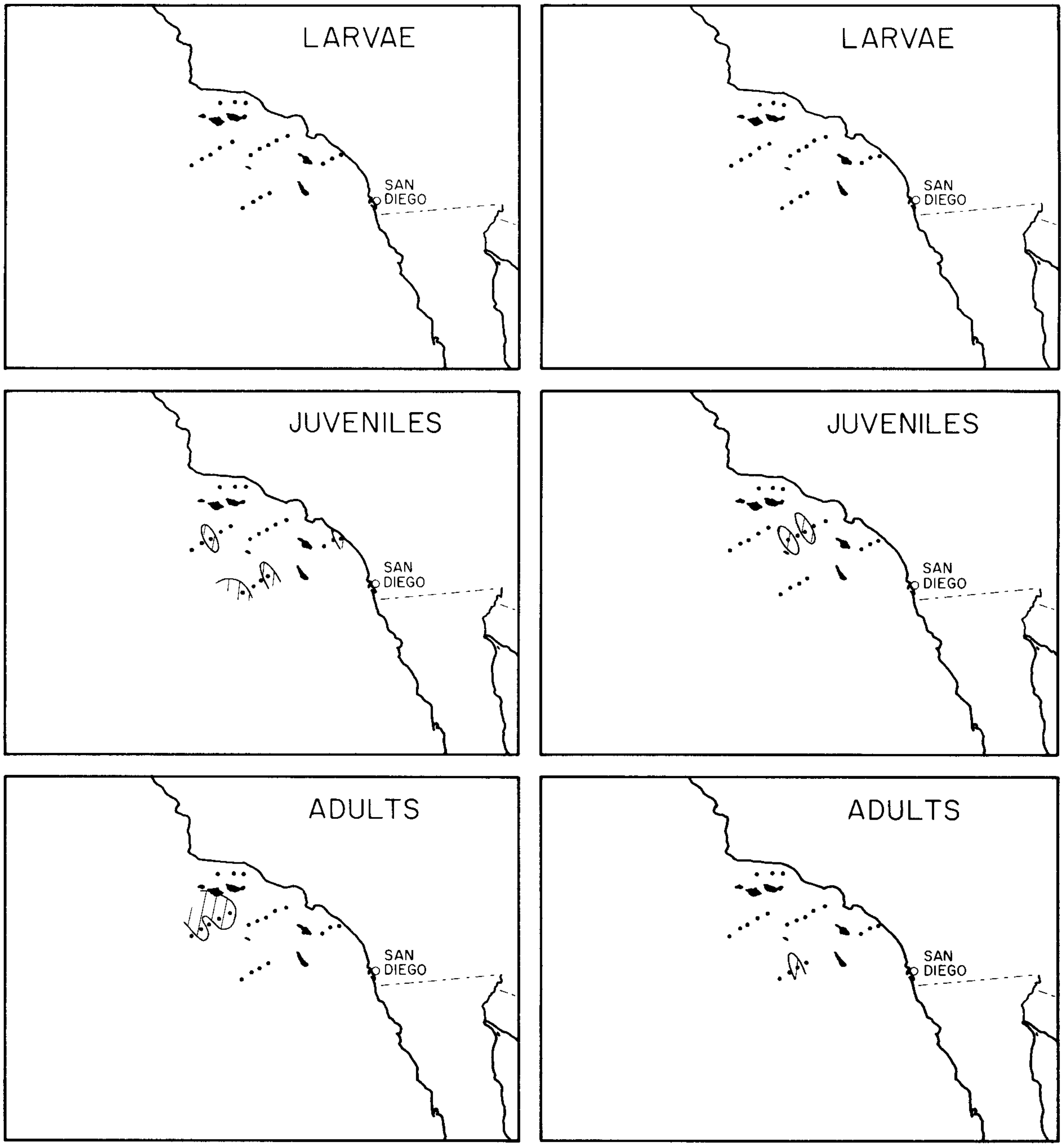
Euphausia gibboides
Stylocheiron affine
5509-I

CALCOFI CRUISE 5509-I
12-17 SEPTEMBER 1955

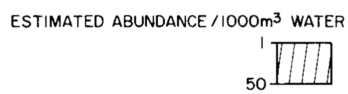


CALCOFI CRUISE 5509 - II
15 - 19 SEPTEMBER 1955

Euphausiacea
Euphausia gibboides
Stylocheiron affine
5509 - II



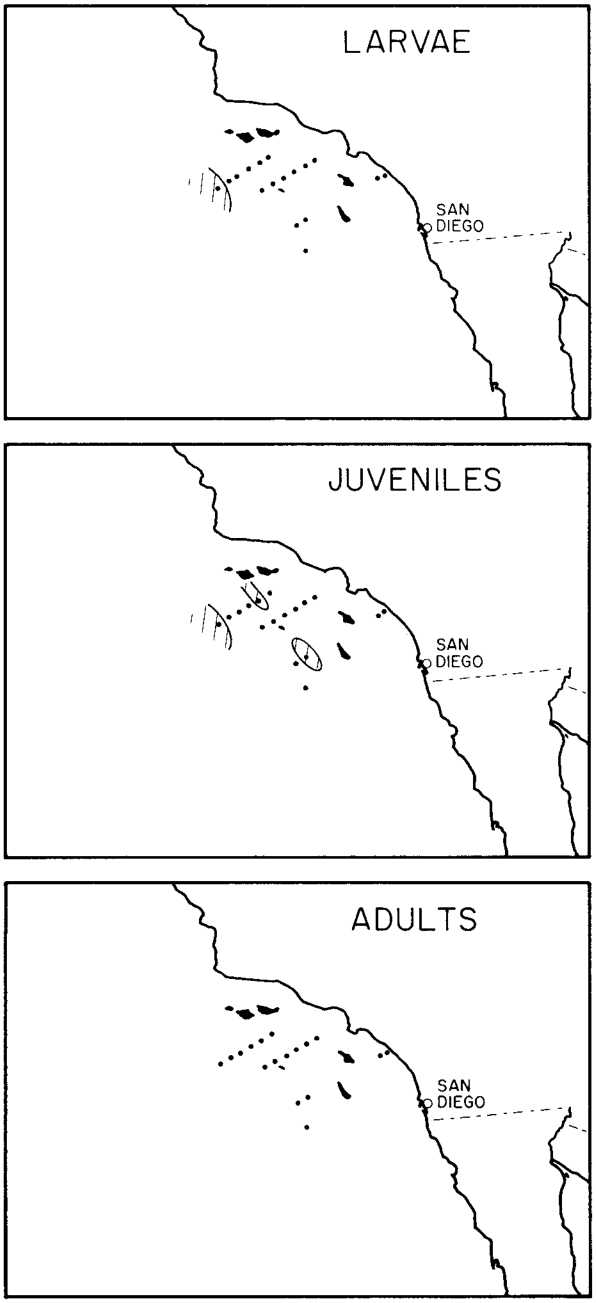
Euphausia gibboides *Stylocheiron affine*



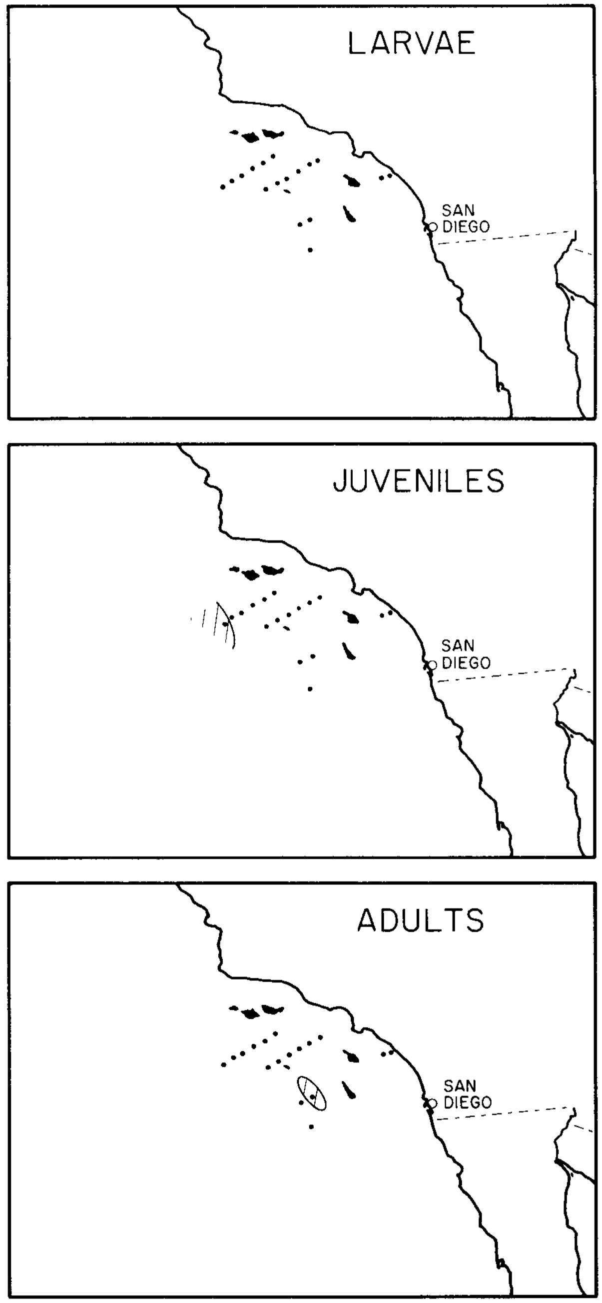
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5509 - III

CALCOFI CRUISE 5509 - III
18-23 SEPTEMBER 1955



Euphausia gibboides



Stylocheiron affine

ESTIMATED ABUNDANCE / 1000m^3 WATER

1

50

CALCOFI CRUISE 5509-IV

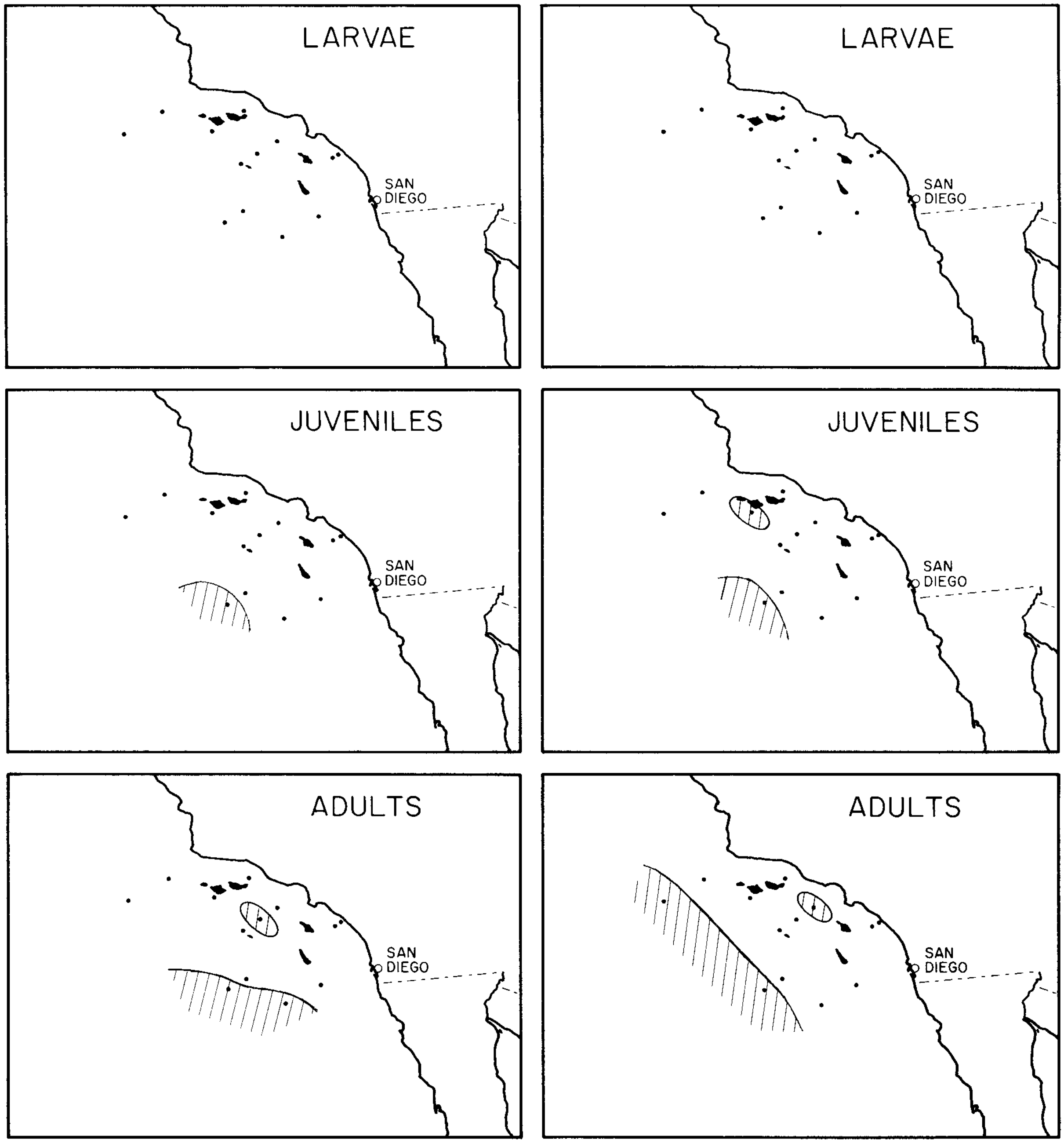
21 - 24 SEPTEMBER 1955

Euphausiacea

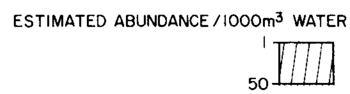
Euphausia gibboides

Stylocheiron affine

5509-IV



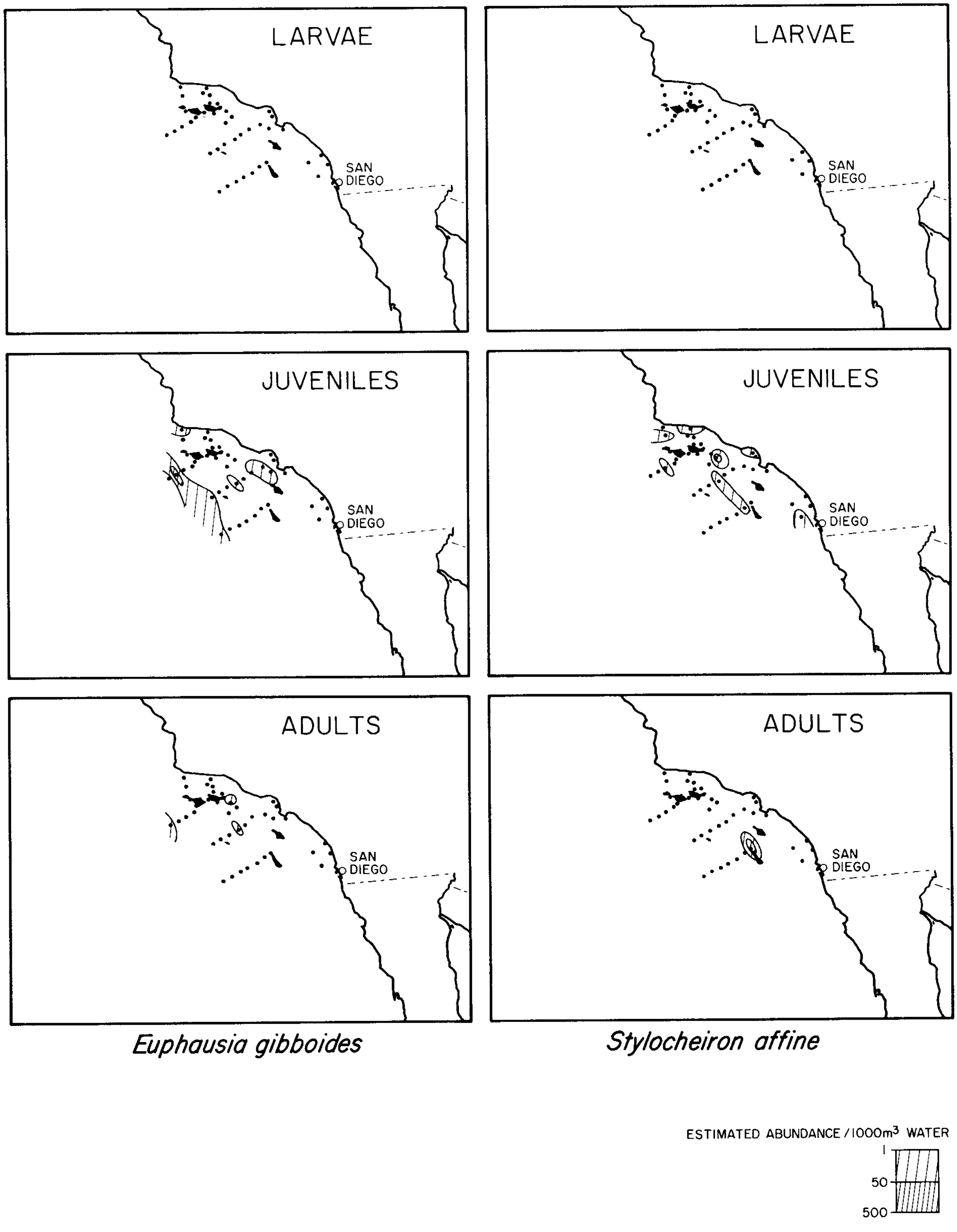
Euphausia gibboides *Stylocheiron affine*



Euphausiacea

Euphausia gibboides
Stylocheiron affine
5510

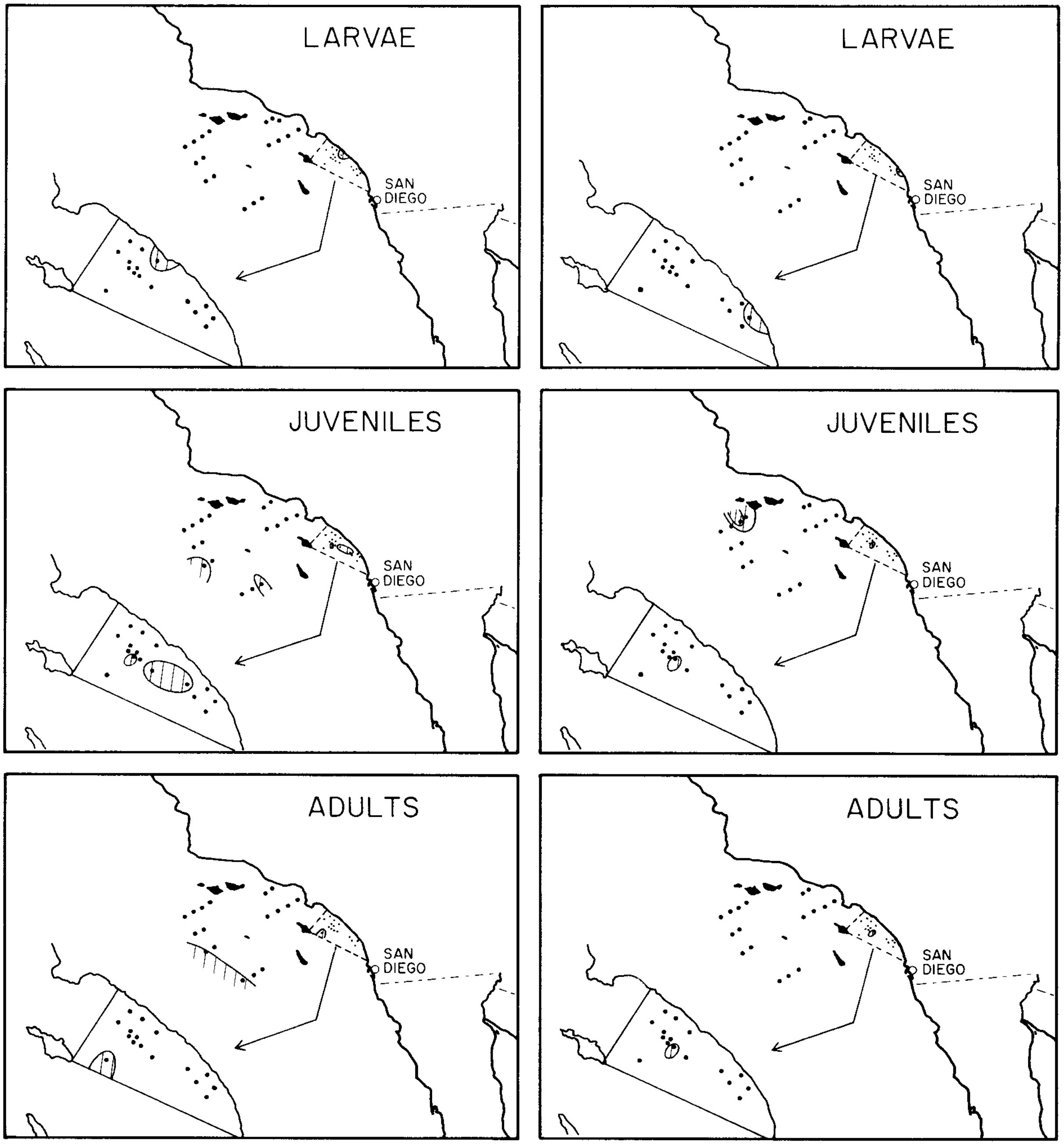
CALCOFI CRUISE 5510
21 – 29 OCTOBER 1955



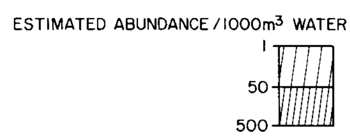
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5511-I

CALCOFI CRUISE 5511-I
8-13 NOVEMBER 1955



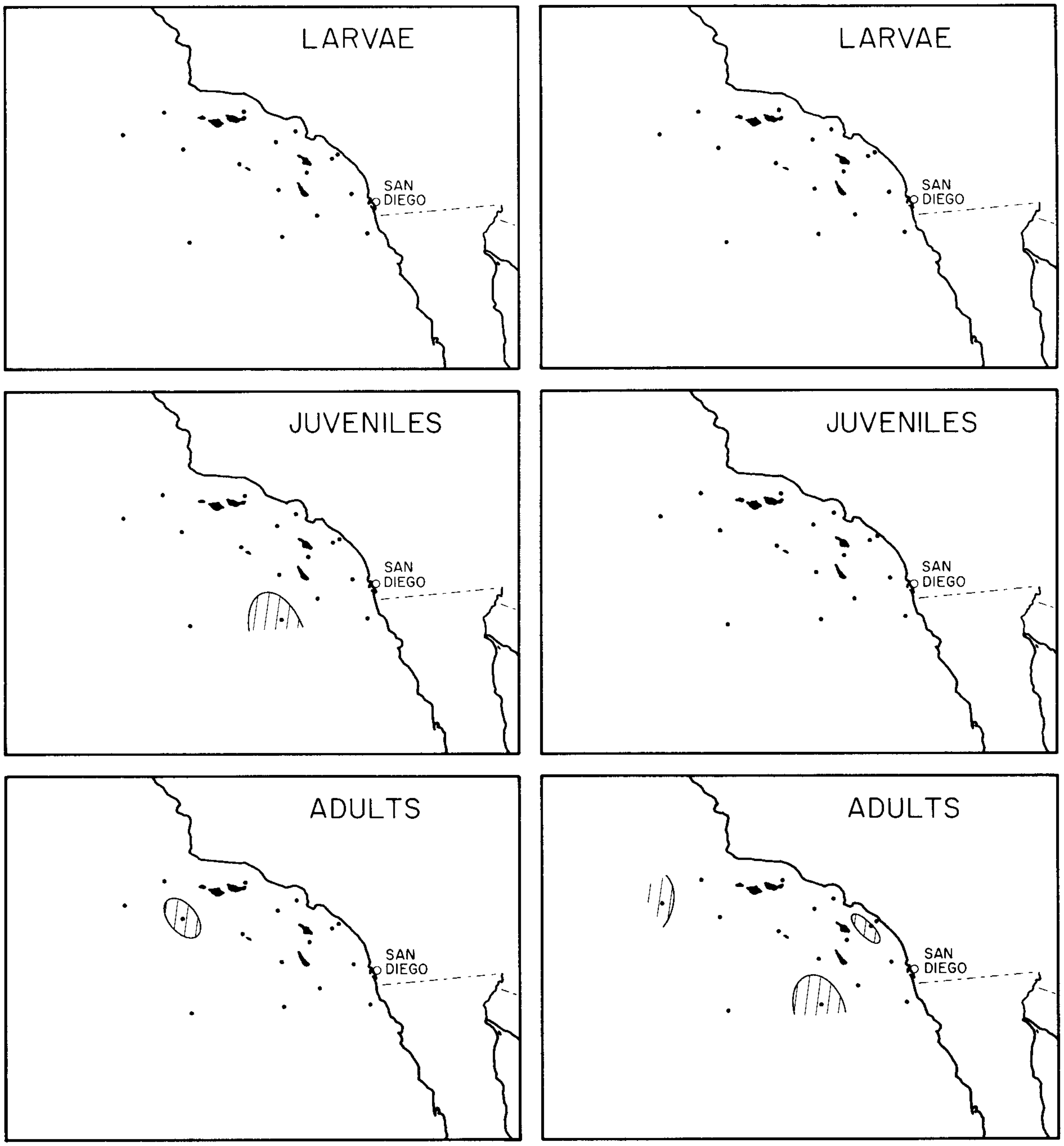
Euphausia gibboides | *Stylocheiron affine*



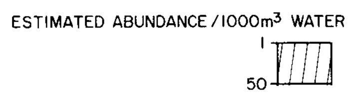
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5511-II

CALCOFI CRUISE 5511-II
16-19 NOVEMBER 1955



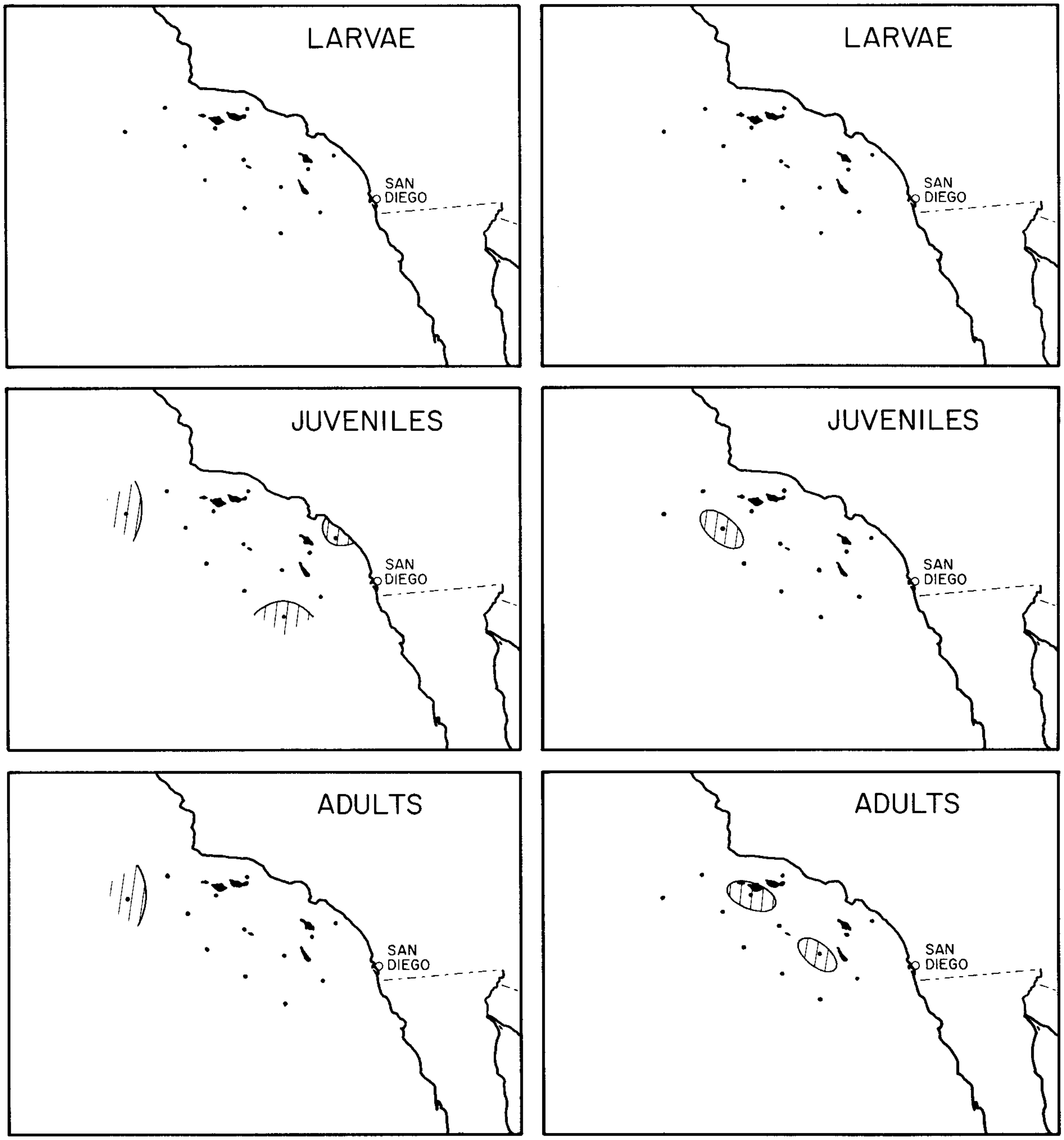
Euphausia gibboides *Stylocheiron affine*



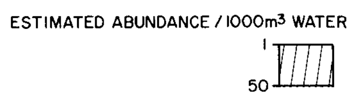
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5512

CALCOFI CRUISE 5512
30 NOVEMBER – 7 DECEMBER 1955



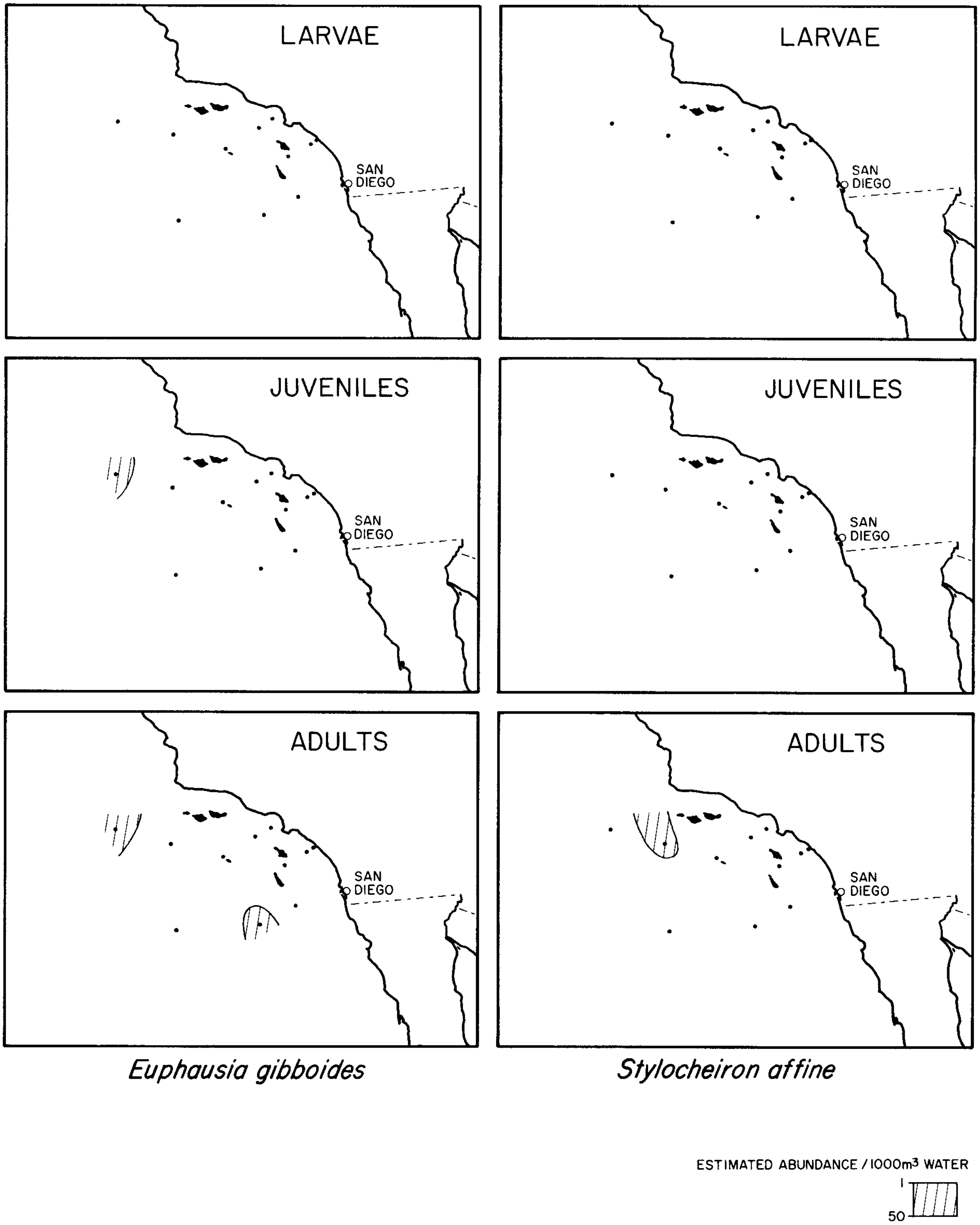
Euphausia gibboides *Stylocheiron affine*



Euphausiacea

Euphausia gibboides
Stylocheiron affine
5601

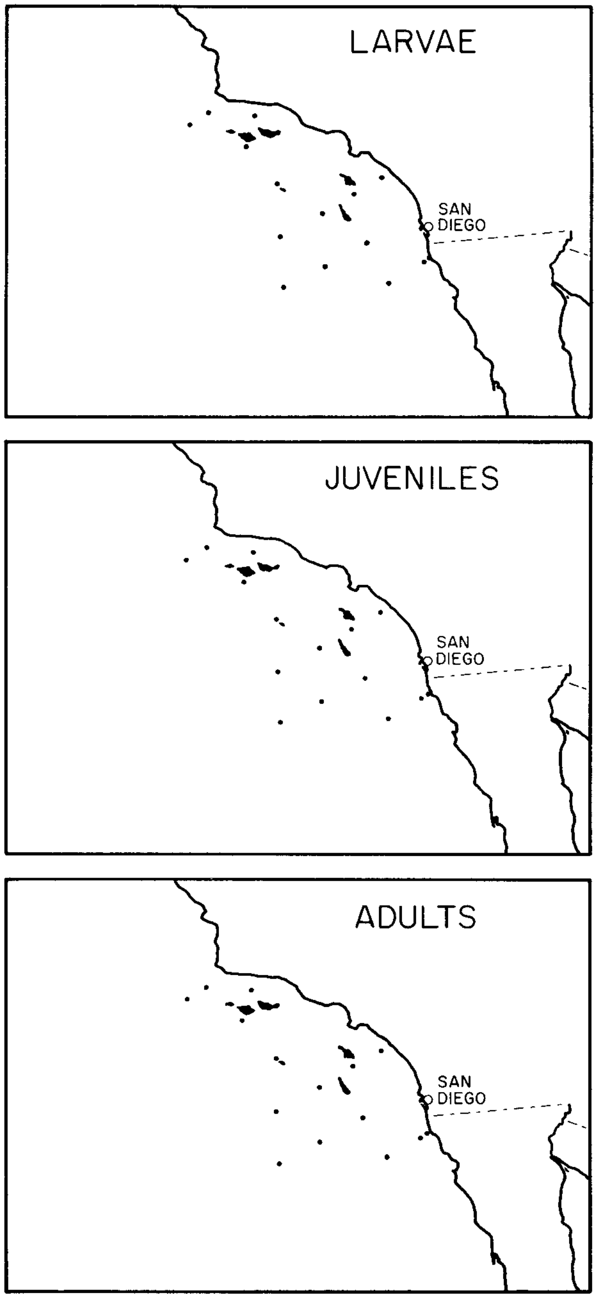
CALCOFI CRUISE 5601
6 - 10 JANUARY 1956



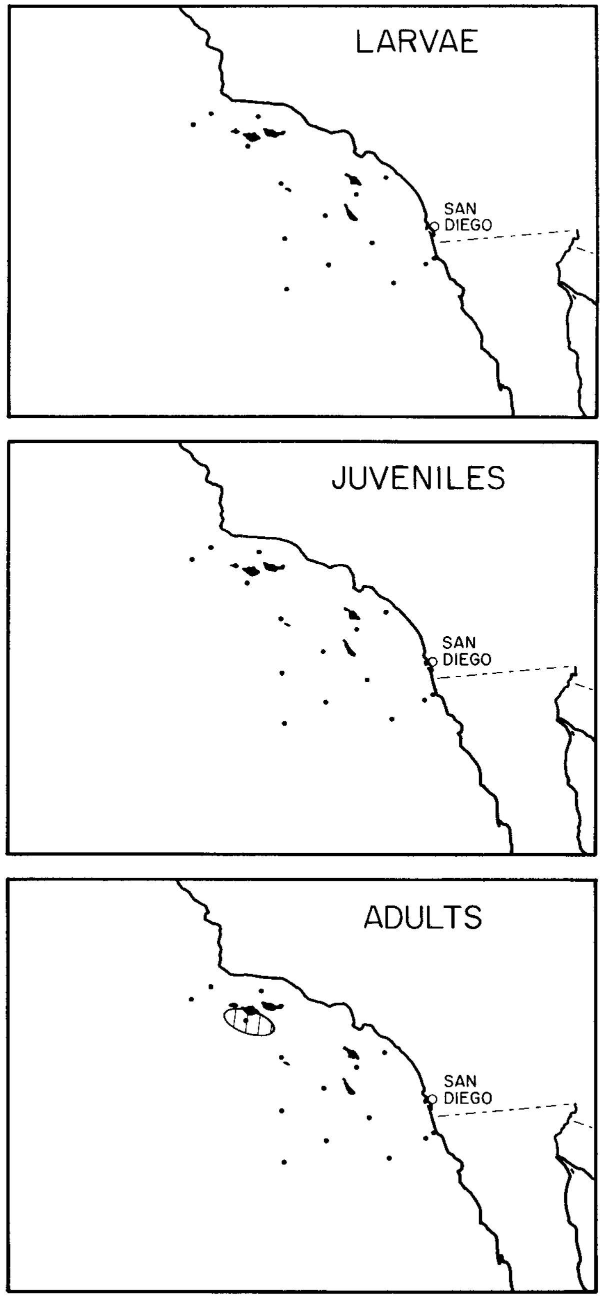
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5602

CALCOFI CRUISE 5602
3 - 10 FEBRUARY 1956

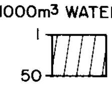


Euphausia gibboides
NO POSITIVE RECORDS



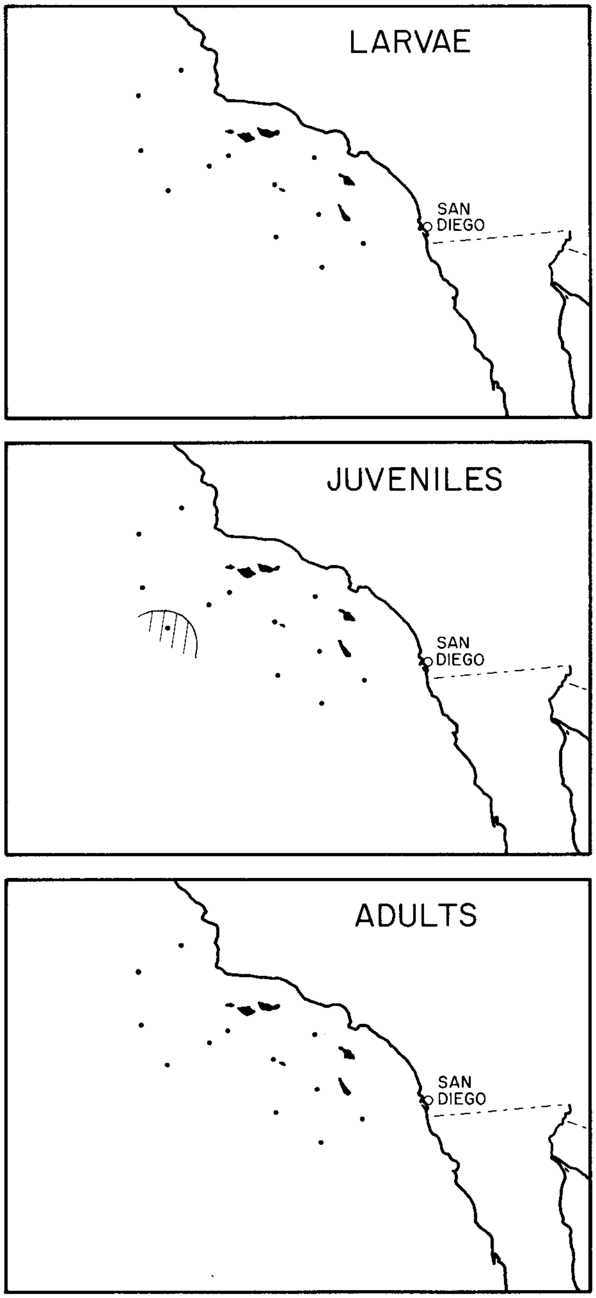
Stylocheiron affine

ESTIMATED ABUNDANCE / 1000m^3 WATER

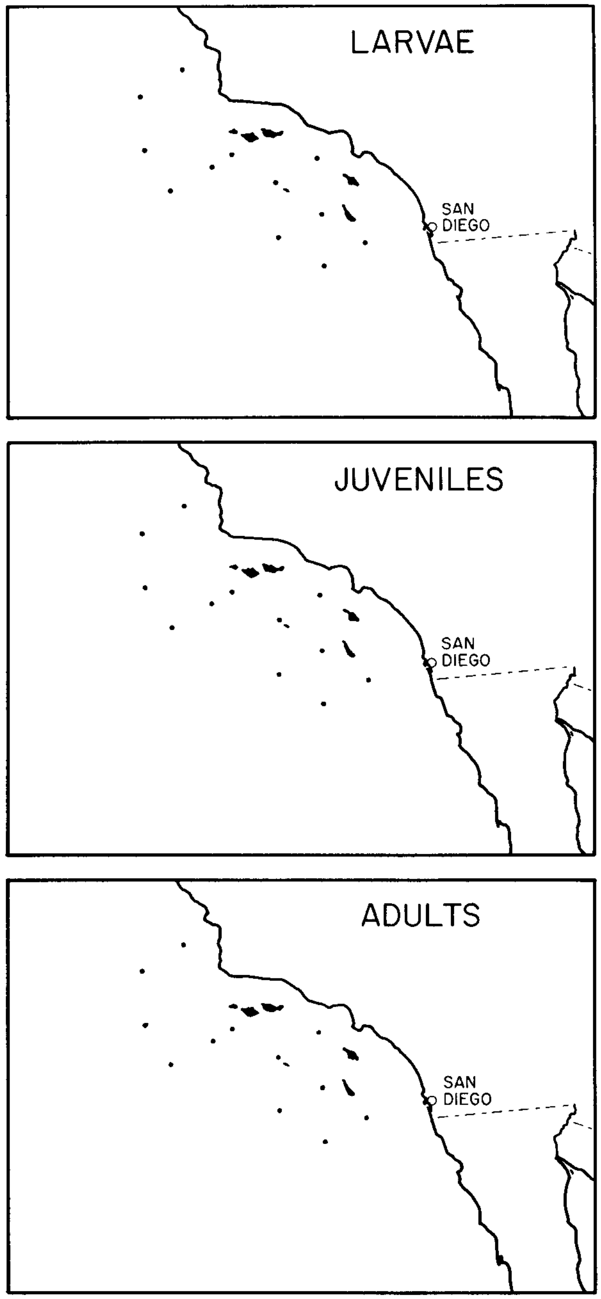


Euphausiacea
Euphausia gibboides
Stylocheiron affine
5603

CALCOFI CRUISE 5603
8–17 MARCH 1956

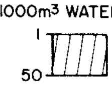


Euphausia gibboides



Stylocheiron affine
NO POSITIVE RECORDS

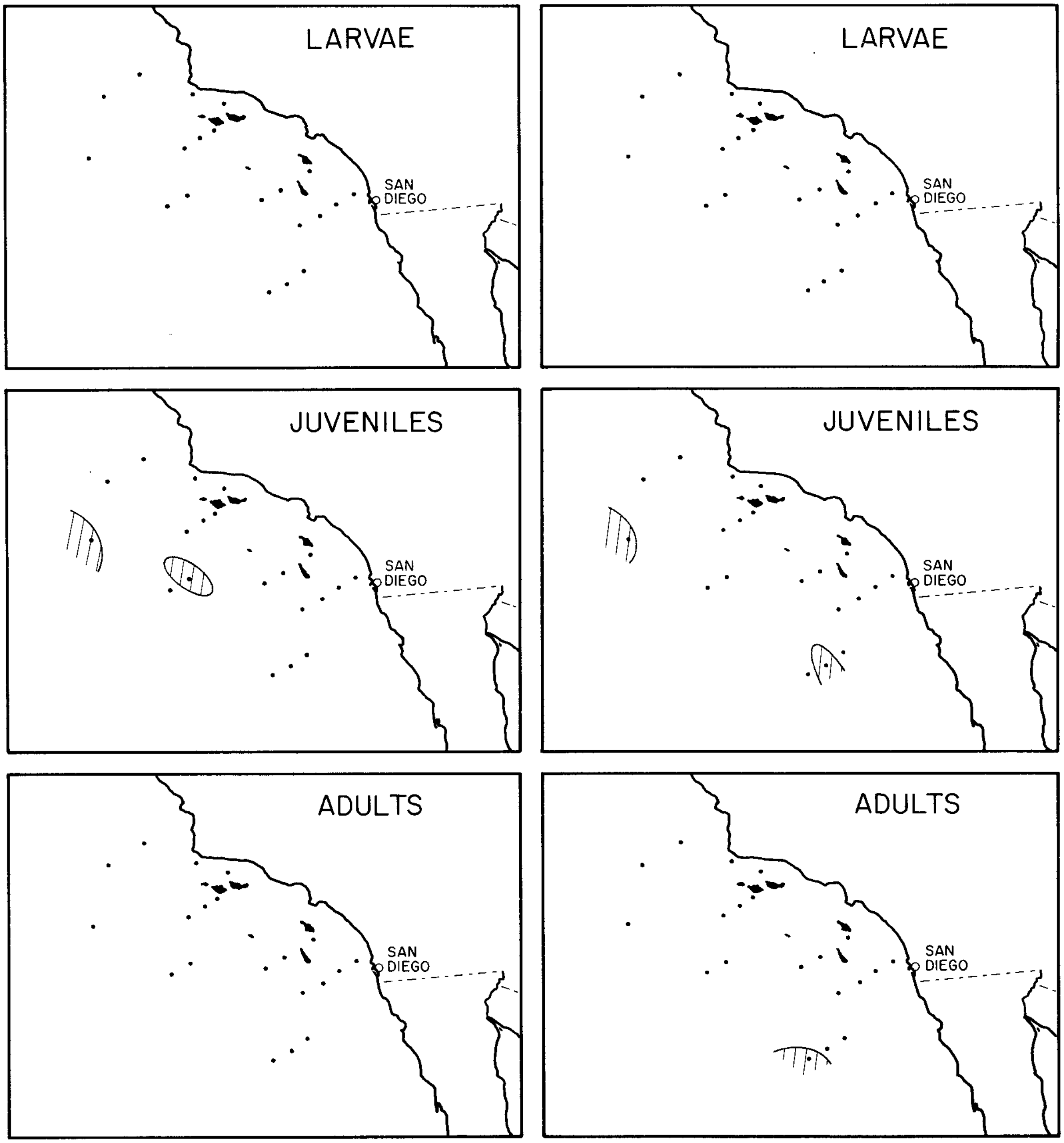
ESTIMATED ABUNDANCE / 1000m^3 WATER



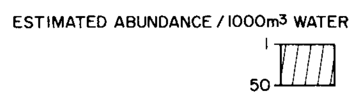
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5604

CALCOFI CRUISE 5604
14 – 21 APRIL 1956

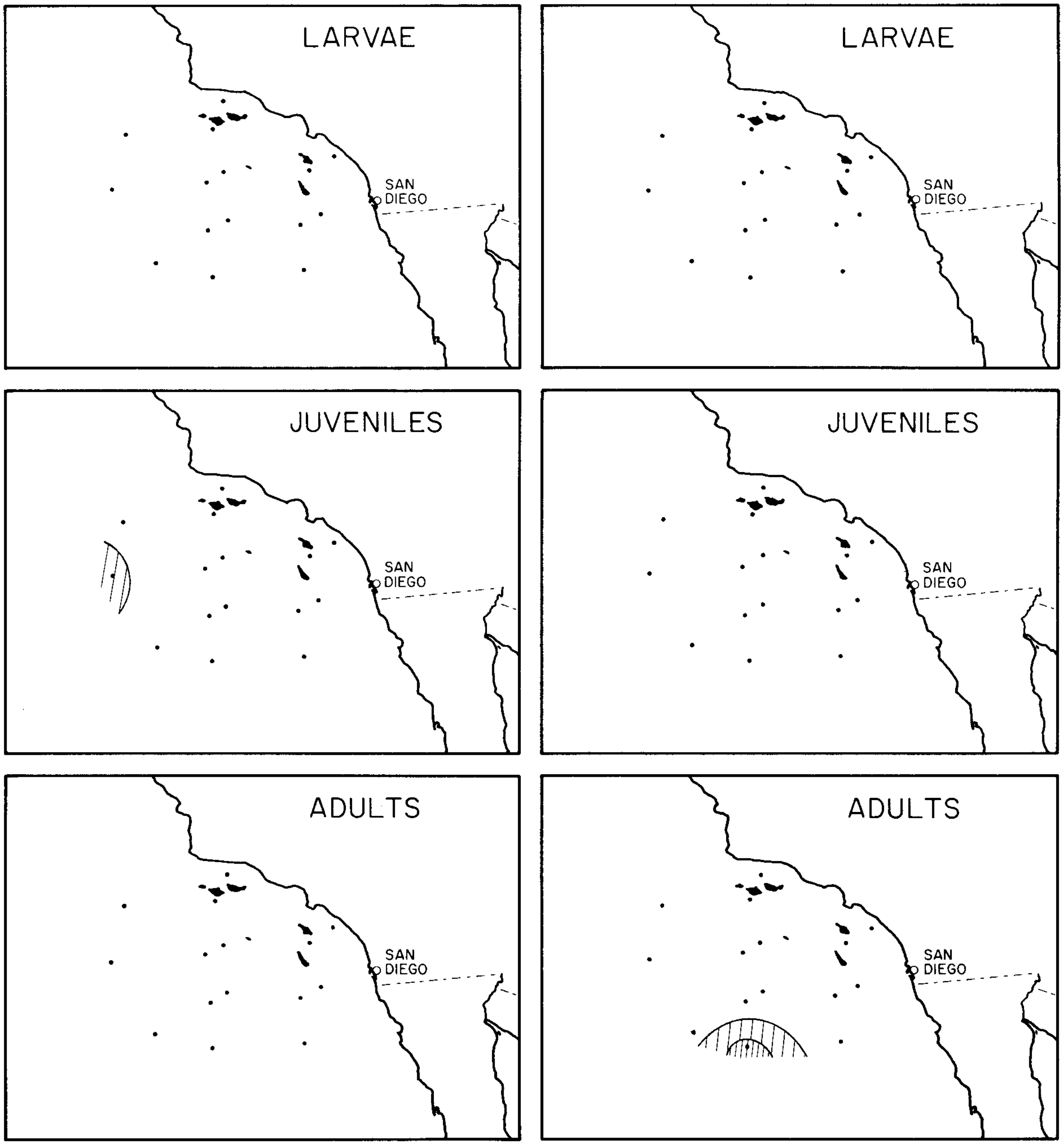


Euphausia gibboides *Stylocheiron affine*



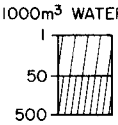
CALCOFI CRUISE 5605
6 - 18 MAY 1956

Euphausiacea
Euphausia gibboides
Stylocheiron affine
5605



Euphausia gibboides *Stylocheiron affine*

ESTIMATED ABUNDANCE / 1000m³ WATER



Euphausiacea

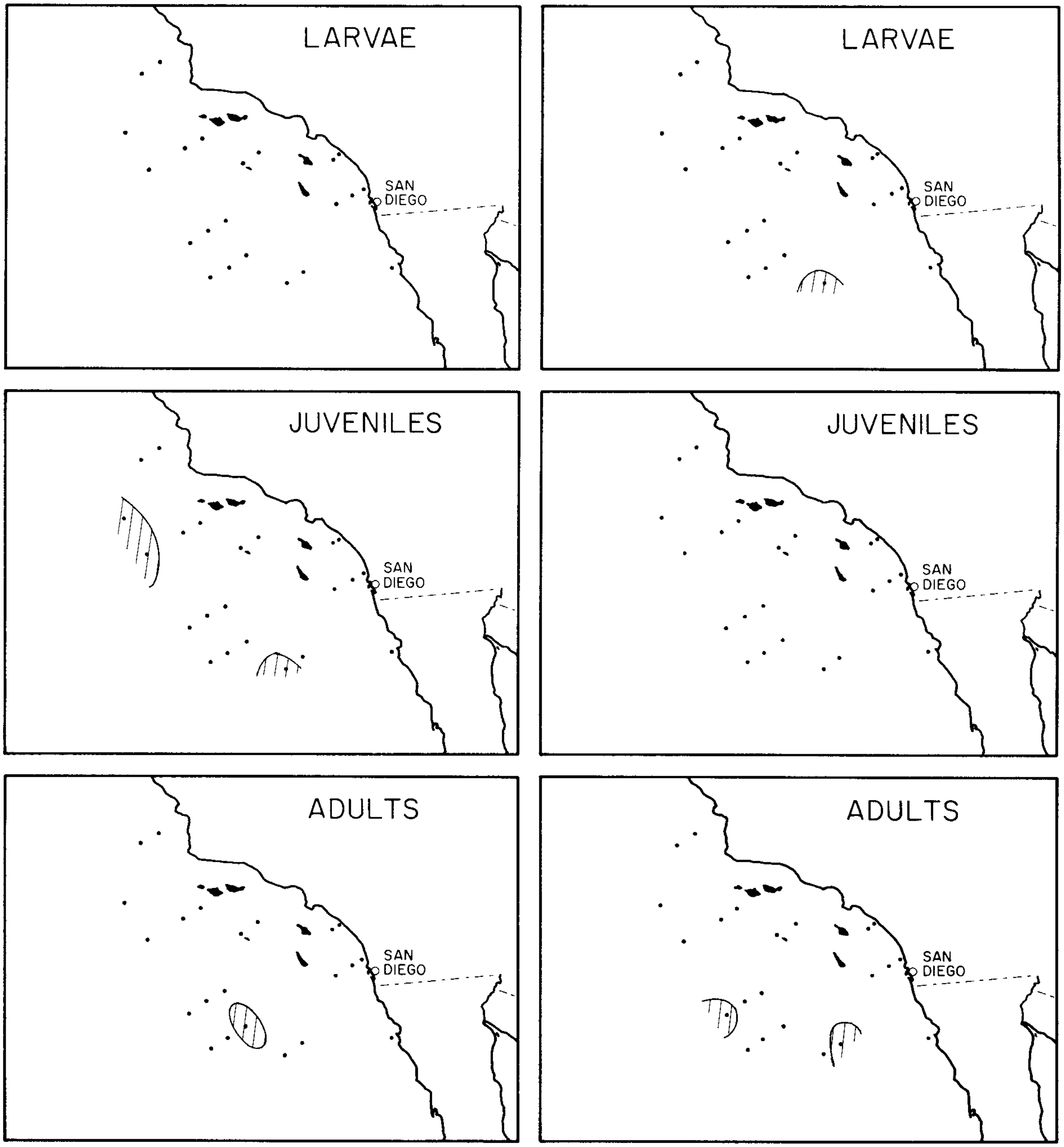
Euphausia gibboides

Stylocheiron affine

5606

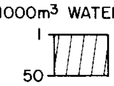
CALCOFI CRUISE 5606

30 MAY – 13 JUNE 1956



Euphausia gibboides *Stylocheiron affine*

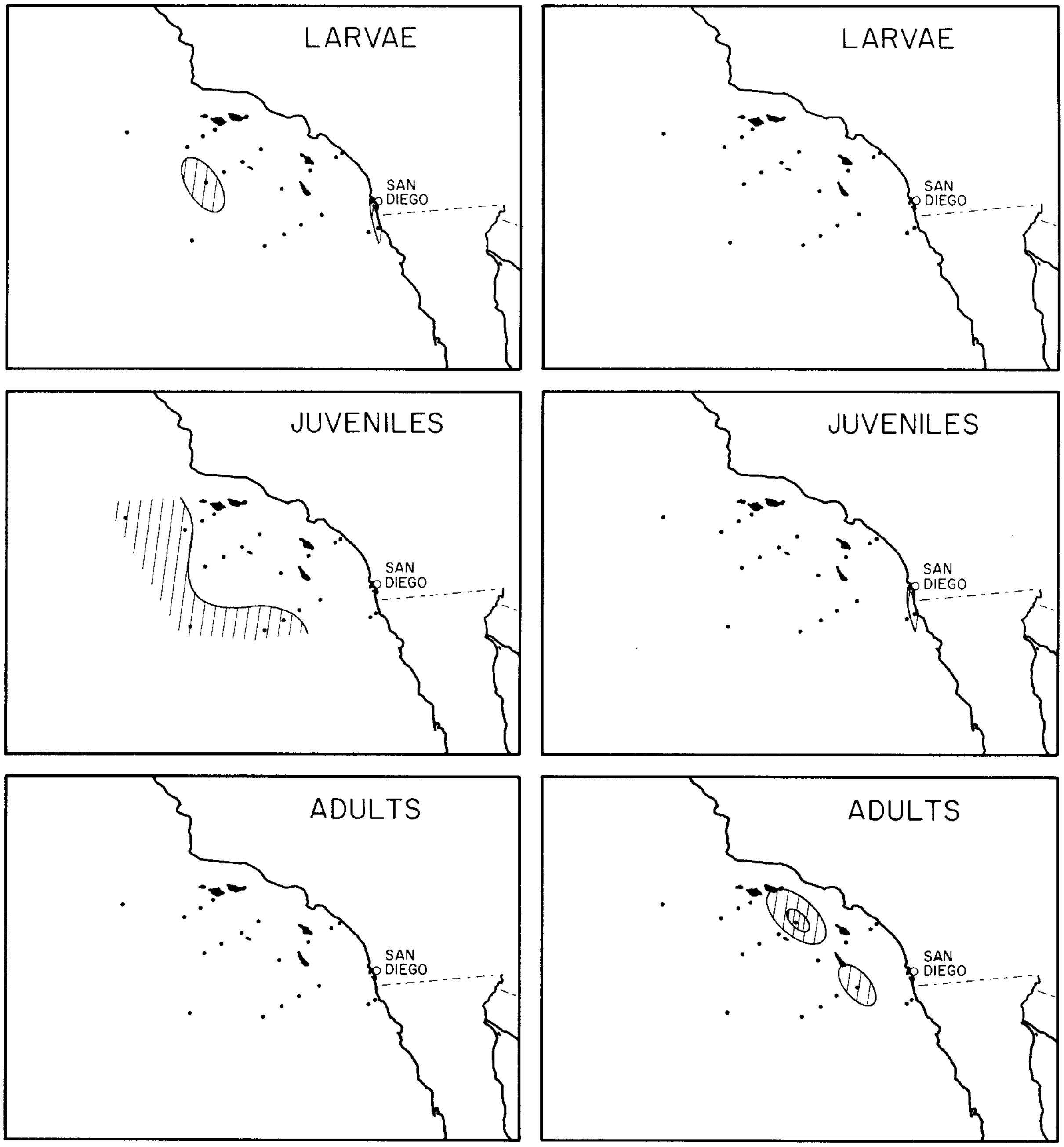
ESTIMATED ABUNDANCE / $1000 m^3$ WATER



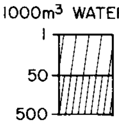
Euphausiacea

Euphausia gibboides
Stylocheiron affine
5607

CALCOFI CRUISE 5607
7 - 15 JULY 1956

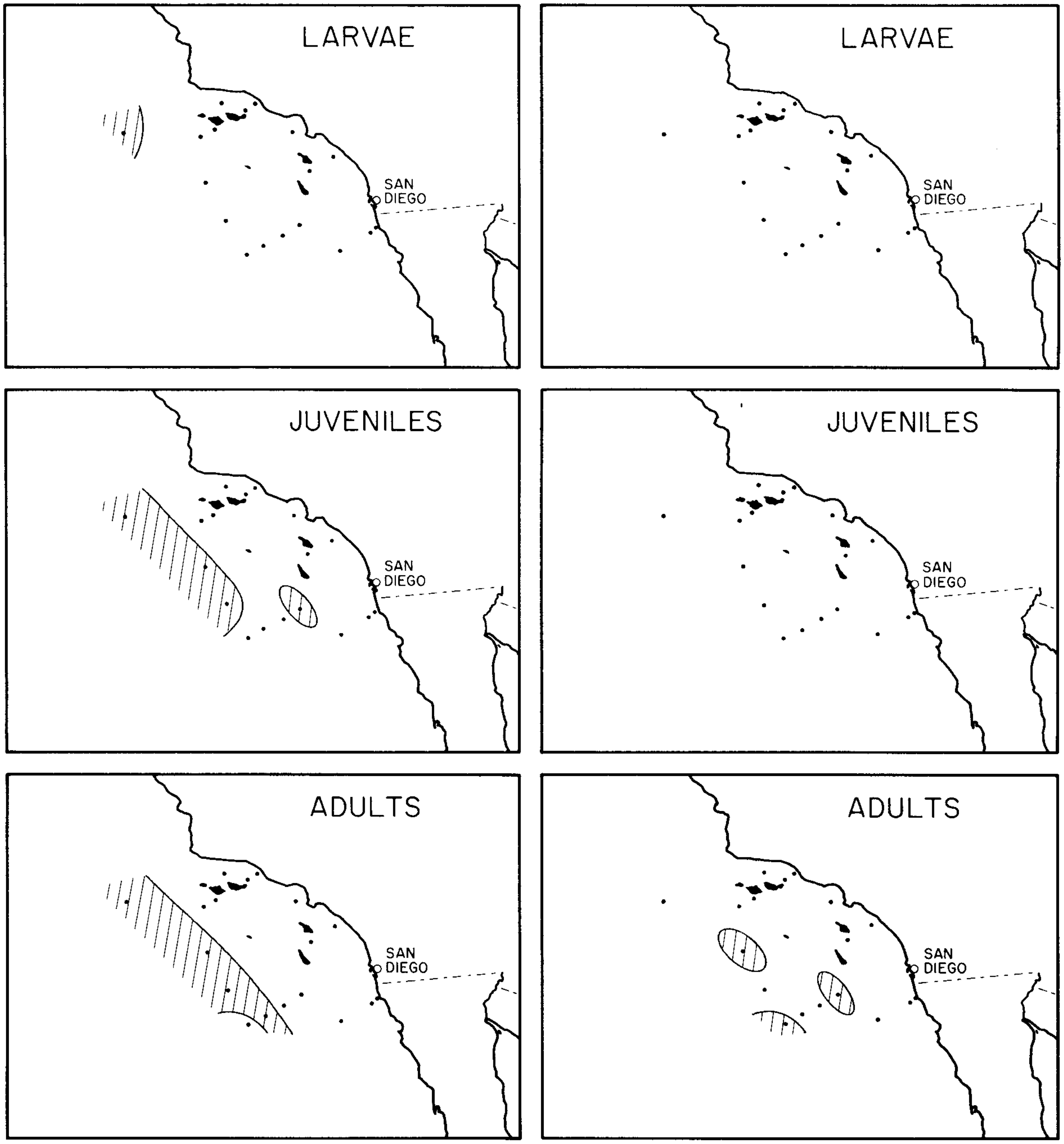


Euphausia gibboides *Stylocheiron affine*

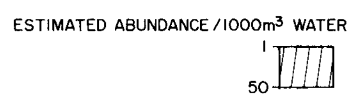


Euphausiacea
Euphausia gibboides
Stylocheiron affine
5610

CALCOFI CRUISE 5610
29 SEPTEMBER – 5 OCTOBER 1956



Euphausia gibboides *Stylocheiron affine*



Euphausiacea

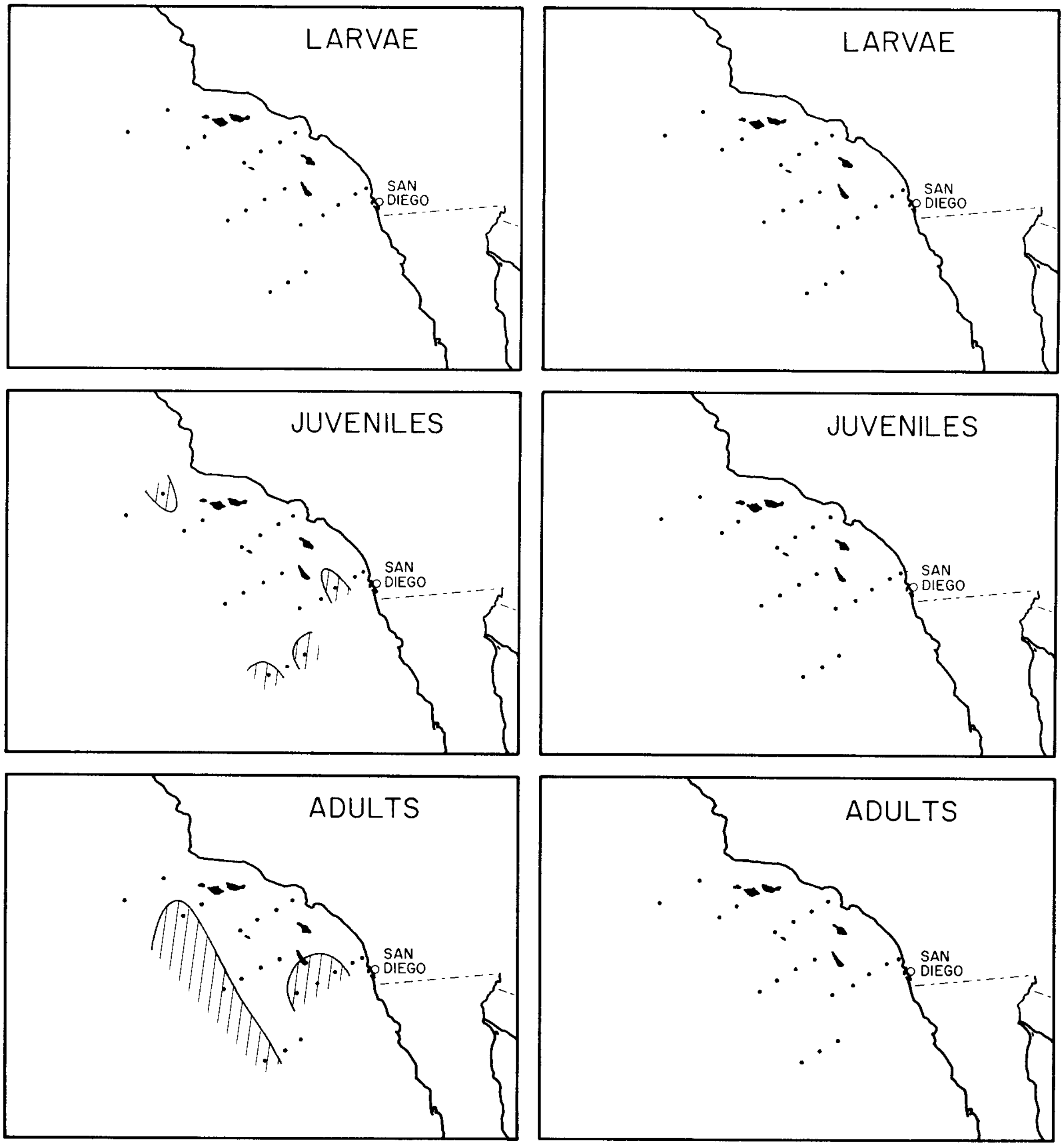
Euphausia gibboides

Stylocheiron affine

5611

CALCOFI CRUISE 5611

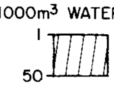
30 OCTOBER – 5 NOVEMBER 1956



Euphausia gibboides

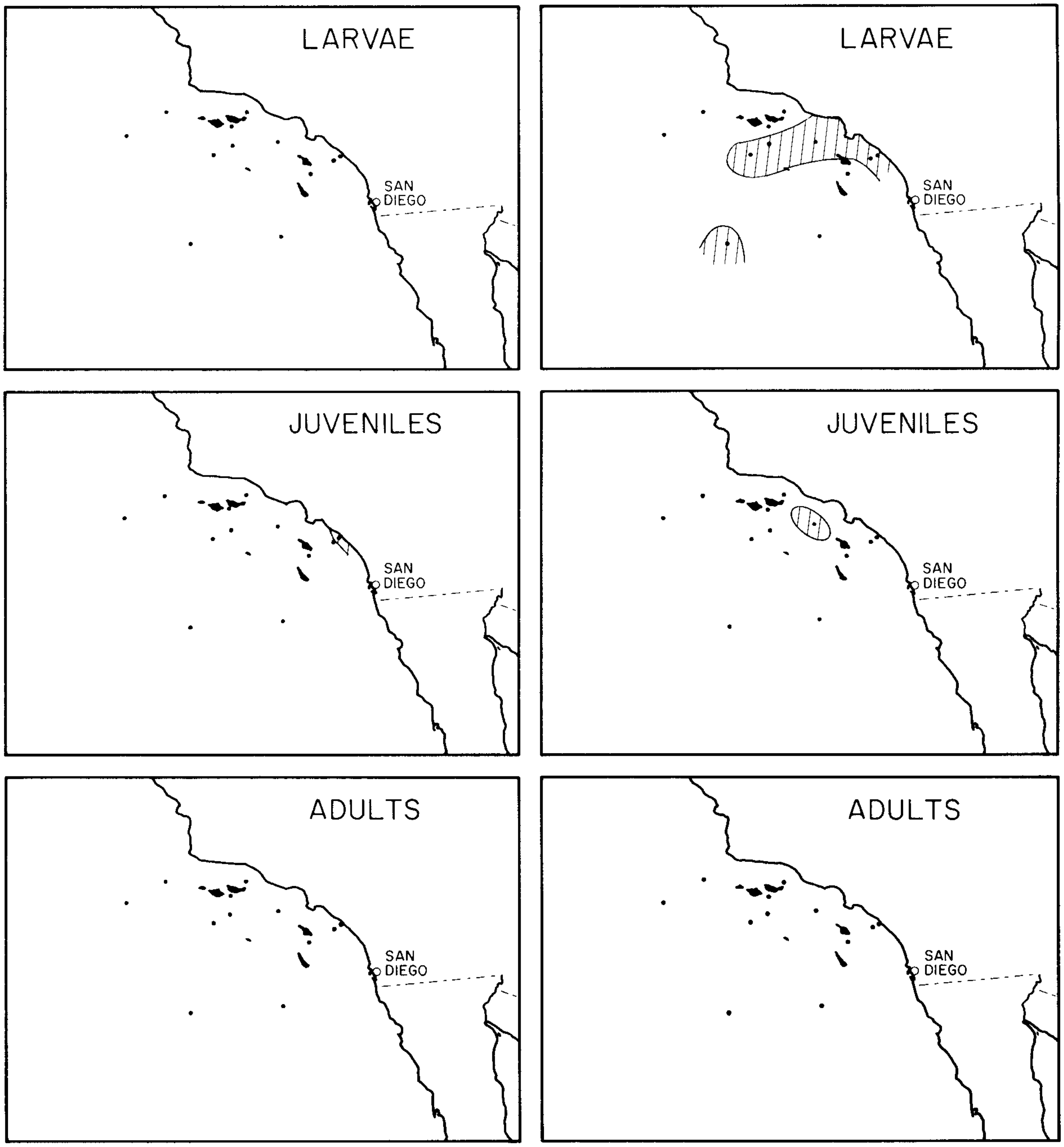
Stylocheiron affine
NO POSITIVE RECORDS

ESTIMATED ABUNDANCE / 1000m^3 WATER

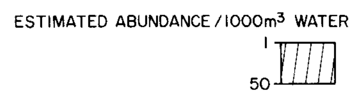


Euphausiacea
Euphausia gibboides
Stylocheiron affine
5612

CALCOFI CRUISE 5612
6 - 12 DECEMBER 1956



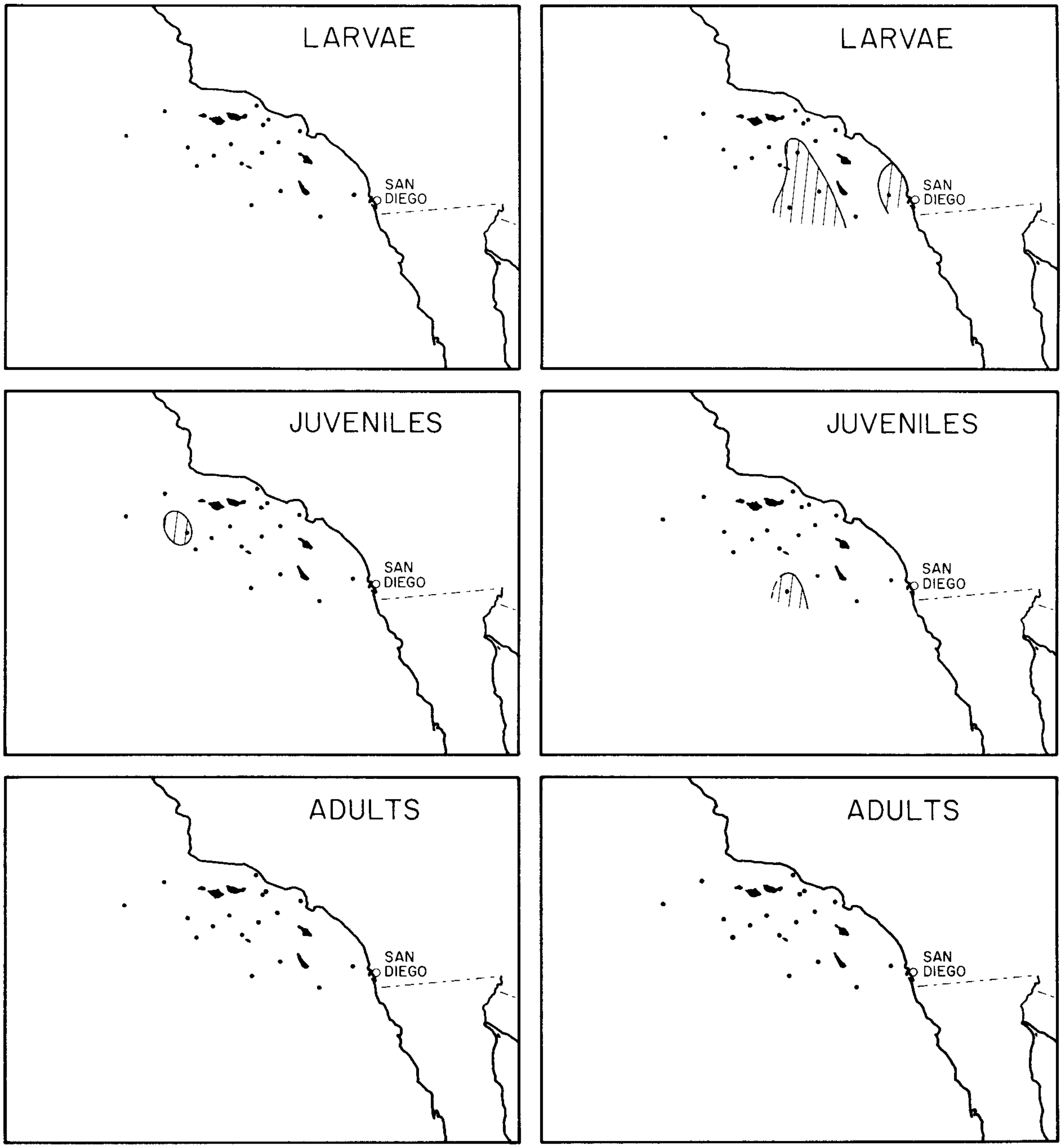
Thysanoessa spinifera *Euphausia eximia*



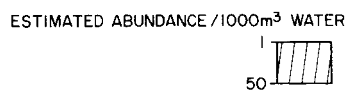
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5301

CALCOFI CRUISE 5301
9 - 17 JANUARY 1953

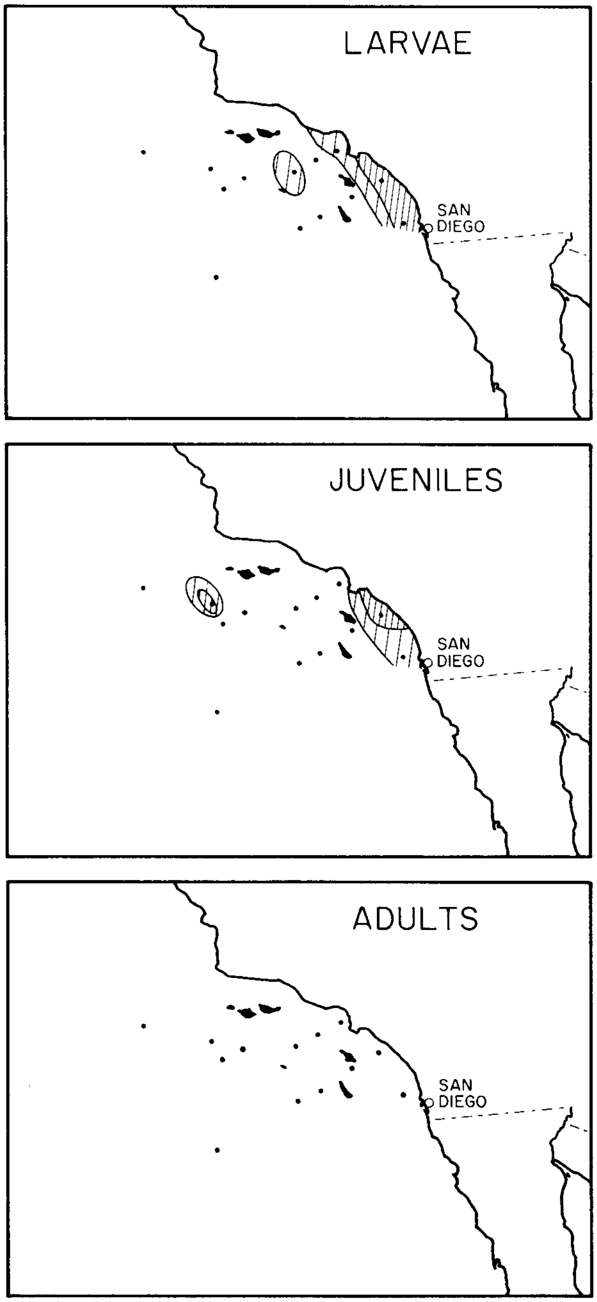


Thysanoessa spinifera — *Euphausia eximia*

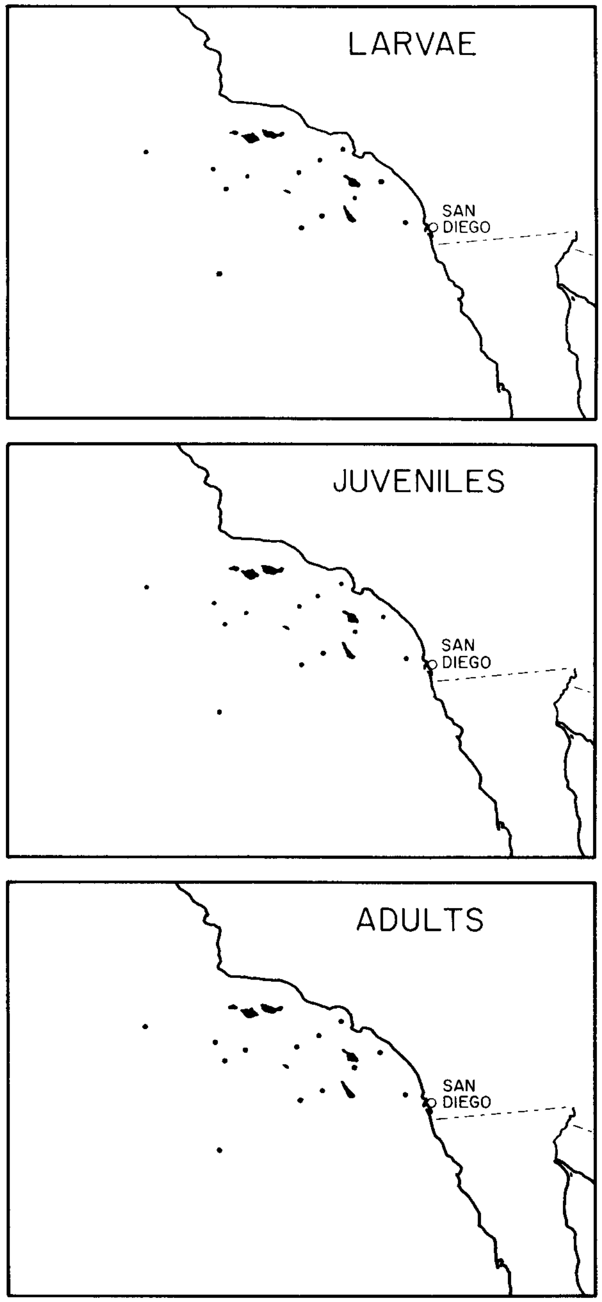


CALCOFI CRUISE 5302
4 - 14 FEBRUARY 1953

Euphausiacea
Thysanoessa spinifera
Euphausia eximia
5302

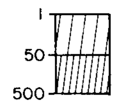


Thysanoessa spinifera



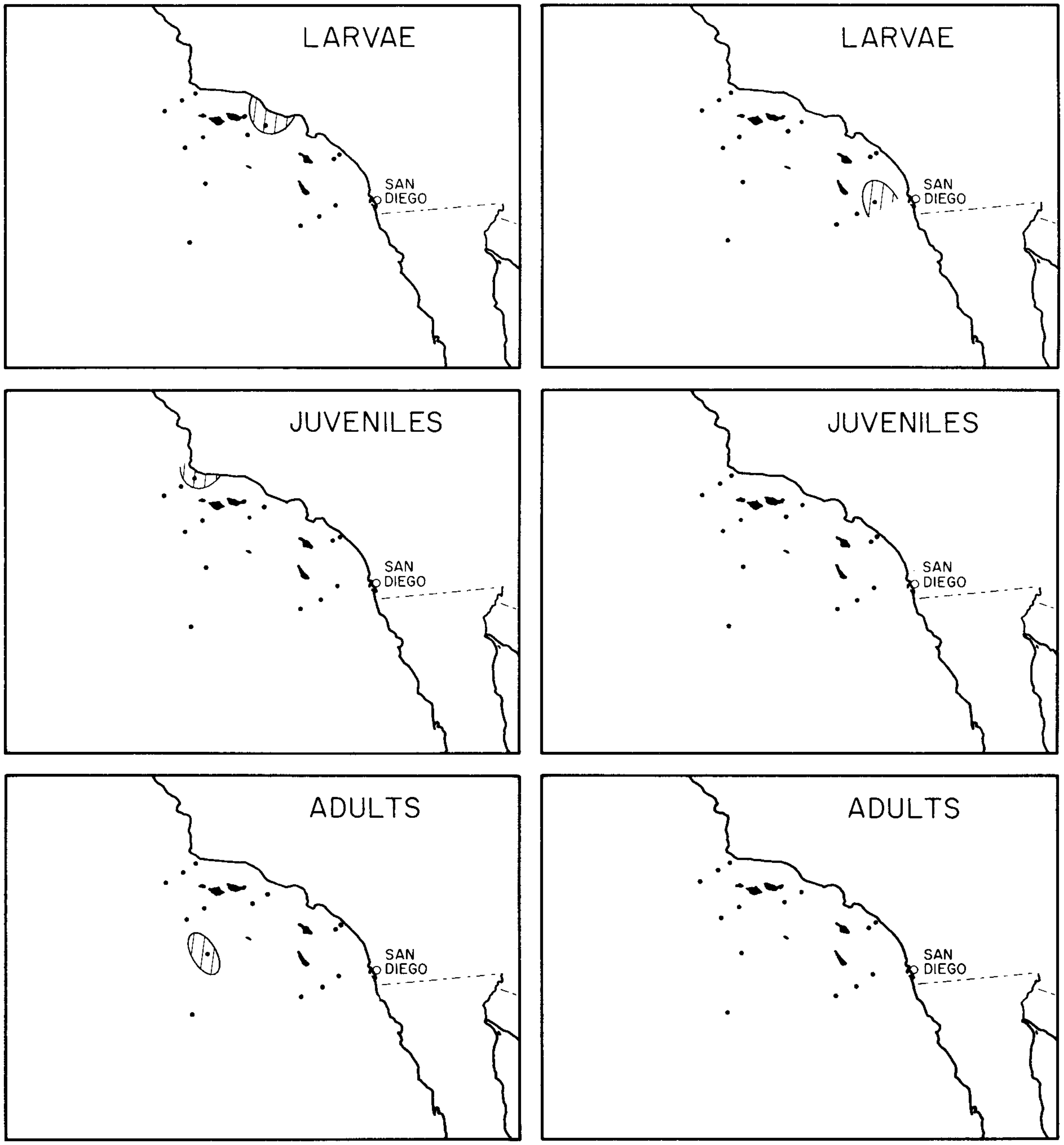
Euphausia eximia
NO POSITIVE RECORDS

ESTIMATED ABUNDANCE / 1000m^3 WATER

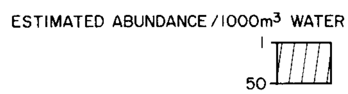


CALCOFI CRUISE 5303
6 - 20 MARCH 1953

Euphausiacea
Thysanoessa spinifera
Euphausia eximia
5303



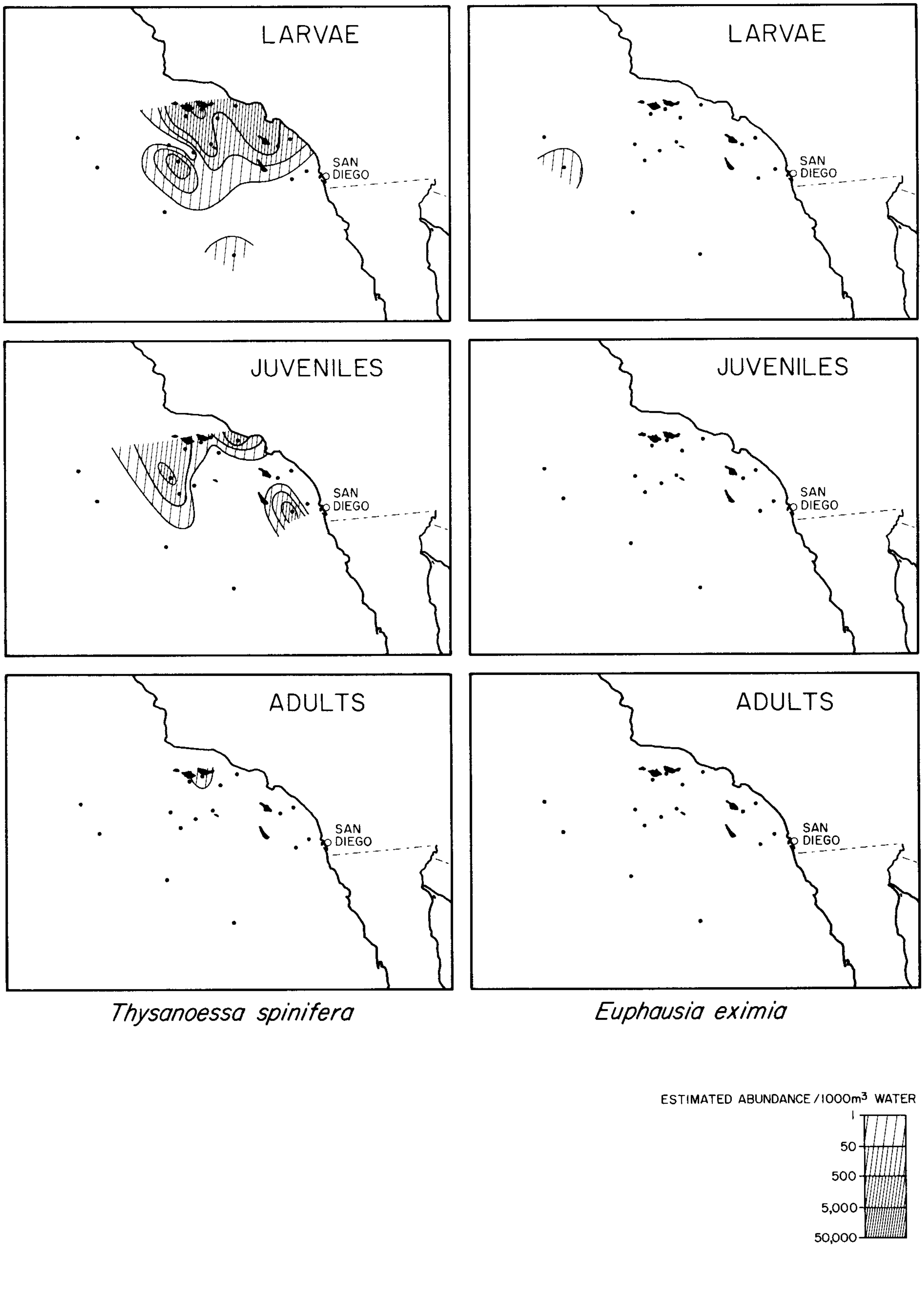
Thysanoessa spinifera *Euphausia eximia*



Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5304

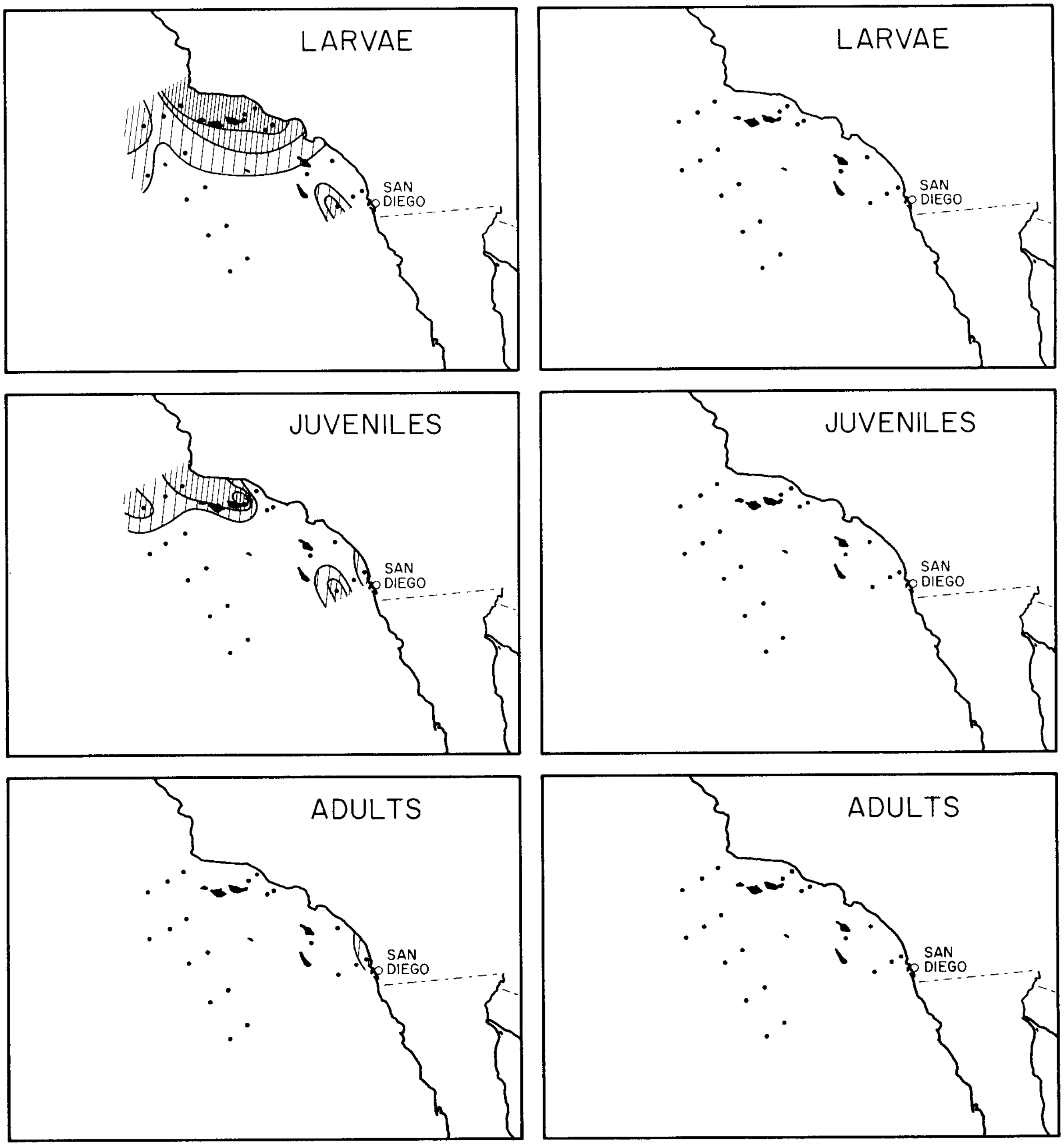
CALCOFI CRUISE 5304
7 - 17 APRIL 1953



Euphausiacea

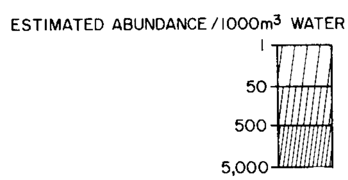
Thysanoessa spinifera
Euphausia eximia
5305

CALCOFI CRUISE 5305
5 - 18 MAY 1953



Thysanoessa spinifera

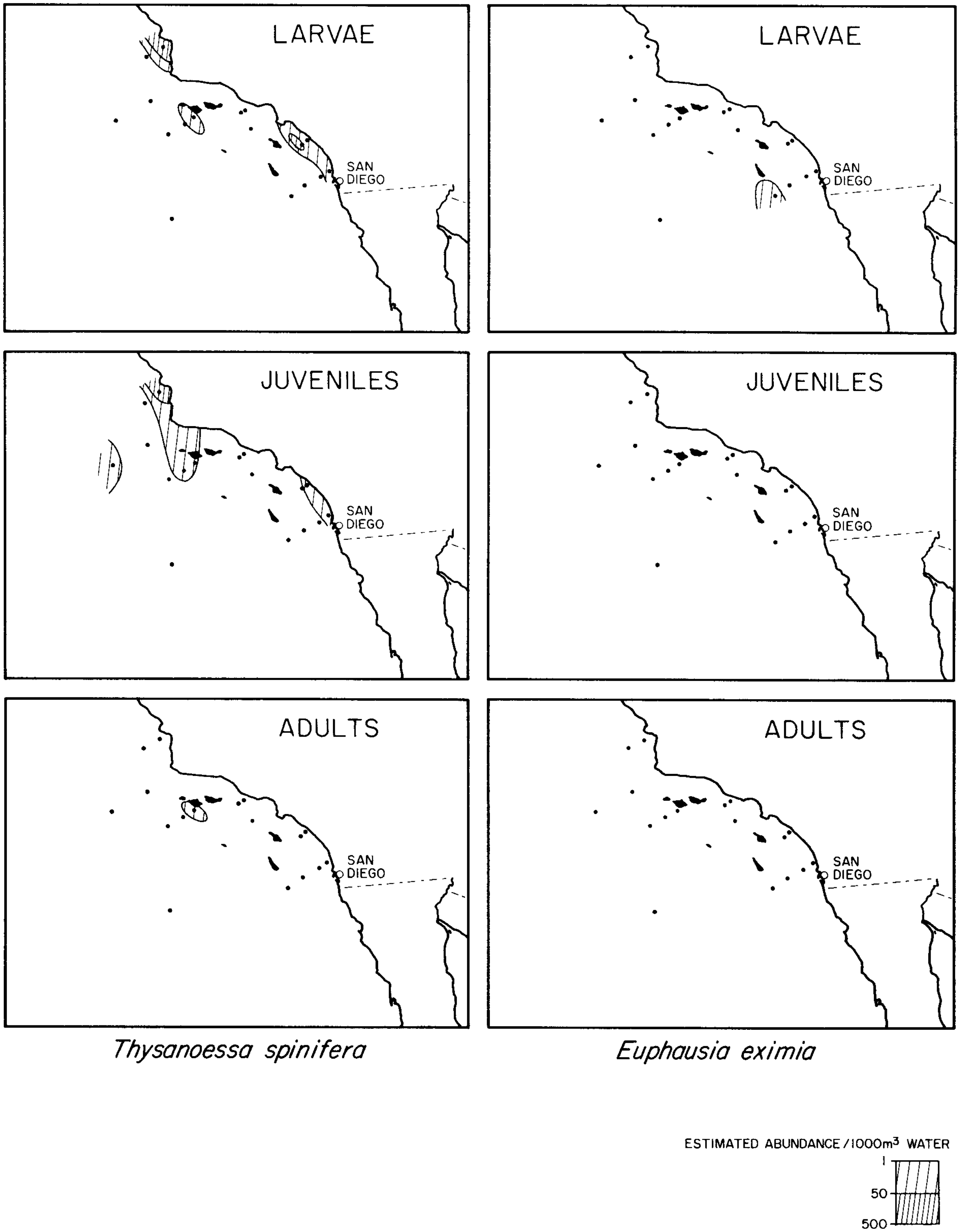
Euphausia eximia
NO POSITIVE RECORDS



Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5306

CALCOFI CRUISE 5306
5 - 12 JUNE 1953



CALCOFI CRUISE 5307

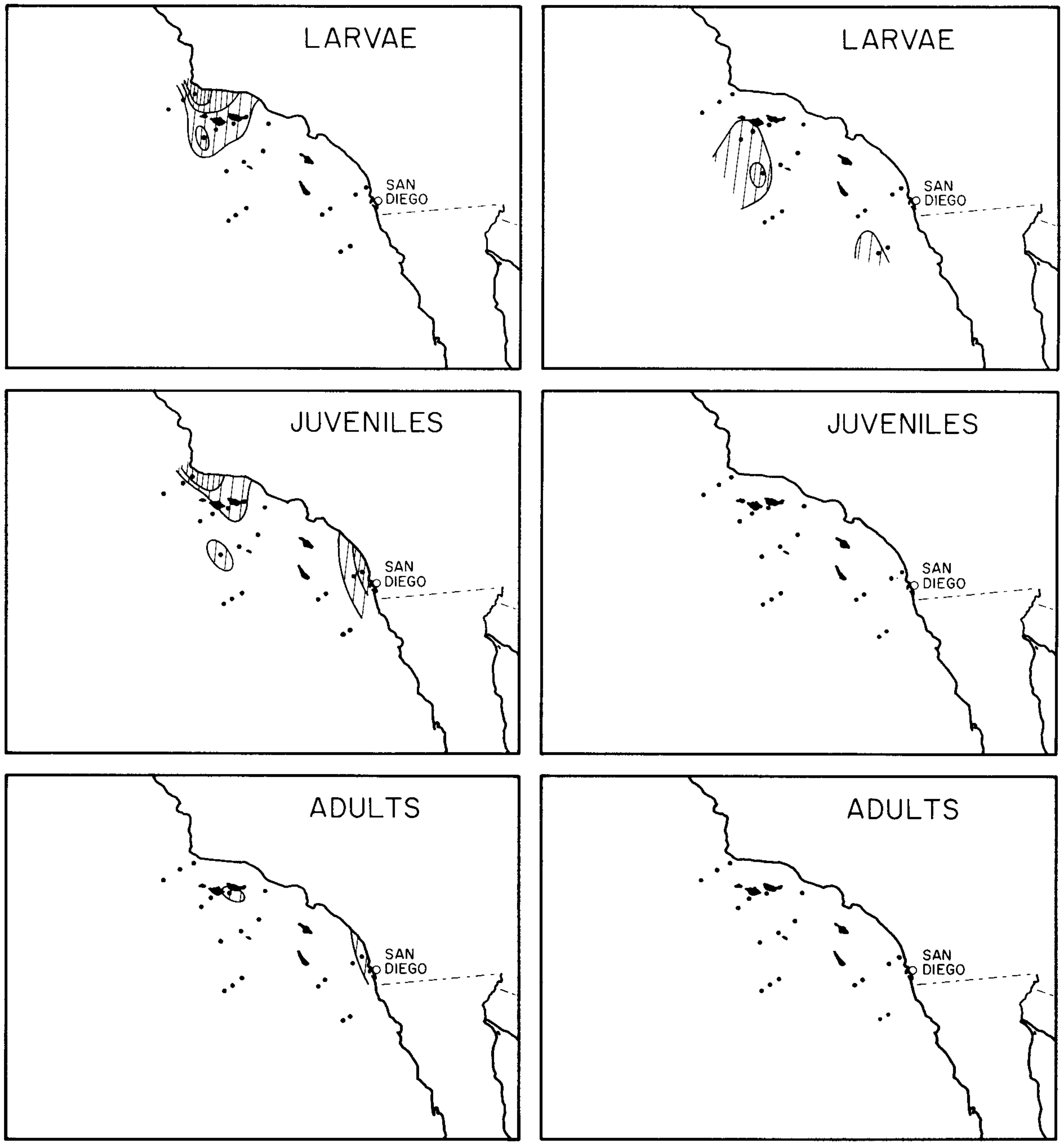
14 - 26 JULY 1953

Euphausiacea

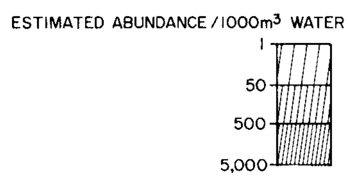
Thysanoessa spinifera

Euphausia eximia

5307



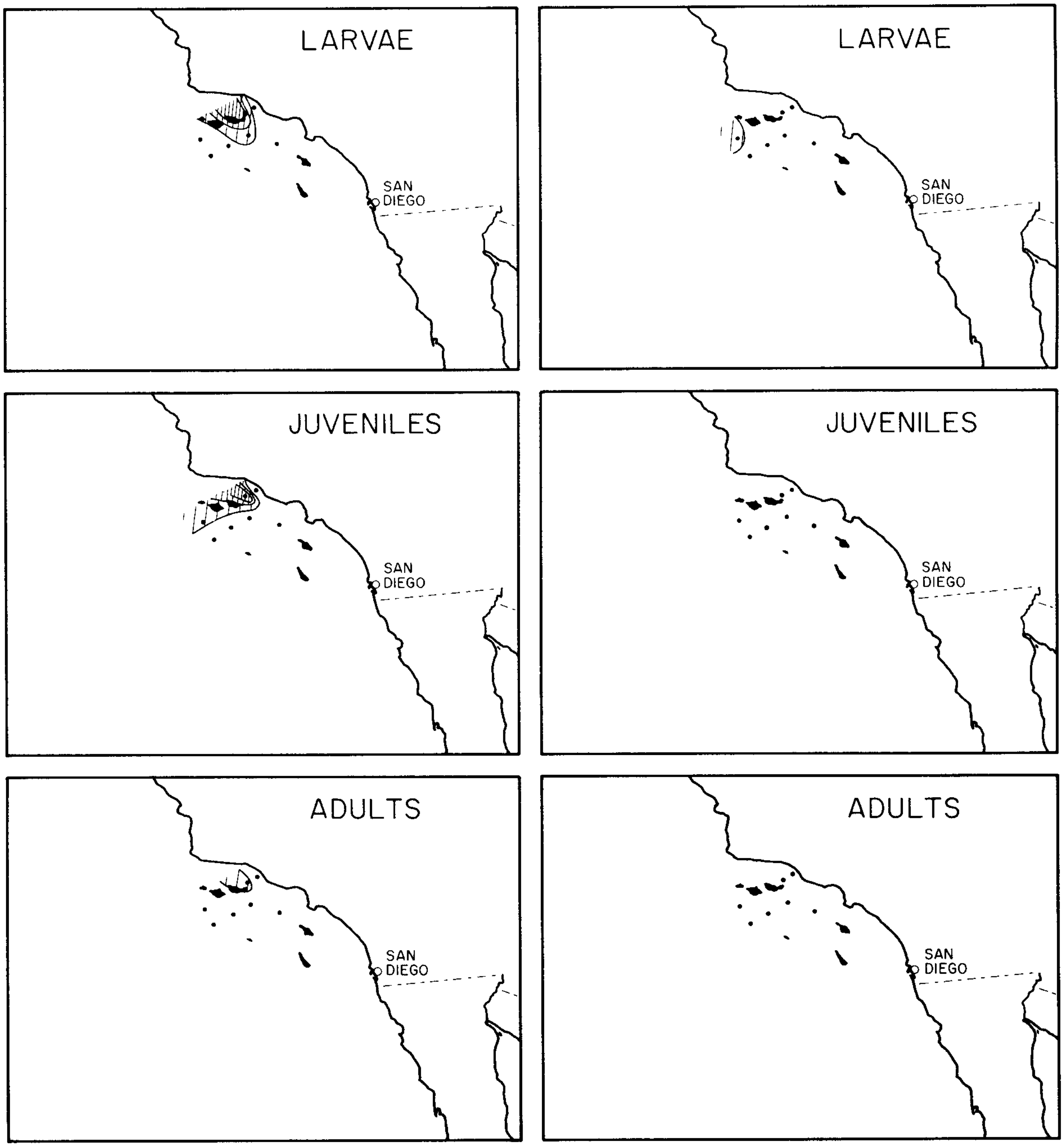
Thysanoessa spinifera *Euphausia eximia*



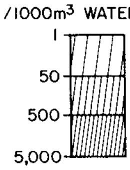
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5308

CALCOFI CRUISE 5308
18 - 29 AUGUST 1953



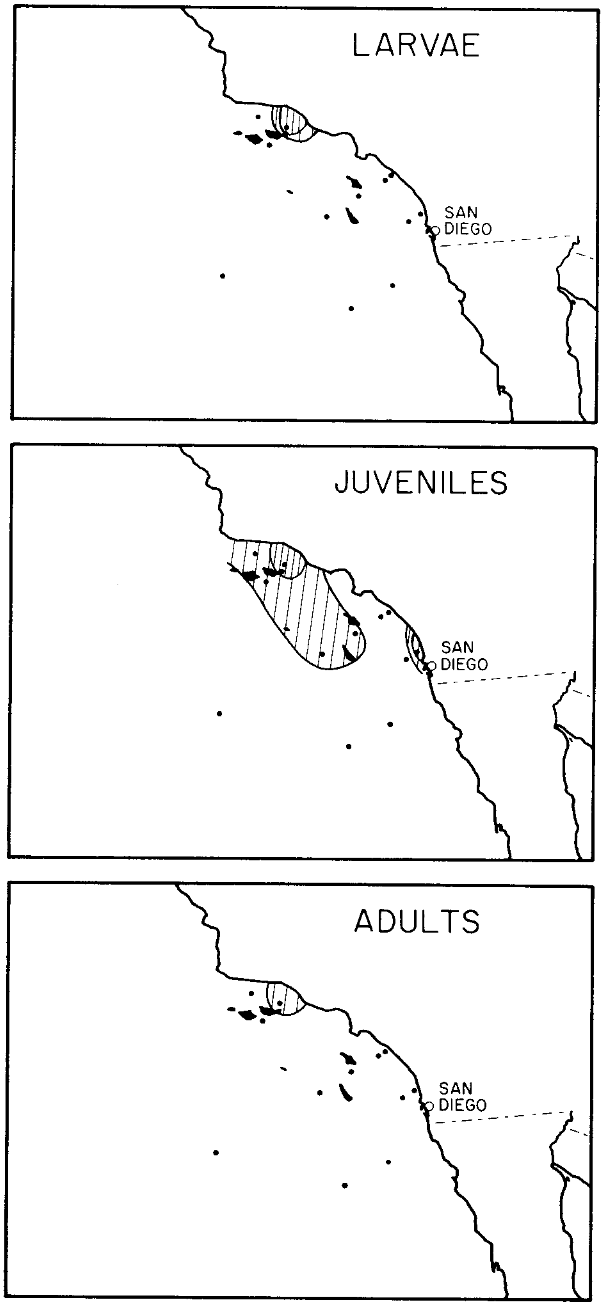
Thysanoessa spinifera *Euphausia eximia*



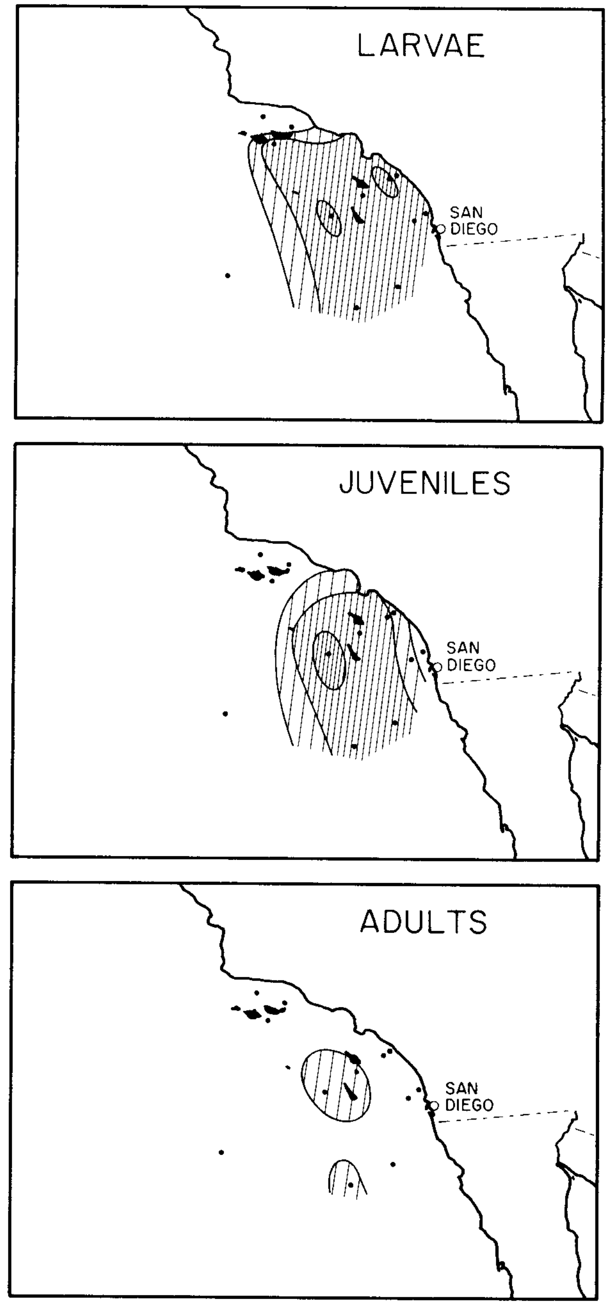
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5309

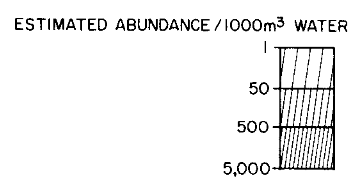
CALCOFI CRUISE 5309
15 - 17 SEPTEMBER 1953



Thysanoessa spinifera



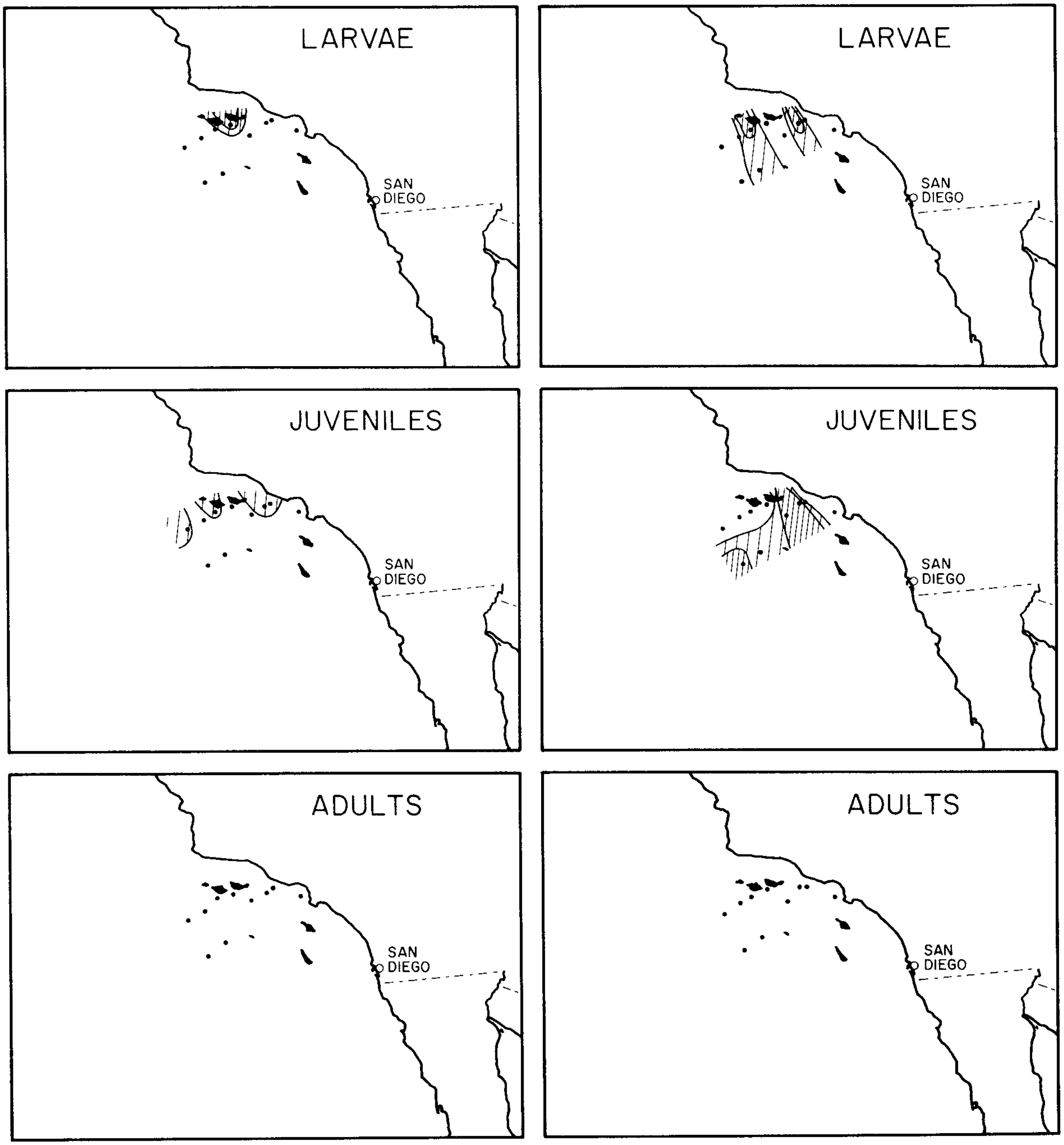
Euphausia eximia



Euphausiacea

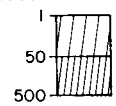
Thysanoessa spinifera
Euphausia eximia
5310

CALCOFI CRUISE 5310
19 - 22 OCTOBER 1953



Thysanoessa spinifera *Euphausia eximia*

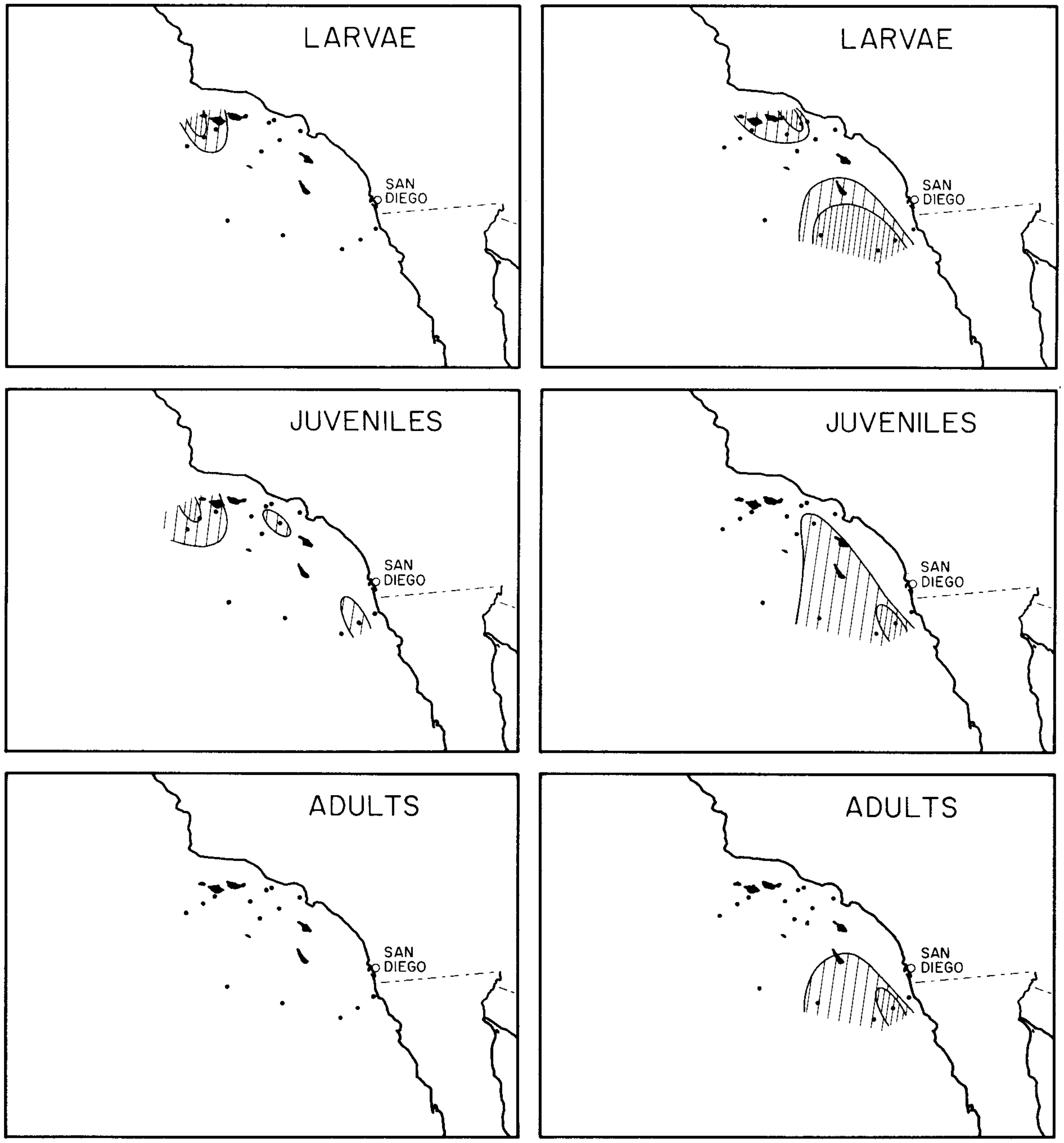
ESTIMATED ABUNDANCE / 1000m³ WATER



Euphausiacea

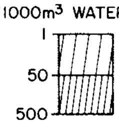
Thysanoessa spinifera
Euphausia eximia
5311

CALCOFI CRUISE 5311
10 - 12 NOVEMBER 1953



Thysanoessa spinifera *Euphausia eximia*

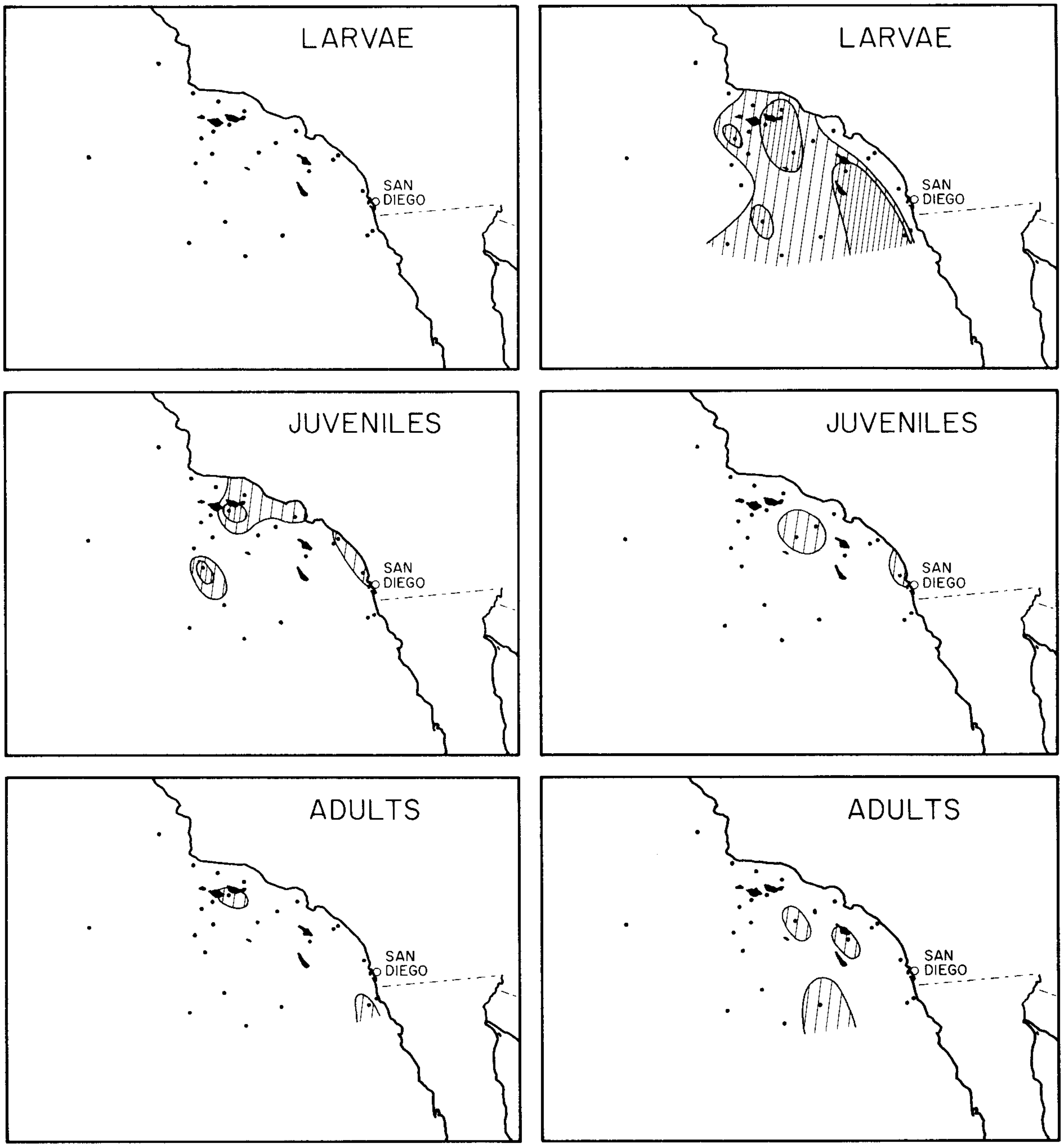
ESTIMATED ABUNDANCE / 1000m³ WATER



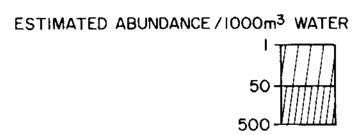
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5312

CALCOFI CRUISE 5312
3 - 9 DECEMBER 1953



Thysanoessa spinifera *Euphausia eximia*

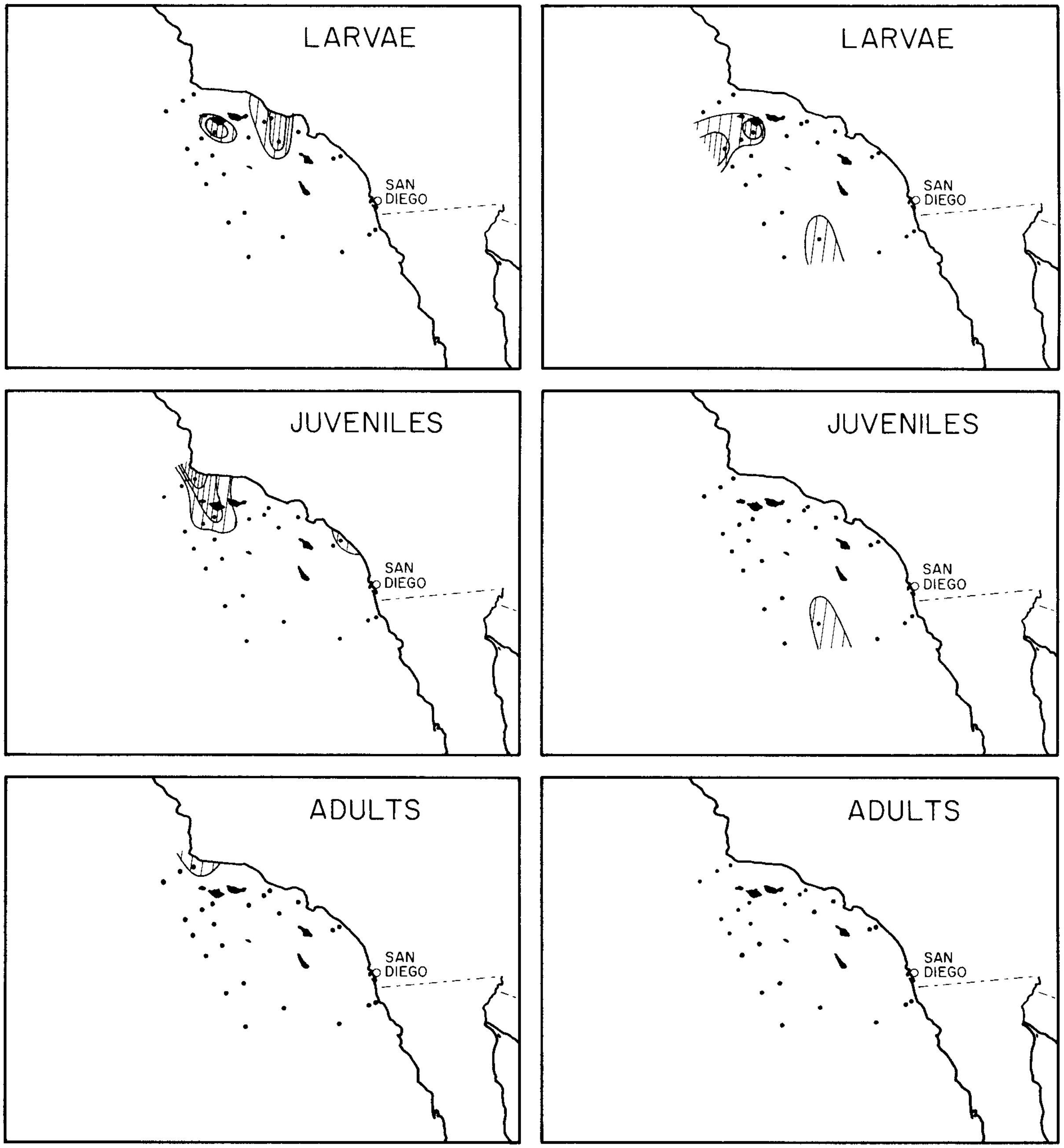


Euphausiacea

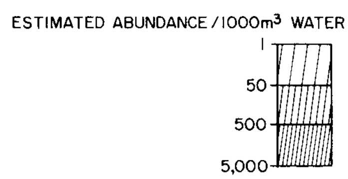
Thysanoessa spinifera
Euphausia eximia
5401

CALCOFI CRUISE 5401

5 - 15 JANUARY 1954



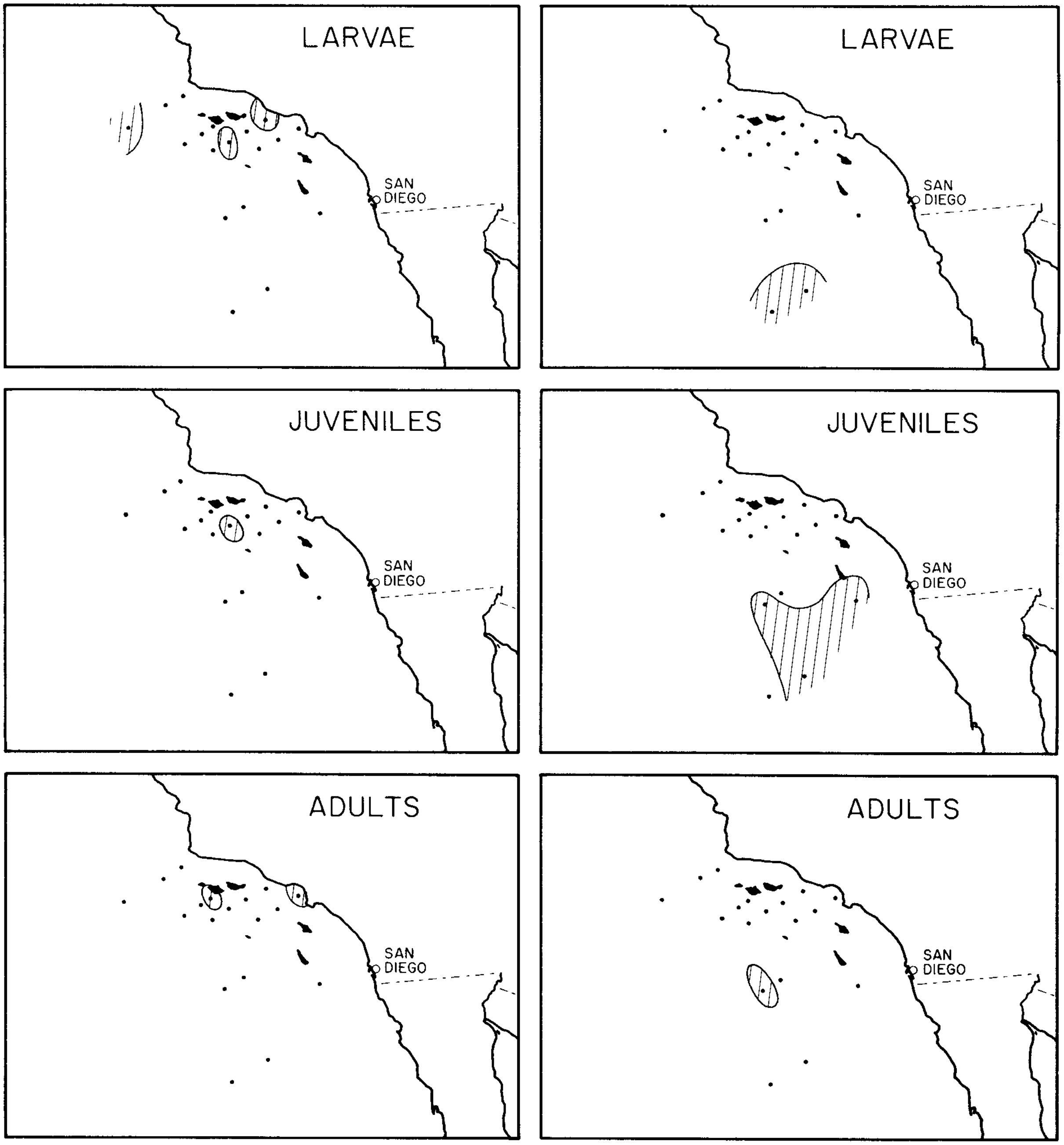
Thysanoessa spinifera *Euphausia eximia*



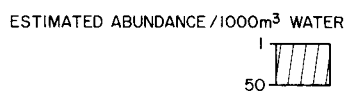
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5402

CALCOFI CRUISE 5402
3 - 12 FEBRUARY 1954



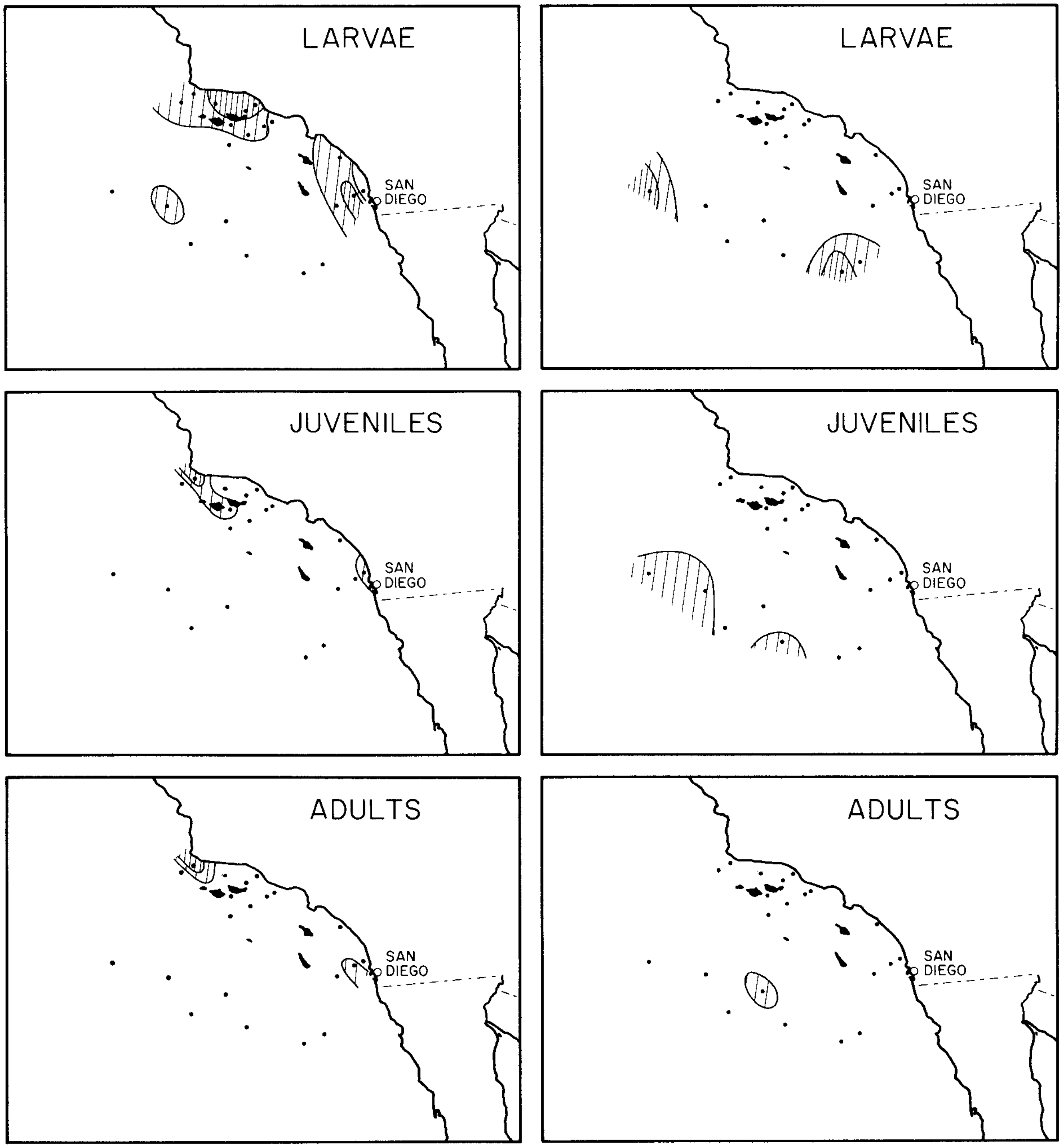
Thysanoessa spinifera *Euphausia eximia*



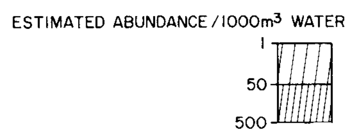
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5403

CALCOFI CRUISE 5403
5 - 18 MARCH 1954



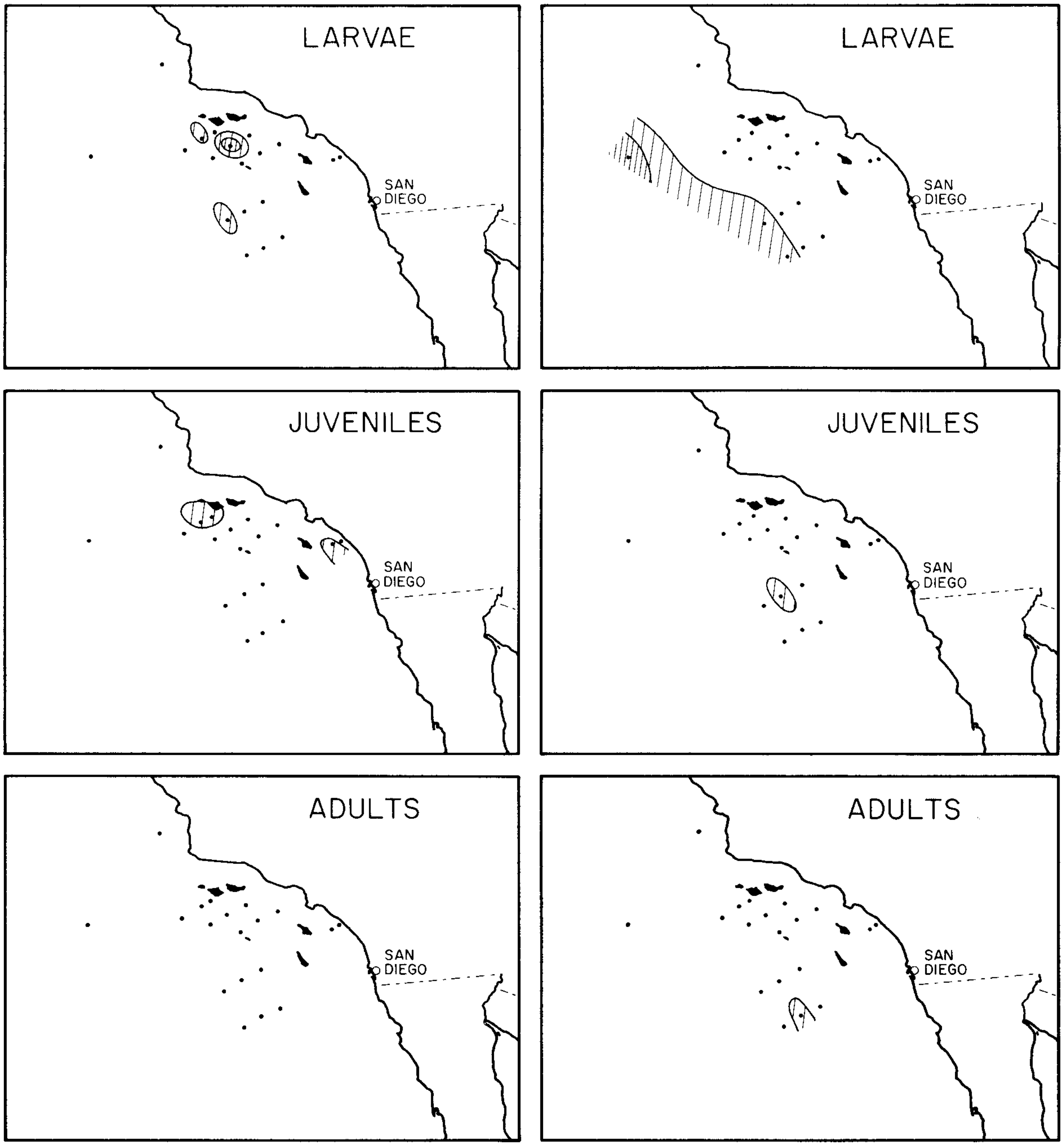
Thysanoessa spinifera *Euphausia eximia*



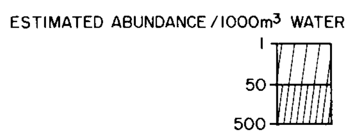
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5404

CALCOFI CRUISE 5404
7 - 19 APRIL 1954



Thysanoessa spinifera — *Euphausia eximia*

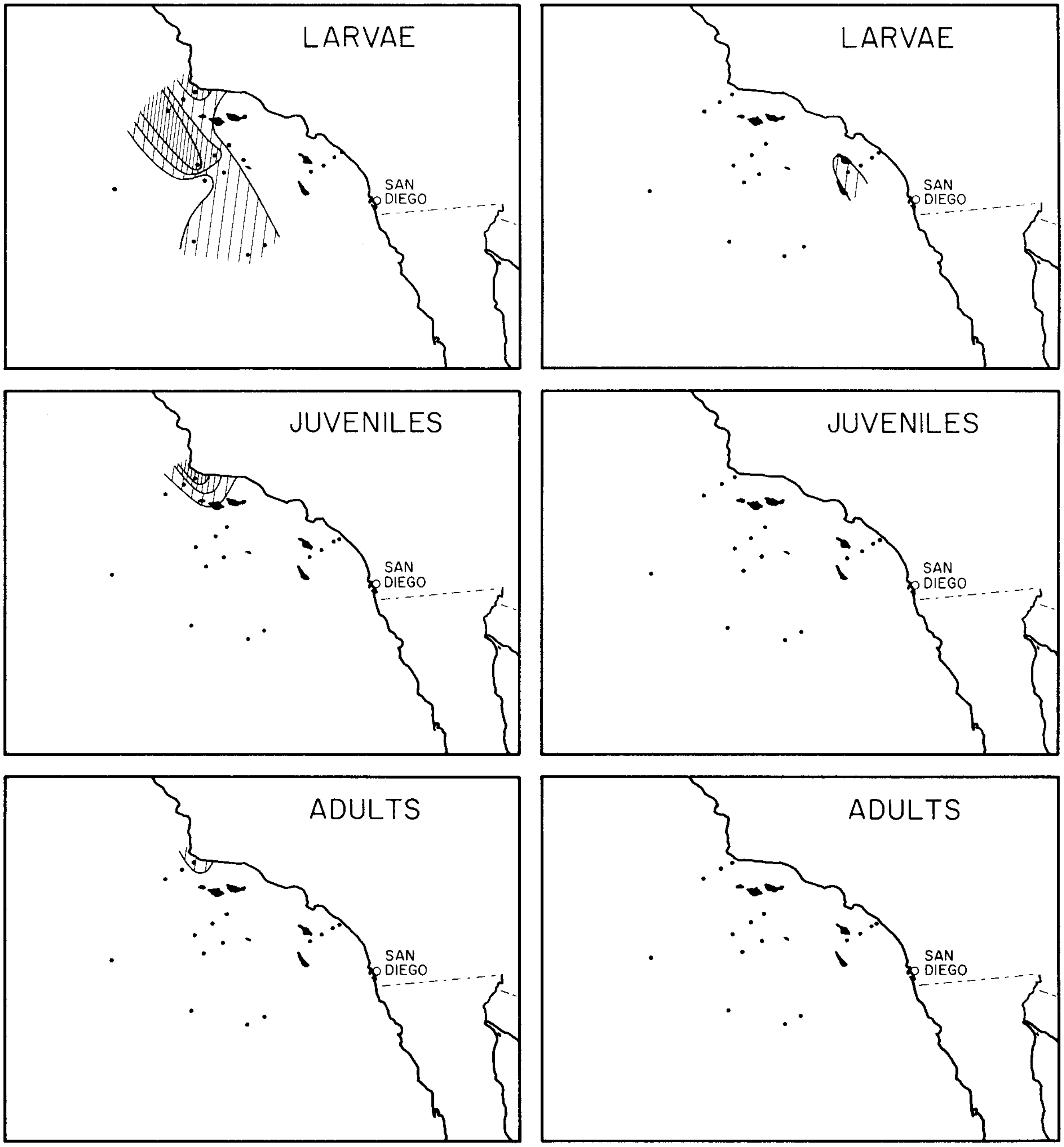


CALCOFI CRUISE 5405

13 - 22 MAY 1954

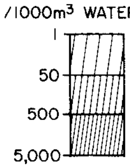
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5405



Thysanoessa spinifera *Euphausia eximia*

ESTIMATED ABUNDANCE / 1000m³ WATER



CALCOFI CRUISE 5406

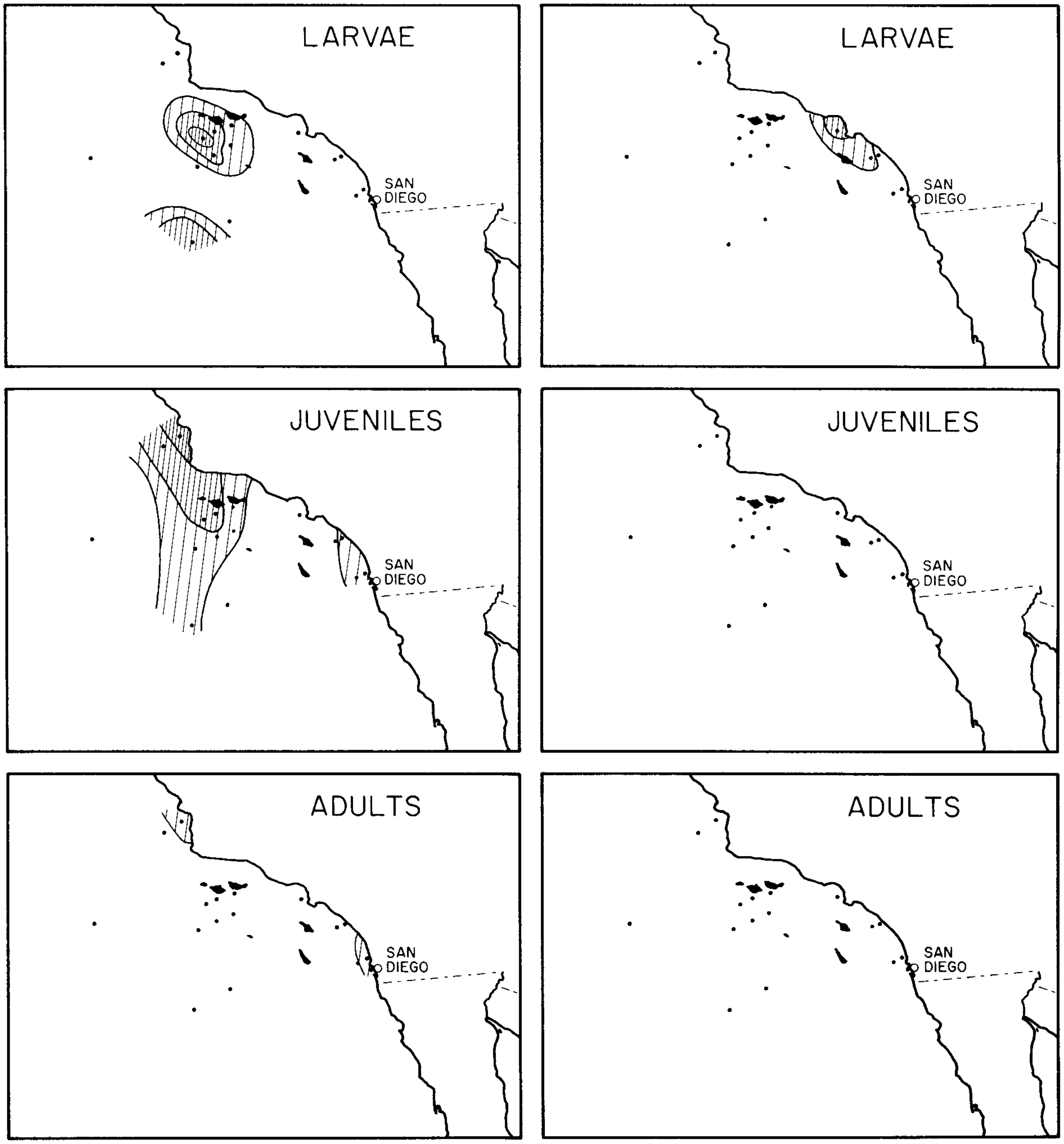
13 - 20 JUNE 1954

Euphausiacea

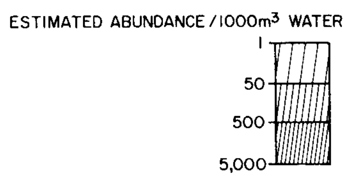
Thysanoessa spinifera

Euphausia eximia

5406



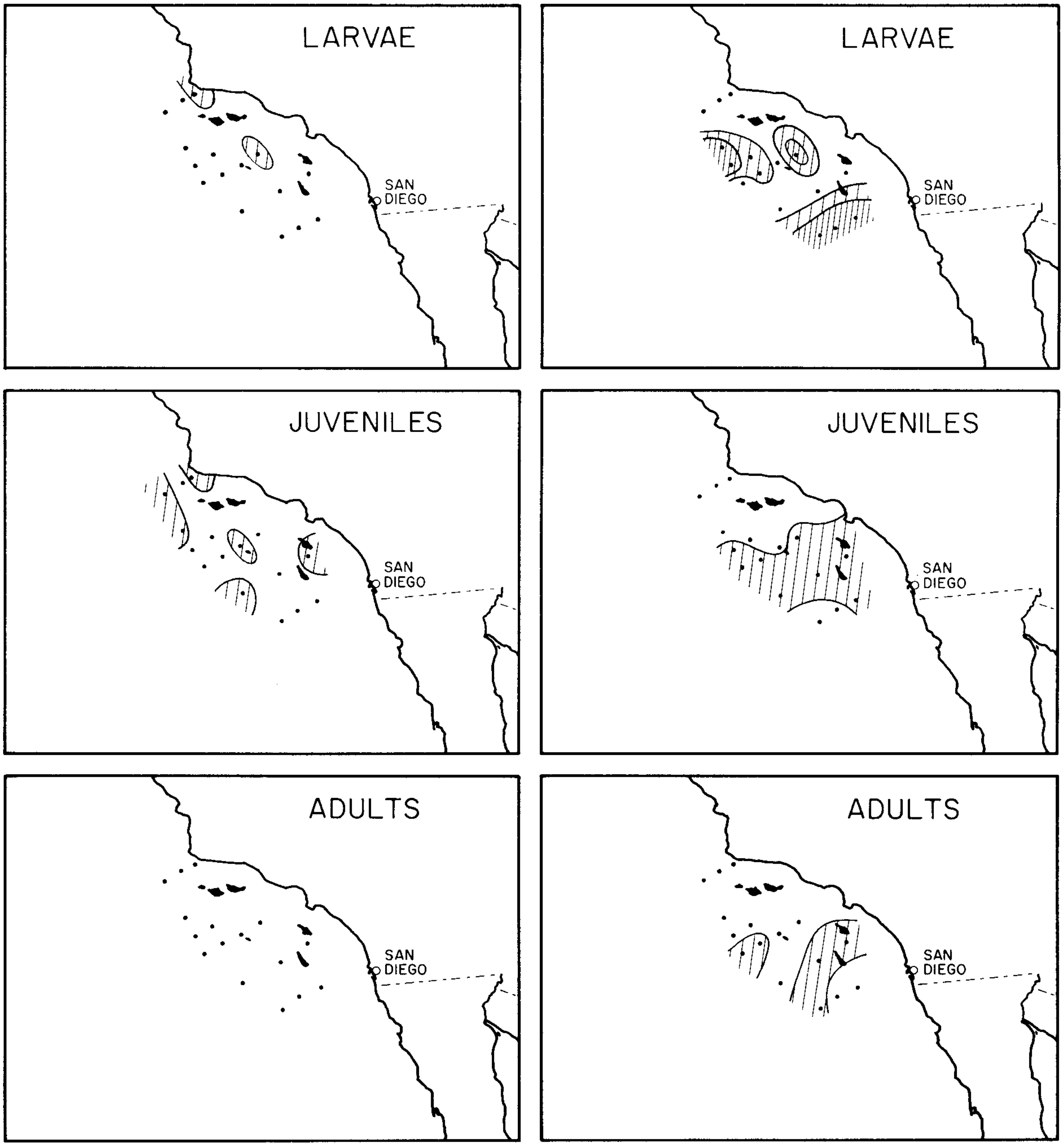
Thysanoessa spinifera *Euphausia eximia*



Euphausiacea

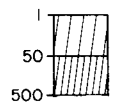
Thysanoessa spinifera
Euphausia eximia
5407

CALCOFI CRUISE 5407
13 - 21 JULY 1954



Thysanoessa spinifera *Euphausia eximia*

ESTIMATED ABUNDANCE / 1000m³ WATER

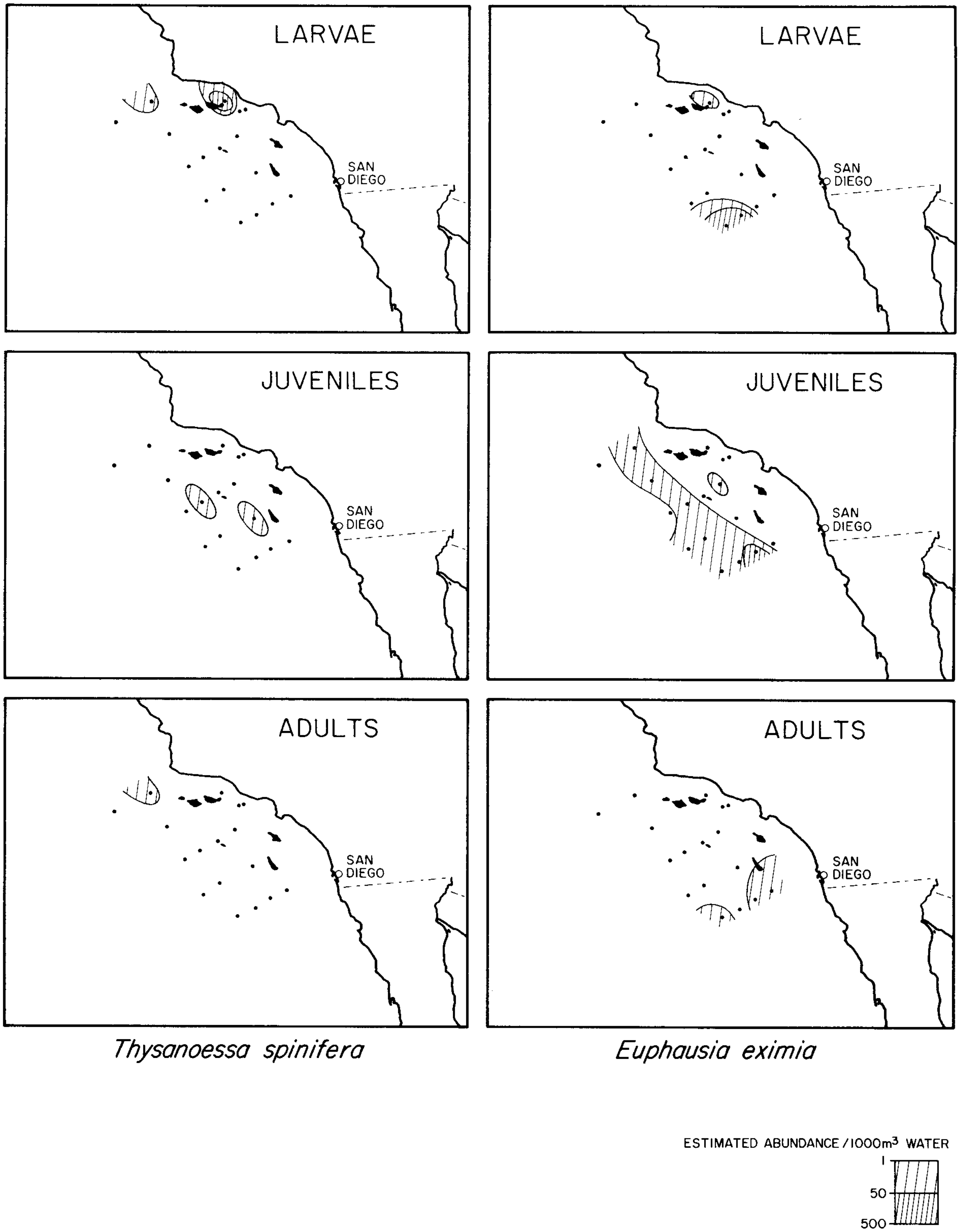


Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5408

CALCOFI CRUISE 5408

4-9 SEPTEMBER 1954
MAIN PORTION OF CRUISE OCCUPIED IN AUGUST



Euphausiacea

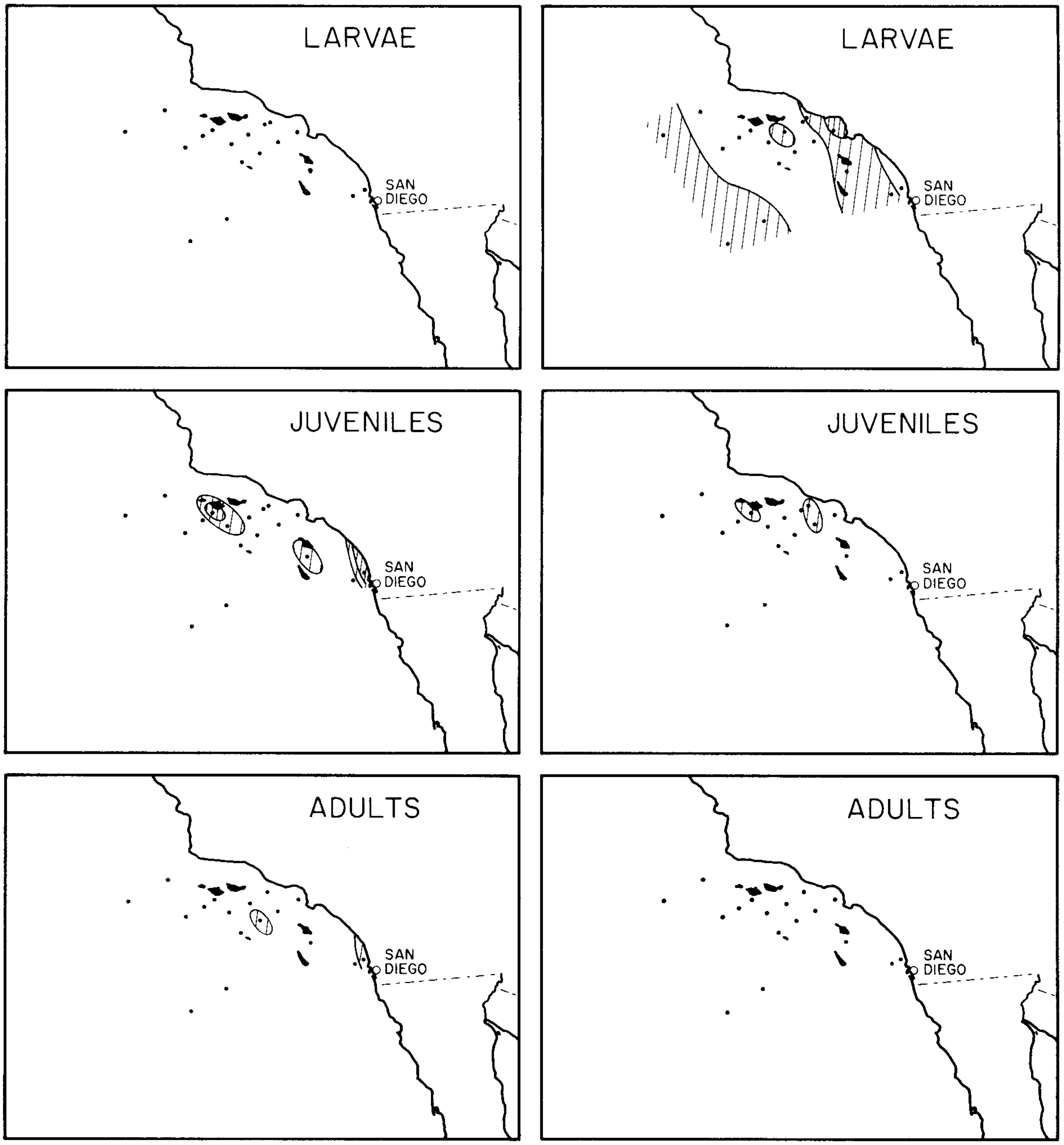
Thysanoessa spinifera

Euphausia eximia

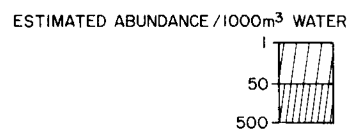
5410

CALCOFI CRUISE 5410

7 - 14 OCTOBER 1954



Thysanoessa spinifera *Euphausia eximia*



Euphausiacea

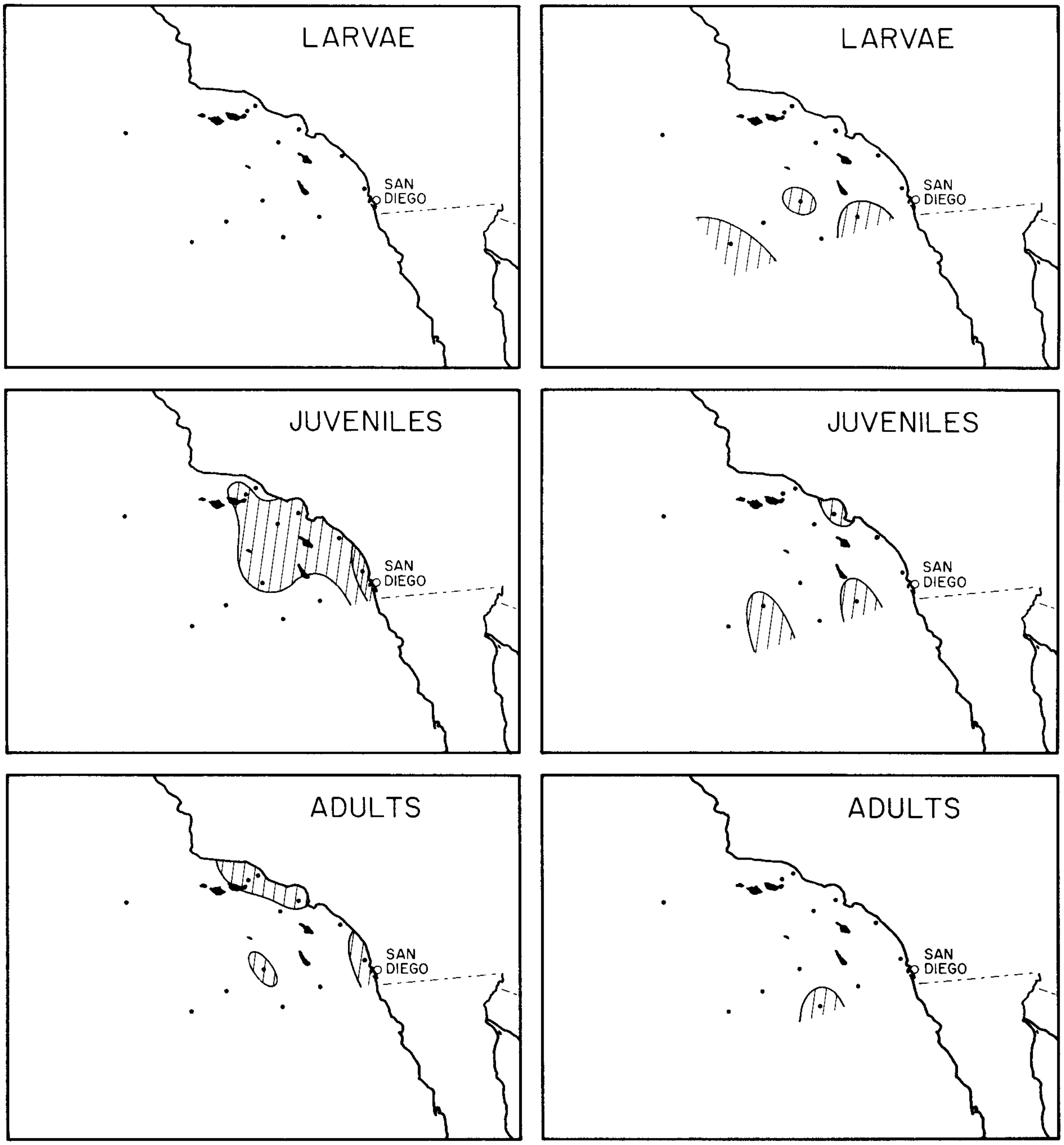
Thysanoessa spinifera

Euphausia eximia

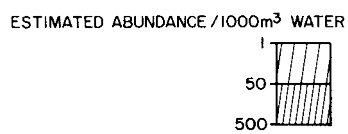
5412

CALCOFI CRUISE 5412

2-9 DECEMBER 1954



Thysanoessa spinifera | *Euphausia eximia*



CALCOFI CRUISE 5501

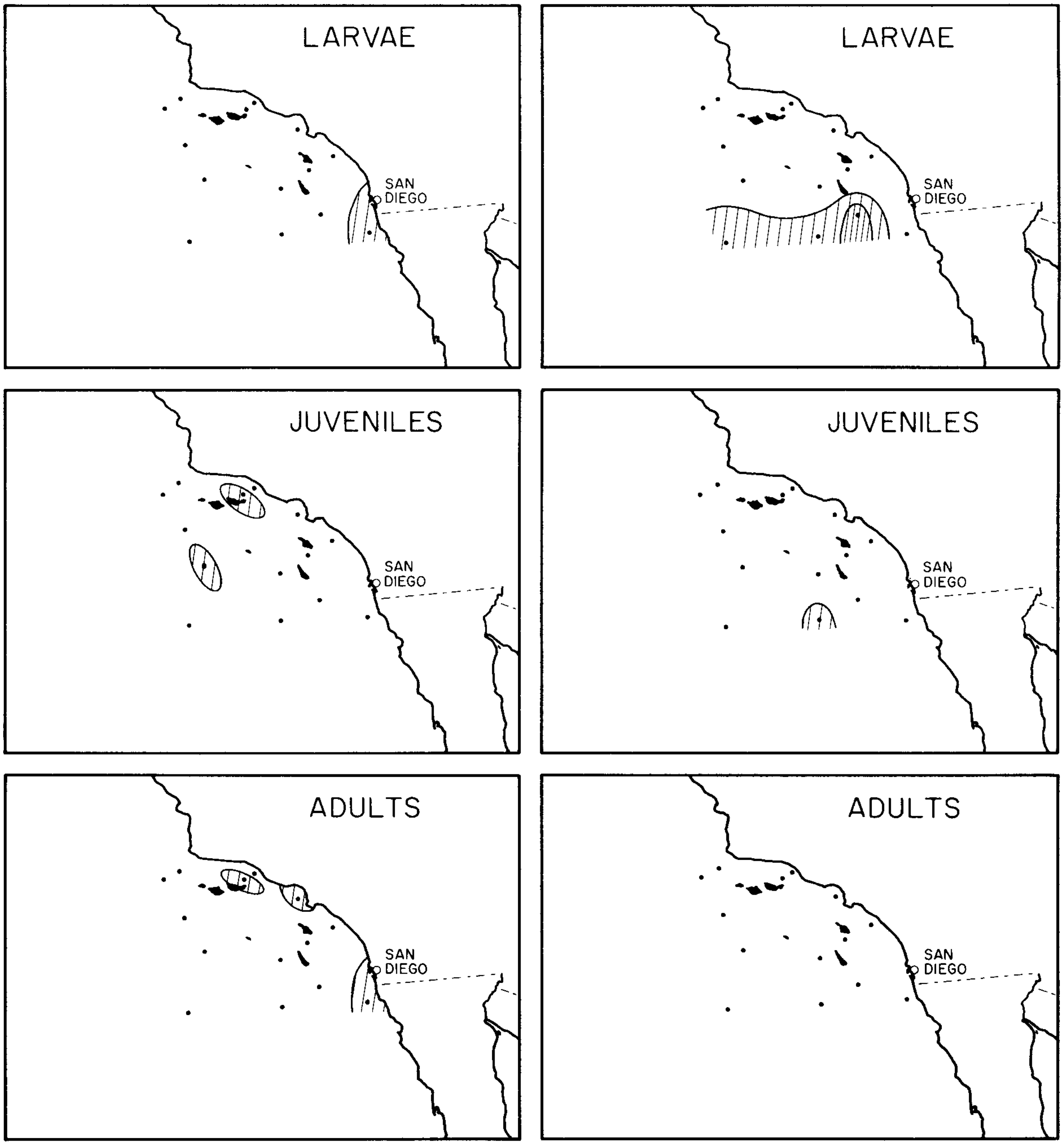
13 - 19 JANUARY 1955

Euphausiacea

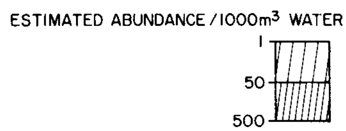
Thysanoessa spinifera

Euphausia eximia

5501



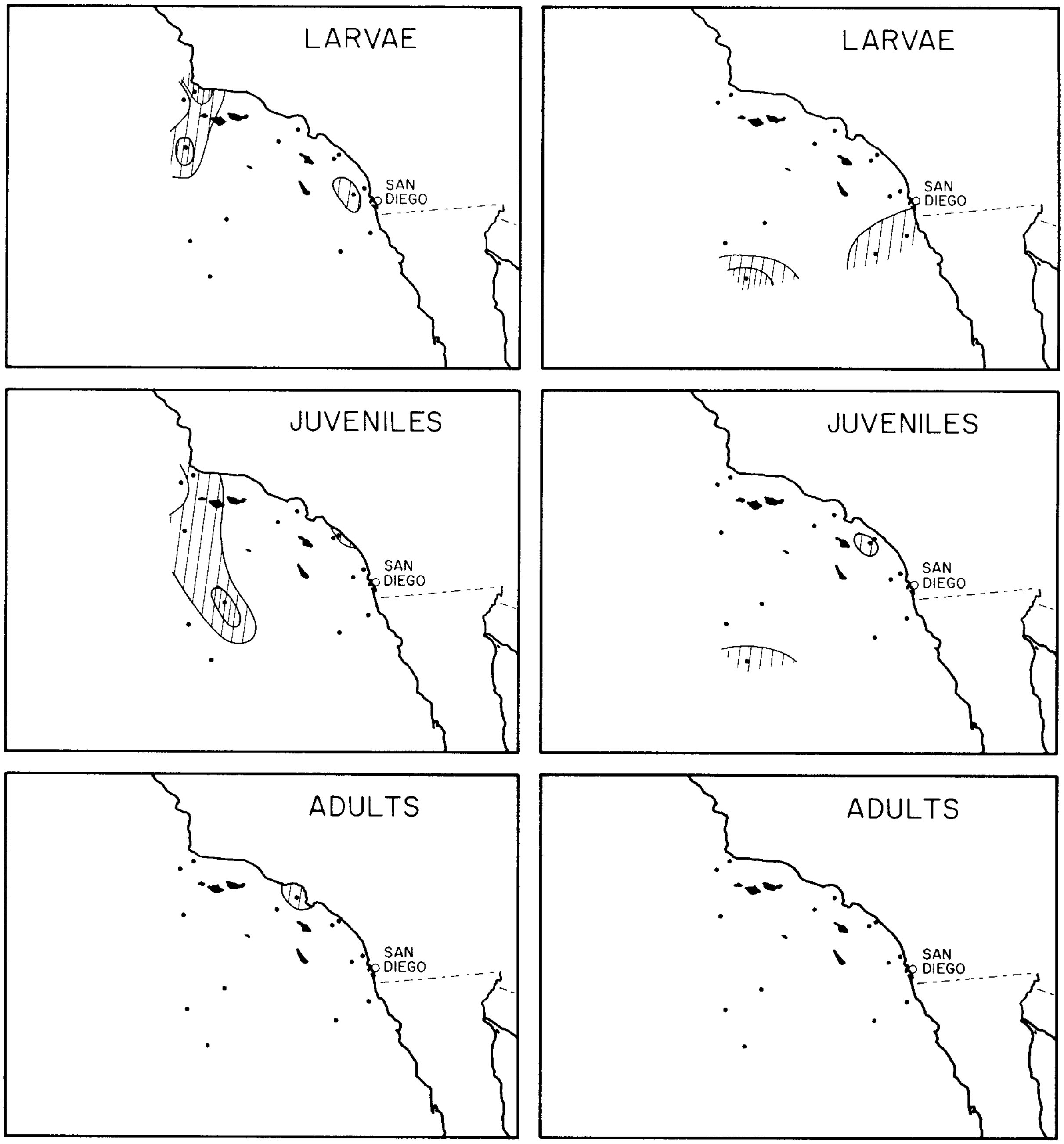
Thysanoessa spinifera *Euphausia eximia*



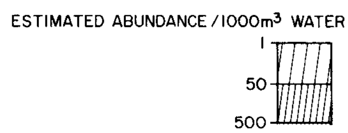
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5502

CALCOFI CRUISE 5502
11 - 17 FEBRUARY 1955



Thysanoessa spinifera *Euphausia eximia*

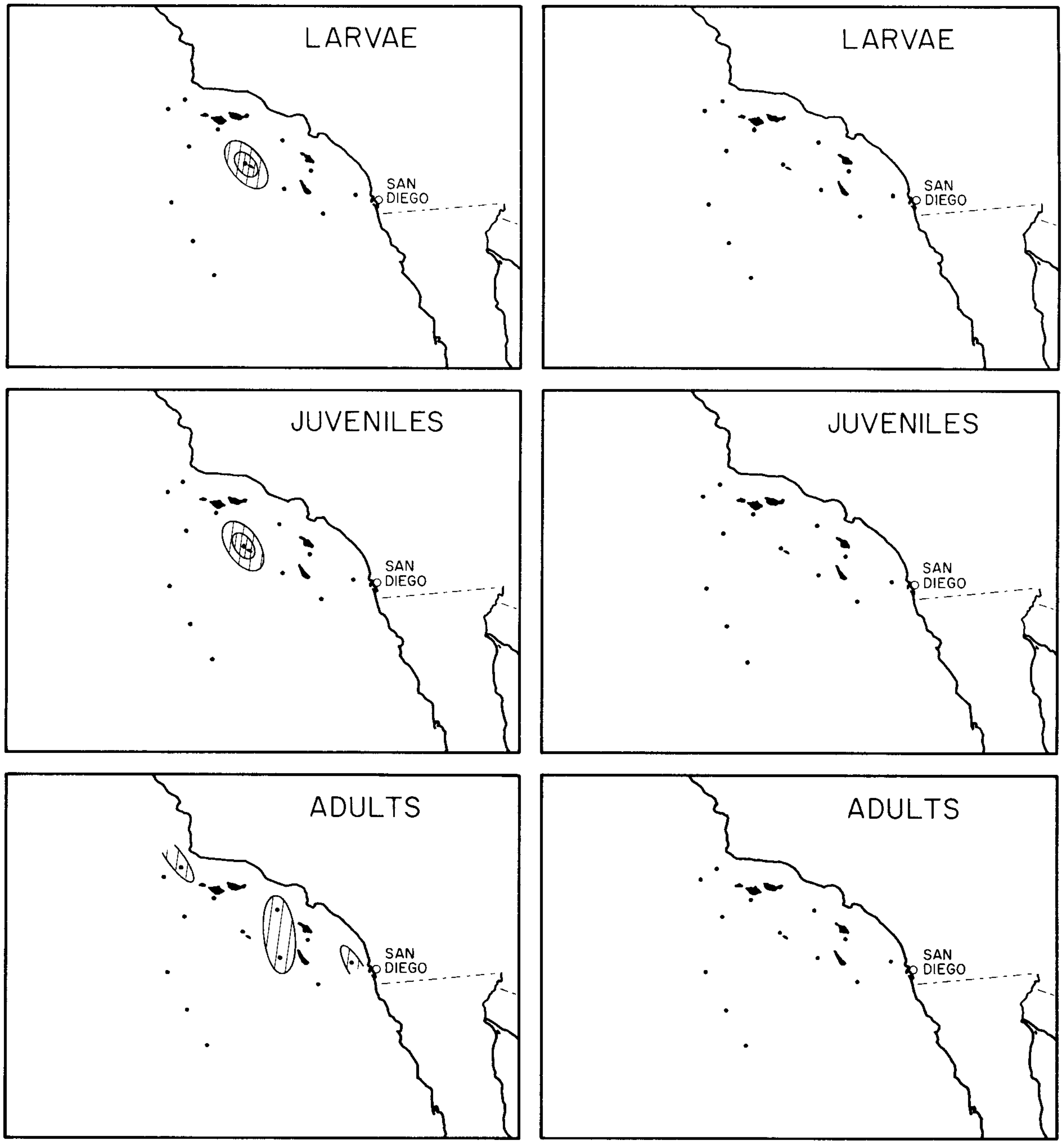


Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5503

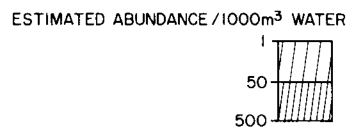
CALCOFI CRUISE 5503

8-16 MARCH 1955



Thysanoessa spinifera

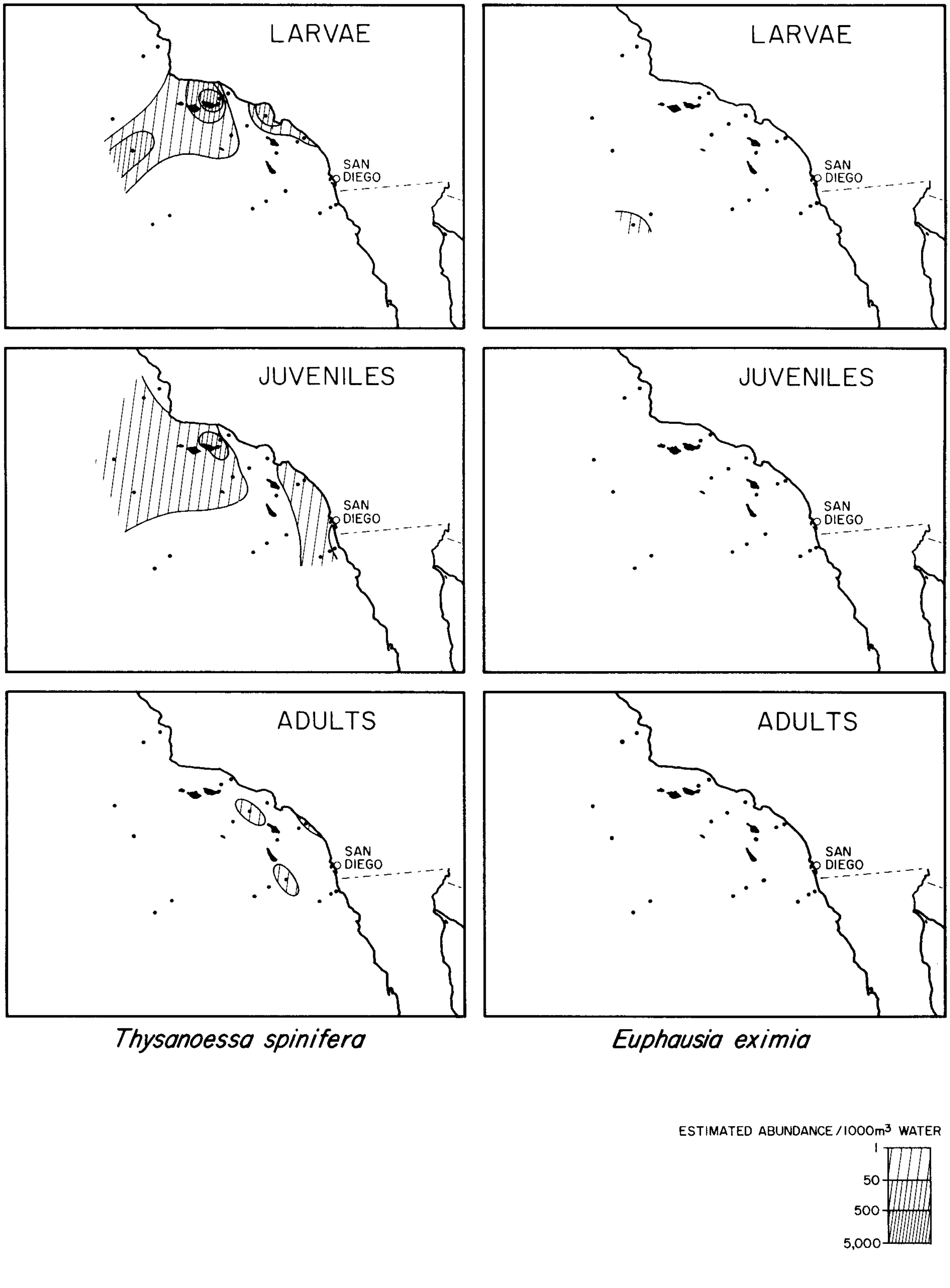
Euphausia eximia
NO POSITIVE RECORDS



Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5504

CALCOFI CRUISE 5504
7 - 16 APRIL 1955

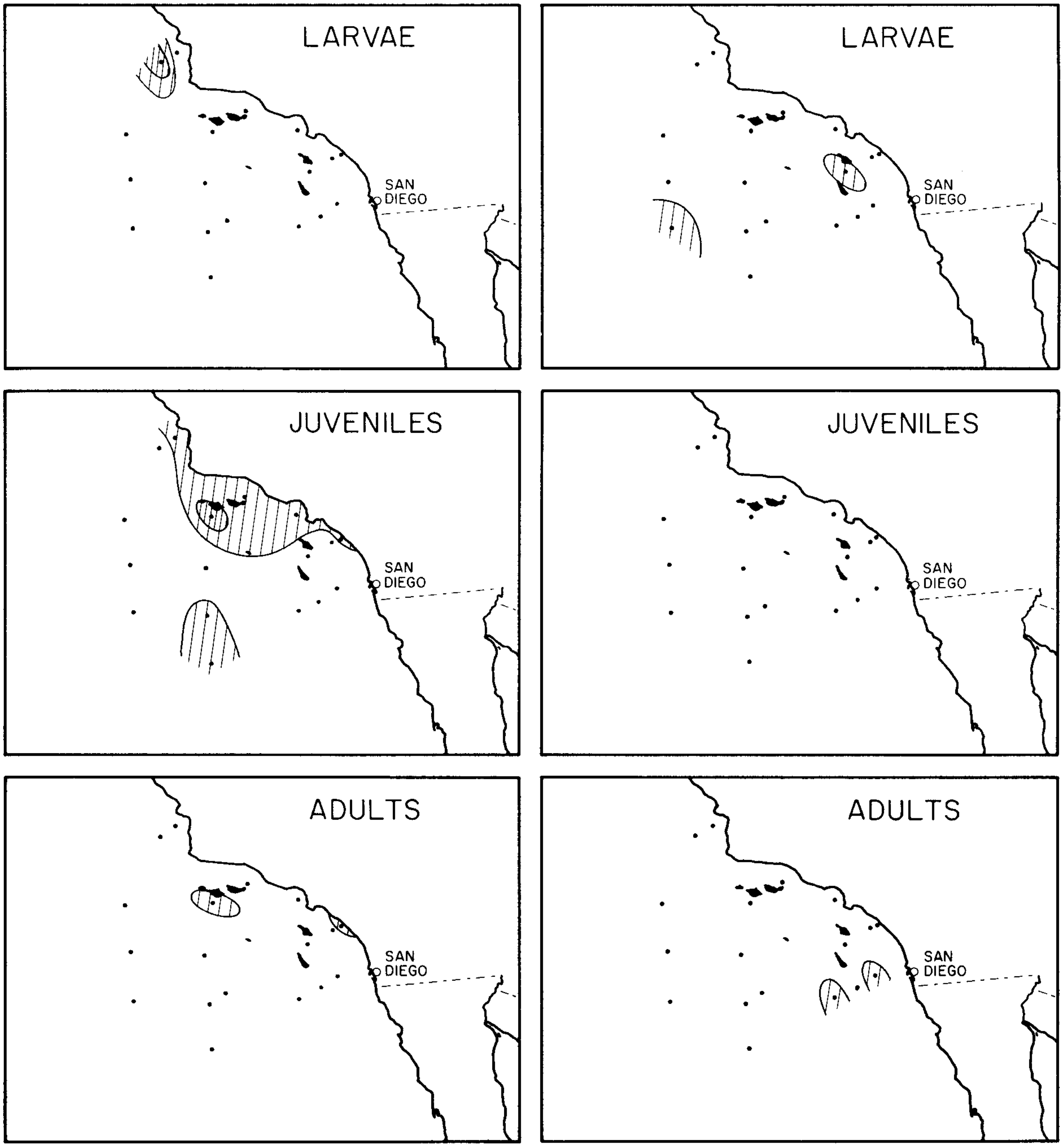


Euphausiacea

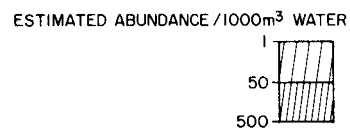
Thysanoessa spinifera
Euphausia eximia
5505

CALCOFI CRUISE 5505

21 MAY - 6 JUNE 19



Thysanoessa spinifera — *Euphausia eximia*

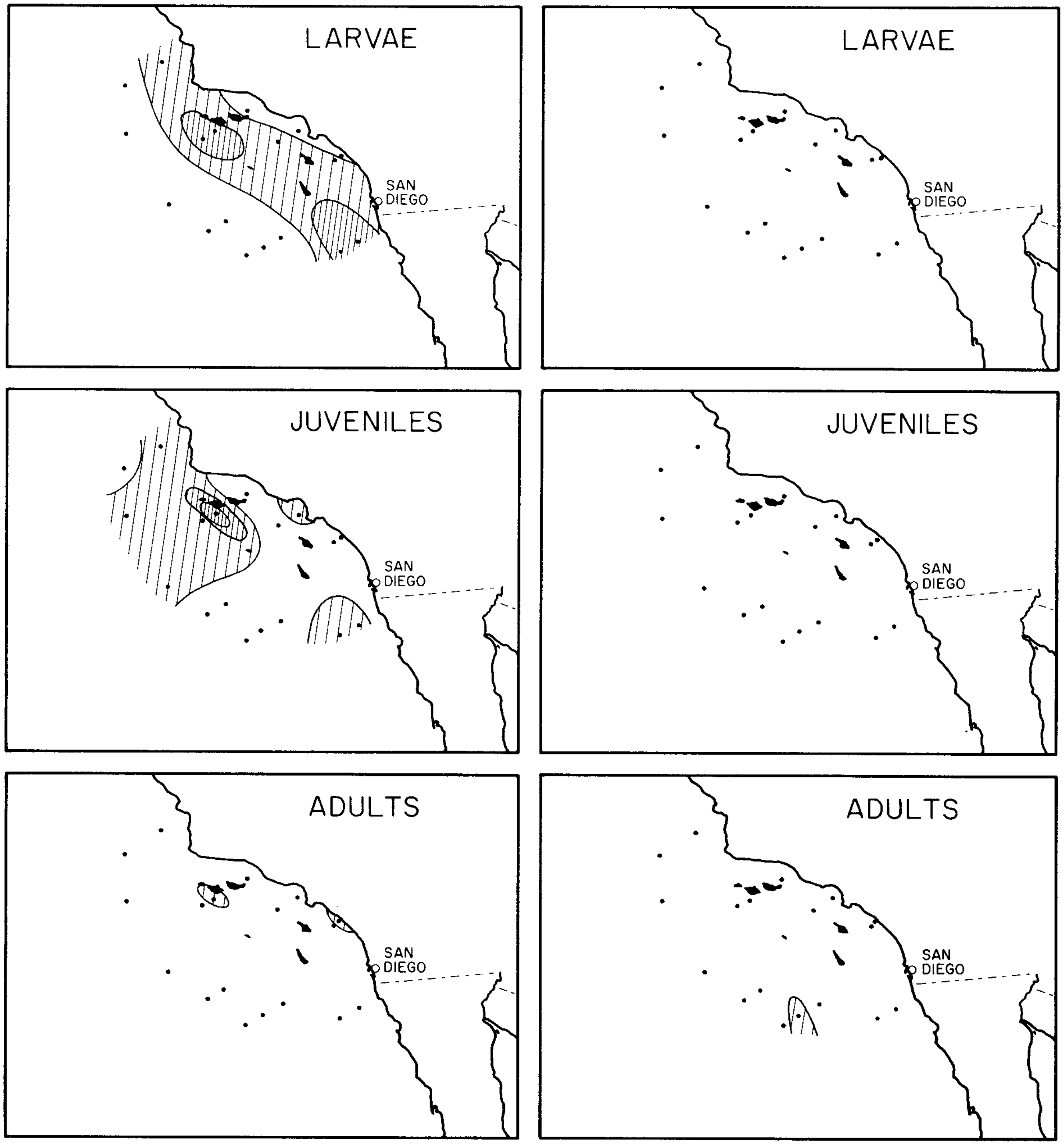


Euphausiacea

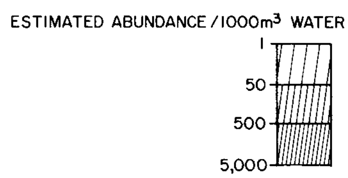
Thysanoessa spinifera
Euphausia eximia
5506

CALCOFI CRUISE 5506

11 - 20 JUNE 1955



Thysanoessa spinifera — *Euphausia eximia*



Euphausiacea

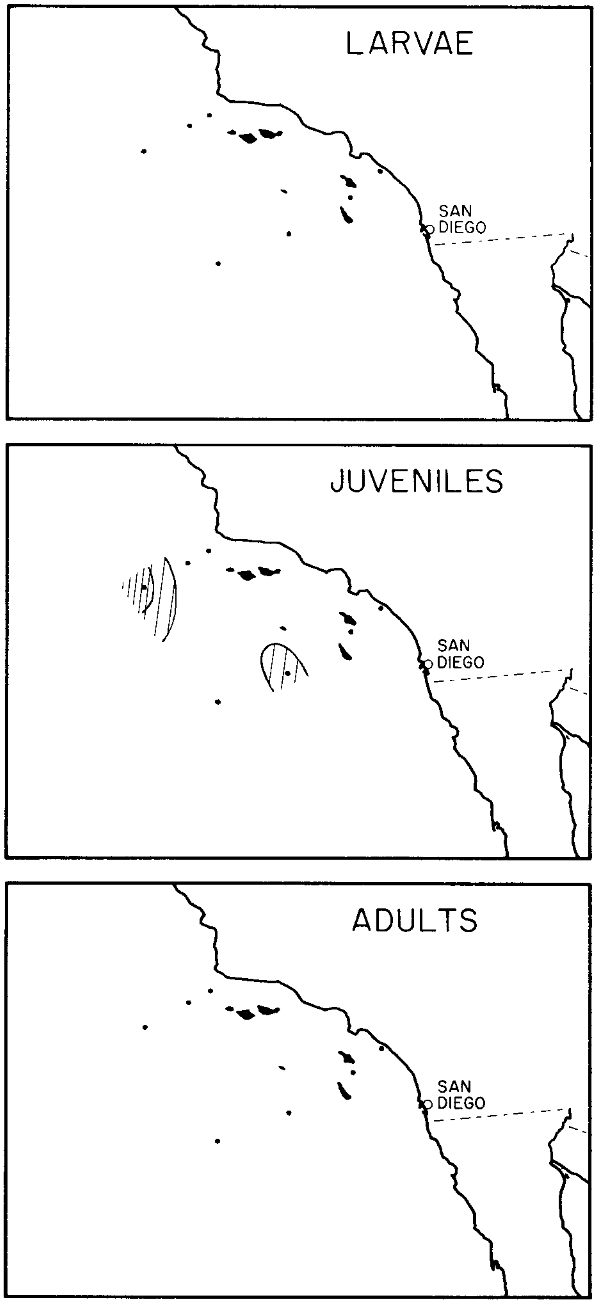
Thysanoessa spinifera

Euphausia eximia

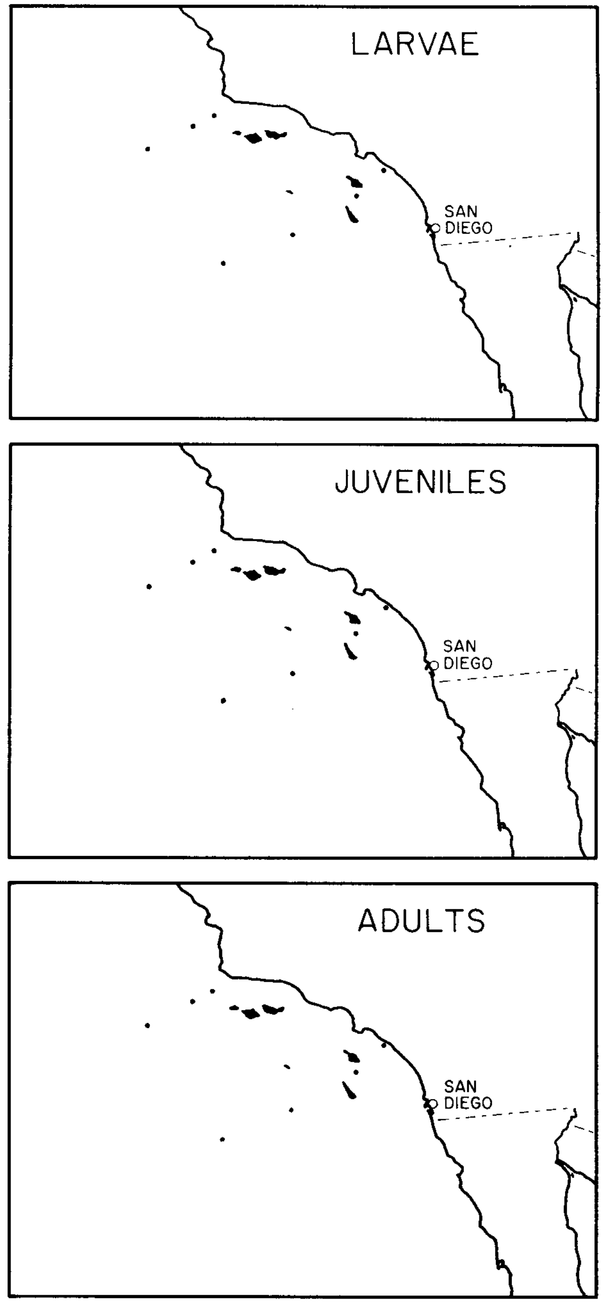
5507

CALCOFI CRUISE 5507

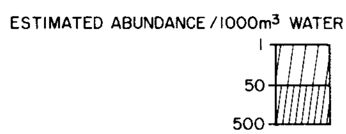
7 - 13 JULY 1955



Thysanoessa spinifera



Euphausia eximia
NO POSITIVE RECORDS

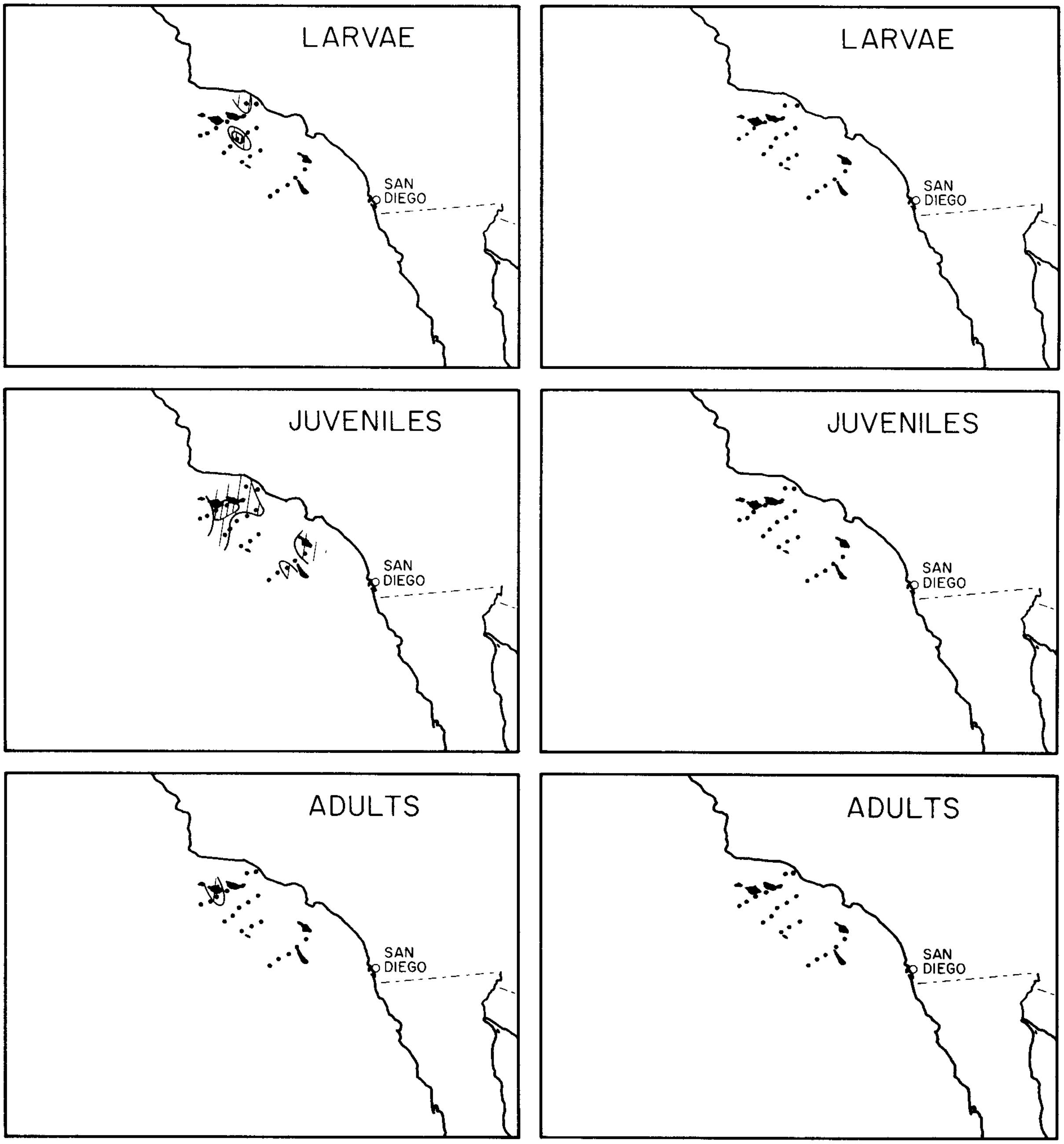


CALCOFI CRUISE 5508 'NORPAC'

4 - 6 SEPTEMBER 1955
MAIN PORTION OF CRUISE OCCUPIED IN AUGUST

Euphausiacea

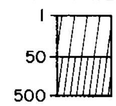
Thysanoessa spinifera
Euphausia eximia
5508 'NORPAC'



Thysanoessa spinifera

Euphausia eximia
NO POSITIVE RECORDS

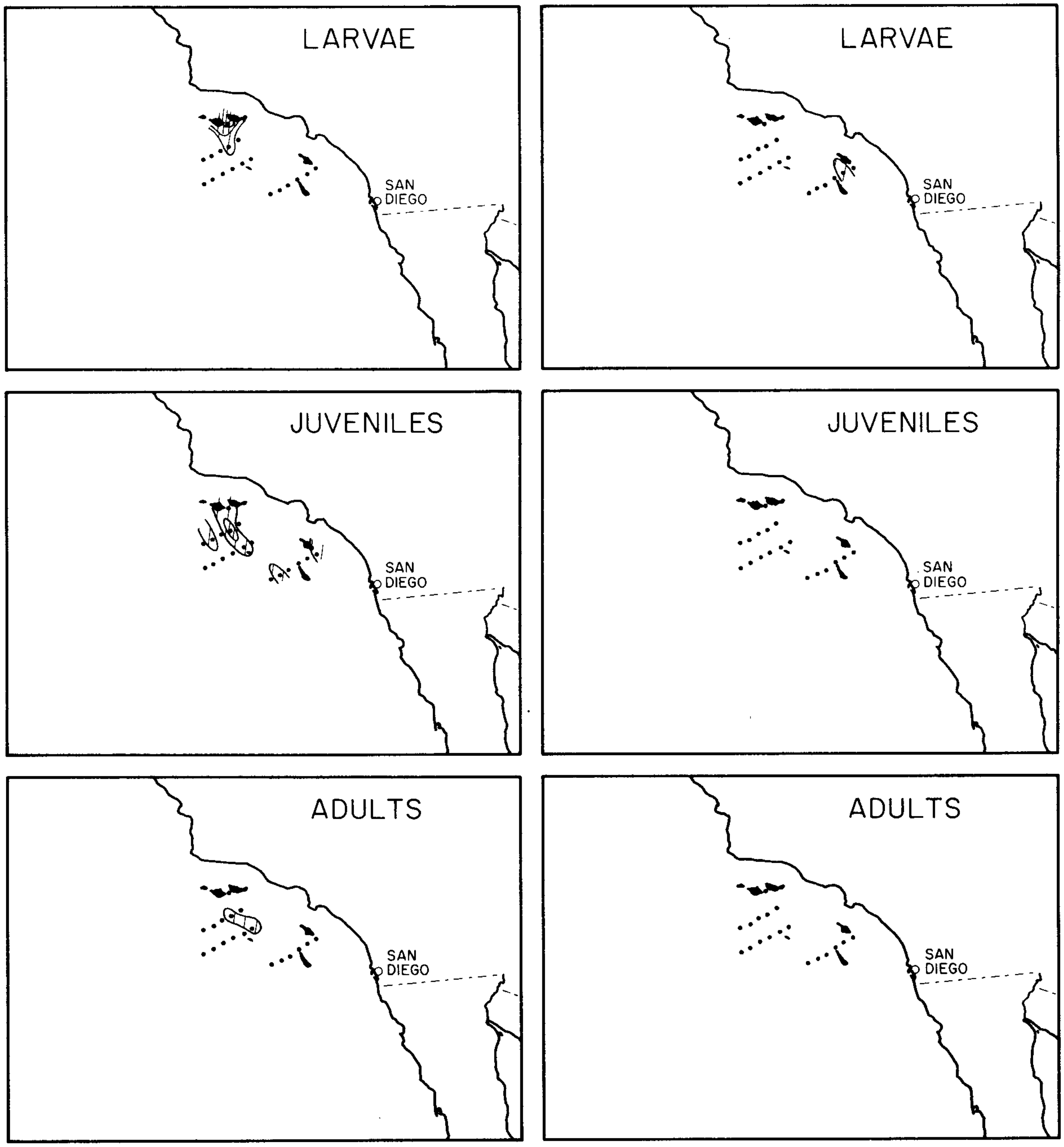
ESTIMATED ABUNDANCE / 1000m³ WATER



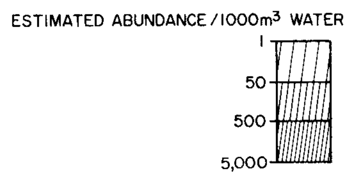
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5509-I

CALCOFI CRUISE 5509-I
12 - 17 SEPTEMBER 1955



Thysanoessa spinifera *Euphausia eximia*

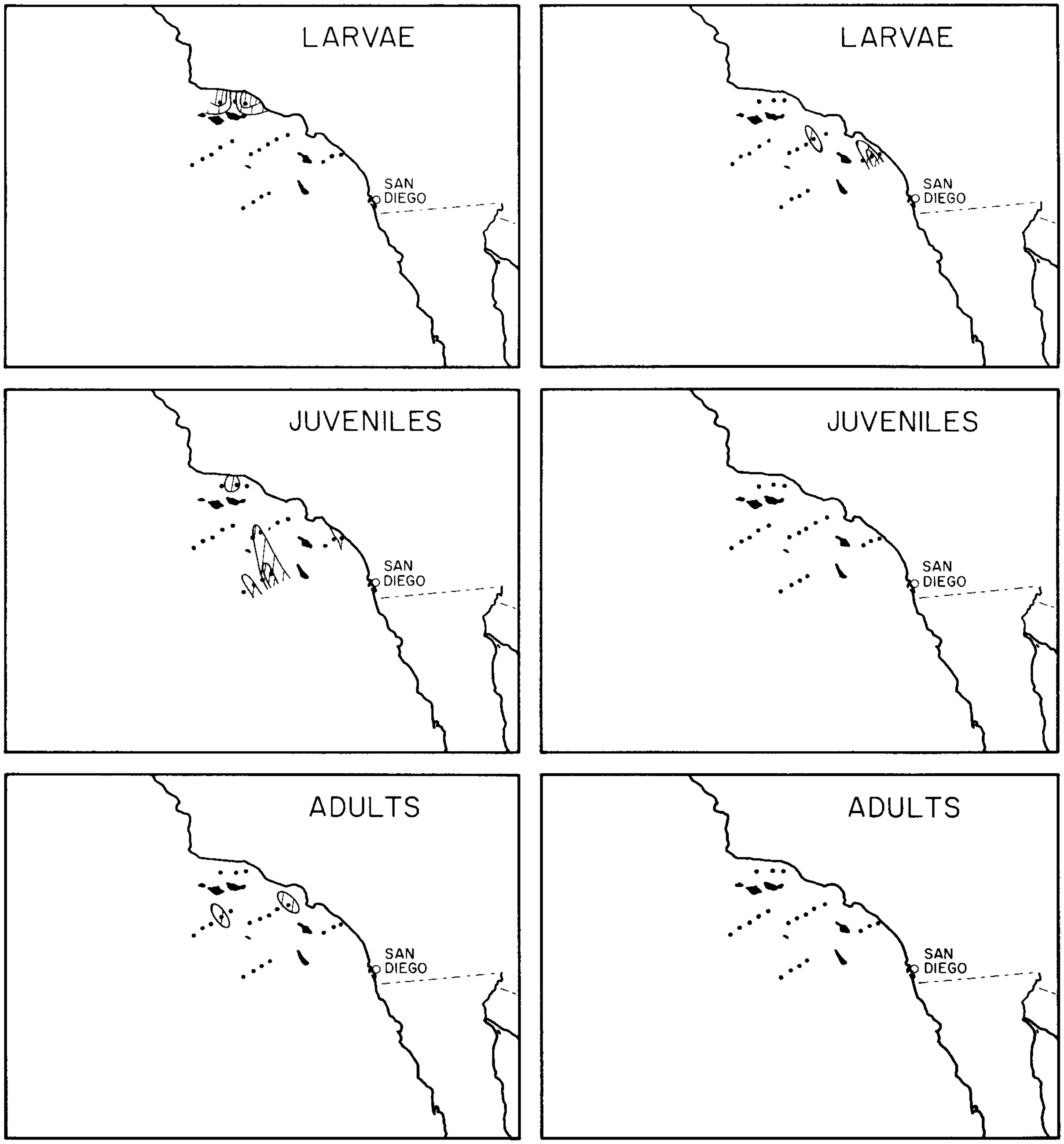


Euphausiacea

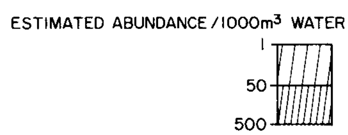
Thysanoessa spinifera
Euphausia eximia
5509 - II

CALCOFI CRUISE 5509-II

15 - 19 SEPTEMBER 1955



Thysanoessa spinifera *Euphausia eximia*



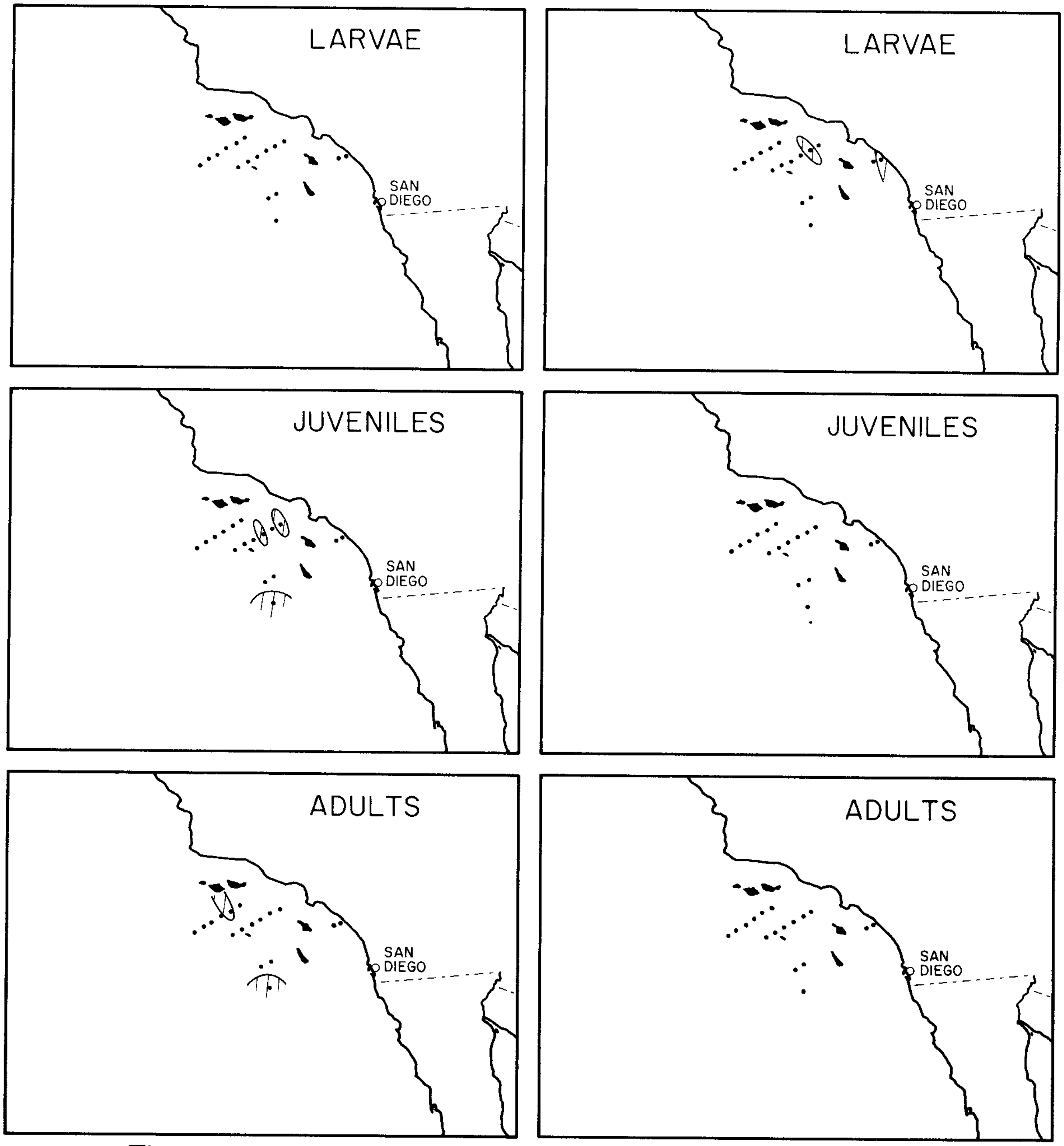
Euphausiacea

Thysanoessa spinifera
Euphausia eximia

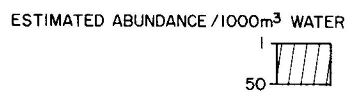
5509 - III

CALCOFI CRUISE 5509 - III

18 - 23 SEPTEMBER 1955



Thysanoessa spinifera — *Euphausia eximia*



Euphausiacea

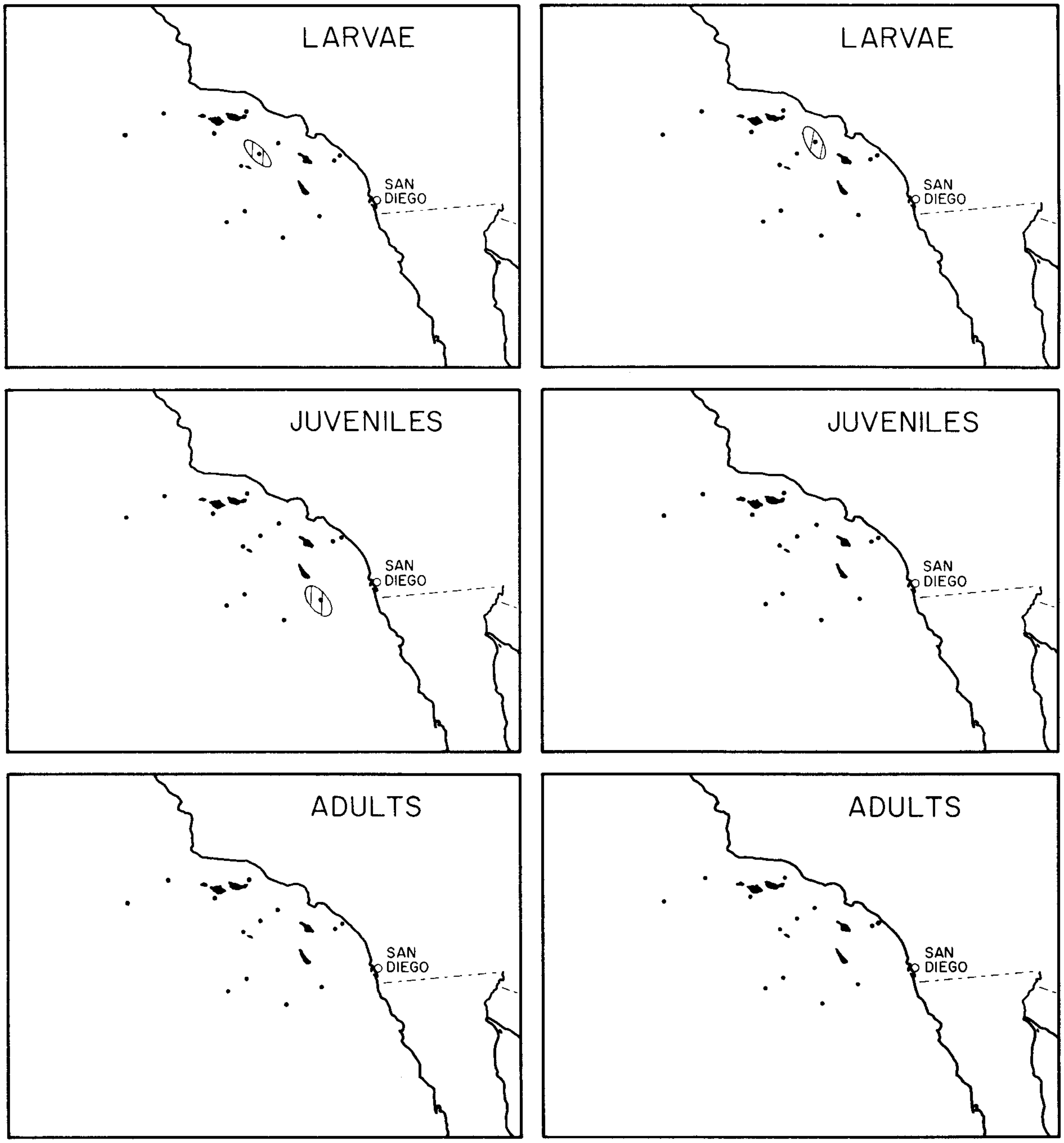
Thysanoessa spinifera

Euphausia eximia

5509 - IV

CALCOFI CRUISE 5509 - IV

21 - 24 SEPTEMBER 1955



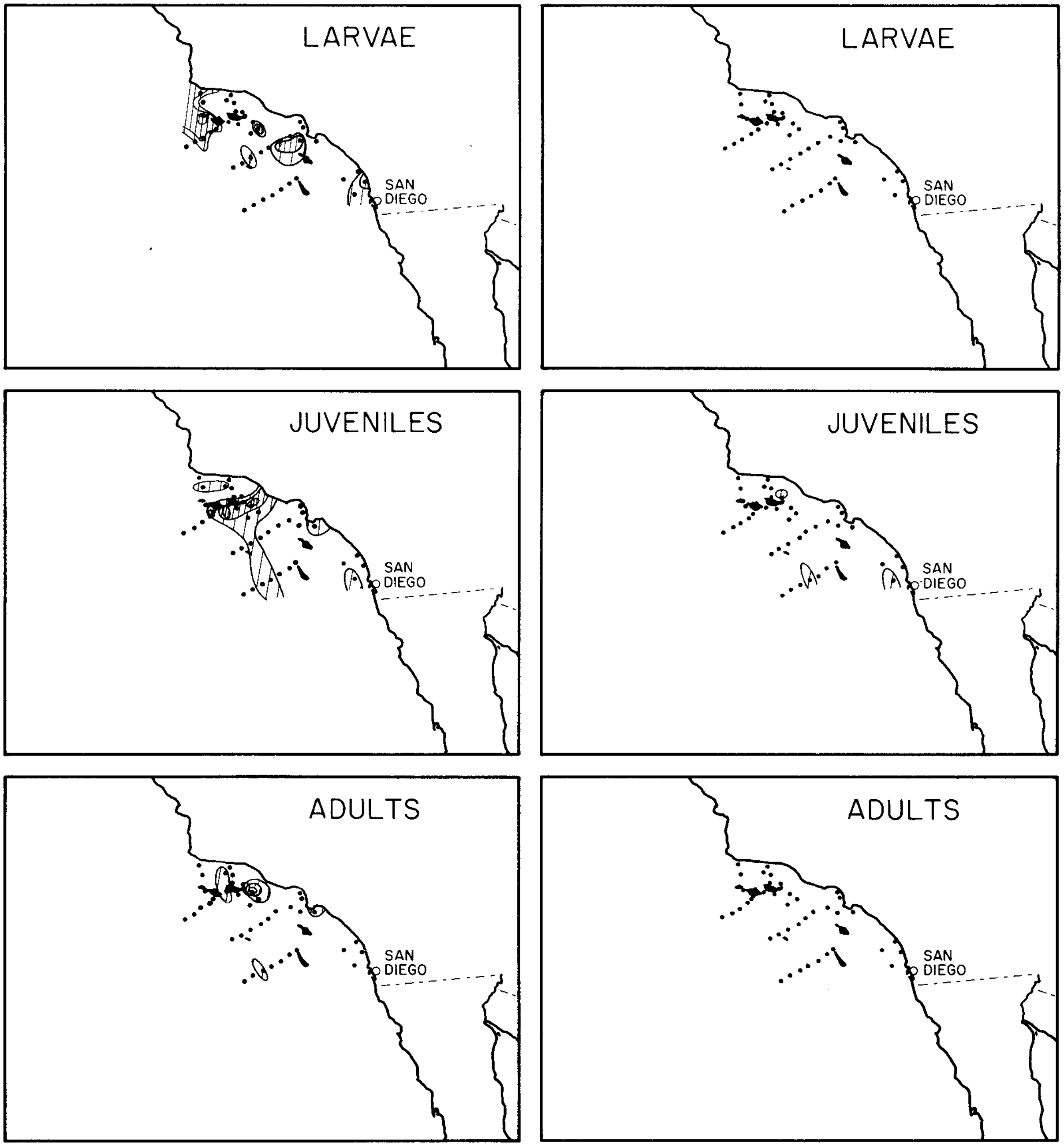
Thysanoessa spinifera *Euphausia eximia*

ESTIMATED ABUNDANCE / 1000m^3 WATER
1
50

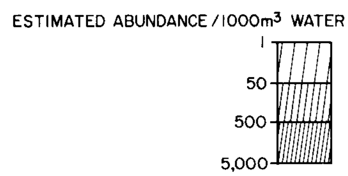
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5510

CALCOFI CRUISE 5510
21 - 29 OCTOBER 1955



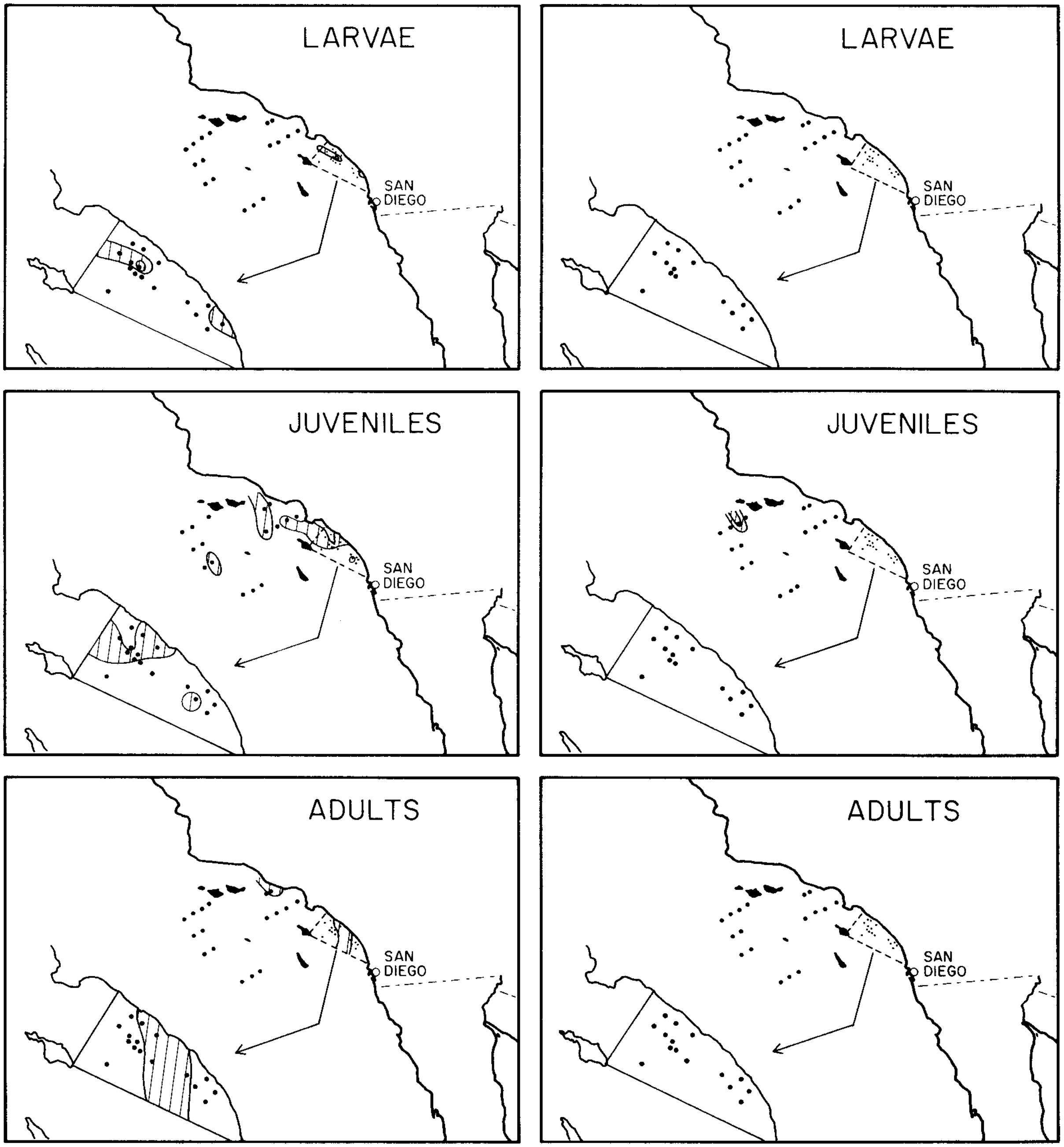
Thysanoessa spinifera | *Euphausia eximia*



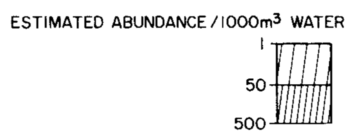
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5511-I

CALCOFI CRUISE 5511-I
8-13 NOVEMBER 1955



Thysanoessa spinifera — *Euphausia eximia*



CALCOFI CRUISE 5511 - II

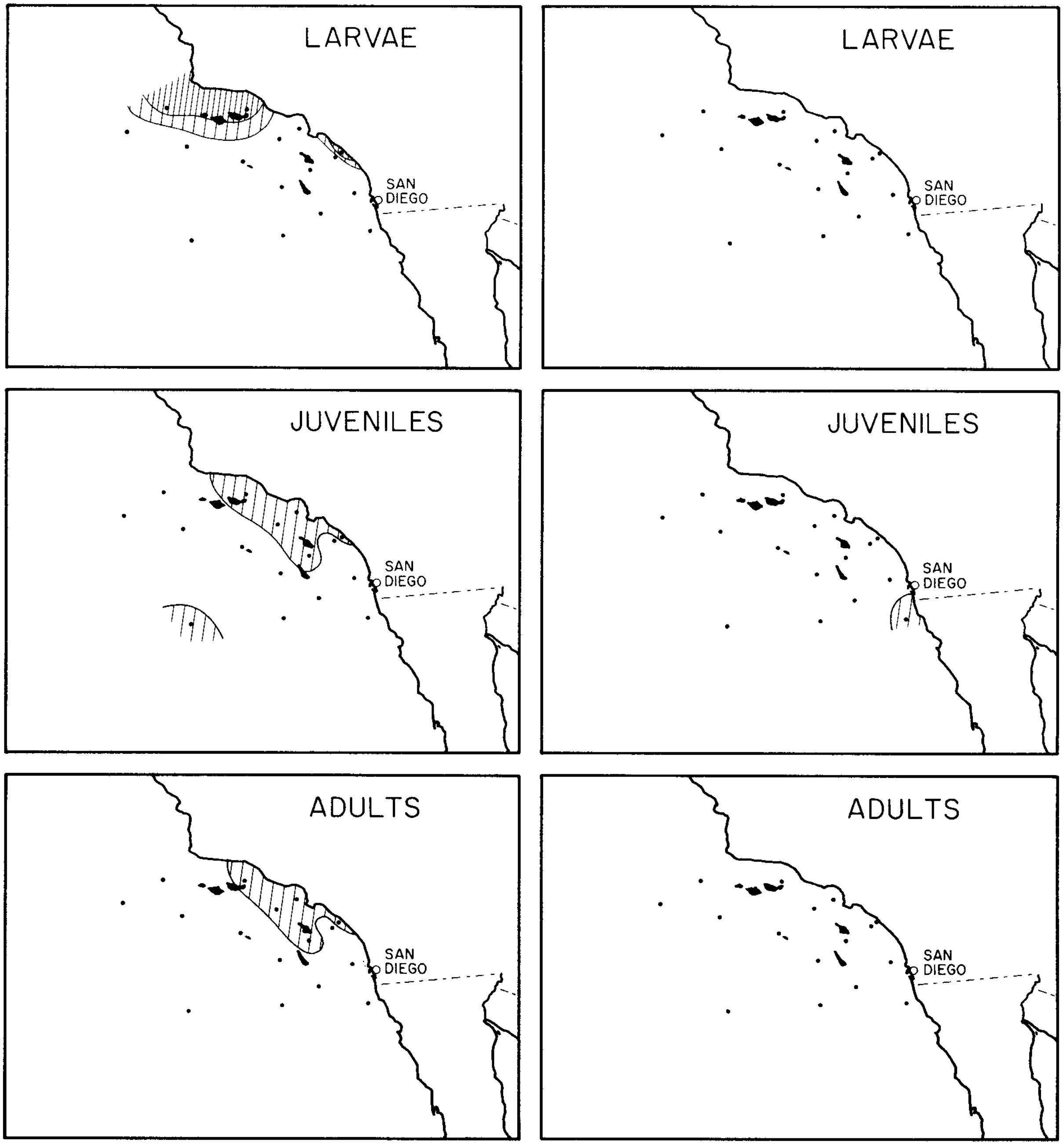
16 - 19 NOVEMBER 1955

Euphausiacea

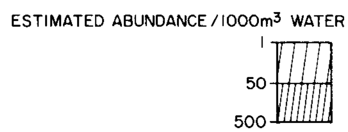
Thysanoessa spinifera

Euphausia eximia

5511 - II



Thysanoessa spinifera *Euphausia eximia*

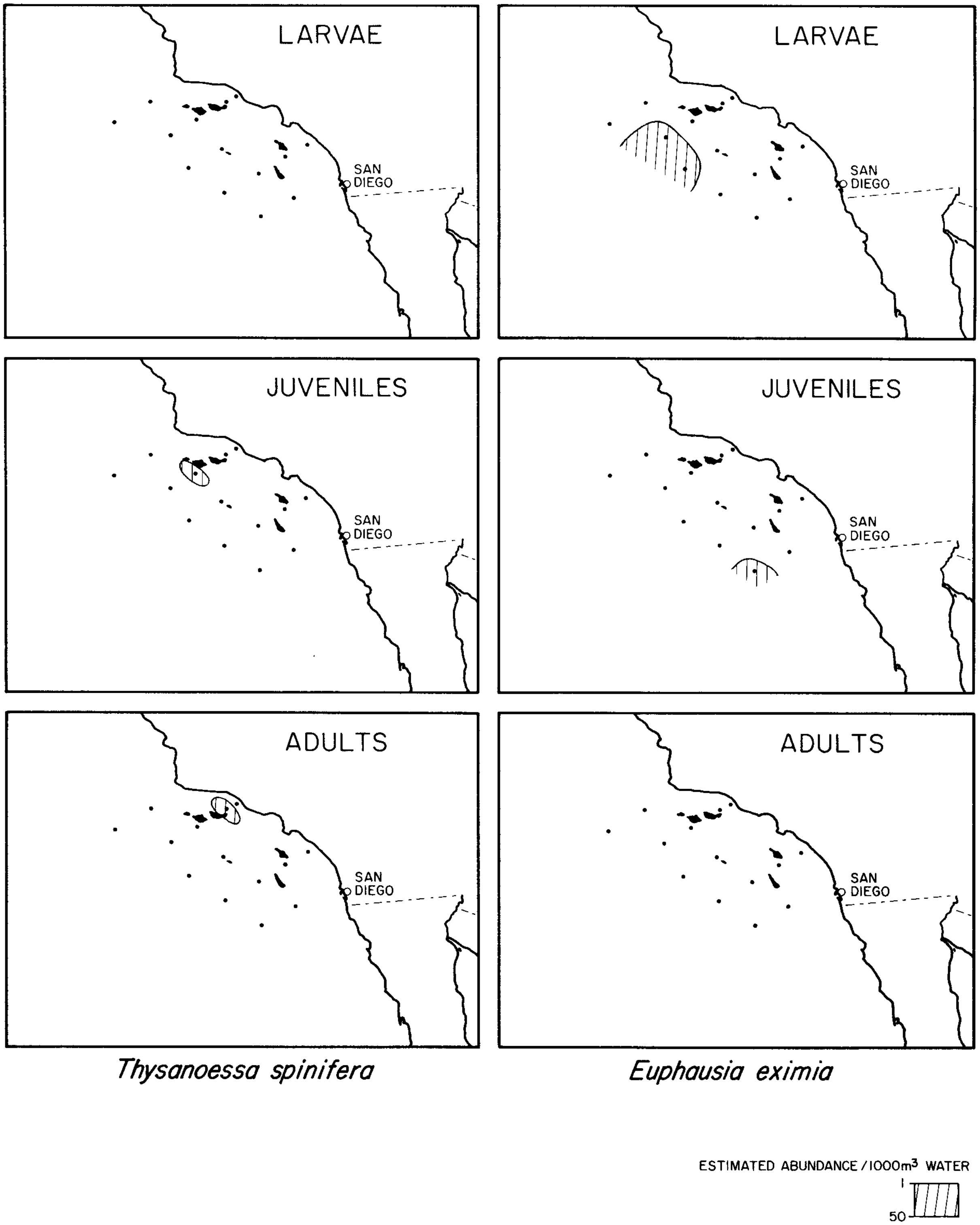


Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5512

CALCOFI CRUISE 5512

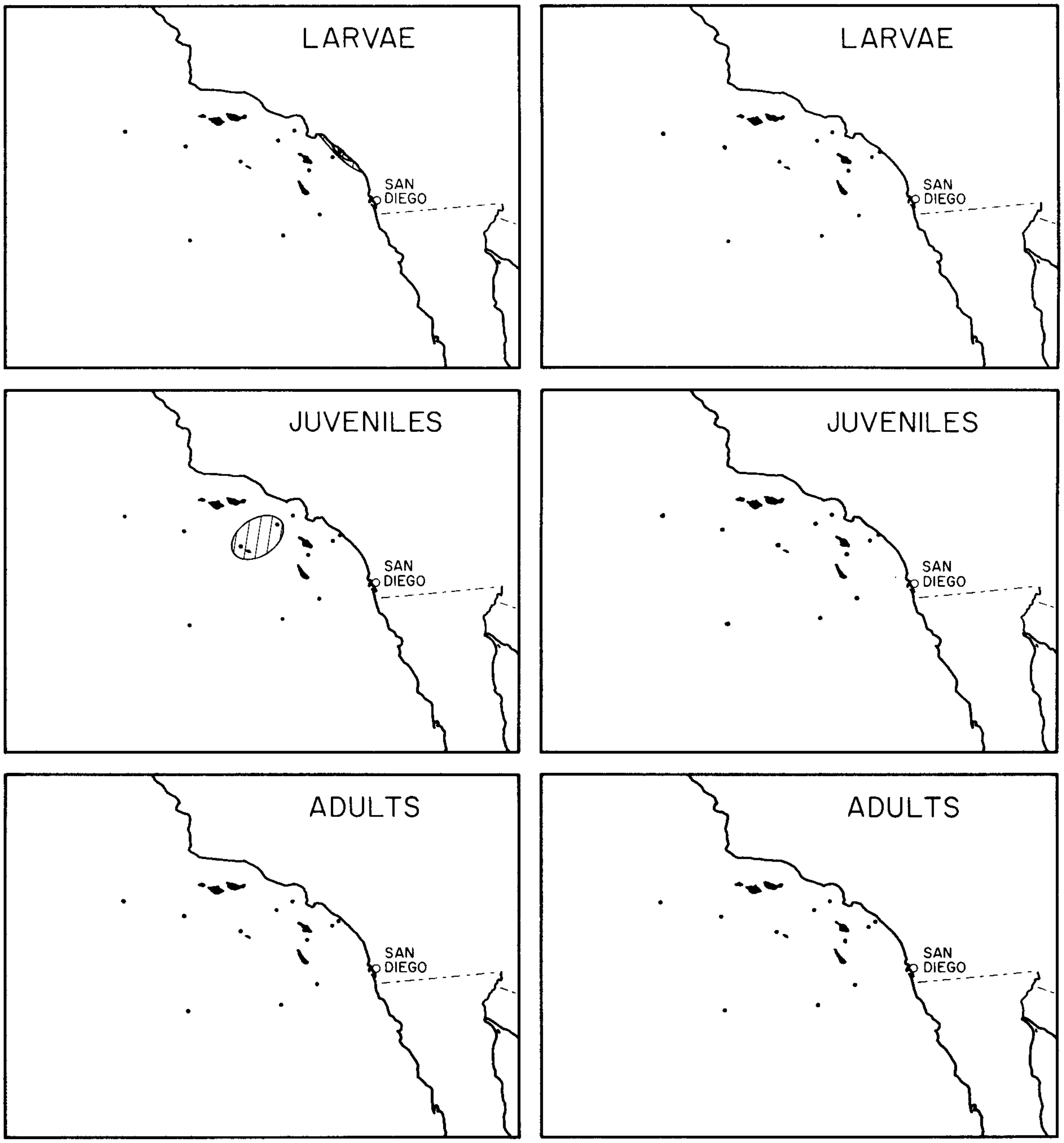
30 NOVEMBER - 7 DECEMBER 1955



Thysanoessa spinifera — *Euphausia eximia*

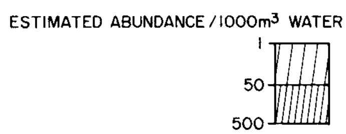
CALCOFI CRUISE 5601
6-10 JANUARY 1956

Euphausiacea
Thysanoessa spinifera
Euphausia eximia
5601



Thysanoessa spinifera

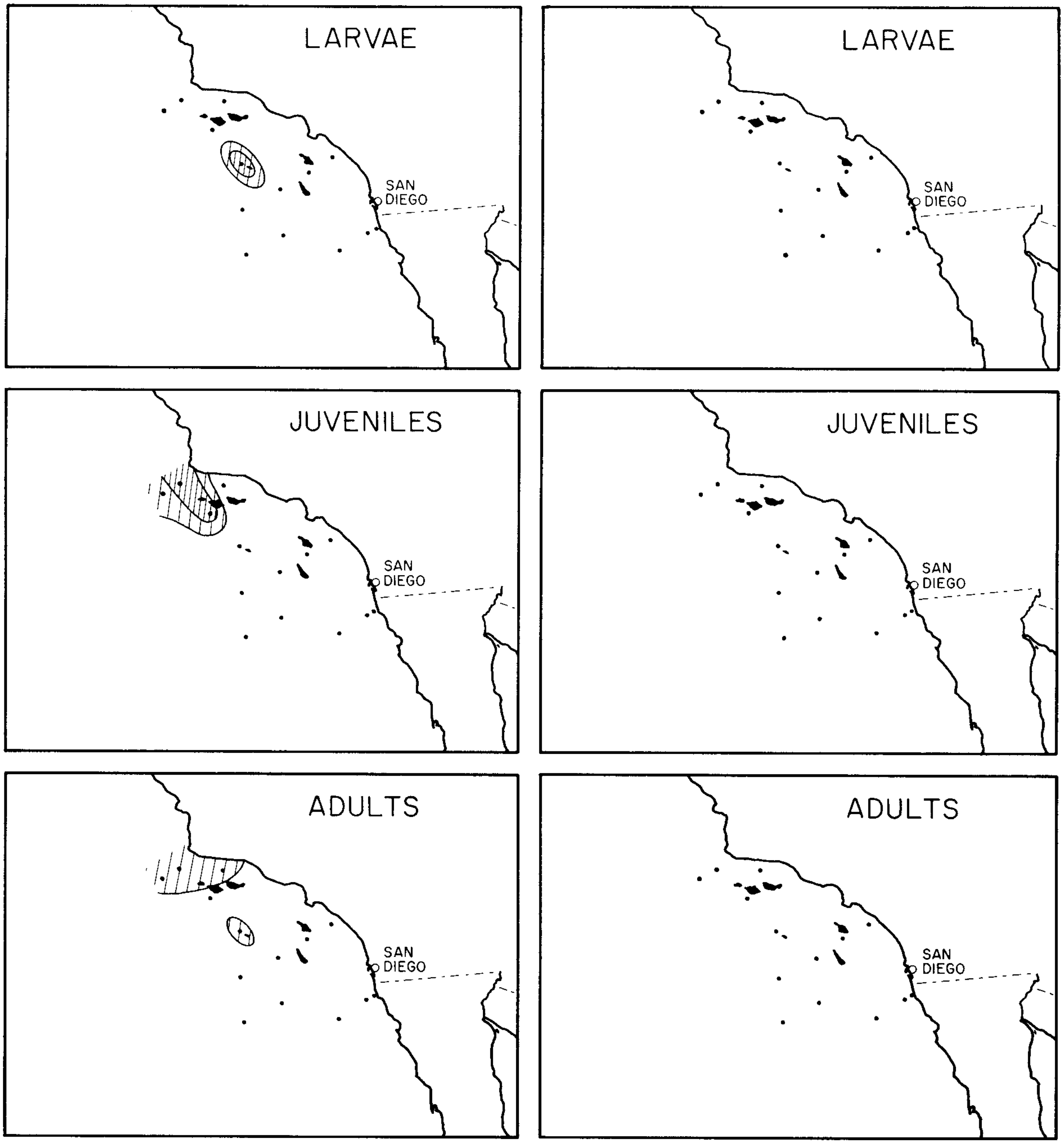
Euphausia eximia
NO POSITIVE RECORDS



Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5602

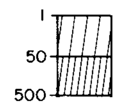
CALCOFI CRUISE 5602
3-10 FEBRUARY 1956



Thysanoessa spinifera

Euphausia eximia
NO POSITIVE RECORDS

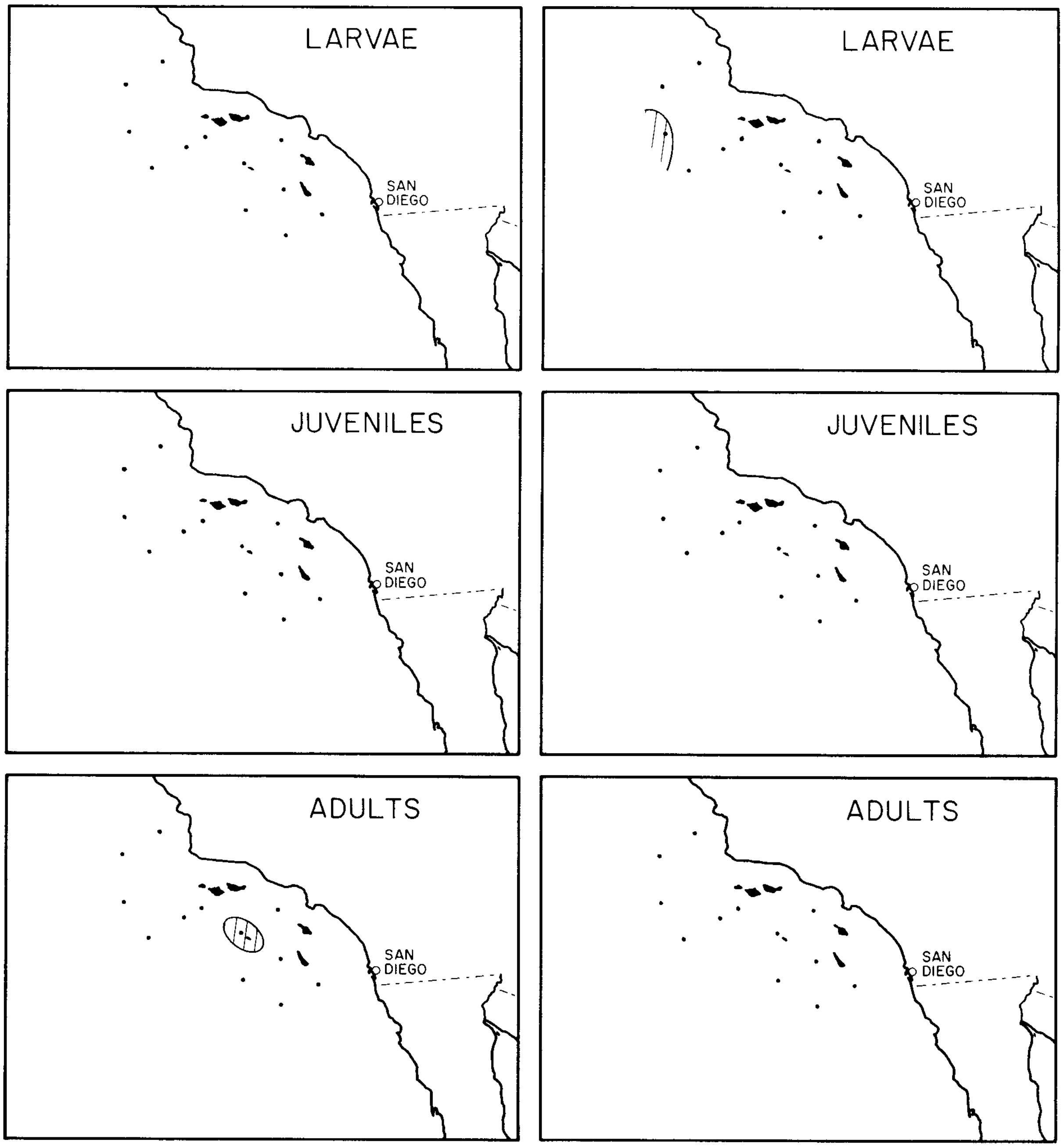
ESTIMATED ABUNDANCE / 1000m^3 WATER



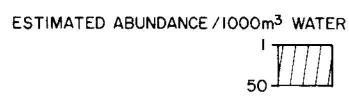
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5603

CALCOFI CRUISE 5603
8 - 17 MARCH 1956



Thysanoessa spinifera *Euphausia eximia*

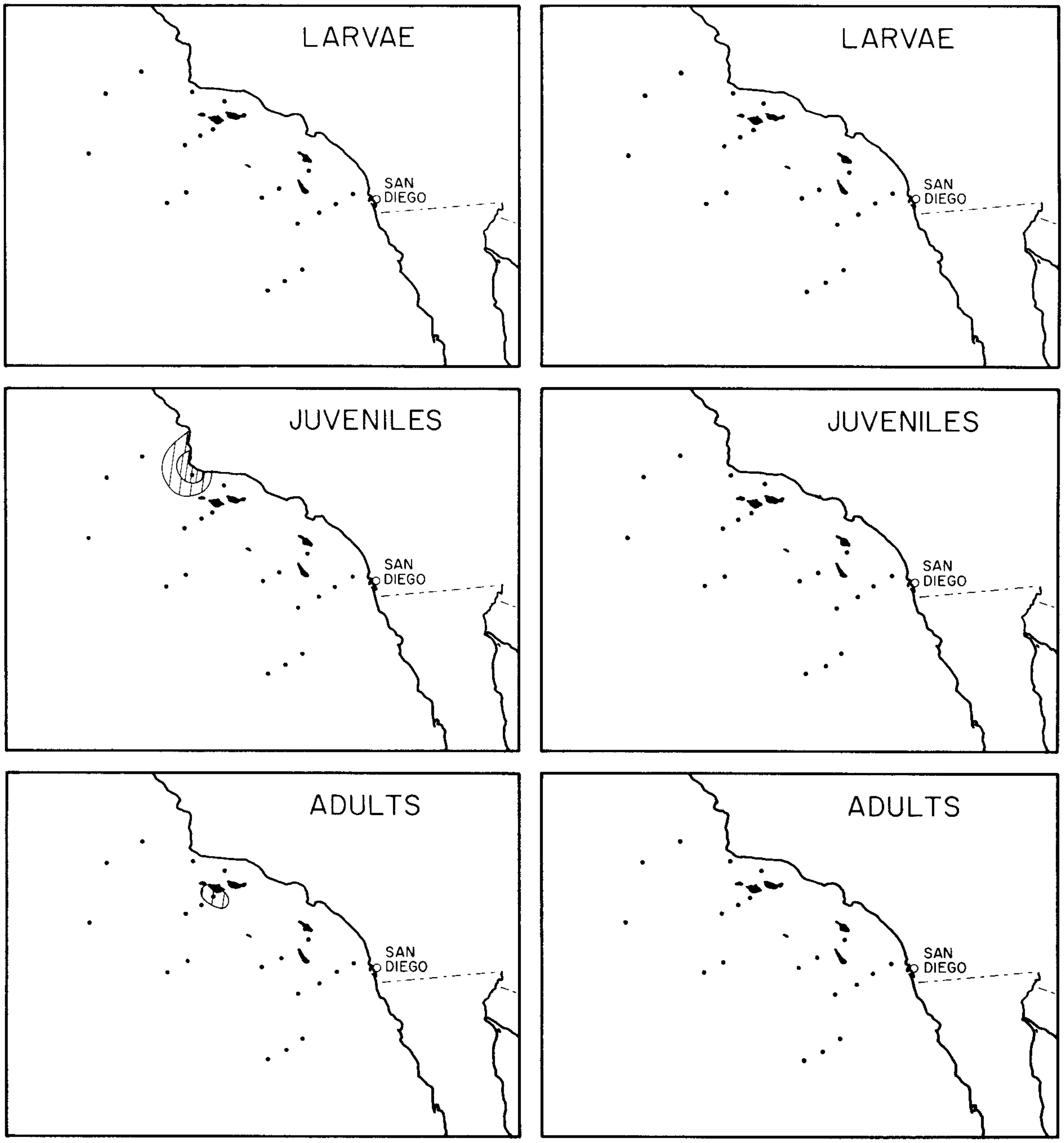


Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5604

CALCOFI CRUISE 5604

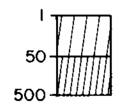
14 – 21 APRIL 1956



Thysanoessa spinifera

Euphausia eximia
NO POSITIVE RECORDS

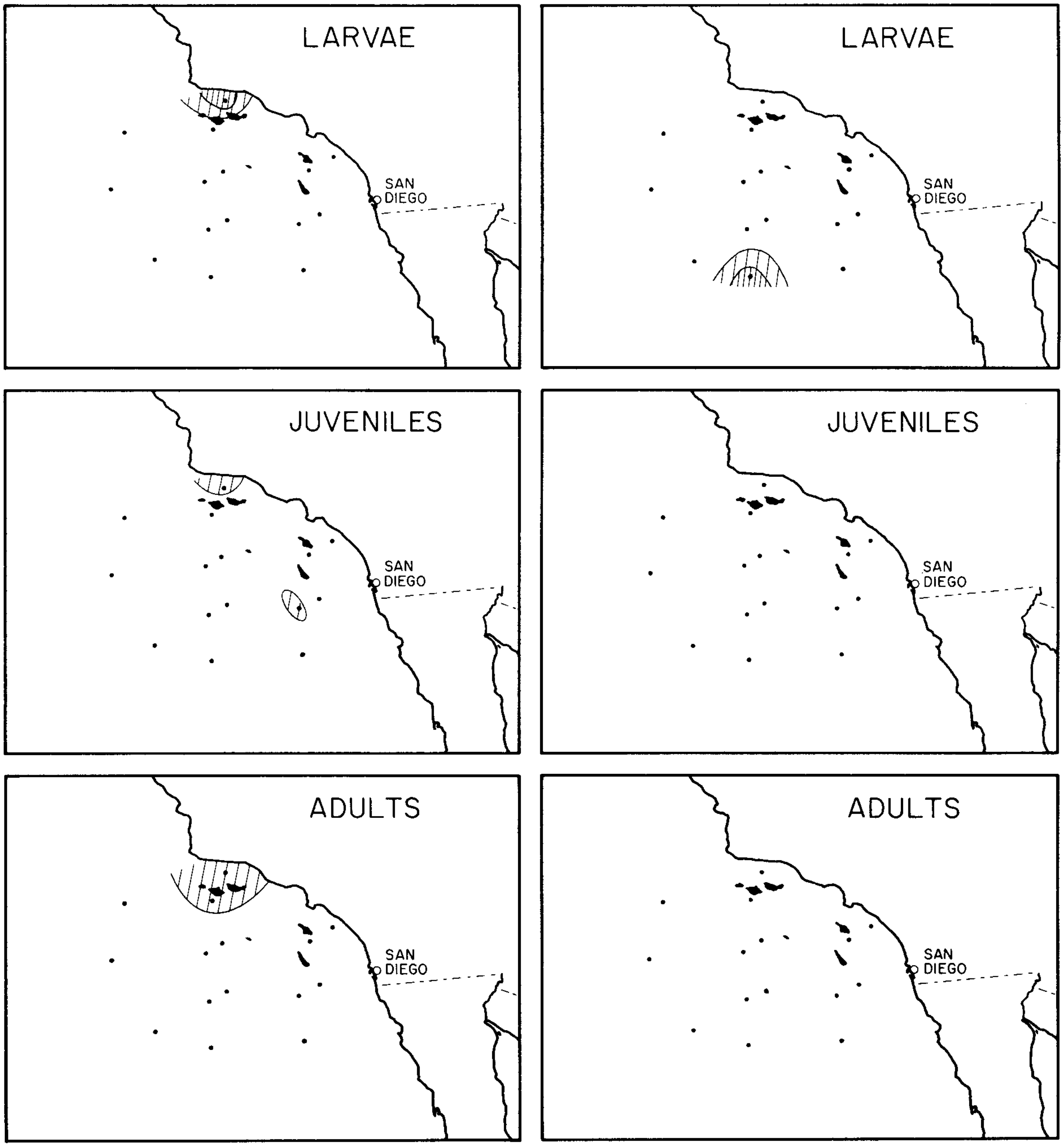
ESTIMATED ABUNDANCE / 1000m³ WATER



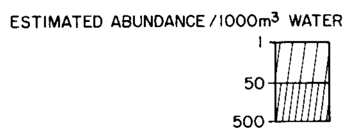
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5605

CALCOFI CRUISE 5605
6-18 MAY 1956

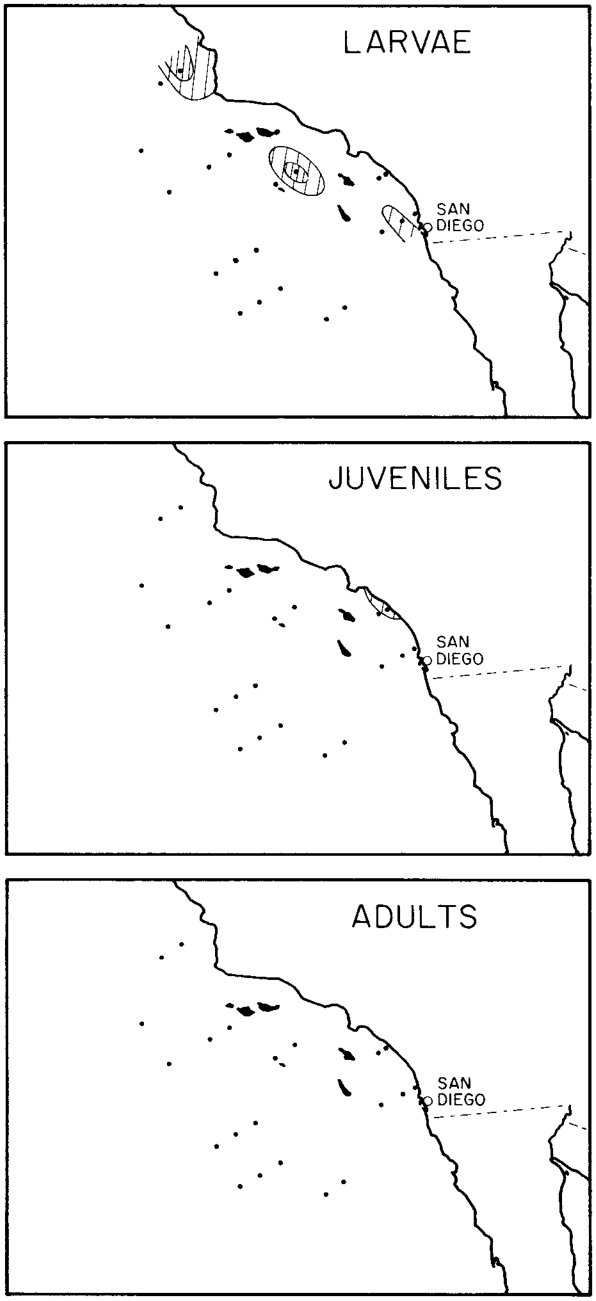


Thysanoessa spinifera *Euphausia eximia*

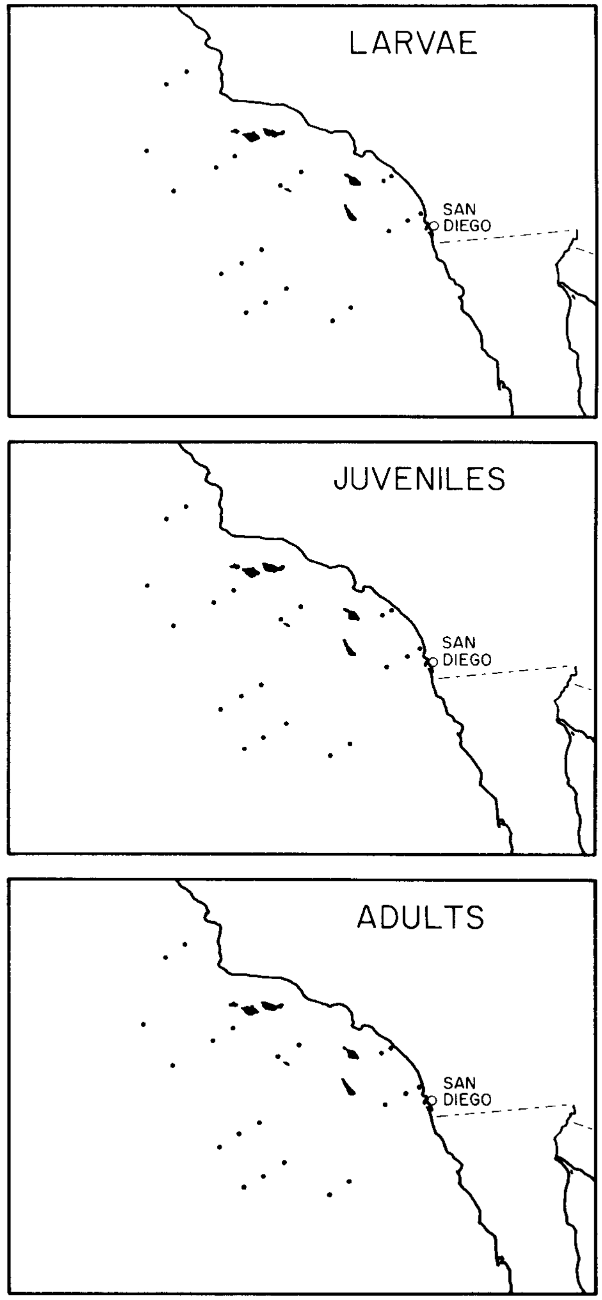


CALCOFI CRUISE 5606
30 MAY – 13 JUNE 1956

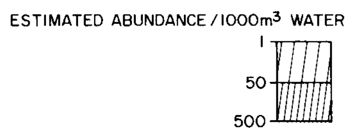
Euphausiacea
Thysanoessa spinifera
Euphausia eximia
5606



Thysanoessa spinifera



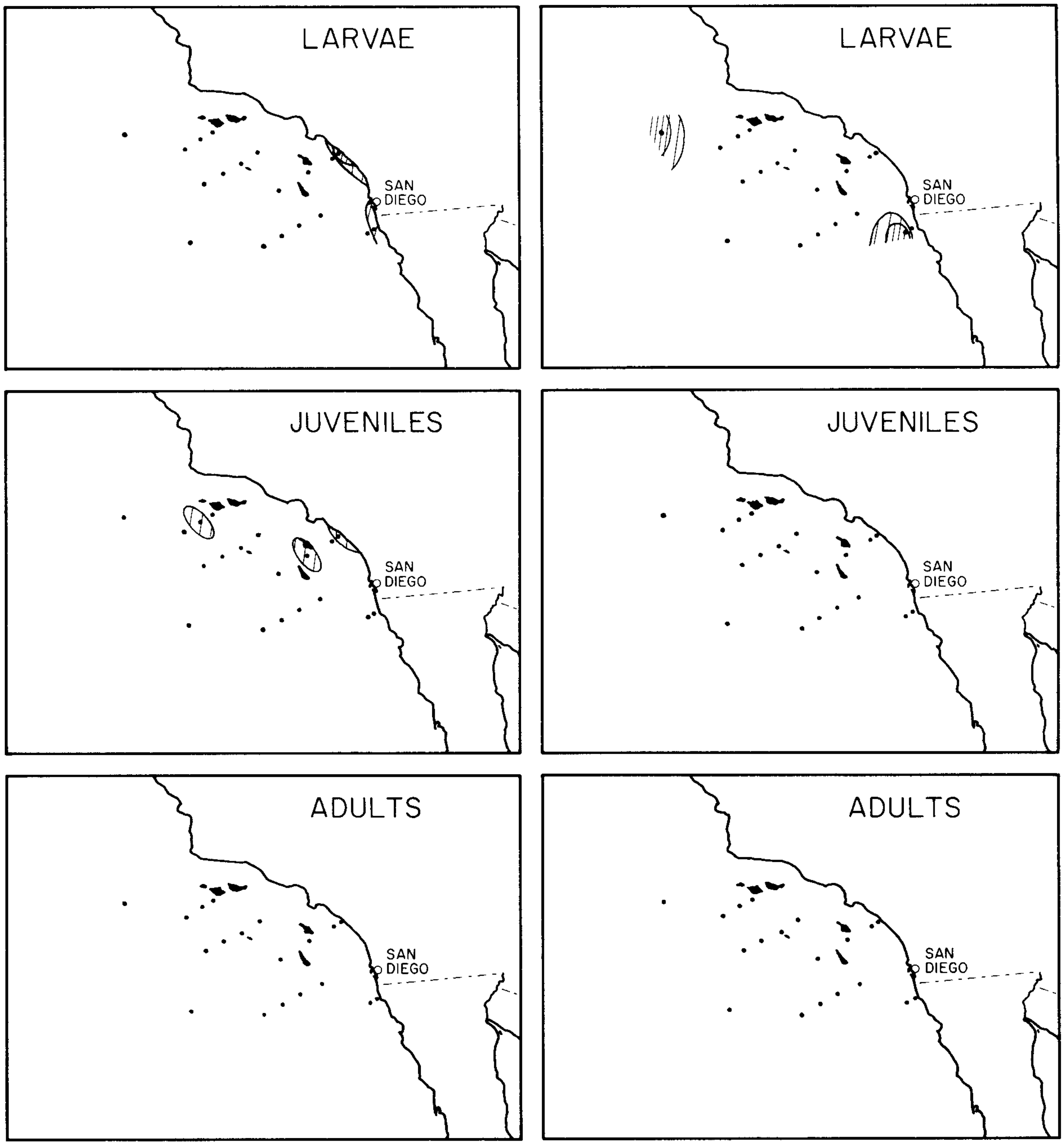
Euphausia eximia
NO POSITIVE RECORDS



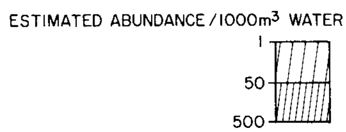
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5607

CALCOFI CRUISE 5607
7 - 15 JULY 1956



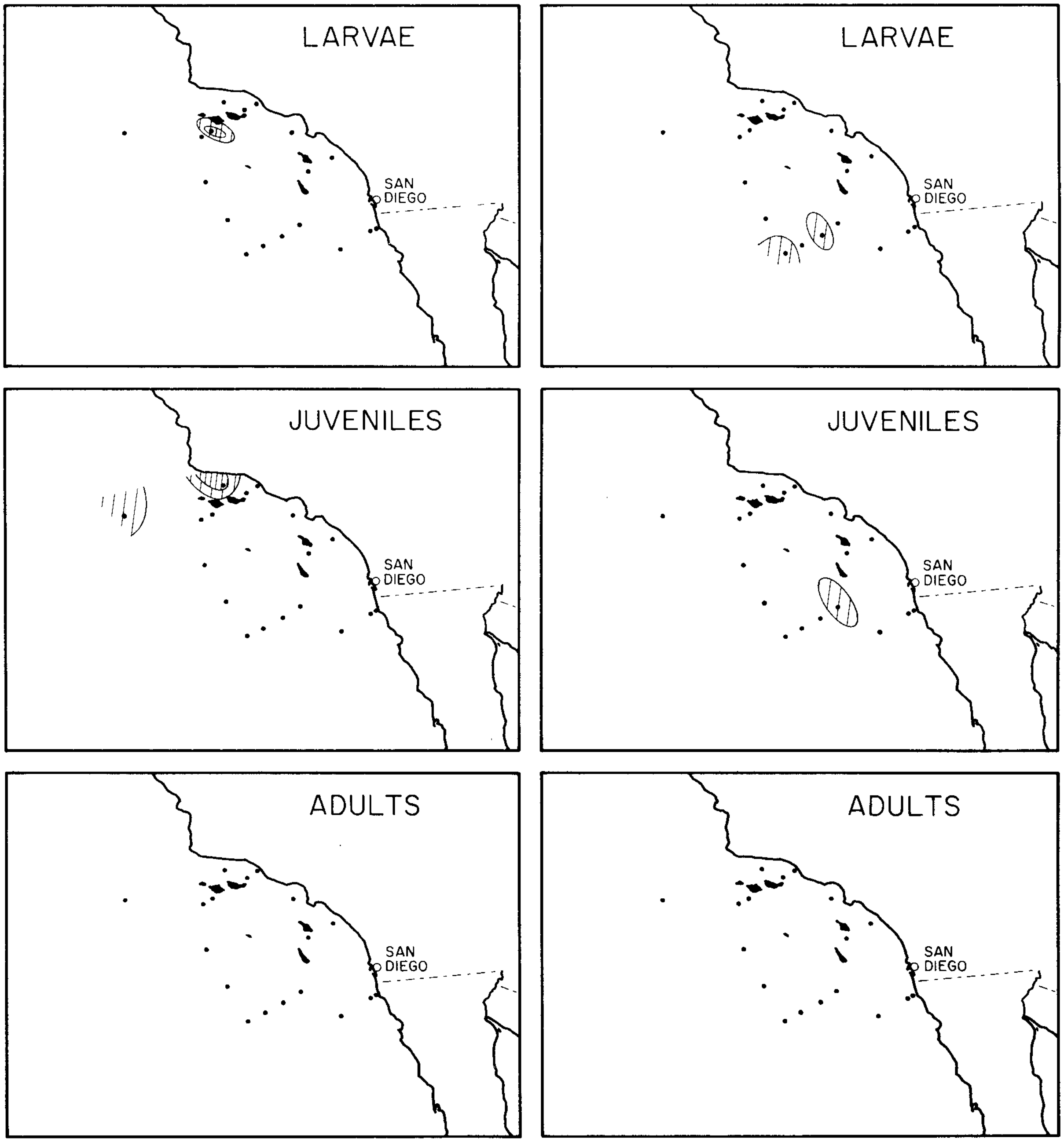
Thysanoessa spinifera | *Euphausia eximia*



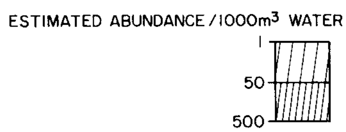
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5610

CALCOFI CRUISE 5610
29 SEPTEMBER - 5 OCTOBER 1956



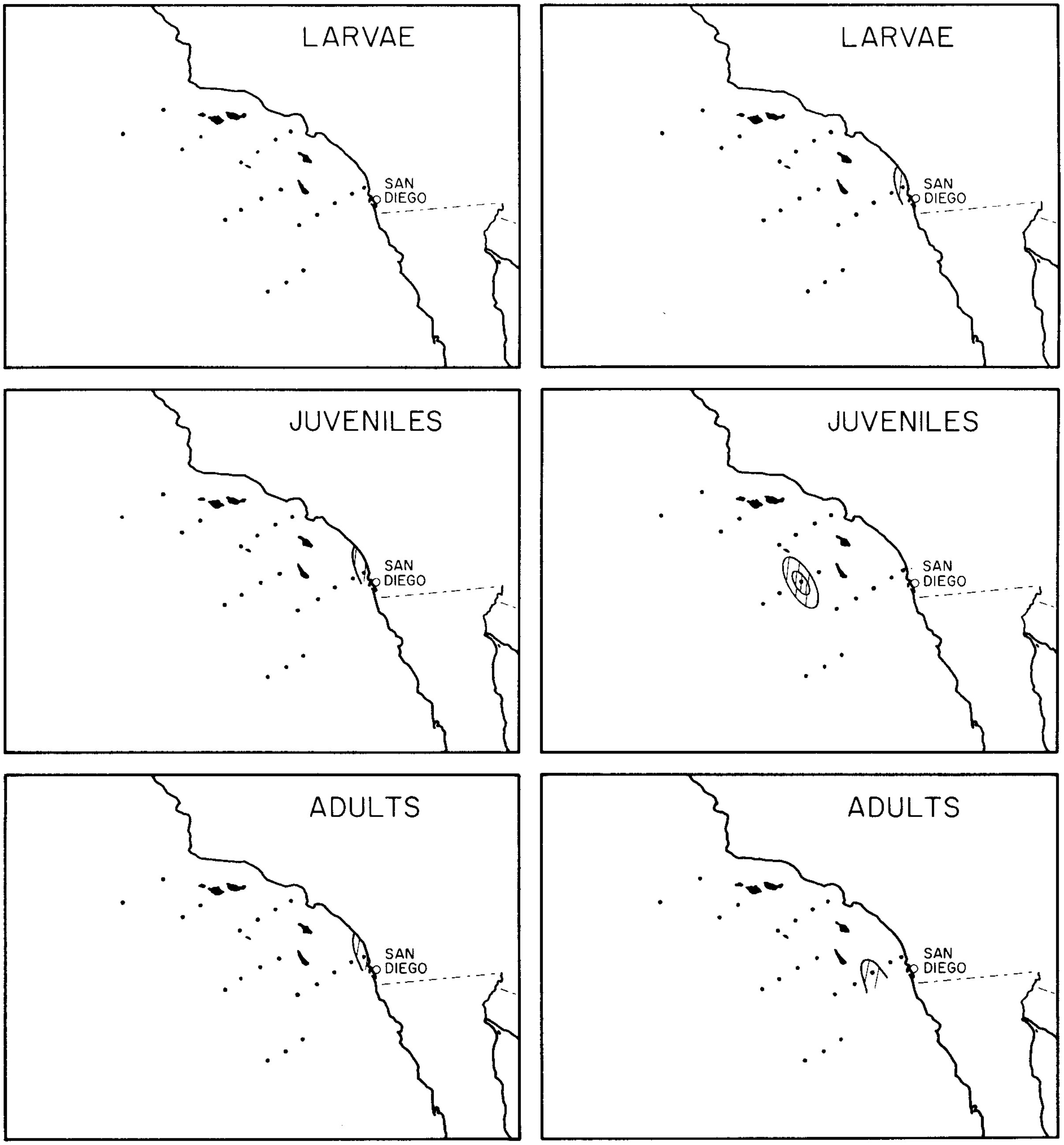
Thysanoessa spinifera *Euphausia eximia*



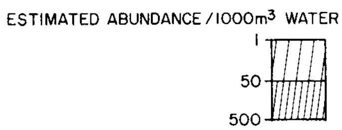
Euphausiacea

Thysanoessa spinifera
Euphausia eximia
5611

CALCOFI CRUISE 5611
30 OCTOBER – 5 NOVEMBER 1956



Thysanoessa spinifera *Euphausia eximia*



CALCOFI CRUISE 5612

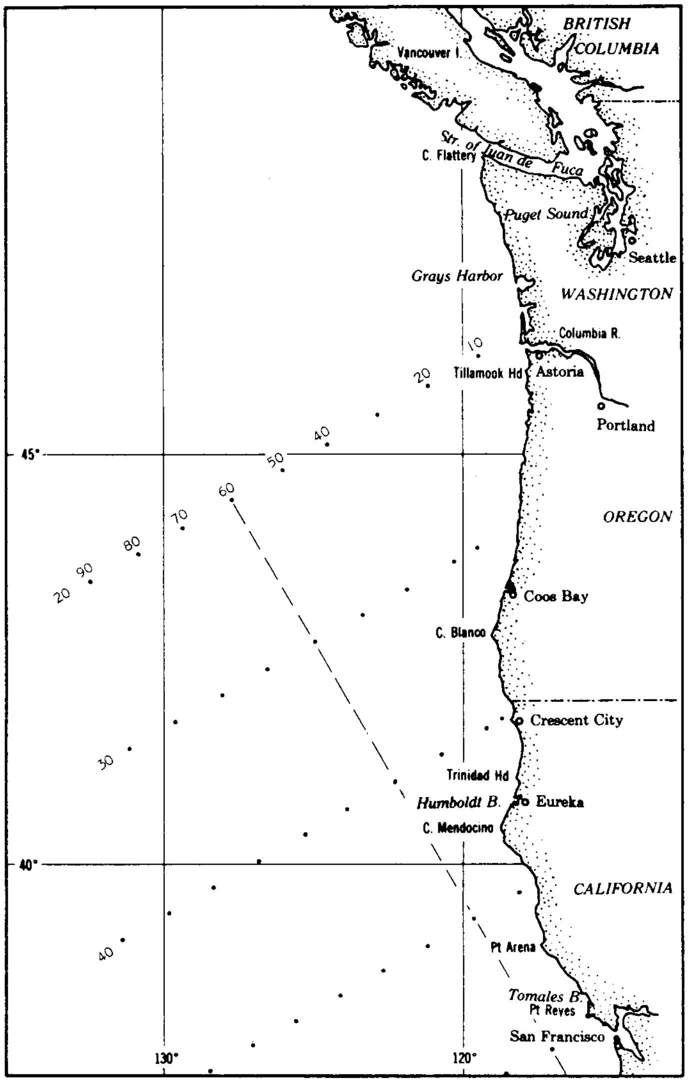
6–12 DECEMBER 1956

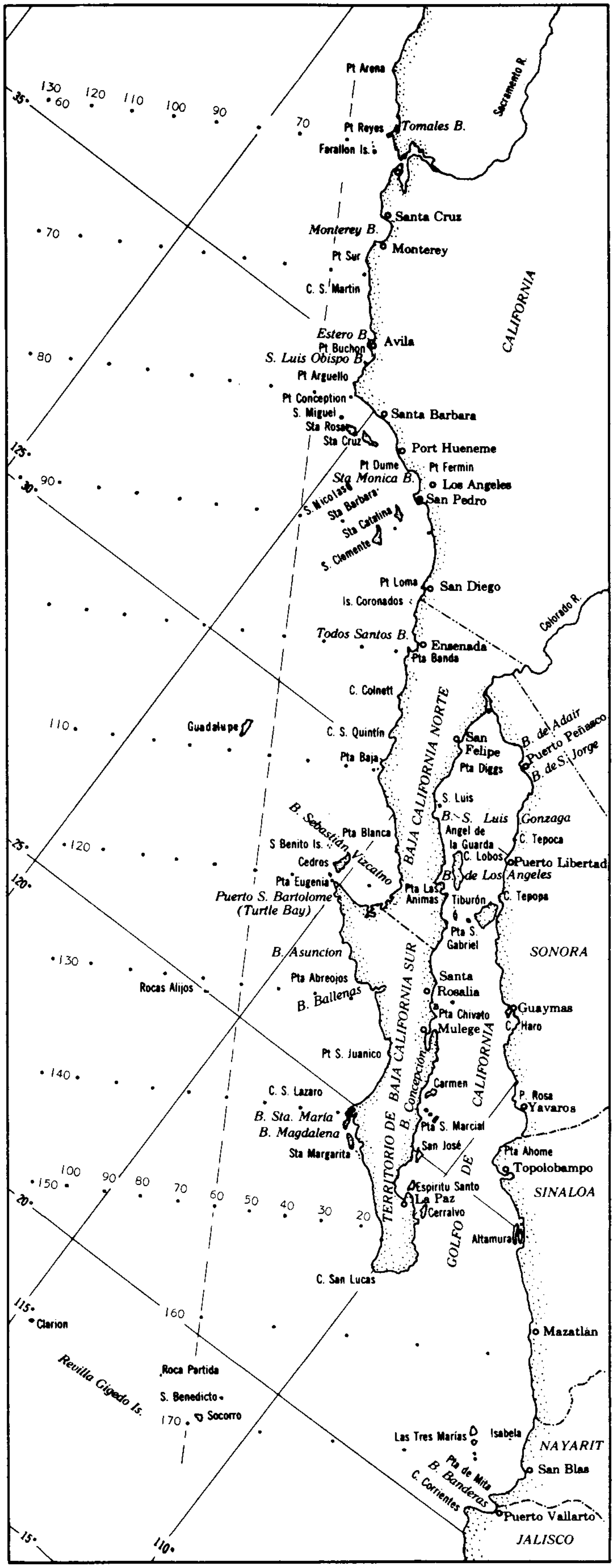
Euphausiacea

Thysanoessa spinifera

Euphausia eximia

5612





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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