



Atlas 7: Fleminger, A. Distributional atlas of calanoid copepods in the California Current region, Part II. Published May 1967.

16 May 2007

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

the Smithsonian web site,

http://ravenel.si.edu/iz/copepod/species/species_Search.cfm

Frost, B. and Fleminger, A. 1968. A revision of the genus *Clausocalanus* (Copepoda: Calanopoda) with remarks on distributional patterns in diagnostic characters. Bulletin of the Scripps Institution of Oceanography 12, 1-235.

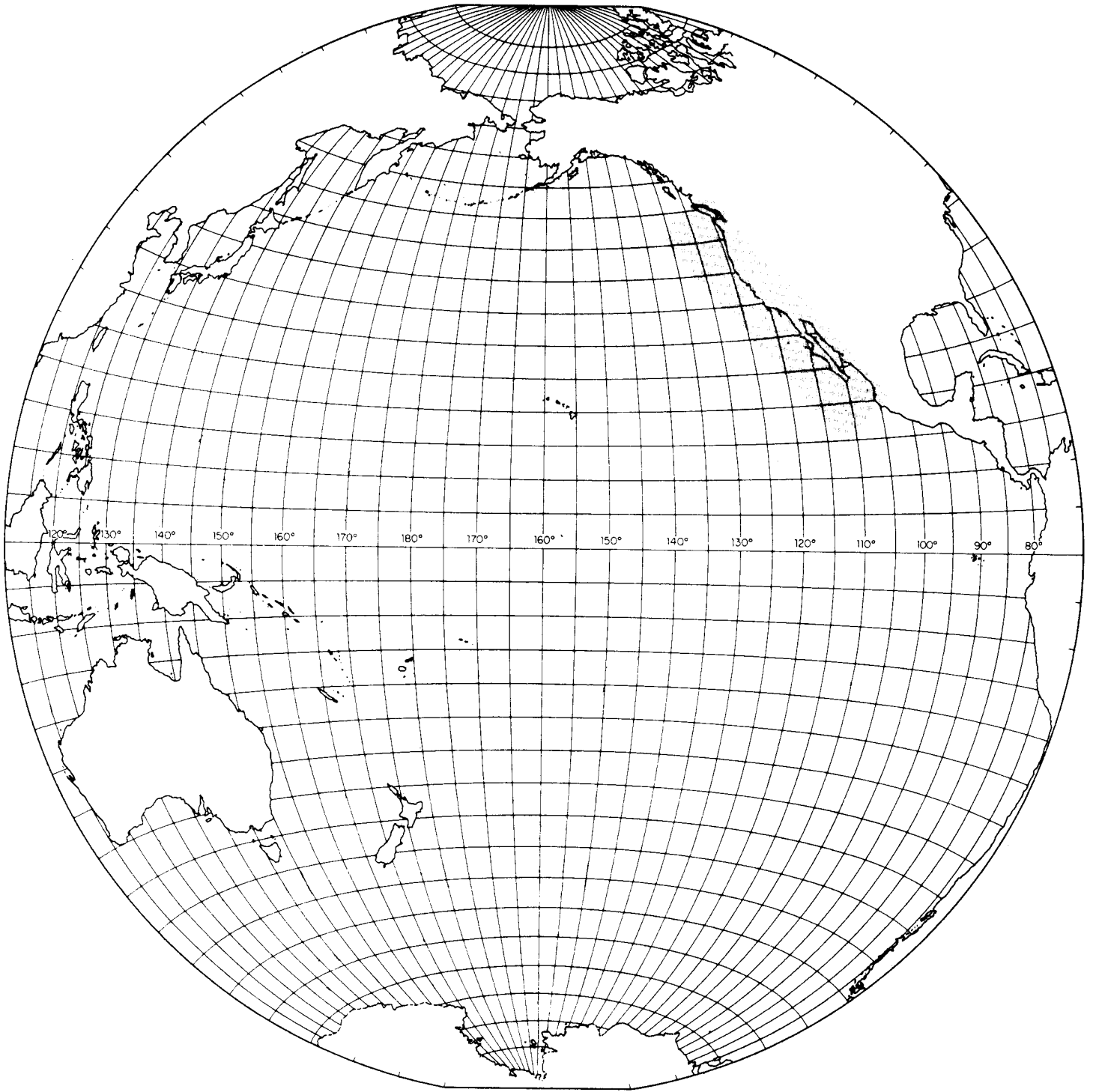
Bradford, J. 1976. Partial Revision of the Acartia subgenus Acartiura (Copepoda: Calanoida: Acartiidae). N.Z. Journal of Marine and Freshwater Research 19(1): 159-202.

Park, T. 1994. Taxonomy and distribution of the marine calanoid copepod family Euchaetidae. Bulletin of the Scripps Institution of Oceanography 29: 1-203.

Mauchline, J. 1998. The Biology of Calanoid Copepods. Advances in Marine Biology 33: 1-710.

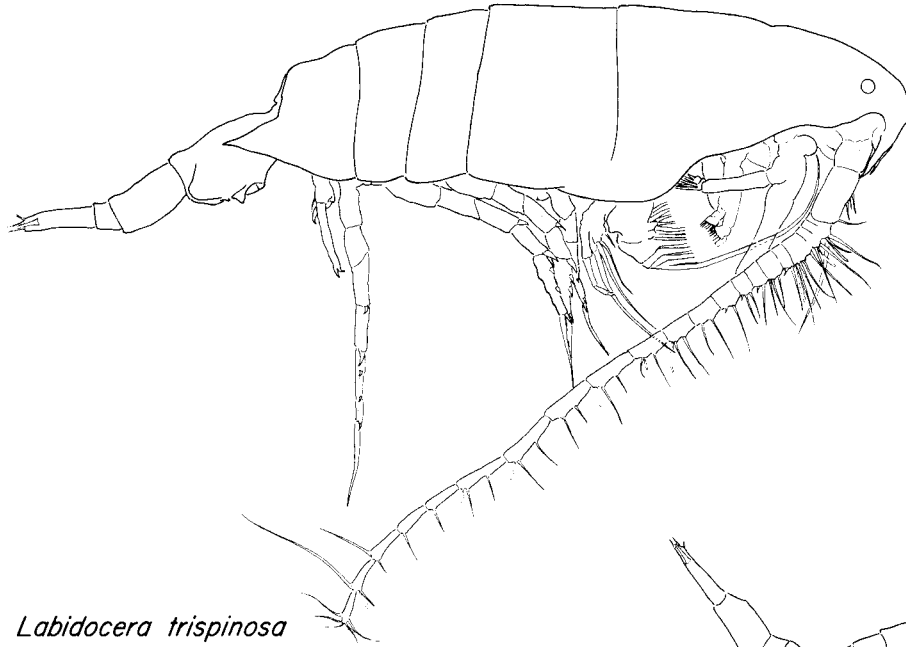
Park, T. 1999. Taxonomy and distribution of the marine calanoid copepod family Heterorhabdidae. Bulletin of the Scripps Institution of Oceanography 31: 1-269.

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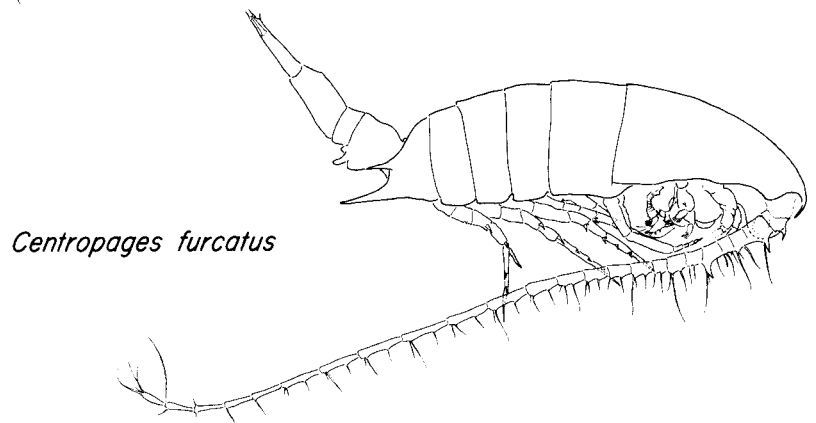
**CALIFORNIA COOPERATIVE OCEANIC
FISHERIES INVESTIGATIONS**

ATLAS No. 7

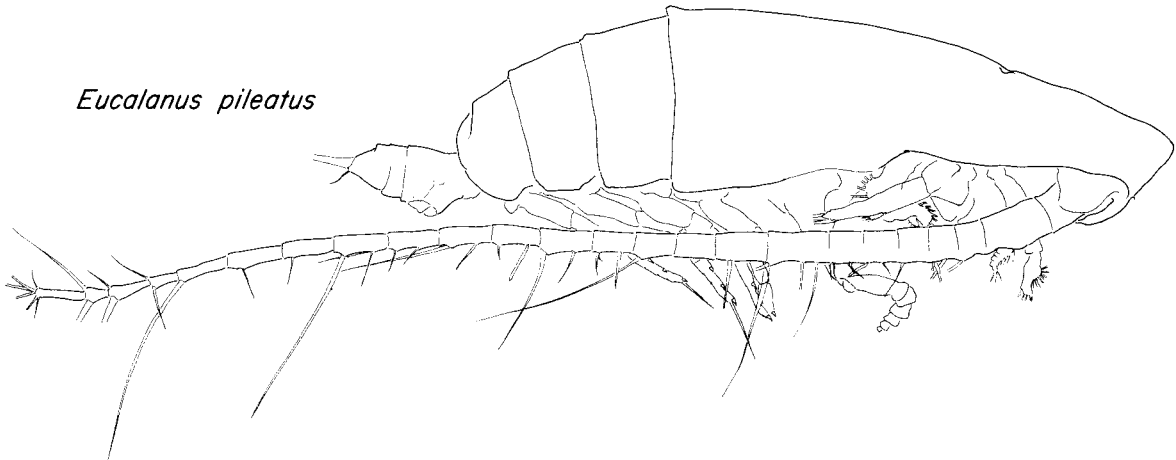


Labidocera trispinosa

0.5 mm



Centropages furcatus



Eucalanus pileatus

CALIFORNIA
COOPERATIVE
OCEANIC
FISHERIES
INVESTIGATIONS

Atlas No. 7

STATE OF CALIFORNIA
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May, 1967

THE CALCOFI ATLAS SERIES

This is the seventh 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
U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries
University of California, Scripps Institution of Oceanography

CalCOFI atlases² are issued as individual units as they become available. They provide processed physical, chemical and biological measurements of the California Current region. Each number may contain one or more contributions. A general description of the CalCOFI Program with its objectives appears in the preface of Atlas No. 2.

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

CalCOFI Atlas Editorial Staff:

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

Atlases in this series, through June 1967, are:

- CalCOFI Atlas No. 1
Anonymus. CalCOFI atlas of 10-meter temperatures and salinities 1949 through 1959.
- CalCOFI Atlas No. 2
Fleminger, A. Distributional atlas of calanoid copepods in the California Current region, Part I.
- CalCOFI Atlas No. 3
Alvaríño, A. Distributional atlas of Chaetognatha in the California Current region.
- CalCOFI Atlas No. 4
Wyllie, J. G. Geostrophic flow of the California Current at the surface and at 200 meters.
- CalCOFI Atlas No. 5
Brinton, E. Distributional atlas of Euphausiacea (Crustacea) in the California Current region, Part I.
- CalCOFI Atlas No. 6
McGowan, J. A. Distributional atlas of pelagic molluscs in the California Current region.
- CalCOFI Atlas No. 7
Fleminger, A. Distributional atlas of calanoid copepods in the California Current region, Part II.
- CalCOFI Atlas No. 8
Bernier, L. Distributional atlas of Thaliacea in the California Current region.

¹ Usually abbreviated CalCOFI, sometimes CALCOFI or CCOFI.

² For citation this issue in the series should be referred to as CalCOFI Atlas No. 7.

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IN THE CALIFORNIA CURRENT REGION, PART II¹

A. Fleminger²

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Introduction

This Atlas, No. 7 in the CalCOFI series, contains the second and final part dealing with the distribution of calanoid copepods in the California Current region (Chart 1) during CalCOFI Cruises 5804, 5807, 5810 and 5901. The area surveyed by the four cruises is roughly outlined by the latitudes 20°N and 40°N, and by longitude 130°W and the Pacific coastline of North America. Part I (Fleminger, 1964) appears in CalCOFI Atlas No. 2, which also contains descriptive accounts of plankton-collecting methods of the CalCOFI Program, procedures used in enumerating calanoid copepods in this study and charted distributions for 92 of the species that were found.

Distribution of the remaining 84 species of Calanoida are shown in the present Atlas. A combined list of calanoid species whose distributions appear in Parts I and II is given in Table I. Descriptive faunal, biogeographical and quantitative notes on these species are summarized in the paragraphs that follow.

¹ This research was carried out under the Scripps Institution's Marine Life Research Program with partial support from the National Science Foundation, Grant GB-2861.

² Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California.

Remarks on Distribution and Abundance

A total of 176 species, belonging to 57 genera, 21 families (Table I), was found in the 154 samples selected for examination. Most of these species occur regularly within the epiplanktonic layer and, in fact, above the thermocline for at least a portion of each 24-hour cycle.

A number of species (e.g., Undeuchaeta intermedia, Scottocalanus helenae, Lophothrix frontalis, Euchirella galeata, Pleuromamma xiphias) occur primarily in samples collected during night hours (local time) with sufficient regularity to suggest that during daylight hours they normally occur below the stratum sampled (about 140 to 0 meters) by the standardized CalCOFI tow. Some, perhaps 10% or less, appear only in isolated instances and are probably based on stray individuals rising from mesoplanktonic depths (e.g., Gaussia, Arietellus). Relatively few surprises are to be found in Table I.

A critical collation by the author of previously published records of calanoid copepods from within this region has yielded a list of about 190 species and 65 genera (unpublished; see Davis, 1949, for a review of the older literature). Many of these records are from tows taken hundreds of meters below the epiplanktonic stratum sampled by CalCOFI tows. They include, for example, 50 meso- or bathyplanktonic species known only from the original description (mostly species of Esterly, 1906-1913). Also contained in the collated list are species broadly neritic in habitat and characteristically restricted to the boreal Subarctic region lying north of Cape Mendocino (e.g., Candacia columbiae Campbell and Centropages abdominalis Sato), or to the equatorial Panamic region bordering on the south (e.g., Pontella agassizi Giesbrecht and Labidocera lubbockii Giesbrecht). Otherwise, Table I contains all the species found previously in the region together with some additions.

Subsequent investigations I have carried out in the California Current region have not added appreciably to this list of species. Thus I consider it likely that Table I contains at least 90% of the epiplanktonic calanoids to be found within the California Current region under the general climatic conditions prevailing during the past decade.

To provide a measure of the epiplanktonic calanoid fauna under discussion, a comparison can be made with a recent zooplankton study undertaken off eastern North America (Grice and Hart, 1962). The two studies are not strictly comparable but Grice and Hart's list of calanoid copepods appears to be about as complete for sampling across the western boundary current of the North Atlantic Ocean as the present list is for sampling across the eastern boundary current in the North Pacific Ocean. In 44 samples Grice and Hart found 115 species of Calanoida. Individually,

the four CalCOFI cruises yielded somewhat higher numbers of species for similar sampling intensities: 5804 -- 141 species in 43 samples; 5807 -- 148 species in 35 samples; 5810 -- 137 species in 37 samples; 5901 -- 139 species in 39 samples. Combining the four CalCOFI seasonal lists brings the total number of different species to 176. Twenty (or 11%) of the California Current species appear in 57% or more of the total number of samples examined. Only two species (or 2%) in the Atlantic study occurred at this frequency. In both studies 70 to 75% of the species occurred in less than 25% of the samples.

At present, faunal and habitat affinities of the calanoids listed in Table I cannot be judged for all species. Some are known from too few localities to assess their affinities with reasonable assurance. Many, however, can be assigned on the combined bases of local distributions, previously published records (too lengthy to cite sources here) and generalized faunal patterns derived from studies on other zooplankton of the region (summarized by Johnson and Brinton, 1963). These species can be classified as to probable faunal affinity with regard to the North Pacific Ocean but it should be pointed out that in other sectors of the world's oceans they may exhibit some what different relationships.

Within the California Current region the copepods appear to fall into the following major biogeographical-habitat groups:

Subarctic species -- Calanus cristatus, C. plumchrus, Scolecithricella minor

Transitional species -- Calanus helgolandicus, Eucalanus bungii californicus, Candacia bipinnata, Rhincalanus nasutus, Pleuromamma borealis, Metridia lucens, Clausocalanus pergens 2, Heterorhabdus tanneri, Racovitzanus antarcticus, Scolecithricella ovata

Central species -- Calanus gracilis, Clausocalanus arcuicornis 2, C. farrani 2, C. paululus, Euchaeta media, Mecynocera clausi, Centropages violaceus, C. elegans, C. elongatus, Pleuromamma xiphias, Paracandacia bispinosa, P. simplex, Eucalanus elongatus hyalinus

Equatorial oceanic species -- Scolecithricella abyssalis, Euchaeta acuta, E. longicornis, Clausocalanus minor, Eucalanus inermis, Centropages gracilis, Paracandacia truncata, Candacia pofi

Coastal-neritic species

Endemics -- Labidocera trispinosa, L. jollae, Pontellopsis occidentalis

Non-endemics, boreal-temperate -- Acartia clausi, Tortanus discaudatus, Epilabidocera longipedata

Non-endemics, temperate-subtropical -- Acartia tonsa, Paracalanus parvus, Temora discaudata, Clausocalanus farrani 1, Candacia curta

Non-endemics, tropical -- Acartia lilljeborgi, Euchaeta wolfendini, Centropages furcatus, Candacia catula, Eucalanus pileatus, Labidocera acuta.

Many of the oceanic species appear regularly in both Central and Equatorial waters: Euchaeta marina, Scolecithrix danae, S. bradyi, Calanus minor, Pleuromamma abdominalis, P. gracilis, Clausocalanus furcatus, C. arcuicornis 1, Eucalanus attenuatus, Scaphocalanus echinatus, Labidocera detruncata, L. acutifrons. Thus, the Calanoida found in the California Current region comprise a heterogeneous group of several faunal and habitat assemblages.

As suggested by the variety of faunal and habitat groupings, plankton sampling by the CalCOFI Program is carried out in a variety of zoned habitats (coastal and offshore neritic, slope, and oceanic waters), and yields a mixture of several biogeographical faunas (Transitional, Central, Equatorial). In general, the assortment of copepods taken in any single CalCOFI sample is not representative of any single faunal or habitat assemblage mentioned above. Usually, a sample contains combinations of Transitional and Subarctic, or Transitional and Central assemblages. More rarely, and only in the southernmost third of the region, Transitional-Equatorial assemblages are encountered. Mixtures of inshore and offshore forms as well as excursions of mesoplanktonic elements also typically affect the composition of individual samples. The absence of sharply zoned assemblages can be attributed to two factors. The first is the over-all oceanic climate of our region characterized by relatively weak physical and chemical gradients, seasonally variable winds, counter-currents and semi-permanent eddies, all of which enhance advection and faunal mixing. The second is sampling through a water column about 140 meters deep, a procedure that obscures vertically zoned habitat or faunal groupings in accordance with the behavior of a species as well as with layering or interleaving of adjacent water masses.

Expatriated forms can be followed to the extent that they remain viable away from their typical habitat, occur in sufficient numbers to satisfy the resolving power of sampling intensity and do not react to expatriation by extensive one-way vertical migration as apparently practiced by certain of the California Current copepods (Fleminger, 1966). CalCOFI plankton-tows taken seaward of the zone dominated by coastal plankton, especially south of Point Conception and north of Punta Eugenia, can and usually do contain a highly diverse, non-homogeneous mixture of different faunal and habitat types.

Finally, note should be taken of the most frequently occurring species in the region (Table II). The 24 species are listed in decreasing order of their appearance in the 154 samples examined during this study. If the list is subdivided by faunal-habitat affinity, and the probable differences in sampling efficiency due to size and behavior of the organisms are overlooked, we find 11 species with joint Central-Equatorial distributions, seven from Transitional water, two from Central water and four broadly neritic, non-endemic, temperate to tropical, species. Thus, faunal heterogeneity of the copepods in the California Current region is evident even among the most frequently appearing species.

Table I. Species List for CalCOFI Cruises 5804, 5807, 5810 and 5901

<p>Family Acartiidae</p> <p><i>Acartia clausi</i> Giesbrecht 1889*</p> <p><i>danae</i> Giesbrecht 1889*</p> <p><i>Hilobobry</i> Giesbrecht 1889*</p> <p><i>negligens</i> Dana 1849*</p> <p><i>tonsa</i> Dana 1849*</p>	<p>Family Lucicutiidae</p> <p><i>Lucicutia clausi</i> (Giesbrecht 1889)</p> <p><i>flavicornis</i> (Claus 1863)*^a</p> <p><i>gaussae</i> Grice 1963</p>
<p>Family Aetideidae</p> <p><i>Aetideus armatus</i> (Boeck 1872)</p> <p><i>Chirundina streetsi</i> Giesbrecht 1895</p> <p><i>Euaetideus acuta</i> (Farran 1929)</p> <p><i>bradyi</i> (A. Scott 1909)</p> <p><i>giesbrechti</i> (Cleve 1904)</p> <p><i>Euchirella amoena</i> Giesbrecht 1888</p> <p><i>carlicauda</i> Giesbrecht 1892</p> <p><i>formosa</i> Verwoort 1949</p> <p><i>galata</i> (Giesbrecht 1888)</p> <p><i>intermedia</i> With 1915</p> <p><i>maxima</i> Wolfenden 1905</p> <p><i>pulchra</i> (Lubbock 1856)</p> <p><i>rostrata</i> (Claus 1866)</p> <p>sp.</p> <p><i>Gaetanus miles</i> Giesbrecht 1888</p> <p><i>minor</i> Farran 1905</p> <p><i>Gaidius pungens</i> Giesbrecht 1895</p> <p><i>Undeuchaeta intermedia</i> A. Scott 1909</p> <p><i>plumosa</i> (Lubbock 1856)</p>	<p>Family Metridiidae</p> <p><i>Gaussia princeps</i> (T. Scott 1894)</p> <p><i>Metridia brevicauda</i> Giesbrecht 1889</p> <p><i>Lucena</i> Boeck 1864 s.l. (= <i>M. pacifica</i> Brodsky 1950)*</p> <p><i>Pleuromamma abdominalis</i> (Lubbock 1856)*</p> <p><i>borealis</i> (Dahl 1893)*</p> <p><i>gracilis</i> (Claus 1863)*</p> <p><i>quadrangulata</i> (Dahl 1893)*</p> <p><i>robusta</i> (Dahl 1893)^b</p> <p><i>ziphius</i> (Giesbrecht 1889)*</p>
<p>Family Arietellidae</p> <p><i>Arietellus plumifer</i> Sars 1905</p> <p><i>setosus</i> Giesbrecht 1892</p> <p><i>Phyllopus integer</i> Esterly 1911</p>	<p>Family Paracalanidae</p> <p><i>Acrocalanus gibber</i> Giesbrecht 1888</p> <p><i>gracilis</i> Giesbrecht 1888</p> <p><i>Longicornis</i> Giesbrecht 1888*</p> <p><i>monachus</i> Giesbrecht 1888</p> <p><i>Calocalanus contractus</i> Farran 1926</p> <p><i>pavo</i> Dana 1849</p> <p><i>pavoninus</i> Farran 1936</p> <p><i>styliremis</i> Giesbrecht 1888</p> <p><i>Ischnocalanus gracilis</i> (Tanaka 1953)</p> <p><i>plumulosus</i> (Claus 1863)</p> <p><i>ternis</i> (Farran 1926)</p> <p><i>Paracalanus aculeatus</i> Giesbrecht 1888*</p> <p><i>denudatus</i> Sewell 1929*</p> <p><i>nanus</i> Sars 1907*</p> <p><i>nudus</i> Sewell 1929*</p> <p><i>parvus</i> (Claus 1863)*</p>
<p>Family Augaptilidae</p> <p><i>Augaptilus lamellifer</i> Esterly 1911 (? = <i>anceps</i> Farran 1908)</p> <p><i>longicaudatus</i> (Claus 1863)</p> <p><i>megalurus</i> Giesbrecht 1892</p> <p><i>Euaugaptilus hecticus</i> (Giesbrecht 1889)</p> <p><i>palumboi</i> (Giesbrecht 1889)</p> <p><i>Haloptilus acutifrons</i> (Giesbrecht 1892)</p> <p><i>austini</i> Grice 1959</p> <p><i>longicornis</i> (Claus 1863)</p> <p><i>micromatus</i> (Claus 1863)</p> <p><i>ornatus</i> (Giesbrecht 1892)</p> <p><i>spiniceps</i> (Giesbrecht 1892)</p>	<p>Family Phaennidae</p> <p><i>Amalophora vorax</i> (Esterly 1911) (= <i>Scolecithrix</i> _)</p> <p><i>Phaenna latus</i> (Esterly 1911) (= <i>Onchocalanus</i> _)</p> <p><i>spinifera</i> Claus 1863</p>
<p>Family Calanidae</p> <p><i>Calanus cristatus</i> Kroyer 1848*</p> <p><i>helgolandicus</i> (Claus 1863) s.l.* (= <i>pacificus</i> Brodsky 1948)</p> <p><i>lighti</i> Bowman 1955*</p> <p><i>plumulosus</i> Marukawa 1921*</p> <p><i>tenuicornis</i> Dana 1849*</p> <p>(<i>Hamocalanus</i>) <i>minor</i> (Claus 1863)*</p> <p>(<i>Neocalanus</i>) <i>gracilis</i> Dana 1849*</p> <p>(<i>Neocalanus</i>) <i>robustus</i> Giesbrecht 1888*</p> <p><i>Canthocalanus pauper</i> (Giesbrecht 1888)</p> <p><i>Undinula darwini</i> (Lubbock 1860)</p> <p><i>vulgaris</i> (Dana 1849)</p>	<p>Family Pontellidae</p> <p><i>Eptalabidocera longipedata</i> (Sato 1913) [= <i>amphitrites</i> (McMurrich 1916)]</p> <p><i>Labidocera acuta</i> (Dana 1849)</p> <p><i>acutifrons</i> (Dana 1849)</p> <p><i>destruata</i> (Dana 1849)</p> <p><i>jollae</i> Esterly 1906</p> <p><i>trispinosa</i> Esterly 1905</p> <p><i>Pontella danae</i> Giesbrecht 1889</p> <p><i>securifer</i> Brady 1883</p> <p><i>tenutremis</i> Giesbrecht 1889</p> <p><i>Pontellina plumata</i> (Dana 1849)</p> <p><i>Pontellopsis occidentalis</i> Esterly 1906</p> <p><i>regalis</i> (Dana 1849)</p>
<p>Family Candaciidae</p> <p><i>Candacia aethiopica</i> (Dana 1849)*</p> <p><i>bipinnata</i> (Giesbrecht 1889)*</p> <p><i>catula</i> (Giesbrecht 1889)*</p> <p><i>curta</i> (Dana 1849)*</p> <p><i>longimana</i> (Claus 1863)*</p> <p><i>poft</i> Grice and Jones 1960</p> <p><i>tenutrema</i> (Giesbrecht 1889)*</p> <p><i>varicosa</i> (Giesbrecht 1892)*</p> <p><i>Rarocandacia bipinnosa</i> (Claus 1863)*</p> <p><i>simplex</i> (Giesbrecht 1889)*</p> <p><i>truncata</i> (Dana 1849)*</p>	<p>Family Pseudocalanidae</p> <p><i>Clausocalanus arcuicornis</i> (Dana 1849) (In Part I = <i>arcuicornis</i> 3)*</p> <p><i>farrani</i> Sewell 1929 (In Part I = <i>farrani</i> 2)</p> <p><i>furcatus</i> (Brady 1883)</p> <p><i>metastigophorus</i> (Claus 1863) (In Part I = <i>arcuicornis</i> 1)</p> <p><i>minor</i> Sewell 1929 (In Part I = <i>arcuicornis</i> 4)</p> <p><i>paululus</i> Farran 1926</p> <p><i>pergens</i> Farran 1926</p> <p>sp. (In Part I = <i>arcuicornis</i> 2)^c</p> <p>sp. (In Part I = <i>farrani</i> 1)^c</p> <p>sp. (In Part I = <i>pergens</i> 1)^c</p> <p><i>Ctenocalanus varius</i> Giesbrecht 1888</p> <p><i>Microcalanus pusillus</i> Sars 1903</p>
<p>Family Centropagidae</p> <p><i>Centropages bradyi</i> Wheeler 1900*</p> <p><i>calaninus</i> (Dana 1849)*</p> <p><i>elegans</i> Giesbrecht 1895*</p> <p><i>elongatus</i> Giesbrecht 1896*</p> <p><i>furcatus</i> (Dana 1849)*</p> <p><i>gracilis</i> (Dana 1849)*</p> <p><i>violaceus</i> (Claus 1863) s.l.*</p>	<p>Family Scolecithricidae</p> <p><i>Lophothrix frontalis</i> Giesbrecht 1895</p> <p><i>Latipes</i> (T. Scott 1894)</p> <p><i>Racovitsanus antarcticus</i> Giesbrecht 1902</p> <p><i>Scaphocalanus curtus</i> (Farran 1926)*</p> <p><i>ochinatus</i> (Farran 1905)*</p> <p><i>magnus</i> (T. Scott 1894)</p> <p><i>medius</i> (Sars 1907)</p> <p><i>Scolecithricella abyssalis</i> (Giesbrecht 1892)*</p> <p><i>auropetiti</i> (Giesbrecht 1892)</p> <p><i>ctenopus</i> (Giesbrecht 1892)*</p> <p><i>dentata</i> (Giesbrecht 1892)*</p> <p><i>minor</i> (Brady 1883)</p> <p><i>nicobarica</i> (Sewell 1929)*</p> <p><i>ovata</i> (Farran 1905)*</p> <p><i>tenuiserrata</i> (Giesbrecht 1892)*</p> <p><i>vittata</i> (Giesbrecht 1892)</p> <p><i>Scolecithrix bradyi</i> Giesbrecht 1888*</p> <p><i>danae</i> (Lubbock 1856)*</p> <p><i>Scotocalanus helena</i> (Lubbock 1856)</p> <p><i>persecans</i> (Giesbrecht 1892)</p> <p><i>securifrons</i> (T. Scott 1894)</p>
<p>Family Eucalanidae</p> <p><i>Eucalanus attenuatus</i> (Dana 1849)</p> <p><i>burgii californicus</i> Johnson 1938</p> <p><i>crassus</i> Giesbrecht 1888</p> <p><i>elongatus hyalinus</i> Claus 1866</p> <p><i>inermis</i> Giesbrecht 1892</p> <p><i>pileatus</i> Giesbrecht 1888</p> <p><i>subcrassus</i> Giesbrecht 1888</p> <p><i>subtennis</i> Giesbrecht 1888</p> <p><i>Meocynoera clausi</i> Thompson 1888</p> <p><i>Rhinoalanus nasutus</i> Giesbrecht 1888</p>	<p>Family Spinocalanidae</p> <p><i>Mimocalanus cultrifer</i> Farran 1908</p> <p><i>Spinocalanus abyssalis</i> Giesbrecht 1888</p> <p><i>magnus</i> Wolfenden 1904</p>
<p>Family Euchaetidae</p> <p><i>Euchaeta acuta</i> Giesbrecht 1892*</p> <p><i>californica</i> Esterly 1906*</p> <p><i>elongata</i> Esterly 1913*</p> <p><i>longicornis</i> Giesbrecht 1888*</p> <p><i>marina</i> (Prestandrea 1853)*</p> <p><i>media</i> Giesbrecht 1888*</p> <p><i>pubera</i> Sars 1925*</p> <p><i>spinosa</i> Giesbrecht 1892*</p> <p><i>ternis</i> Esterly 1906*</p> <p><i>tonsa</i> Giesbrecht 1895*</p> <p><i>wolfendini</i> A. Scott 1909*</p>	<p>Family Temoridae</p> <p><i>Temora discaudata</i> Giesbrecht 1889*</p> <p><i>Temoropia myzobaensis</i> T. Scott 1894</p>
<p>Family Heterorhabdidae</p> <p><i>Heterorhabdus clausi</i> (Giesbrecht 1889)</p> <p><i>papilliger</i> (Claus 1863)</p> <p><i>spinifrons</i> (Claus 1863)</p> <p><i>tanneri</i> (Giesbrecht 1895)</p> <p><i>Heterostylites longicornis</i> (Giesbrecht 1889)</p>	<p>Family Tharybidae</p> <p><i>Undinella brevipes</i> Farran 1908</p>
	<p>Family Tortanidae</p> <p><i>Tortanus discaudatus</i> Thompson and Scott 1897</p>

* Species appearing in Part I (CalCOFI Atlas No. 2)

^a Including *L. gemina* Farran 1926

^b Given as *Pleuromamma indica* in Part I (CalCOFI Atlas No. 2), pp. xiii, 262, 264, 265

^c Descriptions in preparation with B. Frost

Table II. Occurrence (%) and Relative Abundance (No./1000m³) of Common Species (Adults Only)

Species	Occurrence (%) All Cruises, 154 Stations	5804	5807	5810	5901
		Occurrence (%) 43 Stations (Abundance Median; Range 0 to)	Occurrence (%) 35 Stations (Abundance Median; Range 0 to)	Occurrence (%) 37 Stations (Abundance Median; Range 0 to)	Occurrence (%) 39 Stations (Abundance Median; Range 0 to)
1. <i>Calanus tenuicornis</i>	94	100 (210; 1048**)	94 (200; 1289)	92 (62; 815)	87 (53; 491)
2. <i>Ctenocalanus vanus</i> *	92	95 (137; 1170)	97 (170; 2469)	89 (79; 677)	85 (105; 1792)
3. <i>Calanus minor</i>	78	88 (135; 1761)	54 (124; 1656)	92 (365; 1279)	77 (224; 3362)
4. <i>Acartia danae</i> *	78	86 (68; 2419)	74 (201; 899)	84 (61; 582)	67 (27; 135)
5. <i>Clausocalanus furcatus</i> *	77	81 (264; 3797)	54 (304; 2506)	81 (348; 1289)	87 (319; 1646)
6. <i>Heterorhabdus papilliger</i>	74	84 (71; 390)	63 (43; 394)	73 (62; 512)	74 (75; 268)
7. <i>Pleuromamma gracilis</i>	74	74 (107; 1605)	49 (115; 686)	89 (77; 627)	82 (102; 528)
8. <i>Candacia bipinnata</i>	71	84 (48; 595)	66 (22; 602)	78 (63; 368)	54 (1; 213)
9. <i>Pleuromamma abdominalis</i>	70	65 (141; 1156)	54 (194; 1723)	76 (245; 1721)	85 (72; 2354)
10. <i>Pleuromamma borealis</i>	70	74 (279; 8404)	63 (399; 3780)	62 (360; 3733)	77 (421; 10164)
11. <i>Mecynocera clausi</i> *	68	72 (48; 428)	49 (17; 245)	76 (69; 262)	74 (58; 216)
12. <i>Calanus helgolandicus</i>	67	70 (388; 29891)	63 (206; 97483)	62 (161; 4209)	72 (349; 5552)
13. <i>Paracalanus parvus</i> *	67	56 (68; 1599)	74 (485; 17260)	60 (68; 1504)	80 (192; 2361)
14. <i>Candacia curta</i>	66	67 (54; 1476)	46 (38; 1642)	76 (36; 1351)	74 (36; 376)
15. <i>Clausocalanus pergens</i> 1*	64	81 (107; 1558)	71 (118; 2991)	57 (44; 1053)	46 (40; 1419)
16. <i>Lucicutia flavicornis</i>	62	84 (54; 378)	51 (42; 309)	54 (62; 247)	56 (39; 162)
17. <i>Clausocalanus farrani</i> 1*	62	51 (252; 4249)	46 (458; 7551)	73 (603; 9025)	80 (619; 5510)
18. <i>Clausocalanus arcuicornis</i> 1*	59	72 (123; 5400)	31 (259; 825)	65 (191; 1463)	64 (151; 3920)
19. <i>Scolecithrix danae</i>	58	58 (23; 520)	40 (1; 176)	78 (42; 990)	56 (28; 248)
20. <i>Clausocalanus arcuicornis</i> 2*	57	79 (115; 916)	63 (105; 570)	43 (82; 191)	41 (75; 752)
21. <i>Temora discaudata</i>	50	46 (72; 7335)	37 (93; 530)	54 (269; 8903)	62 (45; 1490)
22. <i>Metridia lucens</i>	49	51 (277; 3600)	54 (276; 33499)	54 (285; 44659)	38 (523; 15136)
23. <i>Rhincalanus nasutus</i>	46	74 (95; 11436)	43 (135; 838)	27 (21; 486)	36 (19; 554)
24. <i>Eucalanus bungii californicus</i>	43	63 (137; 6246)	54 (416; 6381)	19 (121; 1389)	33 (41; 587)

* Abundance likely to be underestimated due to small size relative to mesh size of net

** Range 1-1048

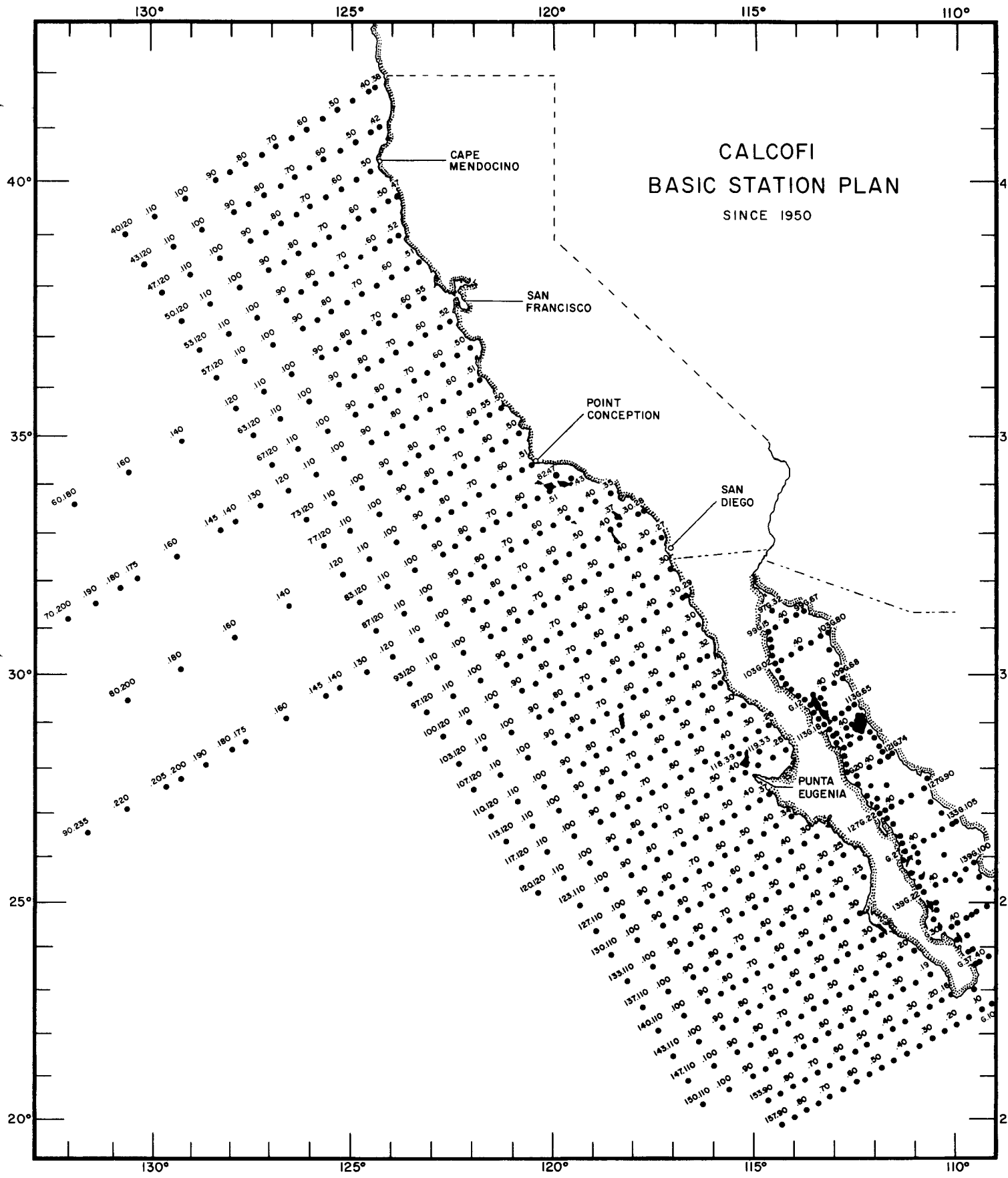
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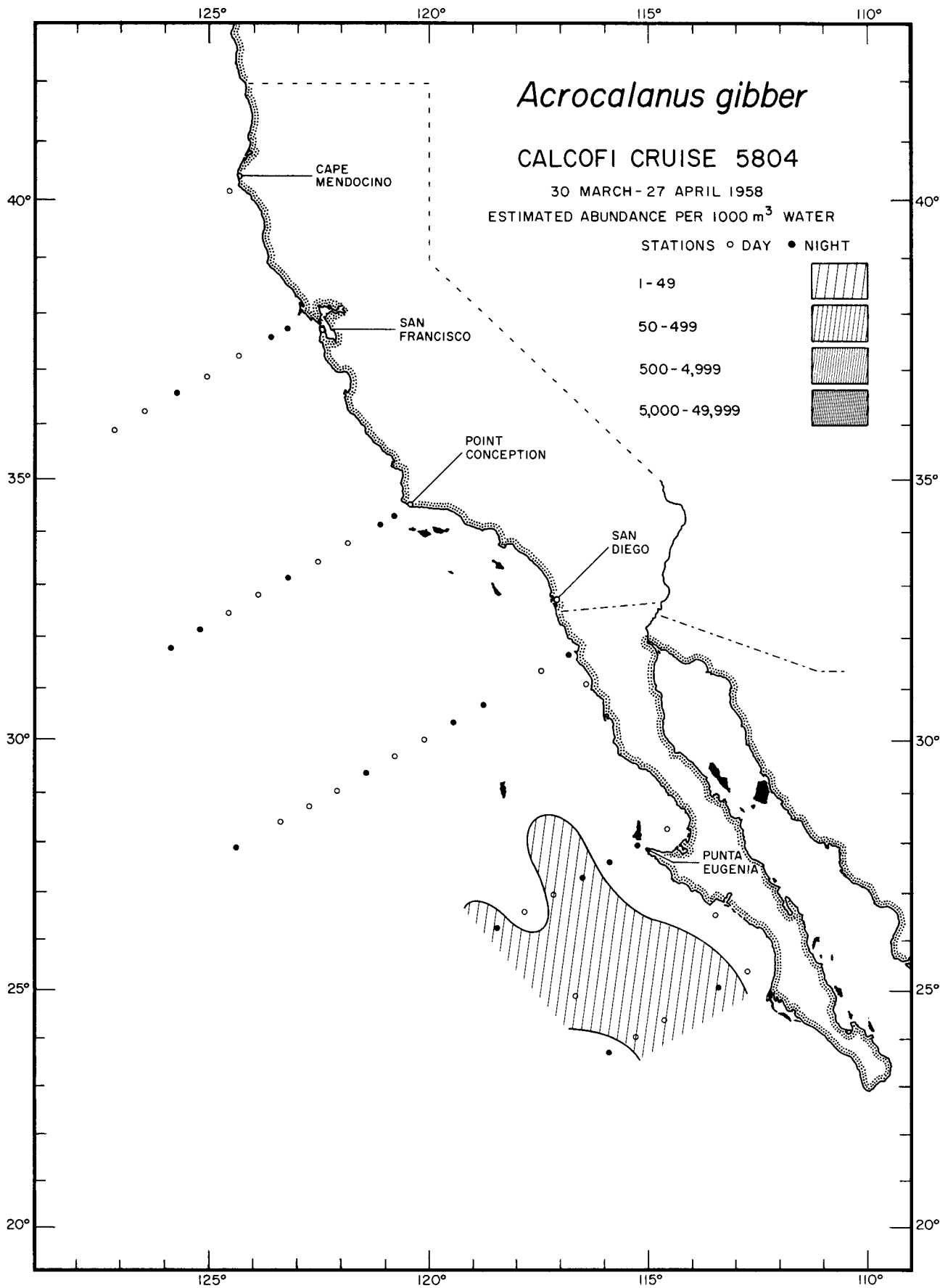
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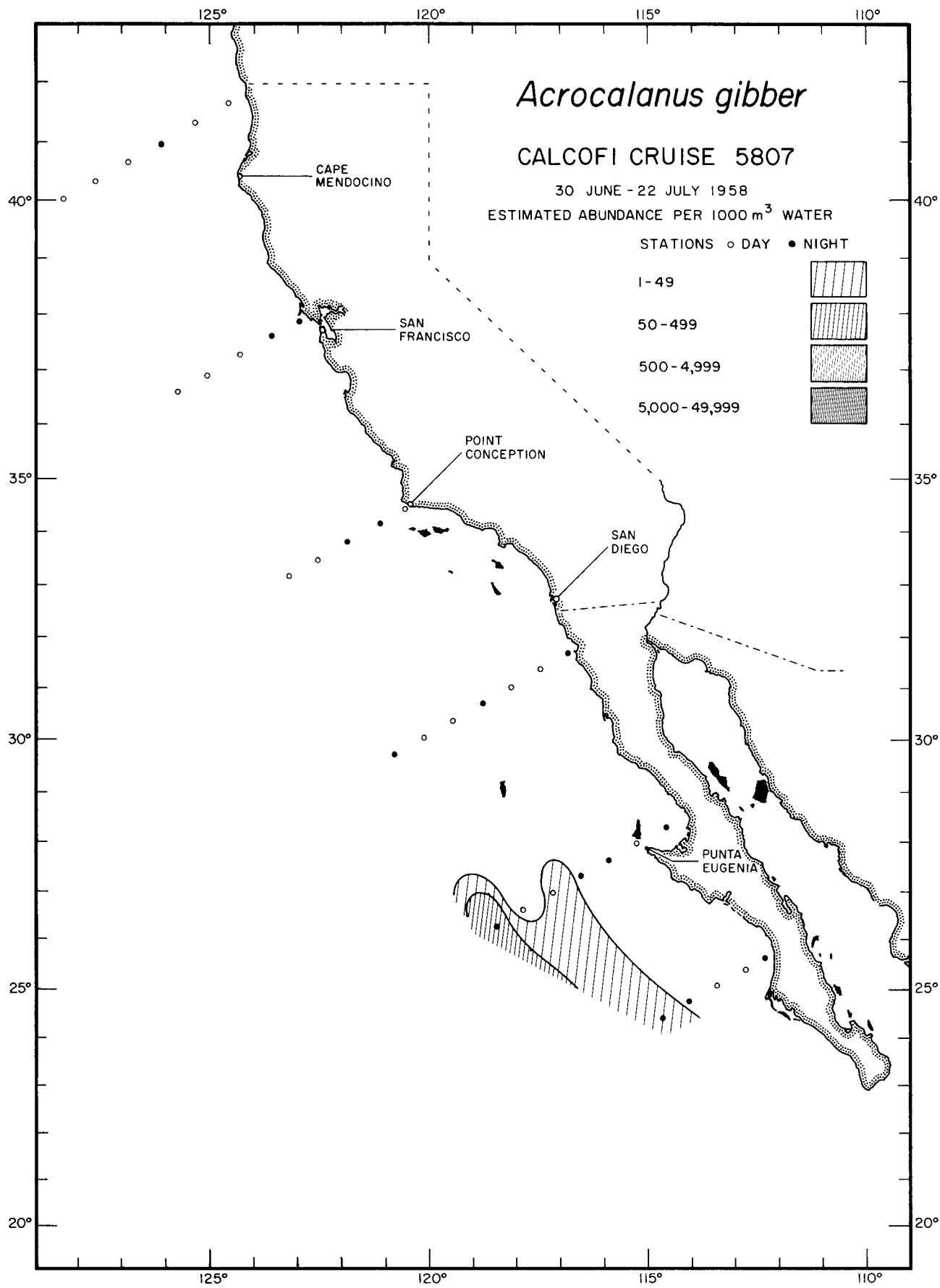


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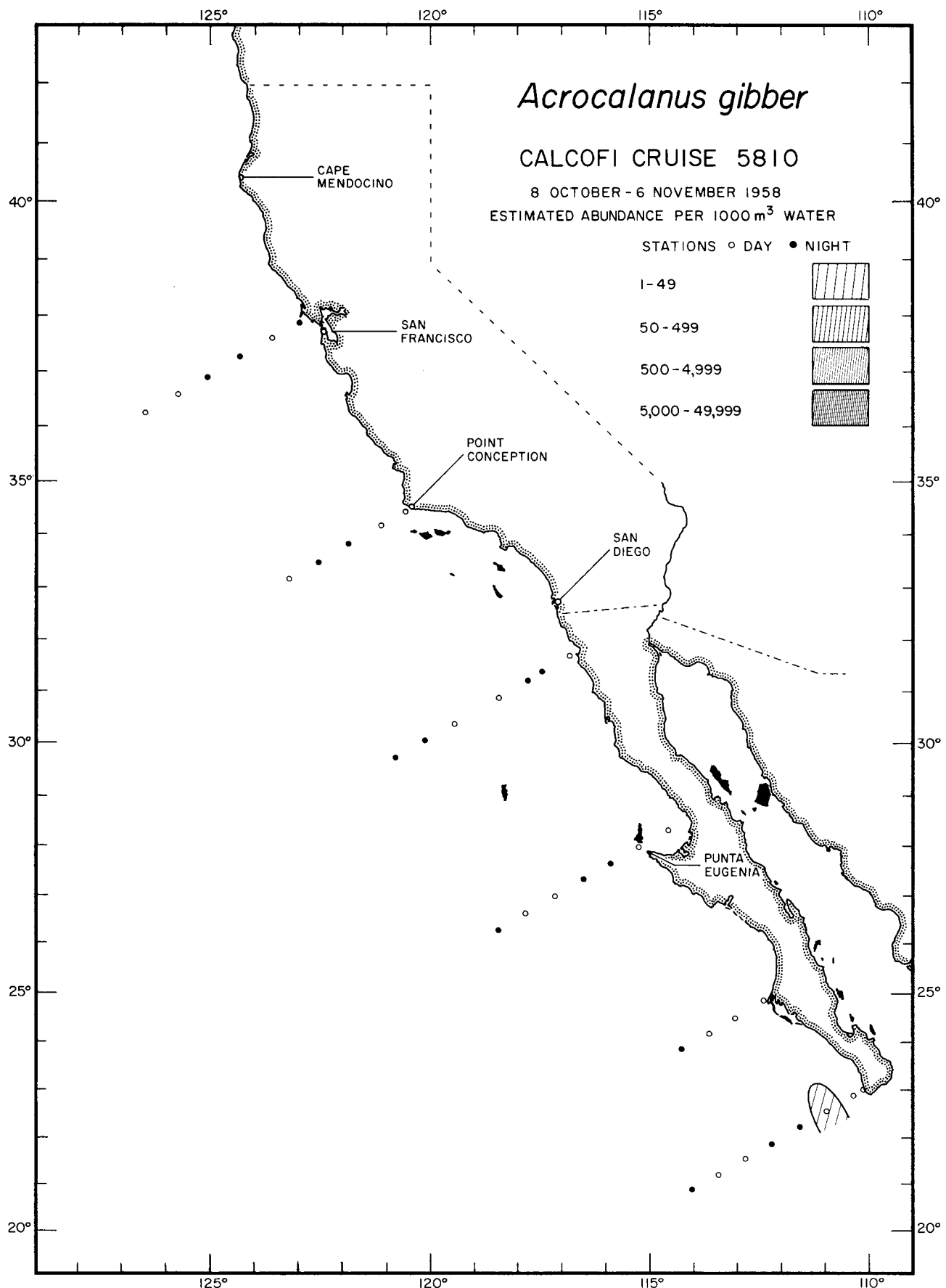
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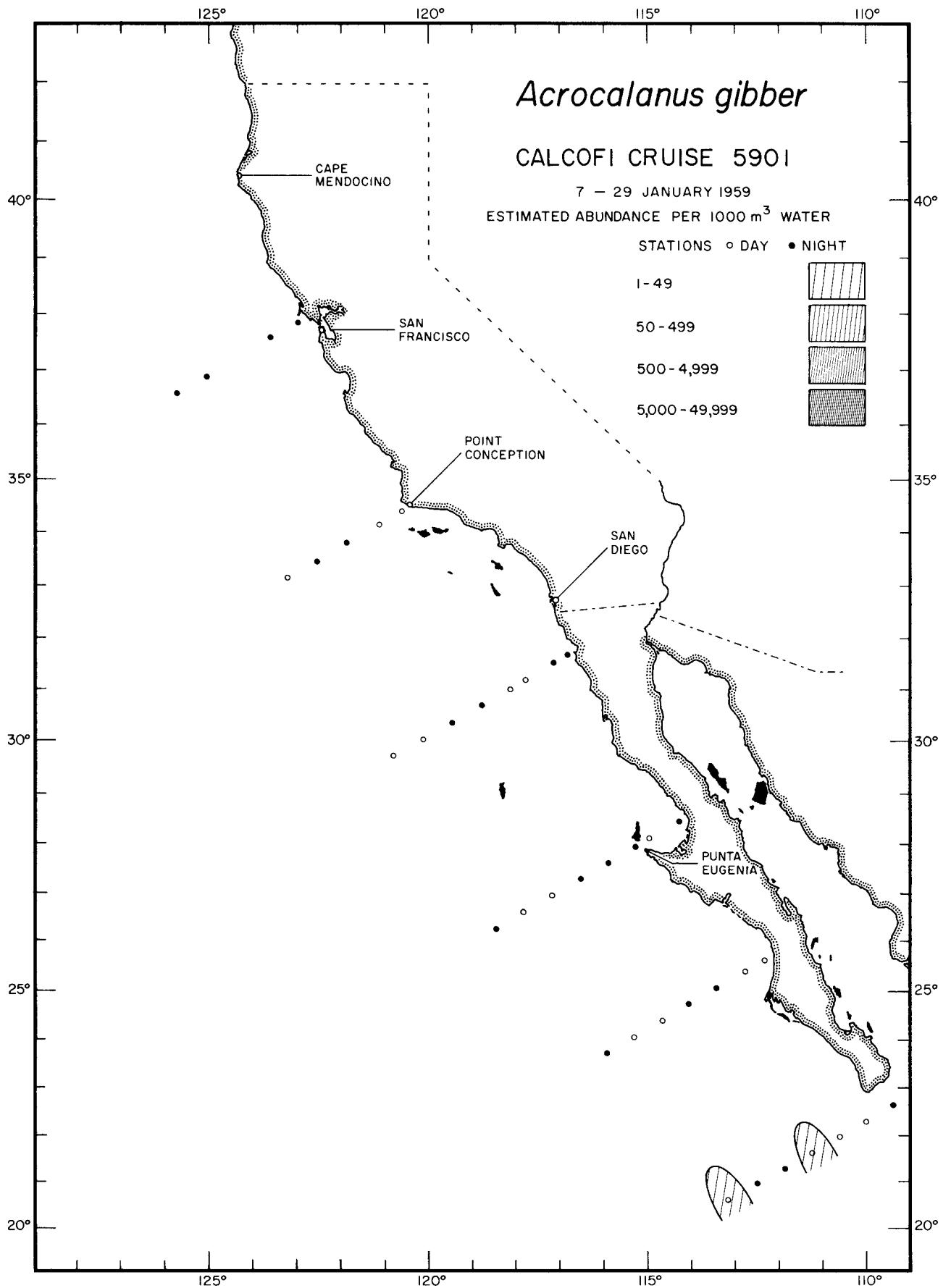
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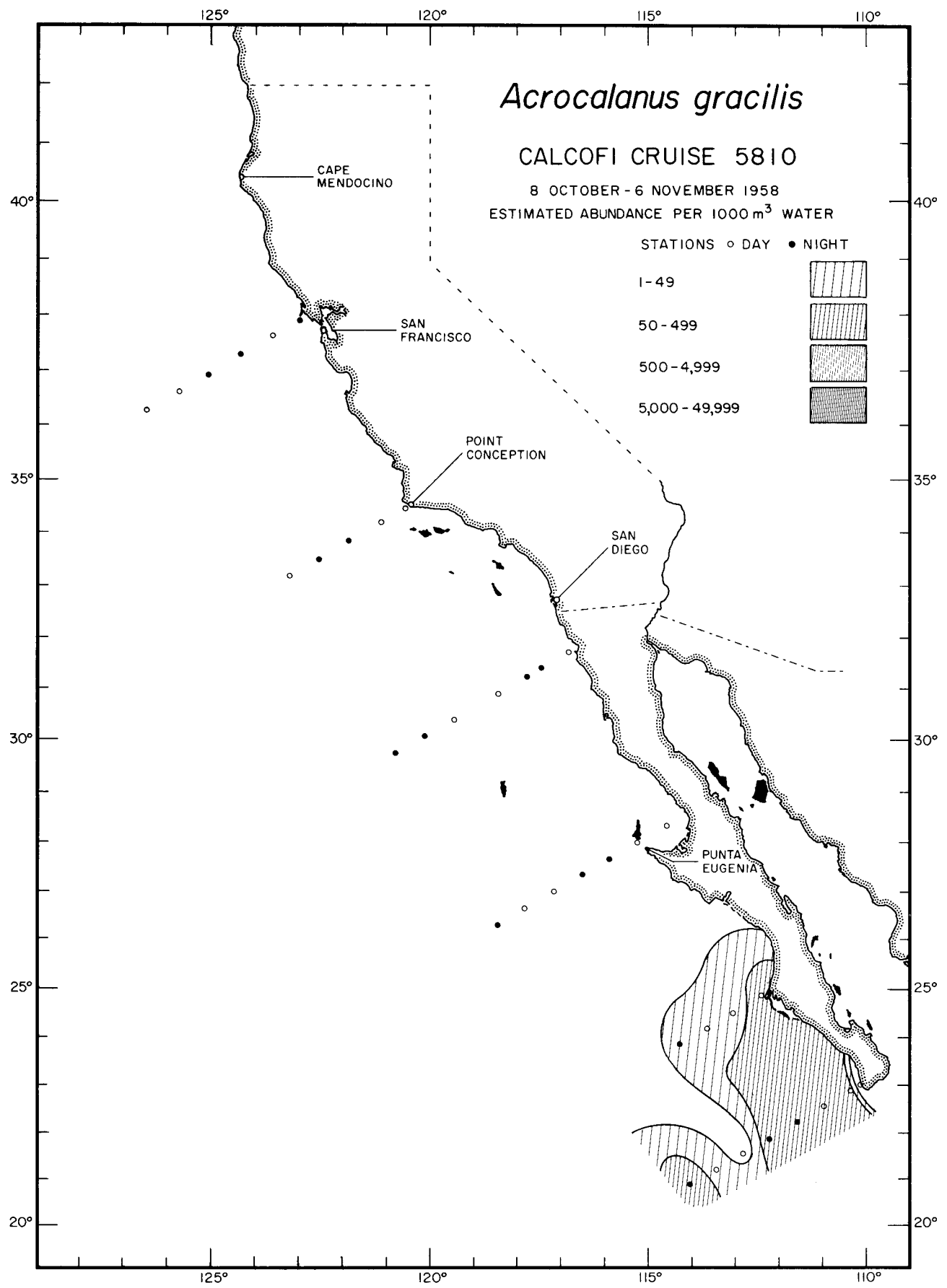
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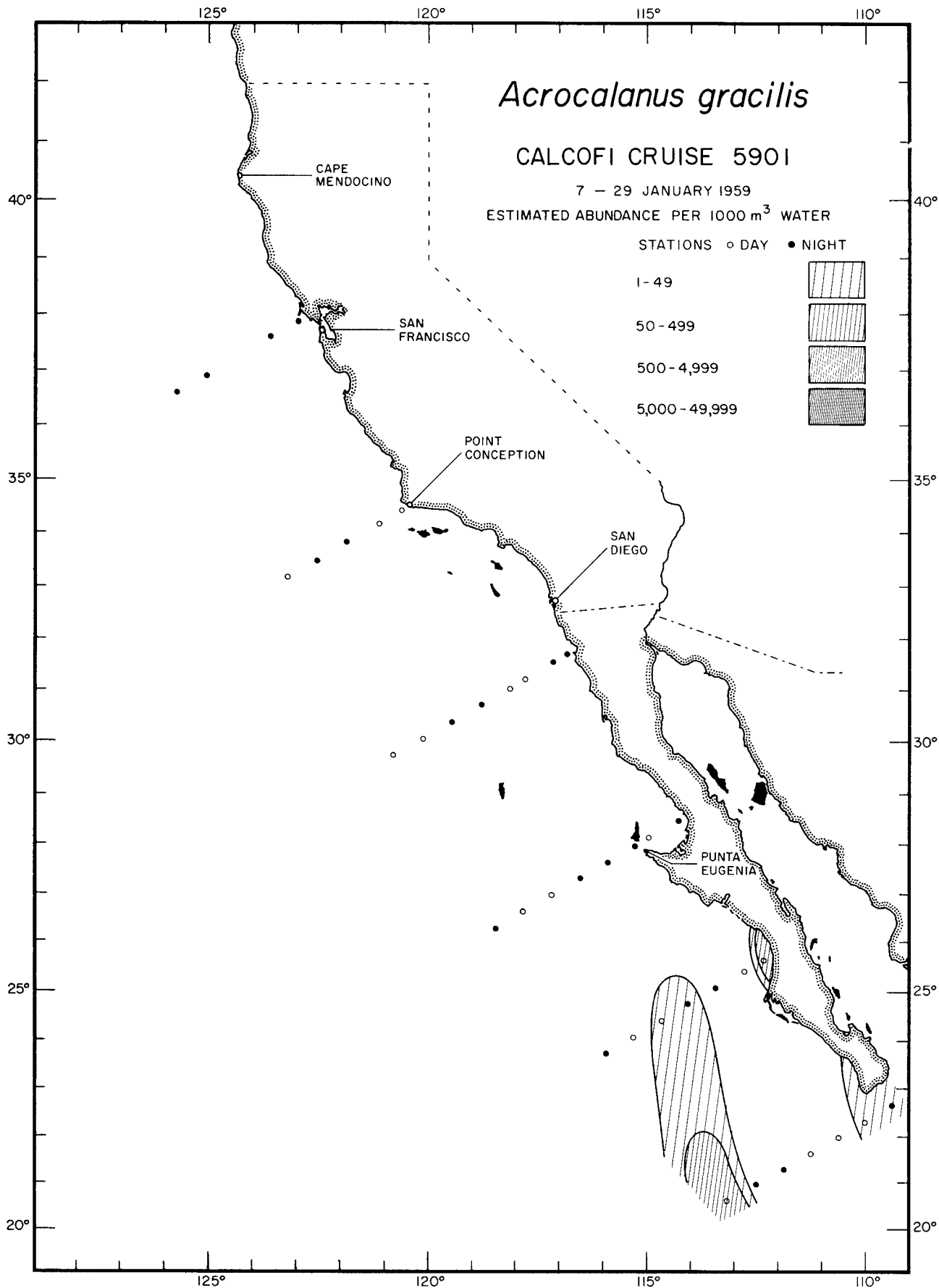
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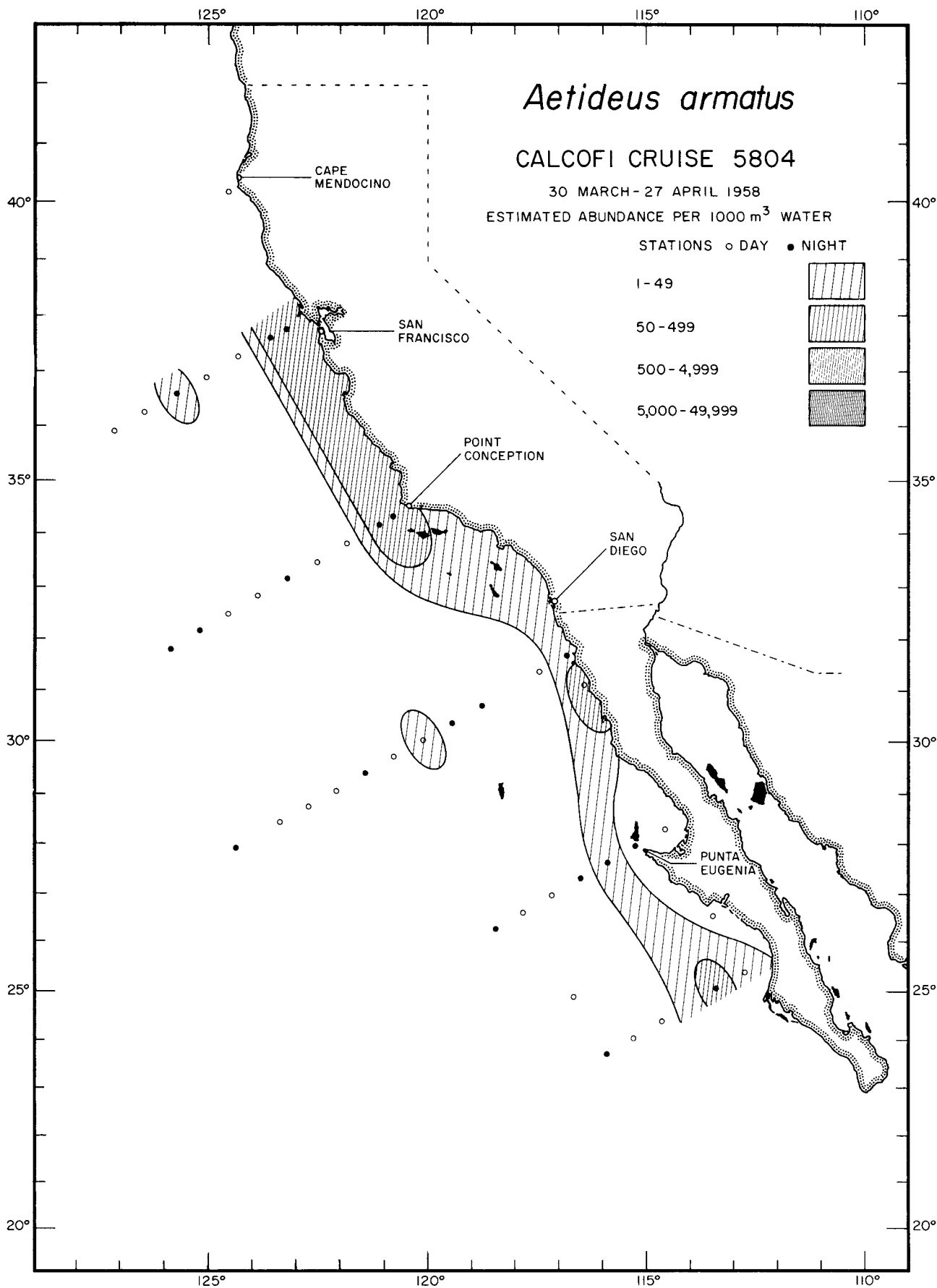
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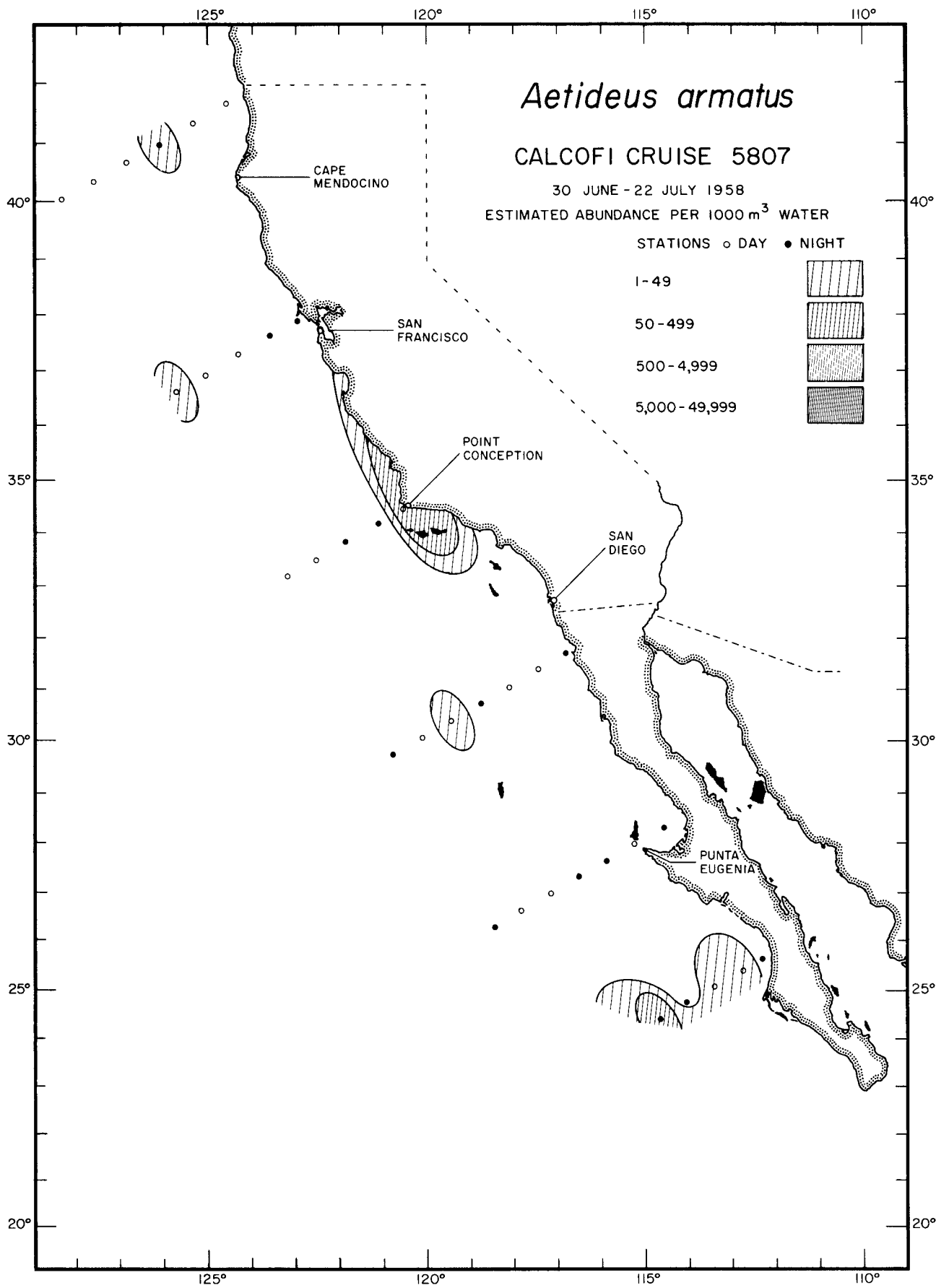
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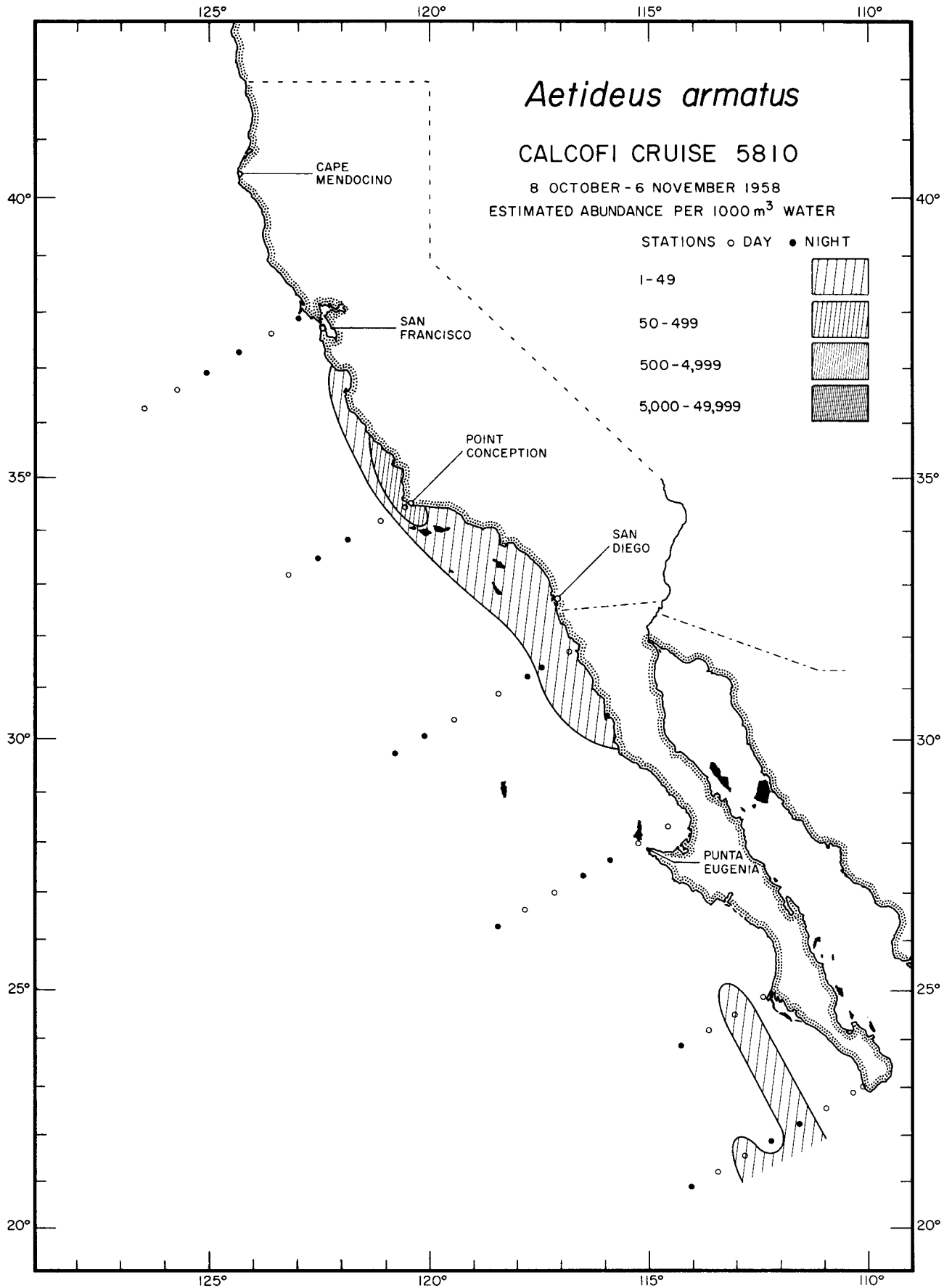
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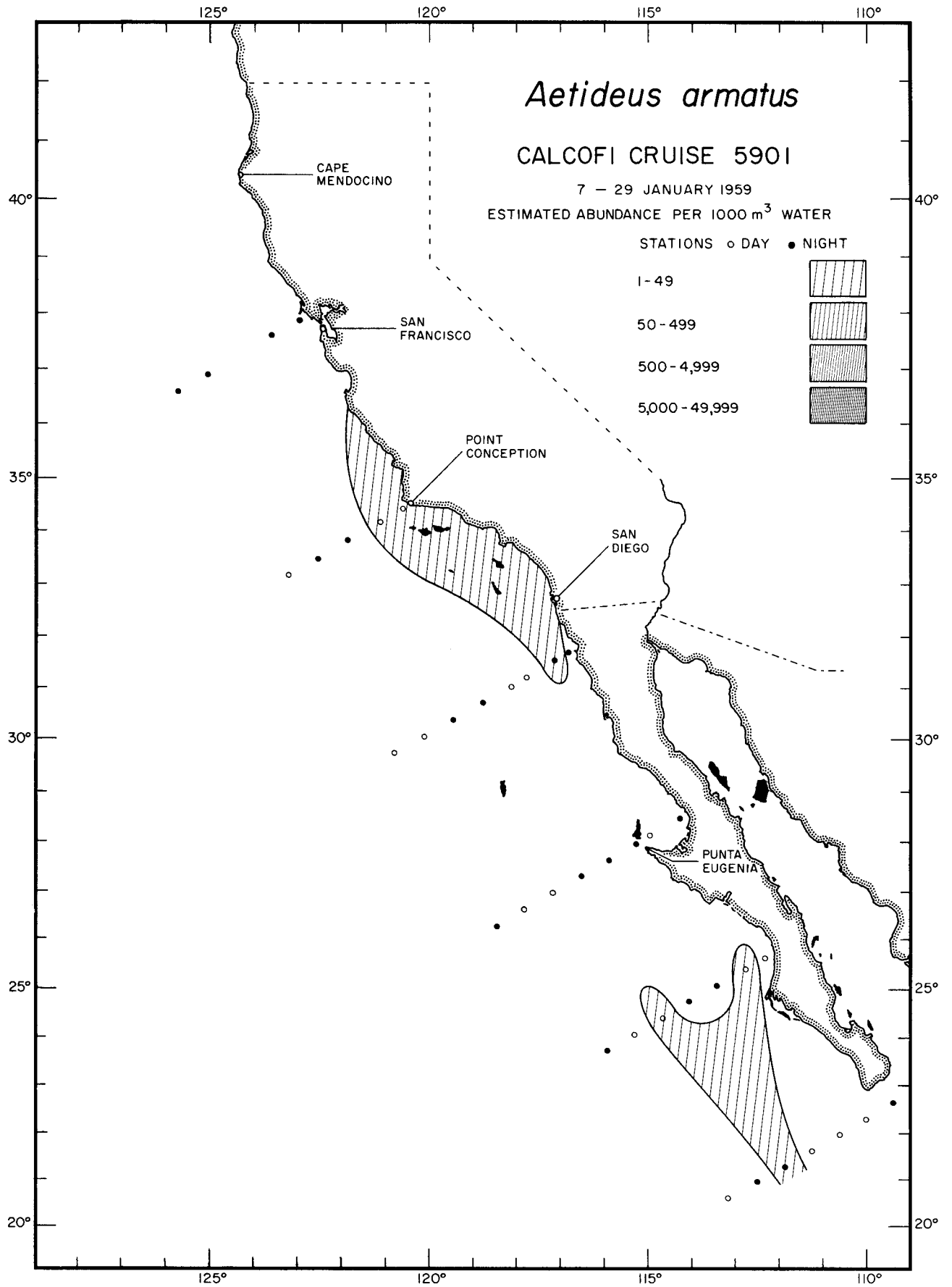
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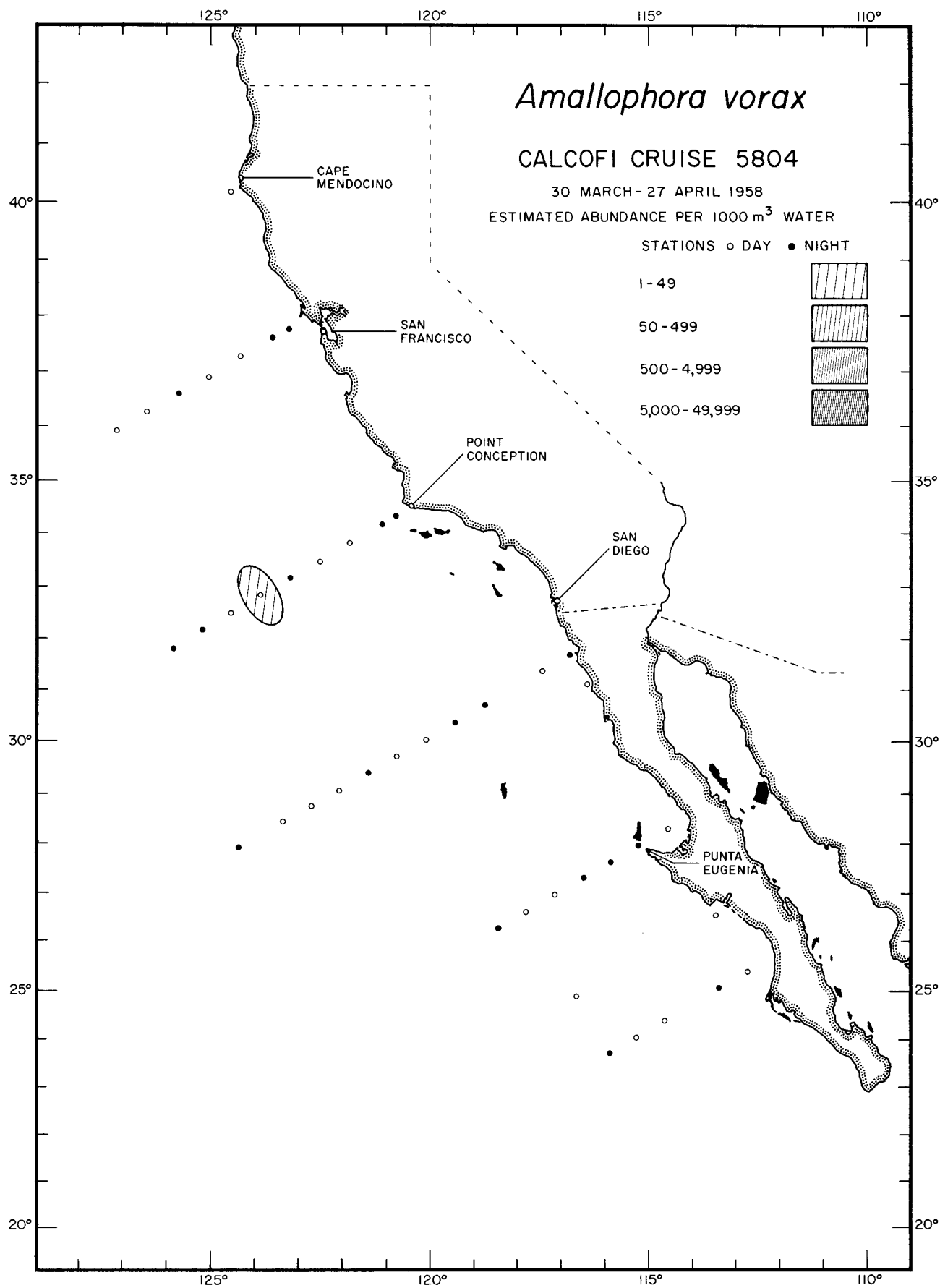
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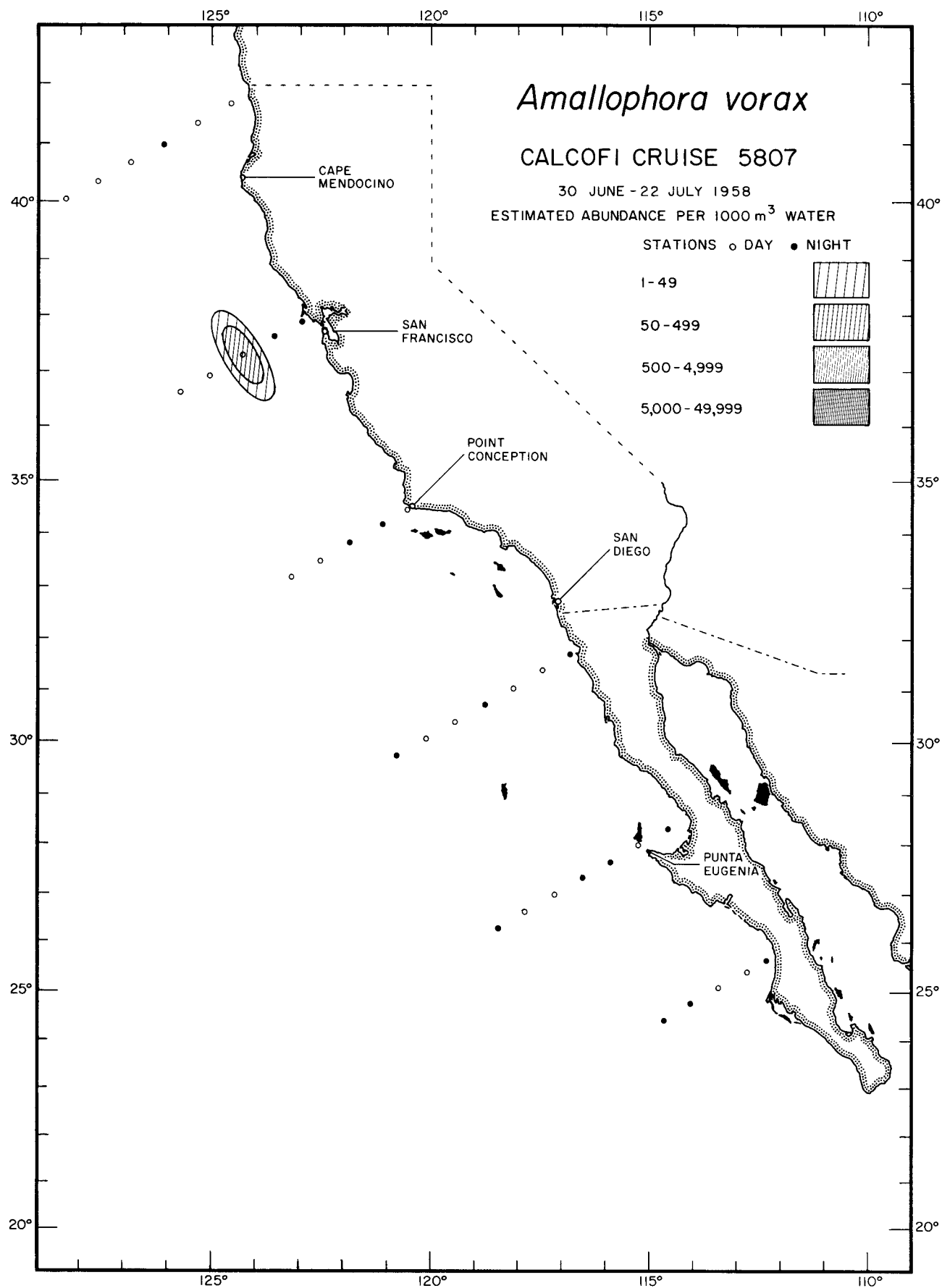
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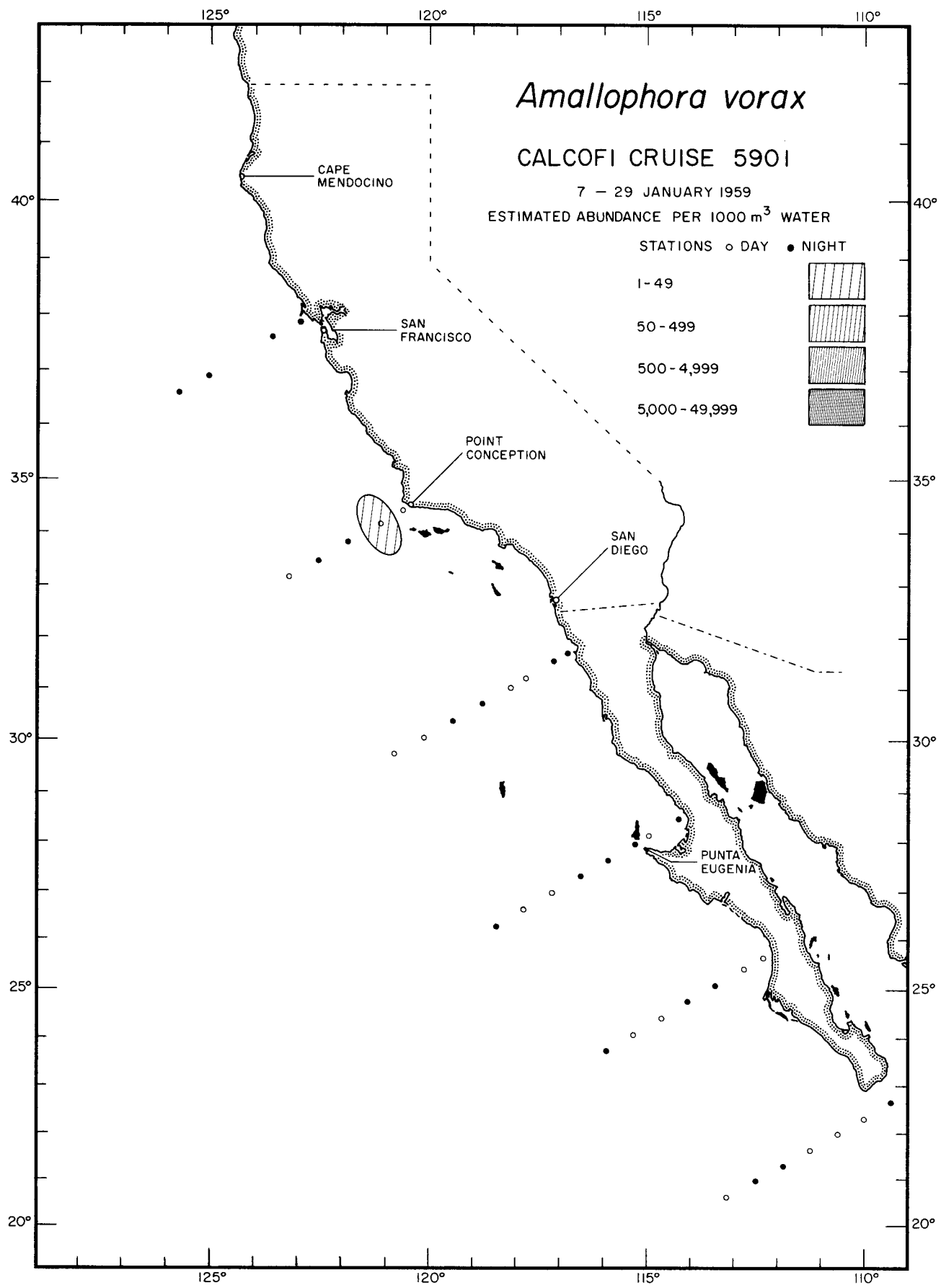
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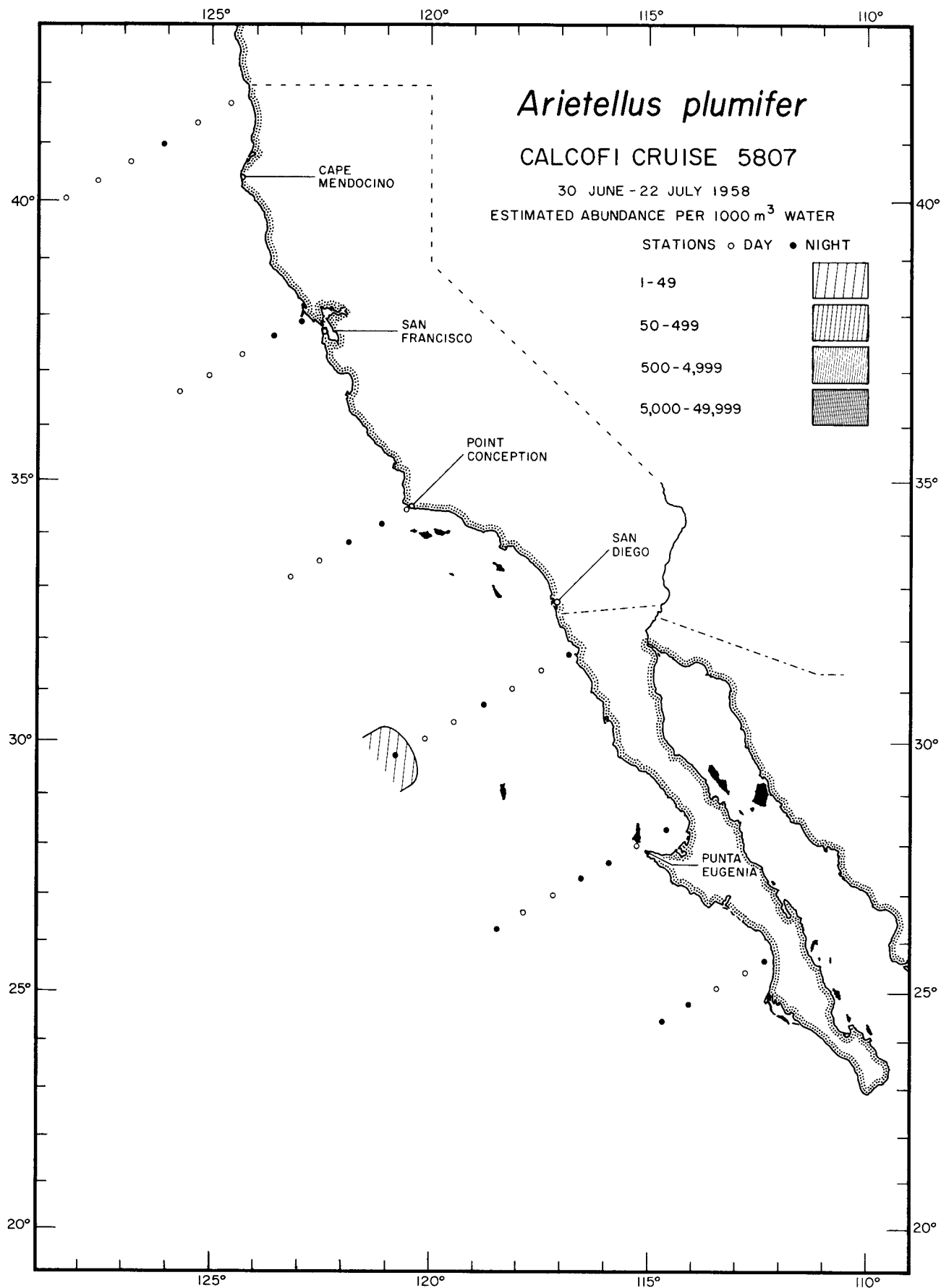
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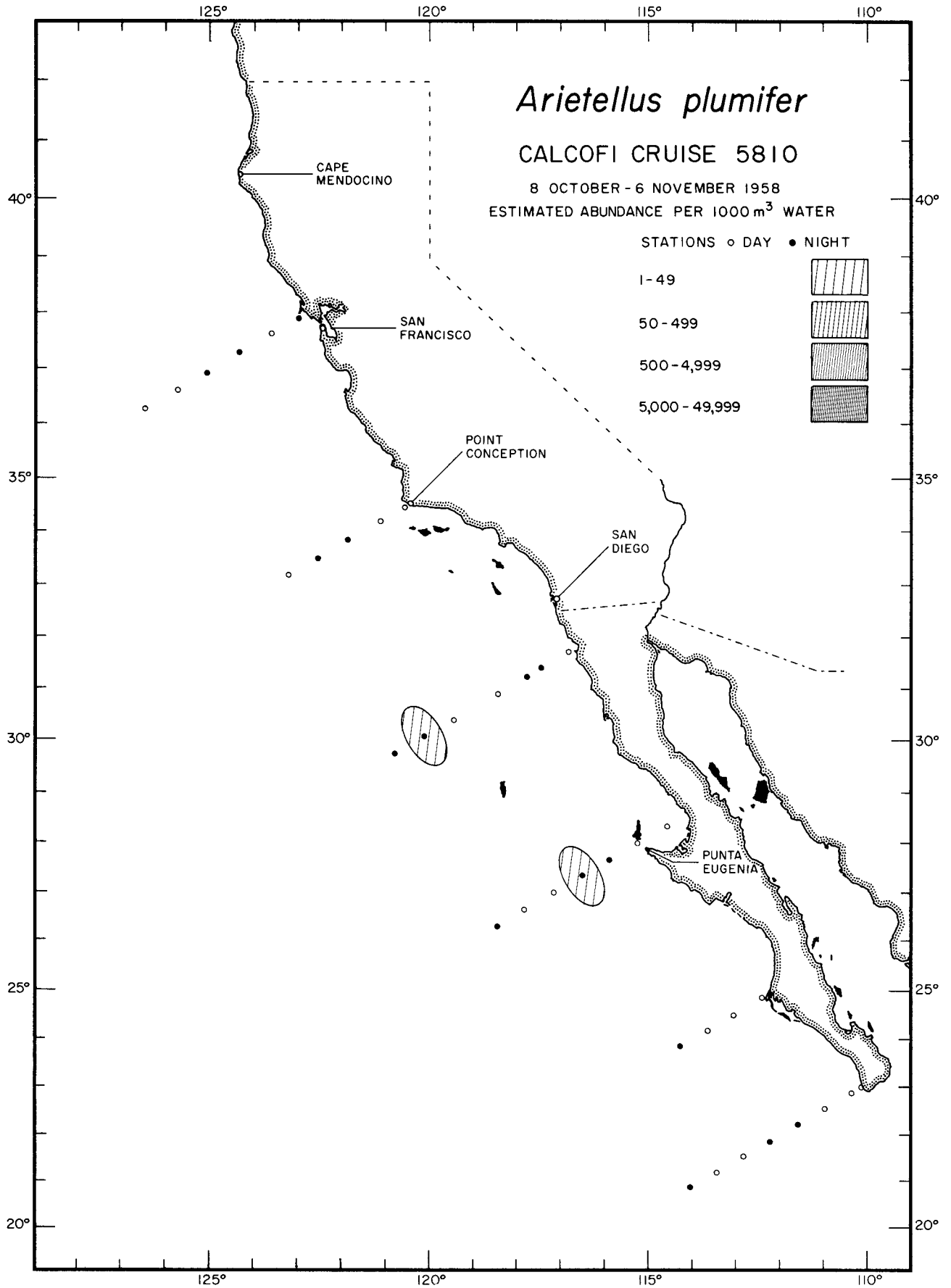


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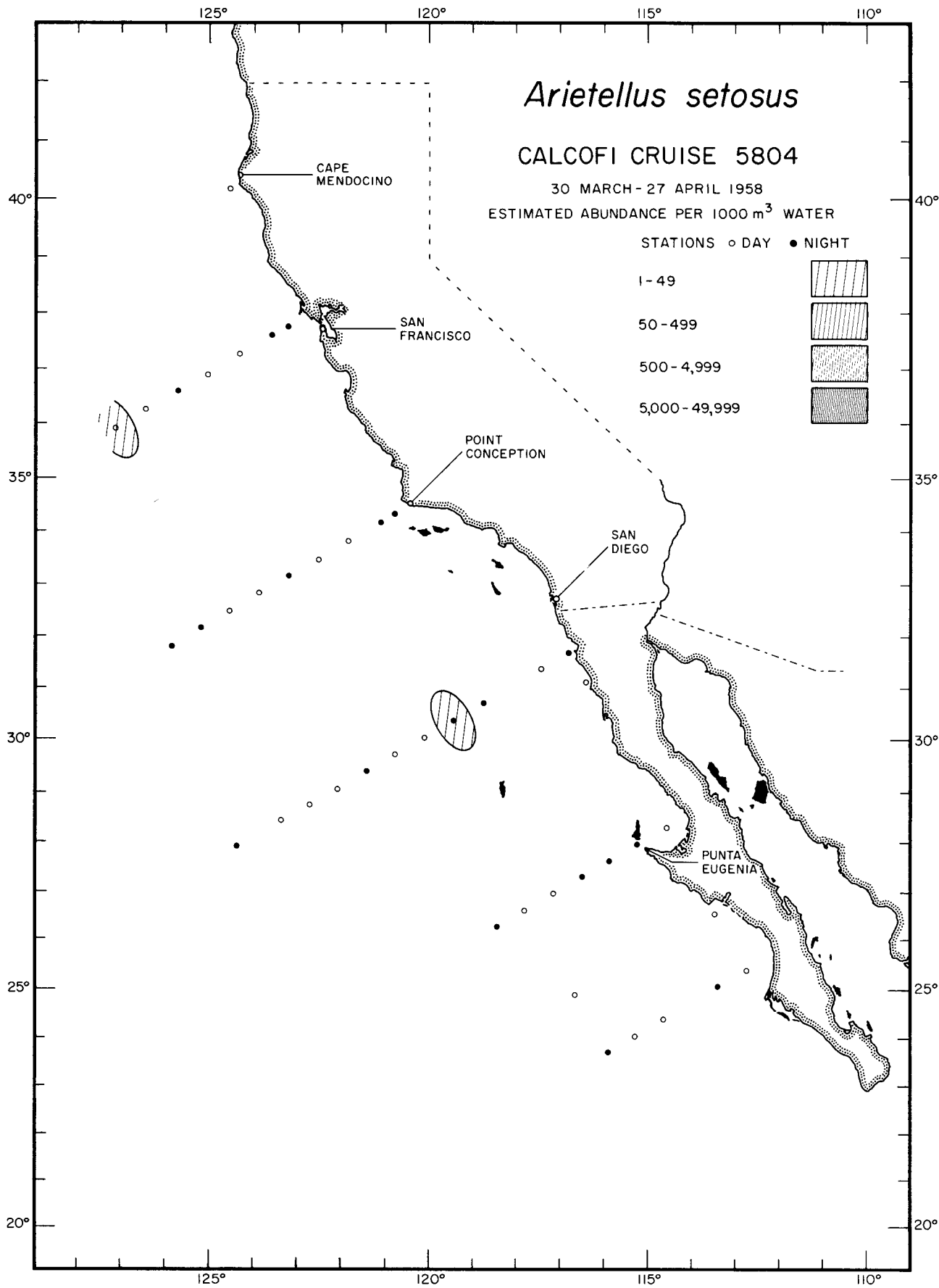


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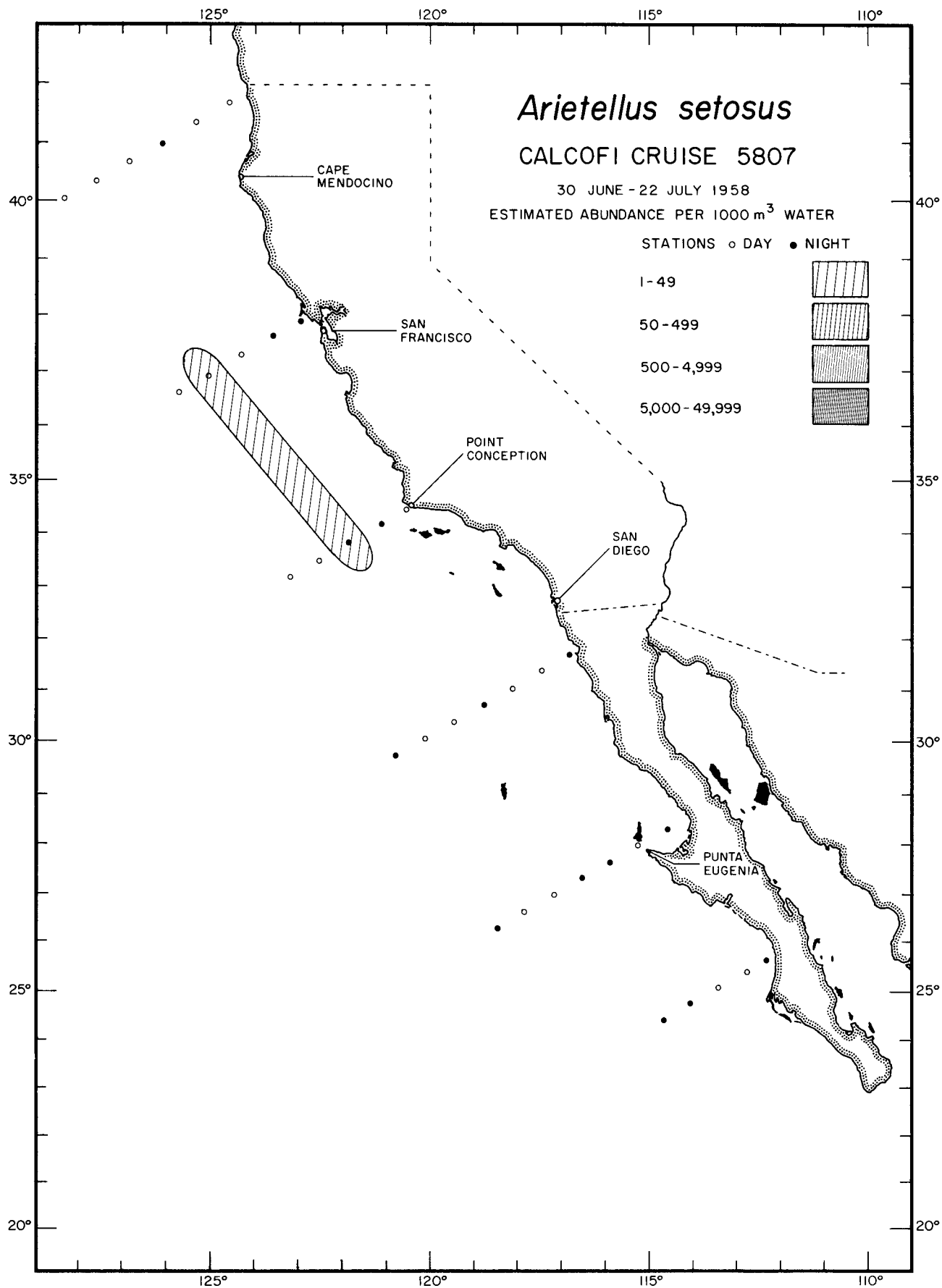
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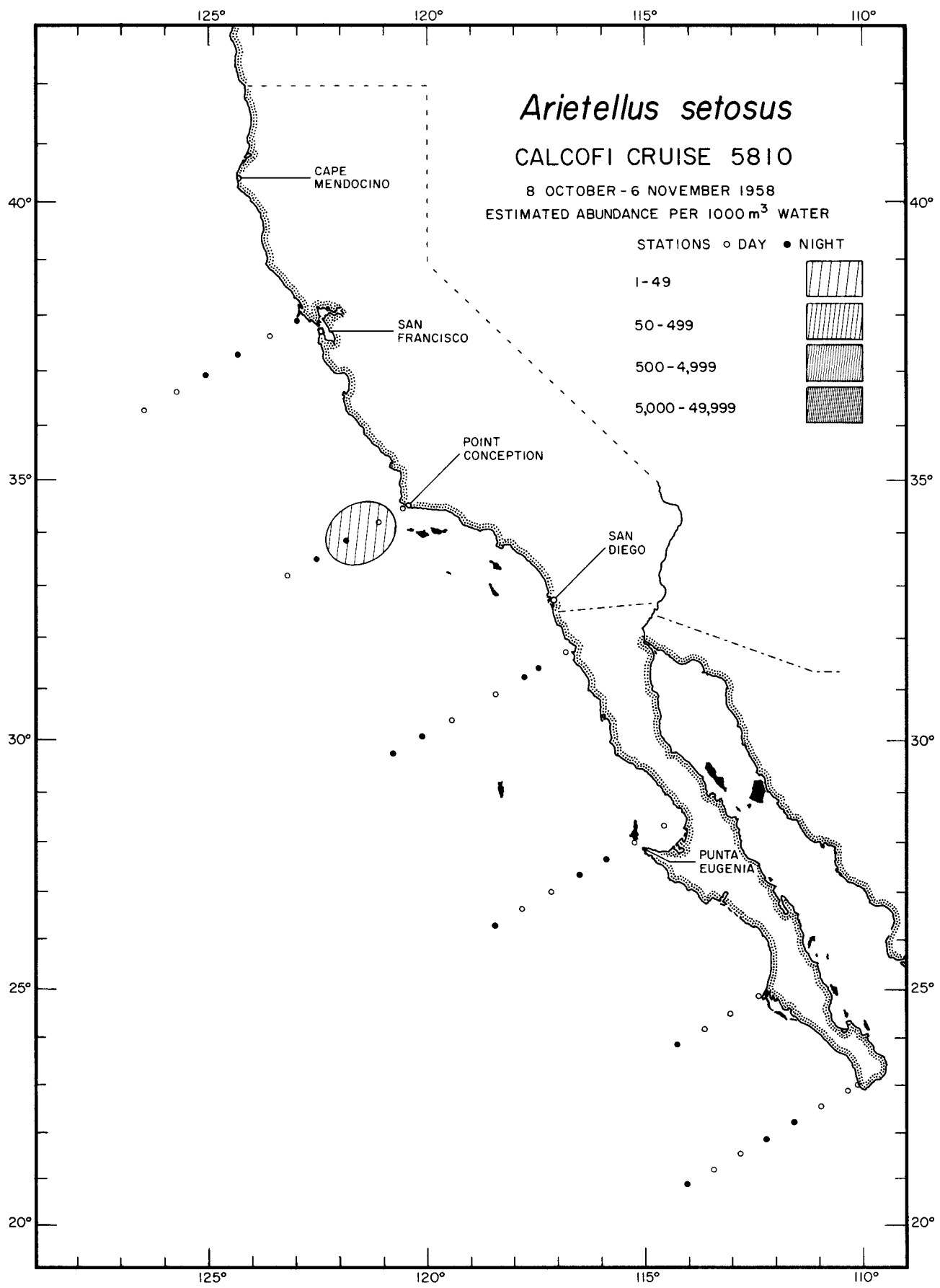
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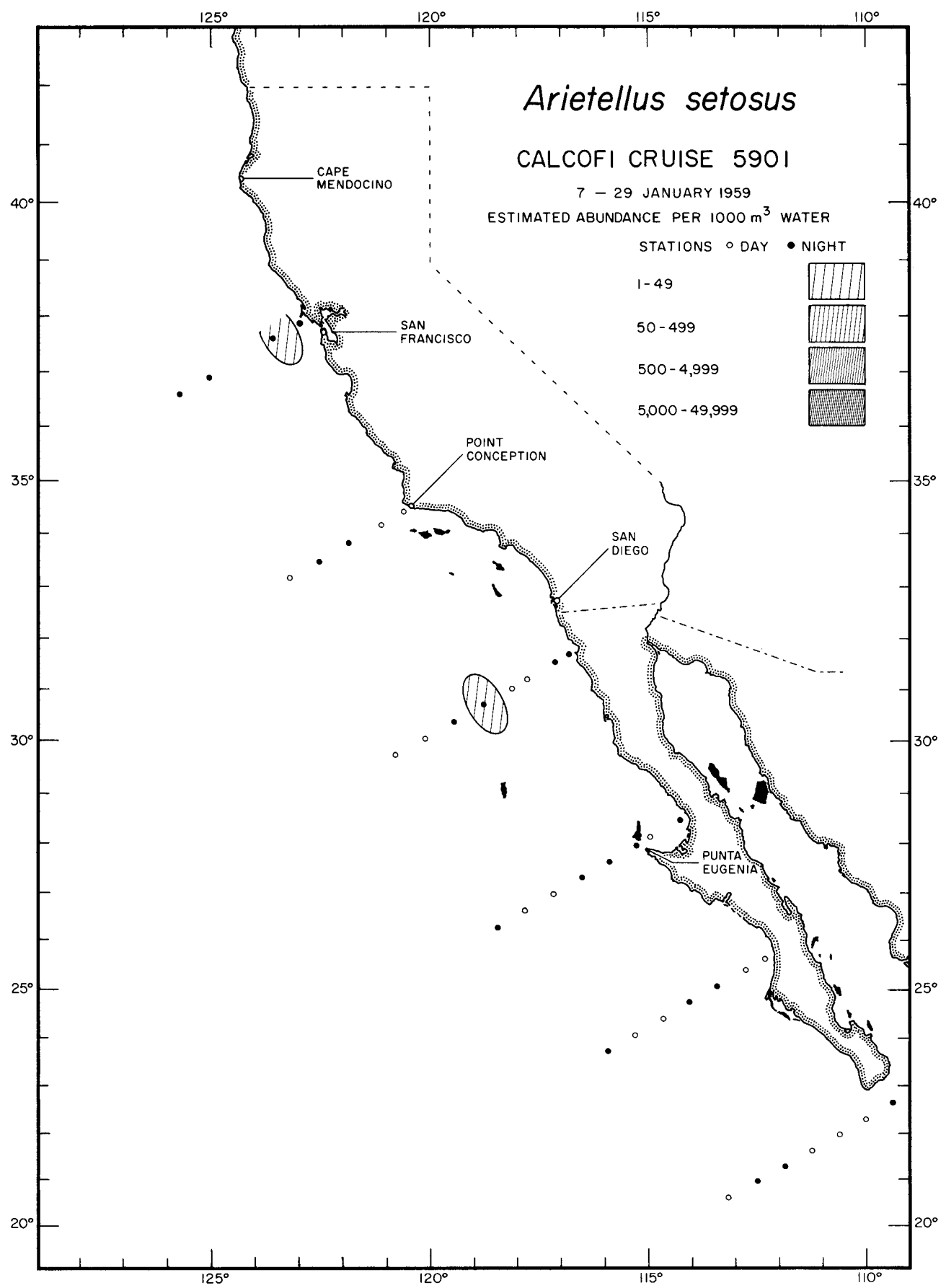
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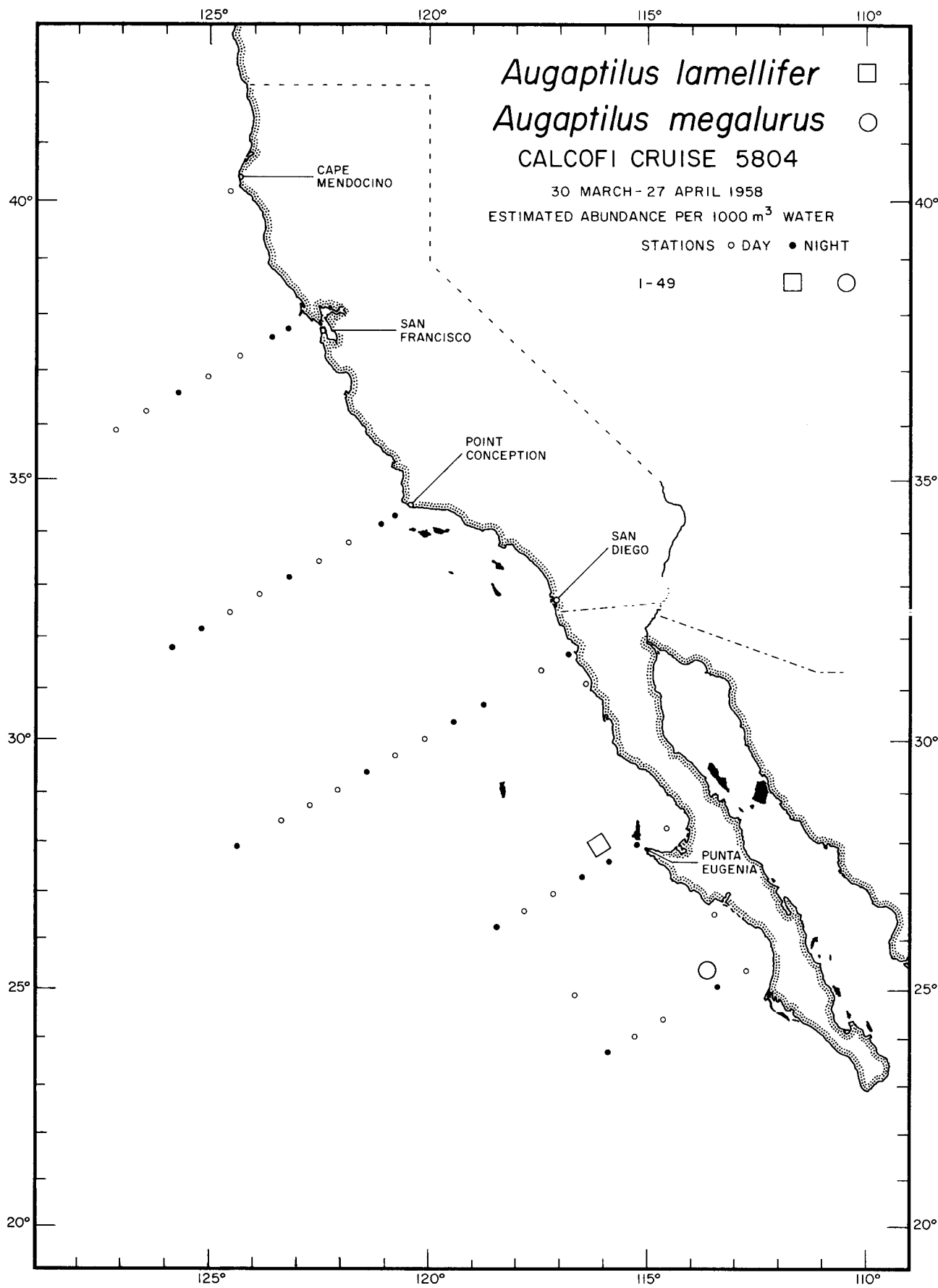
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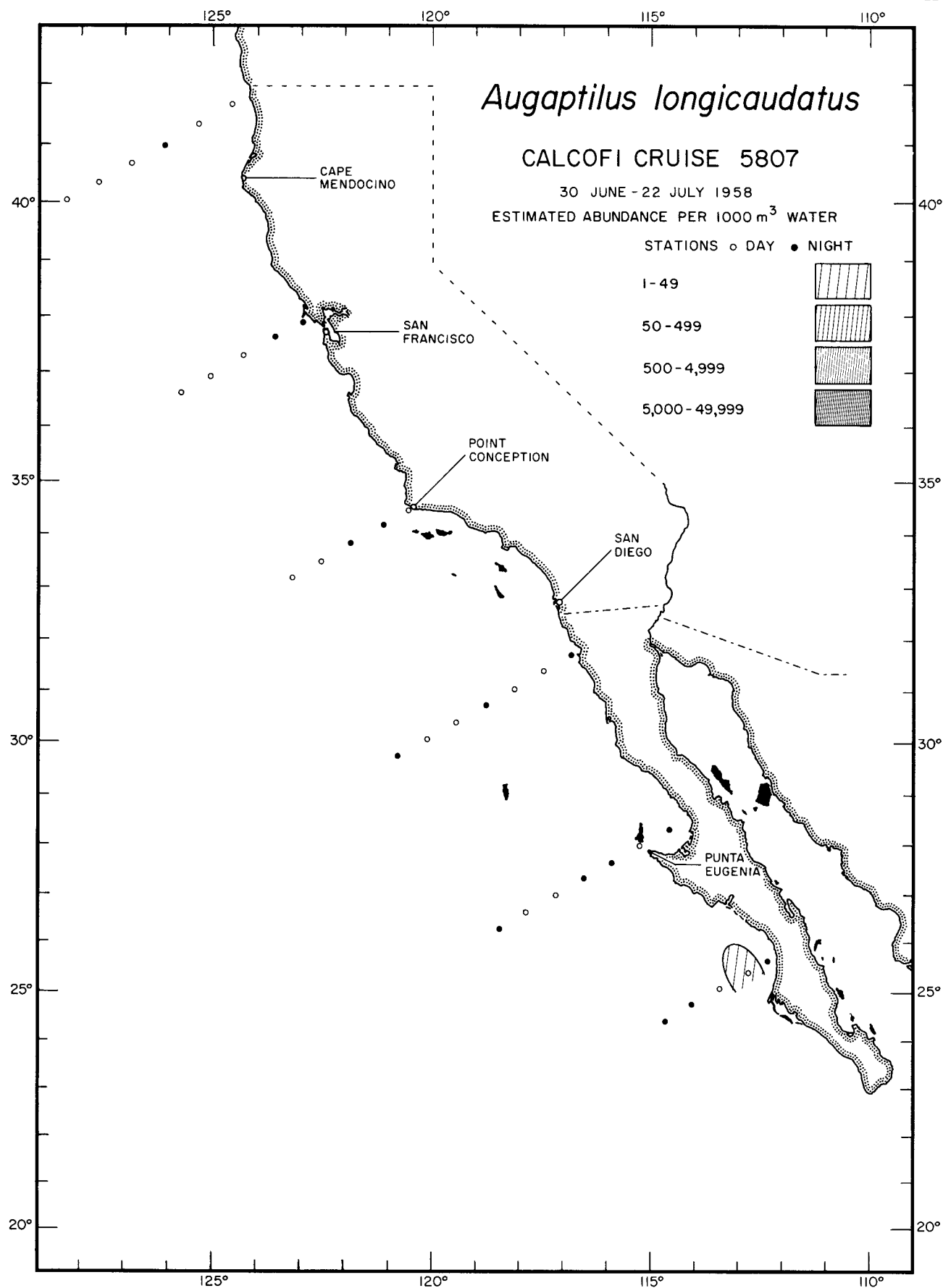
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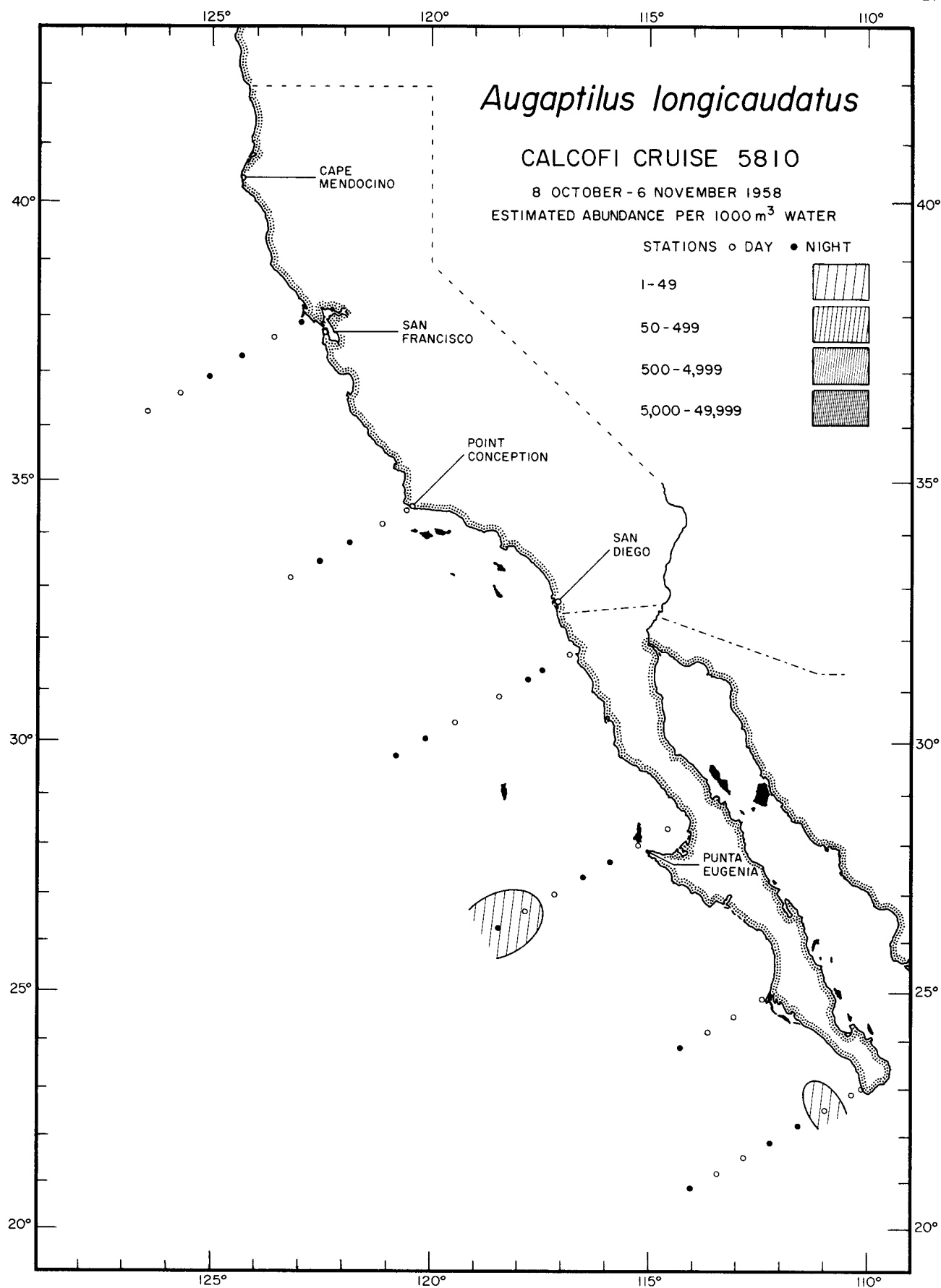


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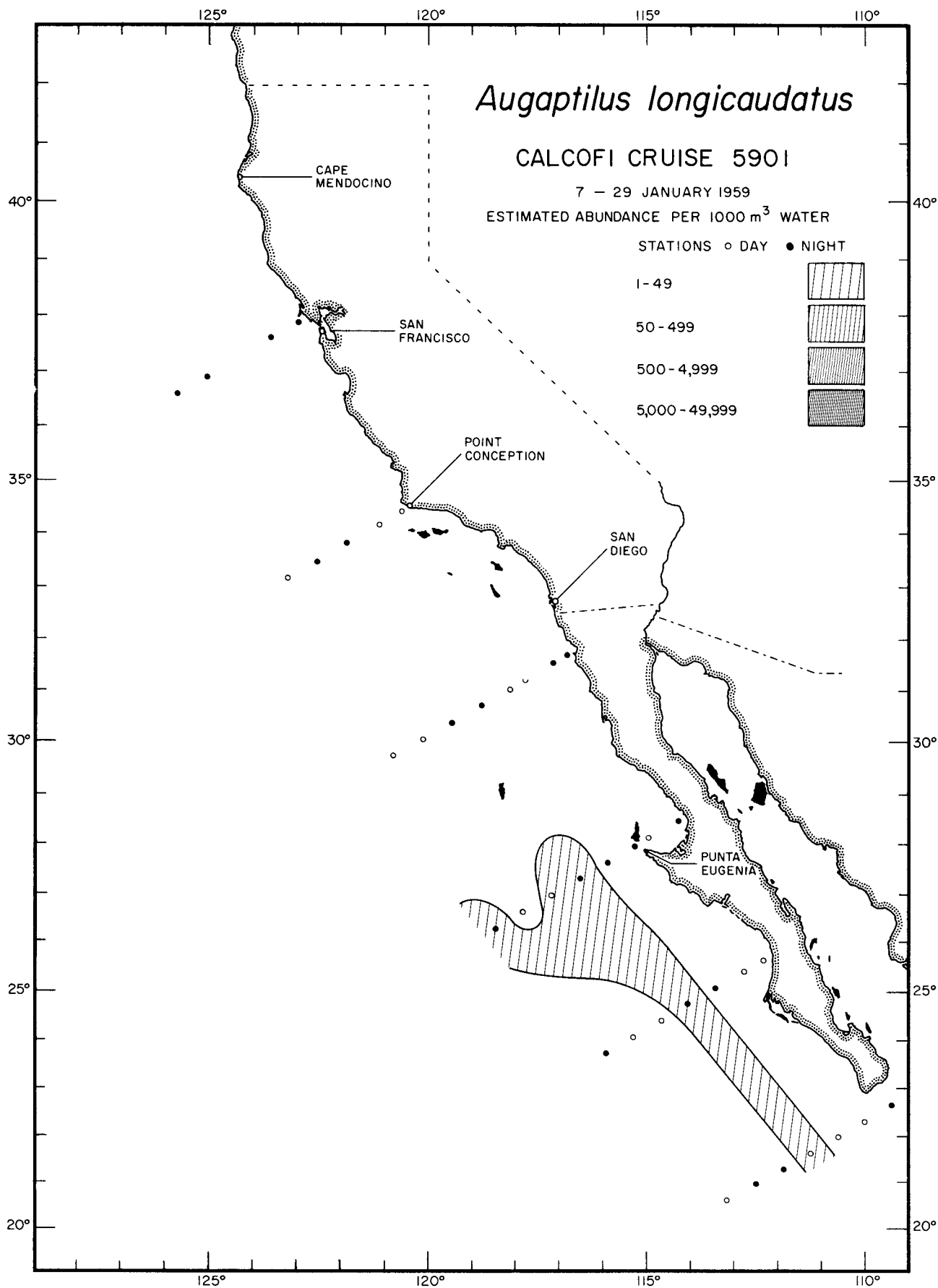




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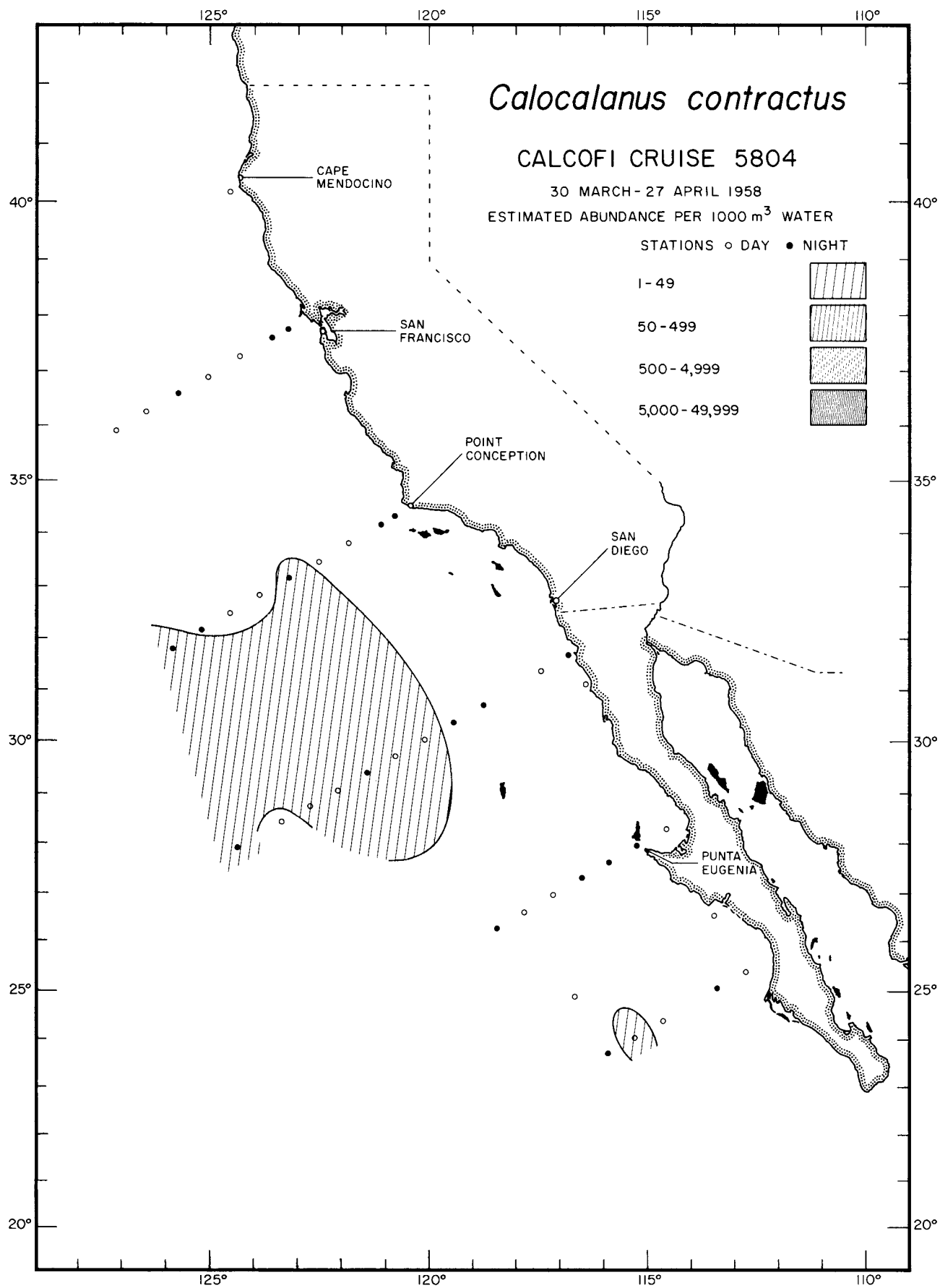
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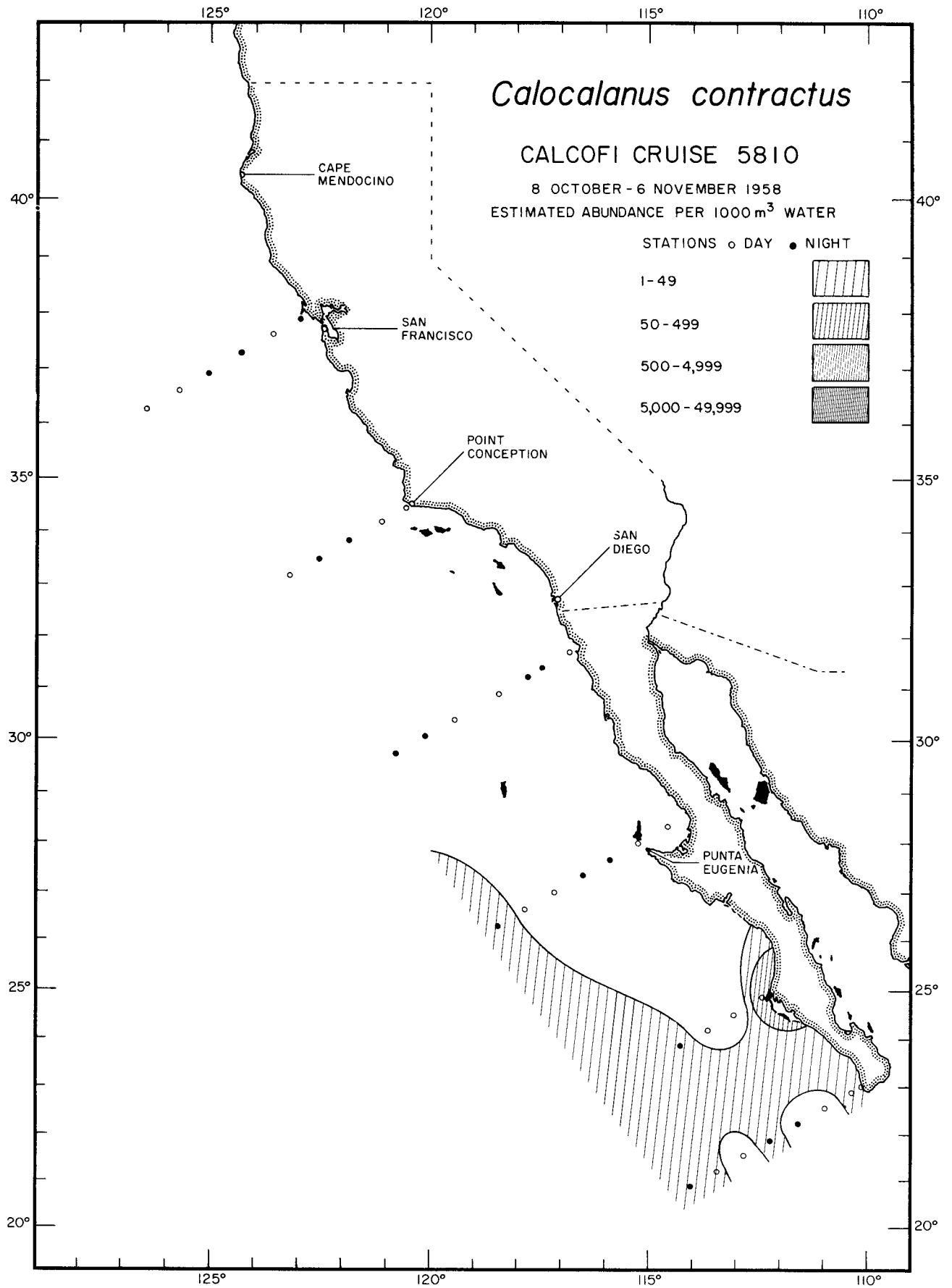
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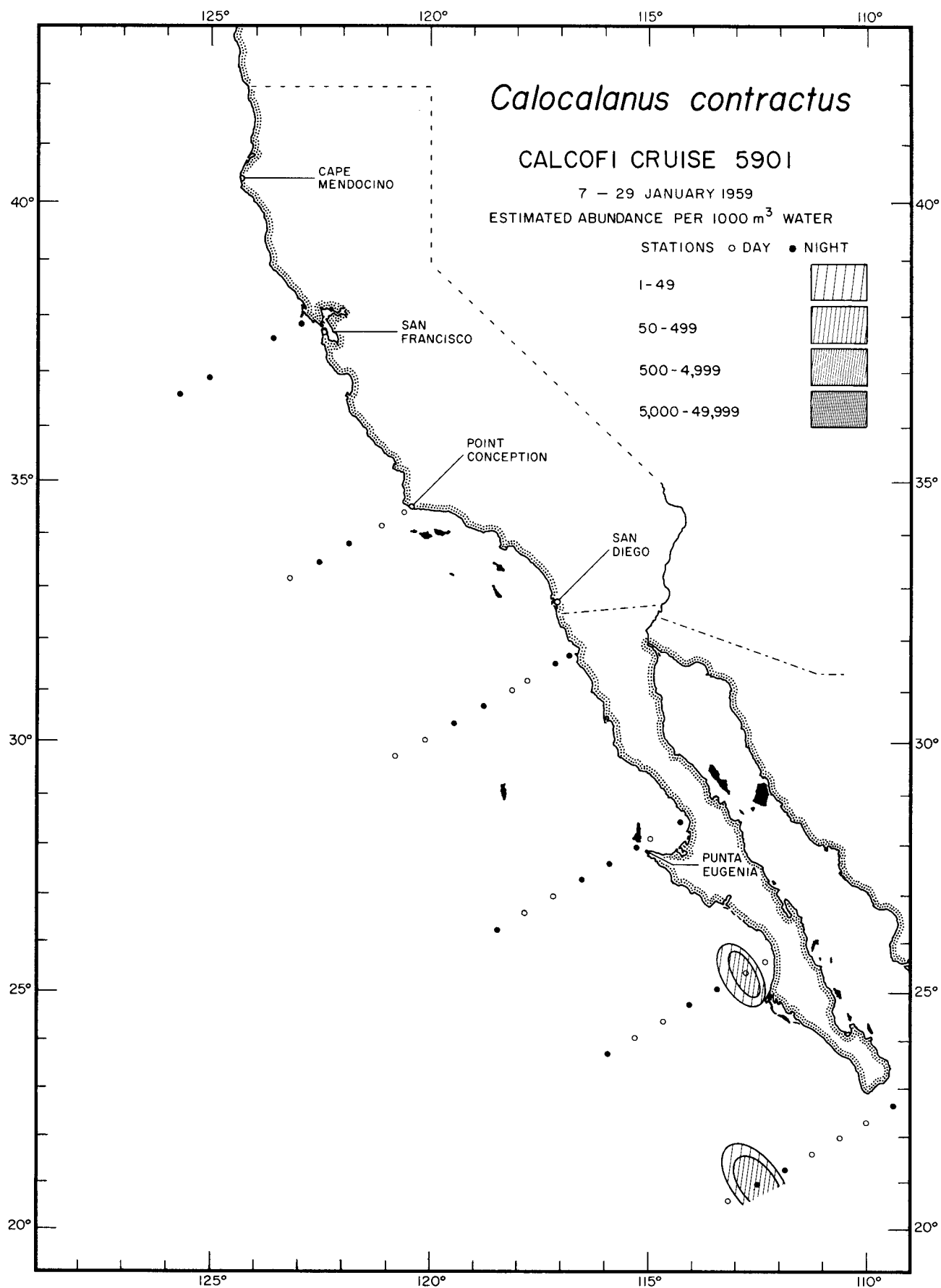
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Calocalanus contractus

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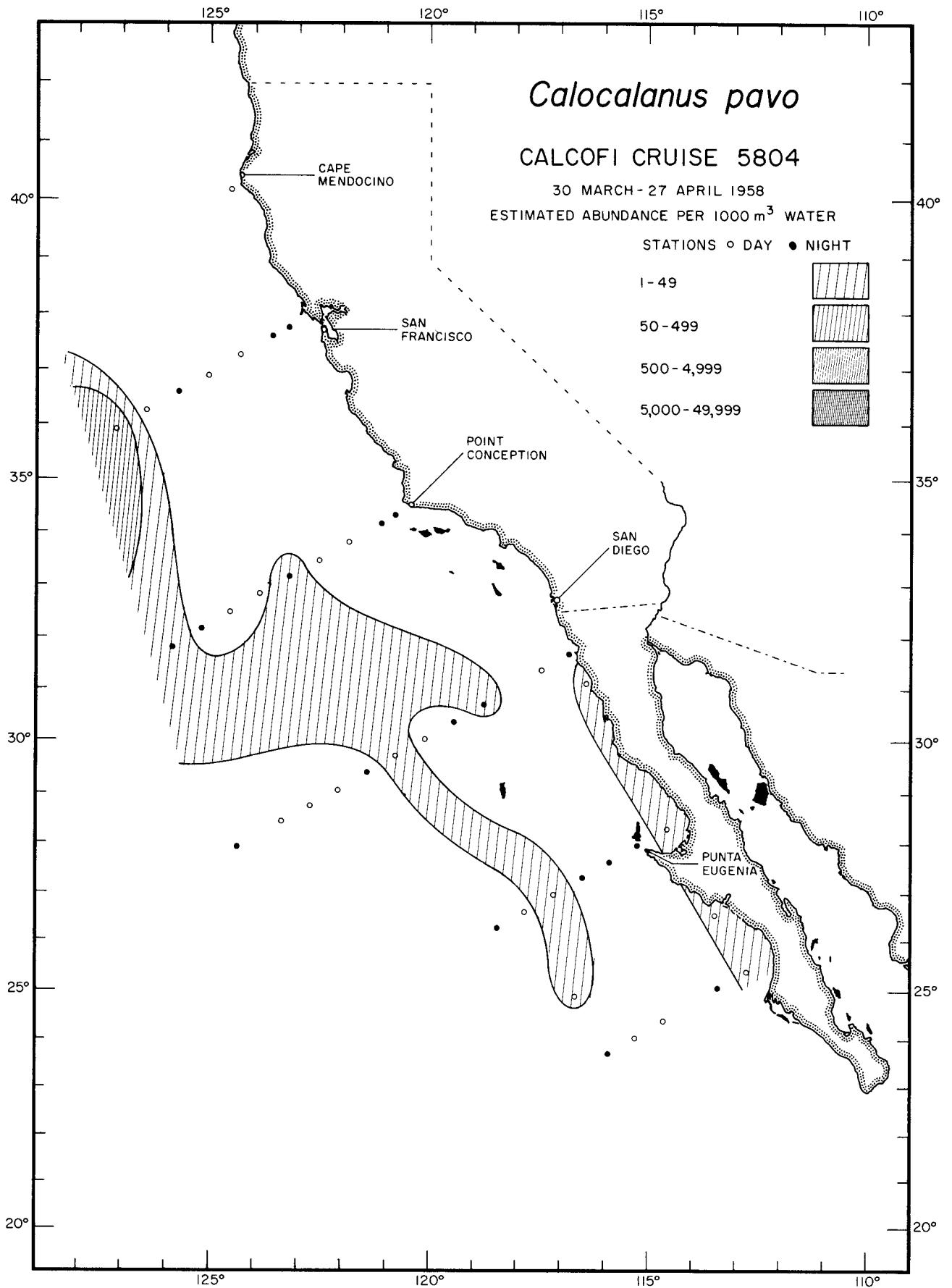
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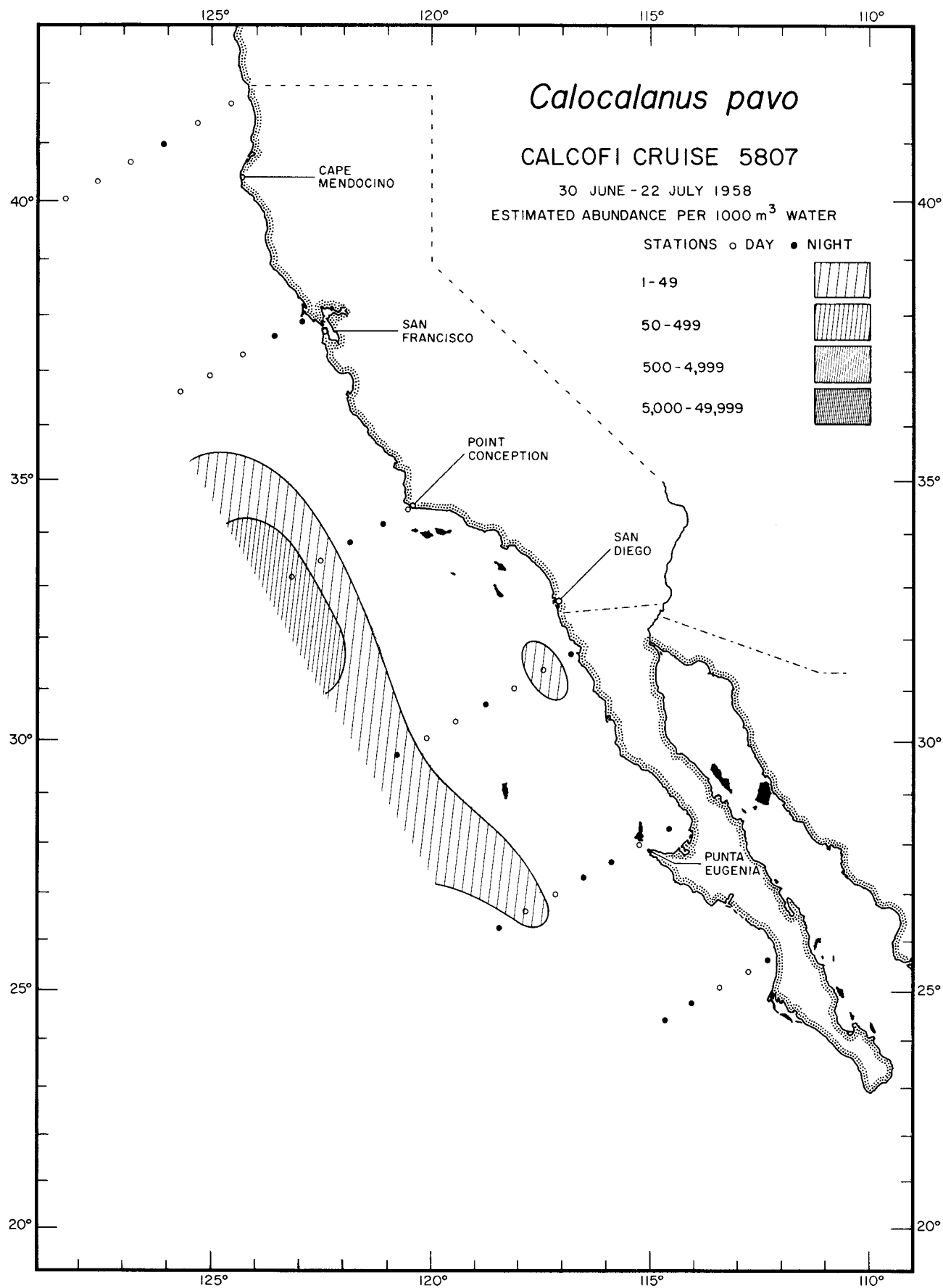
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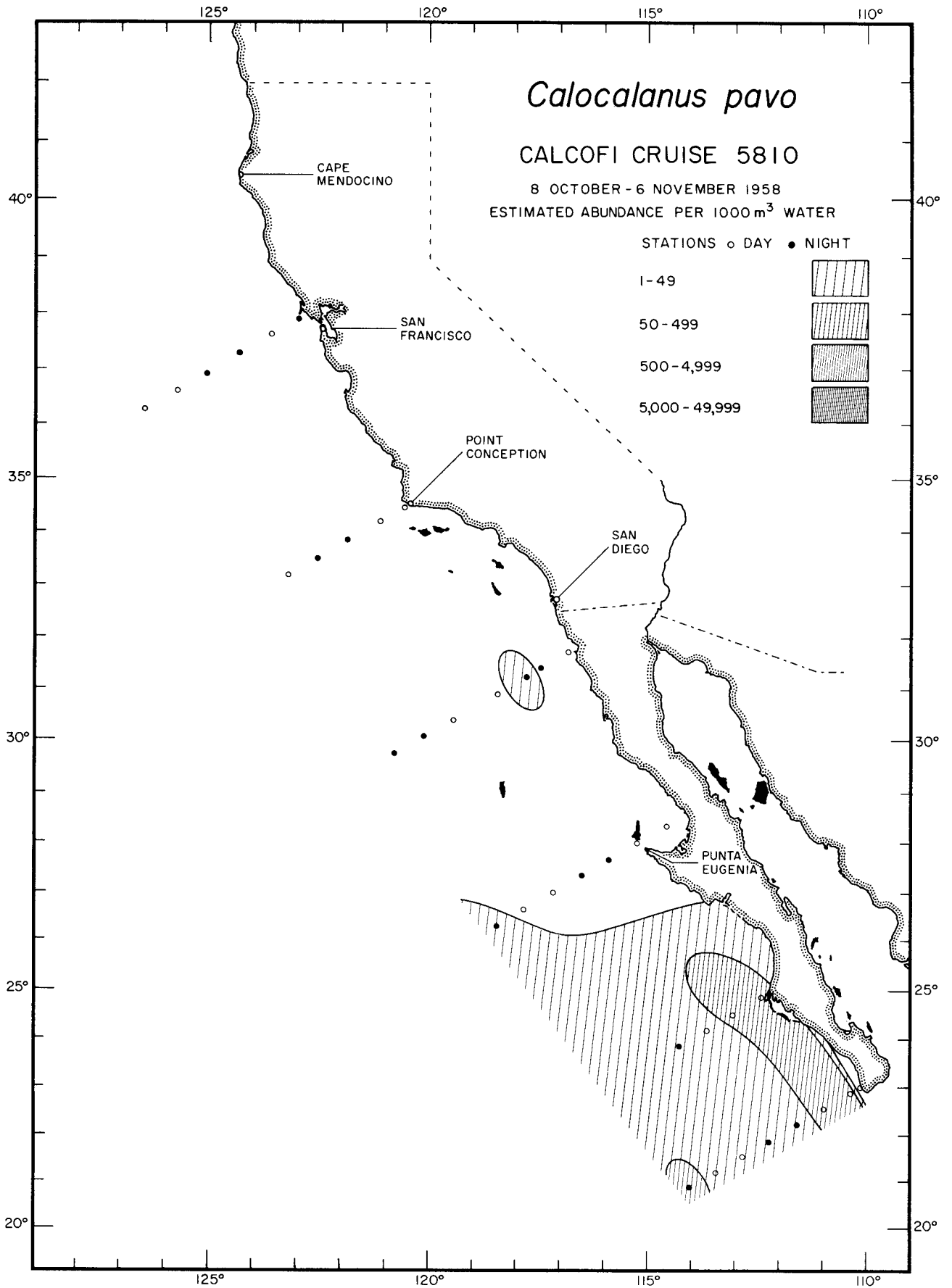
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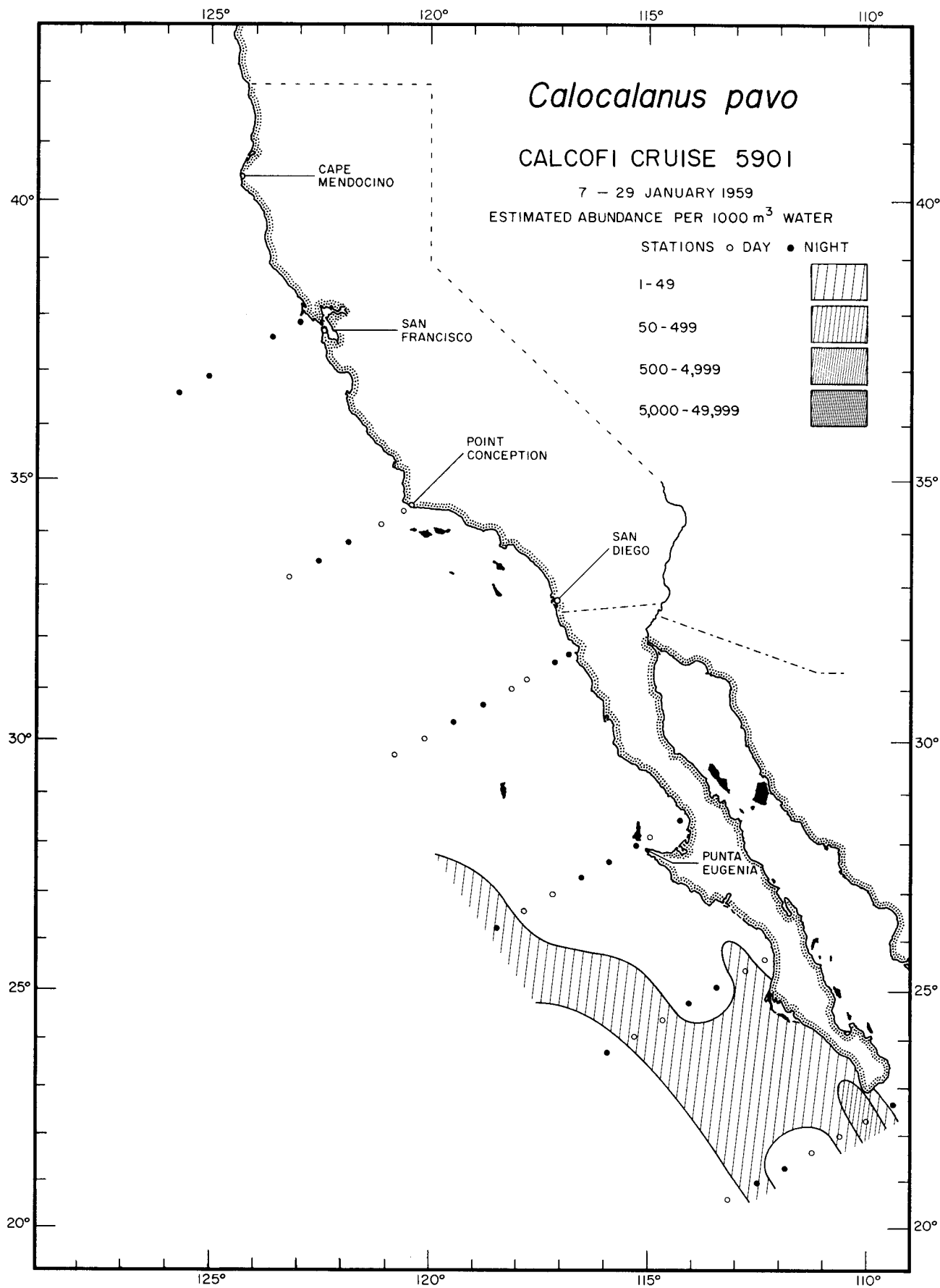
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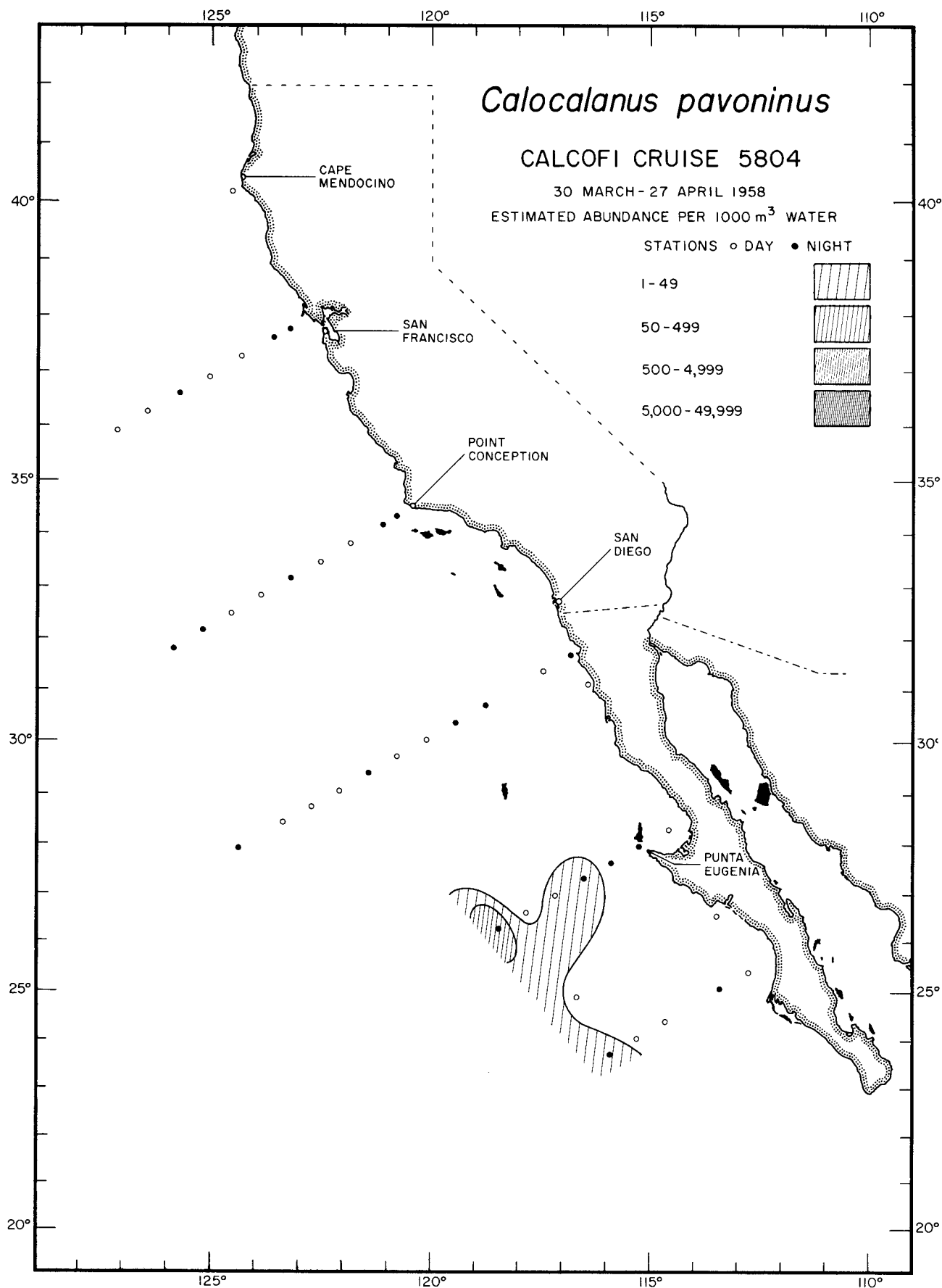
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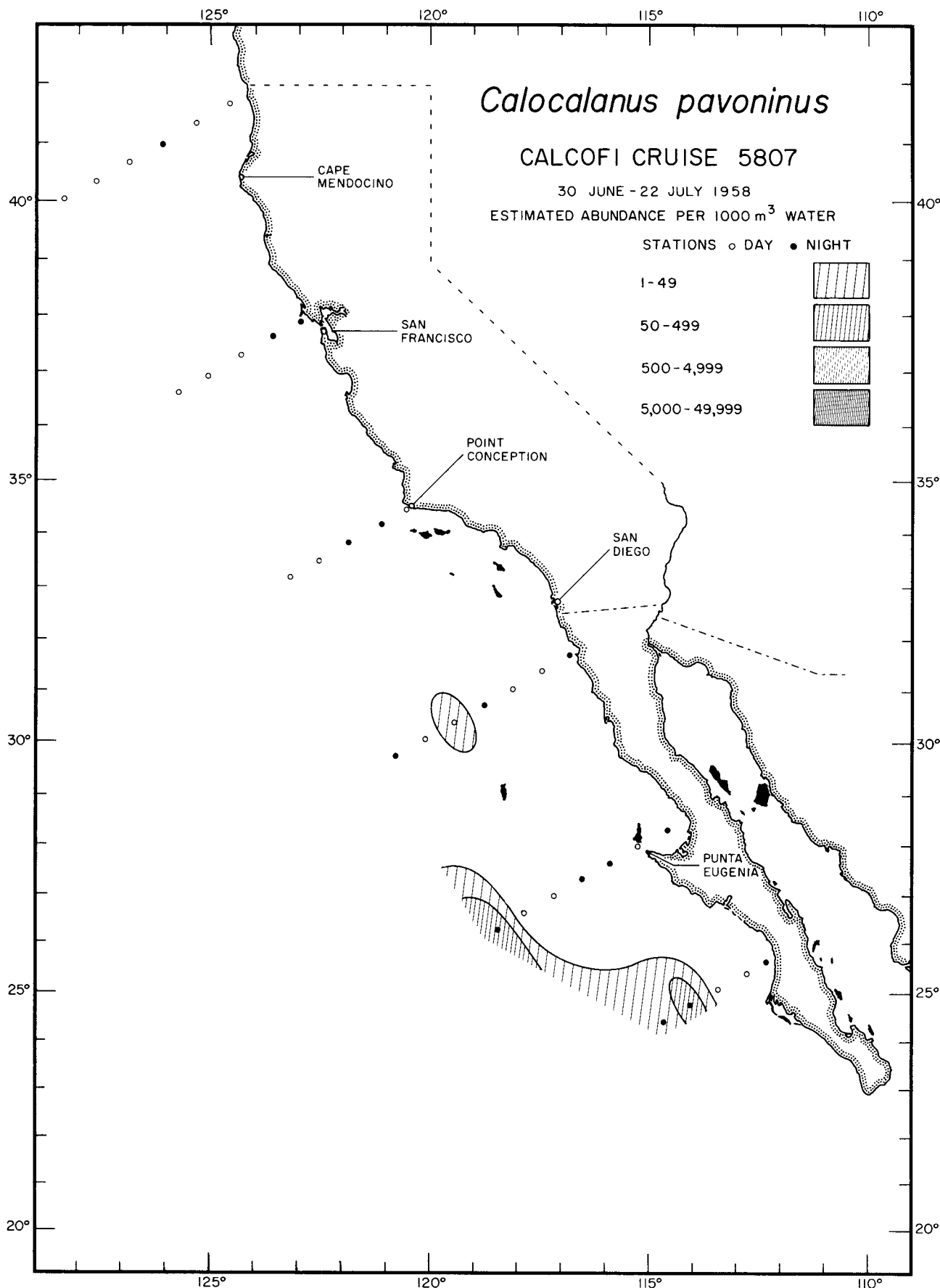
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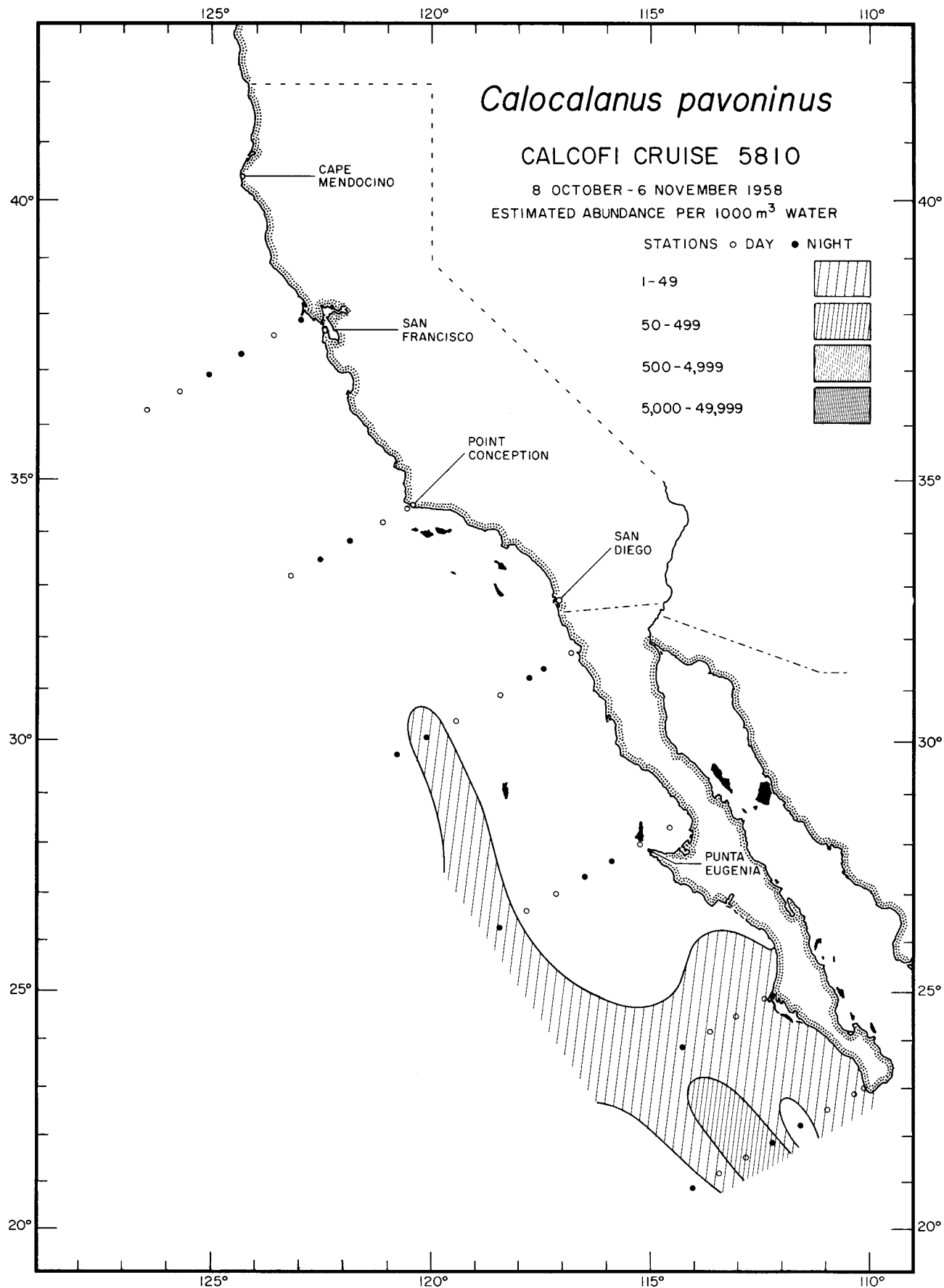
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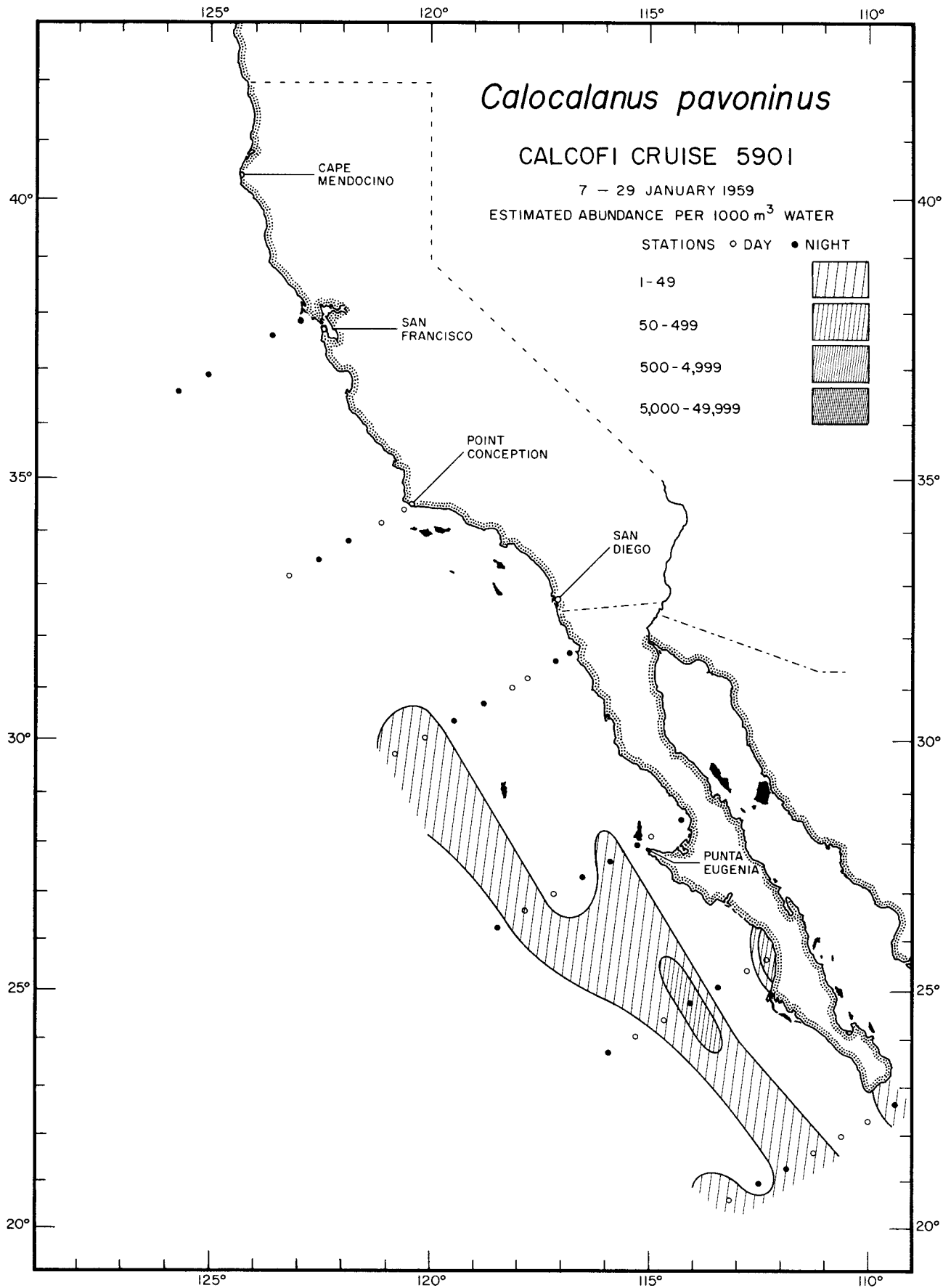
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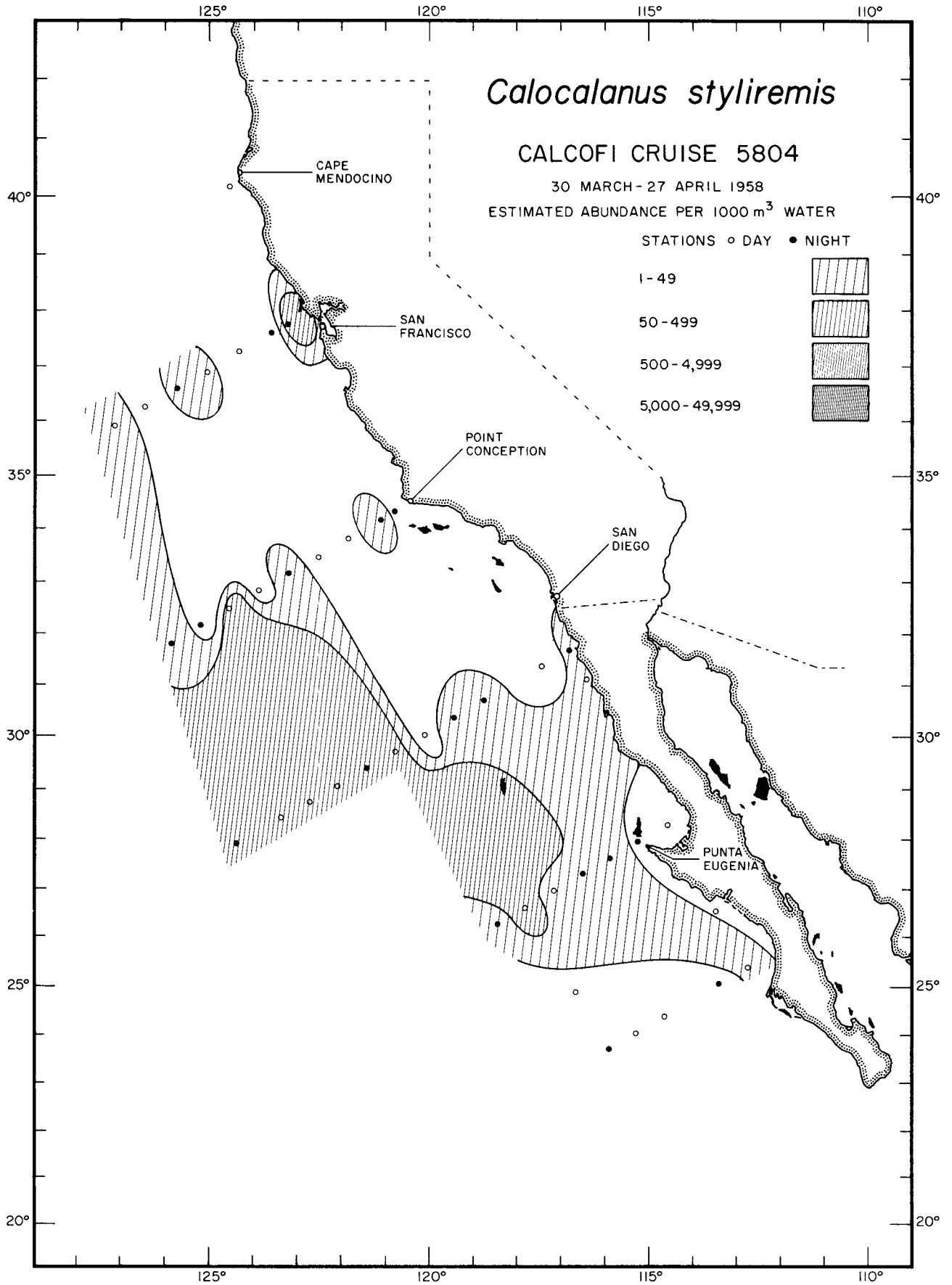
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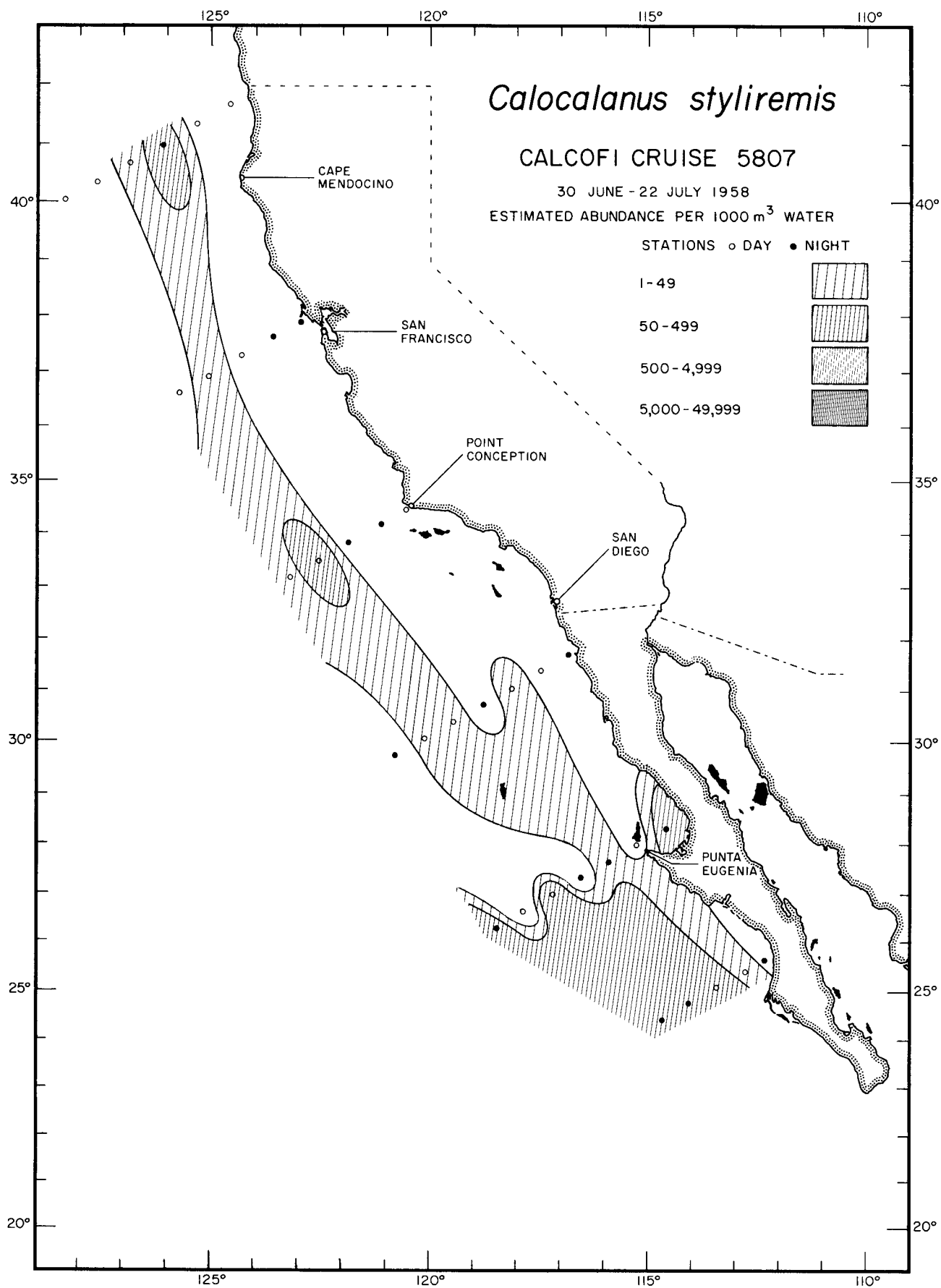
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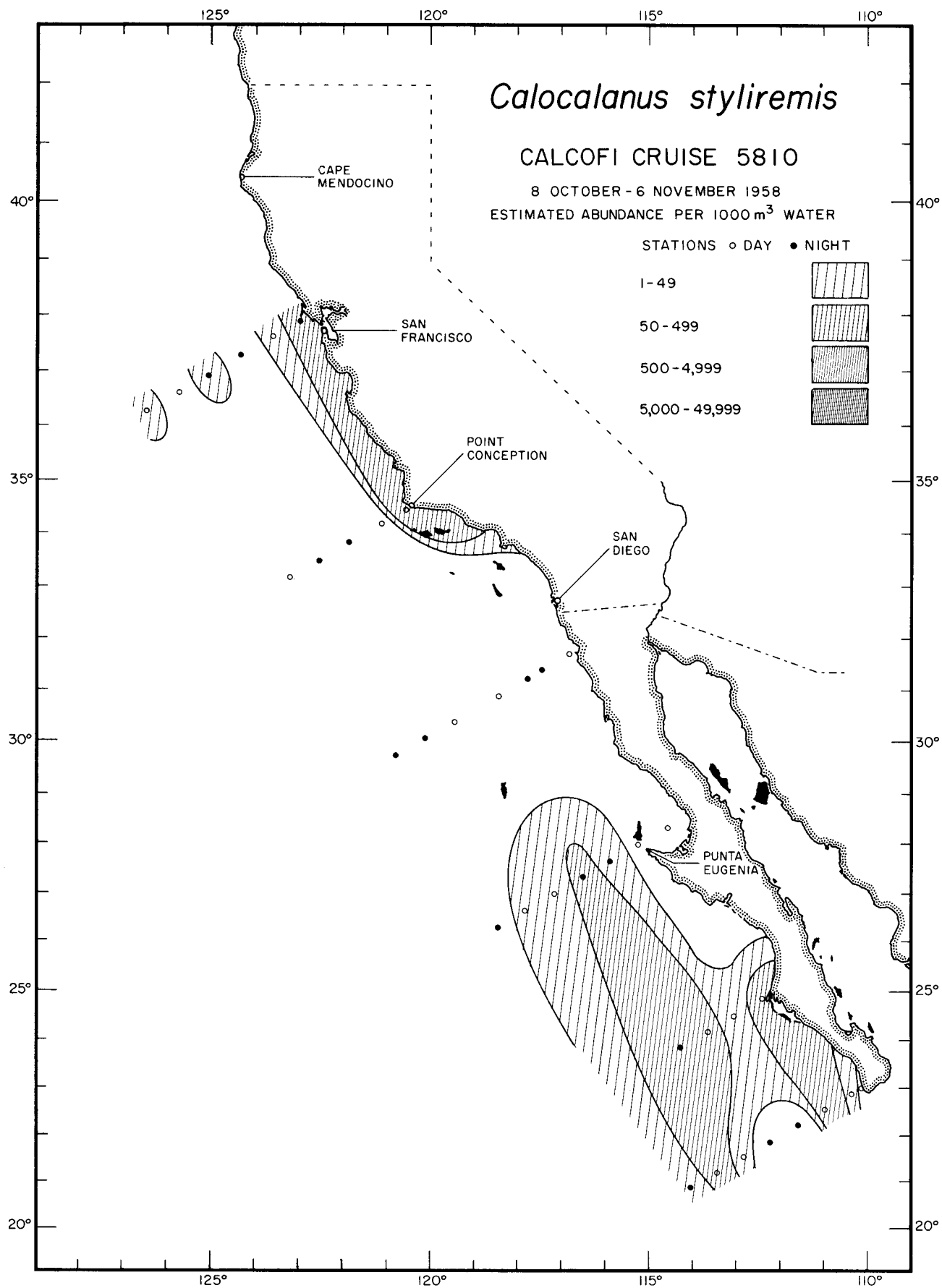
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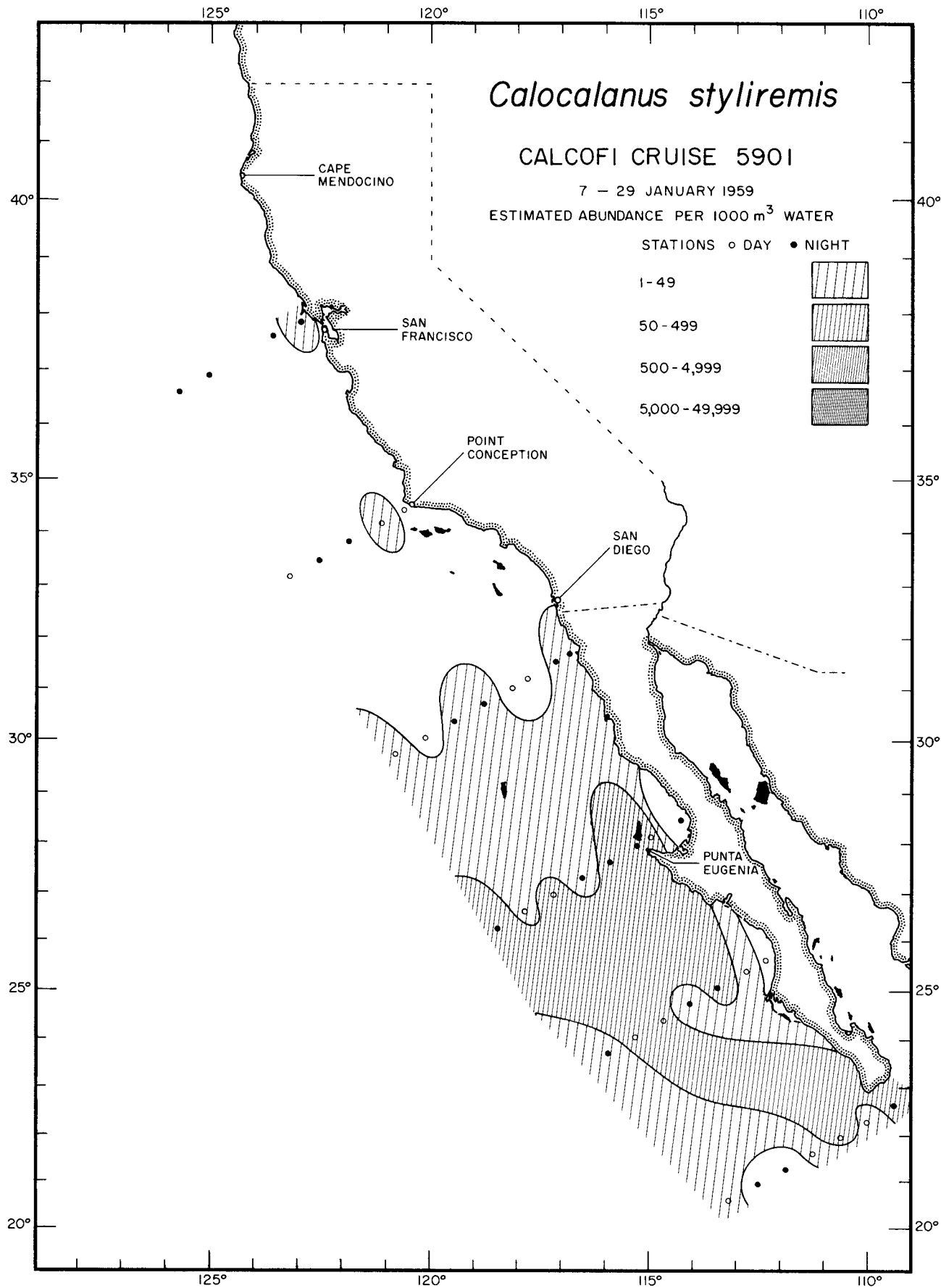
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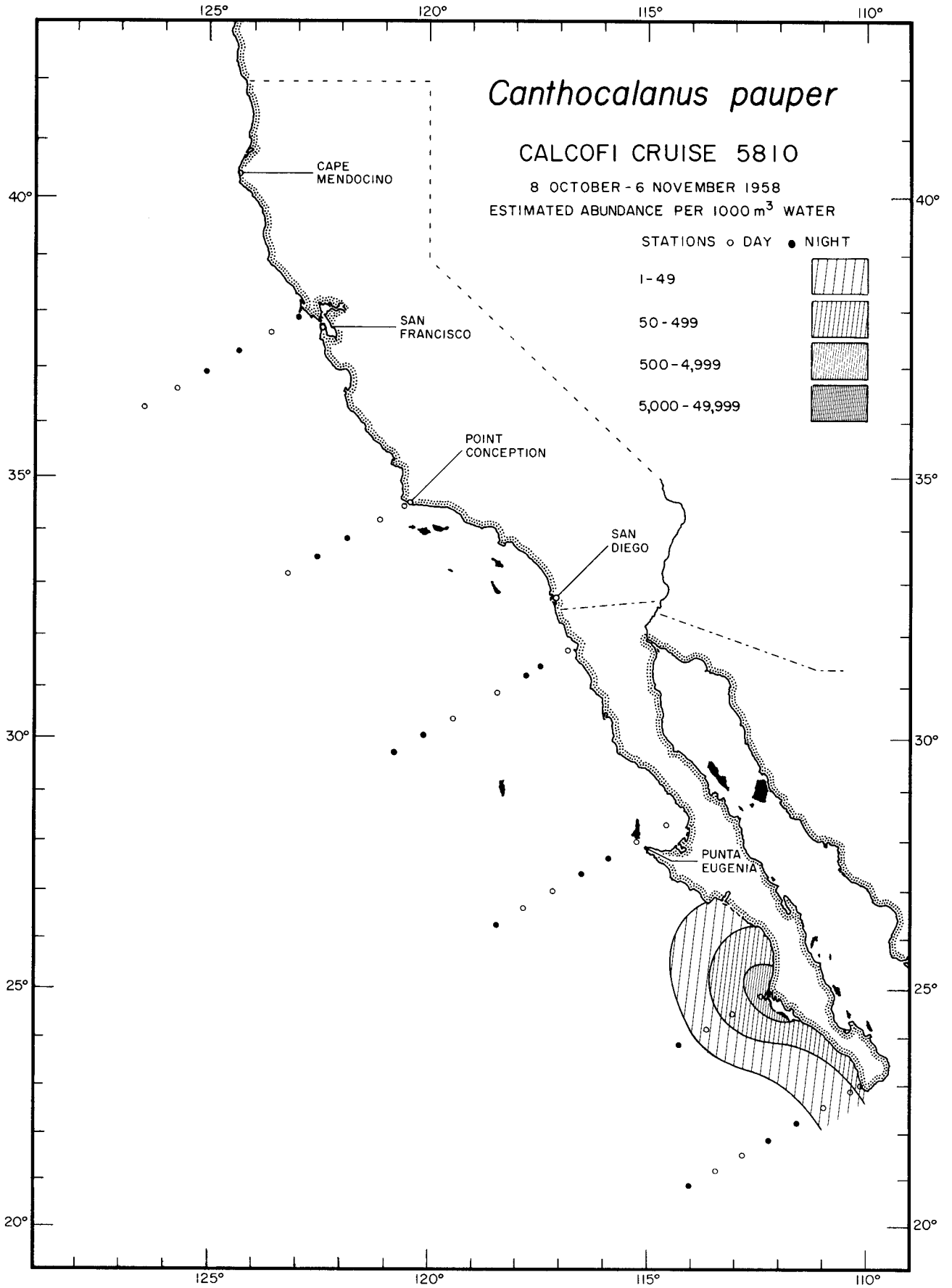
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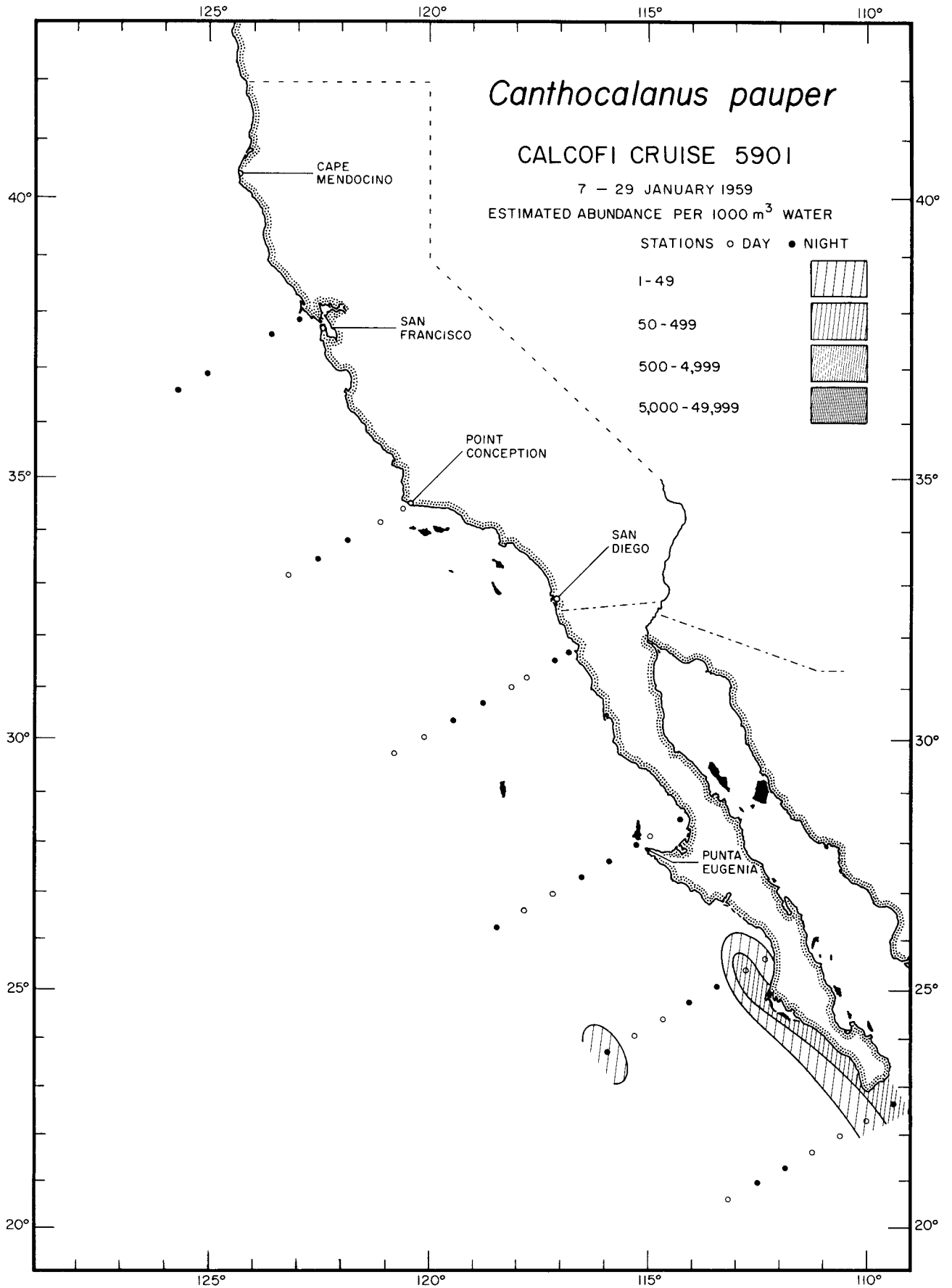
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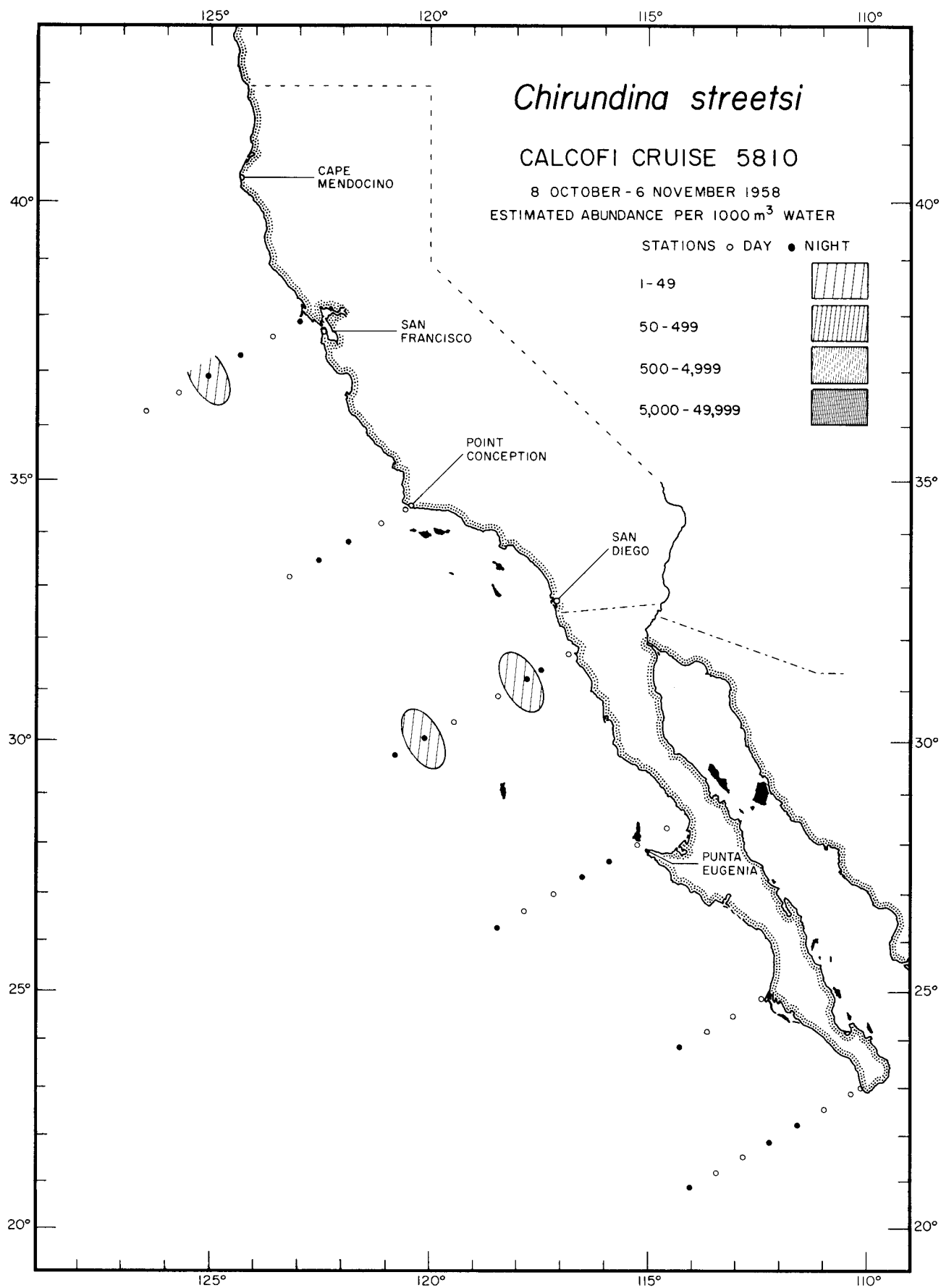
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Calanoida
Canthocalanus pauper
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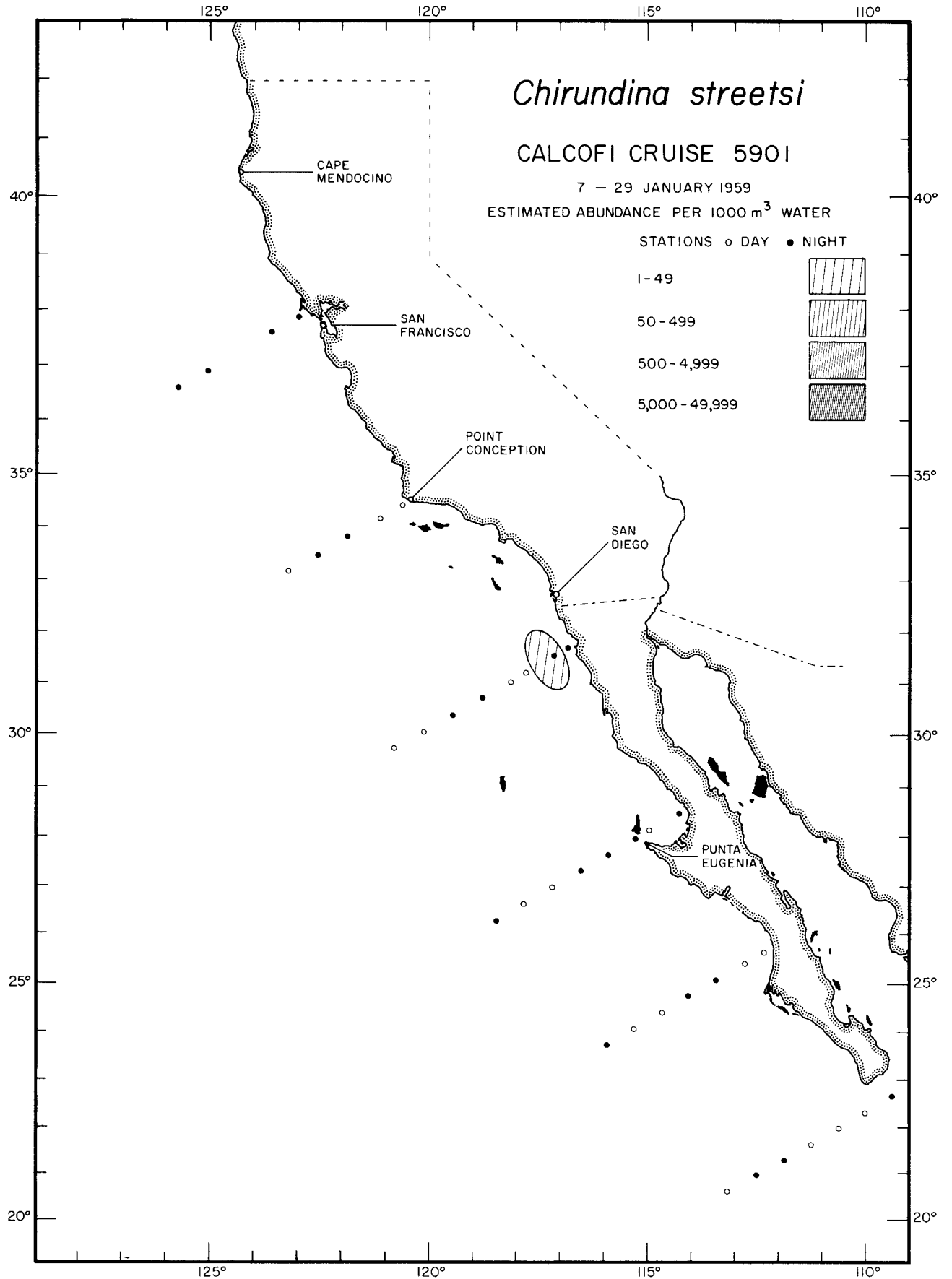
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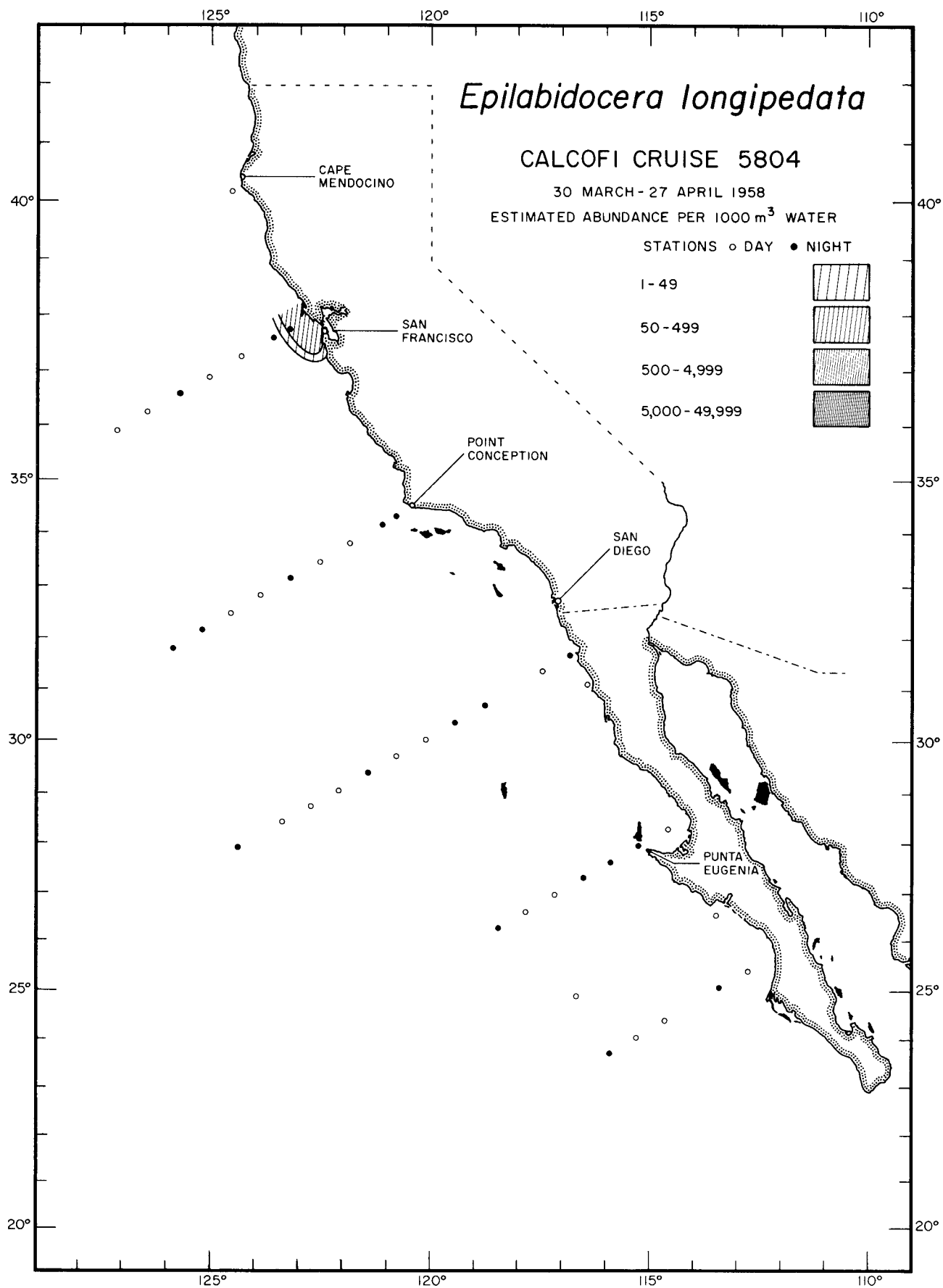
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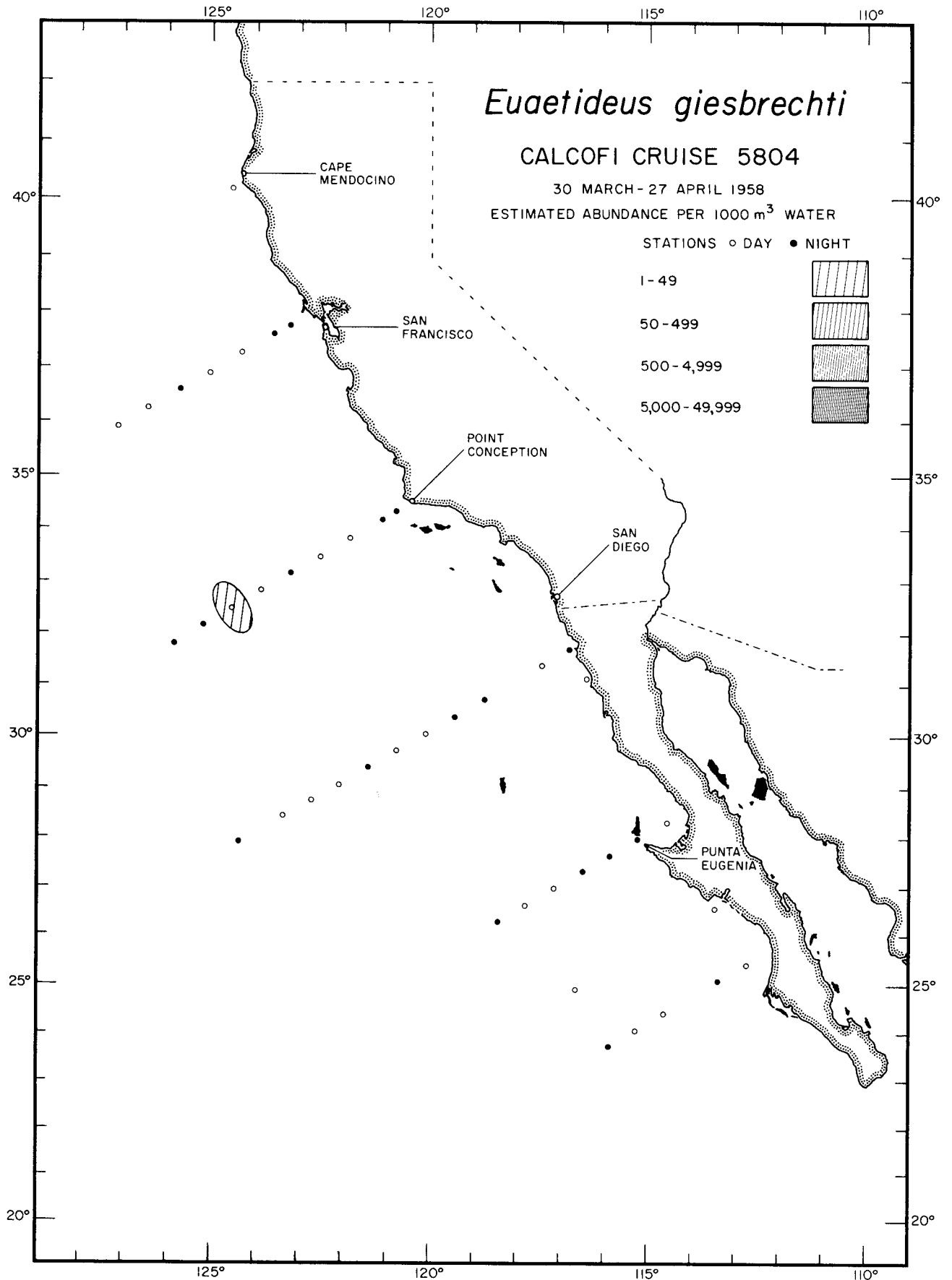
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5901



Calanoida

Epilabidocera longipedata

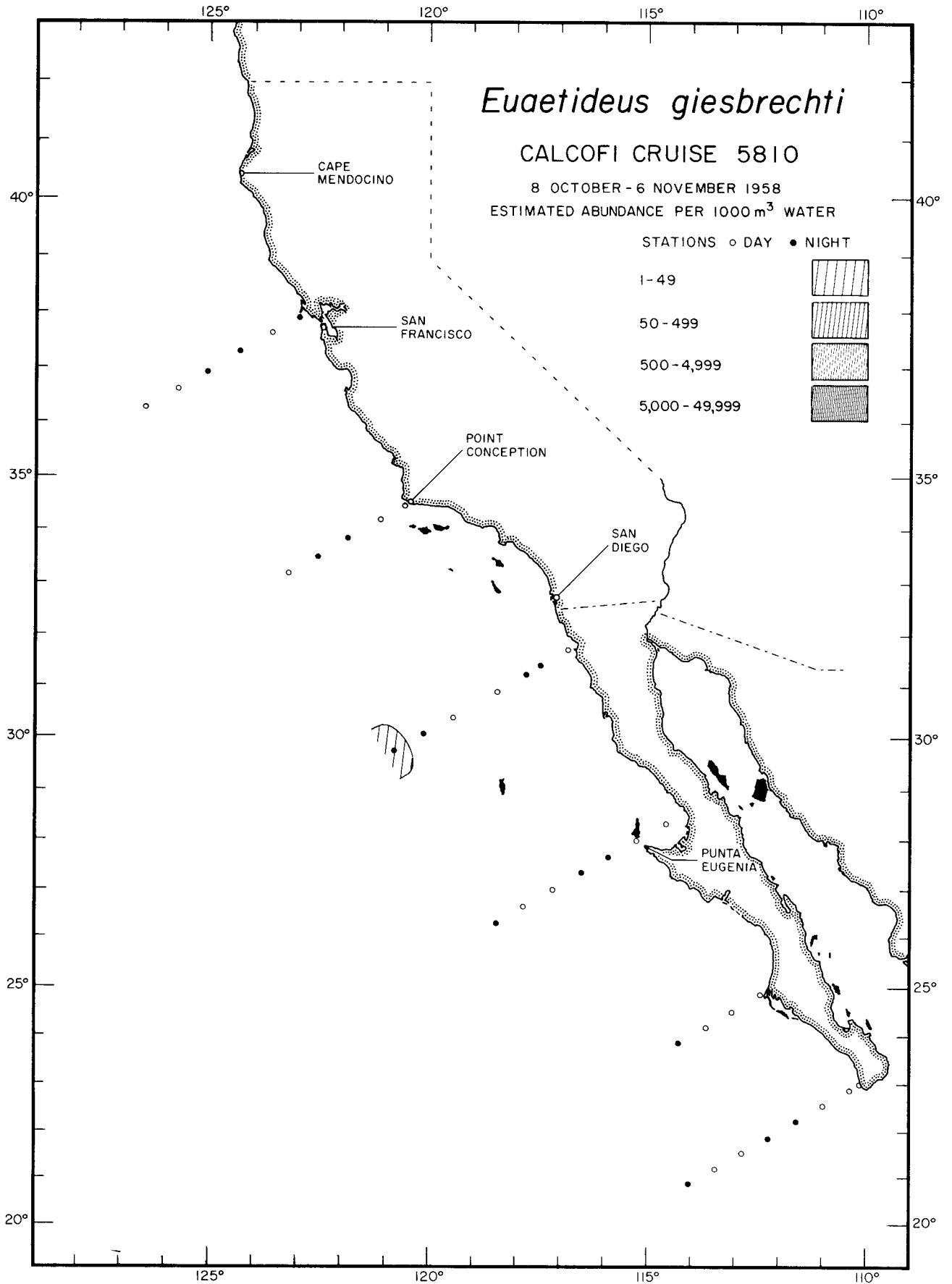
5804



Calanoida

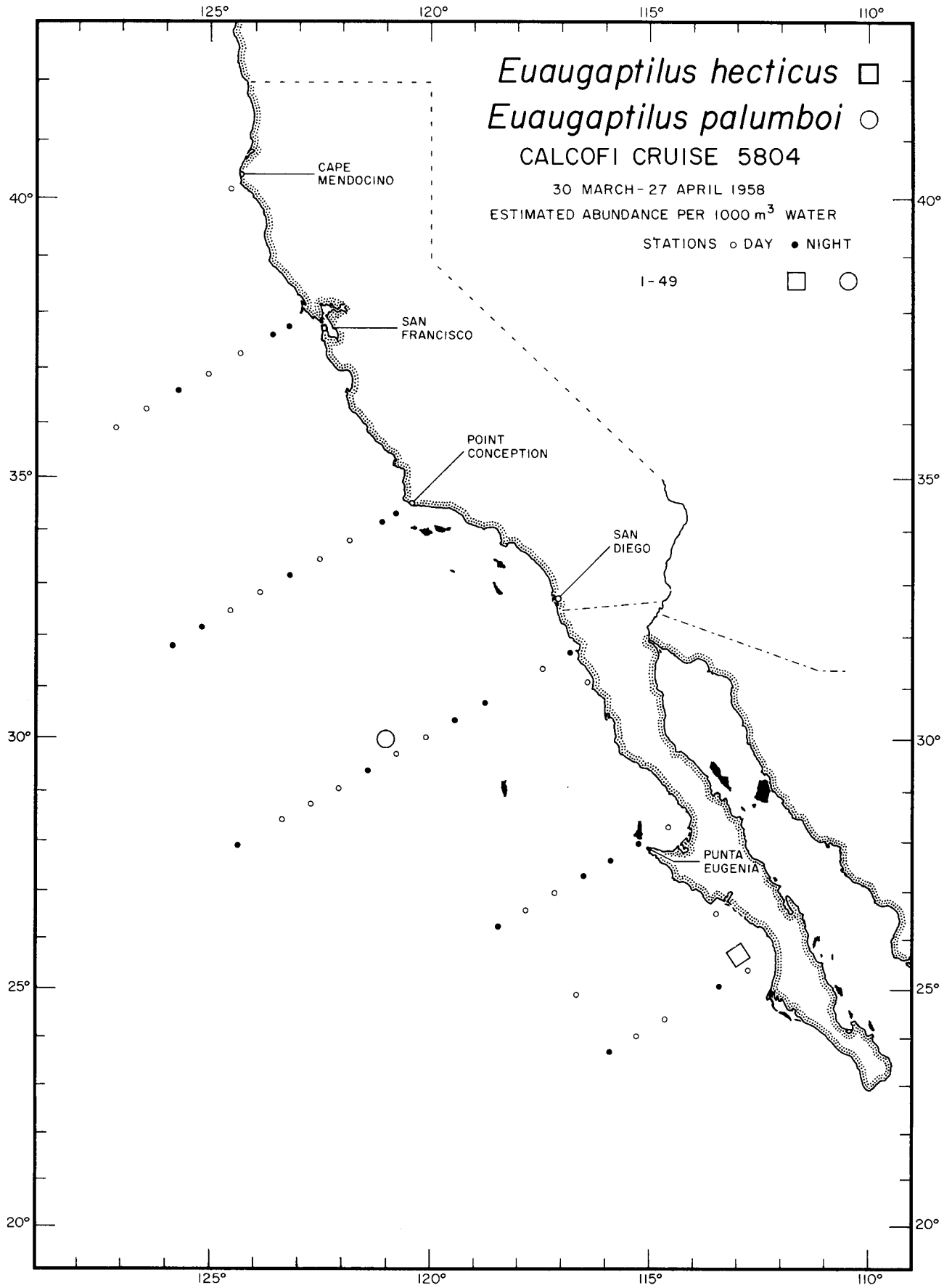
Euaetideus giesbrechti

5804

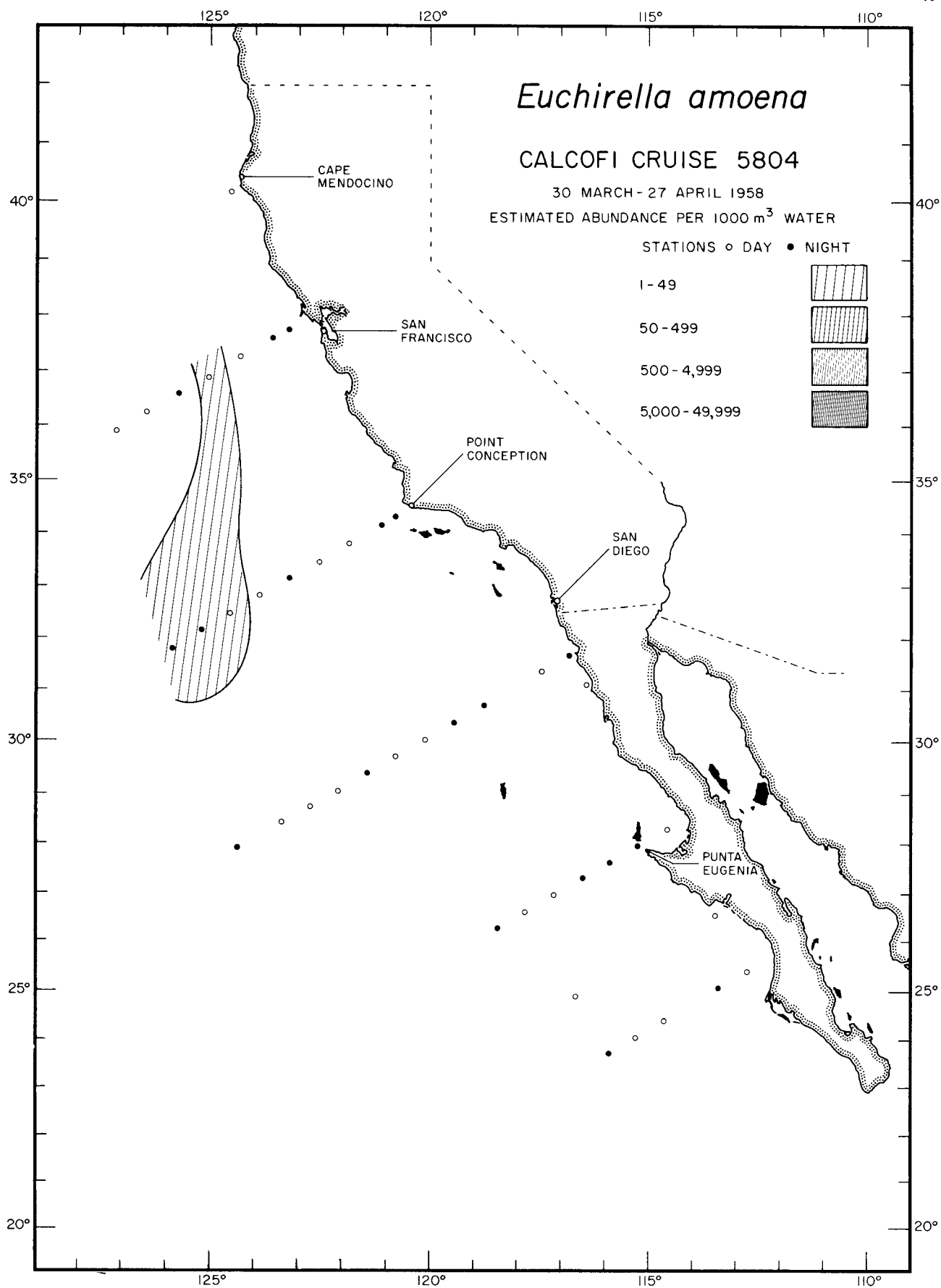


Calanoida

Euaetideus giesbrechti
5810



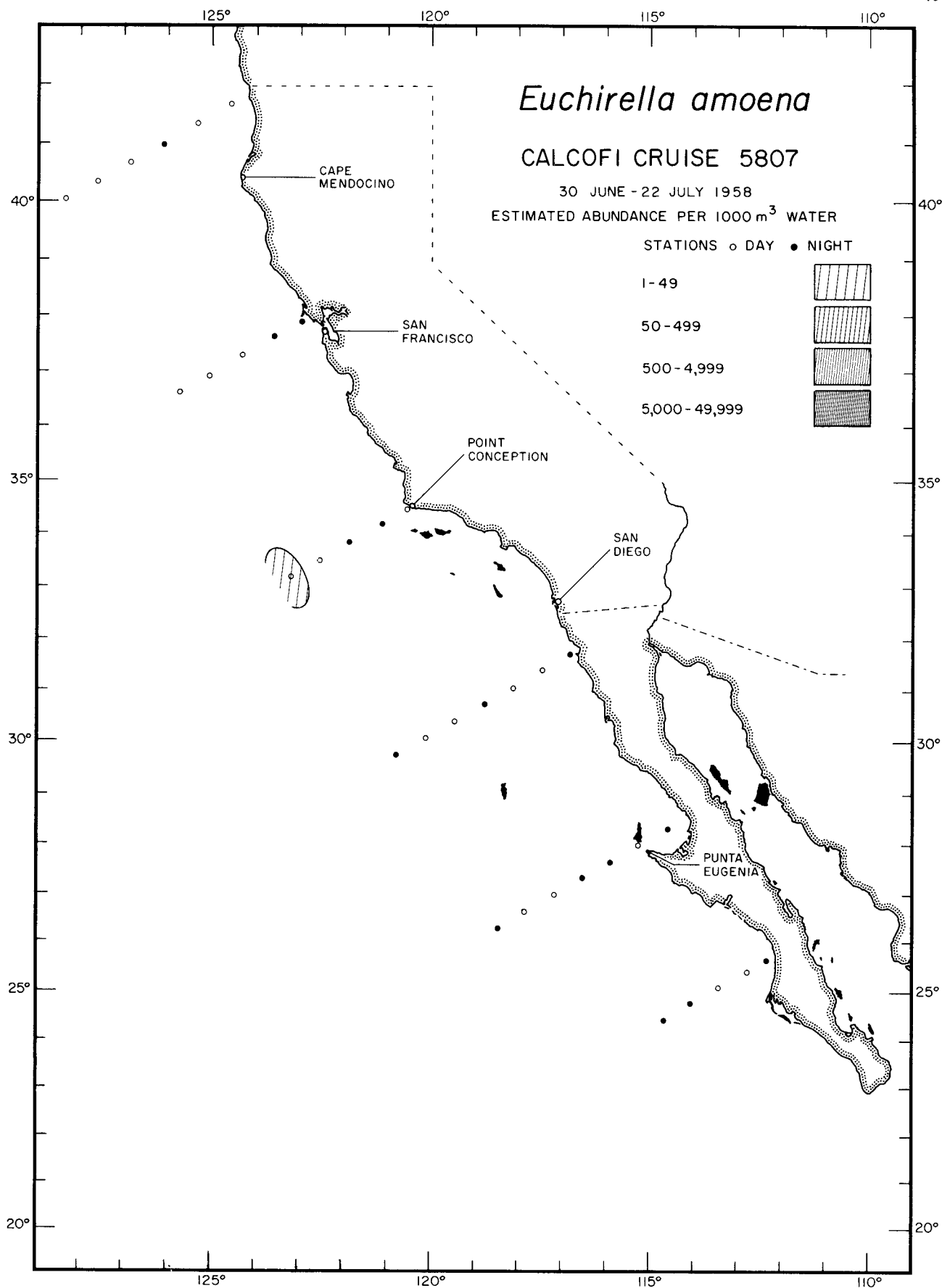
Calanoida
Eucaeretes hecticus
Eucaeretes palumboi
 5804



Calanoida

Euchirella amoena

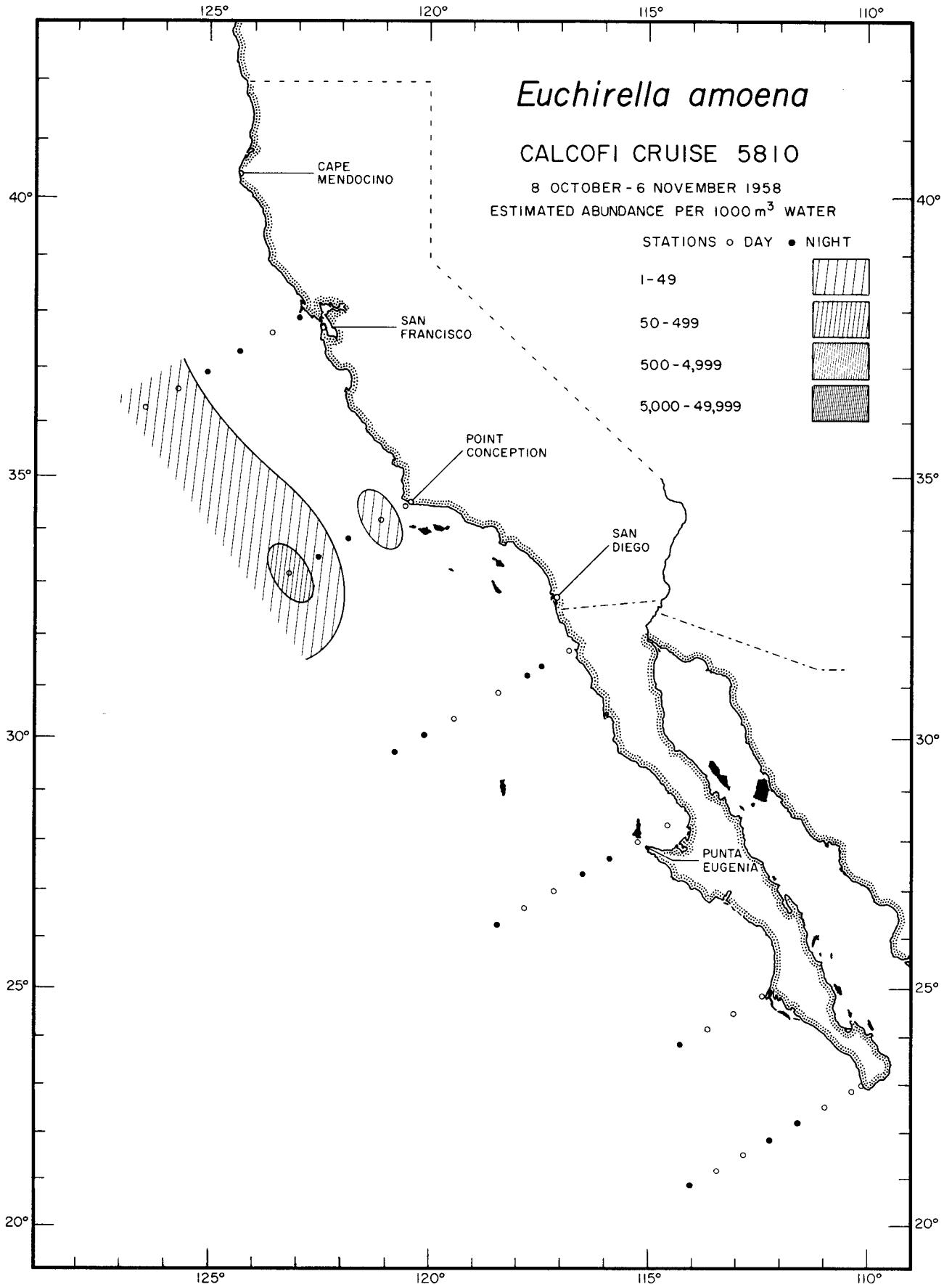
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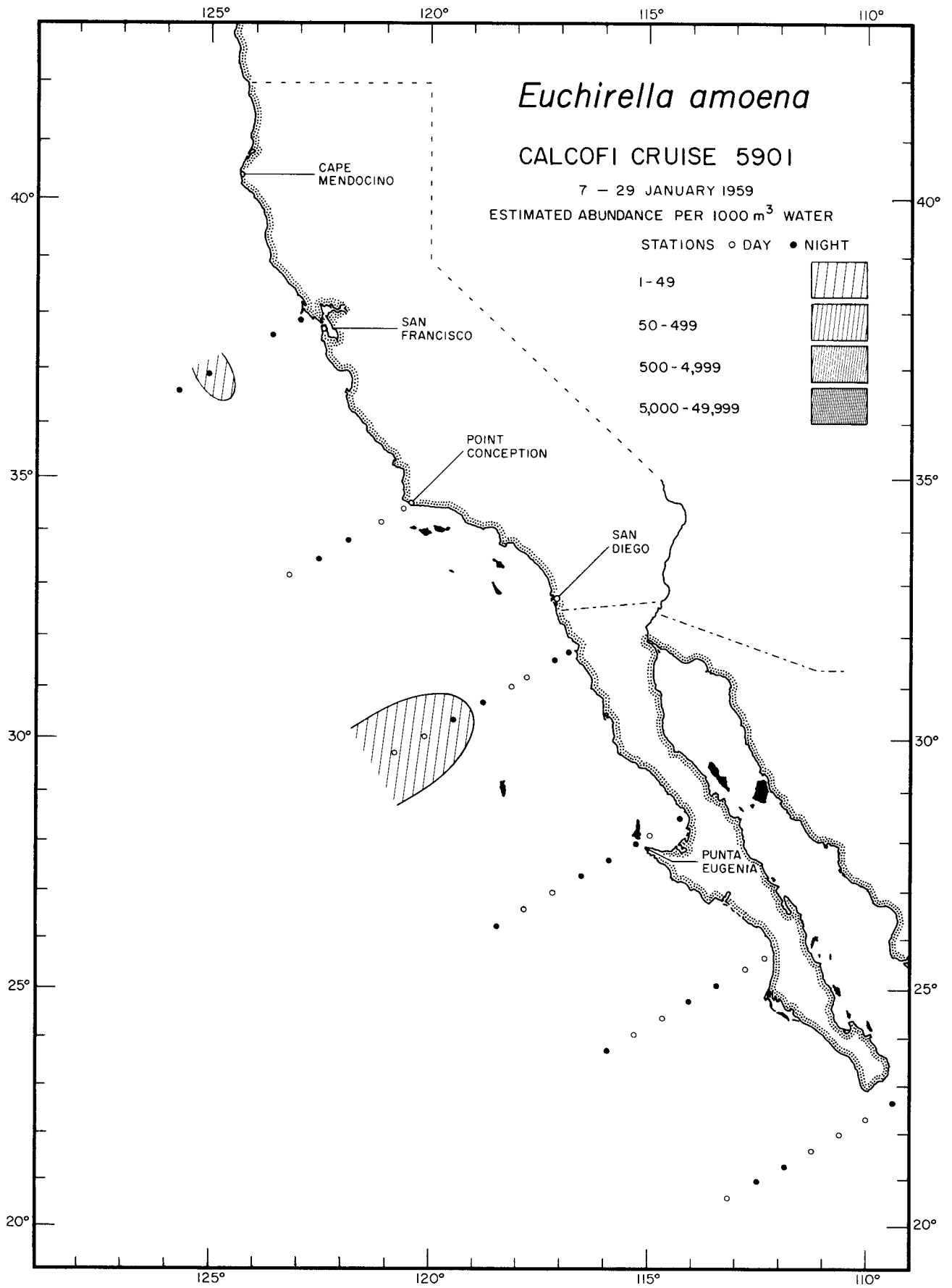
Calanoida

Euchirella amoena

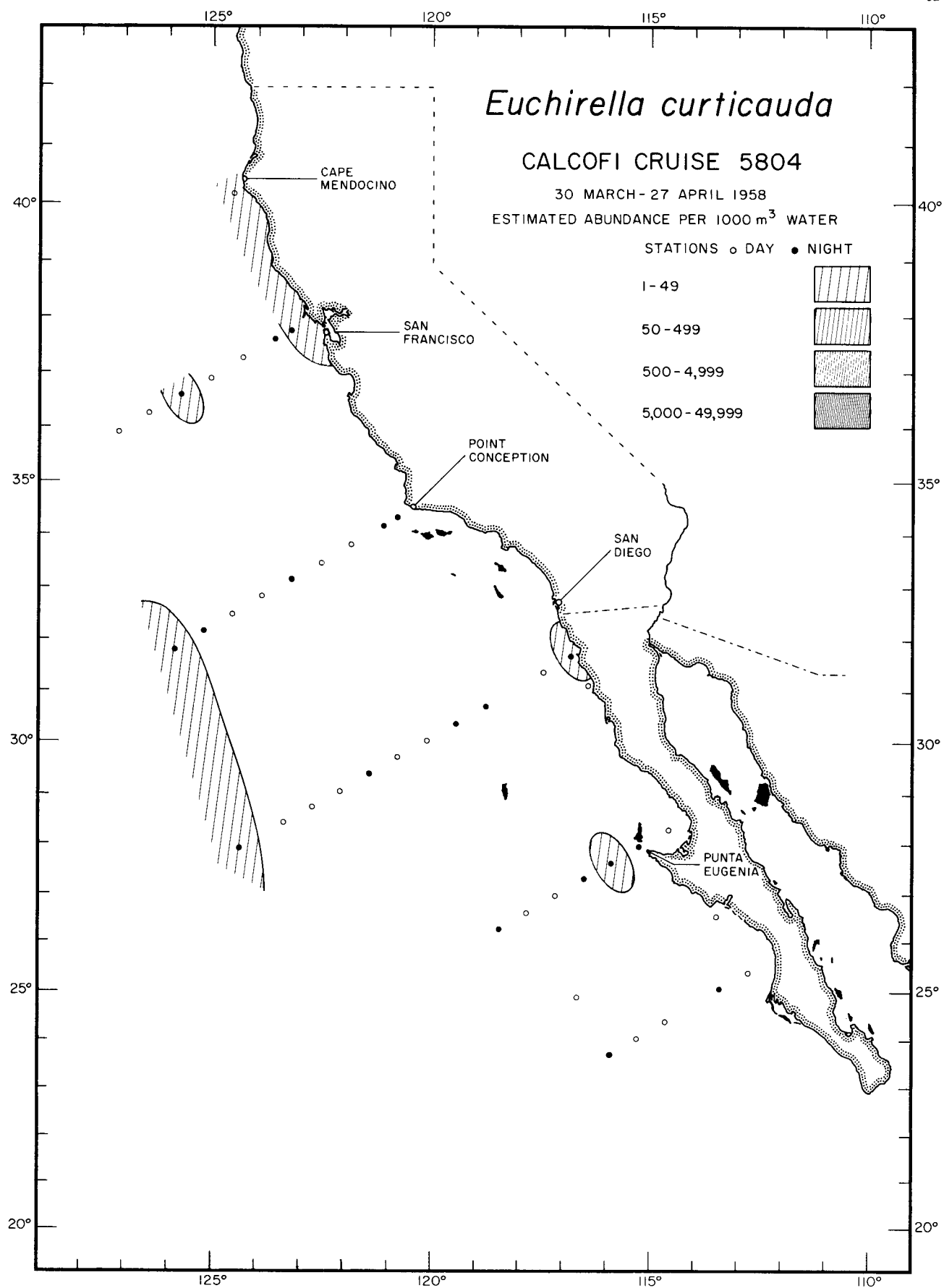
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Calanoida
Euchirella amoena
5810



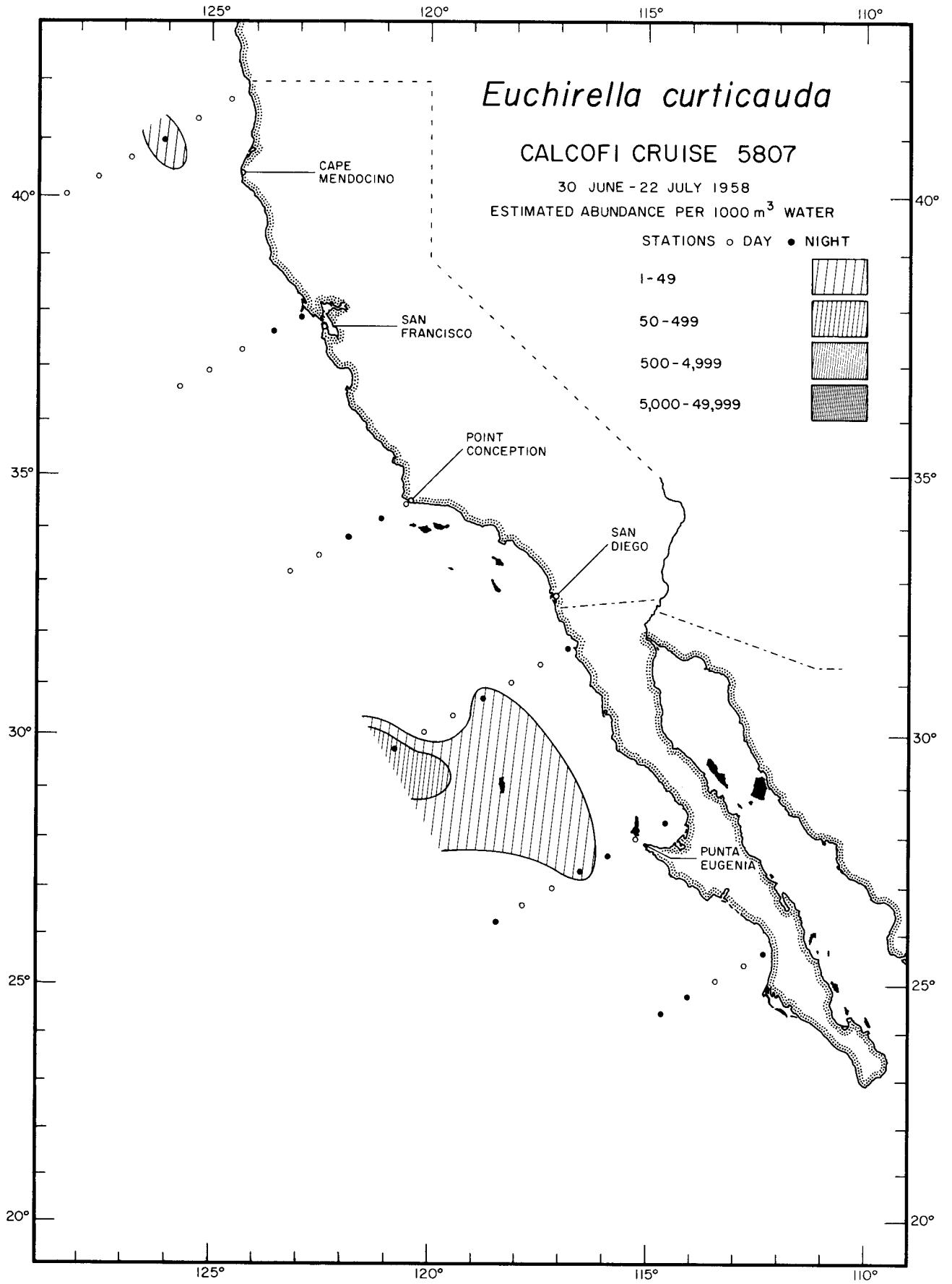
Calanoida
Eucheirella amoena
 5901



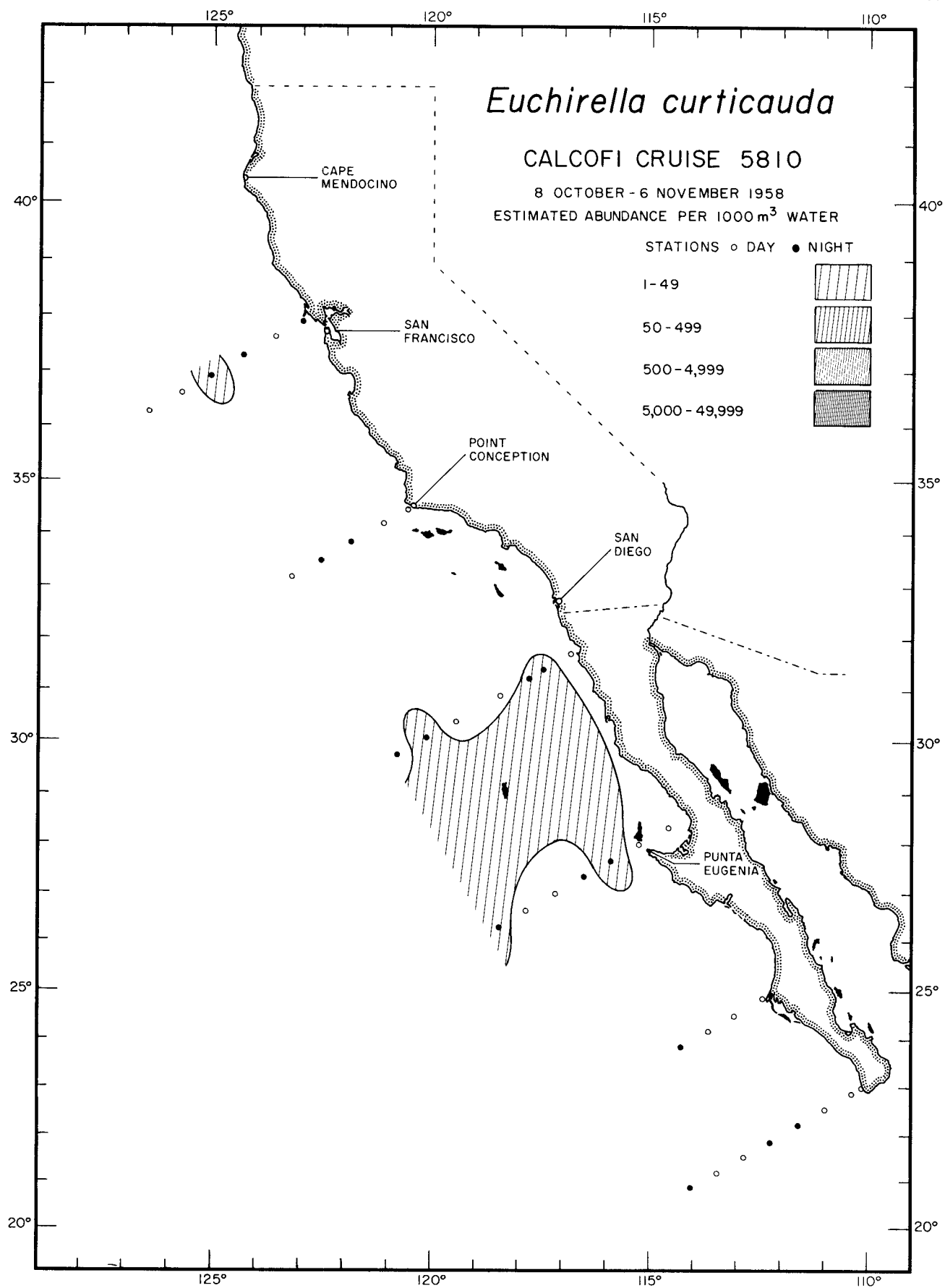
Calanoida

Euchirella curticauda

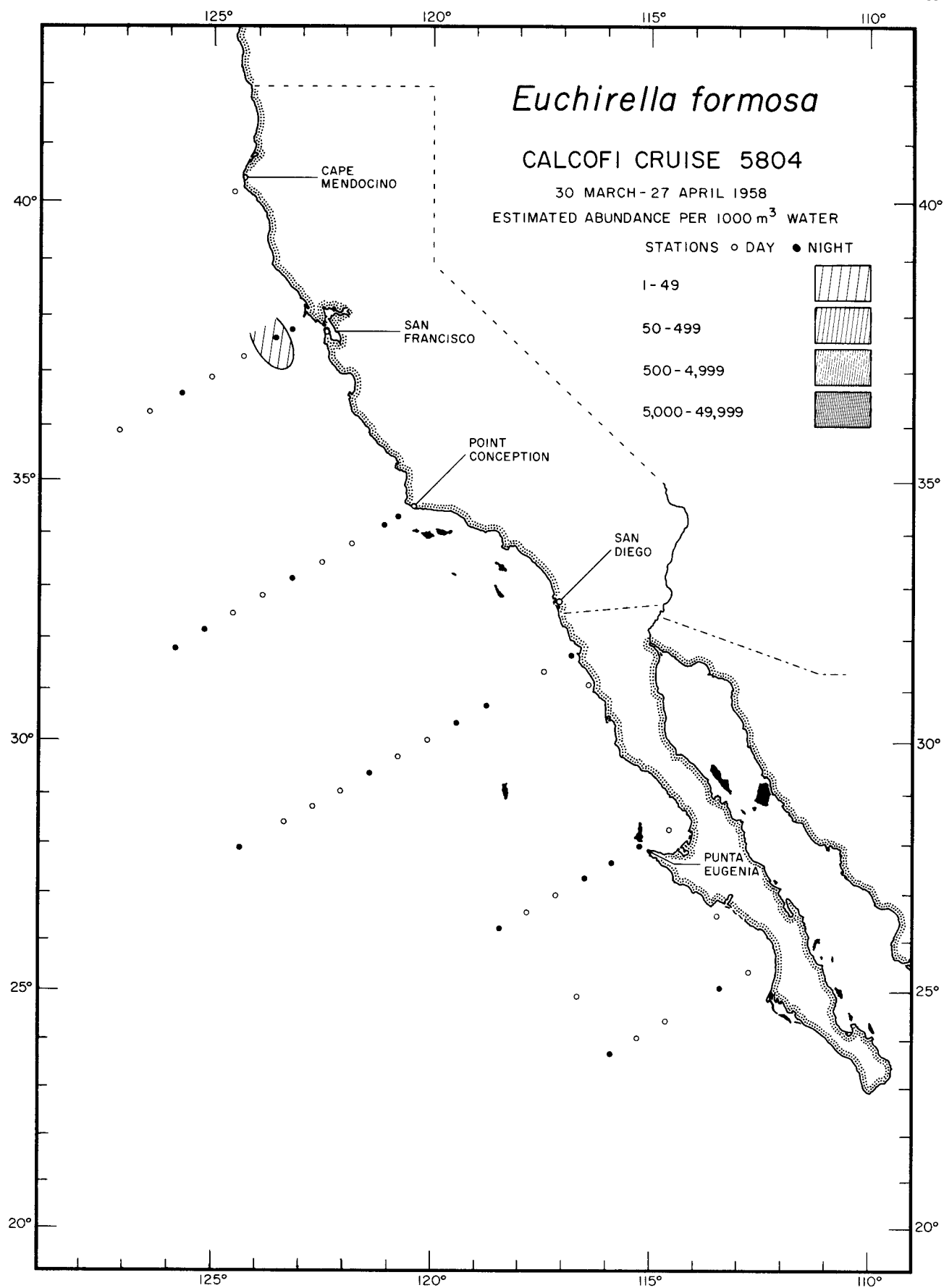
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Calanoida
Eucheirella curticauda
5807



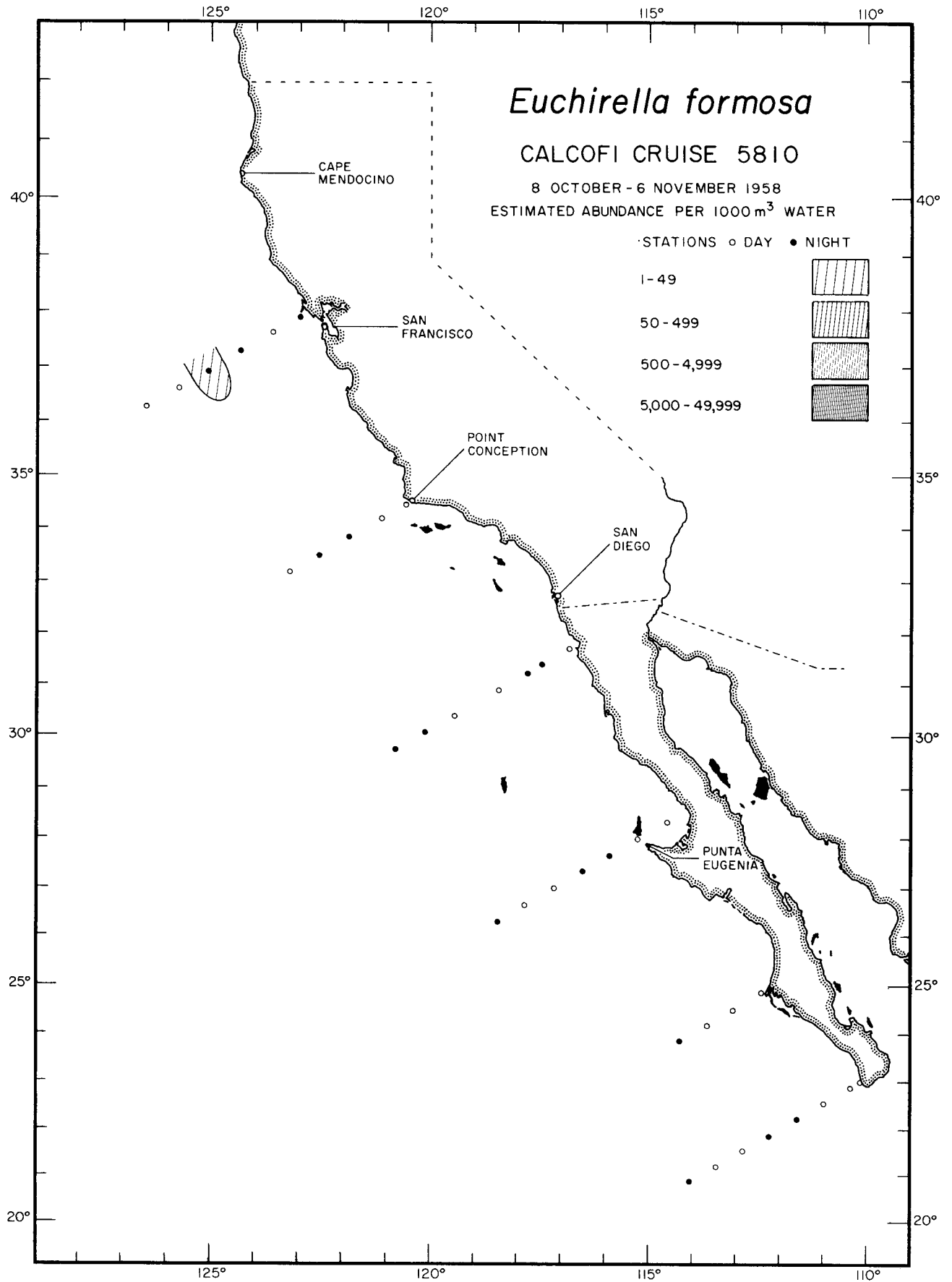
Calanoida
Euchirella curticauda
5810



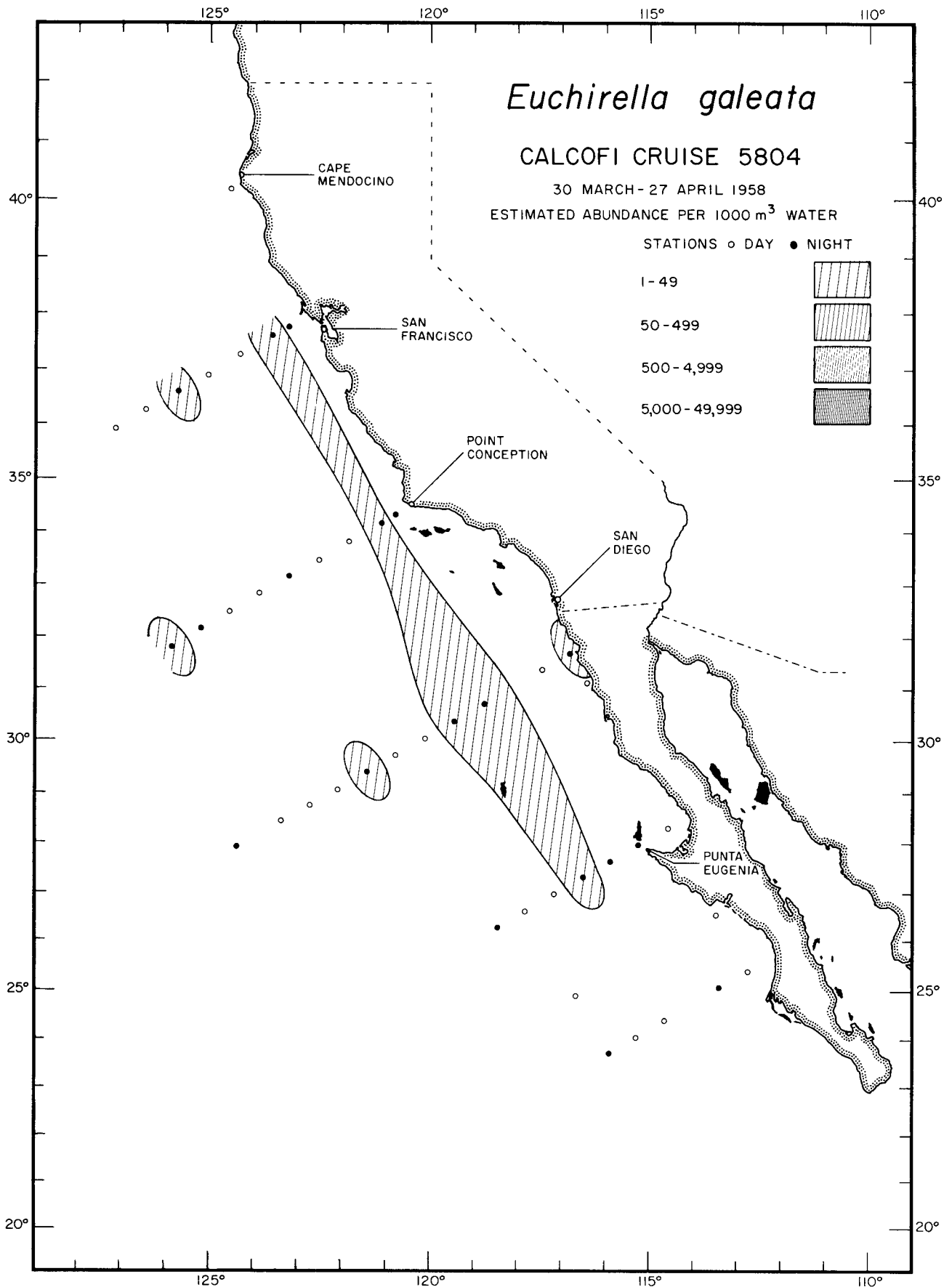
Calanoida

Euchirella formosa

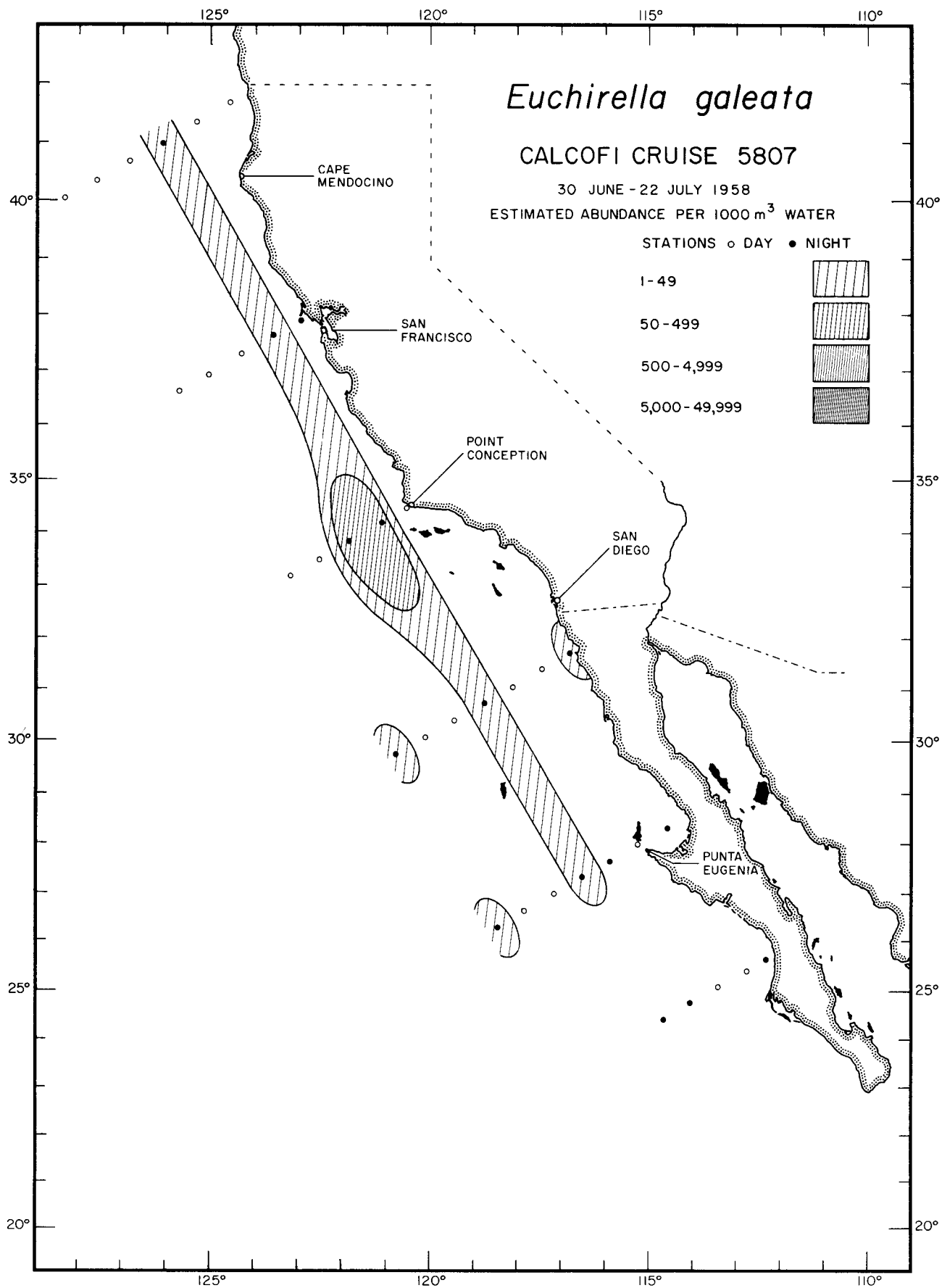
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Calanoida
Euchirella formosa
5810



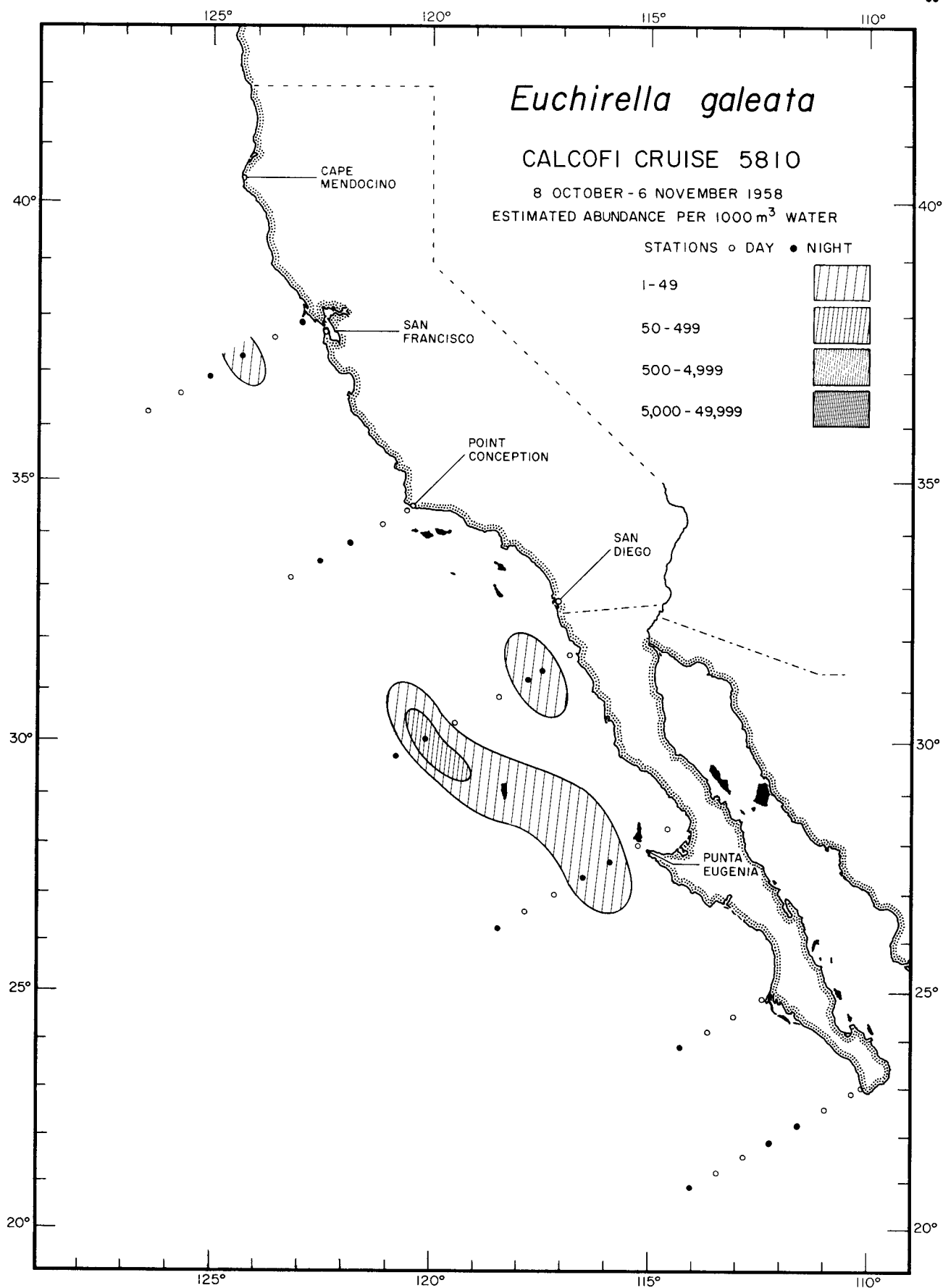
Calanoida
Eucheirella galeata
5804



Calanoida

Euchirella galeata

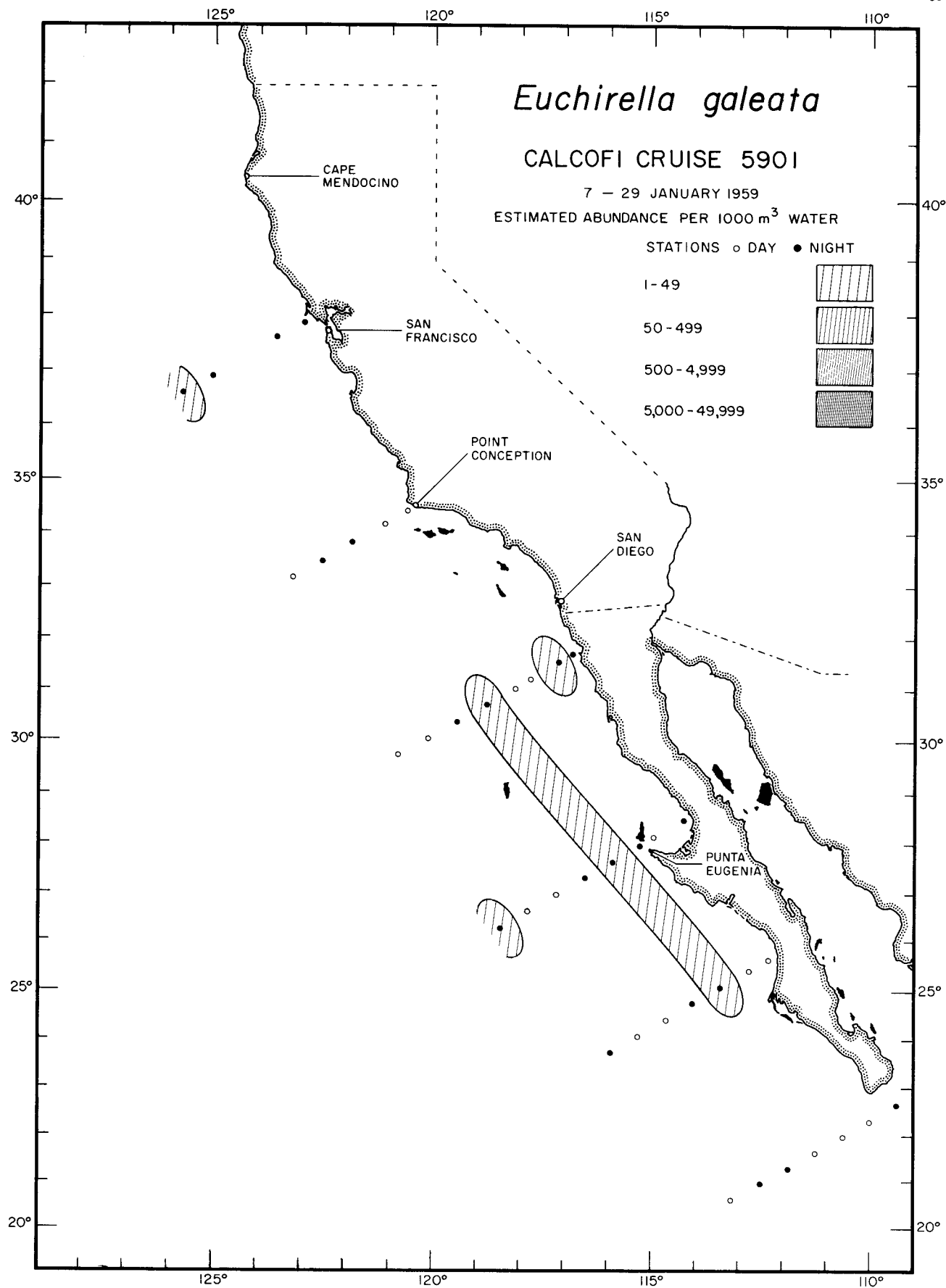
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Calanoida

Euchirella galeata

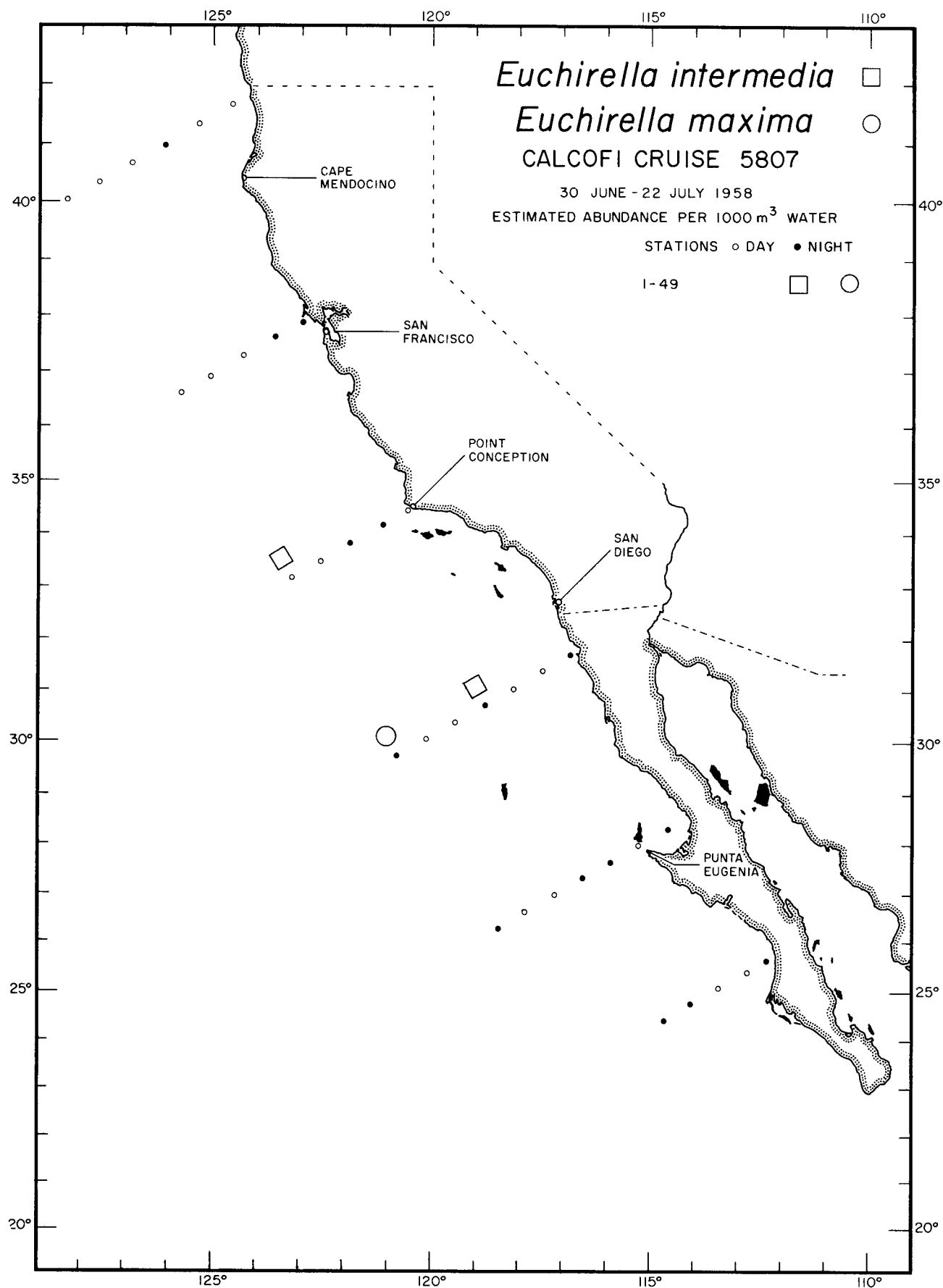
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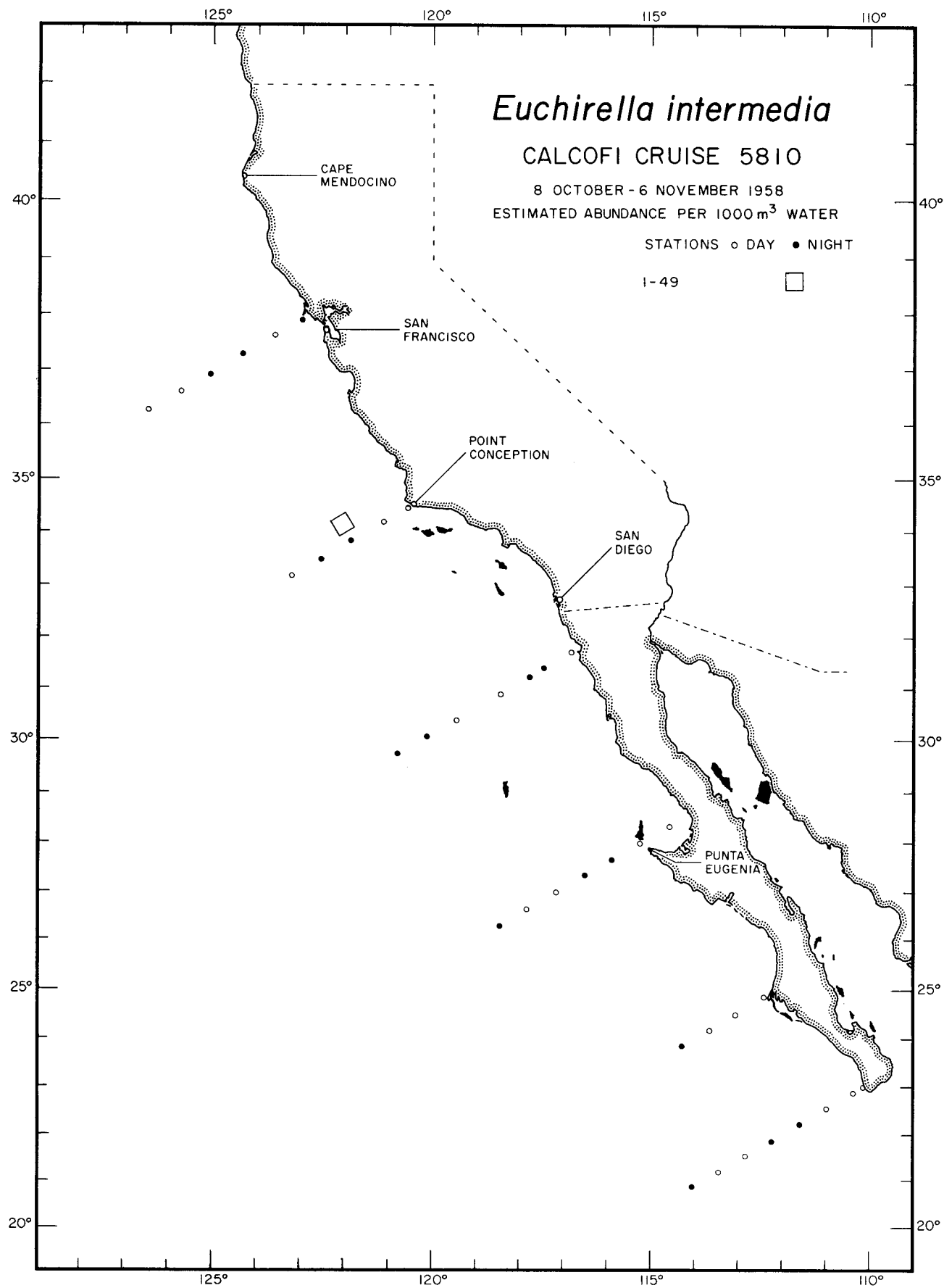
Calanoida

Euchirella galeata

5901



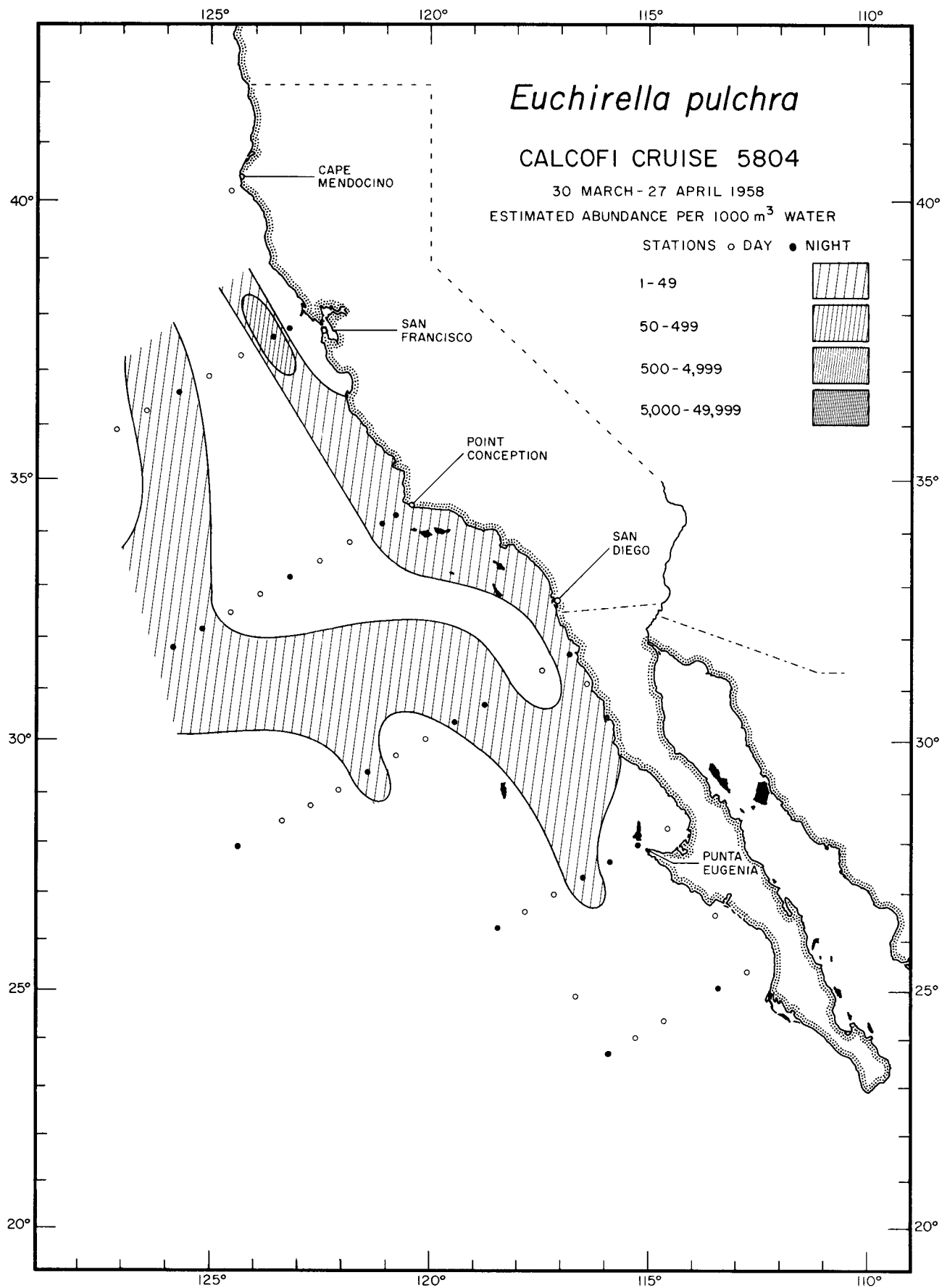
Calanoida
Euchirella intermedia
Euchirella maxima
 5807



Calanoida

Euchirella intermedia

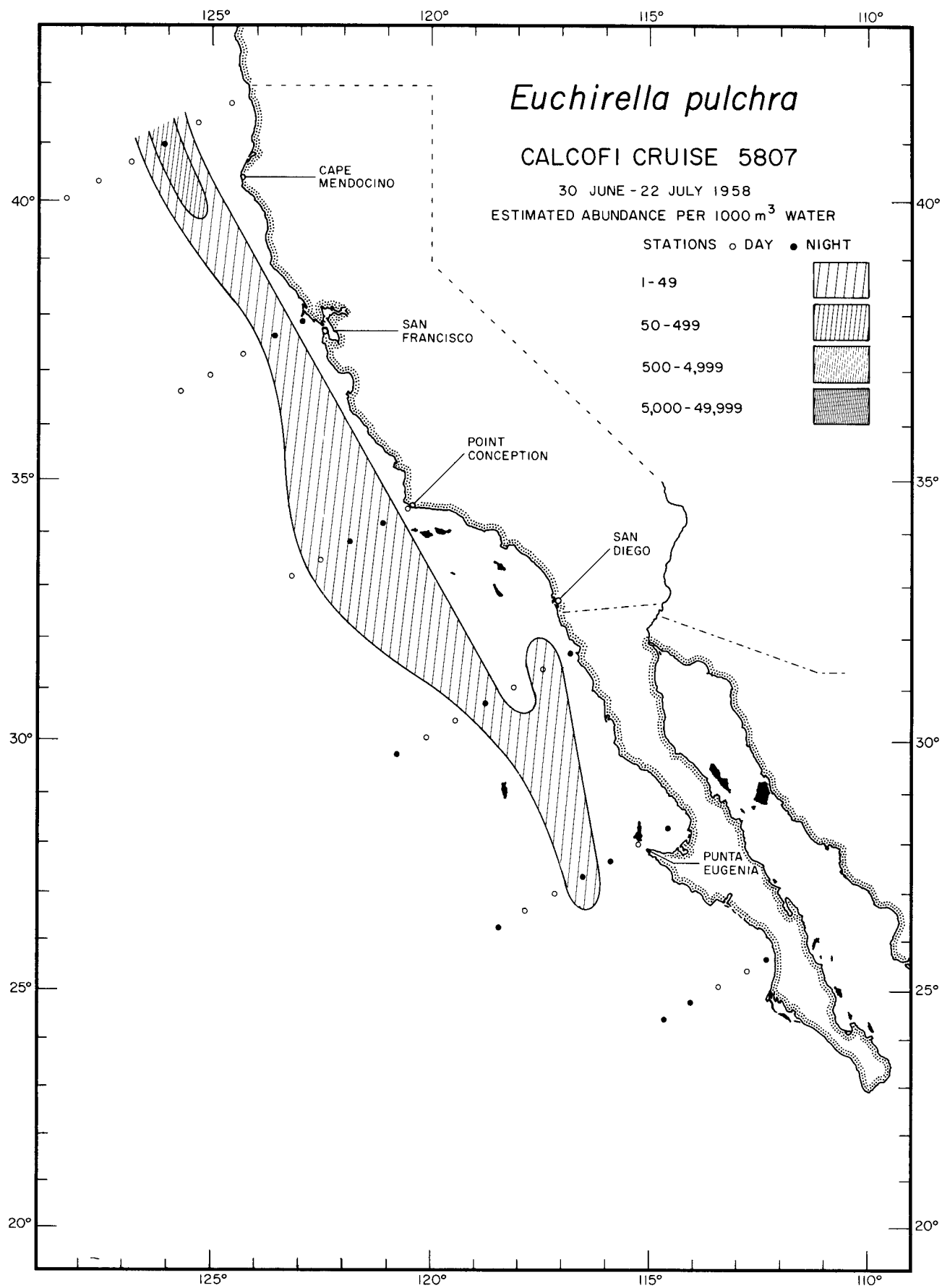
5810



Calanoida

Euchirella pulchra

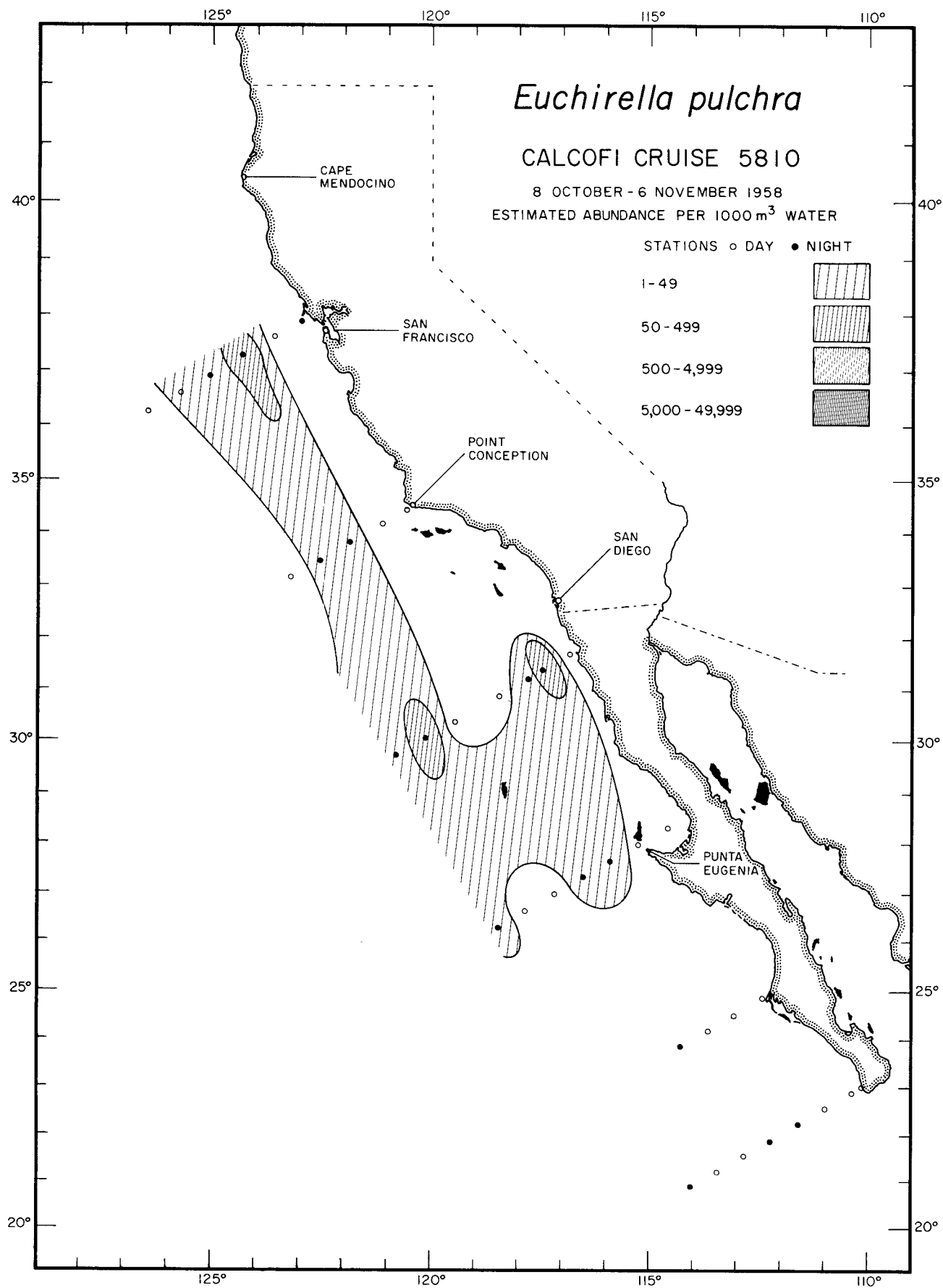
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Calanoida

Euchirella pulchra

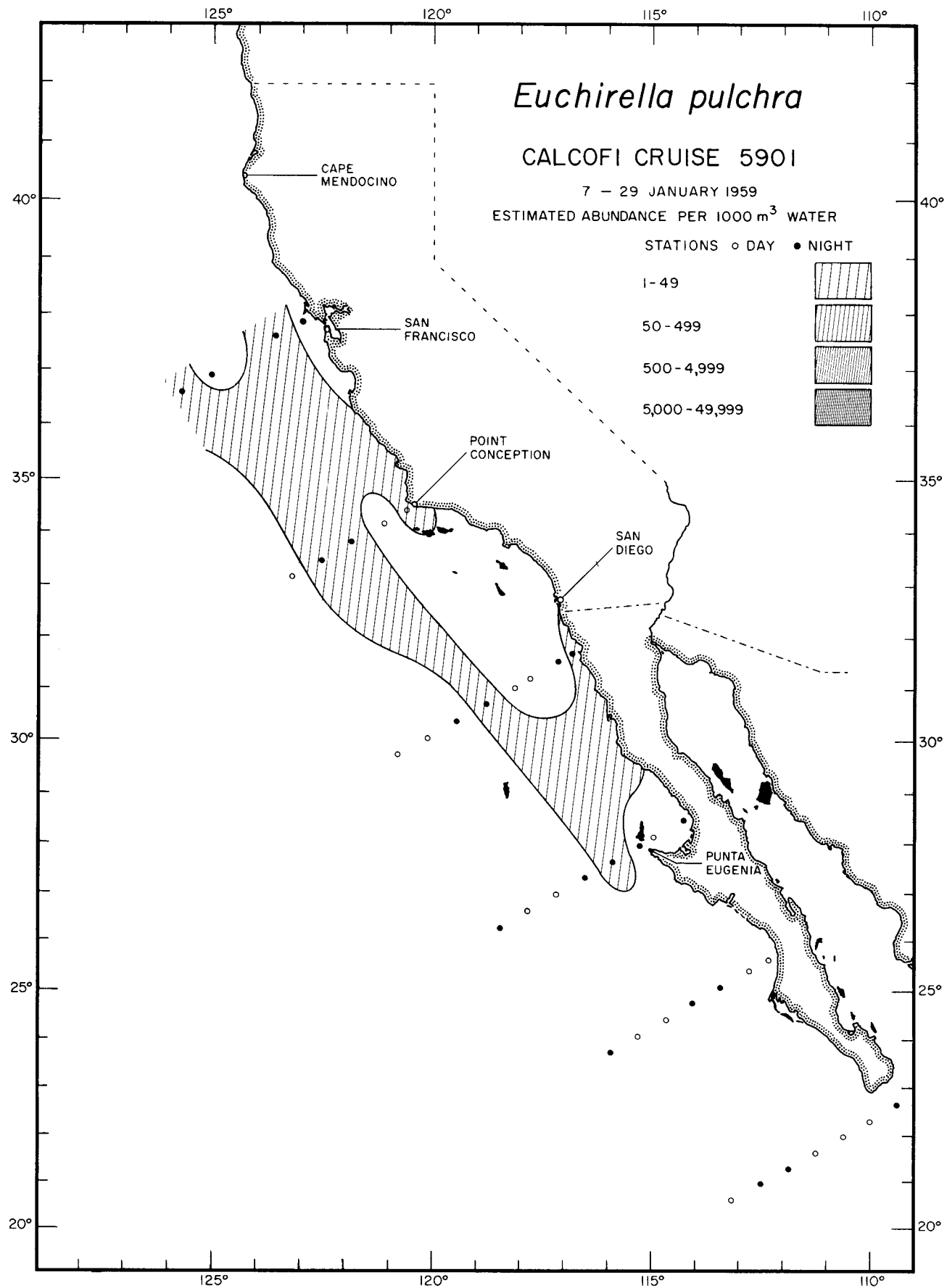
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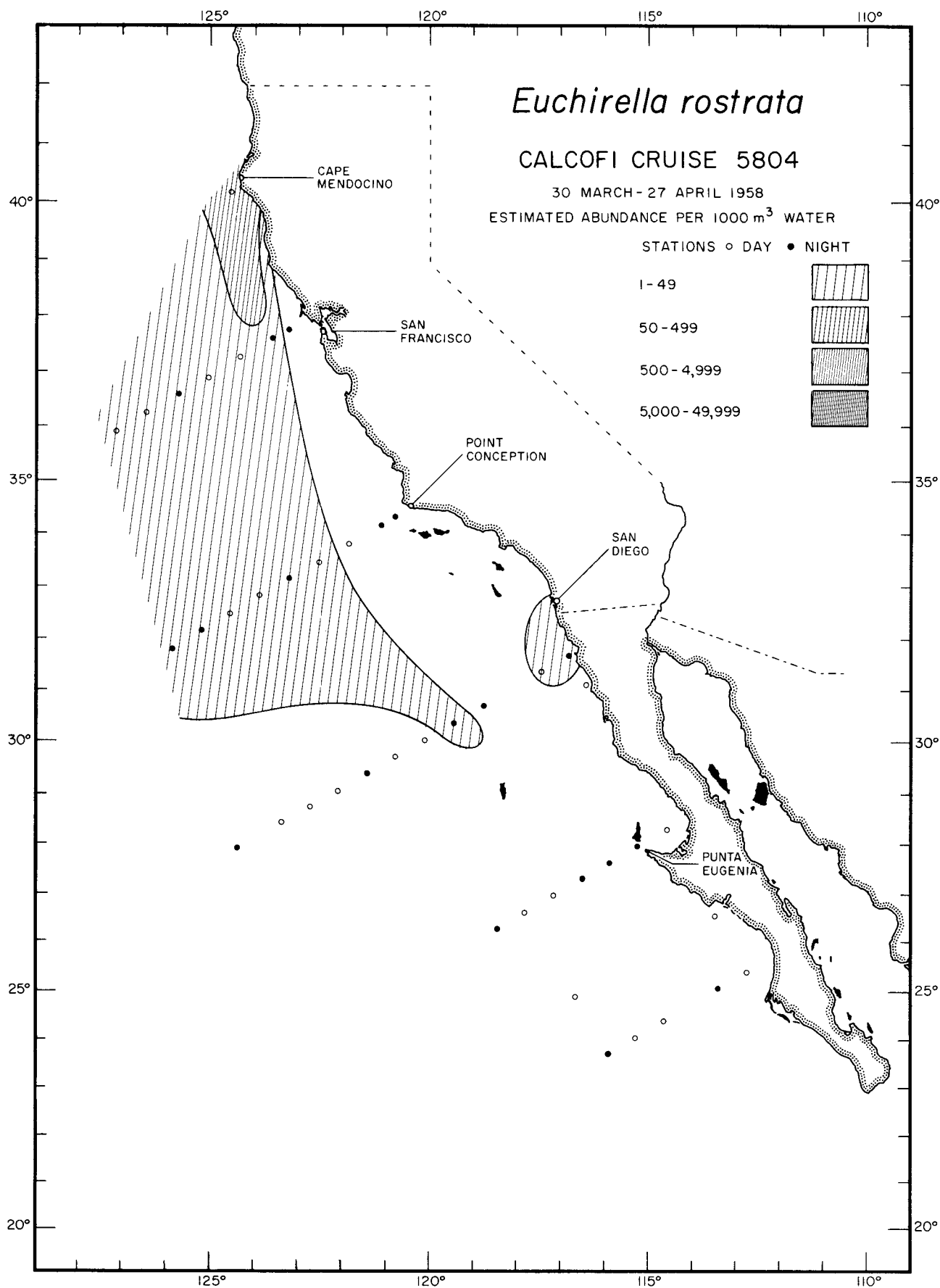
Calanoida

Euchirella pulchra

5810



Calanoida
Eucheirella pulchra
5901



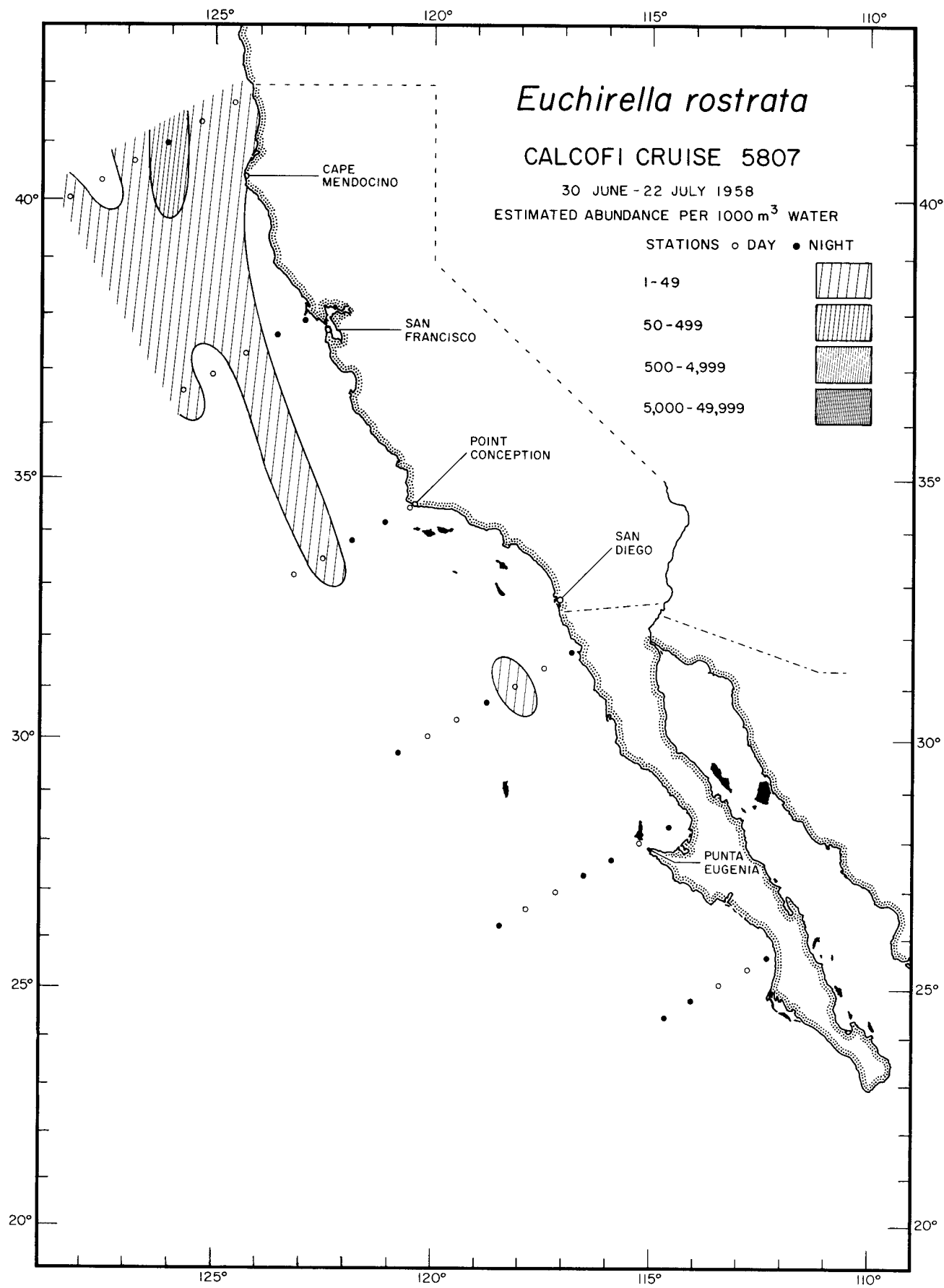
Euchirella rostrata

CALCOFI CRUISE 5804

30 MARCH - 27 APRIL 1958
ESTIMATED ABUNDANCE PER 1000 m³ WATER

STATIONS ○ DAY ● NIGHT

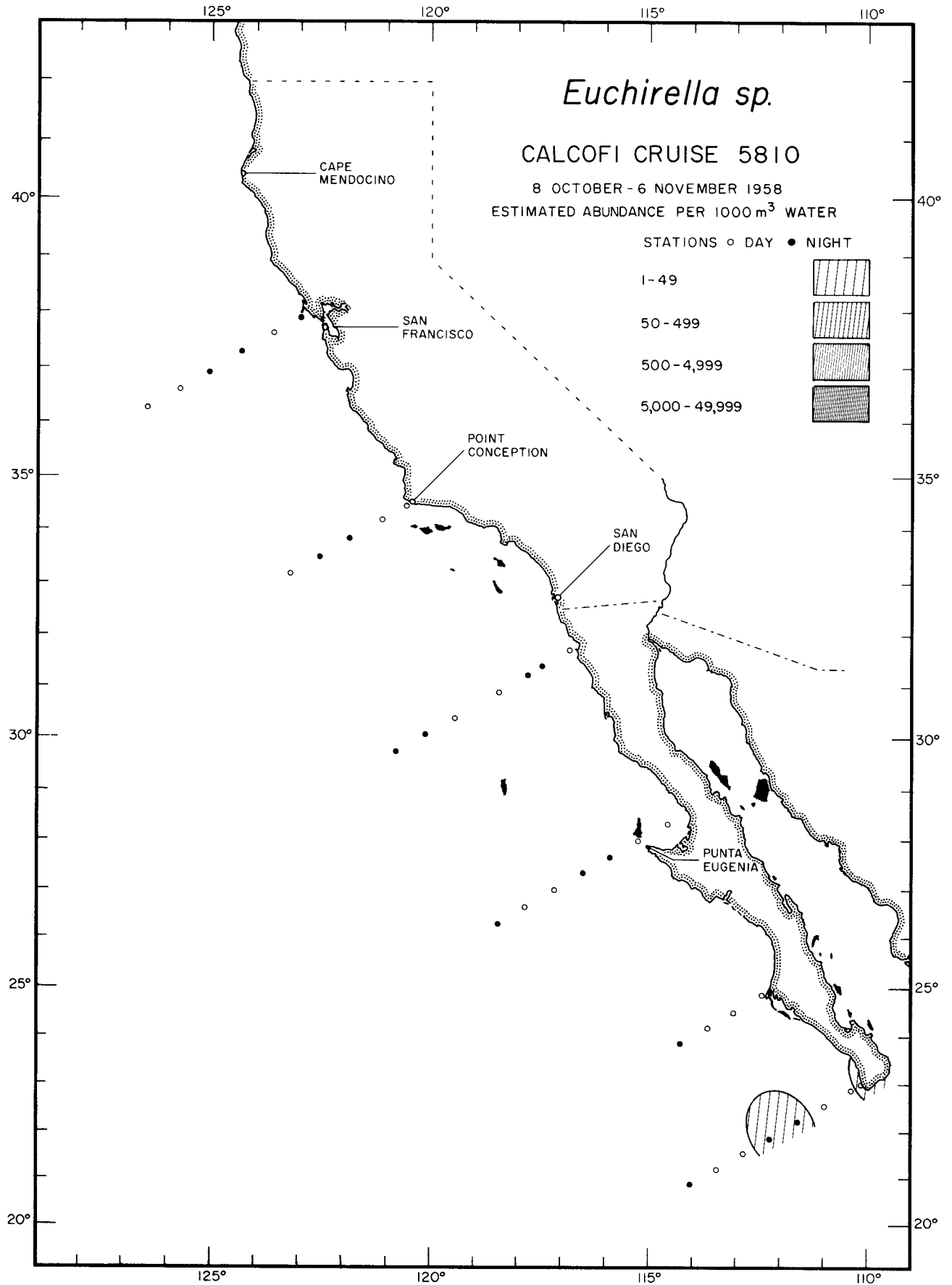
1 - 49	
50 - 499	
500 - 4,999	
5,000 - 49,999	



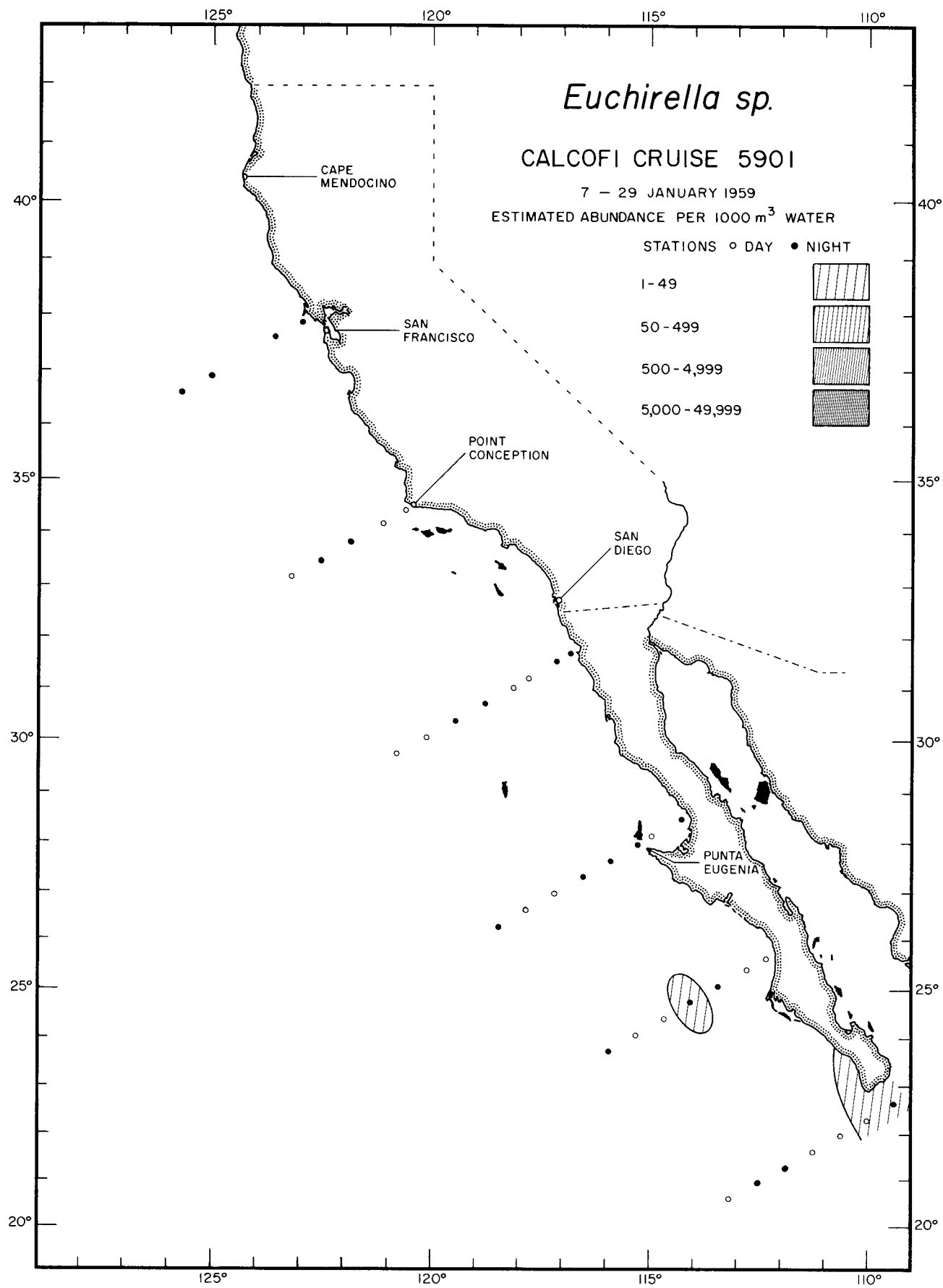
Calanoida

Euchirella rostrata

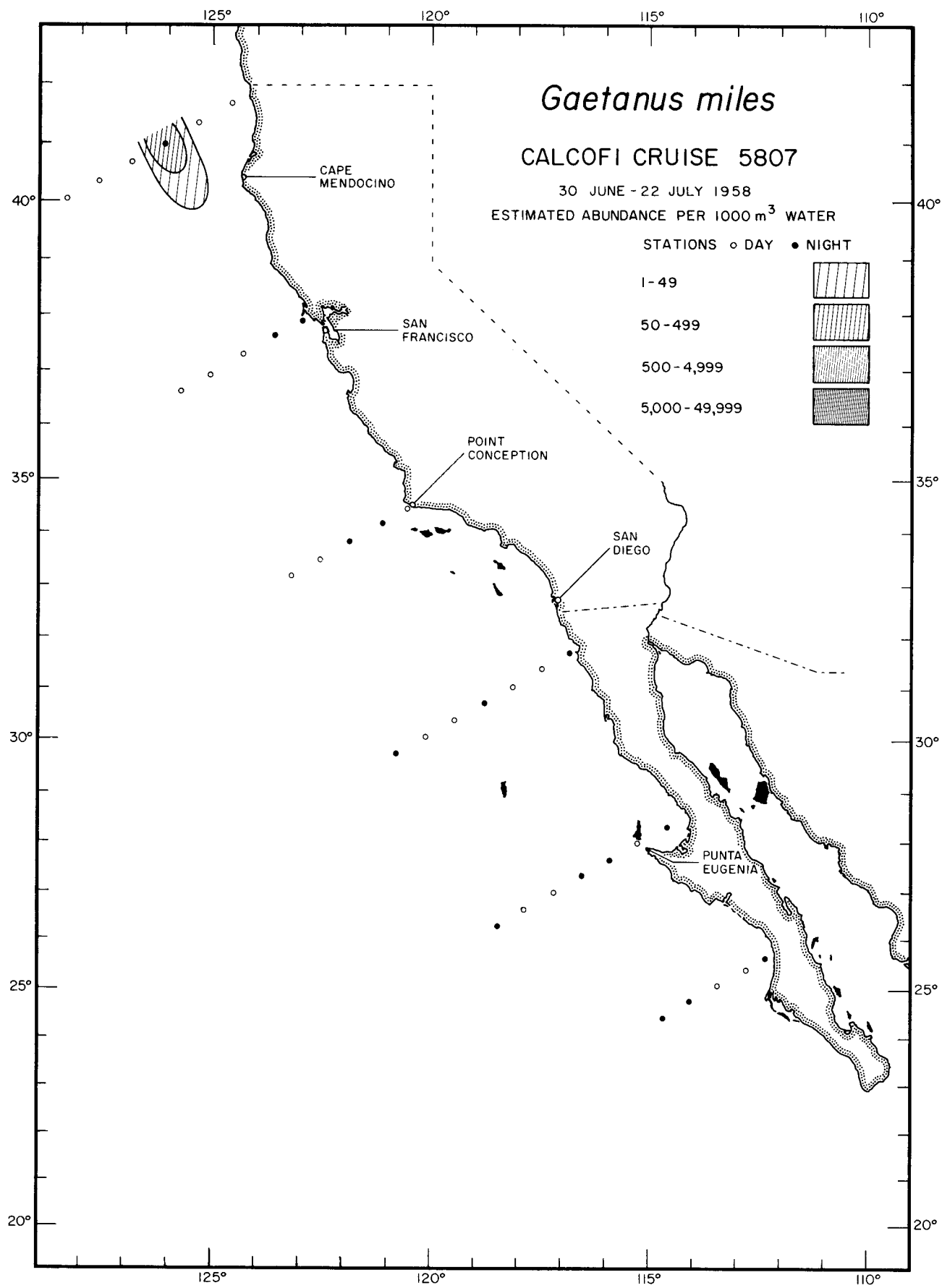
5807



Calanoida
Euchiella sp.
 5810



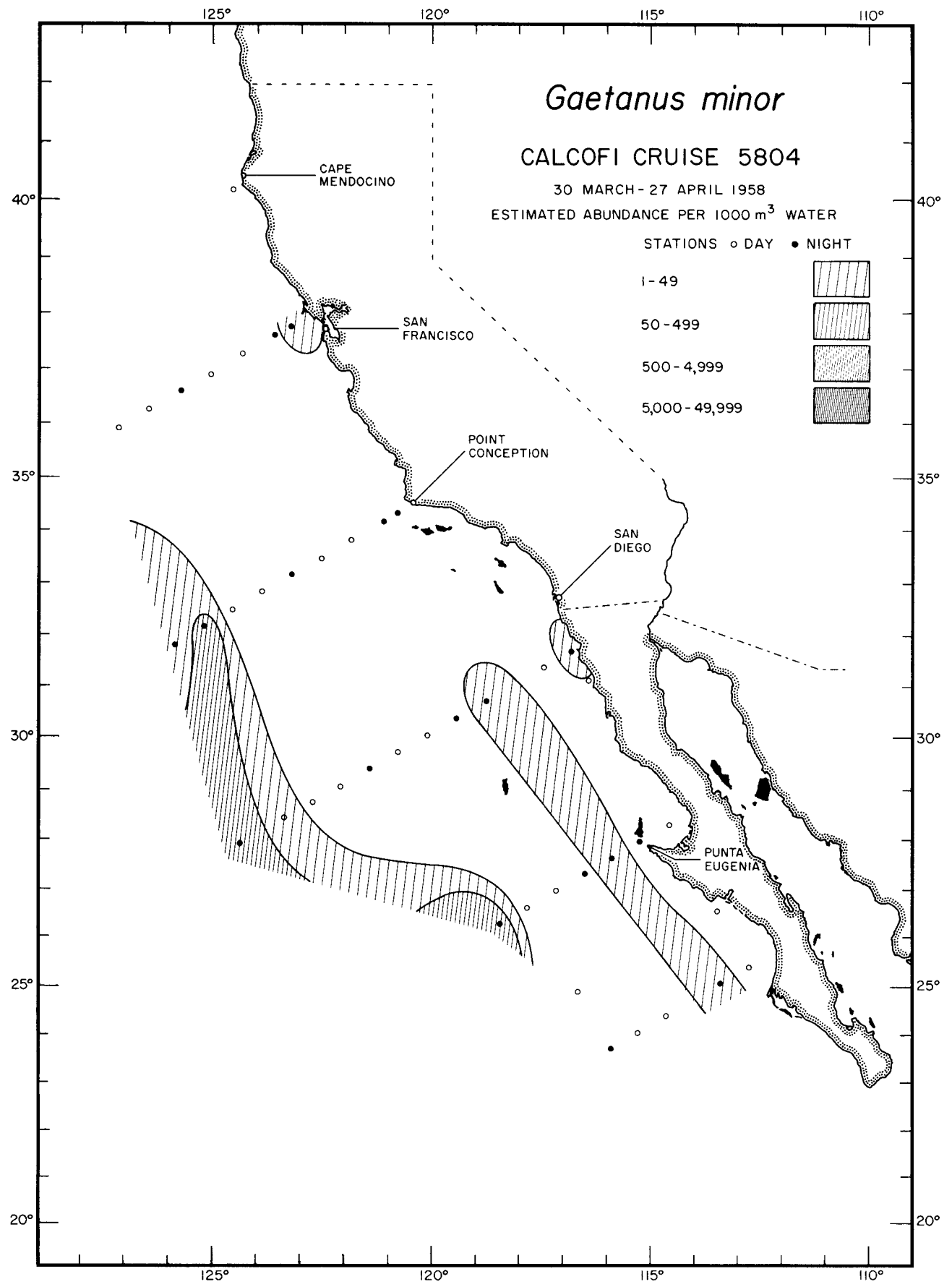
Calanoida
Euchirella sp.
5901



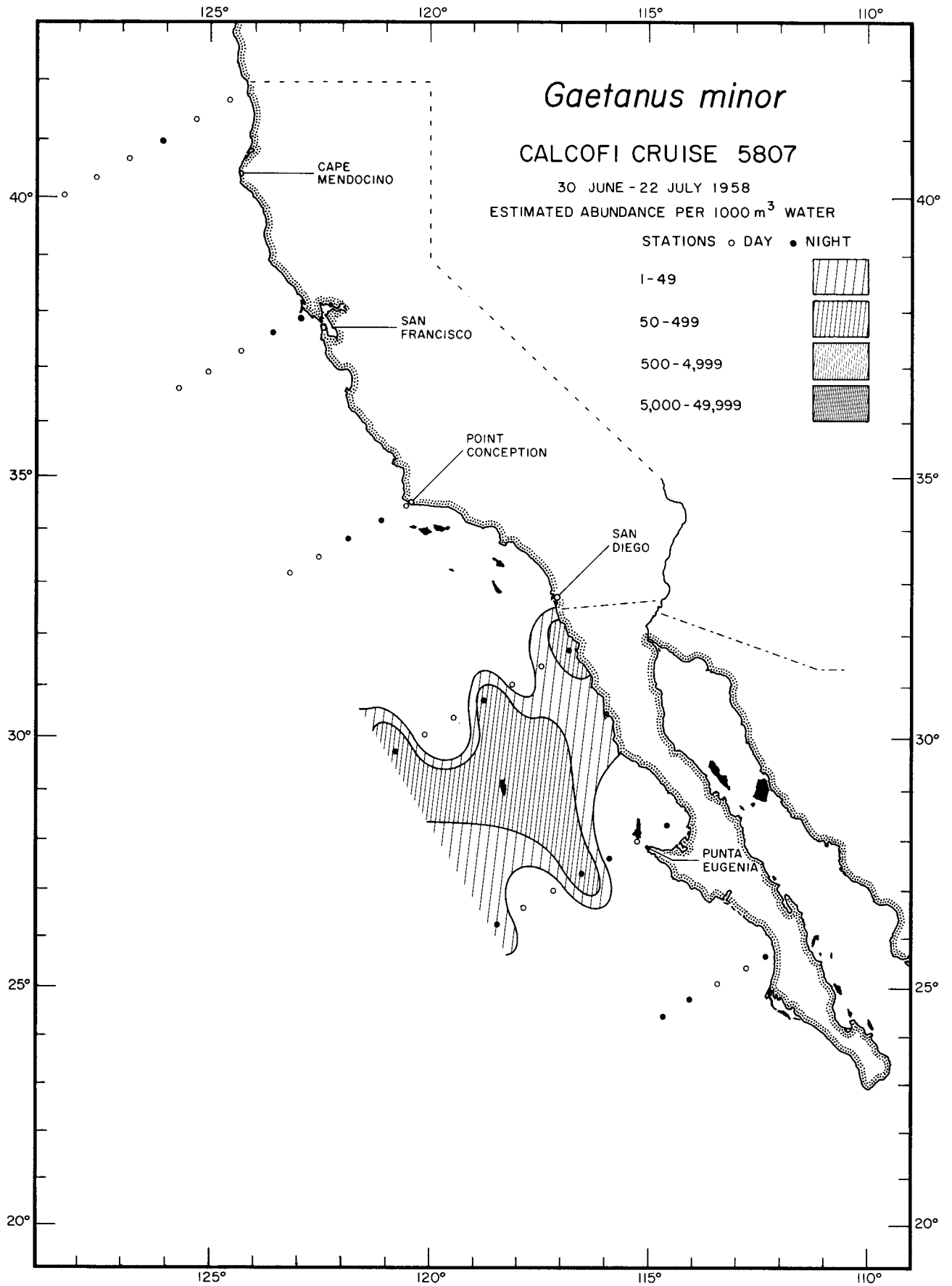
Calanoida

Gaetanus miles

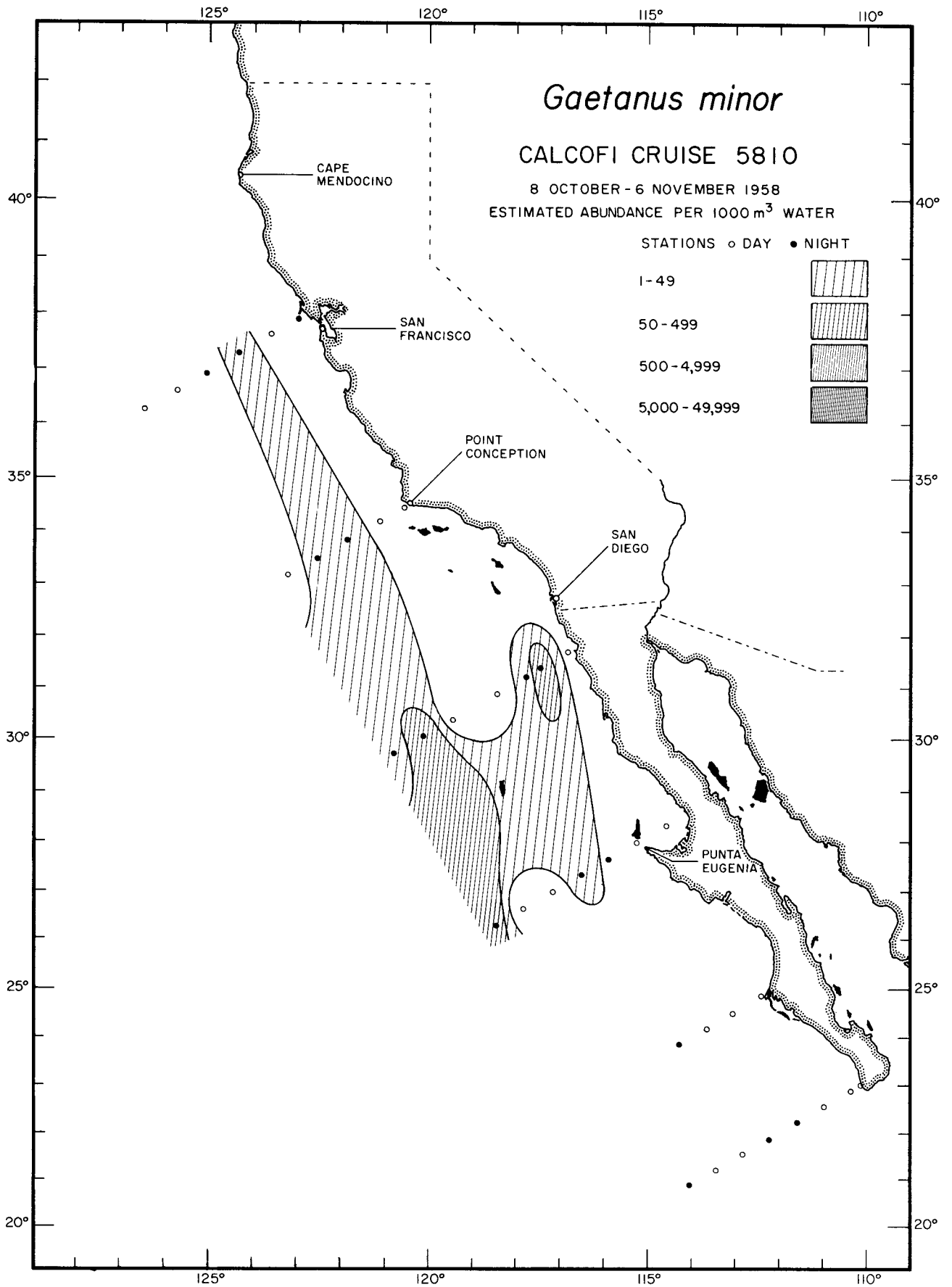
5807



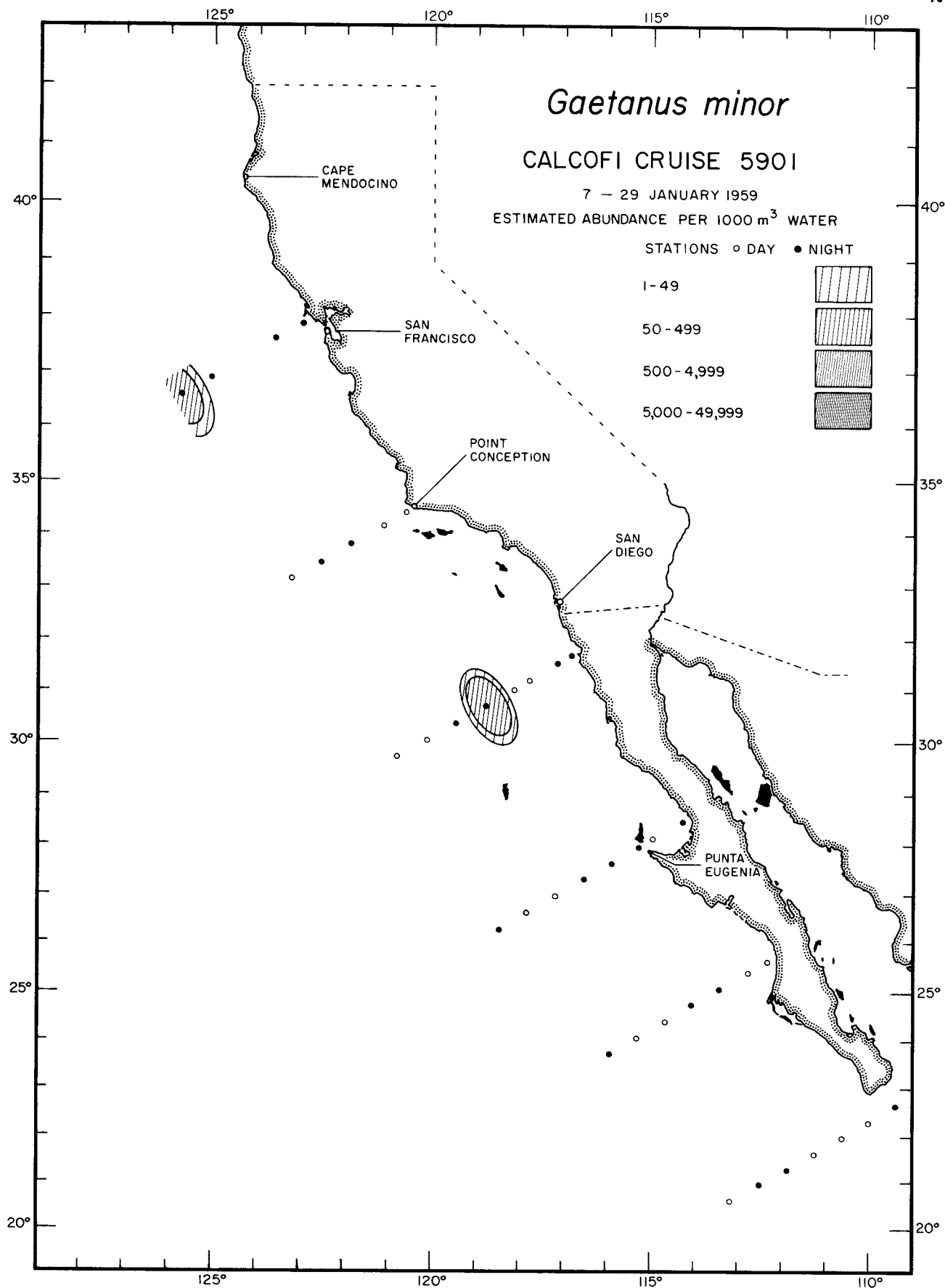
Calanoida
Gaetanus minor
5804



Calanoida
Gaetanus minor
5807



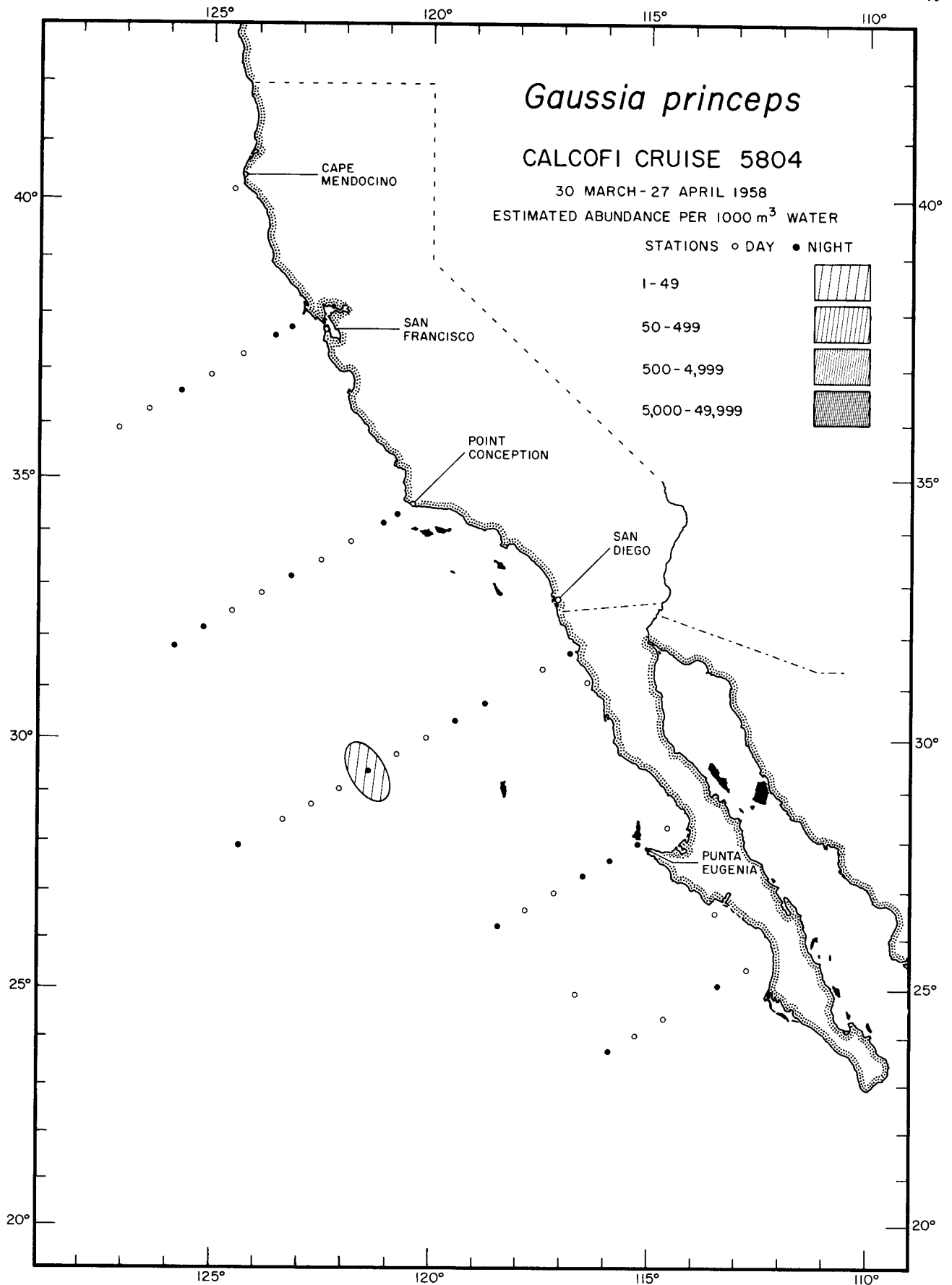
Calanoida
Gaetanus minor
5810



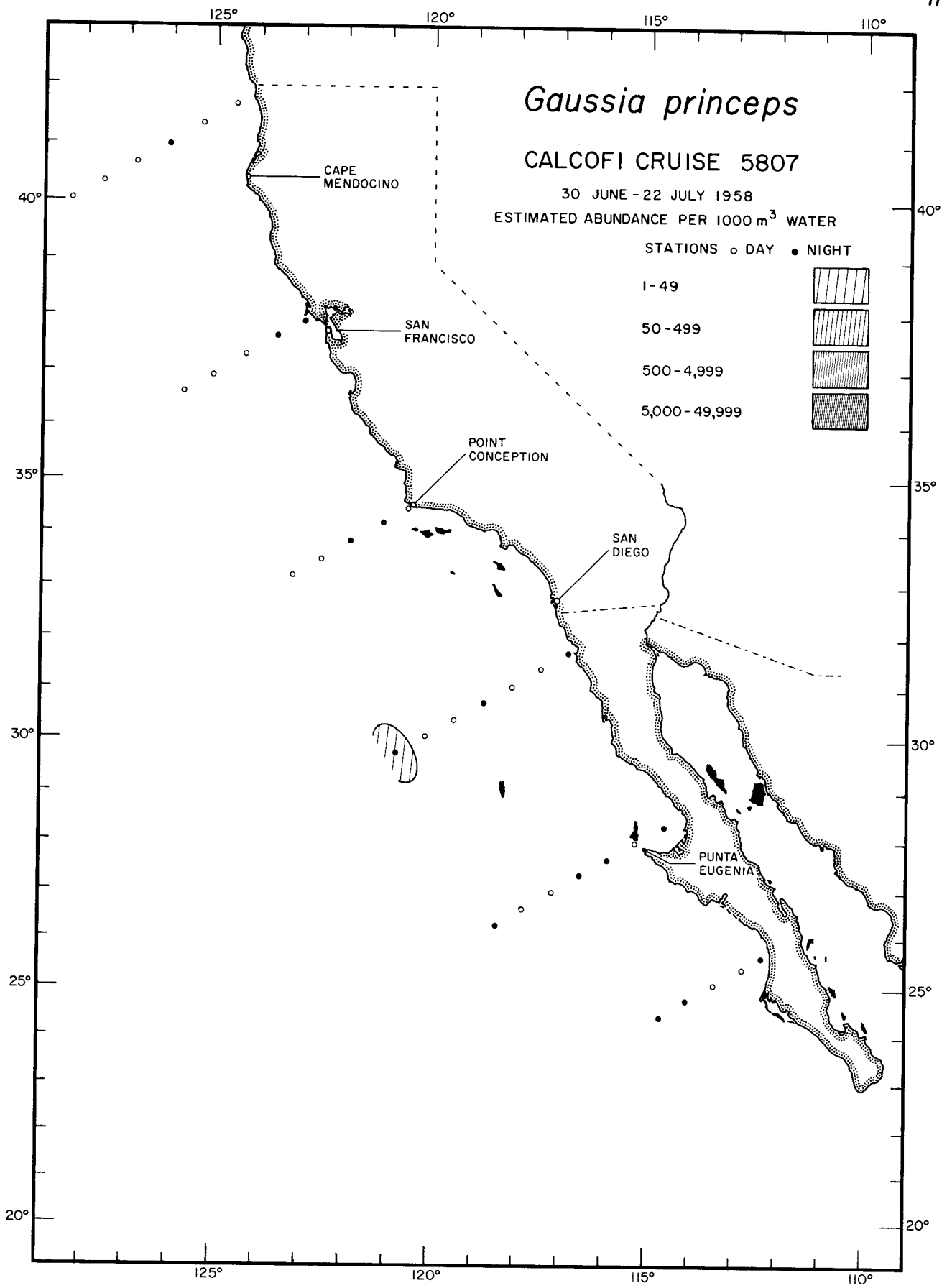
Calanoida

Gaetanus minor

5901



Calanoida
Gaussia princeps
5804



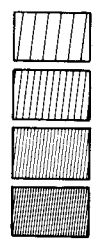
Gausssia princeps

CALCOFI CRUISE 5807

30 JUNE - 22 JULY 1958
ESTIMATED ABUNDANCE PER 1000 m³ WATER

STATIONS ○ DAY ● NIGHT

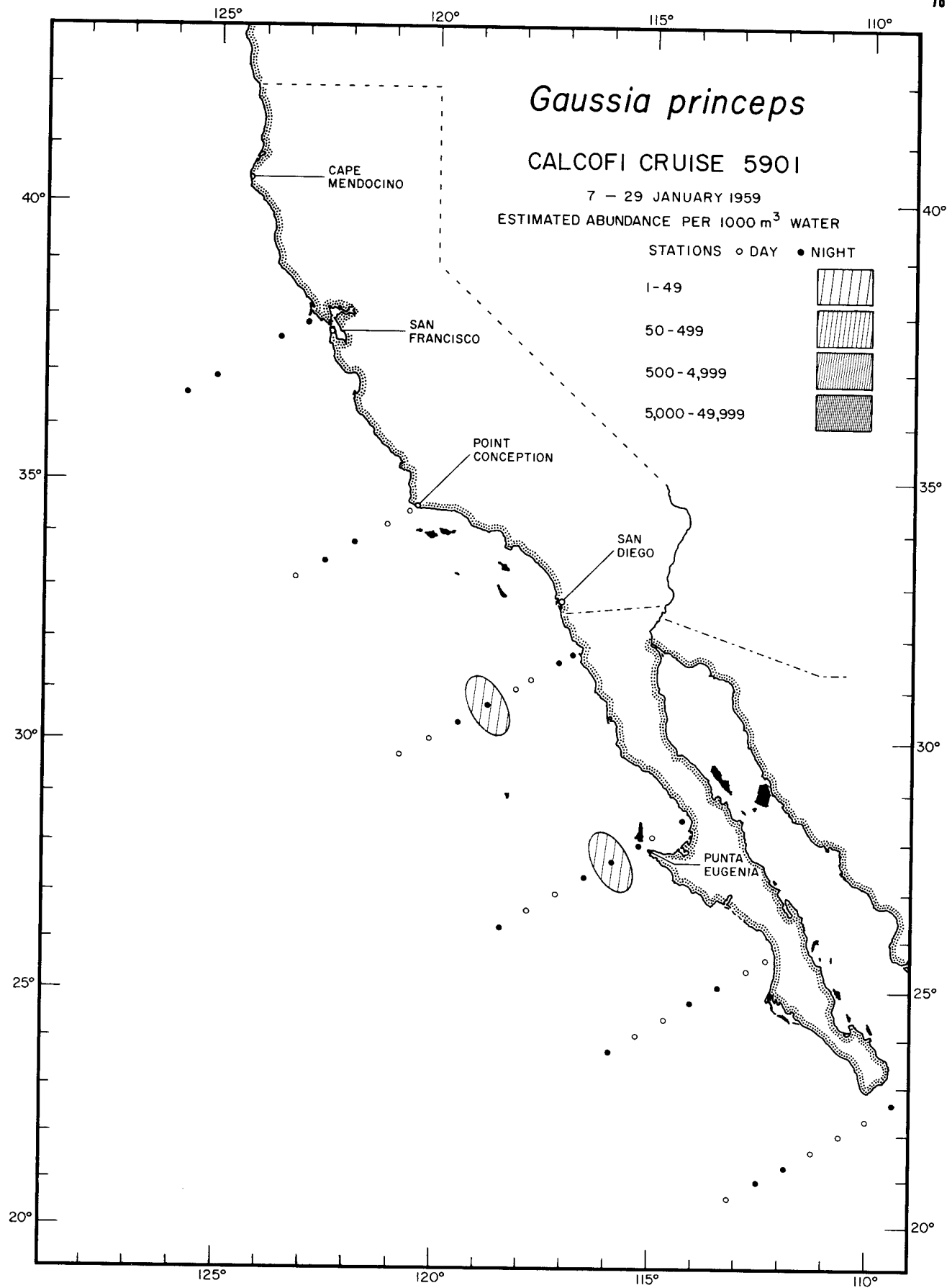
- 1 - 49
- 50 - 499
- 500 - 4,999
- 5,000 - 49,999



Calanoida

Gausssia princeps

5807



Gaussia princeps

CALCOFI CRUISE 5901

7 - 29 JANUARY 1959

ESTIMATED ABUNDANCE PER 1000 m³ WATER

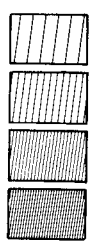
STATIONS ○ DAY ● NIGHT

1 - 49

50 - 499

500 - 4,999

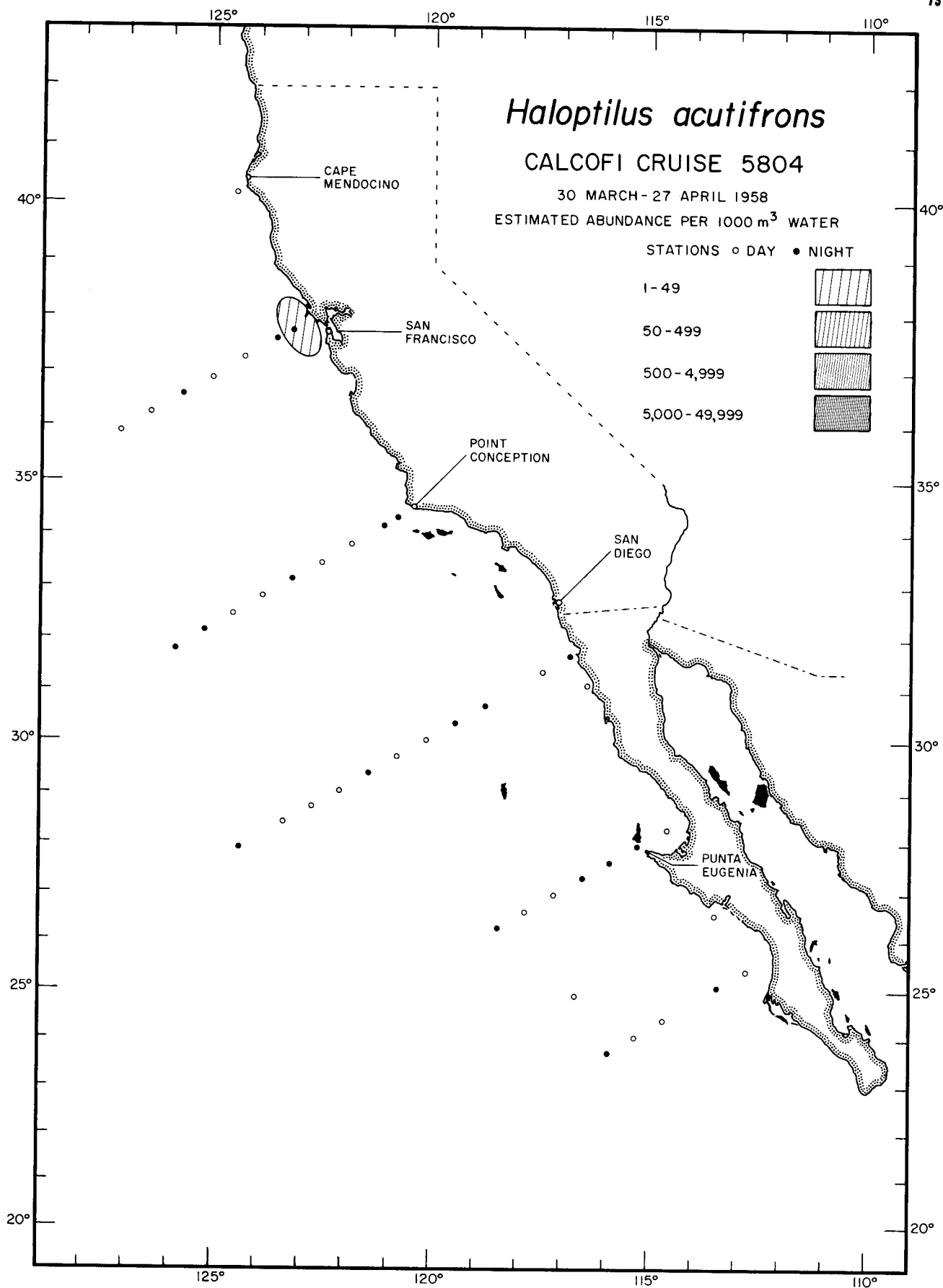
5,000 - 49,999



Calanoida

Gaussia princeps

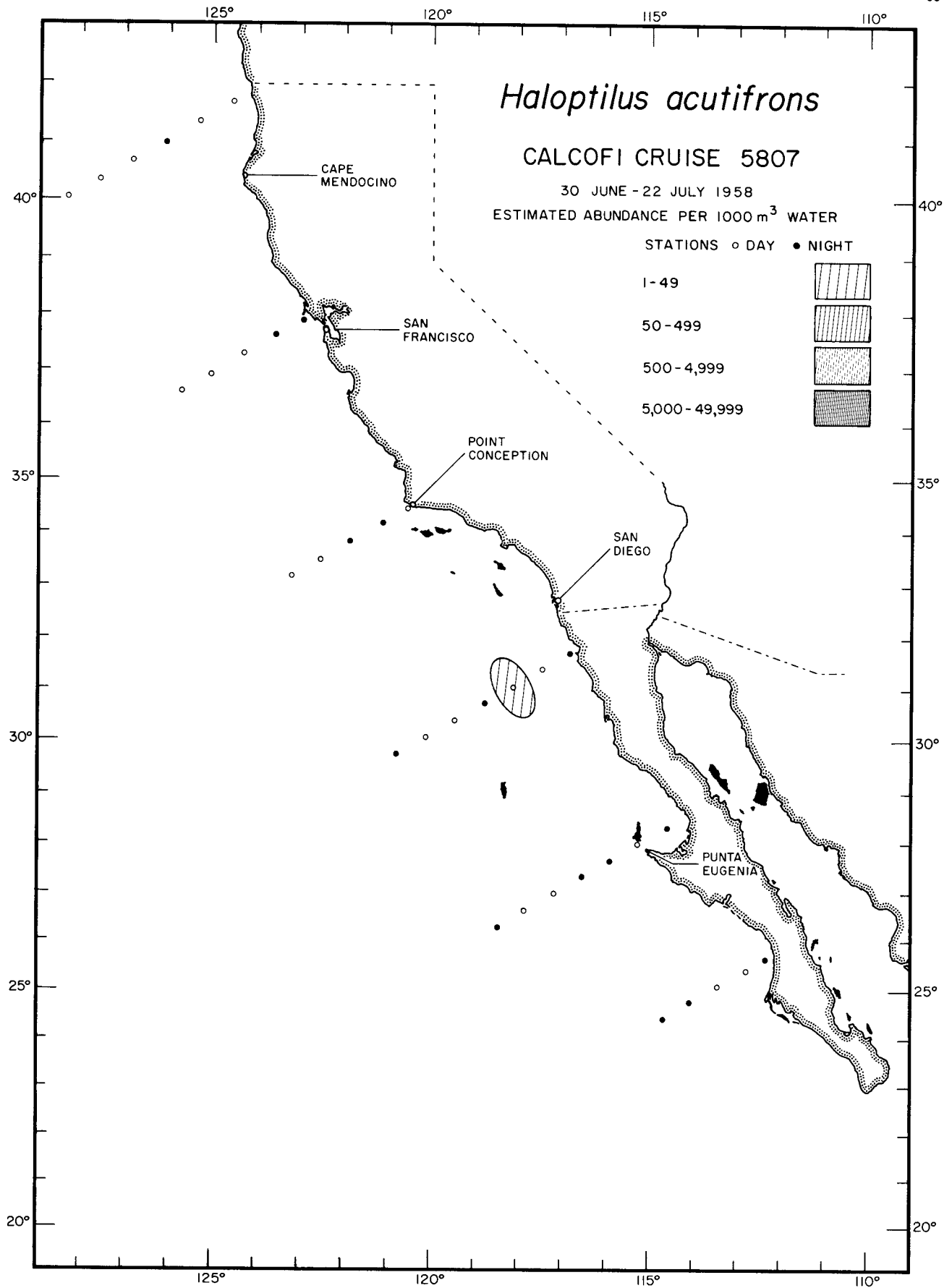
5901



Calanoida

Haloptilus acutifrons

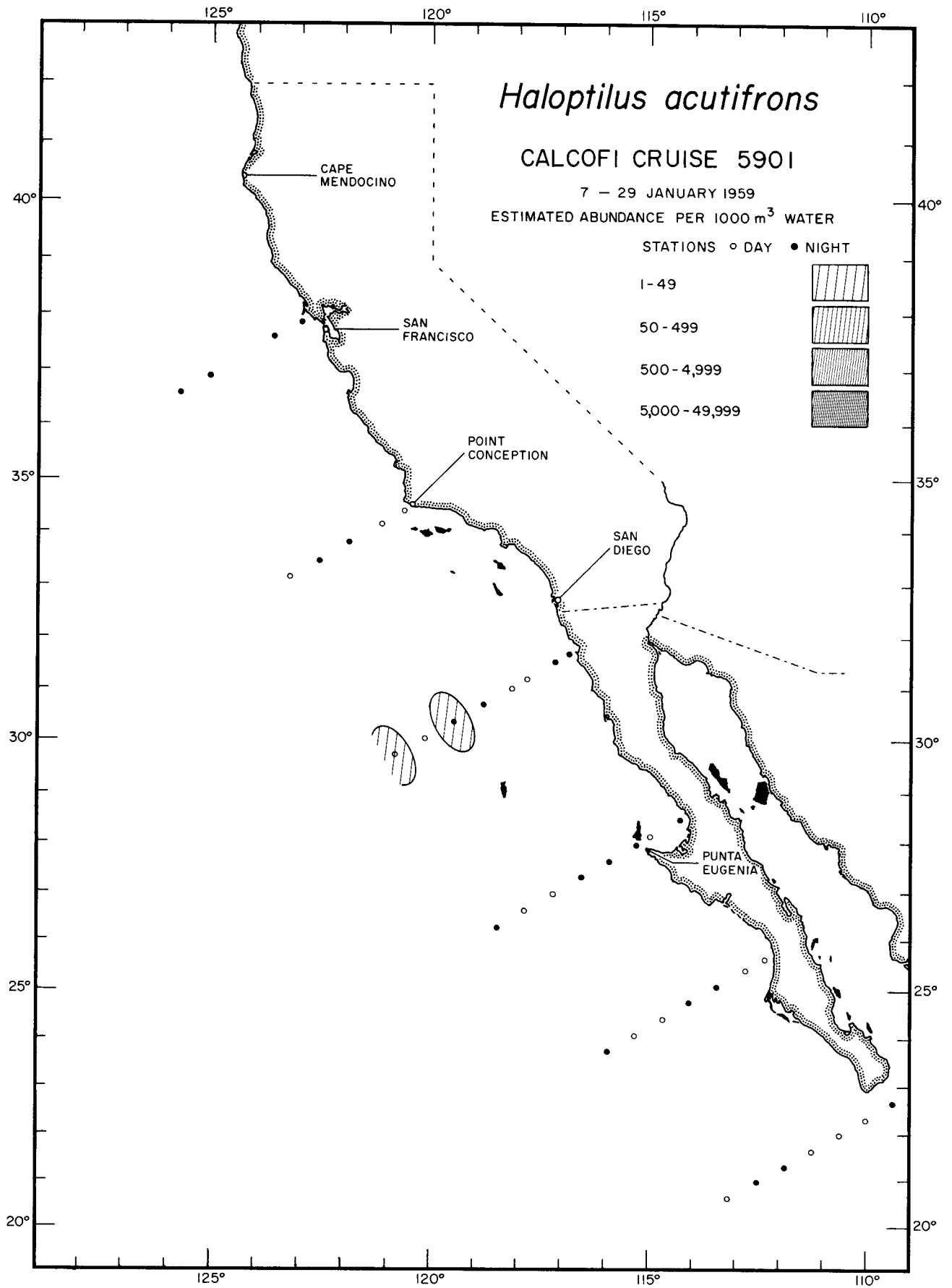
5804



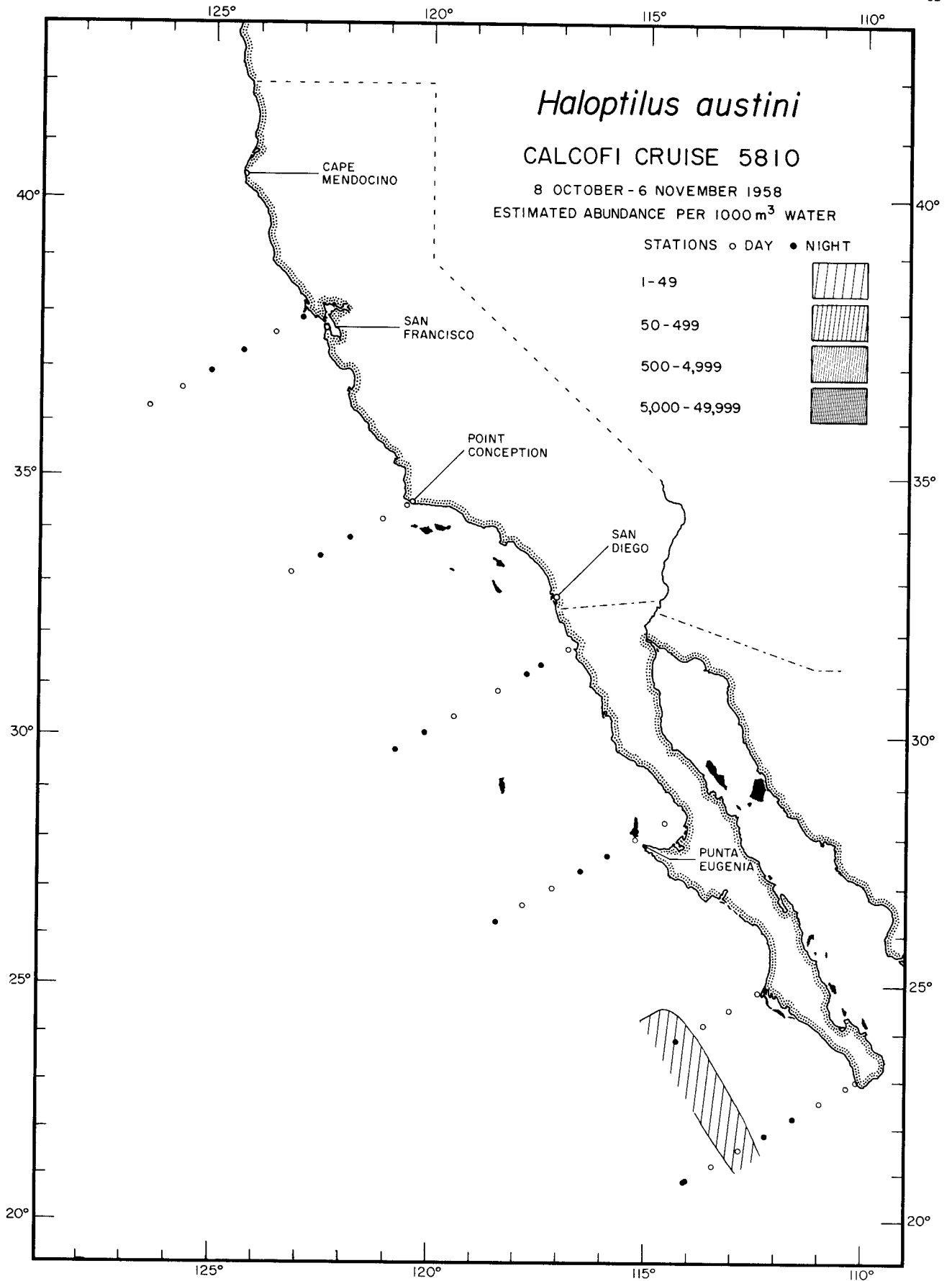
Calanoida

Haloptilus acutifrons

5807



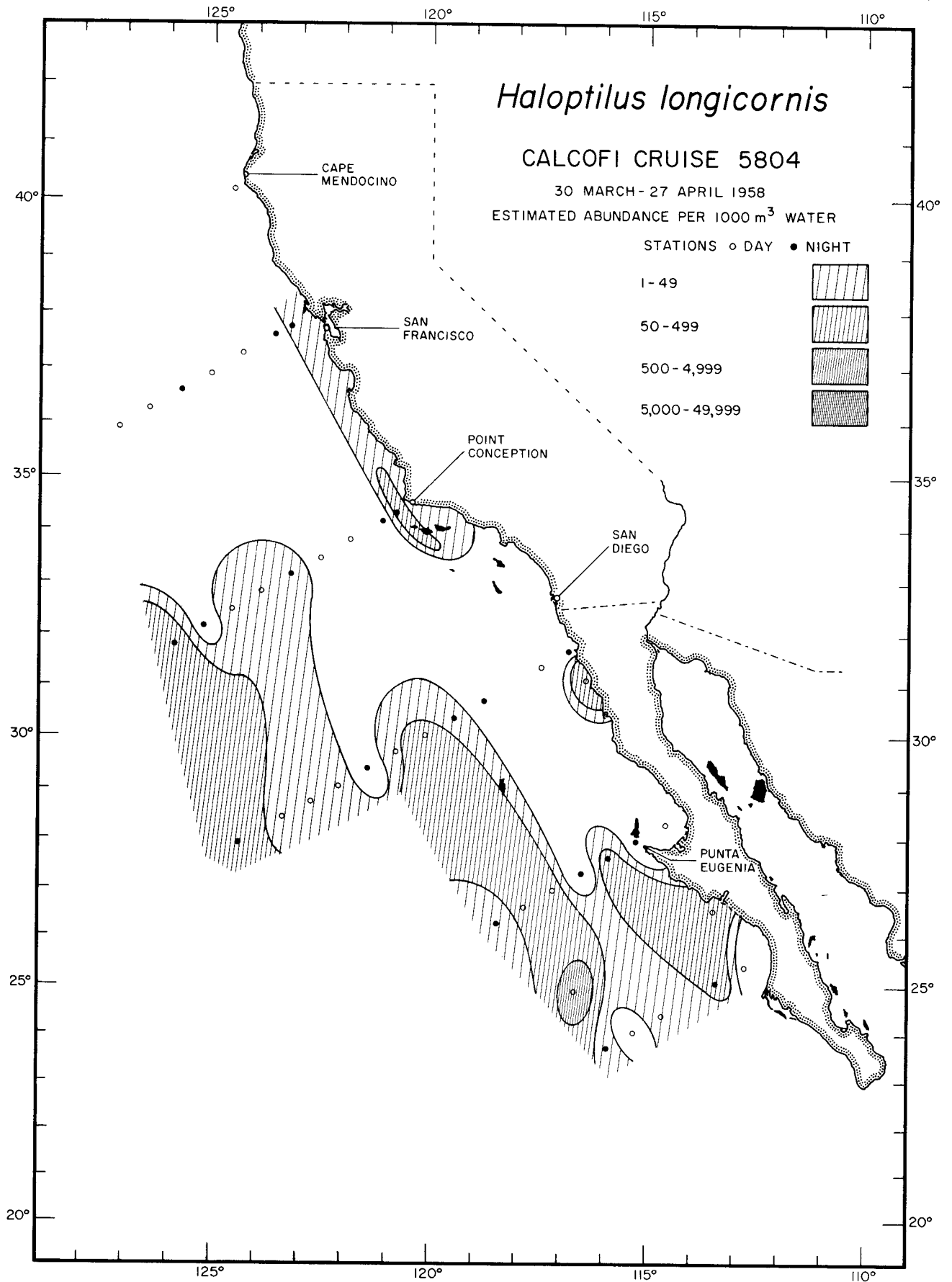
Calanoida
Haloptilus acutifrons
5901



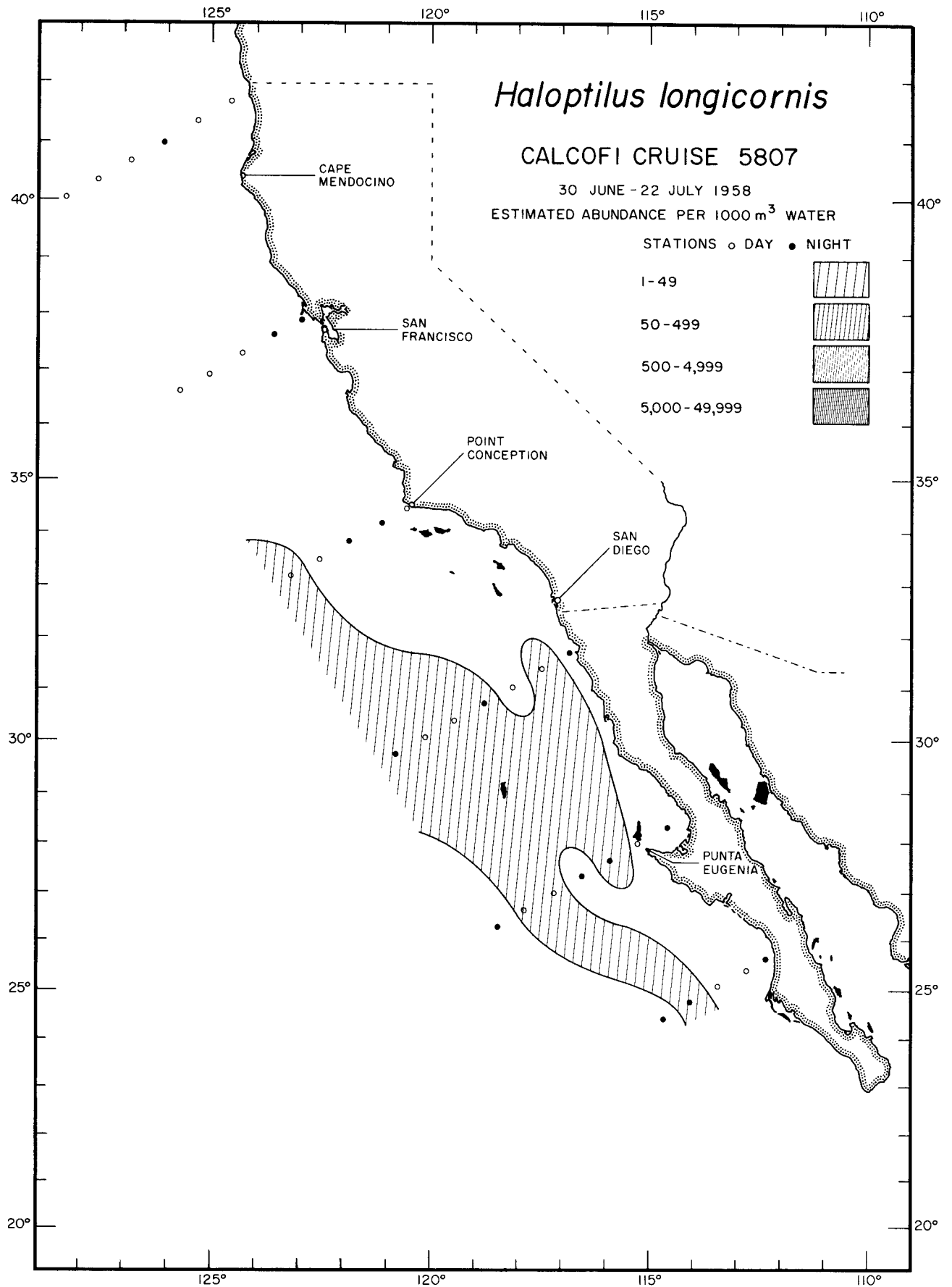
Calanoida

Haloptilus austini

5810



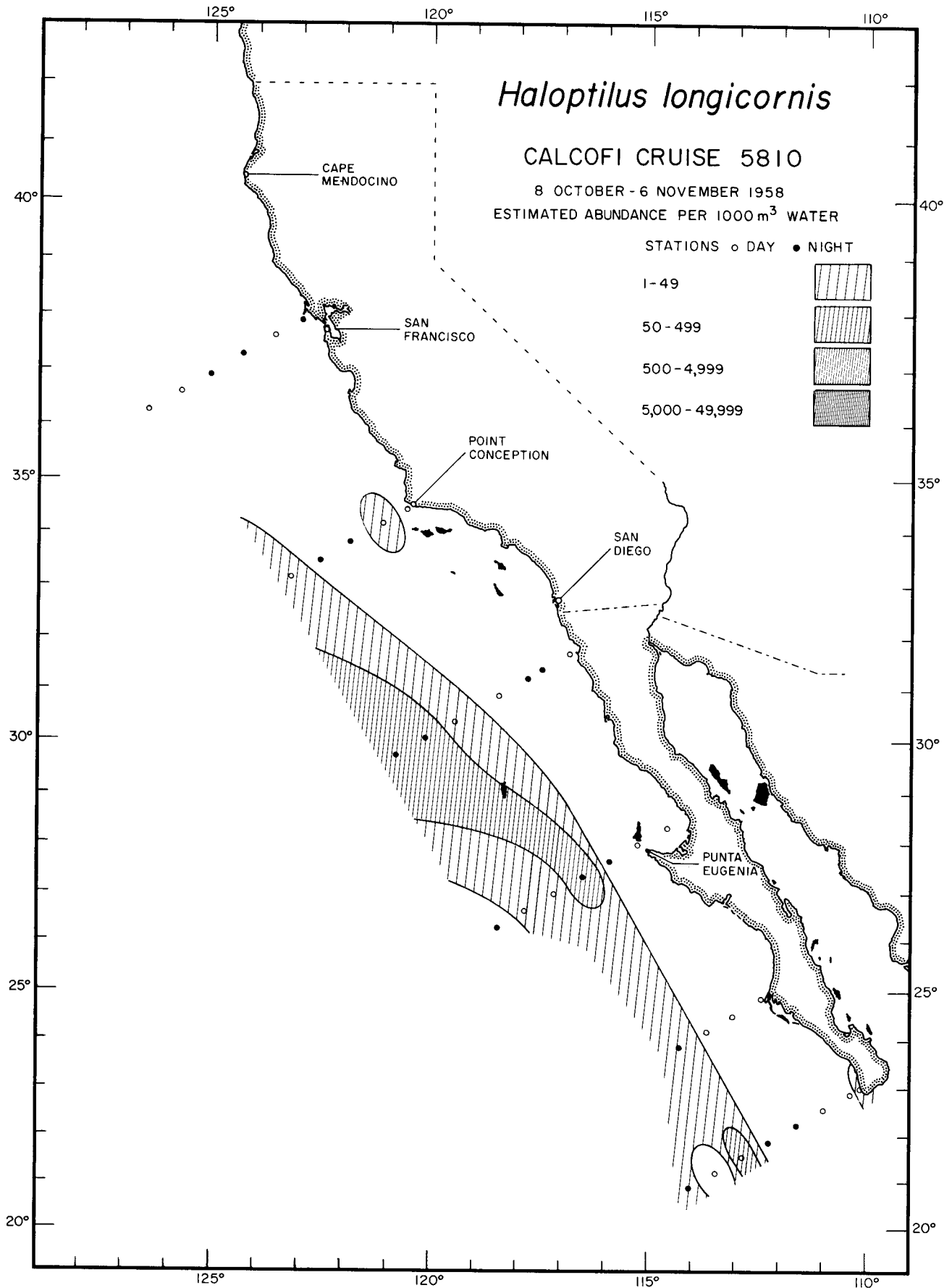
Calanoida
Haloptilus longicornis
5804



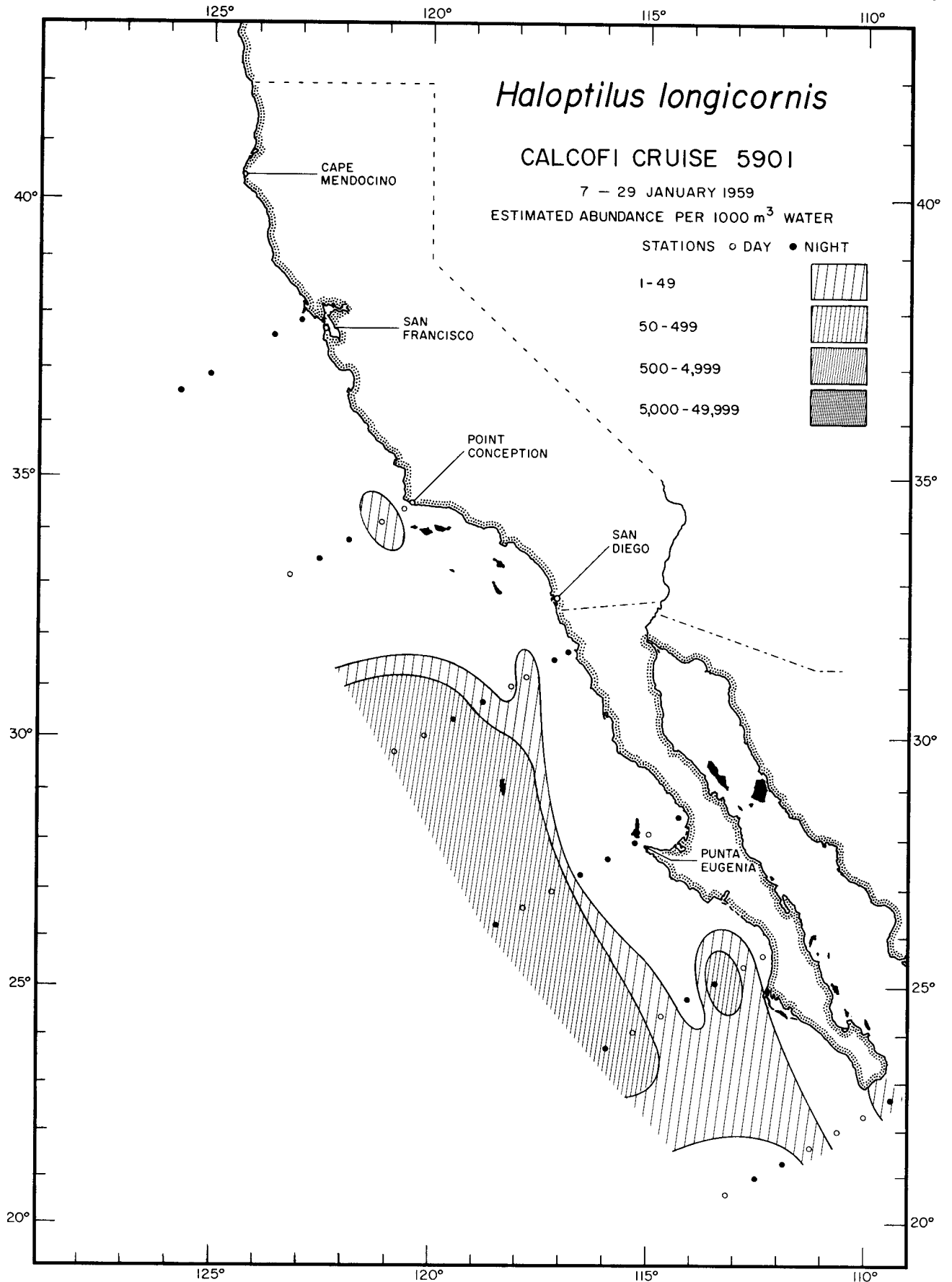
Calanoida

Haloptilus longicornis

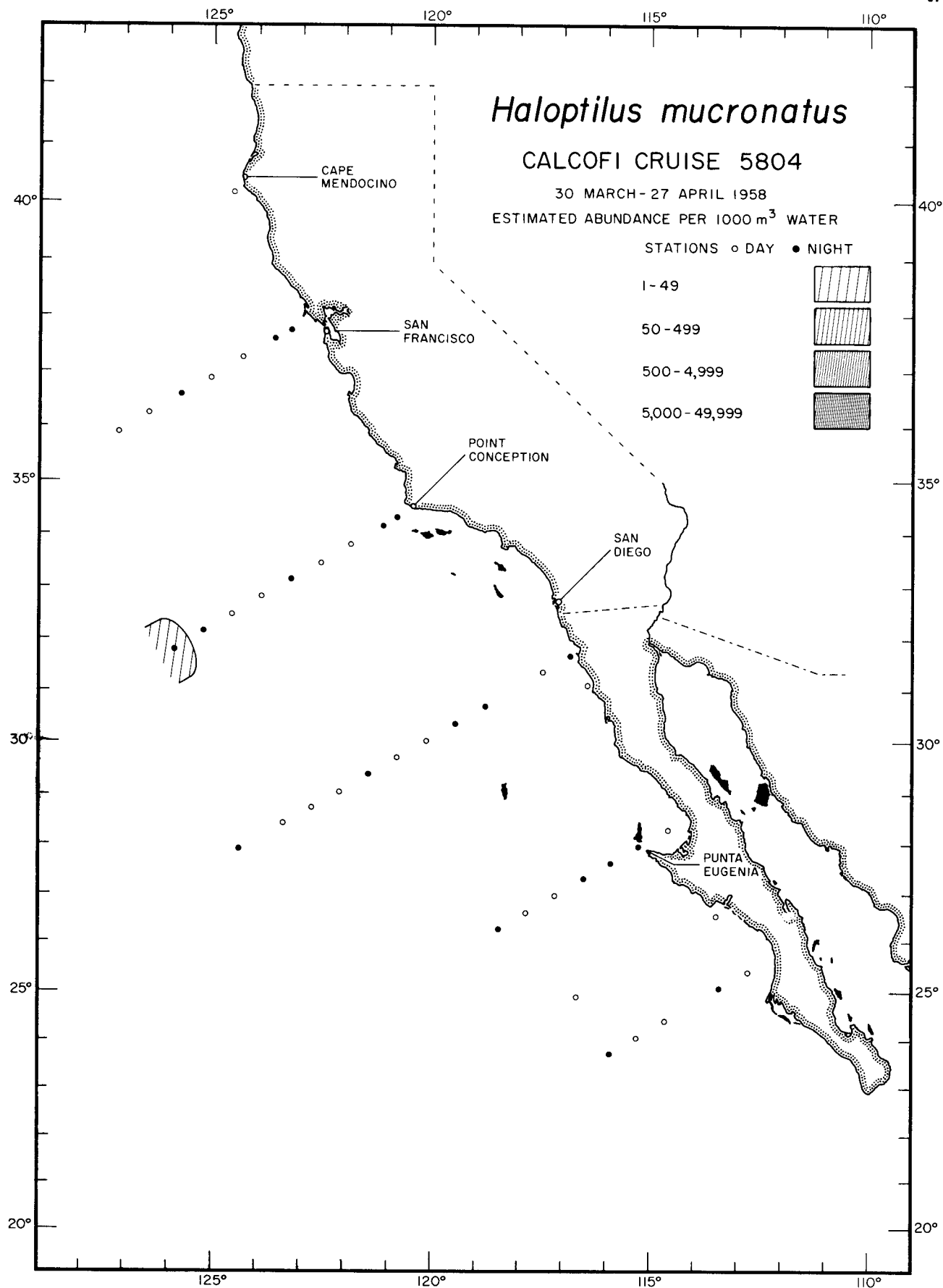
5807



Calanoida
Haloptilus longicornis
5810



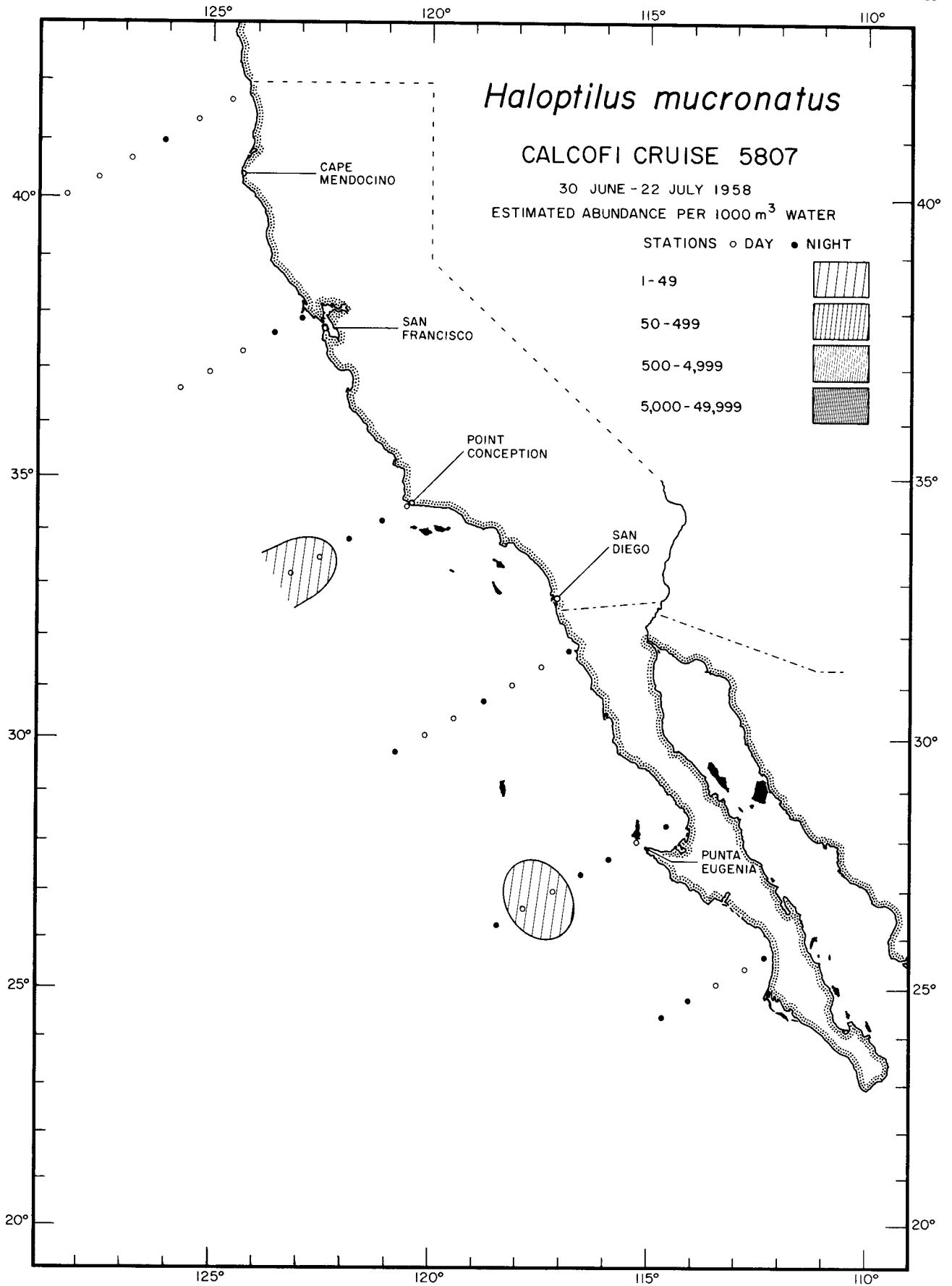
Calanoida
Haloptilus longicornis
5901



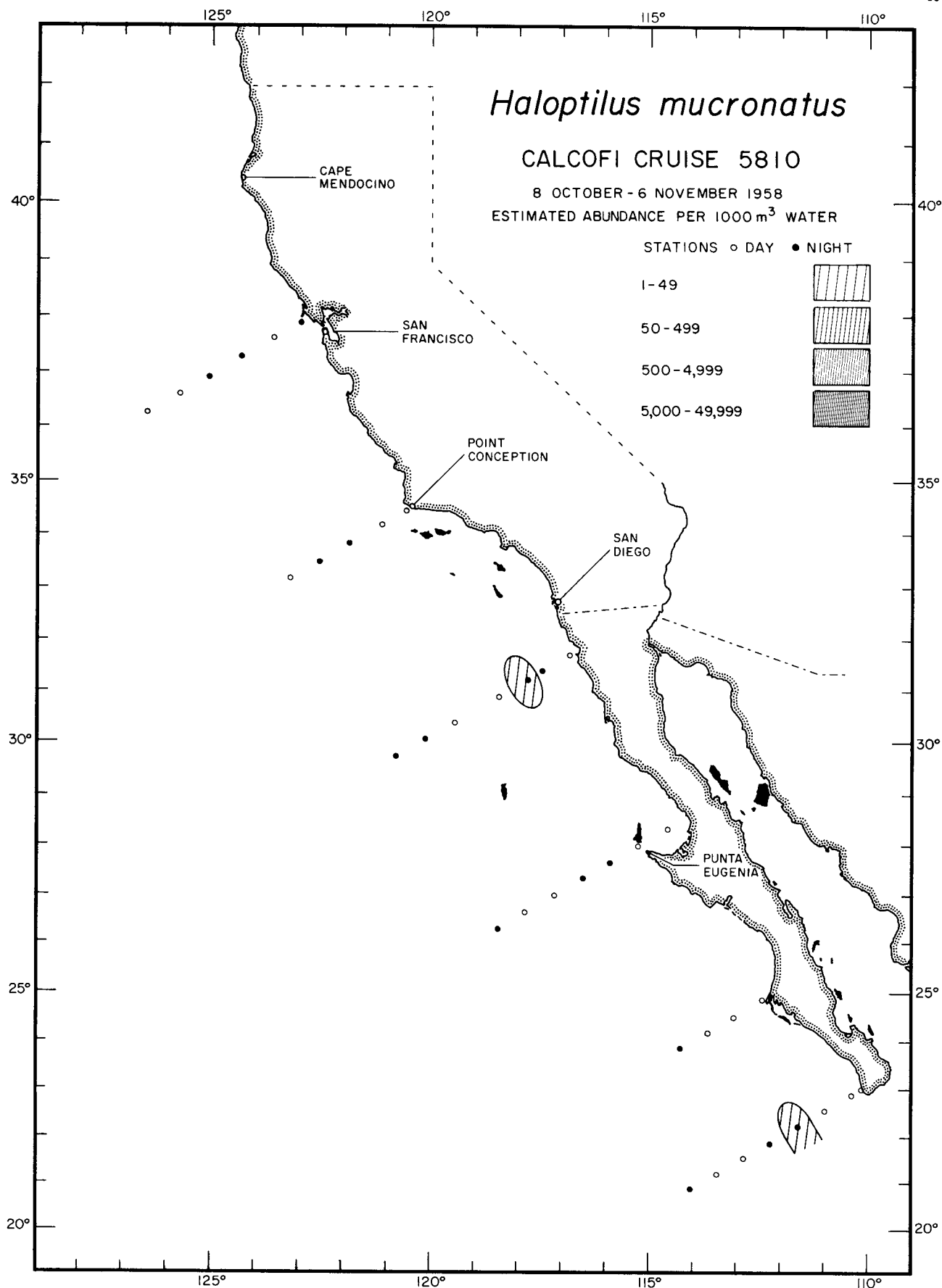
Calanoida

Haloptilus mucronatus

5804



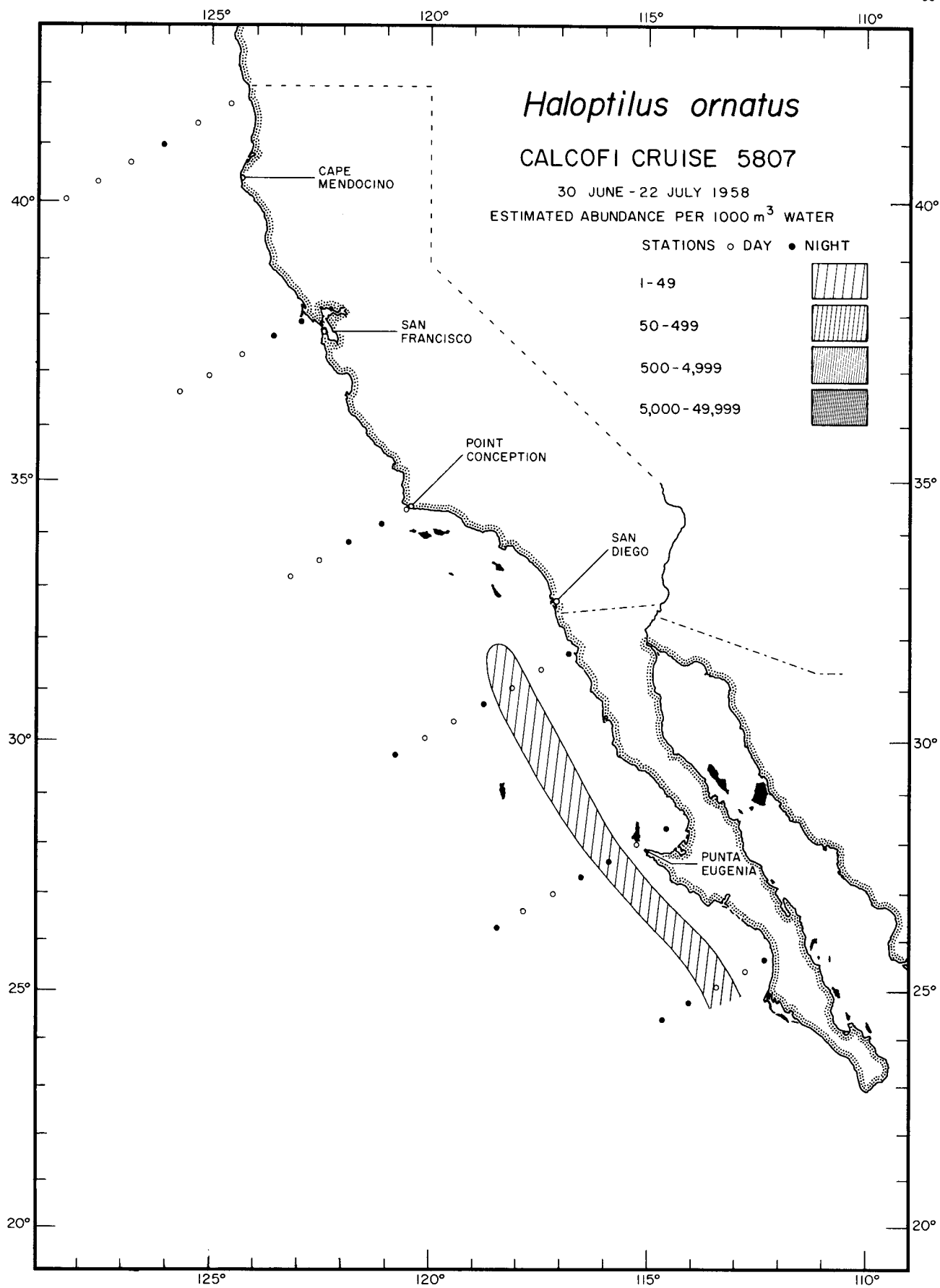
Calanoida
Haloptilus mucronatus
 5807



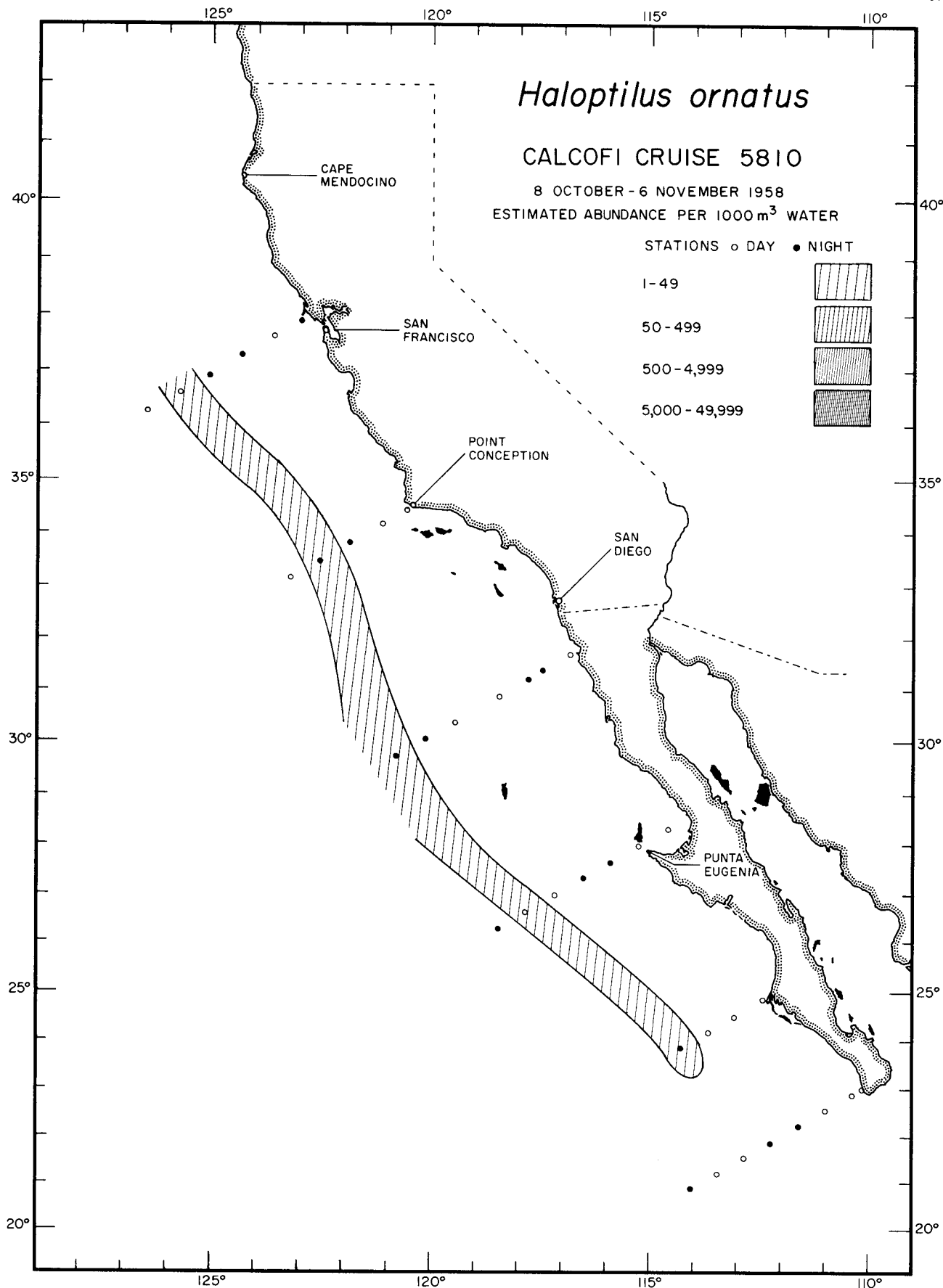
Calanoida

Haloptilus mucronatus

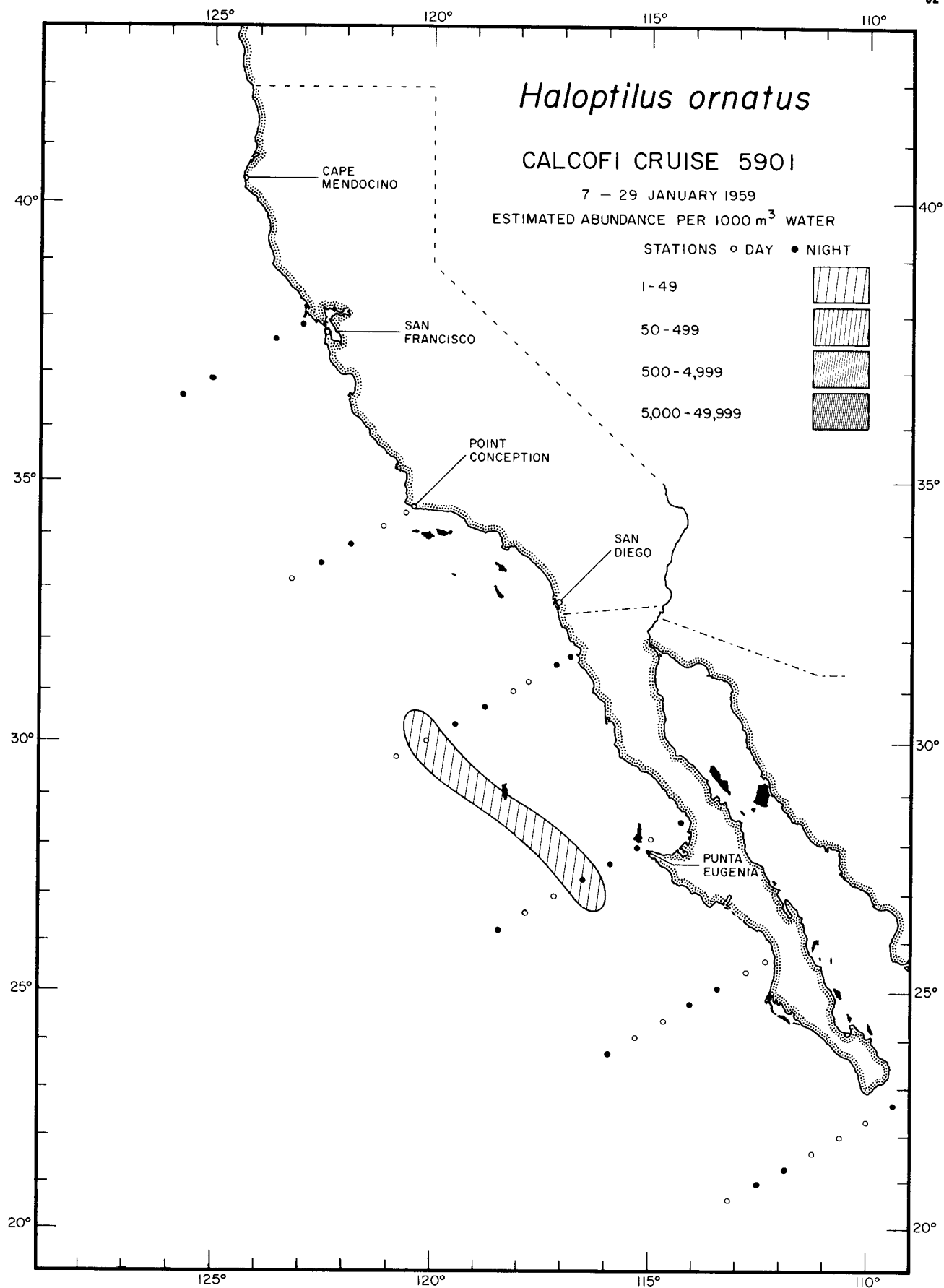
5810



Haloptilus ornatus
5807



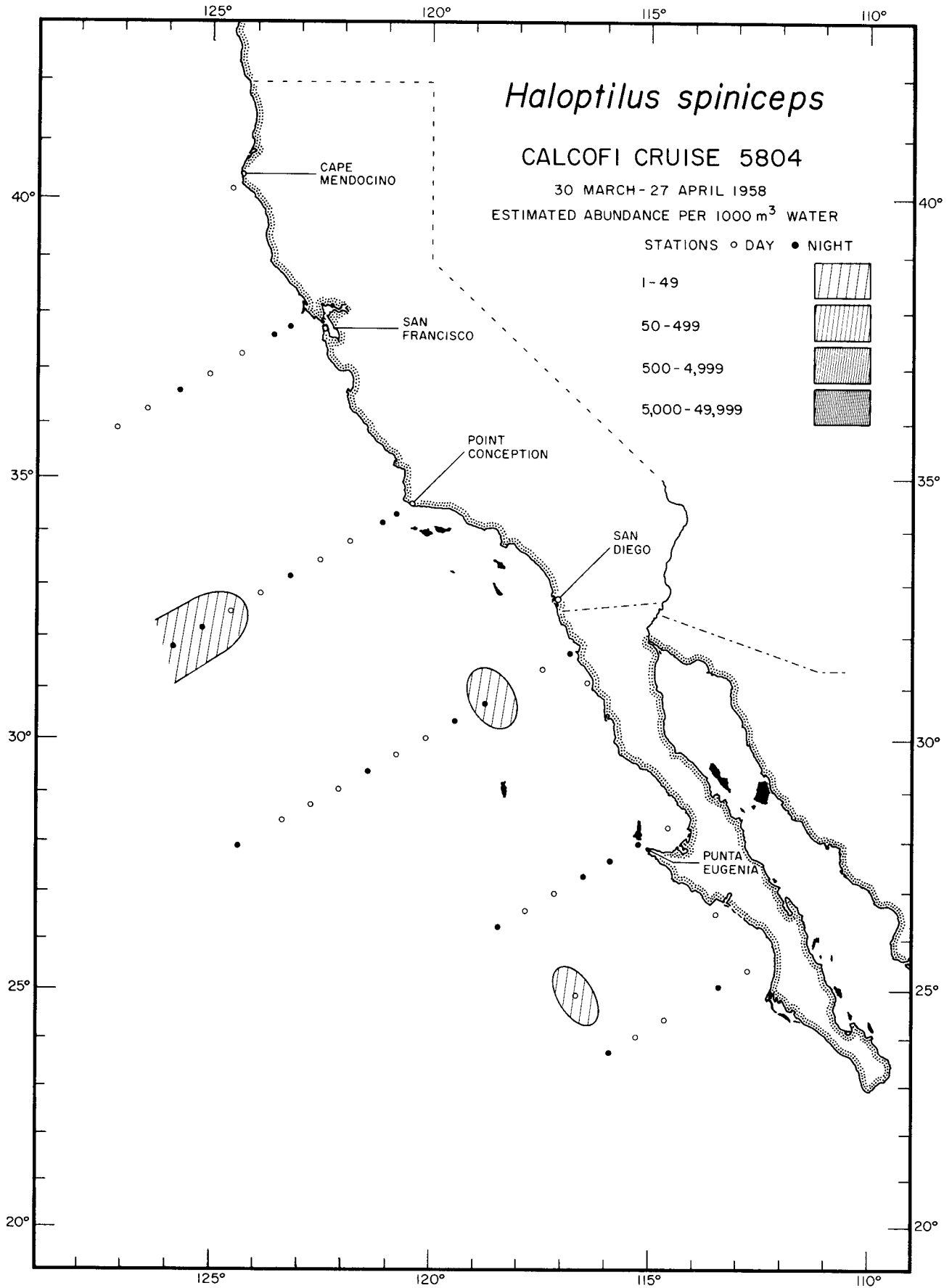
Calanoida
Haloptilus ornatus
5810



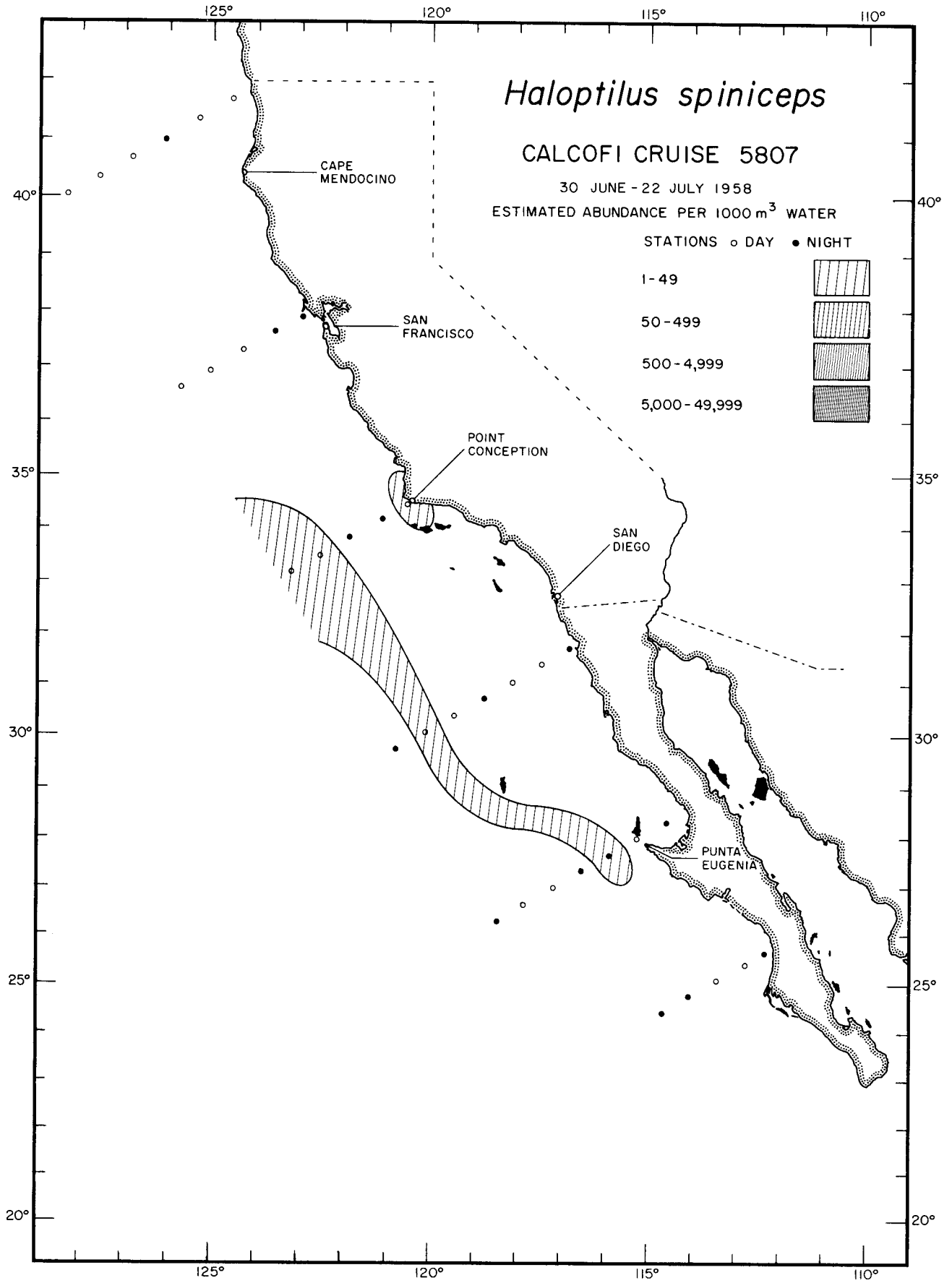
Calanoida

Haloptilus ornatus

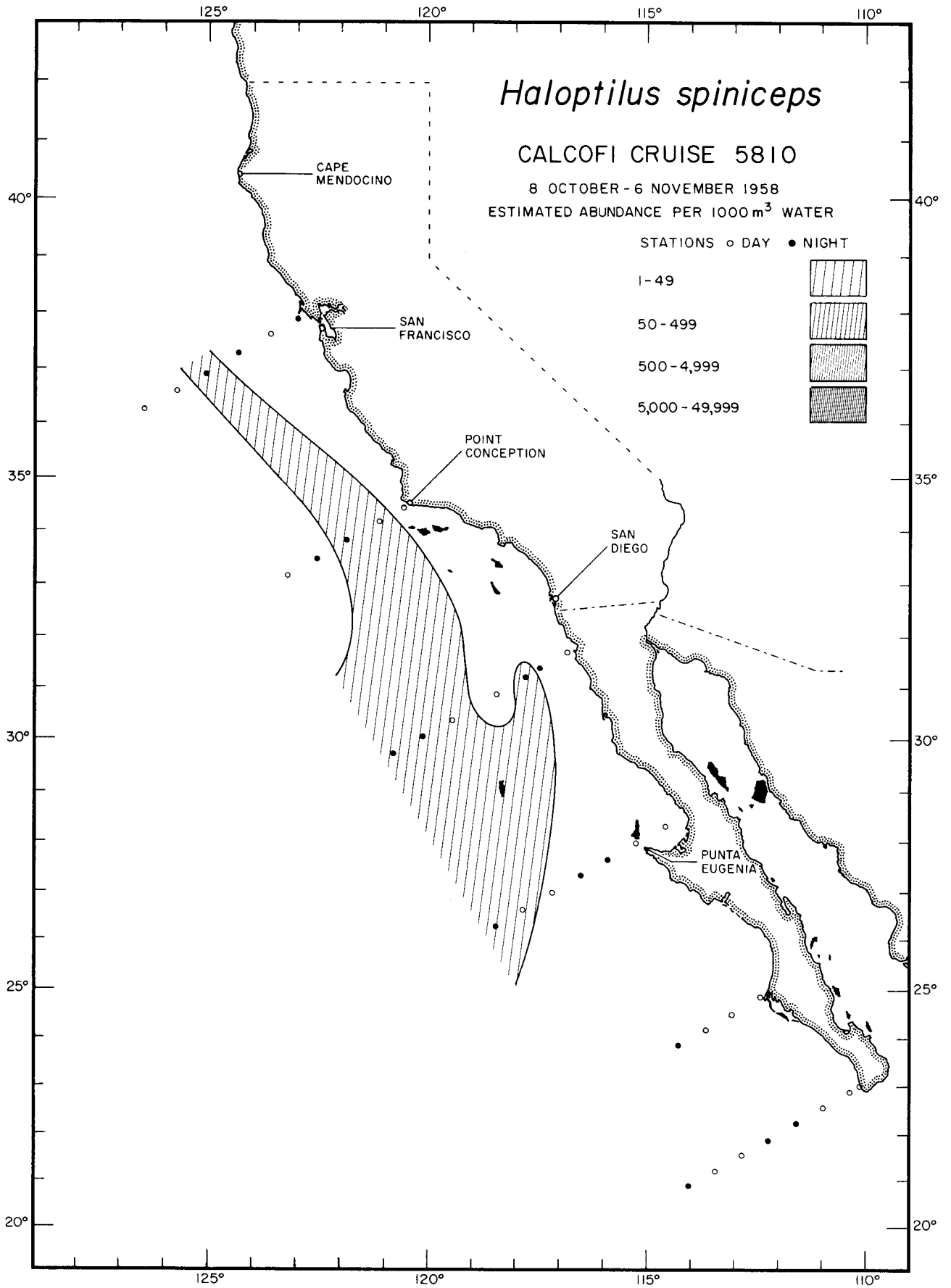
5901



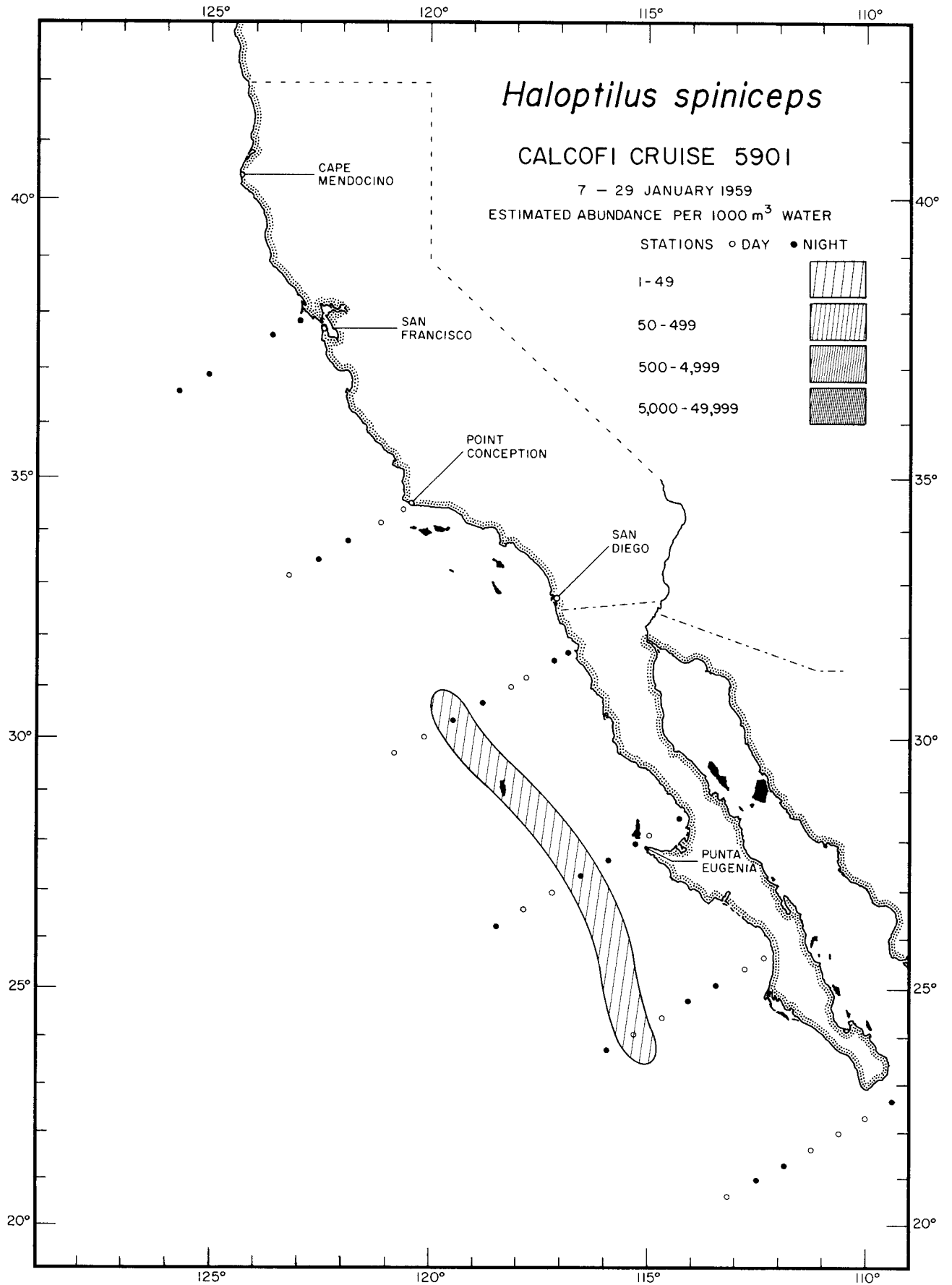
Calanoida
Haloptilus spiniceps
5804



Calanoida
Haloptilus spiniceps
5807



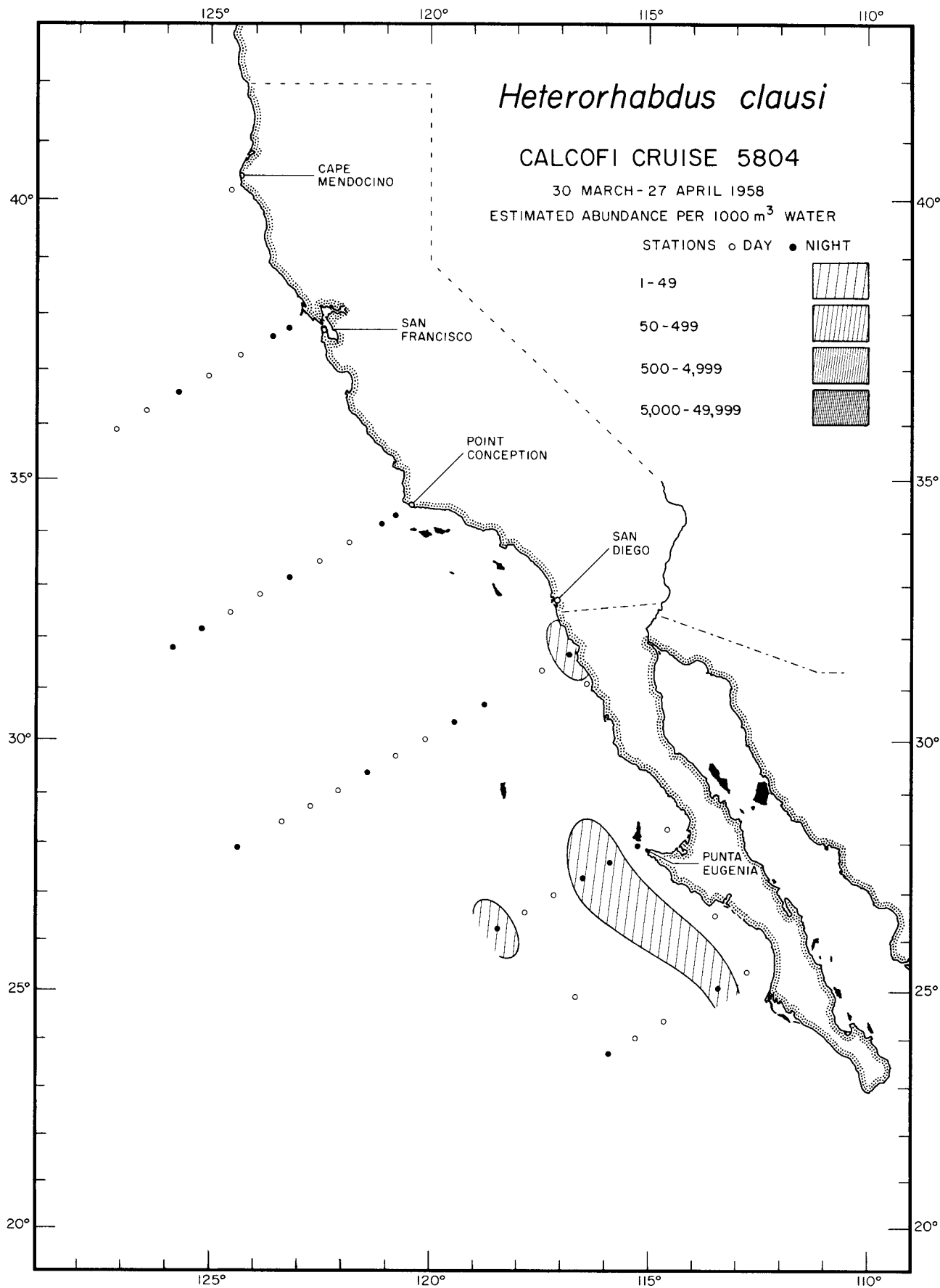
Calanoida
Haloptilus spiniceps
 5810



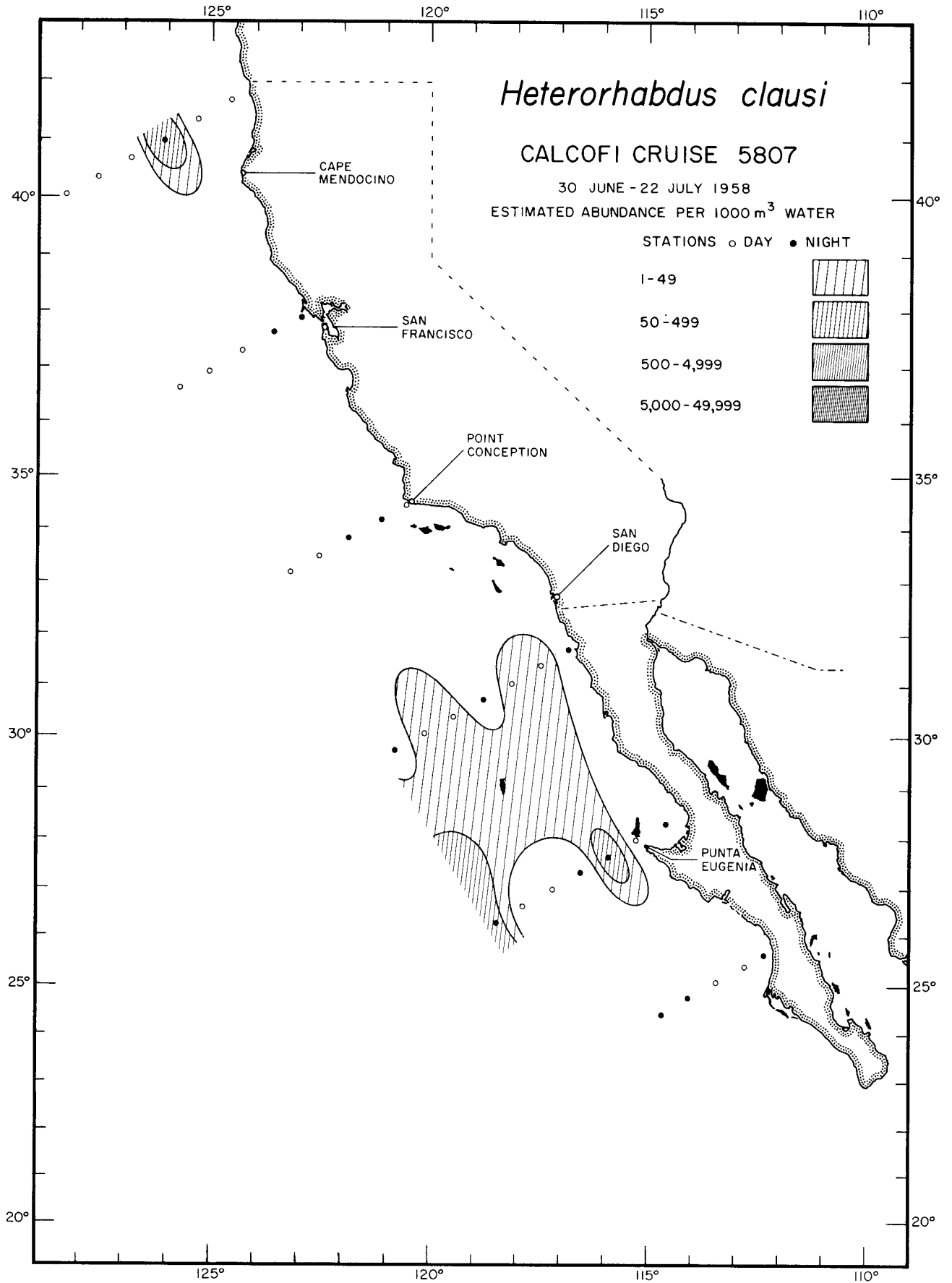
Calanoida

Haloptilus spiniceps

5901



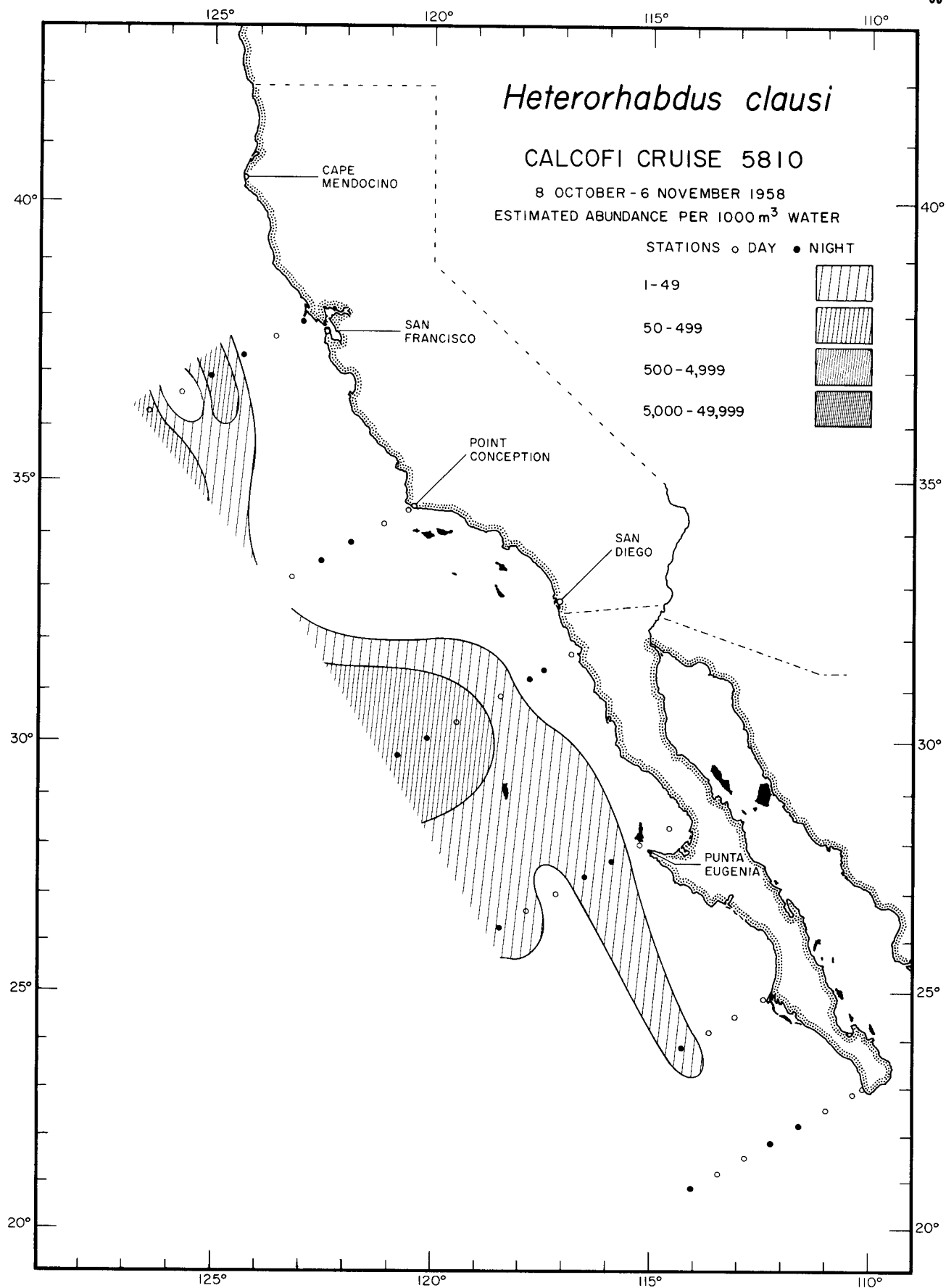
Calanoida
Heterorhabdus clausi
 5804



Calanoida

Heterorhabdus clausi

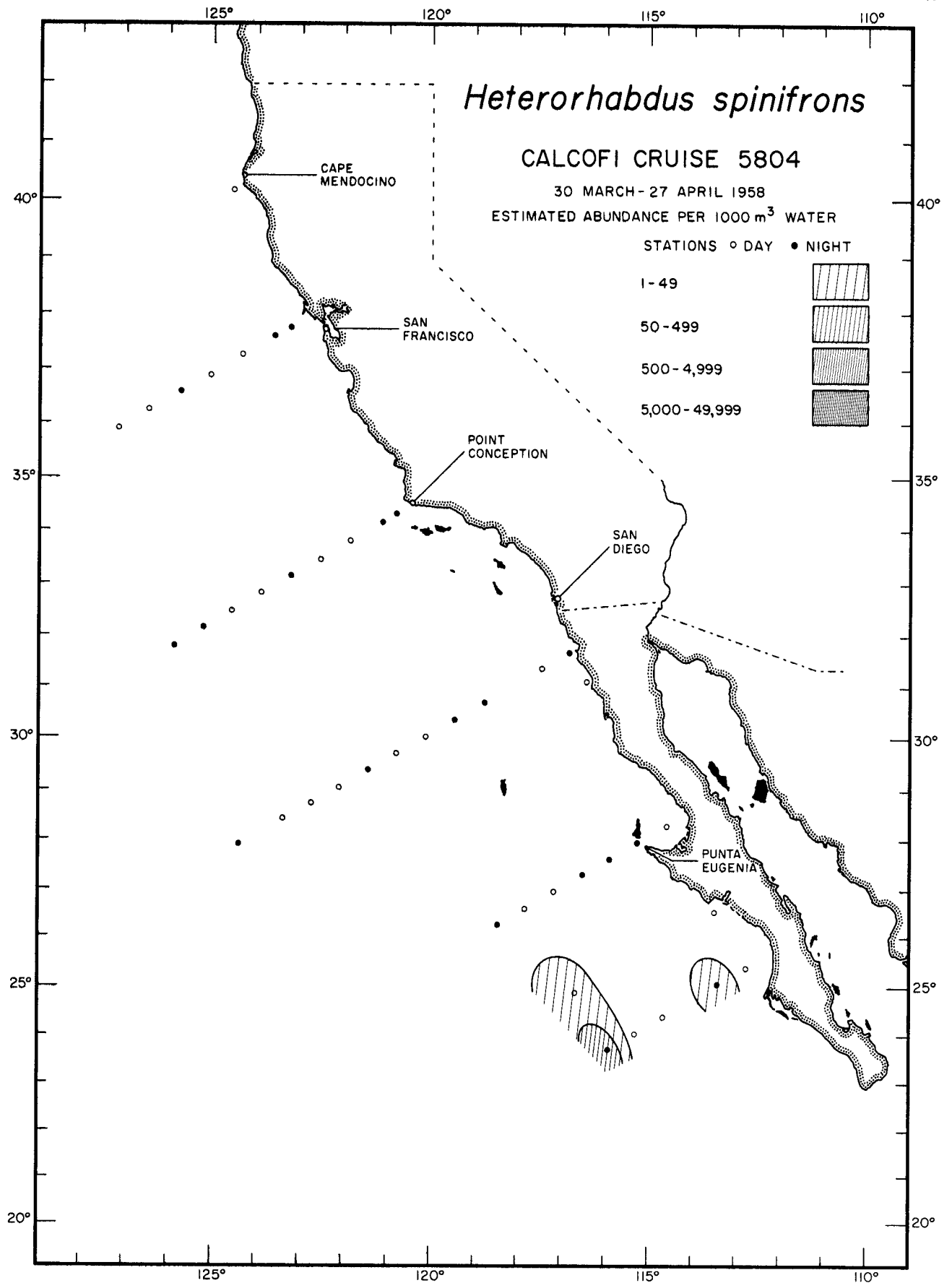
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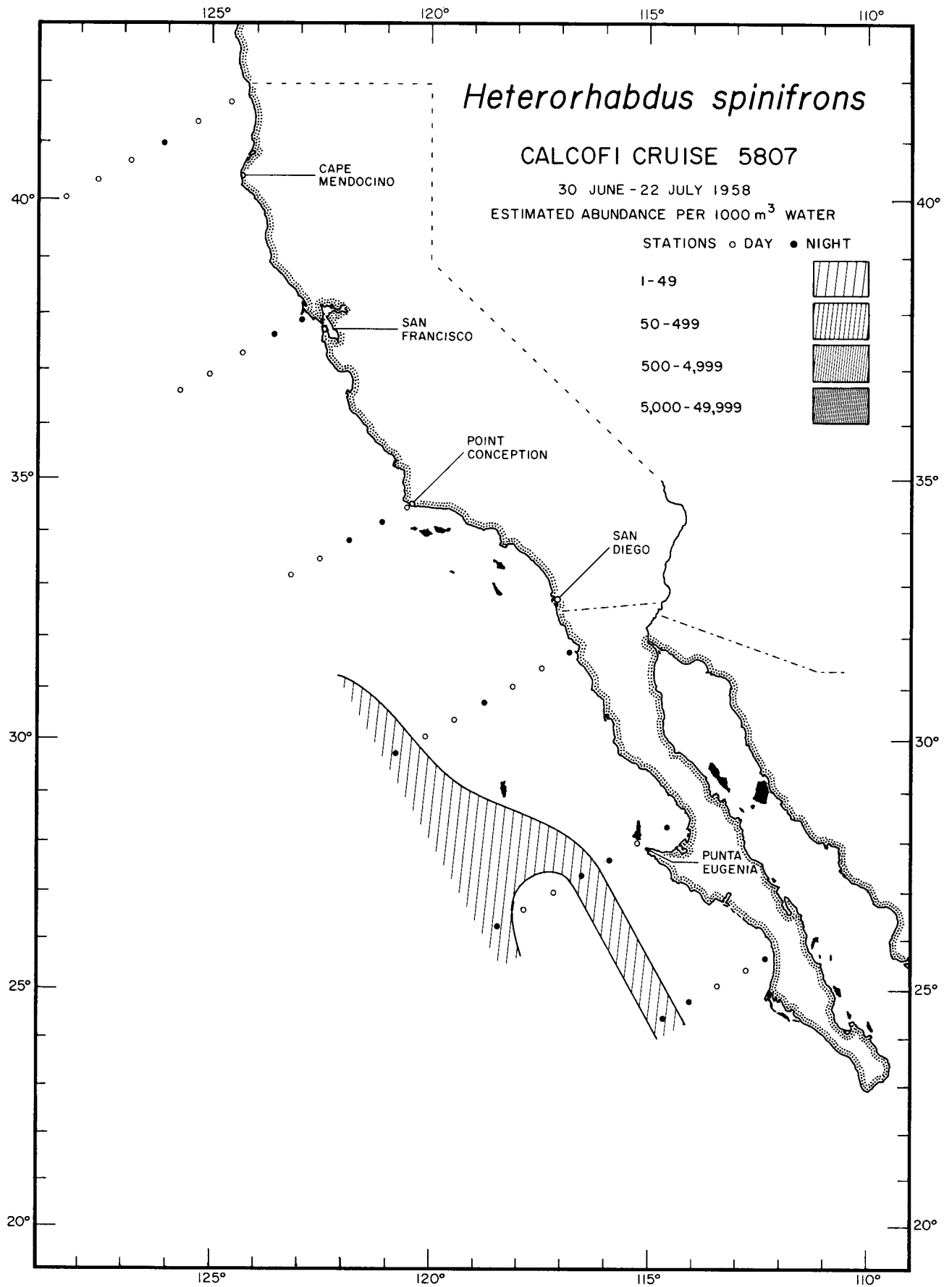
Calanoida

Heterorhabdus clausi

5810



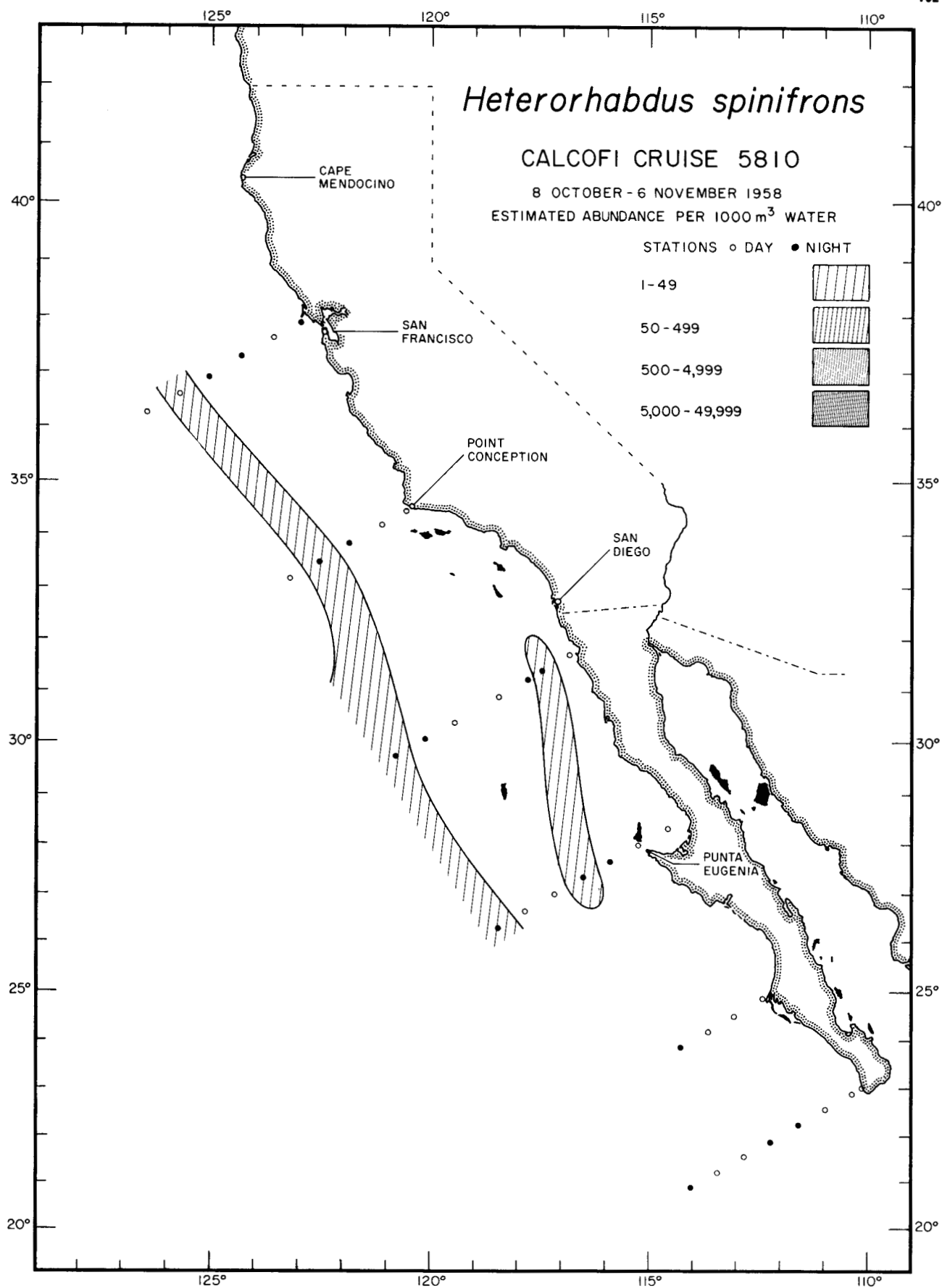
Calanoida
Heterorhabdus spinifrons
 5804



Calanoida

Heterorhabdus spinifrons

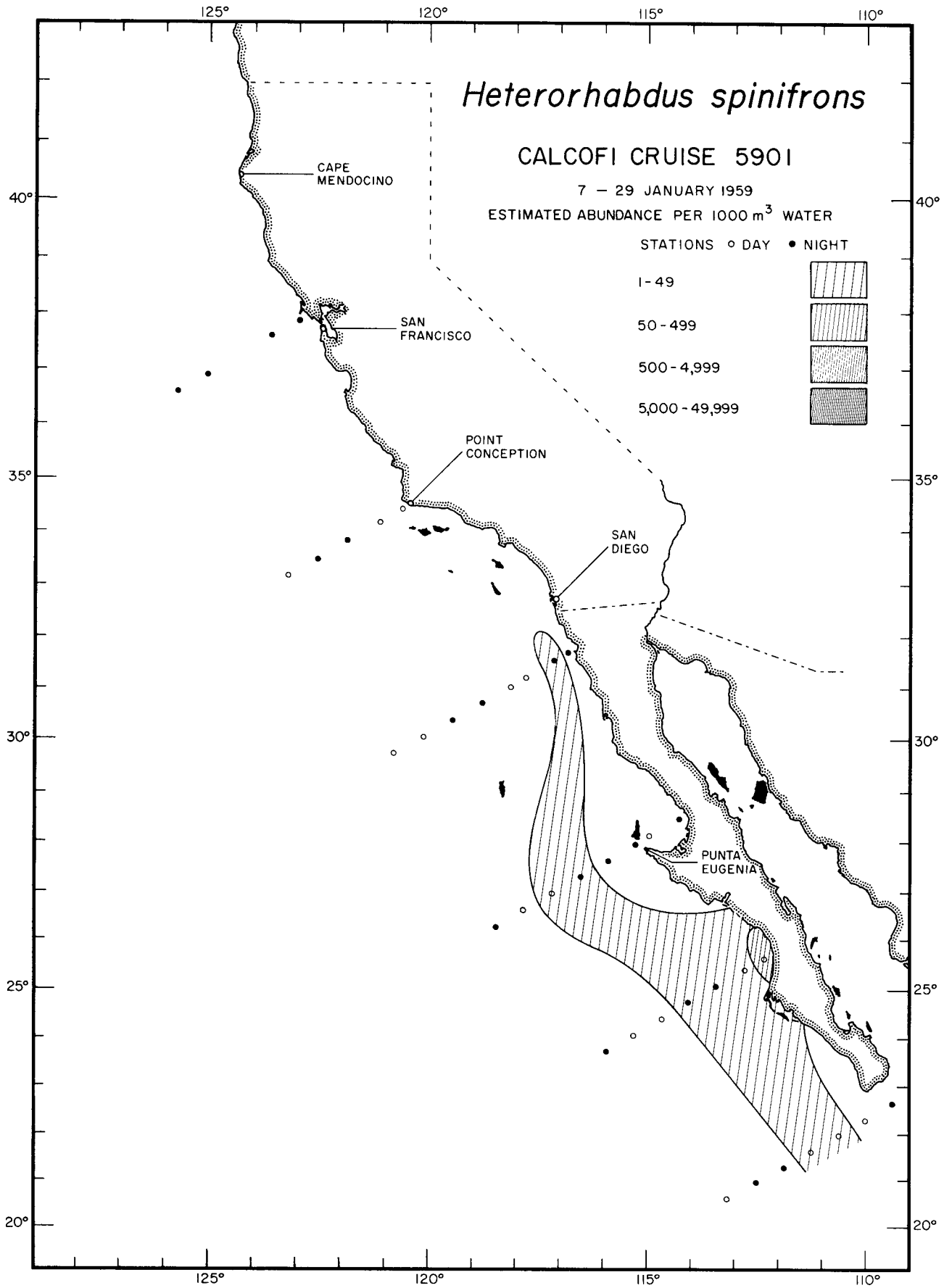
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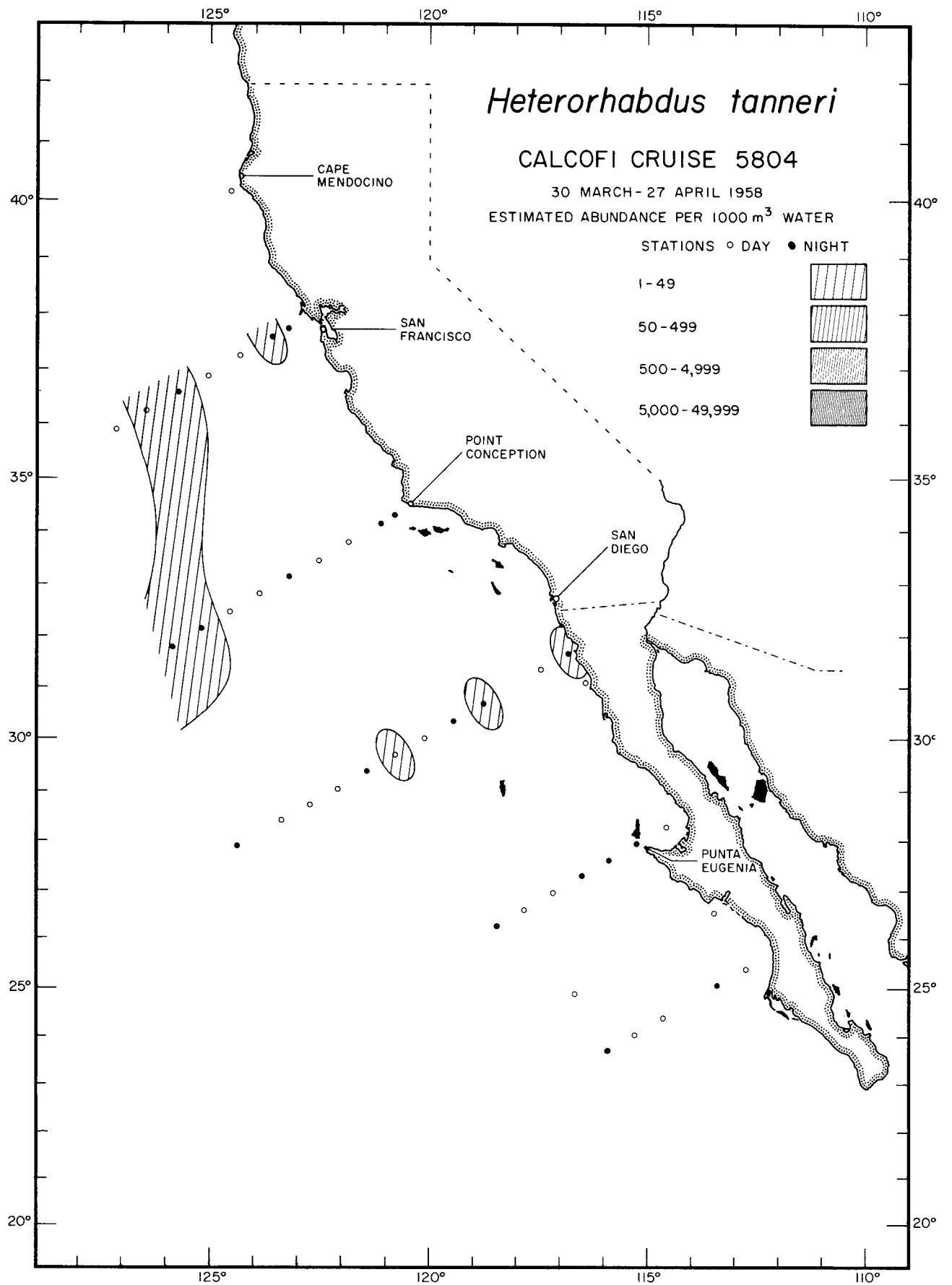
Calanoida

Heterorhabdus spinifrons

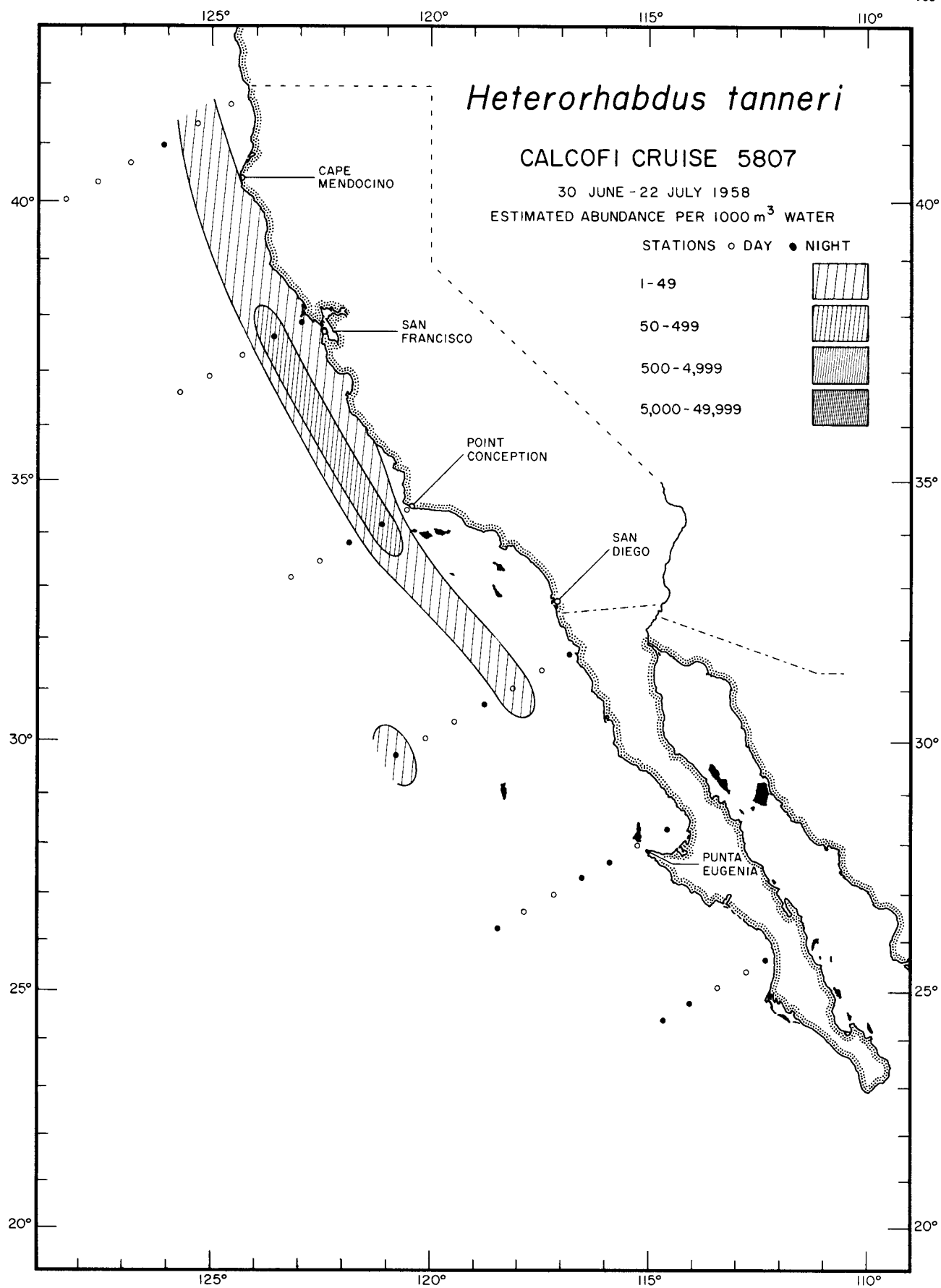
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Calanoida
Heterorhabdus spinifrons
5901



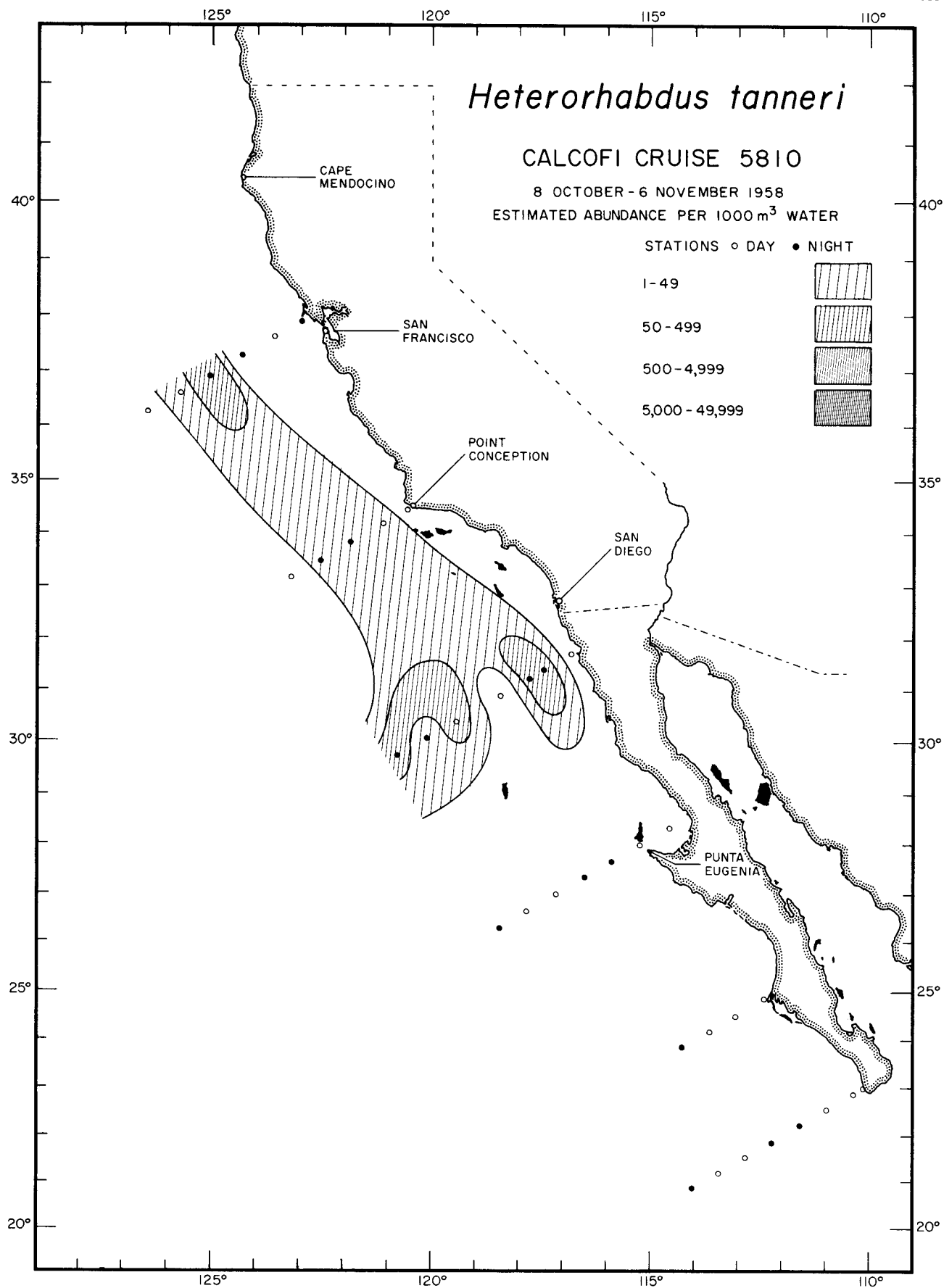
Heterorhabdus tanneri
5804



Calanoida

Heterorhabdus tanneri

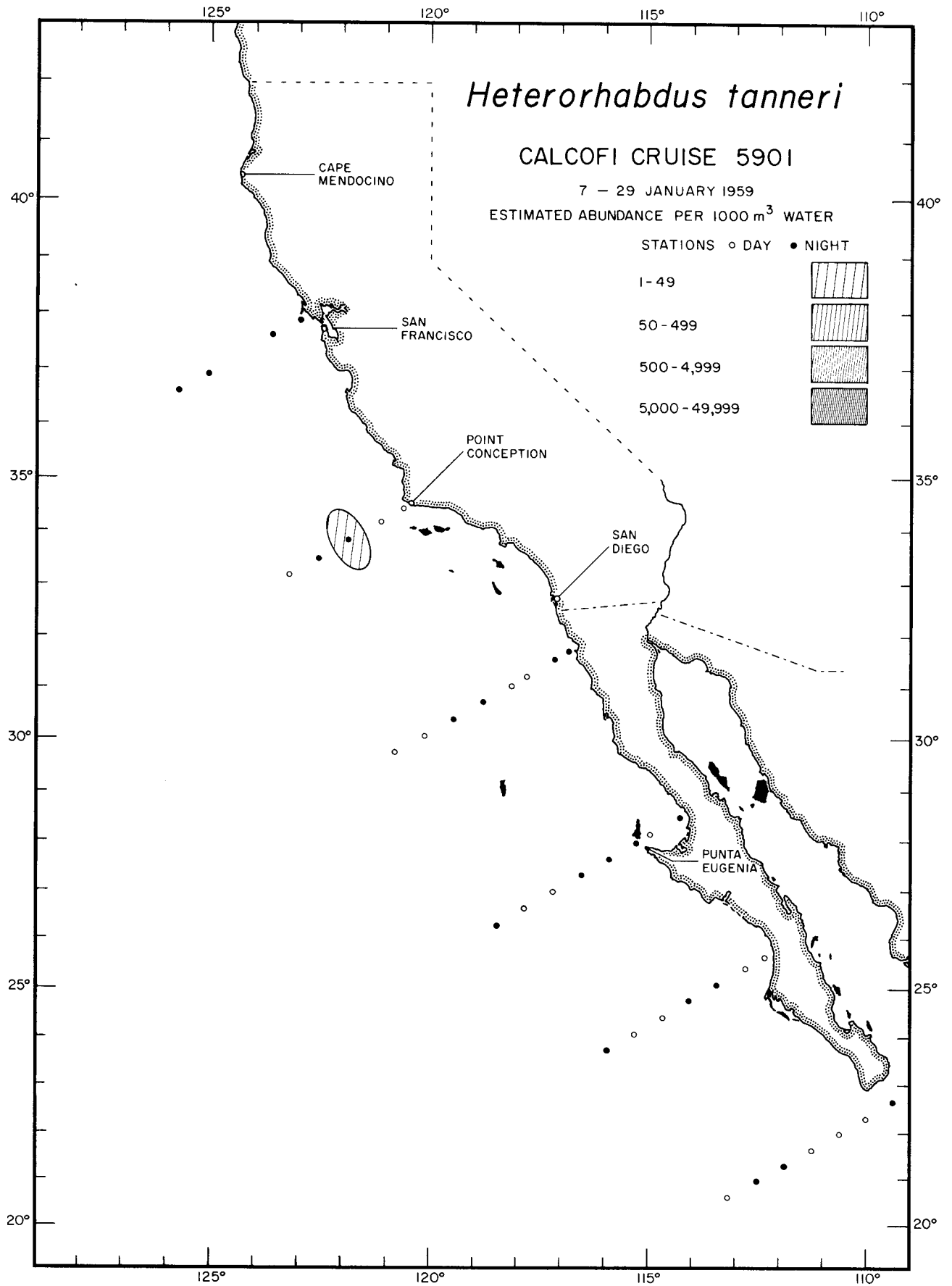
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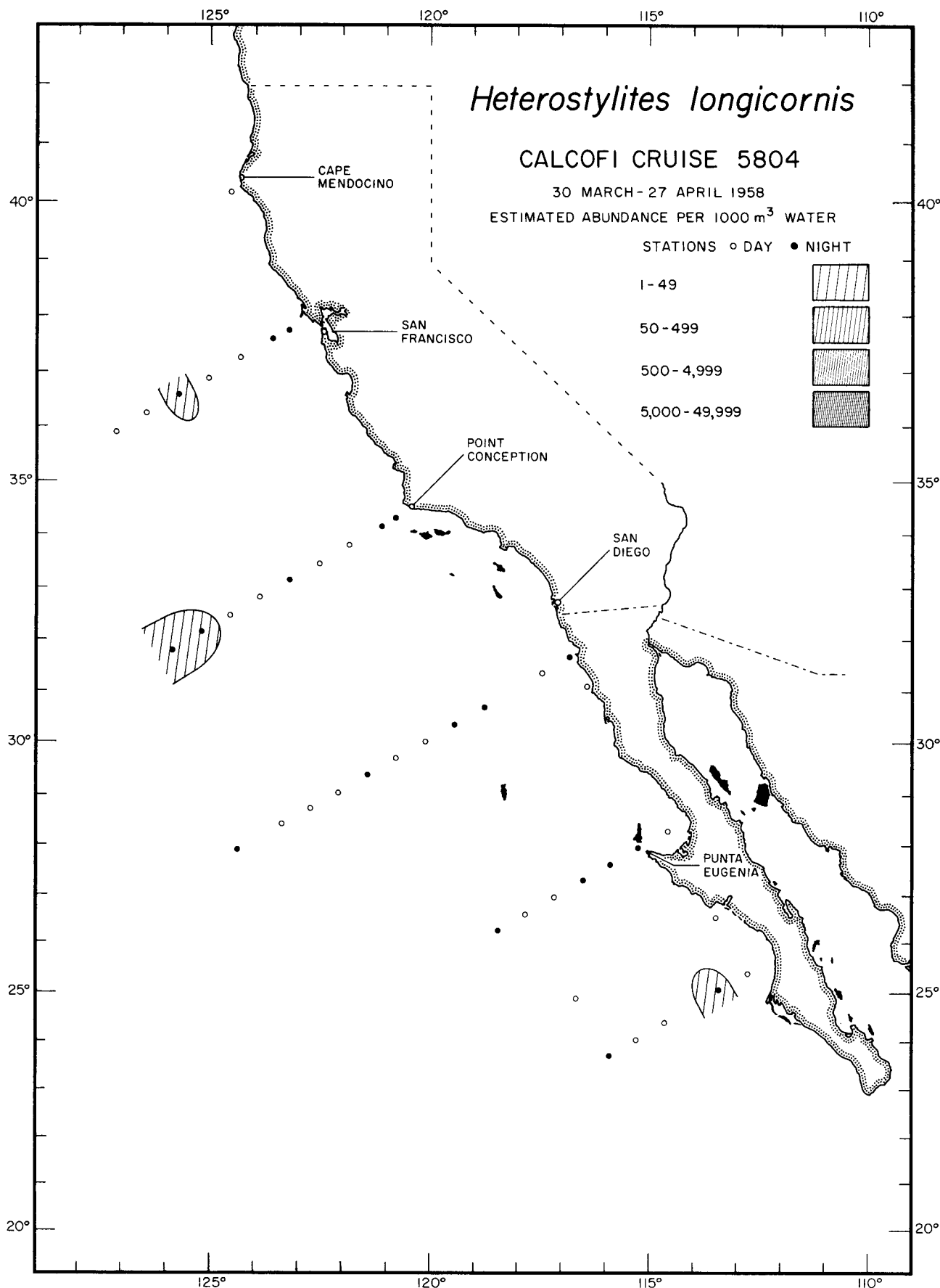
Calanoida

Heterorhabdus tanneri

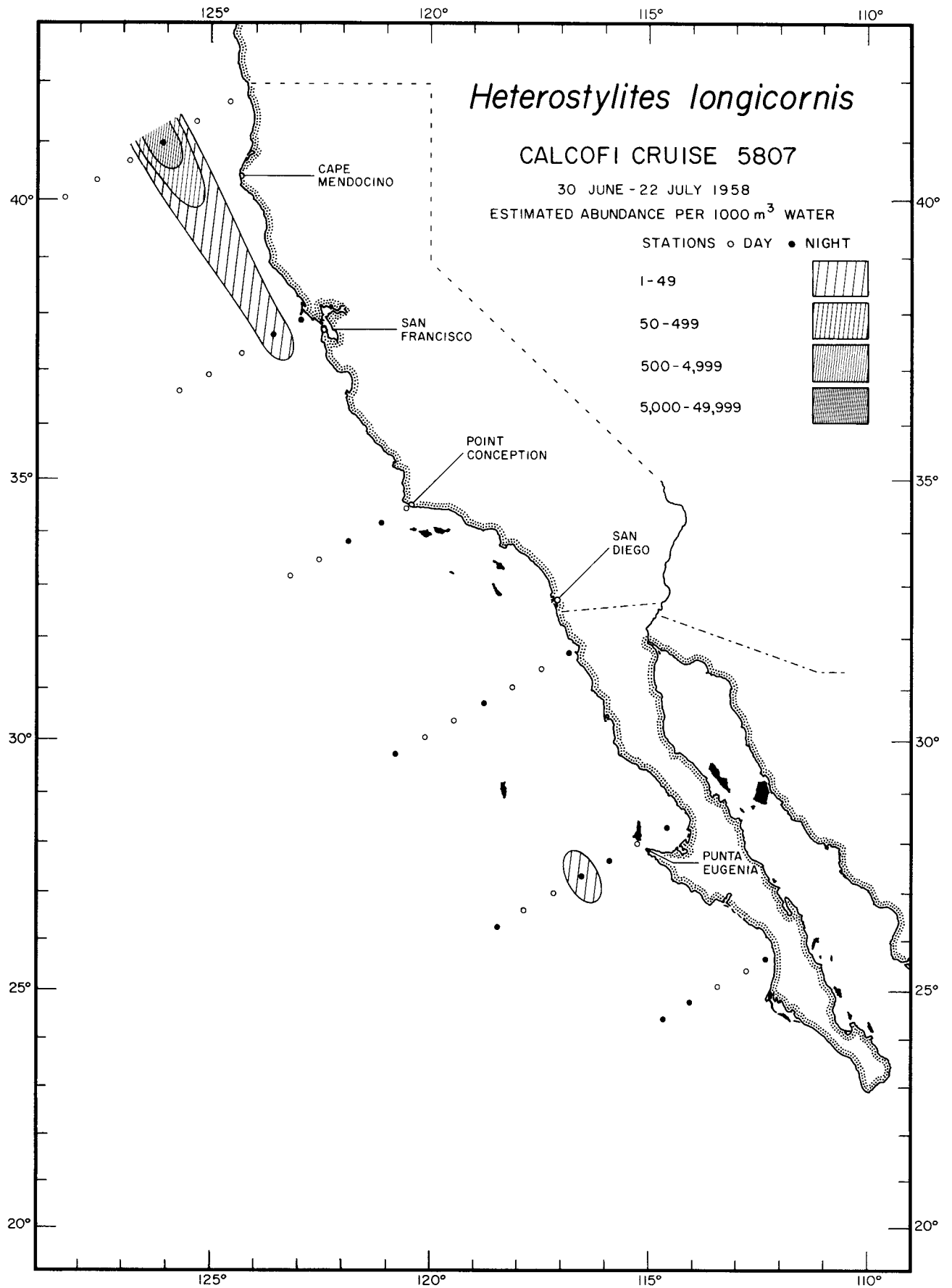
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Calanoida
Heterorhabdus tanneri
5901



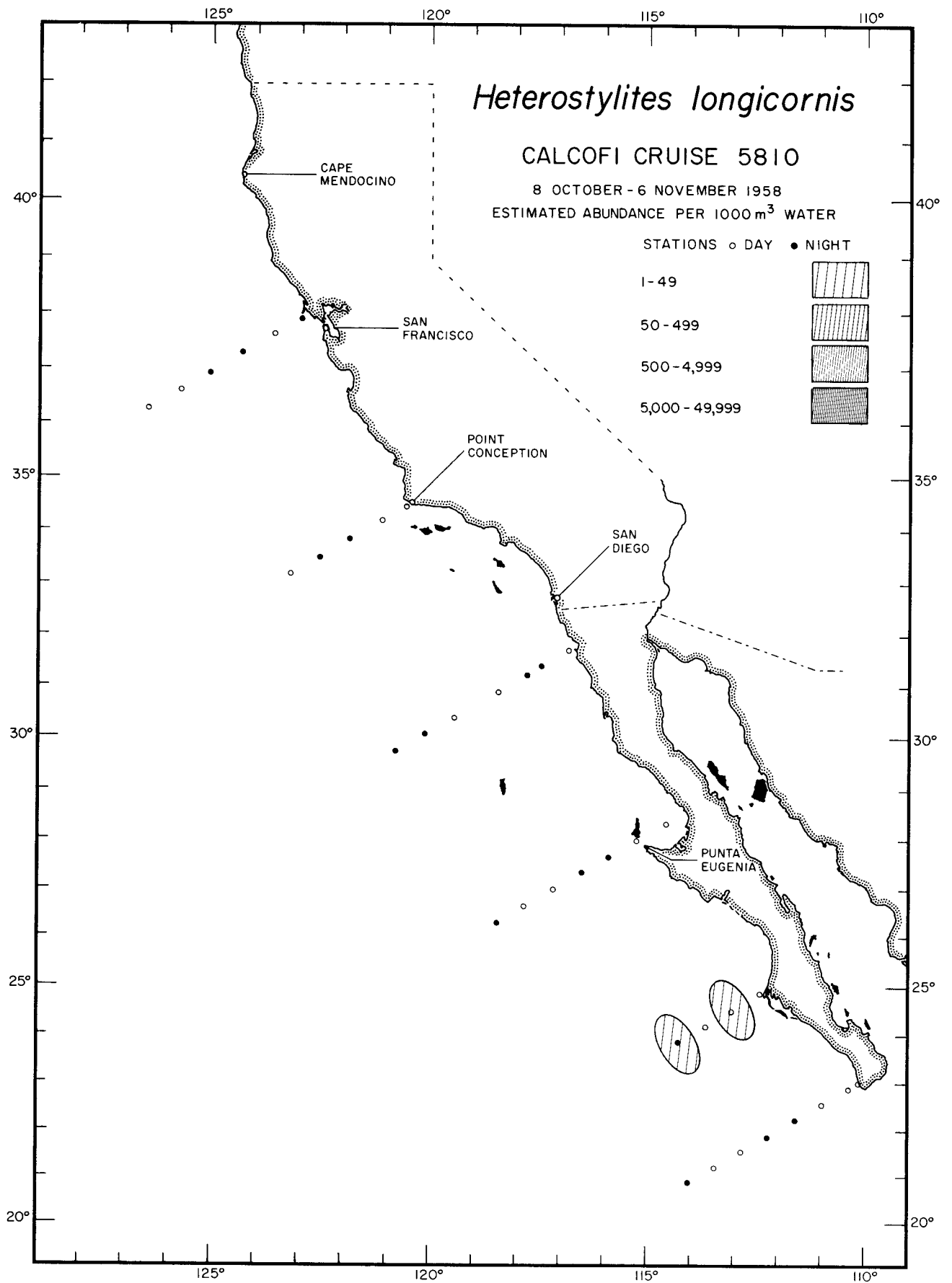
Calanoida
Heterostylites longicornis
5804



Calanoida

Heterostylites longicornis

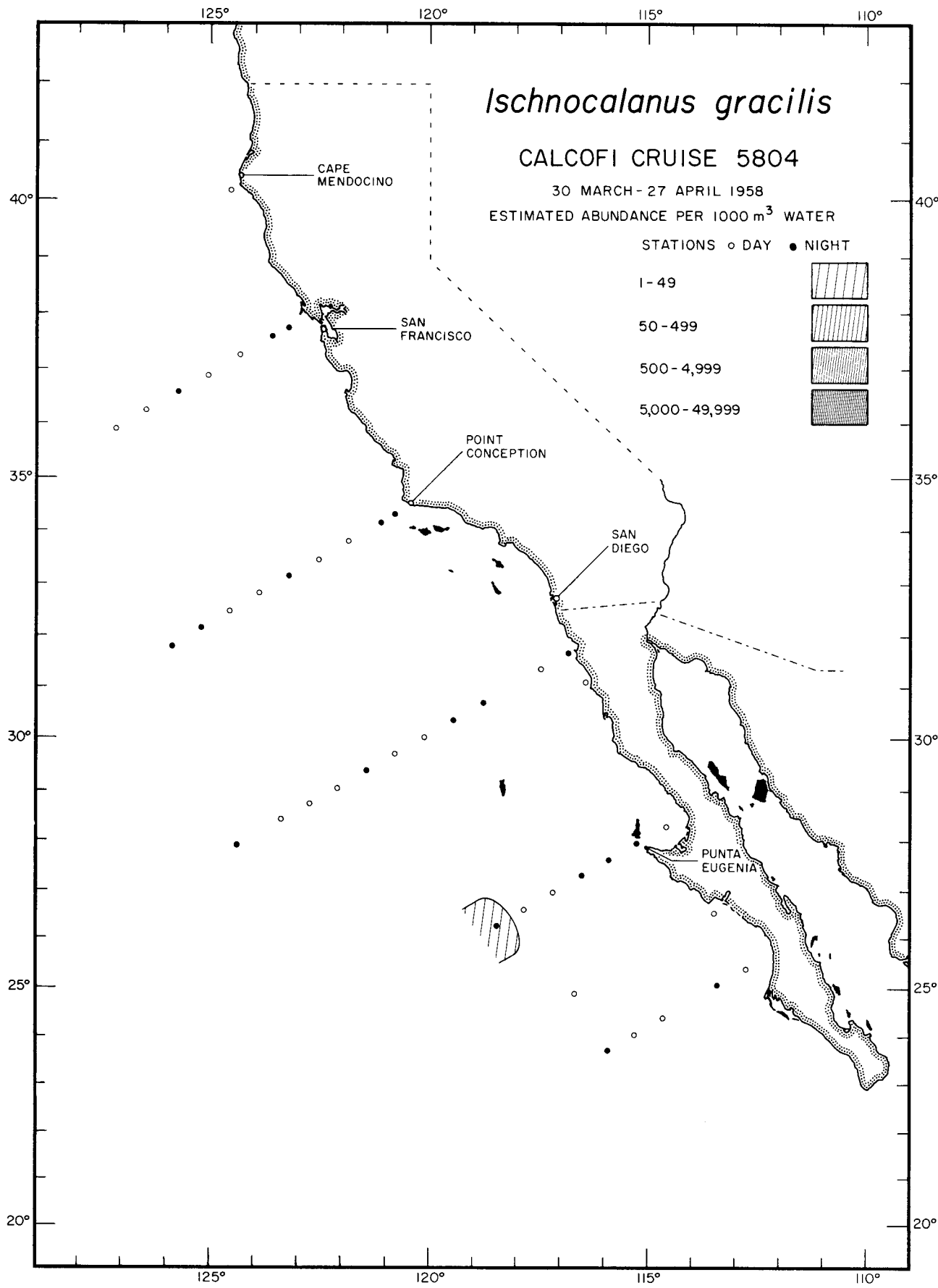
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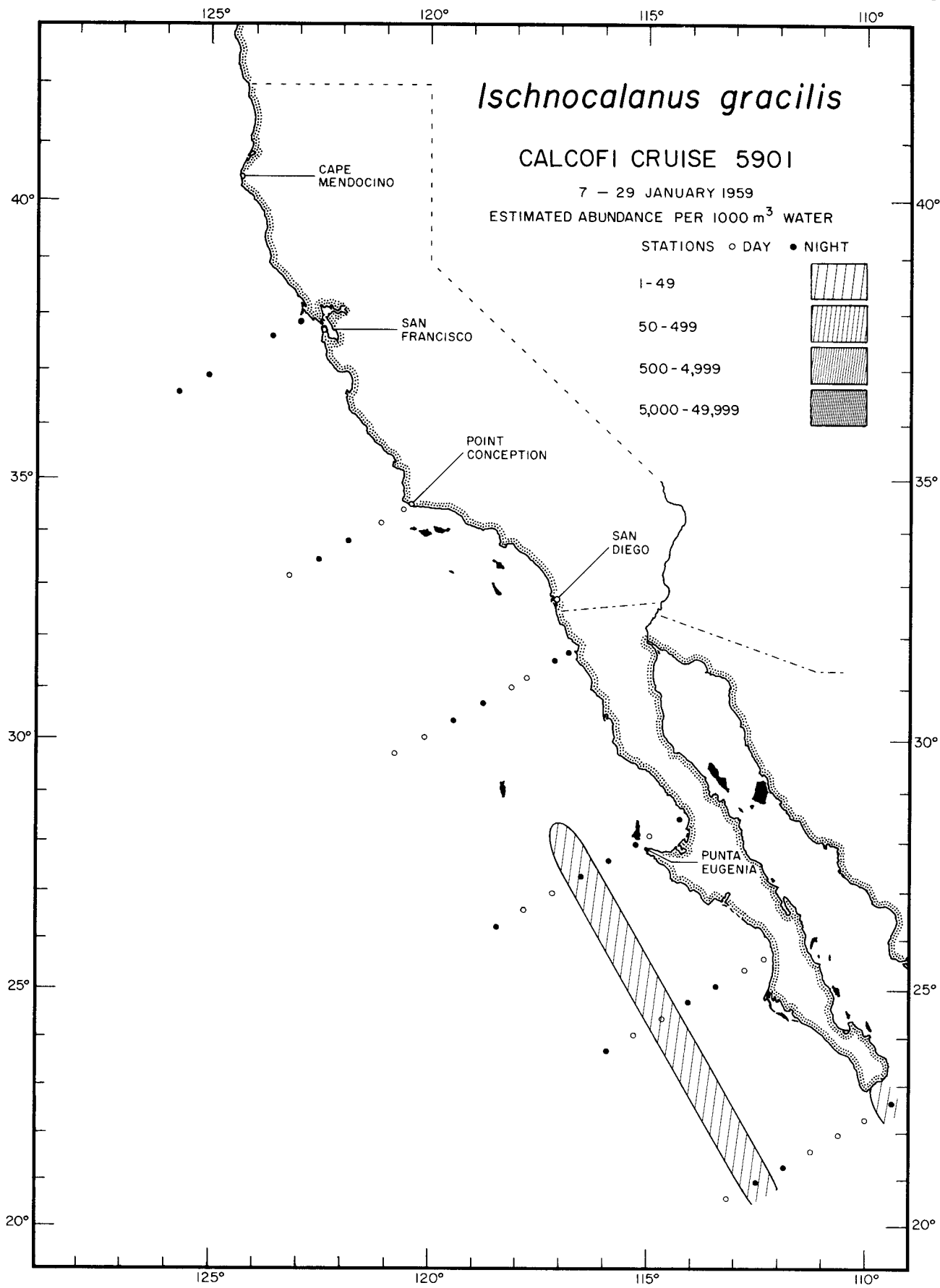
Calanoida

Heterostylites longicornis

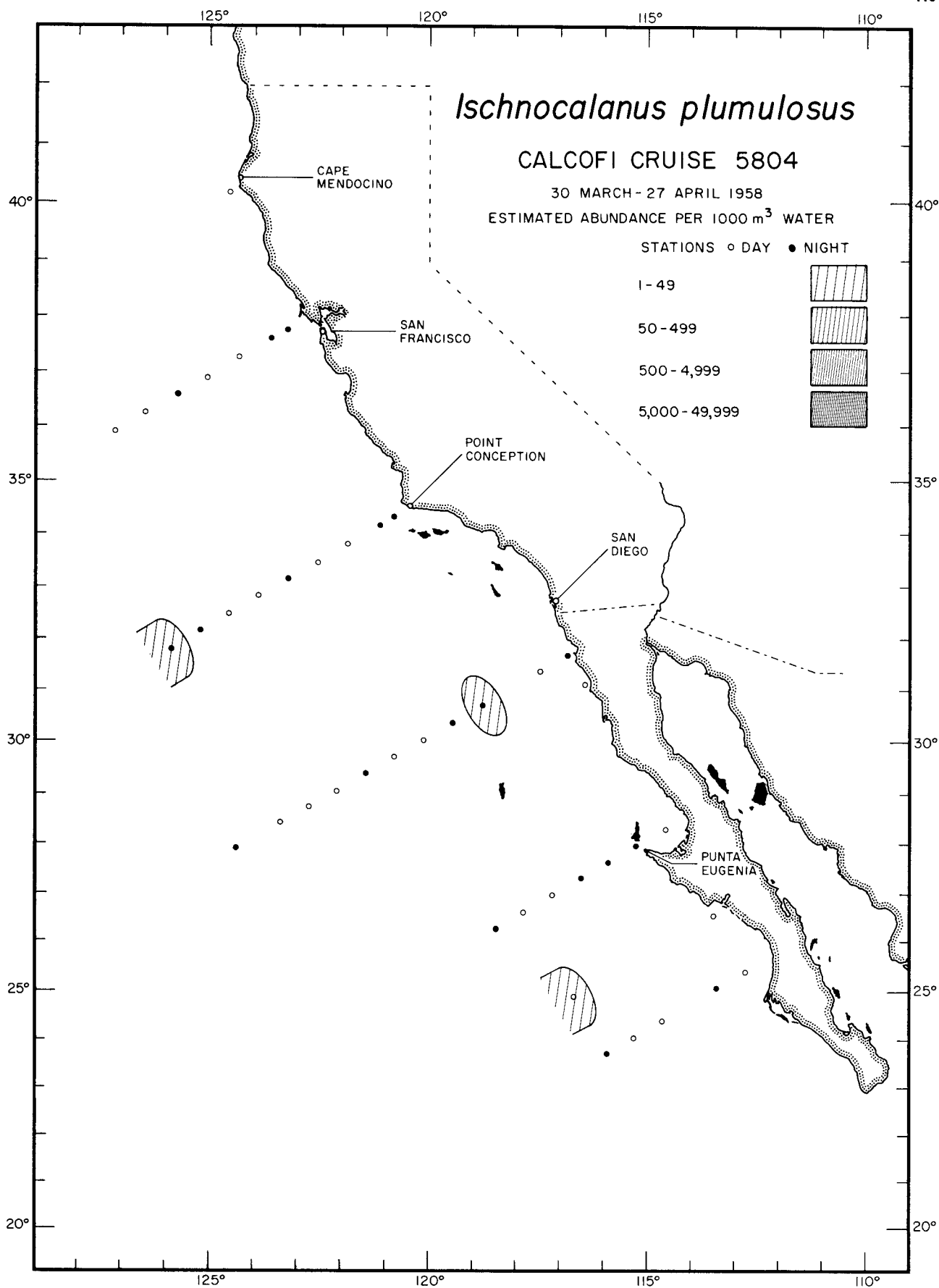
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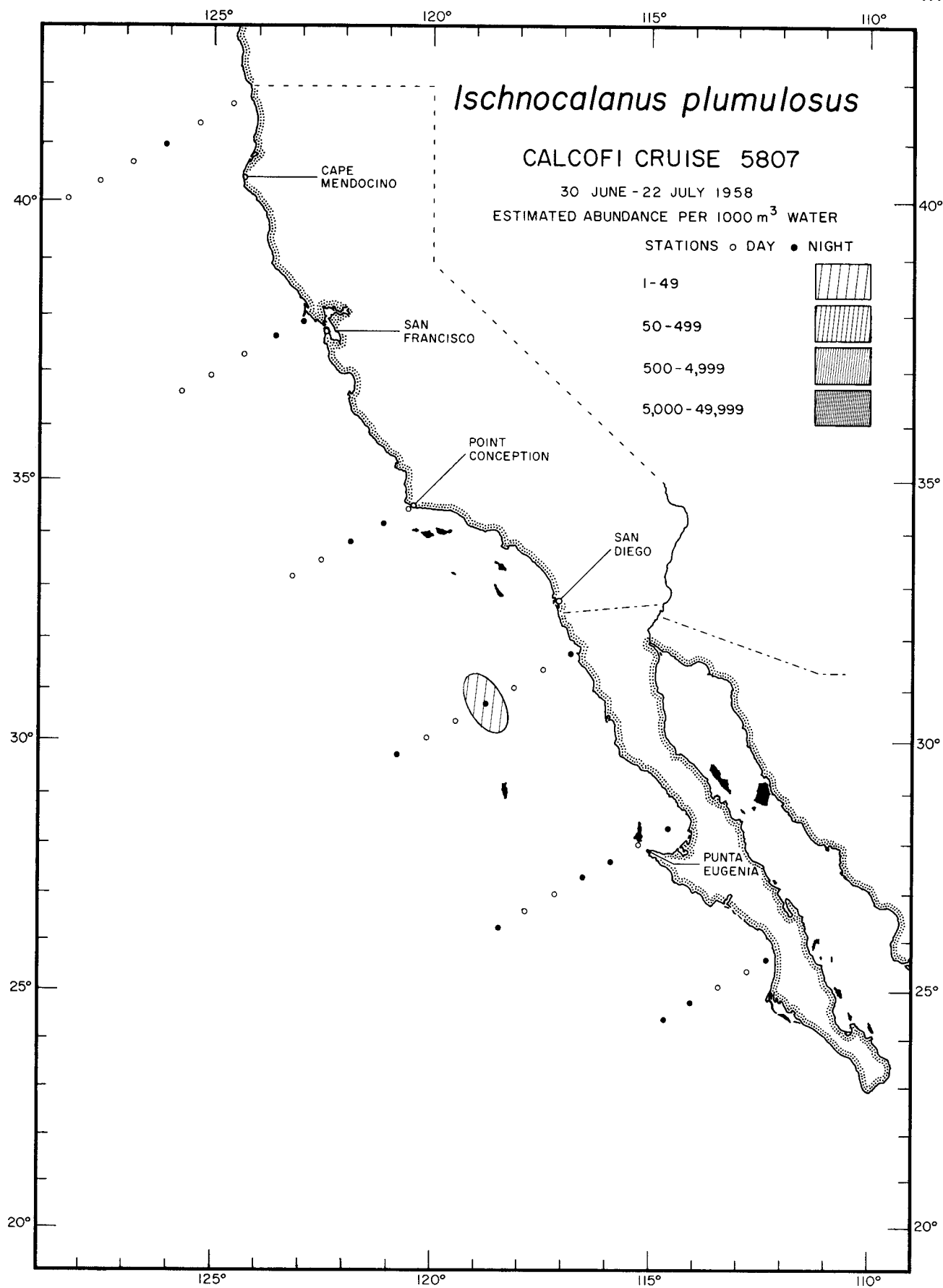
Calanoida
Ischnocalanus gracilis
 5804



Calanoida
Ischnocalanus gracilis
 5901



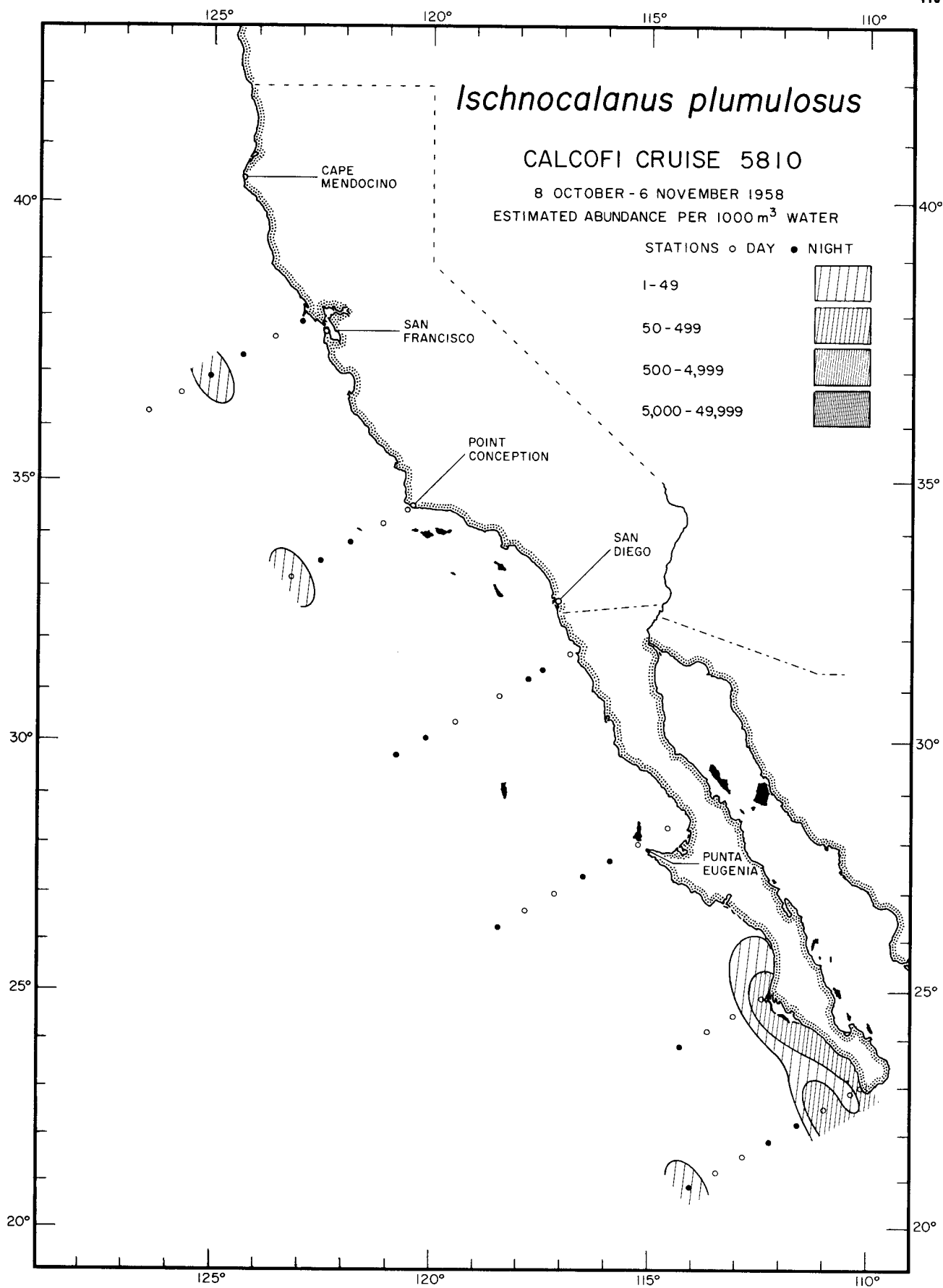
Calanoida
Ischnocalanus plumulosus
5804



Calanoida

Ischnocalanus plumulosus

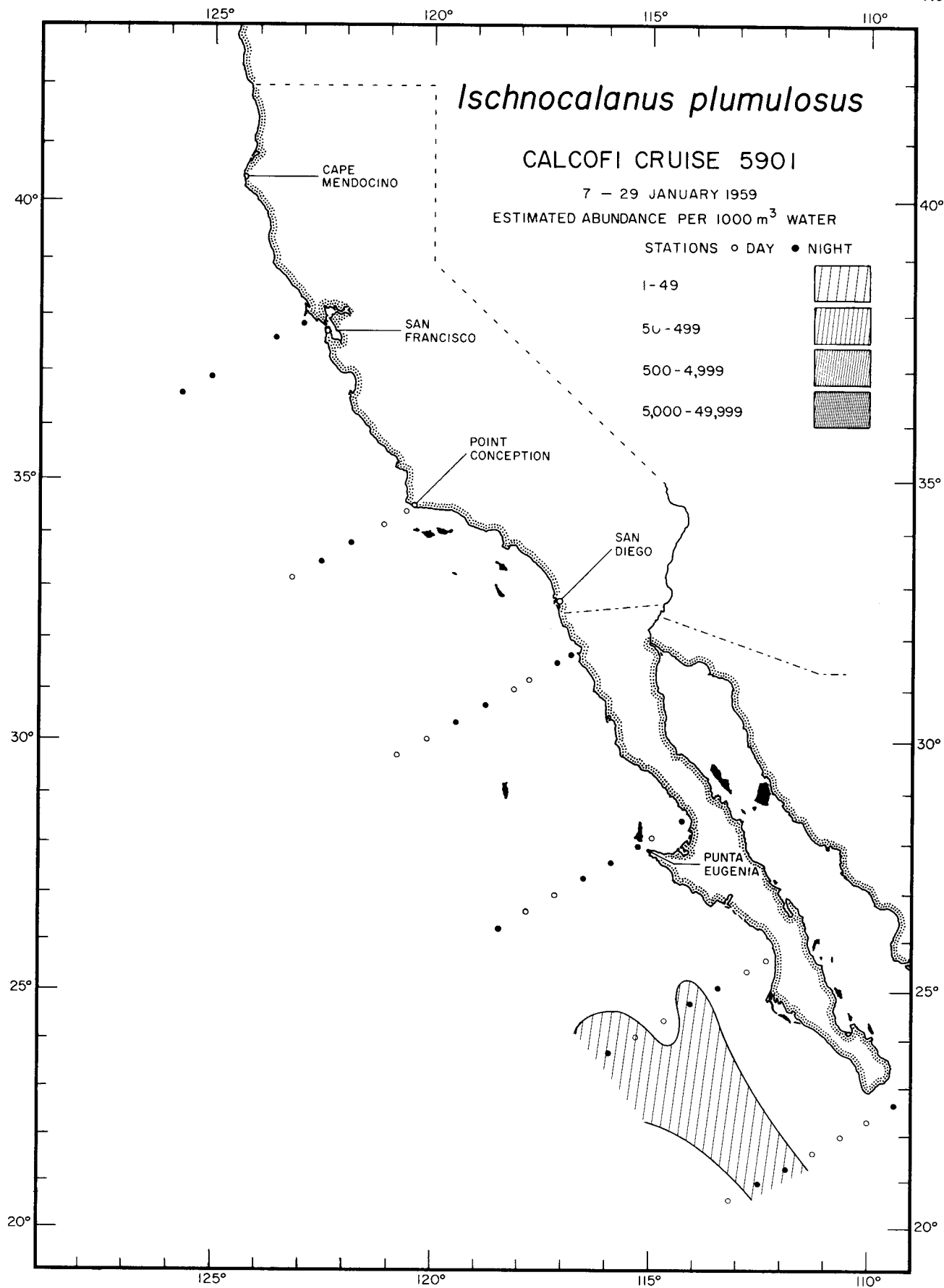
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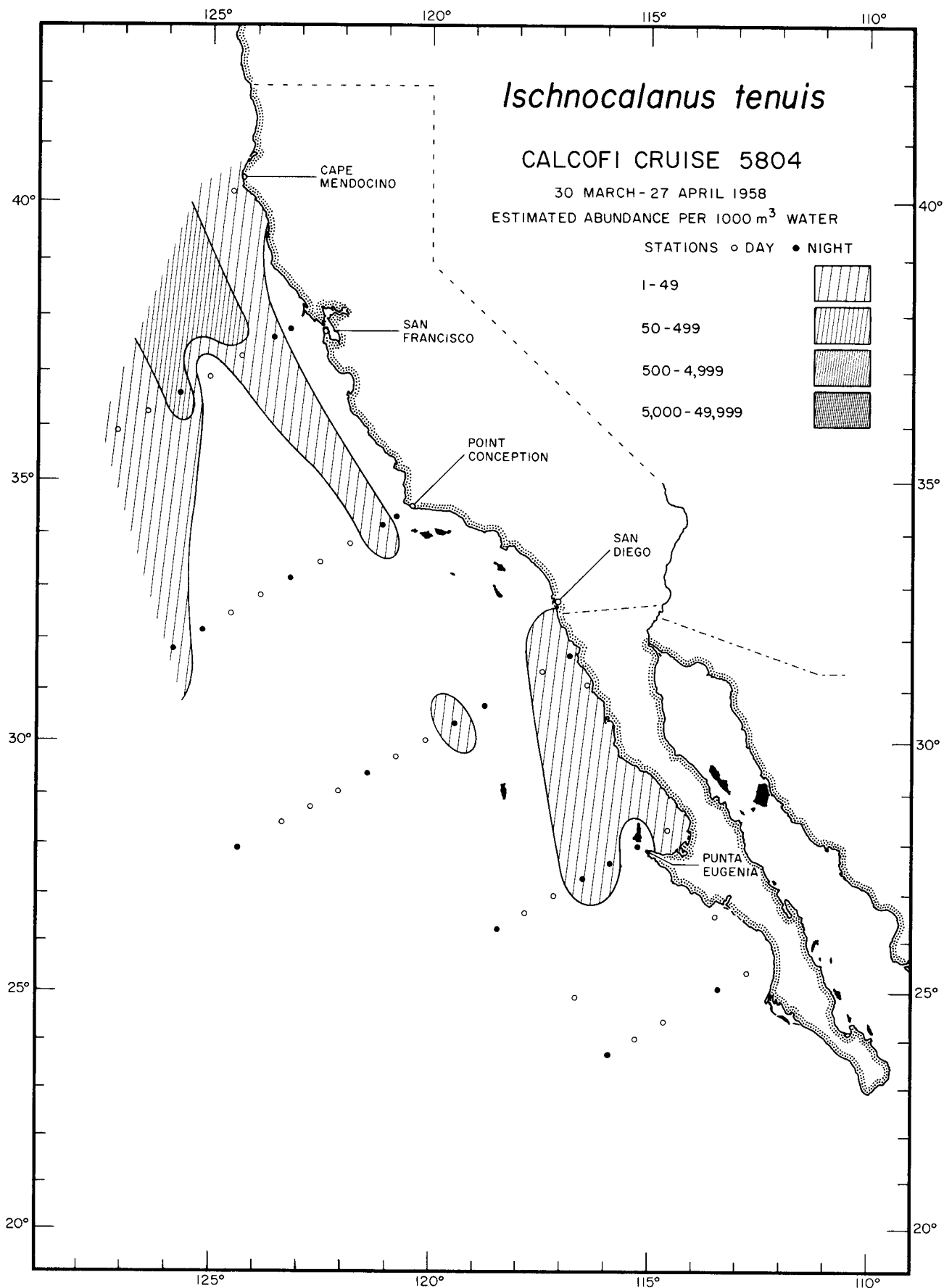
Calanoida

Ischnocalanus plumulosus

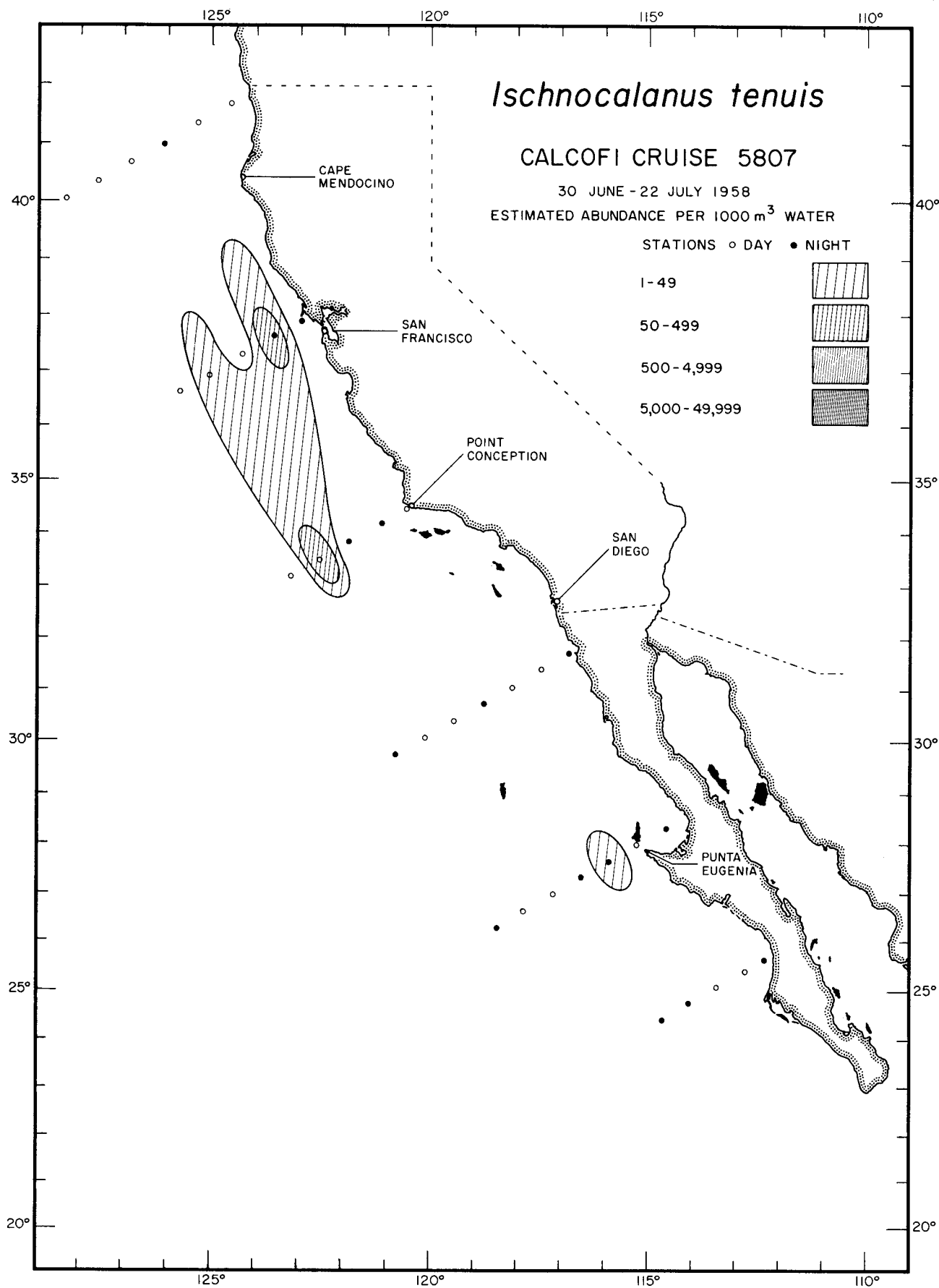
5810



Calanoida
Ischnocalanus plumulosus
5901



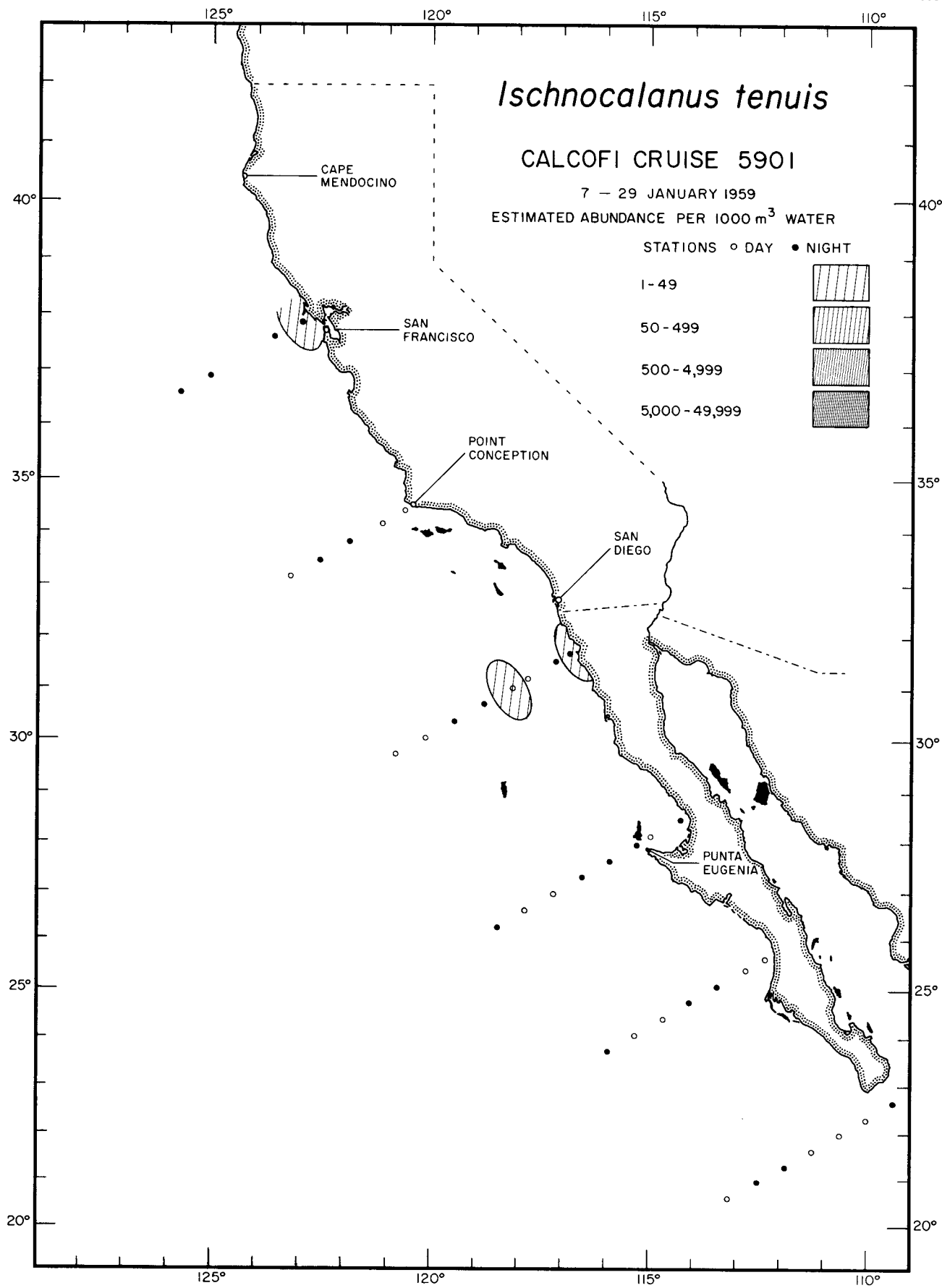
Calanoida
Ischnocalanus tenuis
5804



Calanoida

Ischnocalanus tenuis

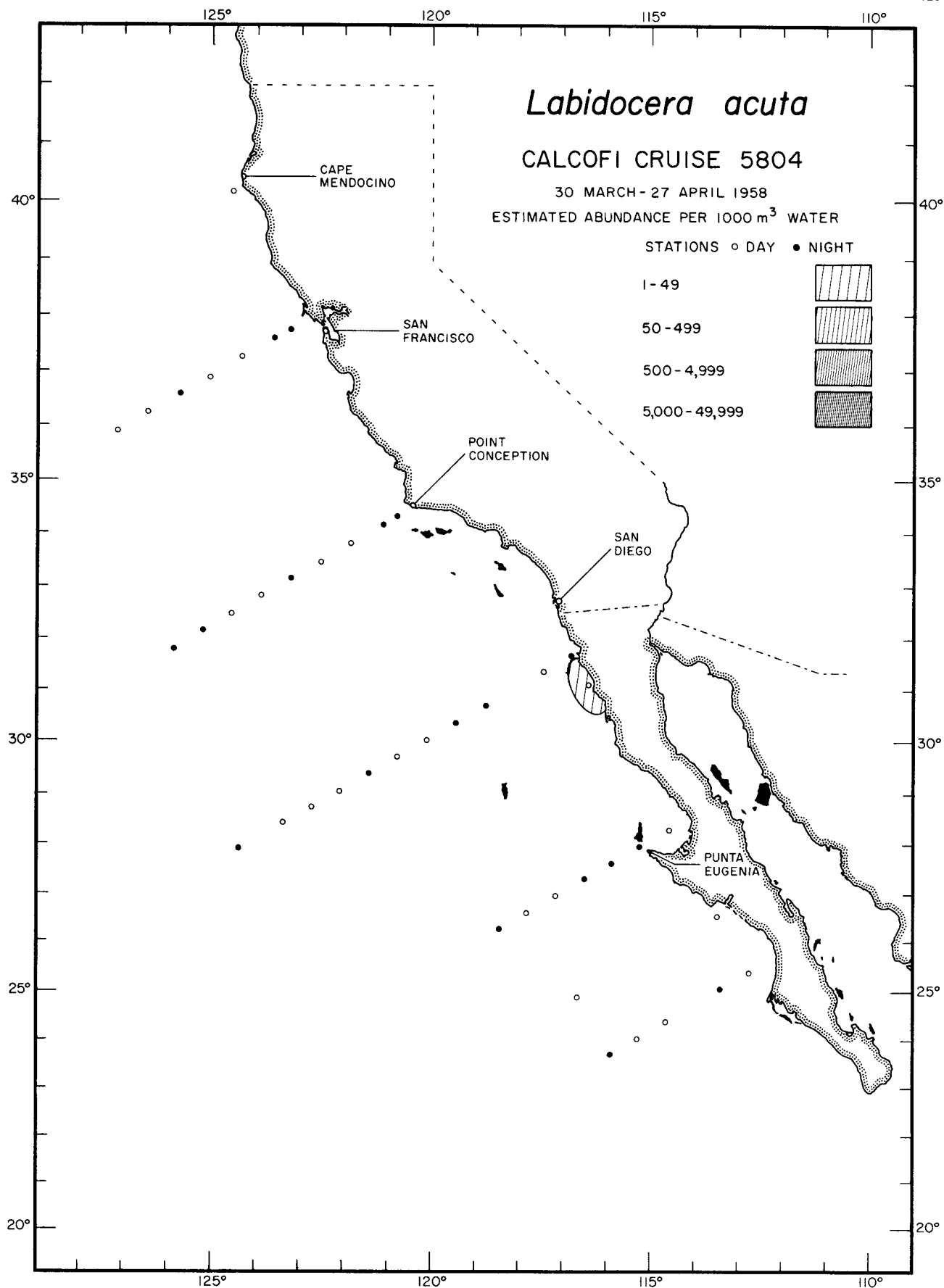
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Calanoida

Ischnocalanus tenuis

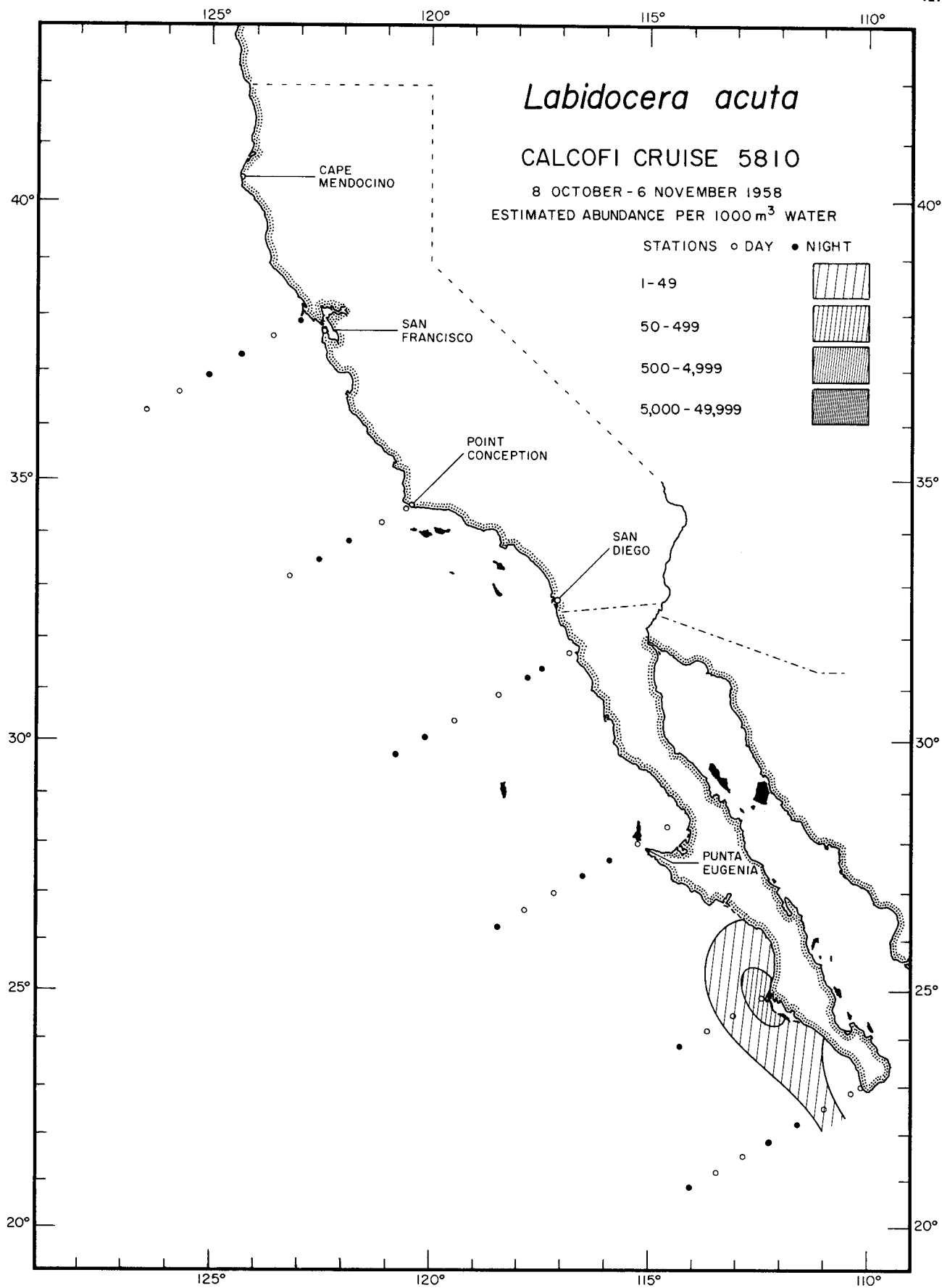
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Calanoida

Labidocera acuta

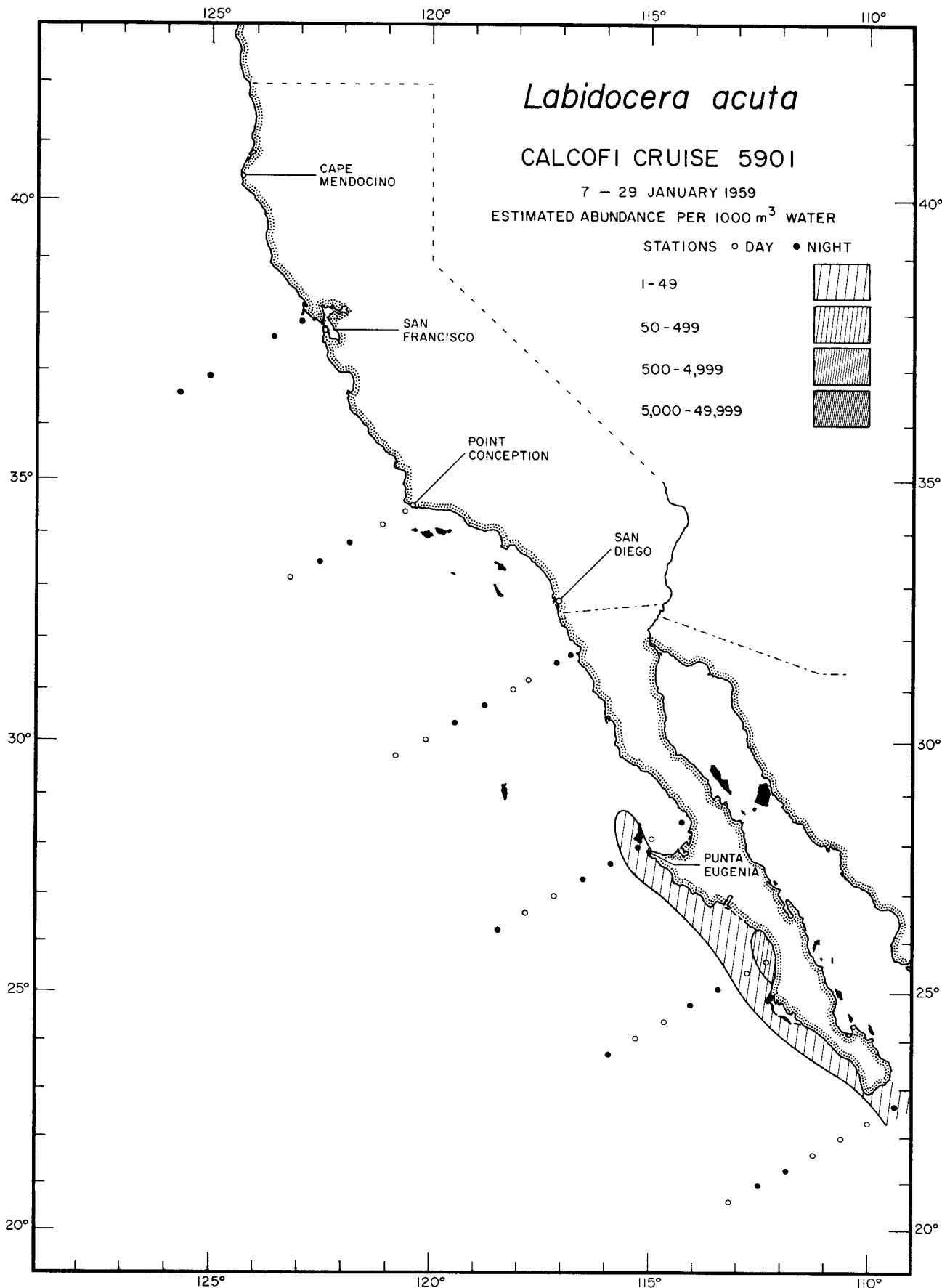
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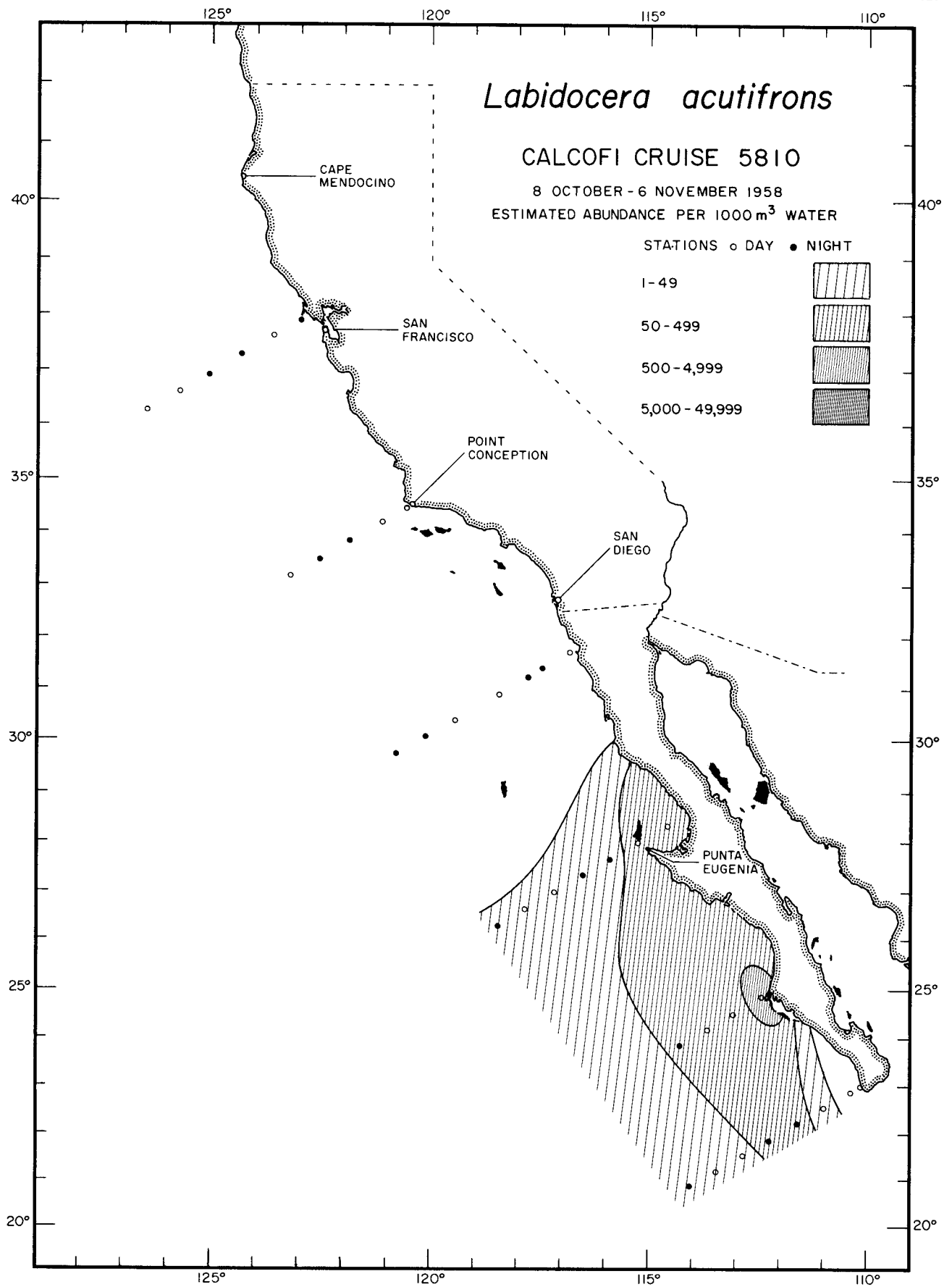
Calanoida

Labidocera acuta

5810



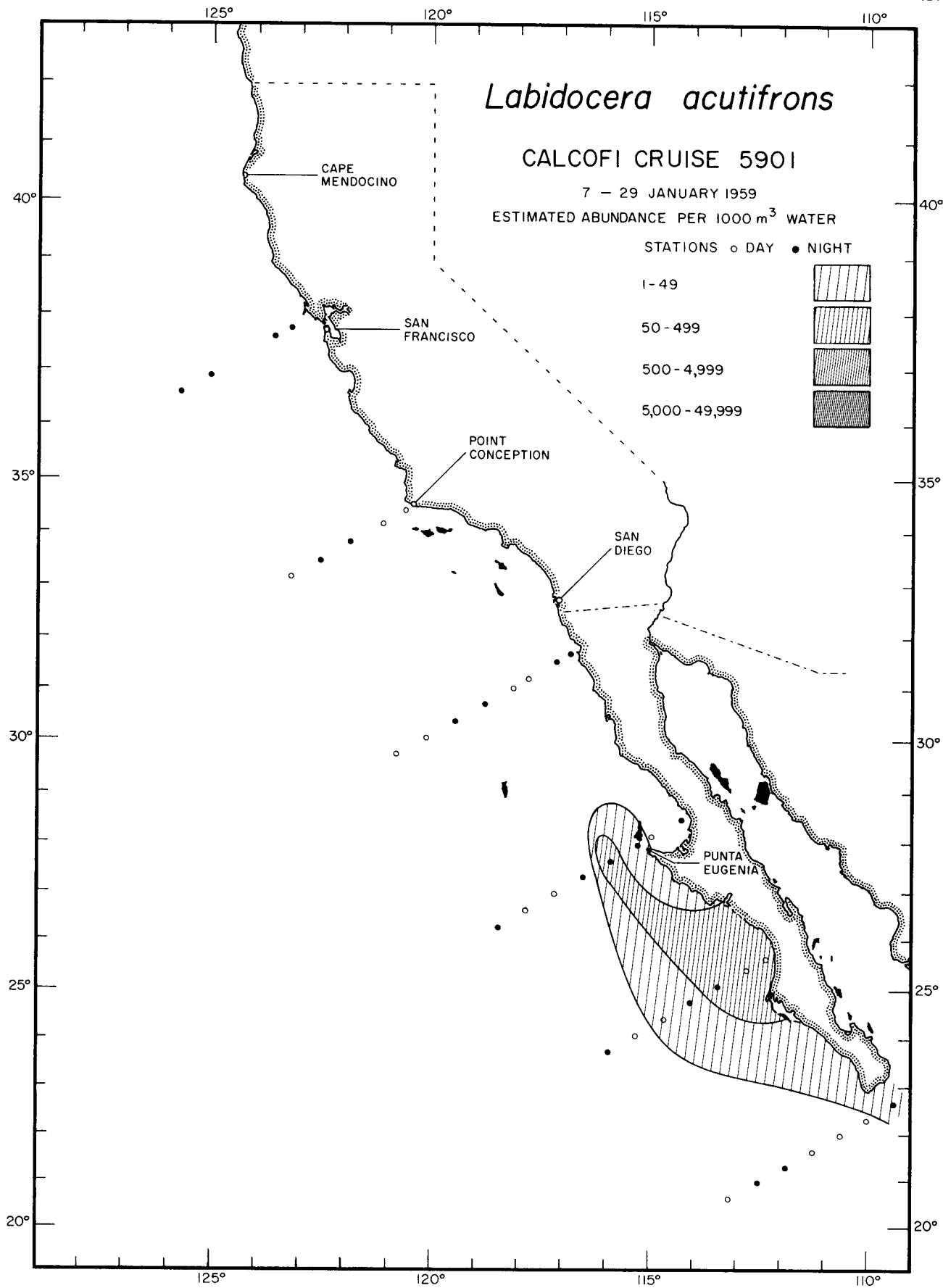
Calanoida
Labidocera acuta
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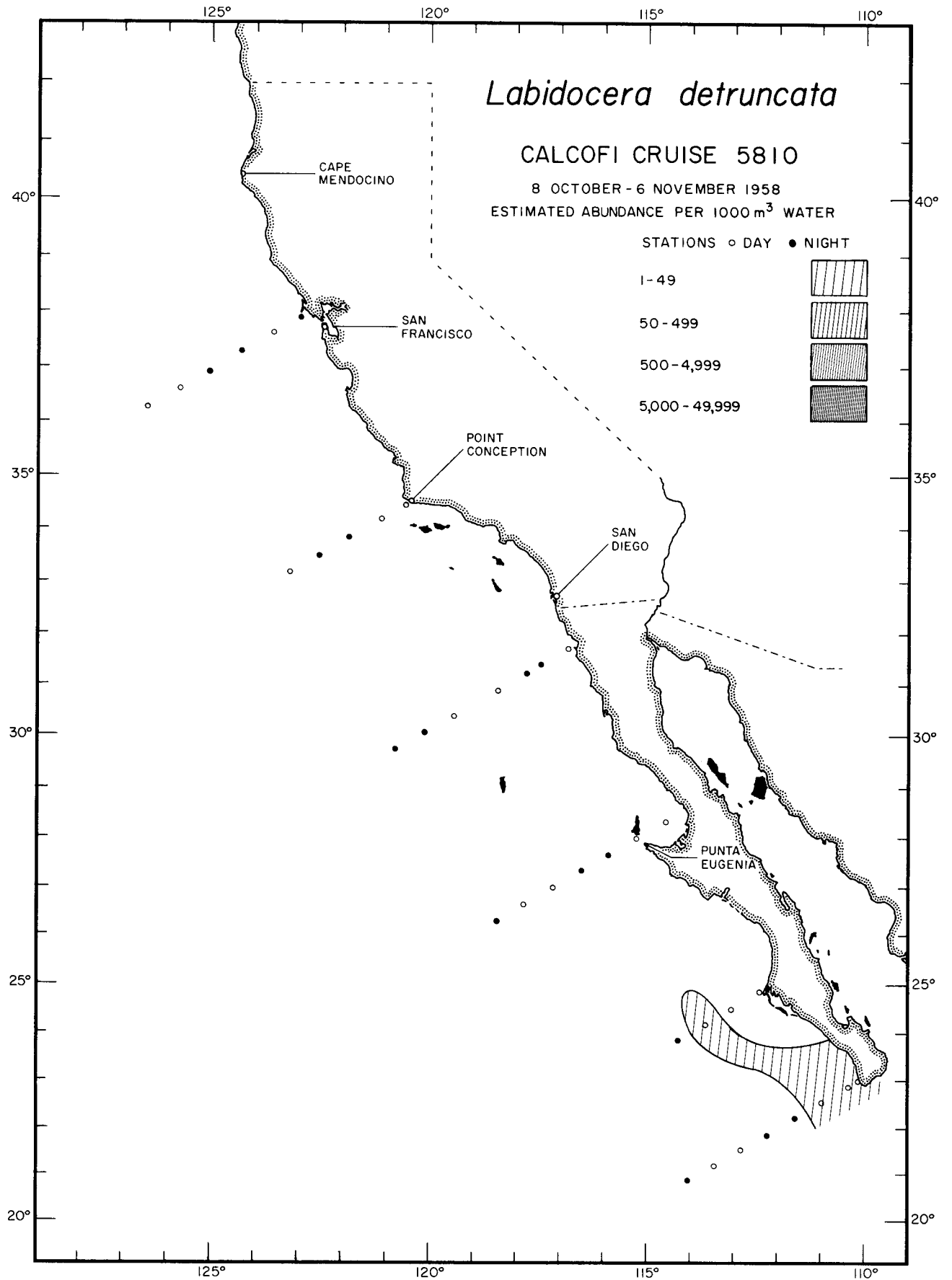
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Labidocera acutifrons

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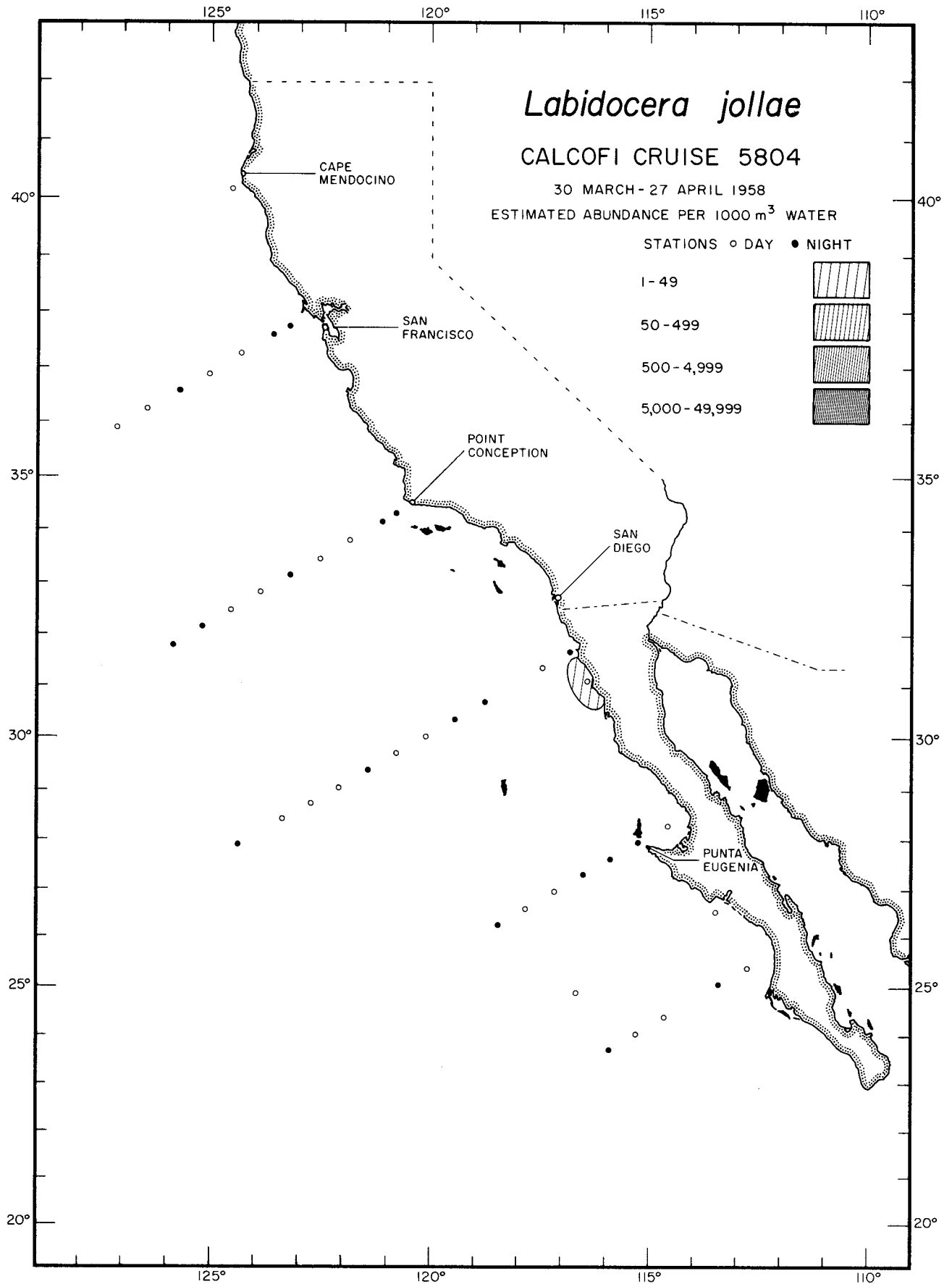
Calanoida
Labidocera acutifrons
5901



Calanoida

Labidocera detruncata

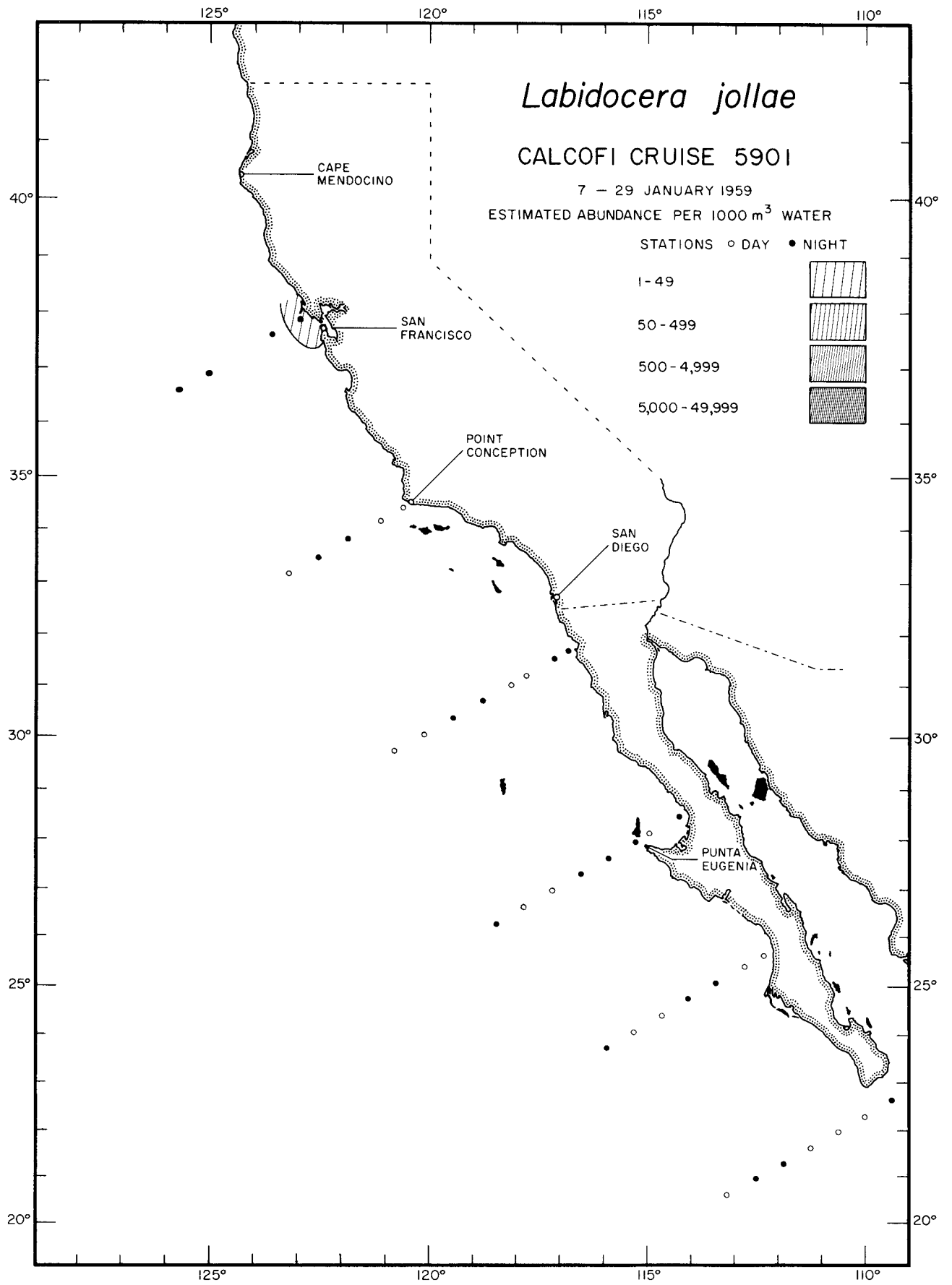
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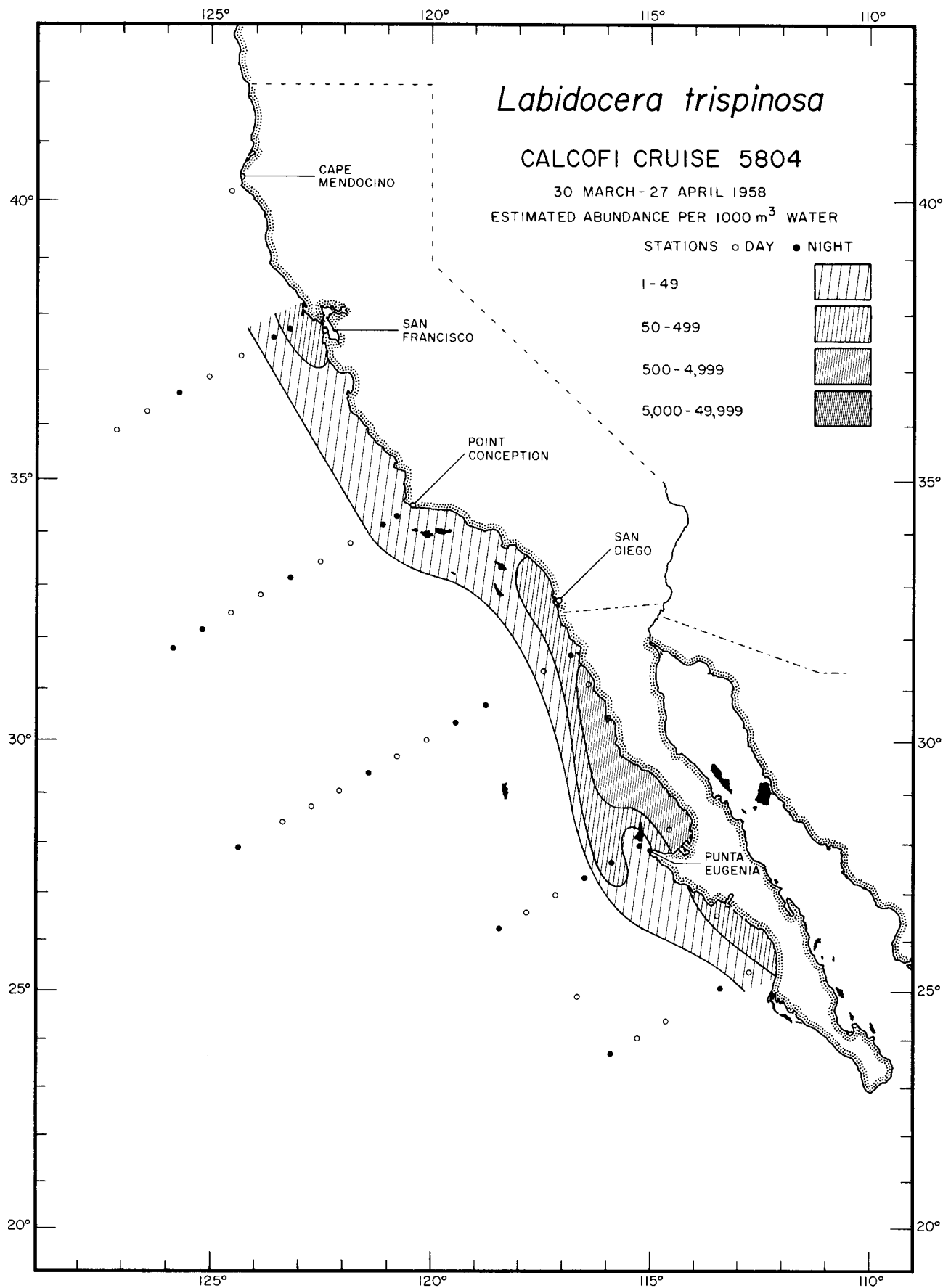
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Labidocera jollae

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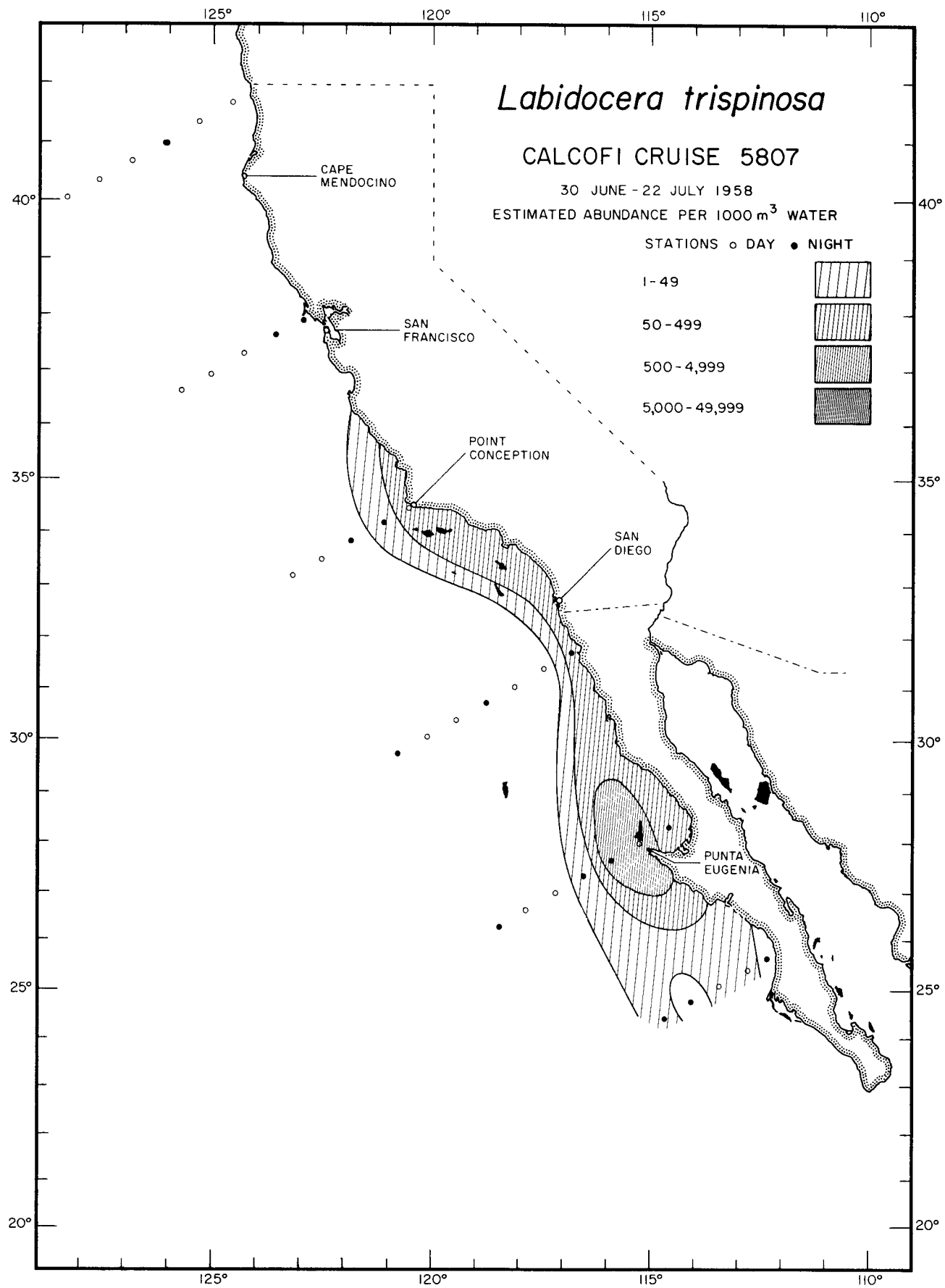
Calanoida
Labidocera jollae
5901



Calanoida

Labidocera trispinosa

5804



Labidocera trispinosa

CALCOFI CRUISE 5807

30 JUNE - 22 JULY 1958

ESTIMATED ABUNDANCE PER 1000 m³ WATER

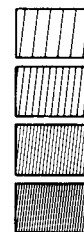
STATIONS ○ DAY ● NIGHT

1-49

50-499

500-4,999

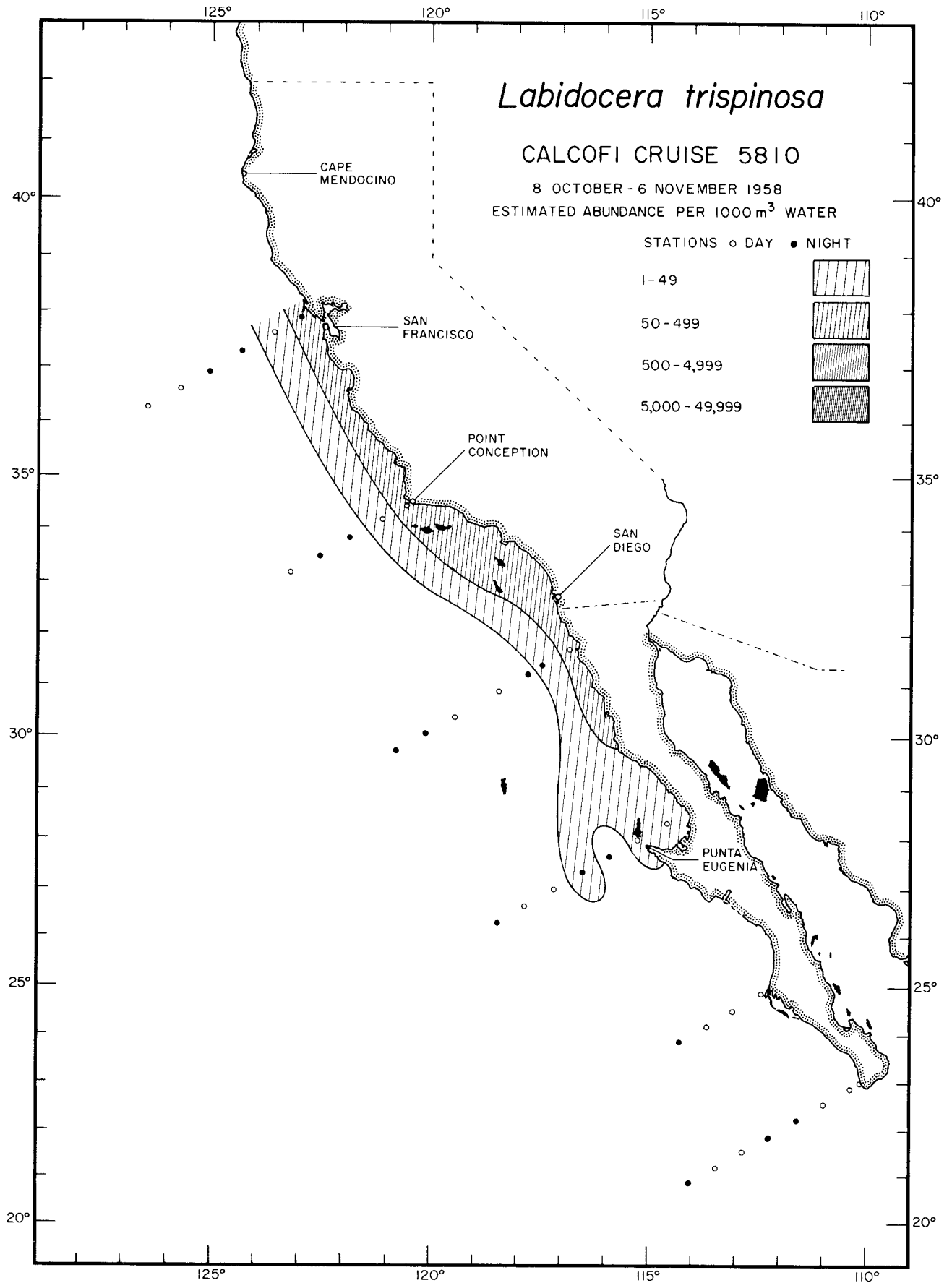
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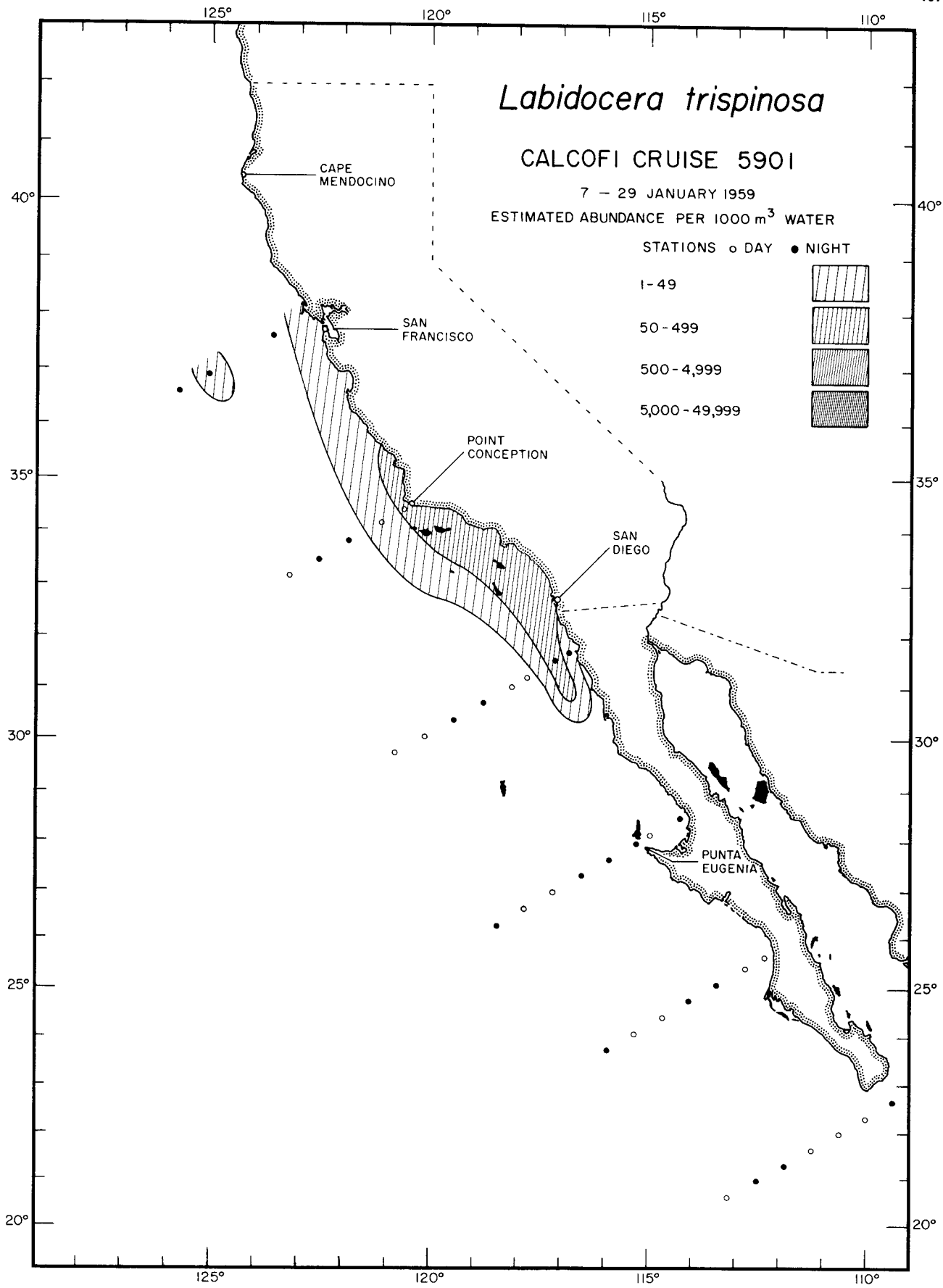
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Labidocera trispinosa

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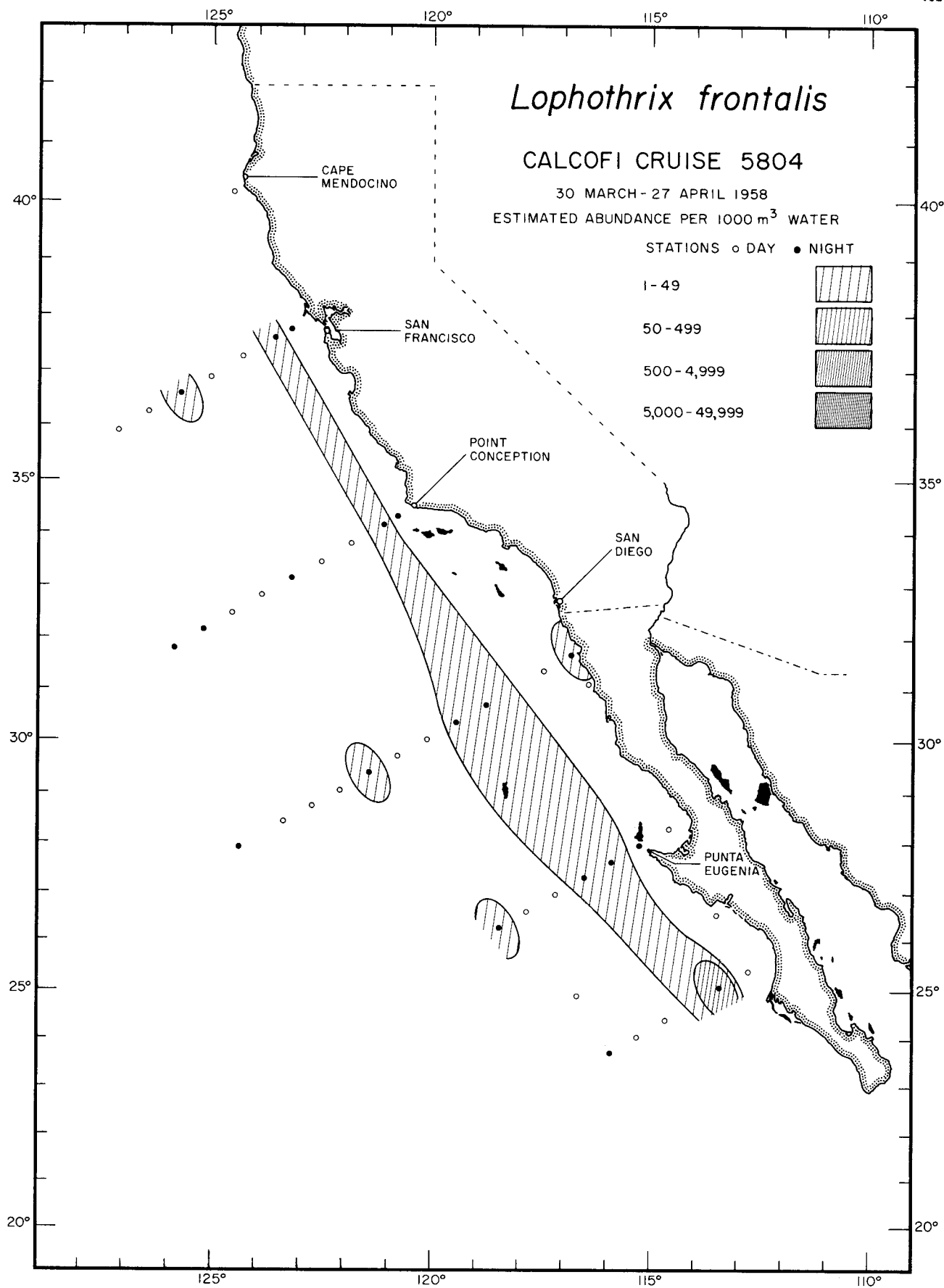
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Labidocera trispinosa
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Calanoida

Labidocera trispinosa

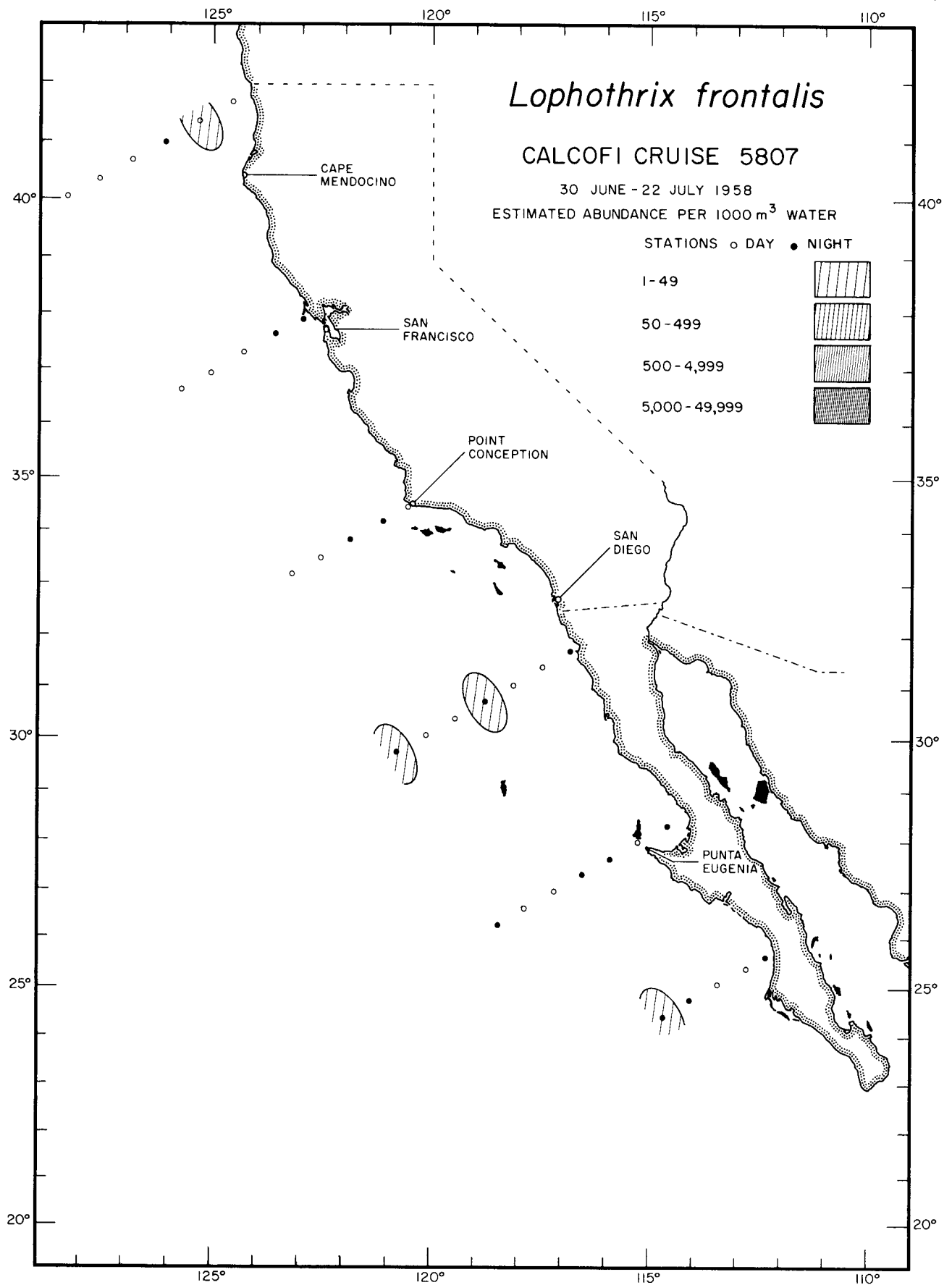
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Calanoida

Lophothrix frontalis

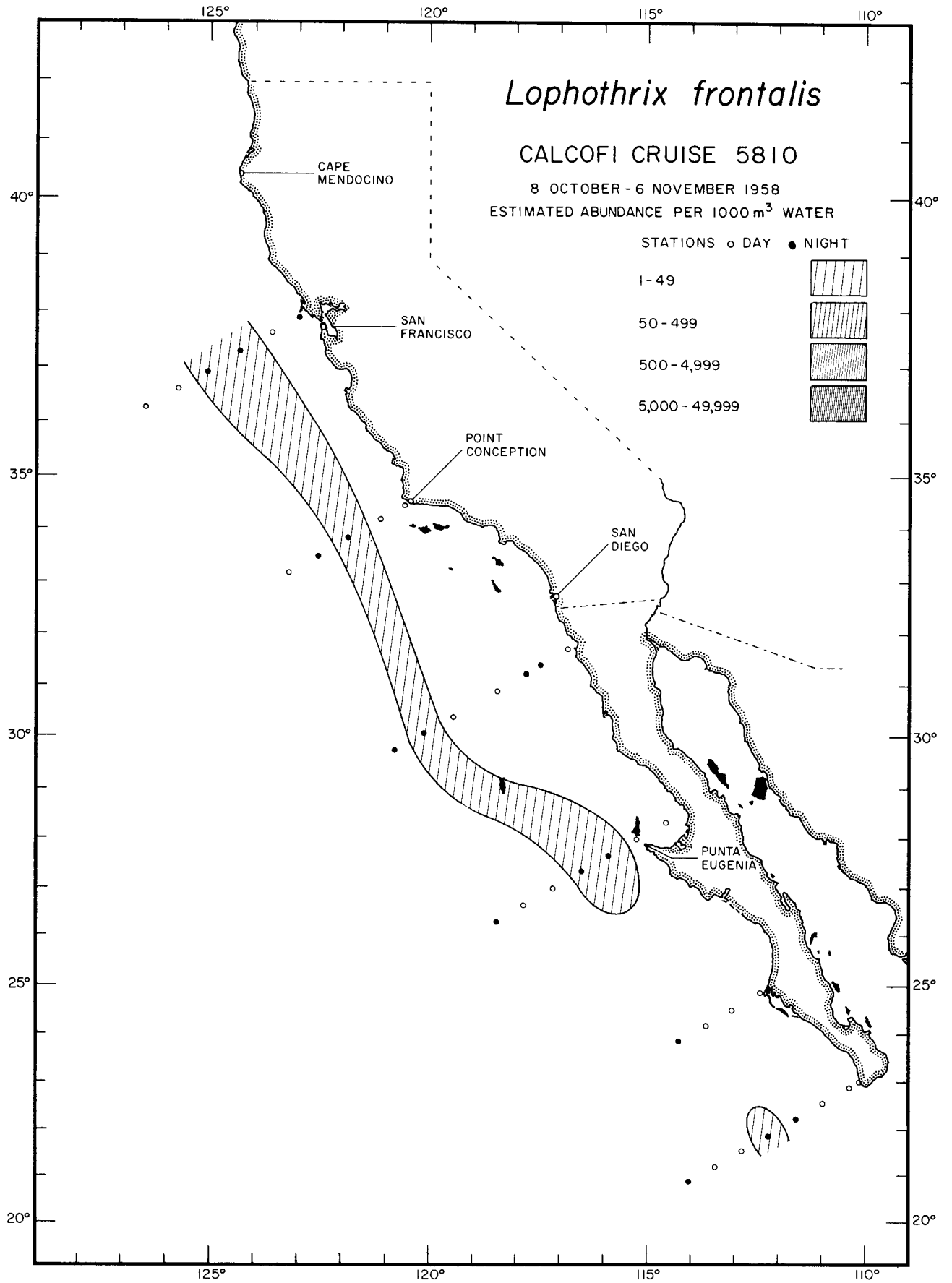
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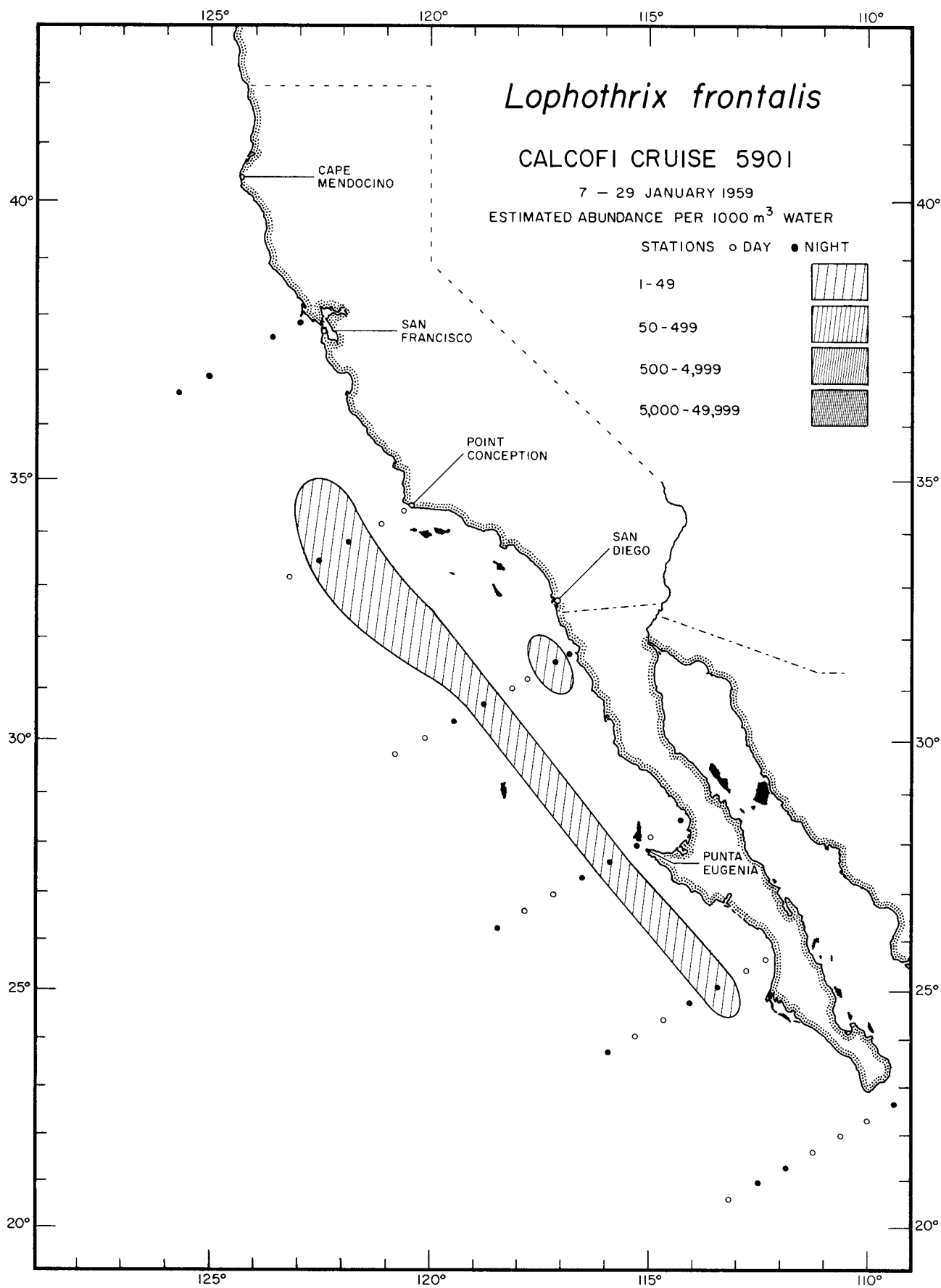
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Lophothrix frontalis

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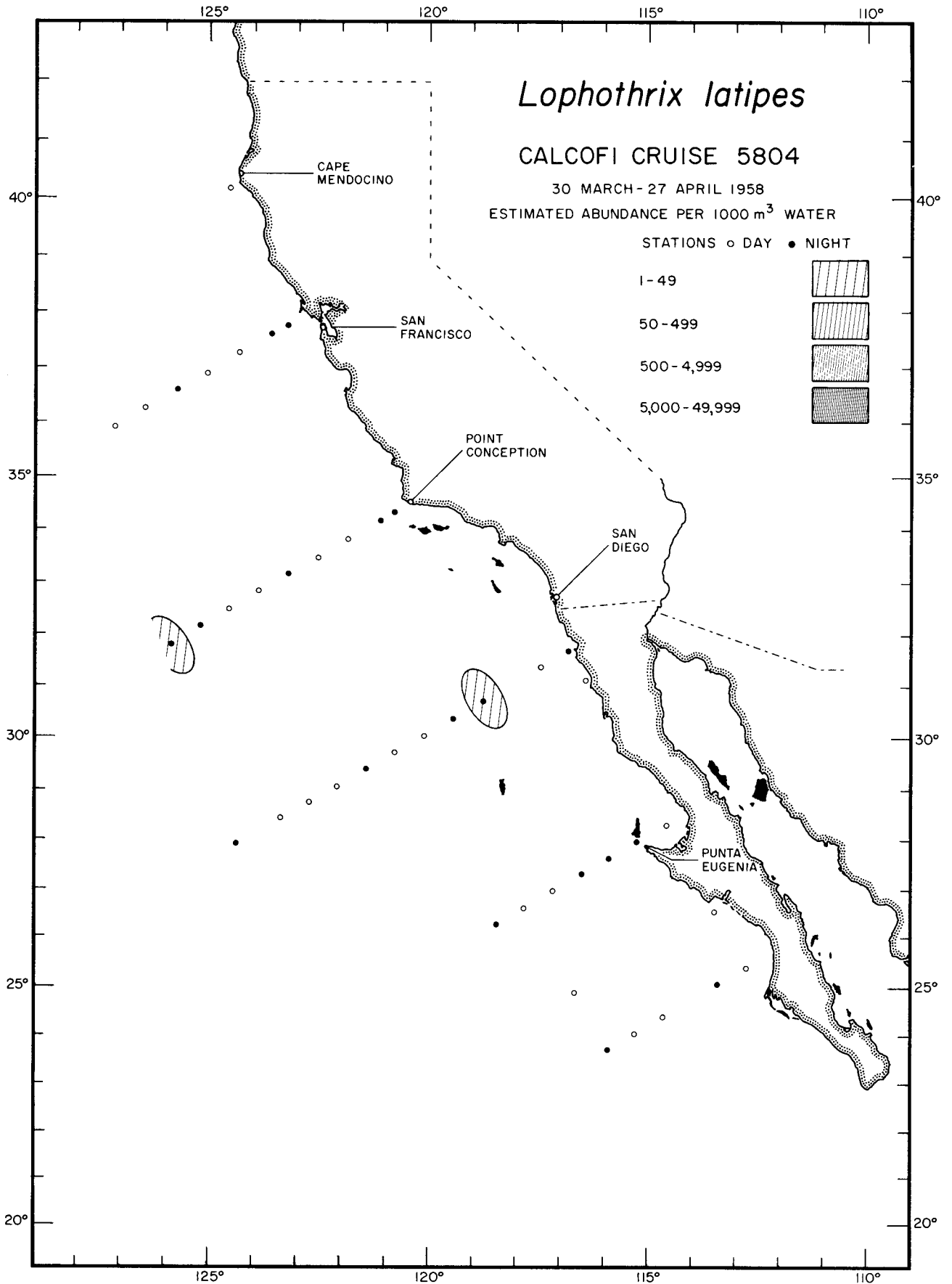
Calanoida
Lophothrix frontalis
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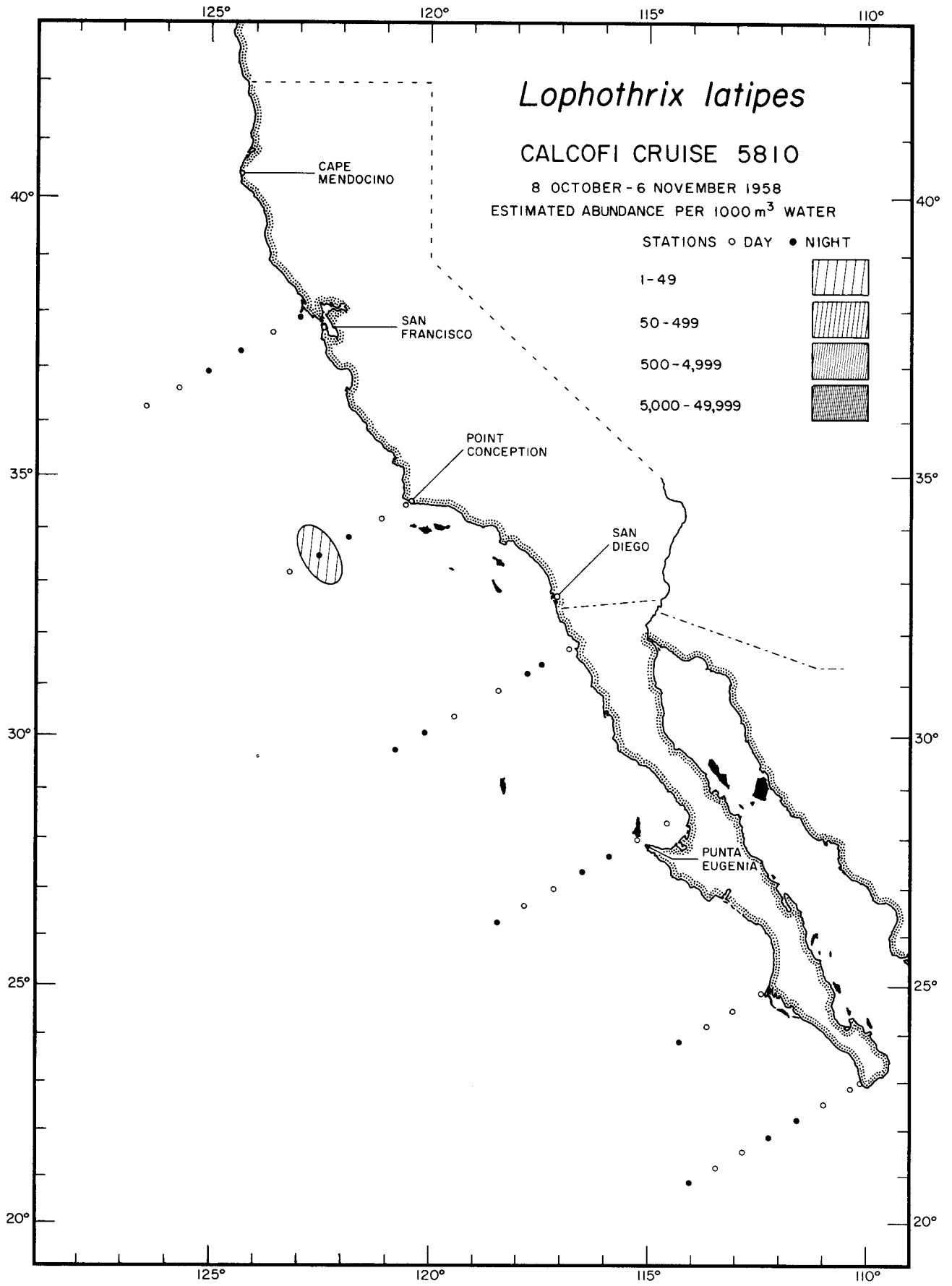
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Lophothrix frontalis

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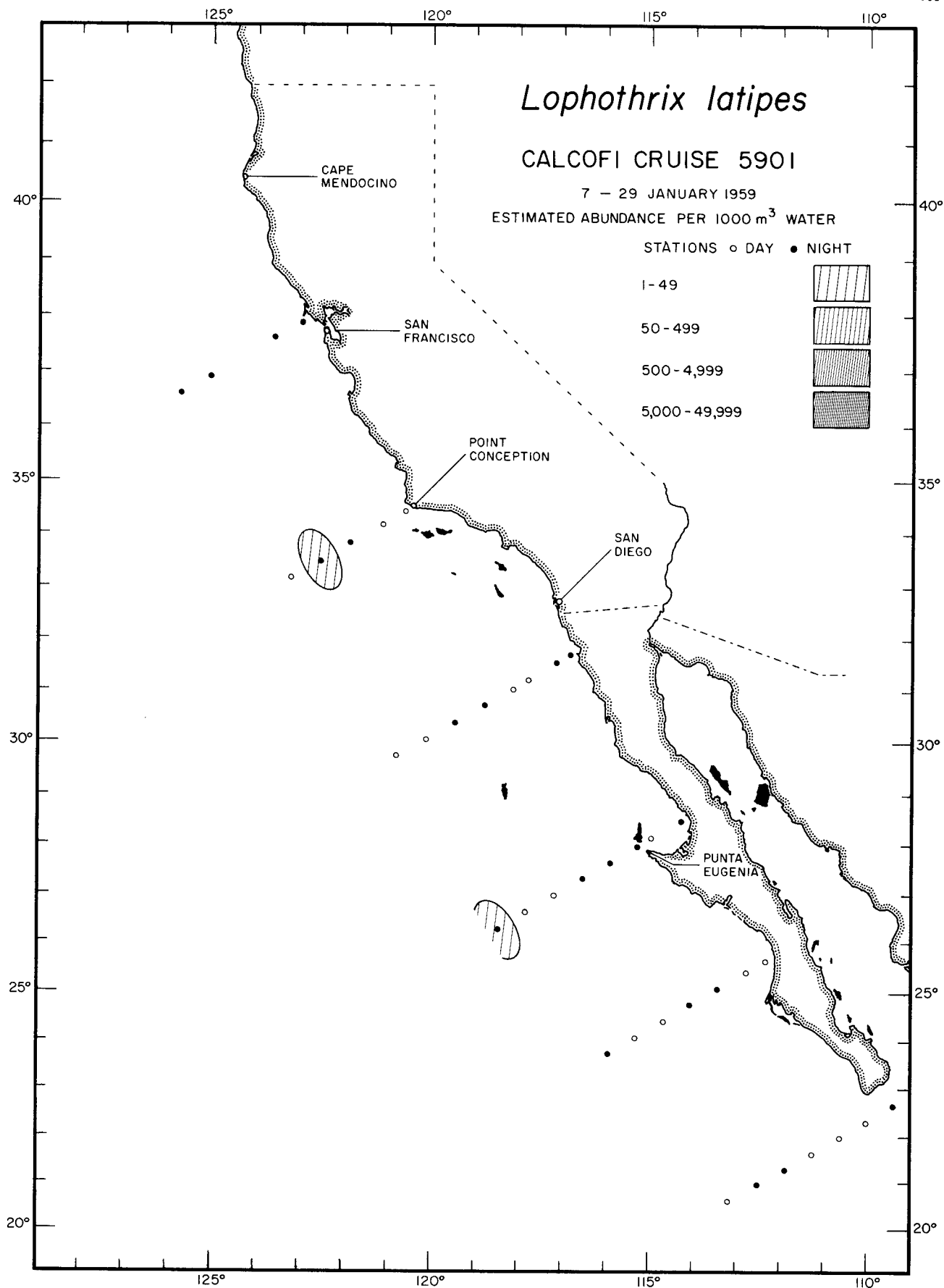
Calanoida
Lophothrix latipes
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Calanoida

Lophothrix latipes

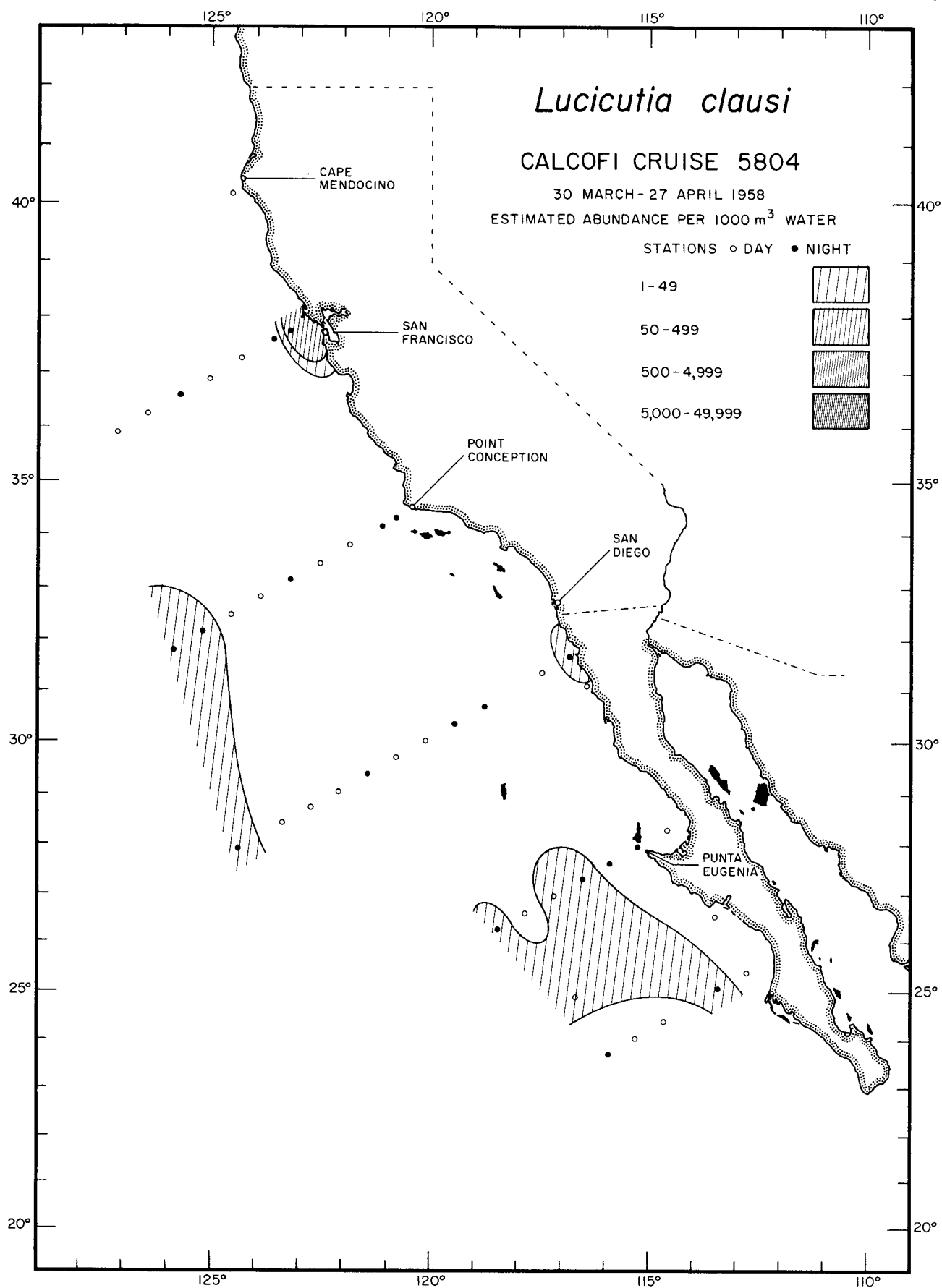
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Lophothrix latipes

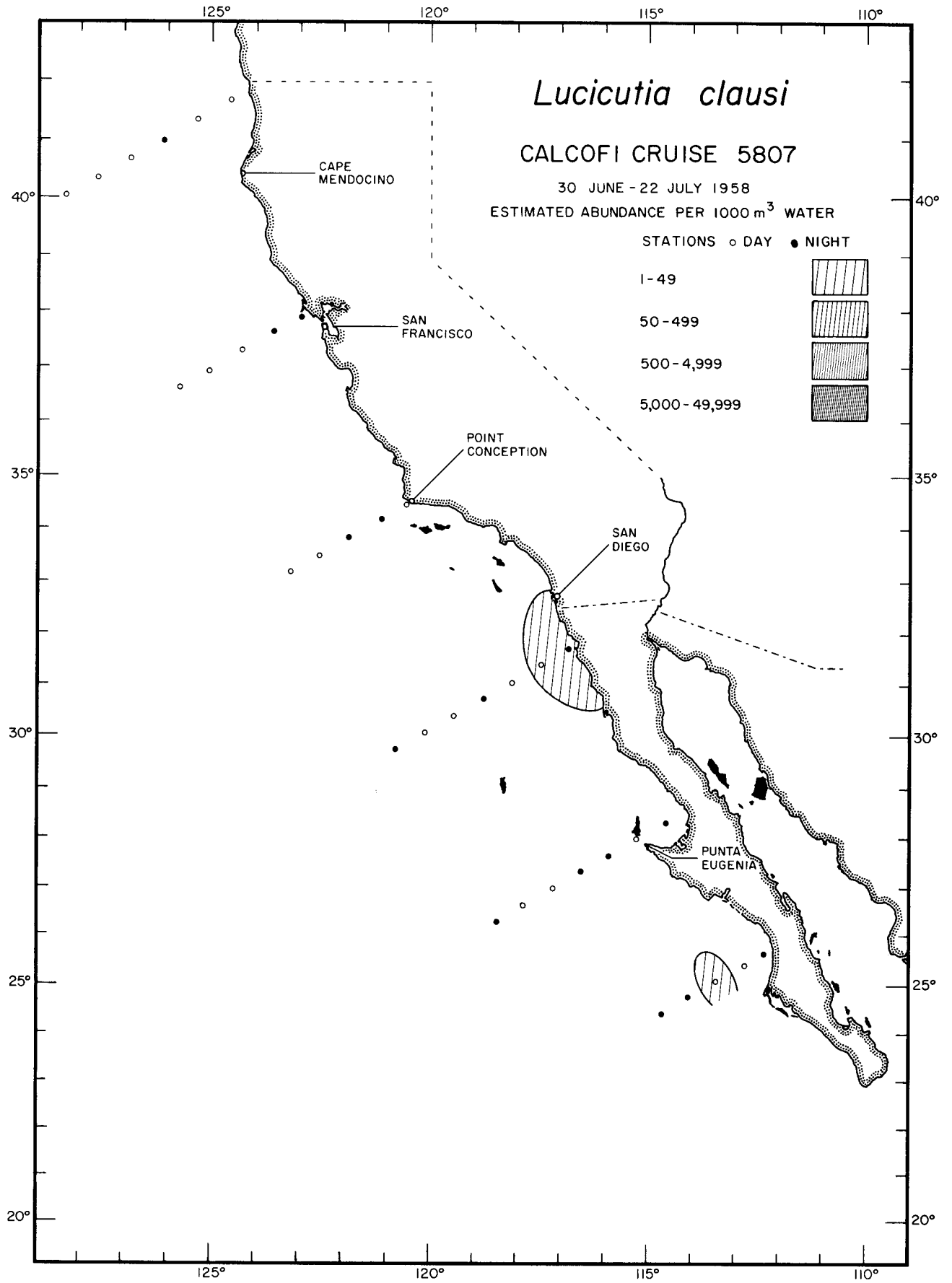
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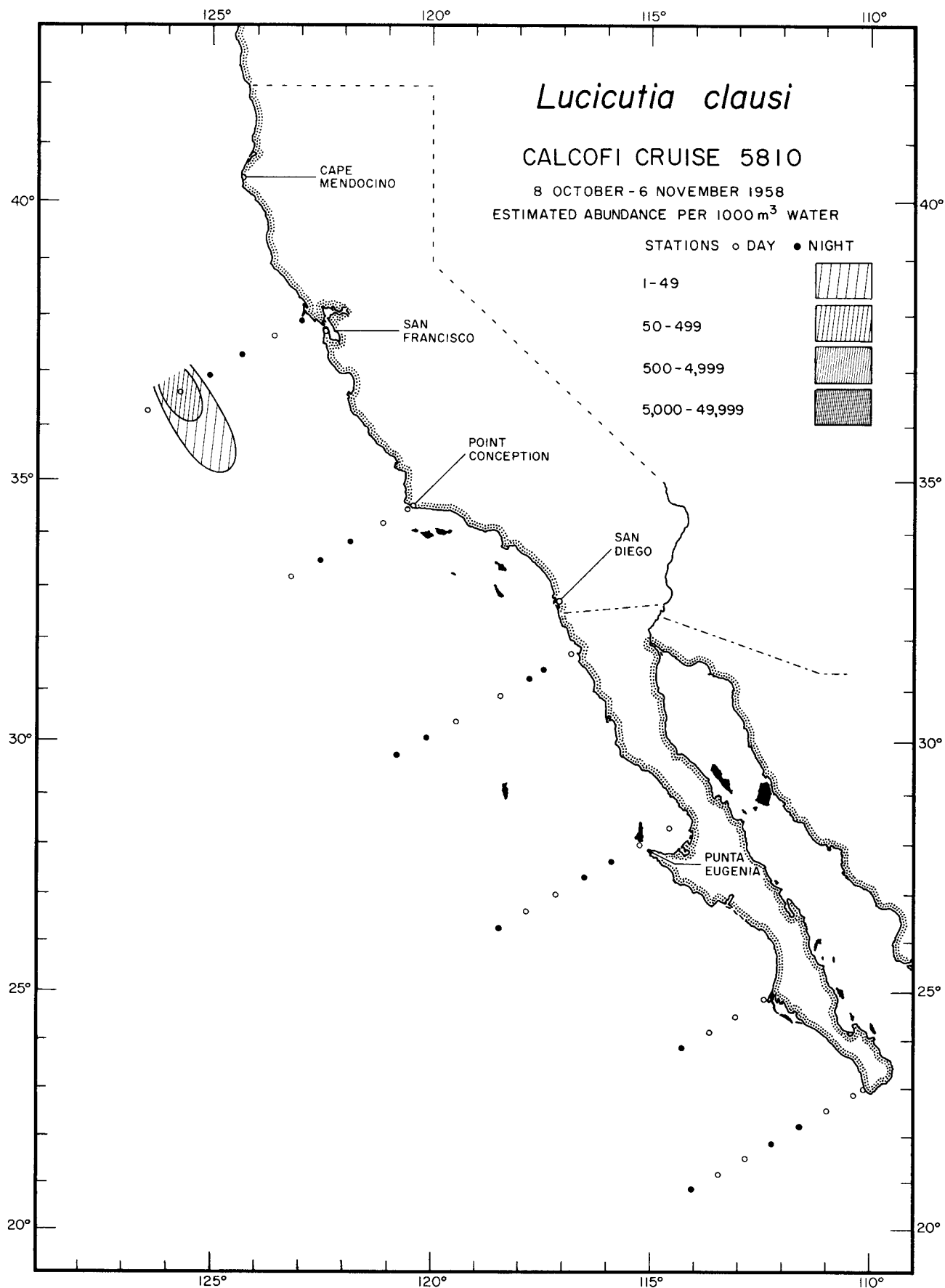
Calanoida

Lucicutia clausi

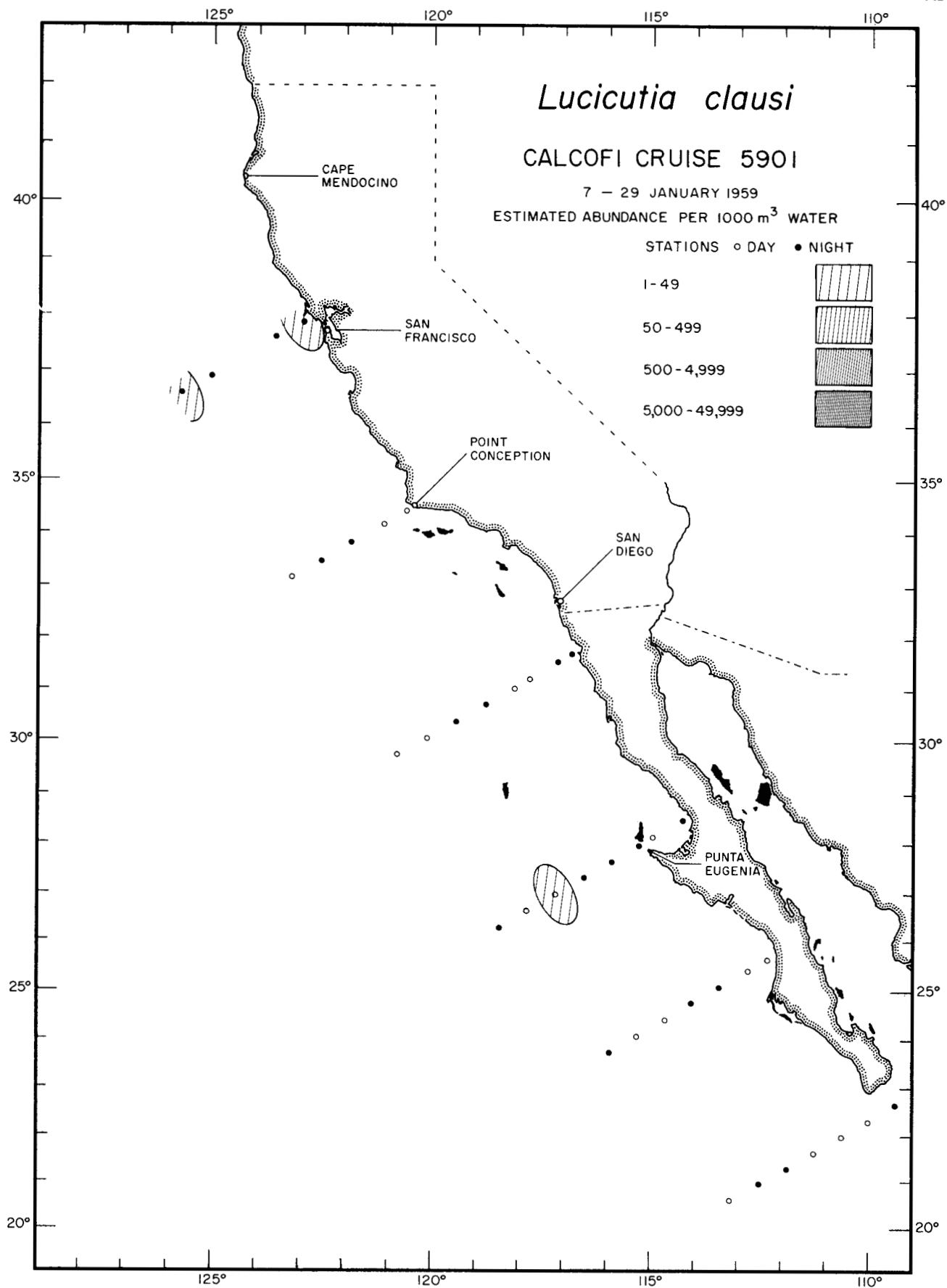
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Calanoida
Lucicutia clausi
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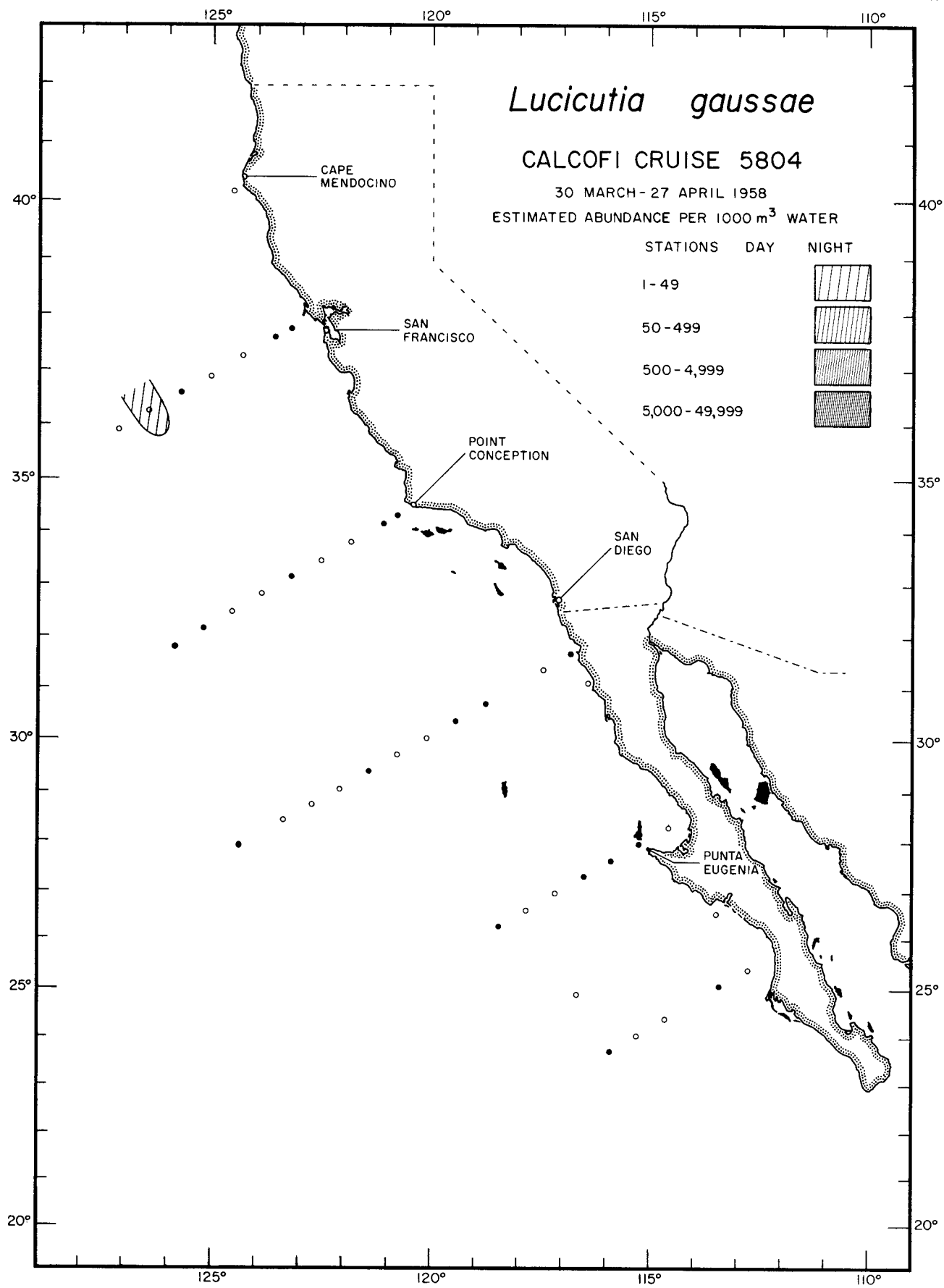
Calanoida
Lucicutia clausi
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Calanoida

Lucicutia clausi

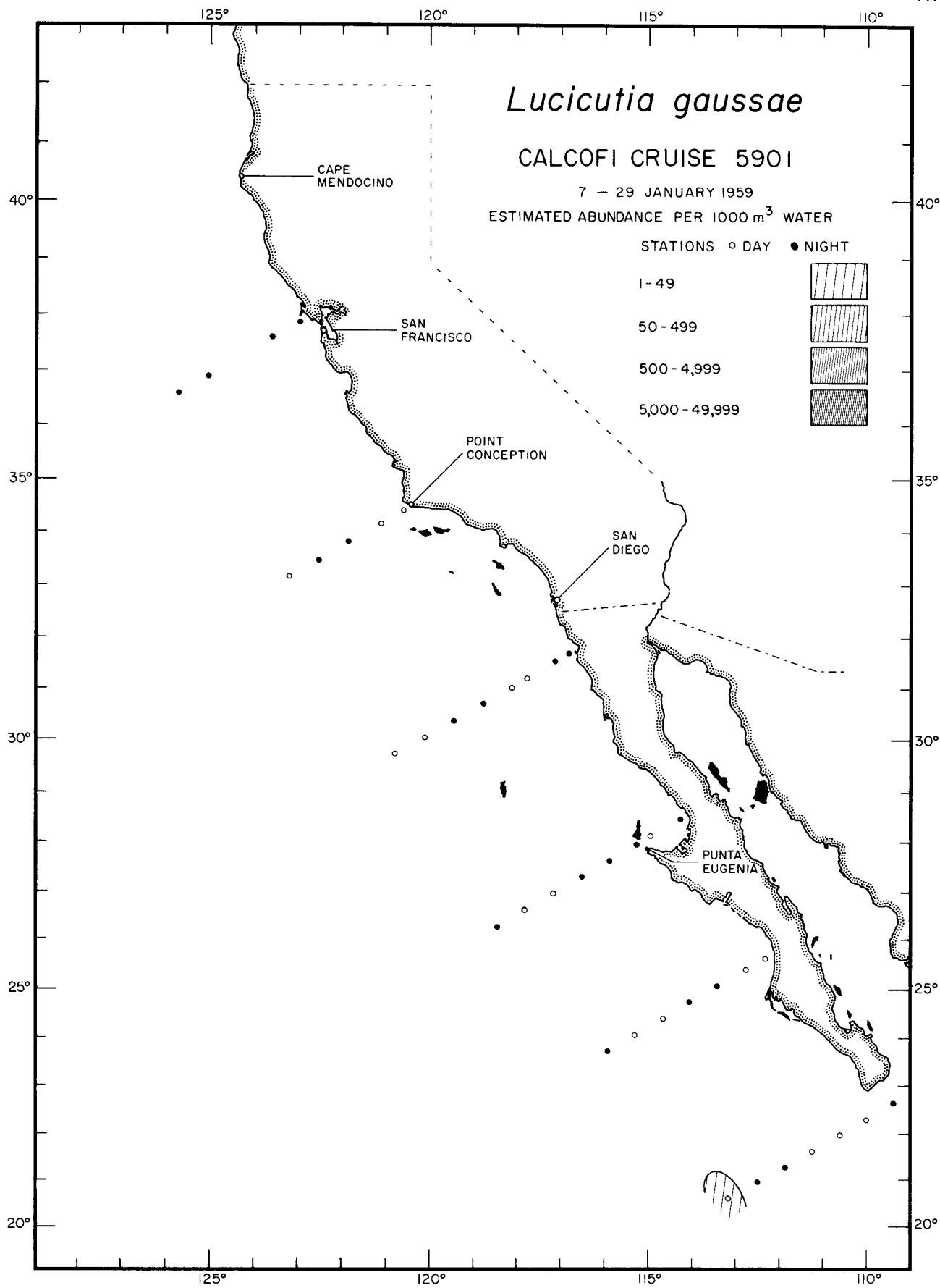
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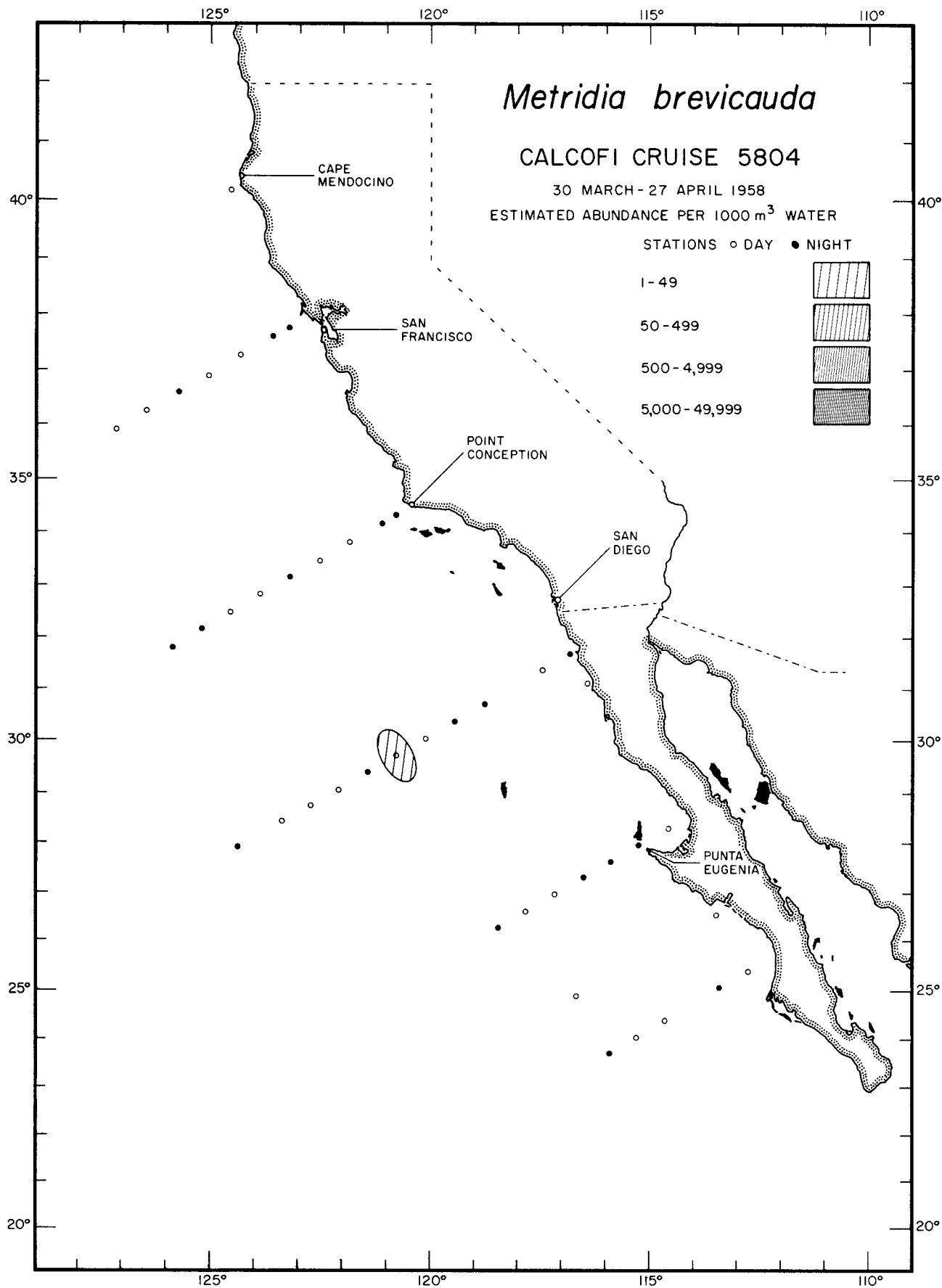
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Lucicutia gaussae

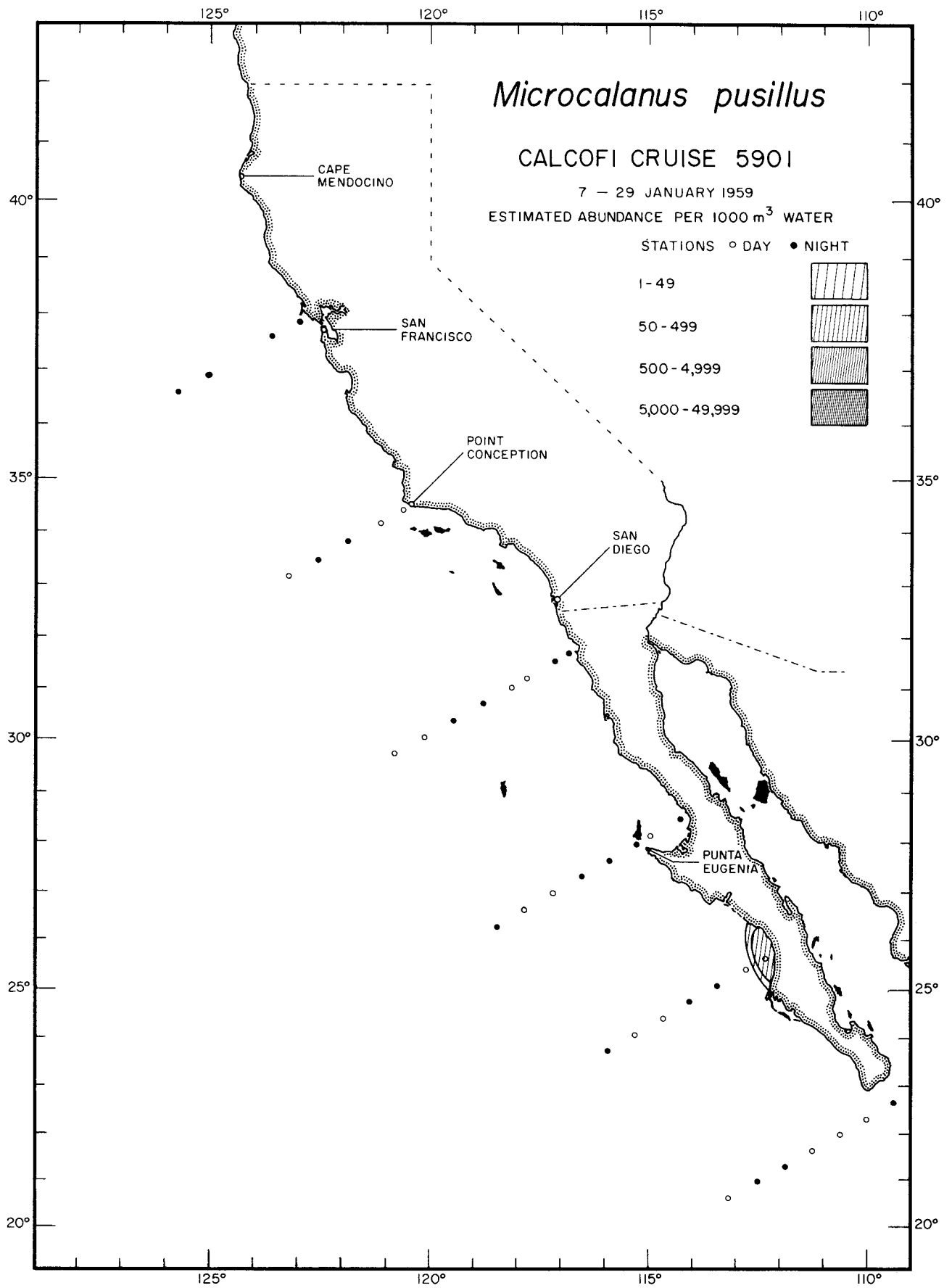
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Calanoida
Lucicutia gaussea
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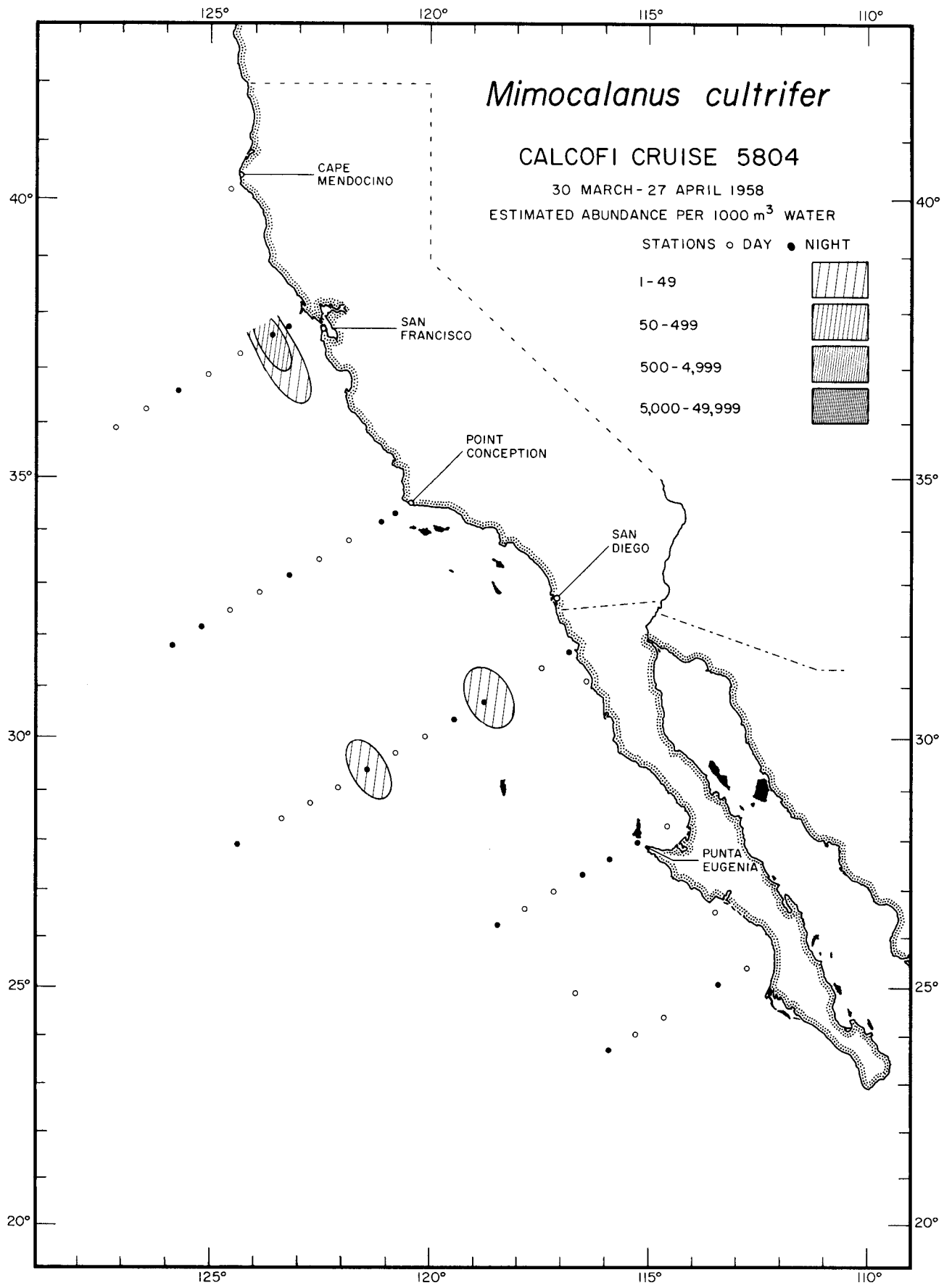
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Metridia brevicauda
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Calanoida

Microcalanus pusillus

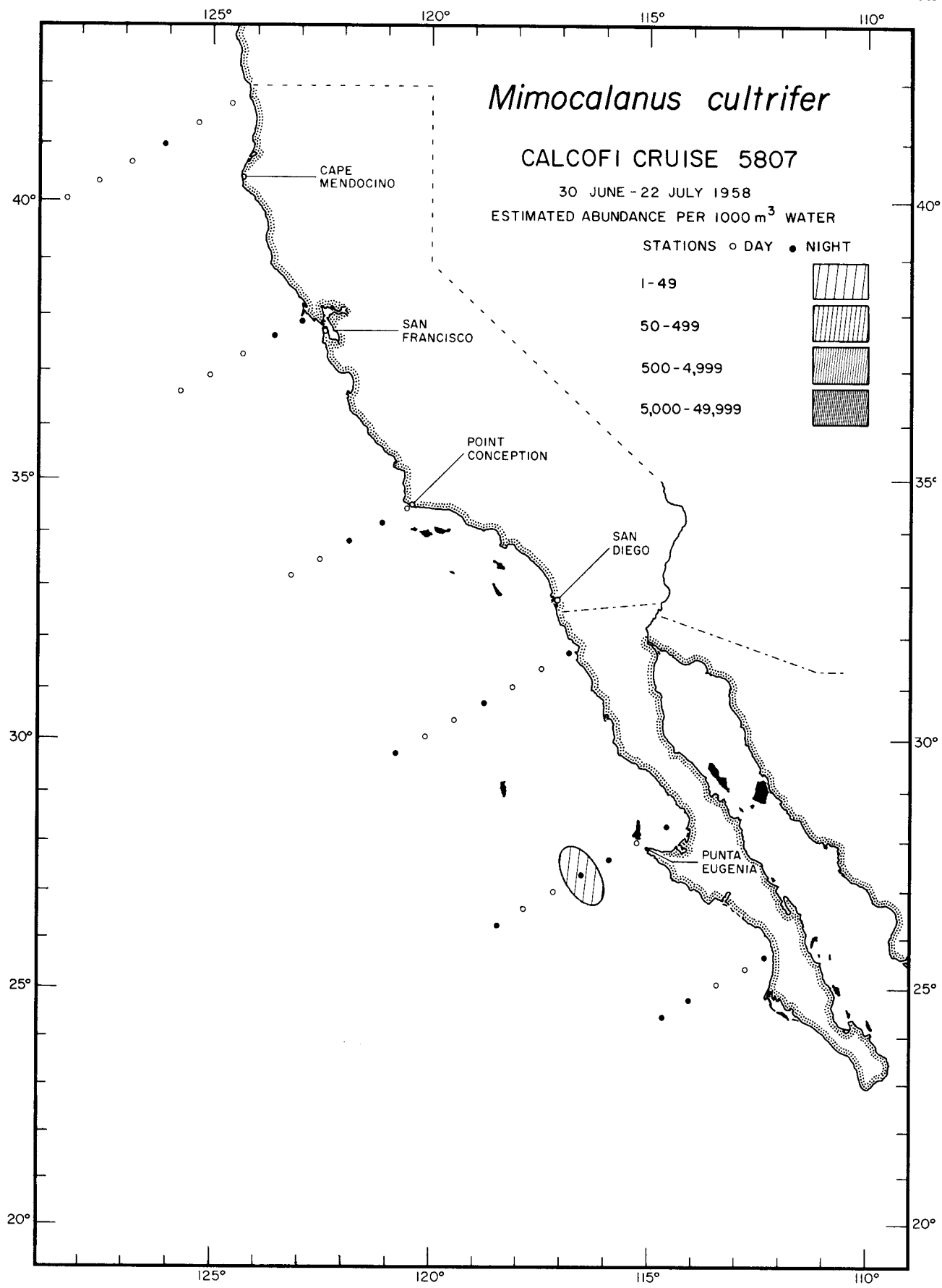
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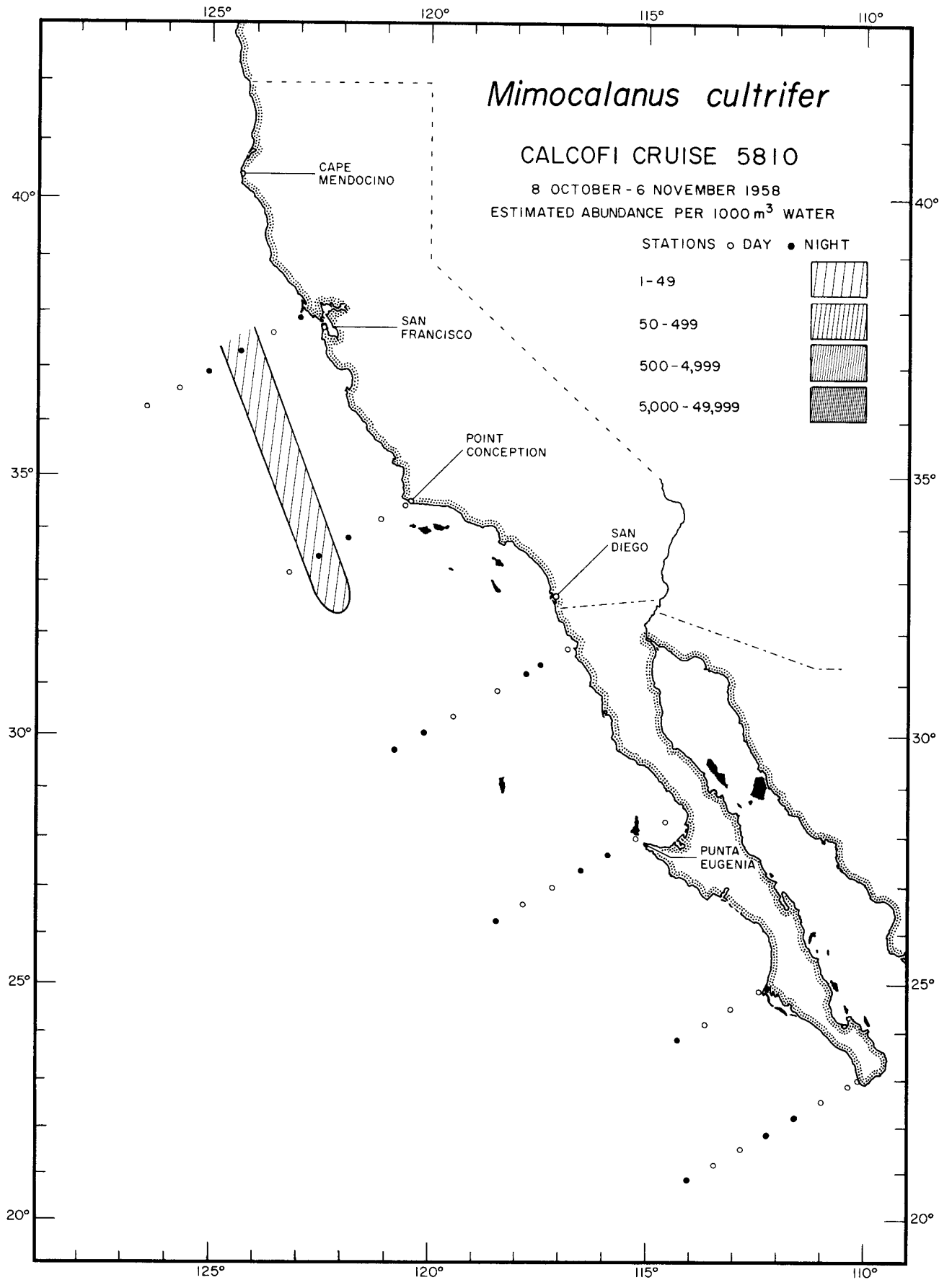
Calanoida

Mimocalanus cultrifer

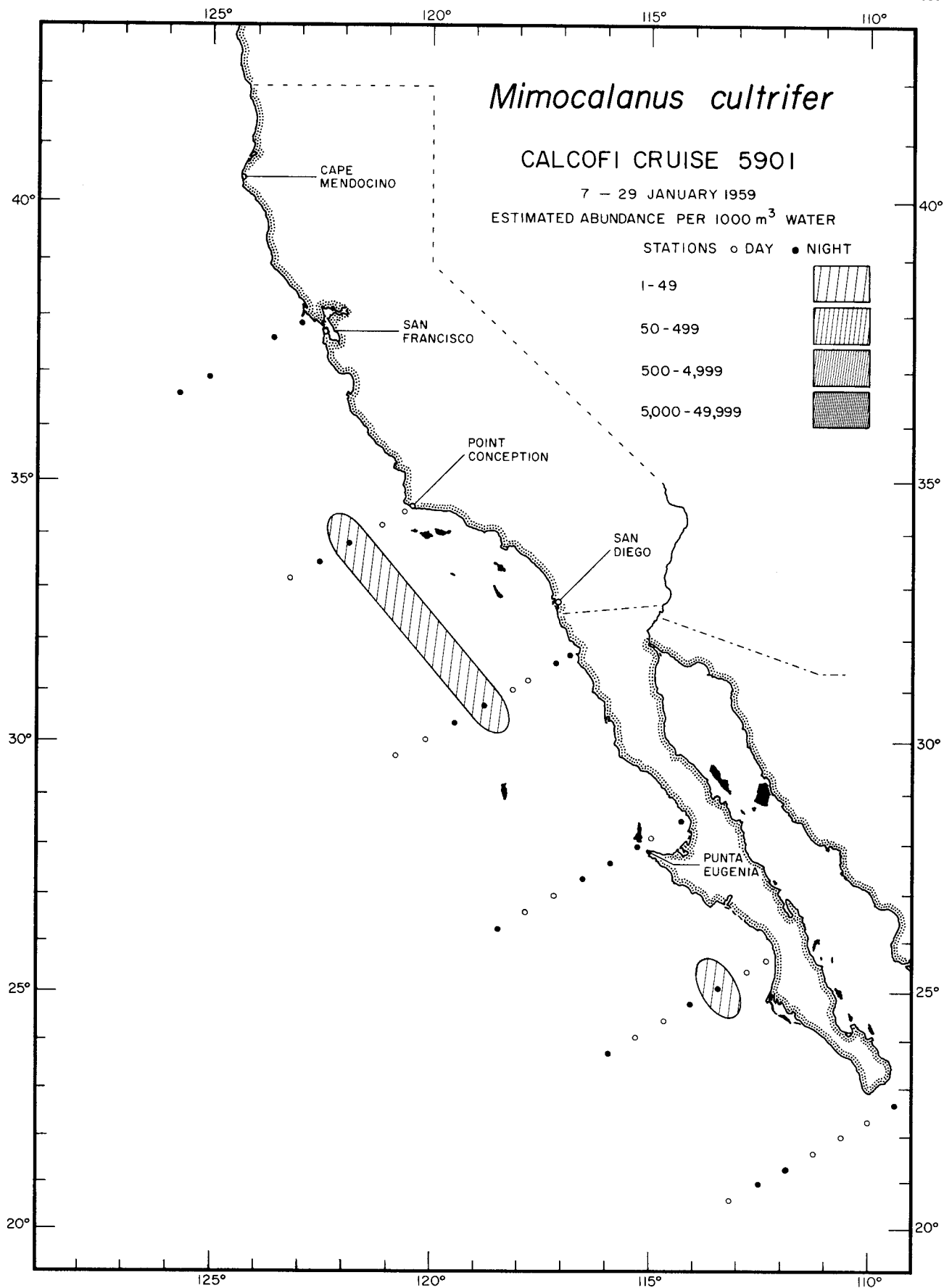
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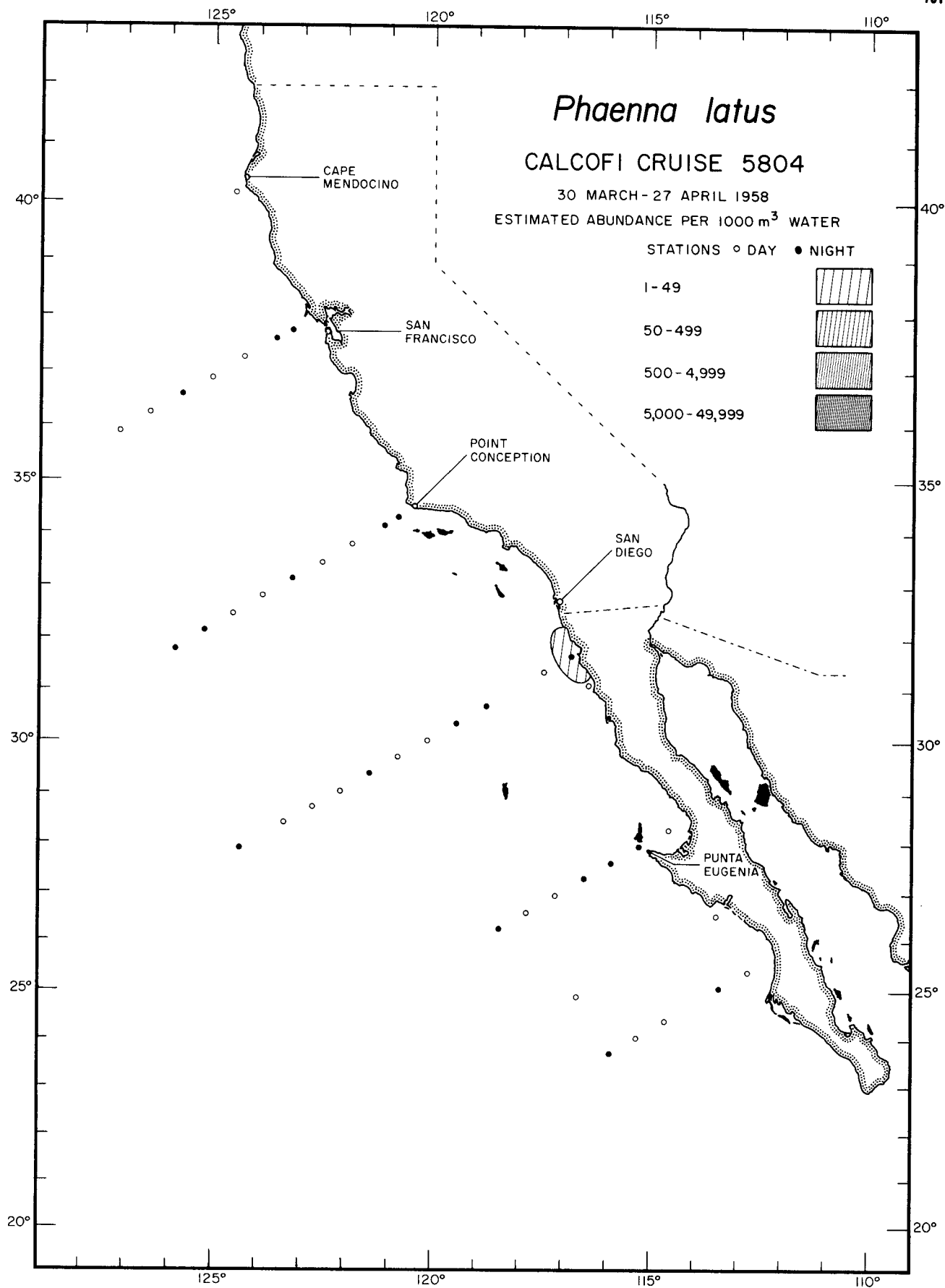
Calanoida
Mimocalanus cultrifer
5807



Calanoida
Mimocalanus cultrifer
 5810

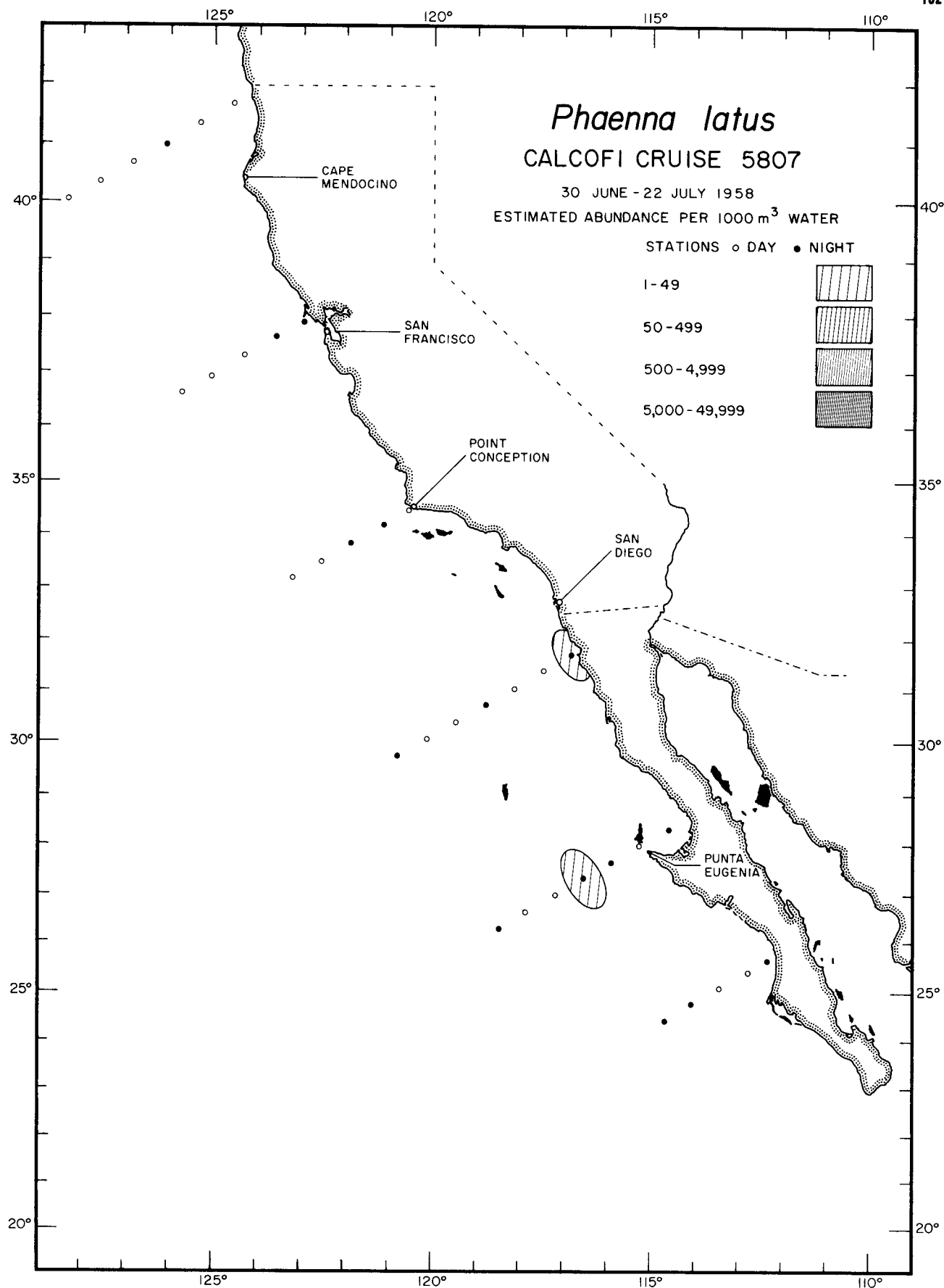


Calanoida
Mimocalanus cultrifer
5901



Calanoida

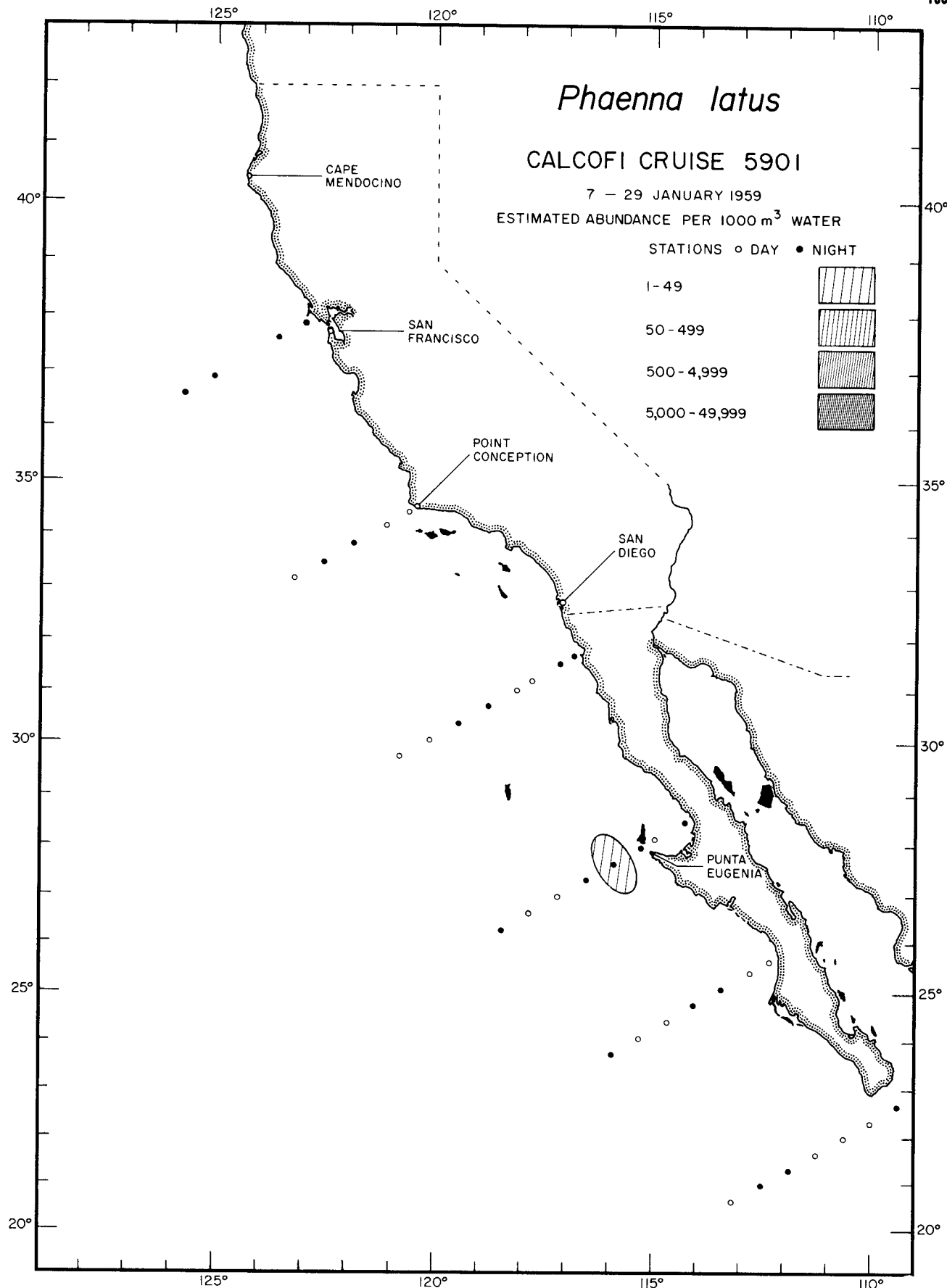
Phaenna latus
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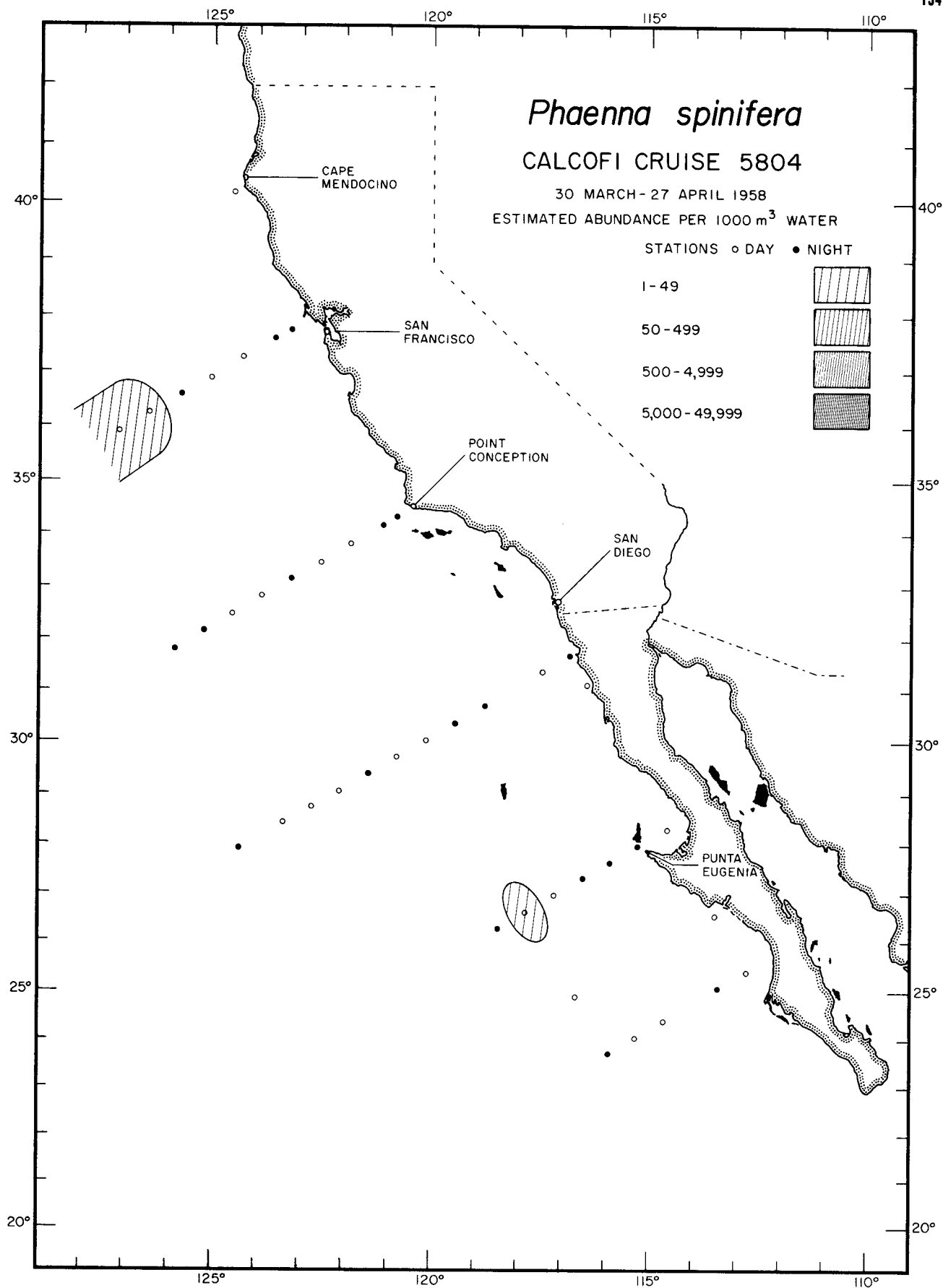
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Phaenna latus

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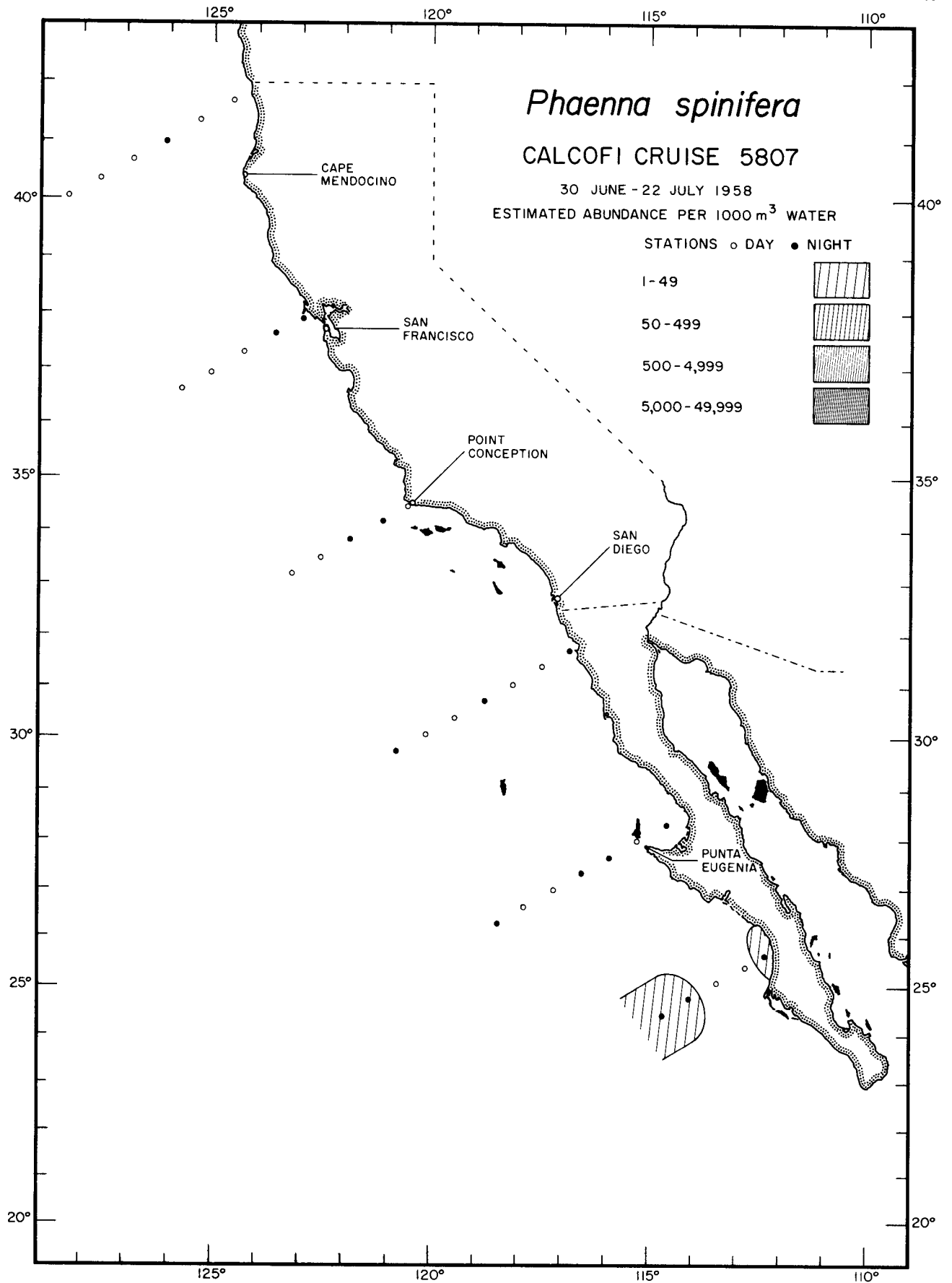
Calanoida
Phaenna latus
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Calanoida

Phaenna spinifera

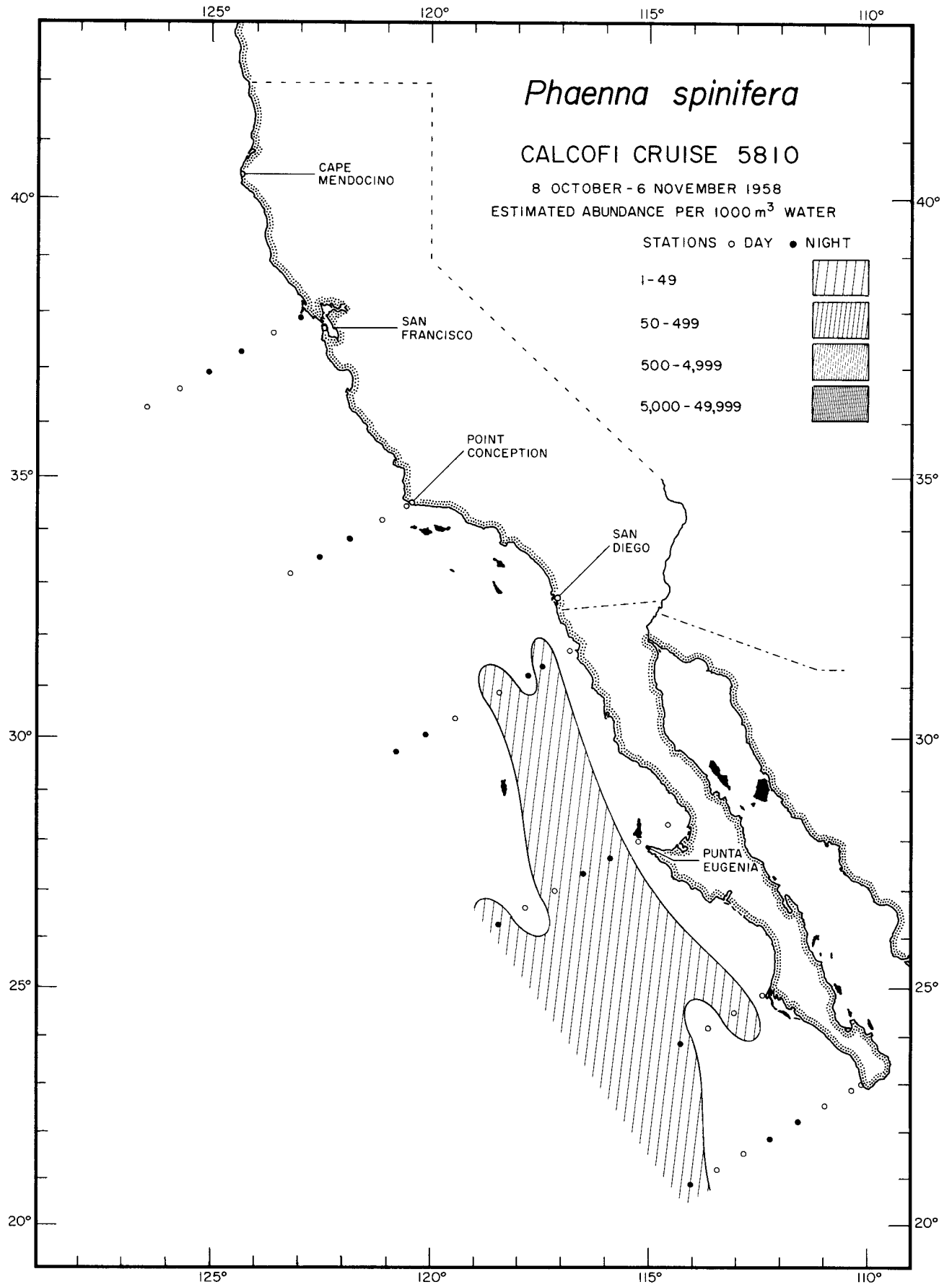
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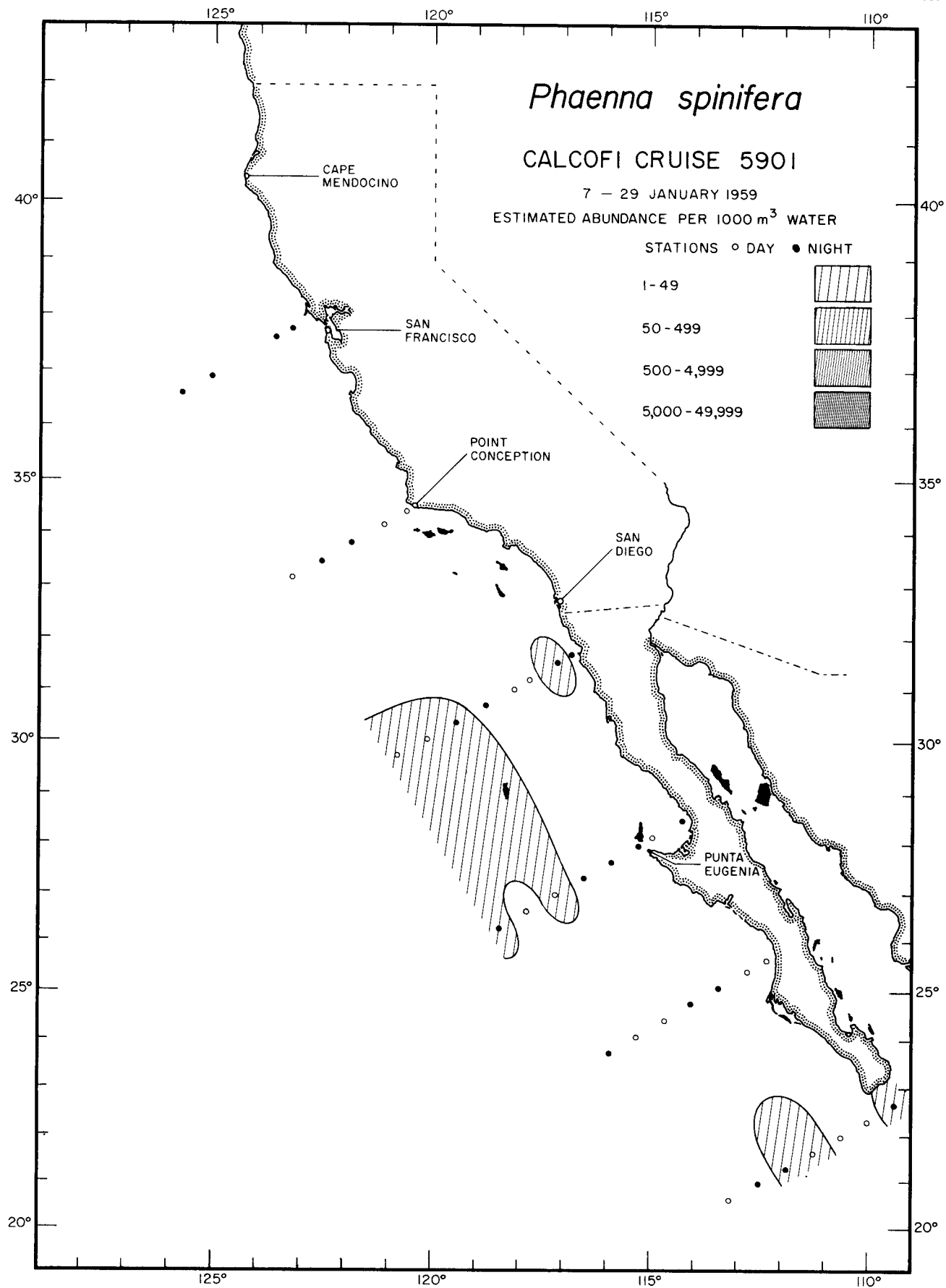
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Phaenna spinifera

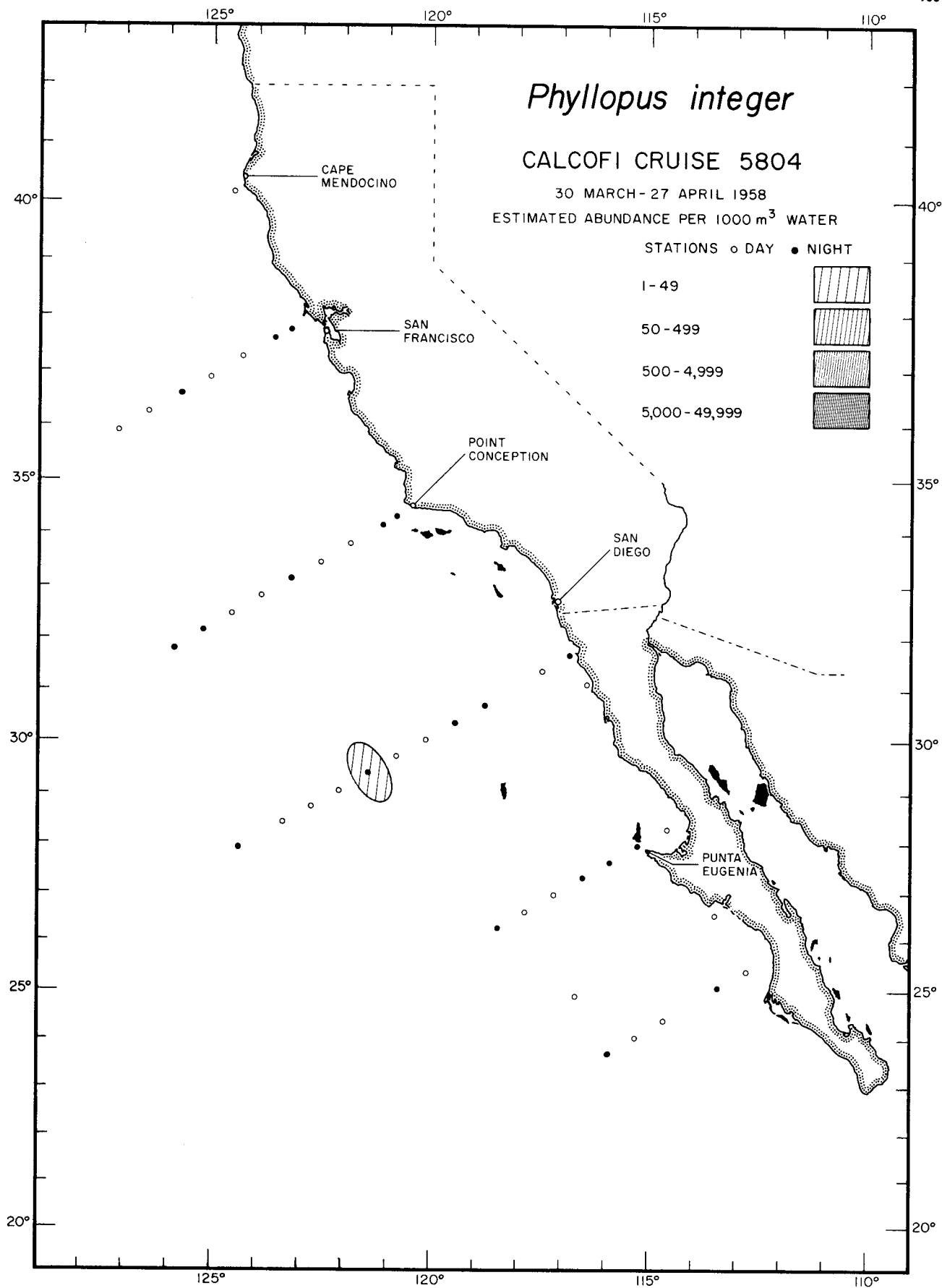
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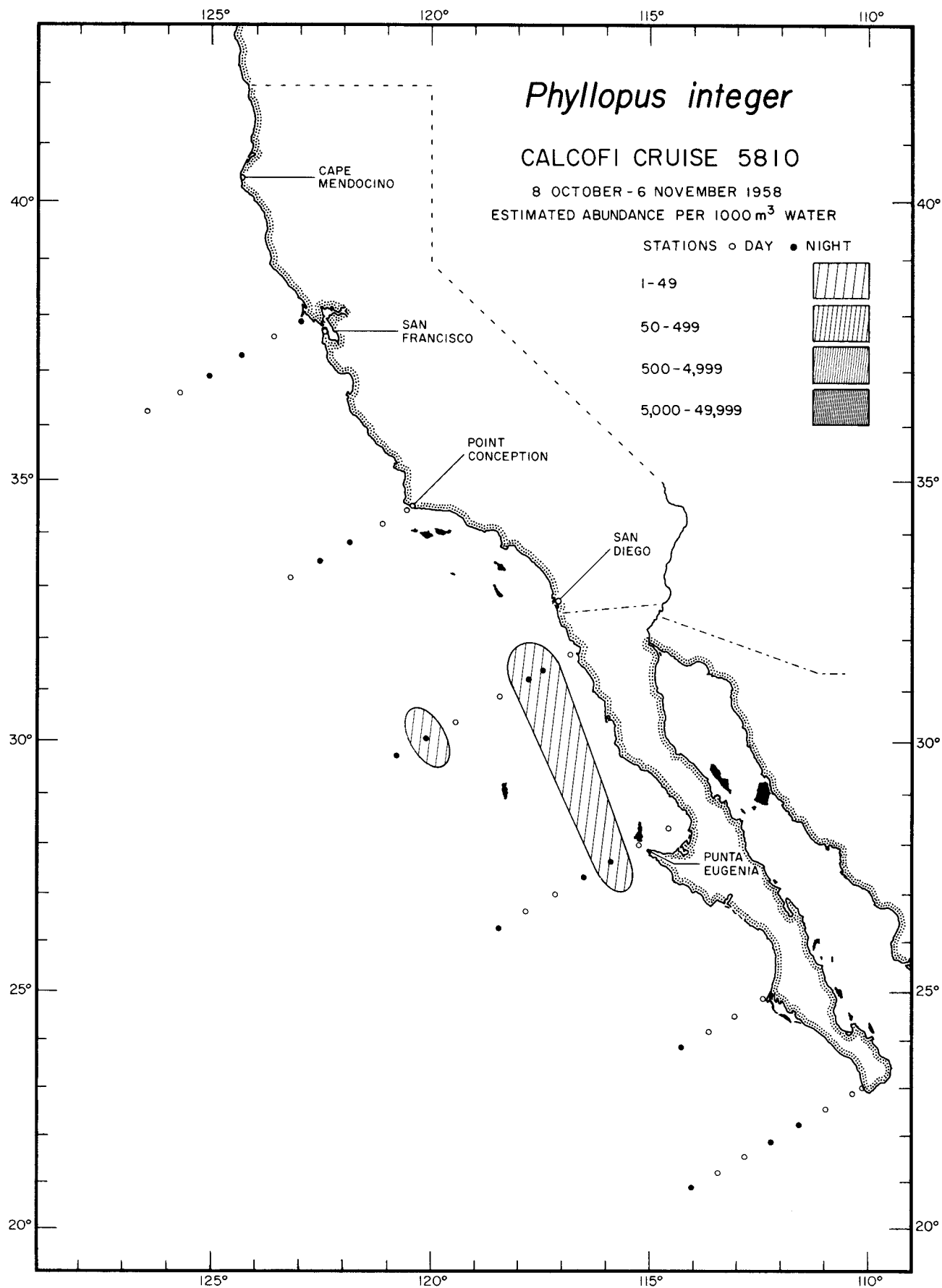
Calanoida
Phaenna spinifera
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Calanoida
Phaenna spinifera
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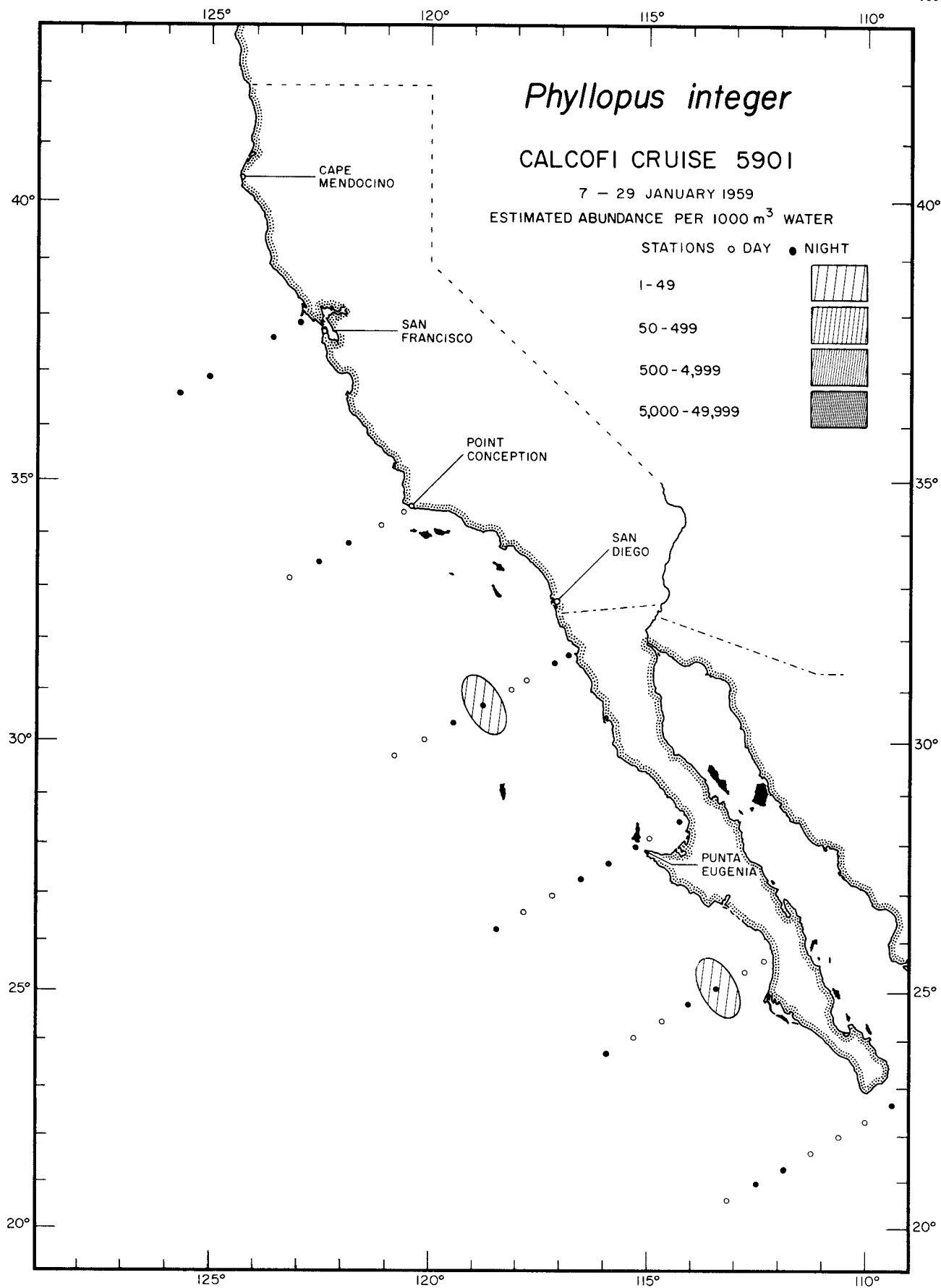
Calanoida
Phyllopus integer
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Calanoida

Phyllopus integer

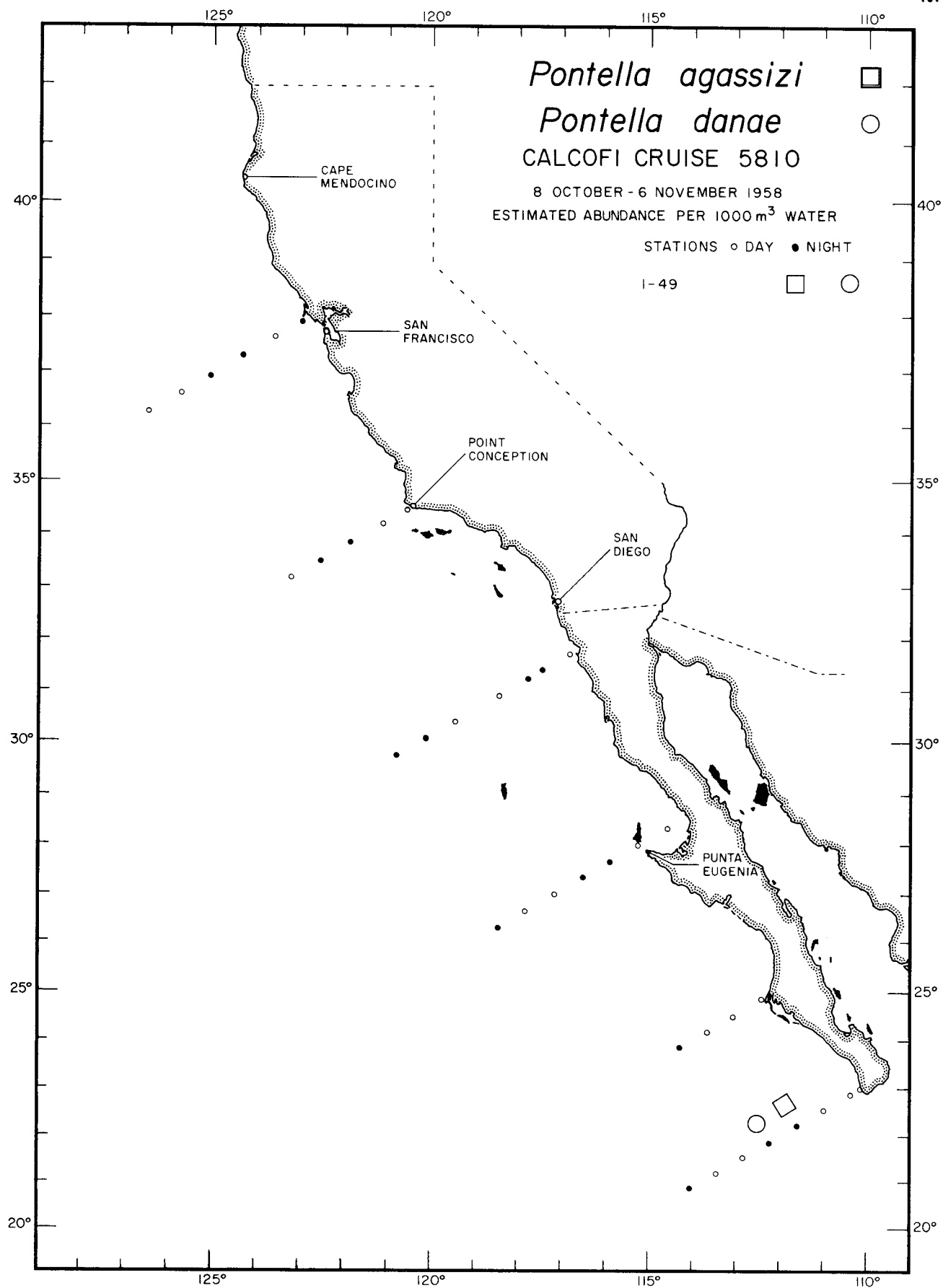
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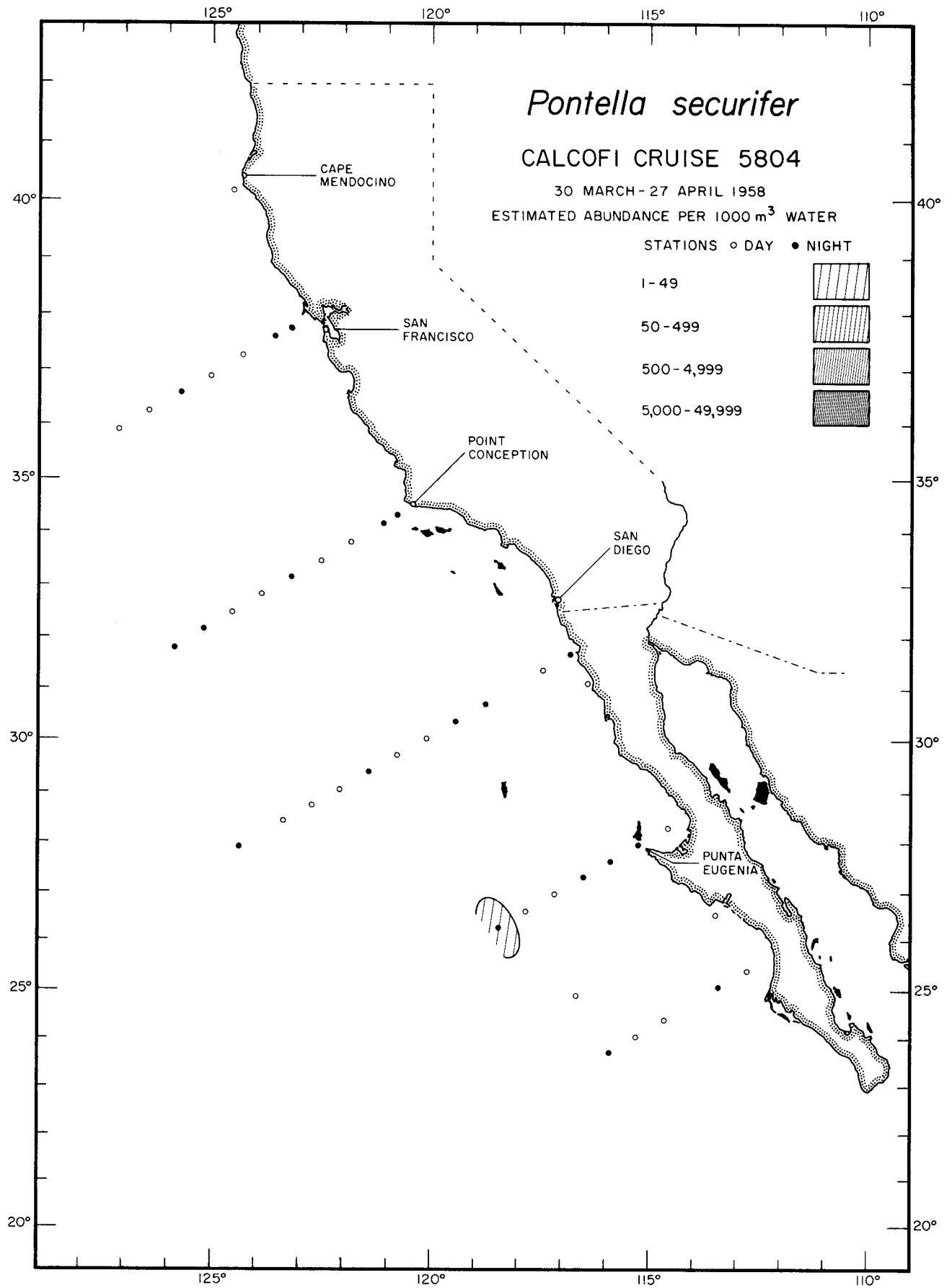
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Phyllopus integer

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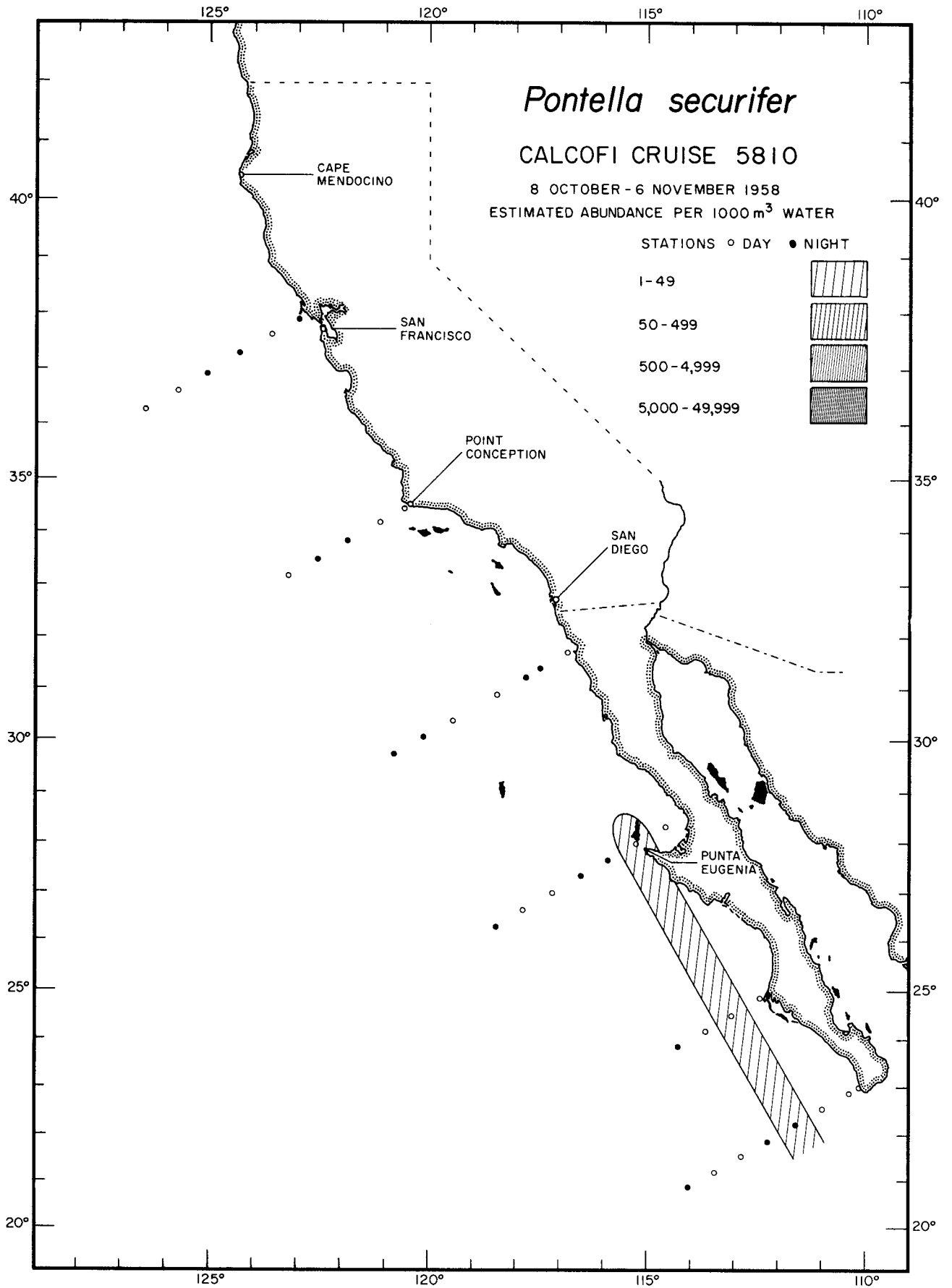
Calanoida
Pontella agassizi
Pontella danae
 5810



Calanoida

Pontella securifer

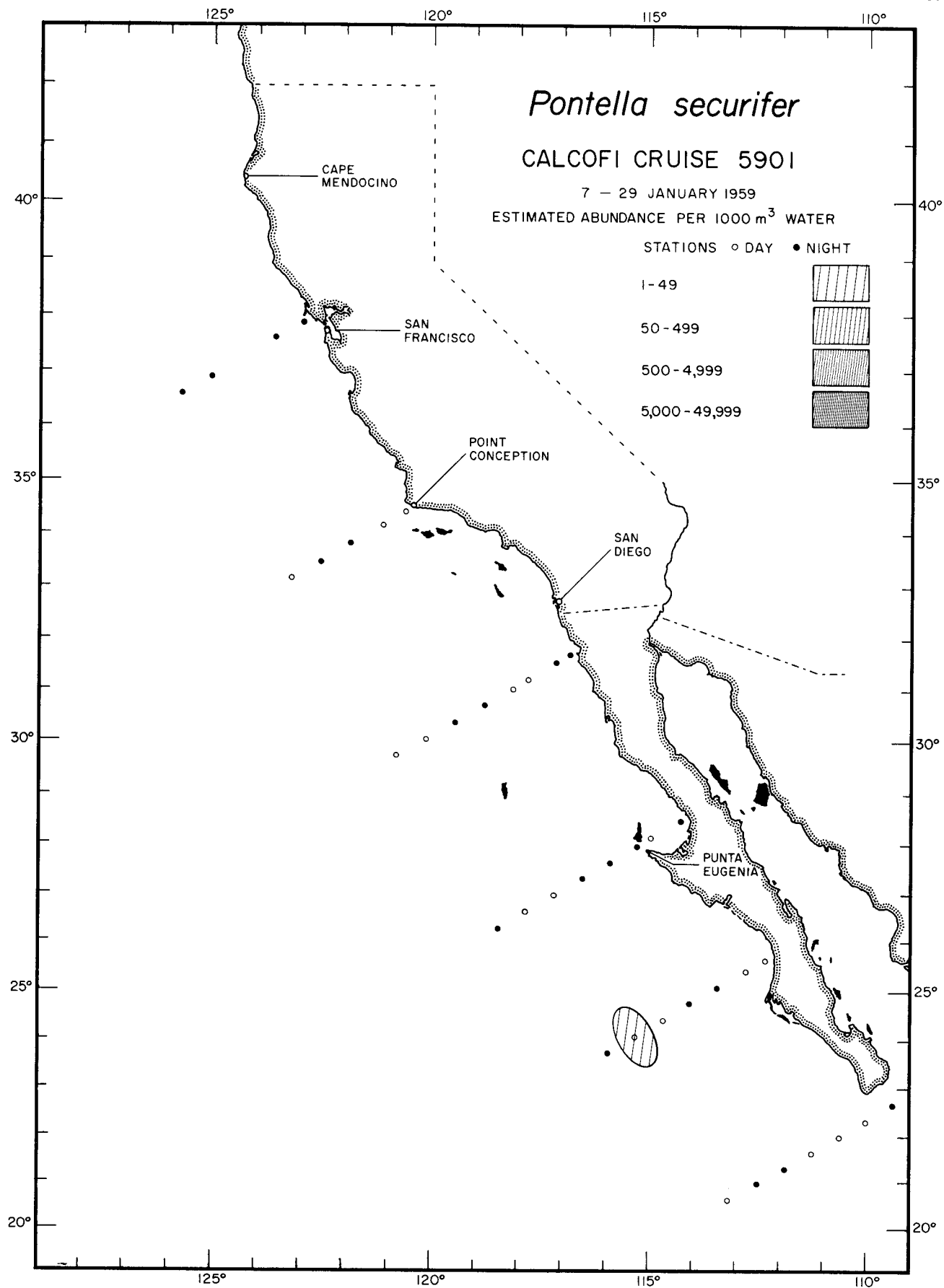
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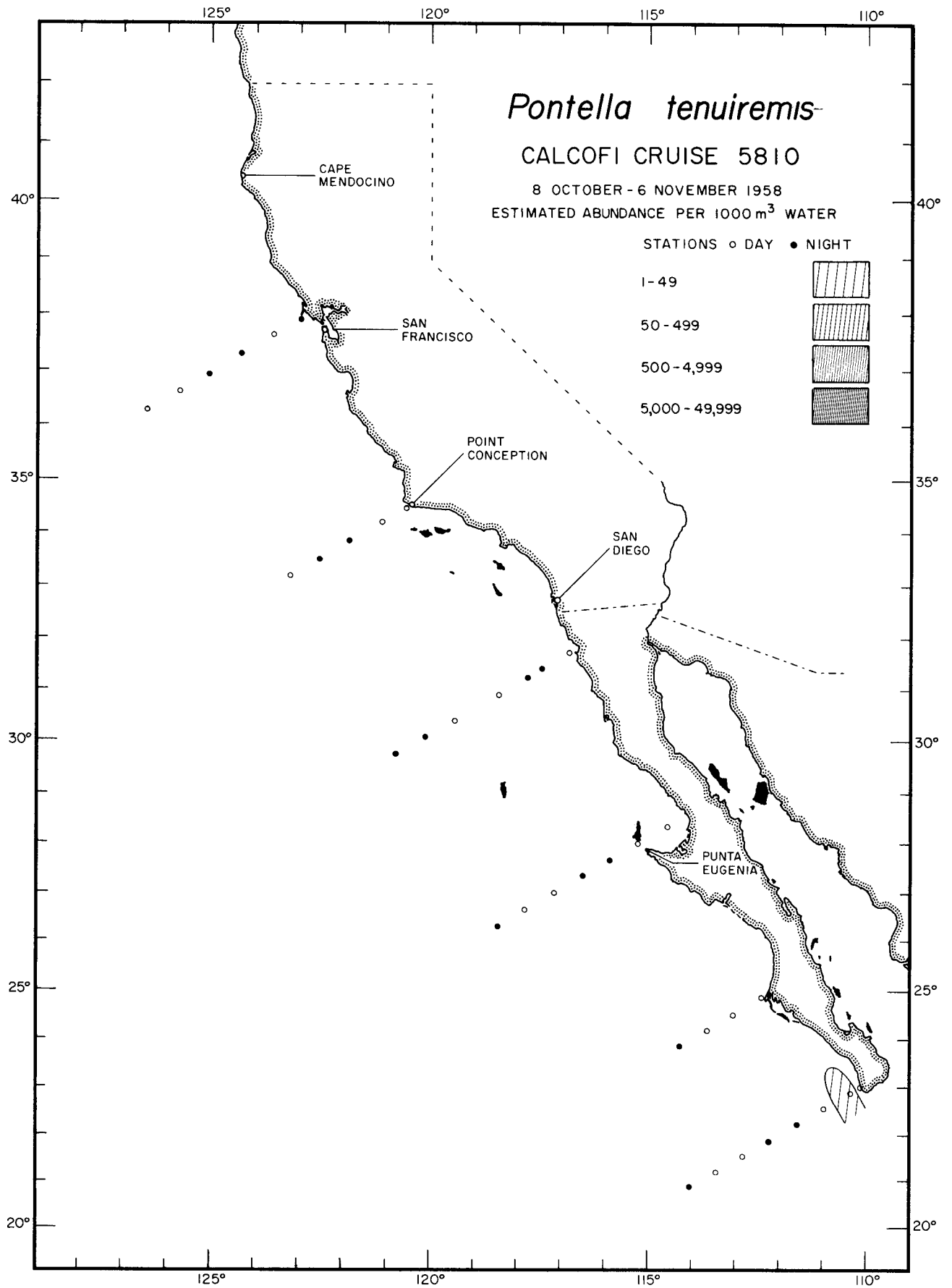
Pontella securifer

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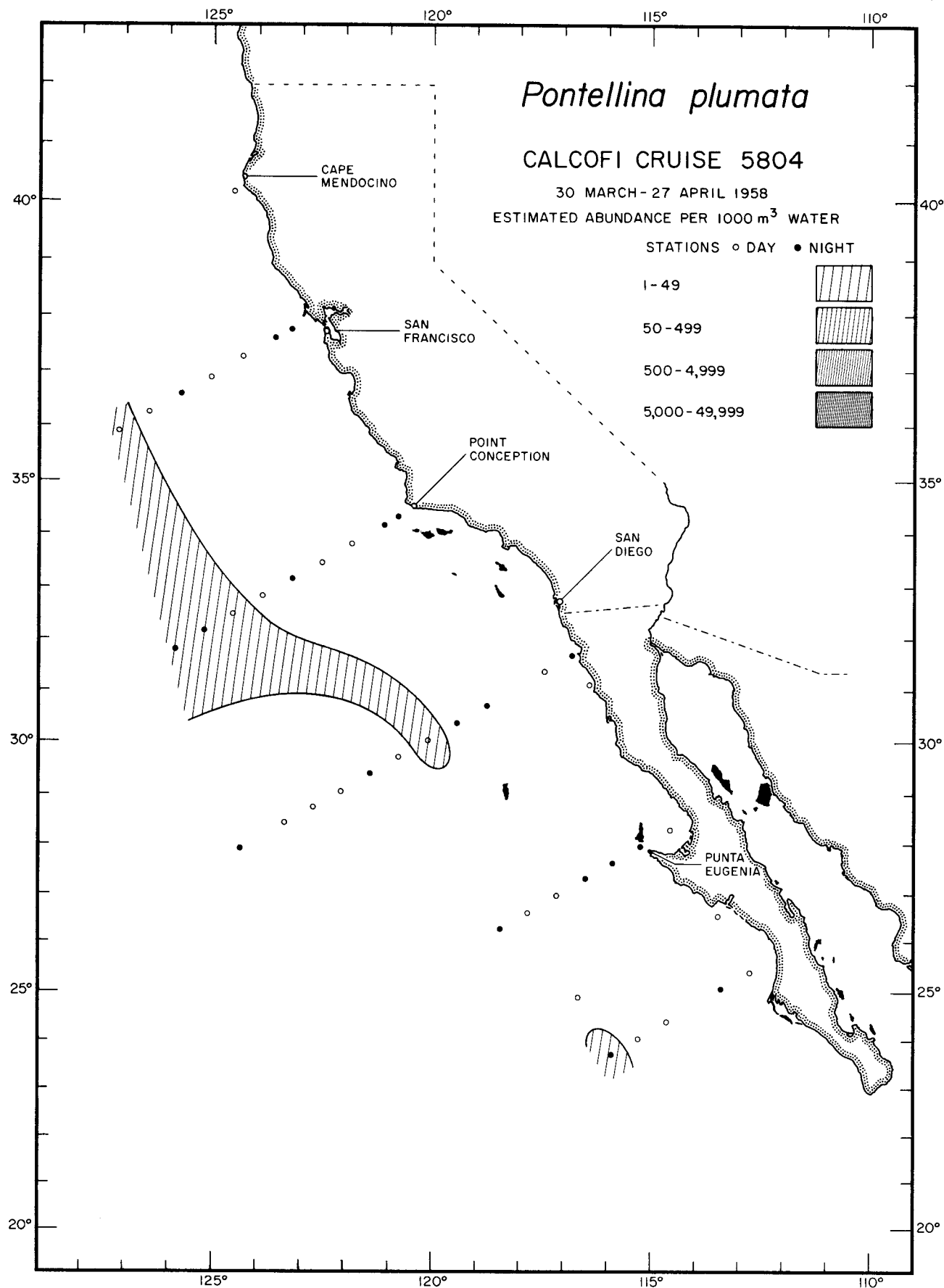
Pontella securifer
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Pontella tenuiremis

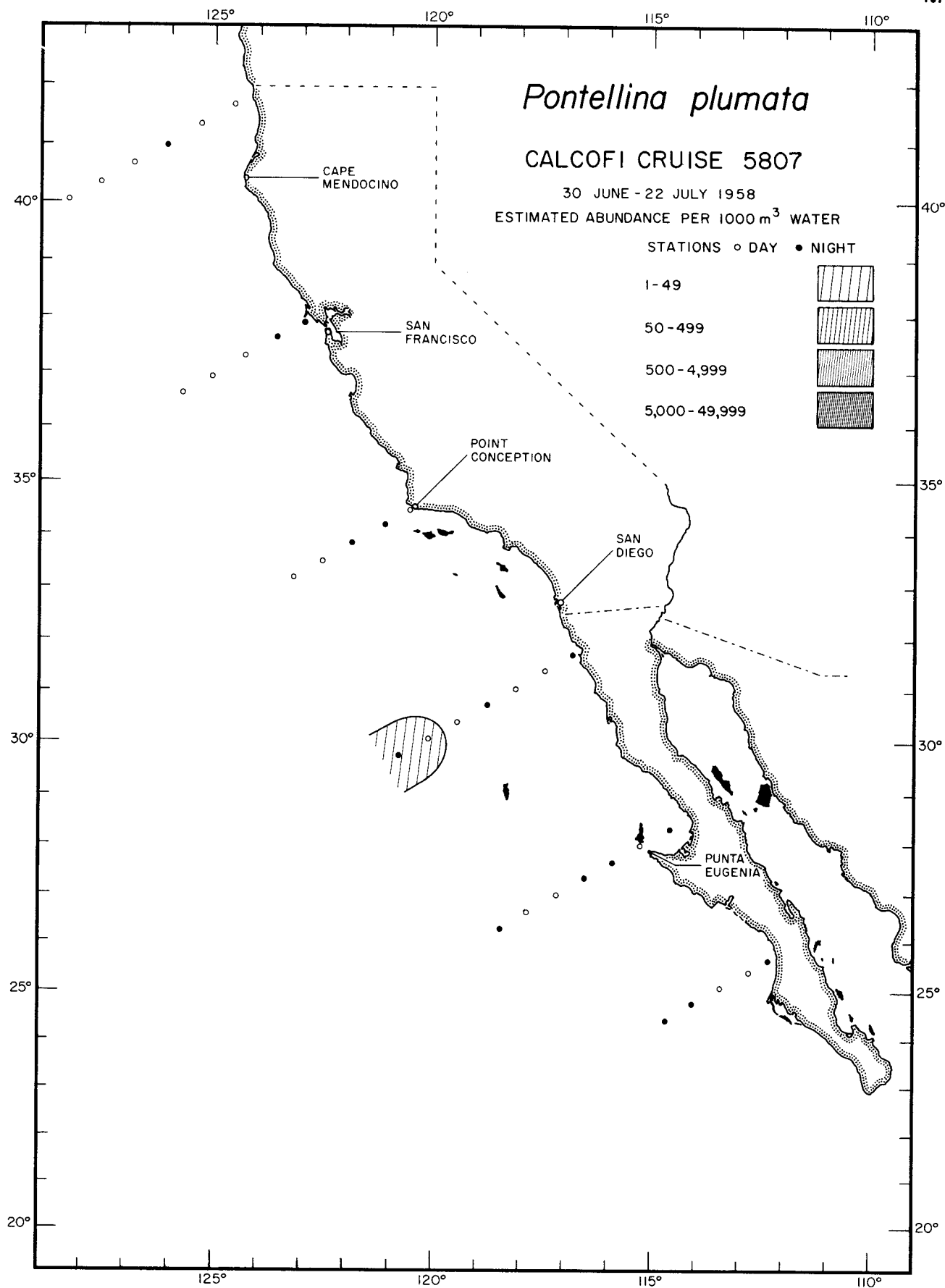
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Calanoida

Pontellina plumata

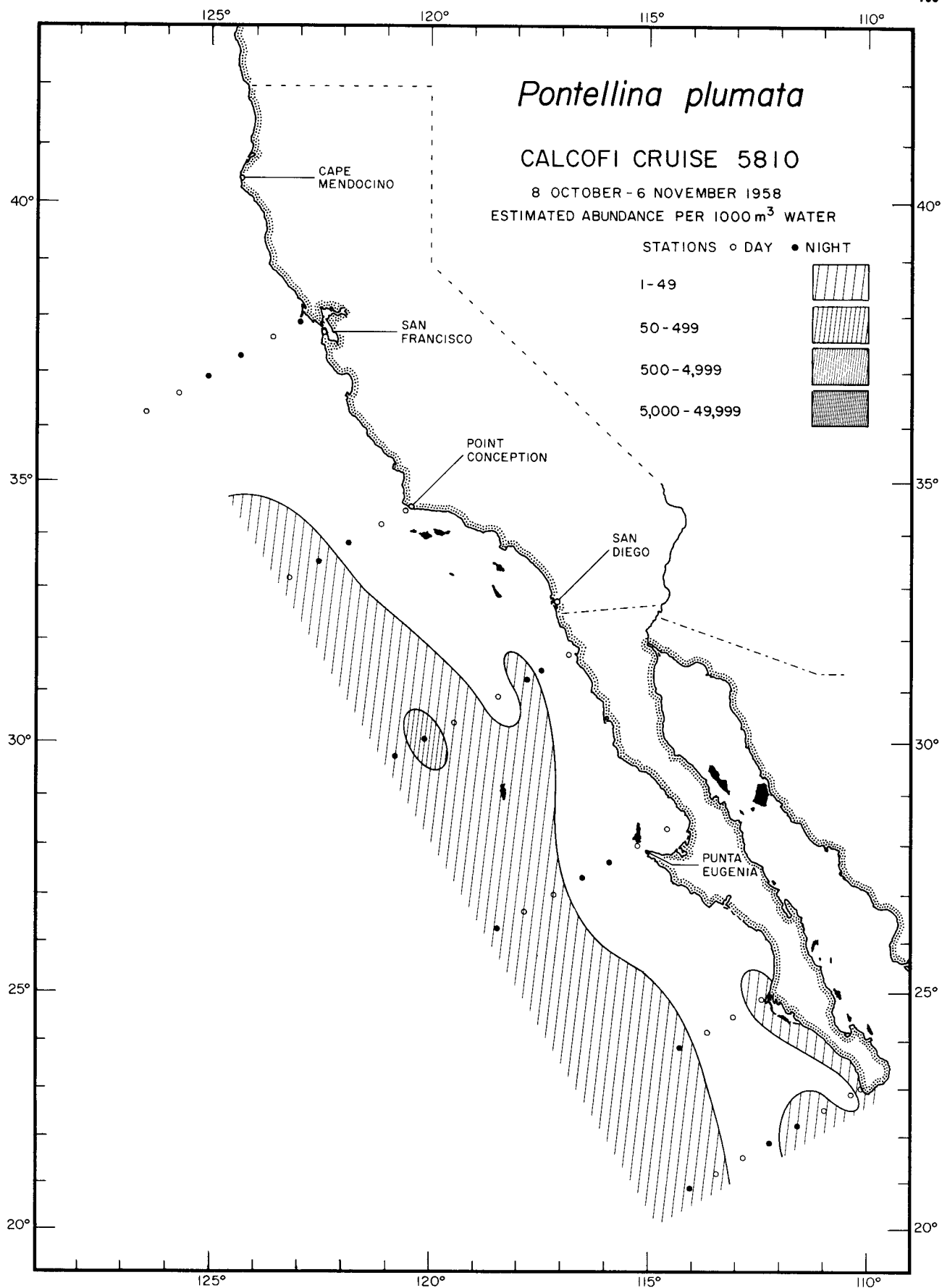
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Pontellina plumata

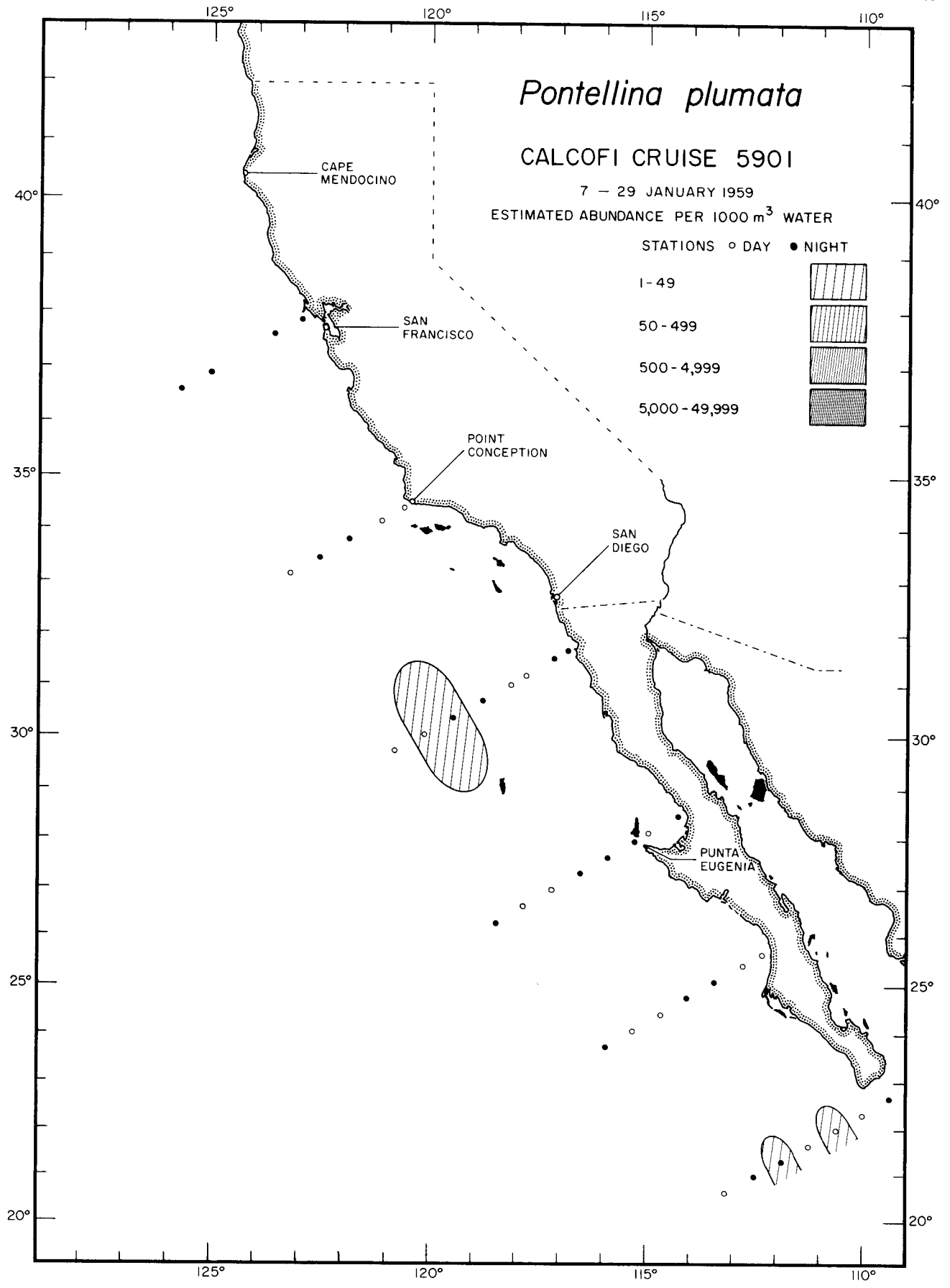
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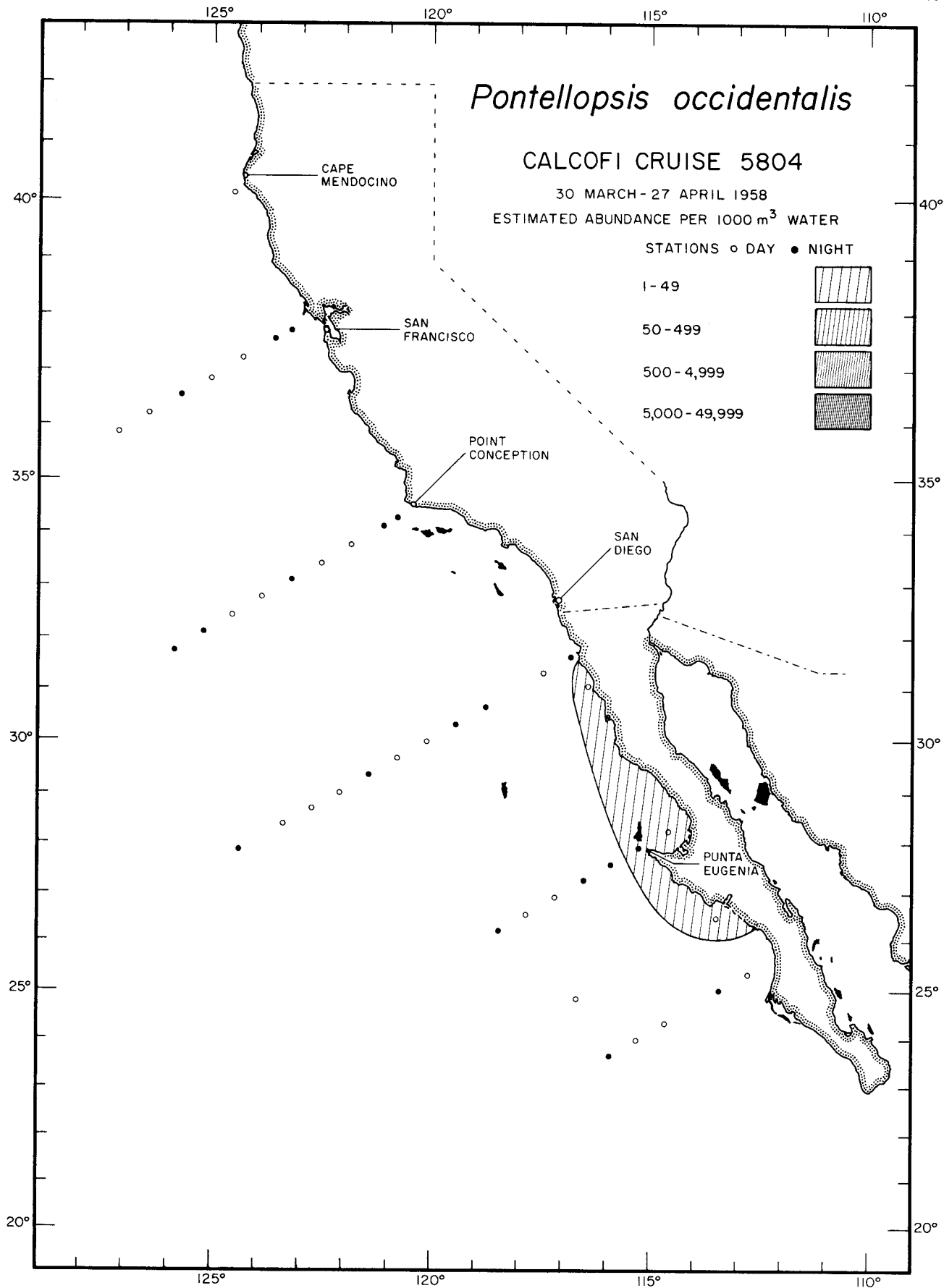
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Pontellina plumata

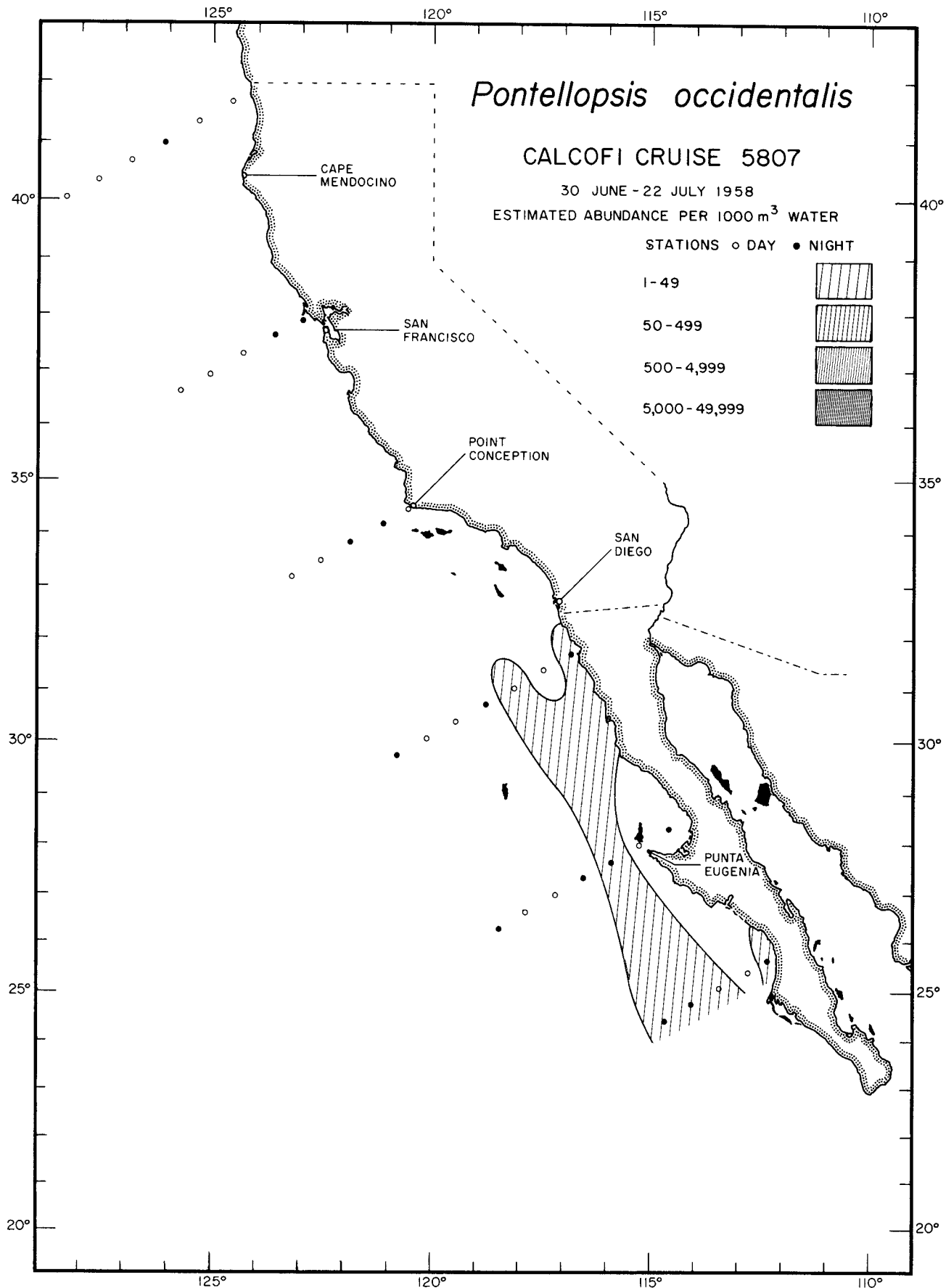
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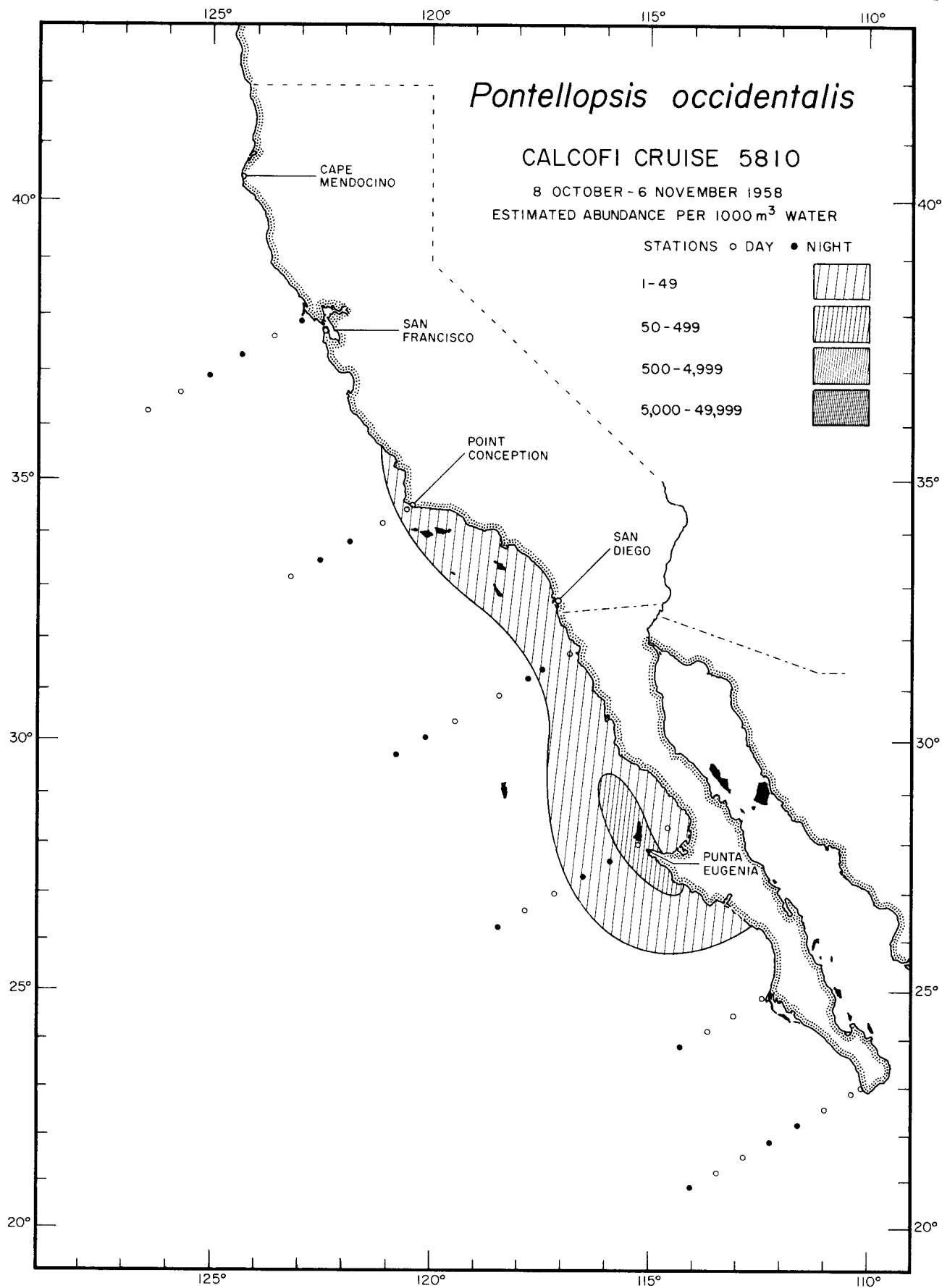
Calanoida
Pontellina plumata
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Calanoida
Pontellopsis occidentalis
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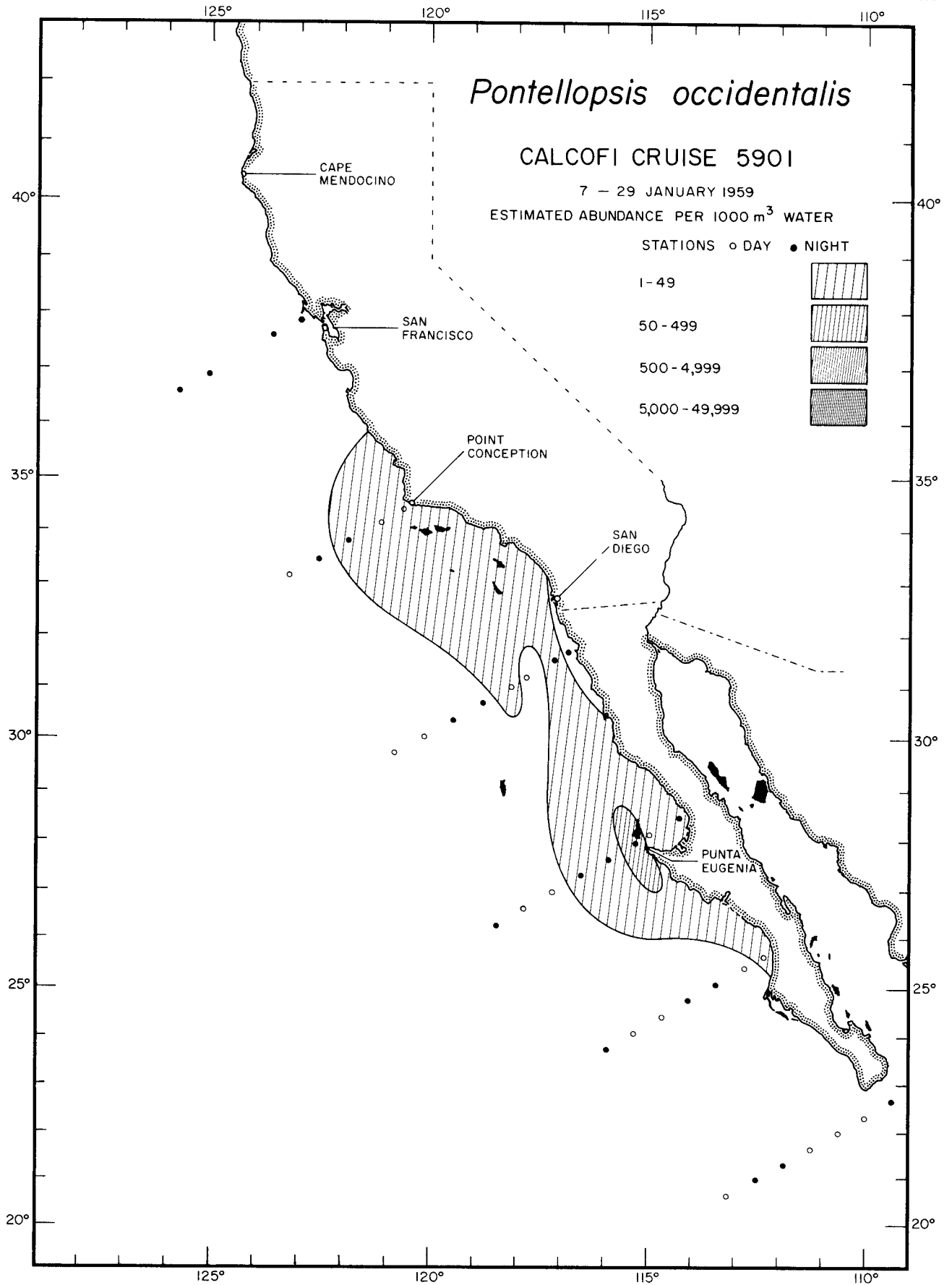
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Pontellopsis occidentalis
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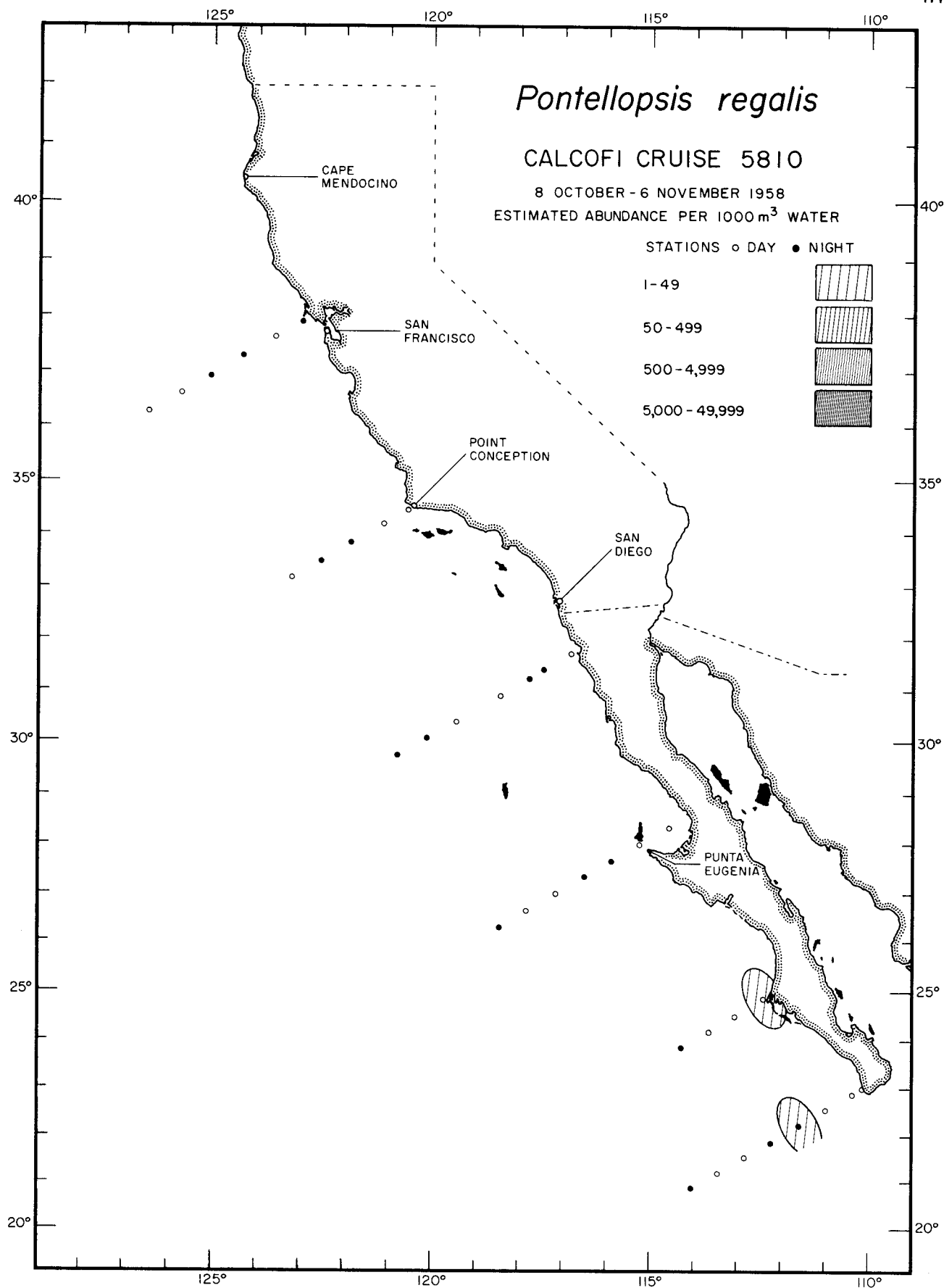
Calanoida

Pontellopsis occidentalis

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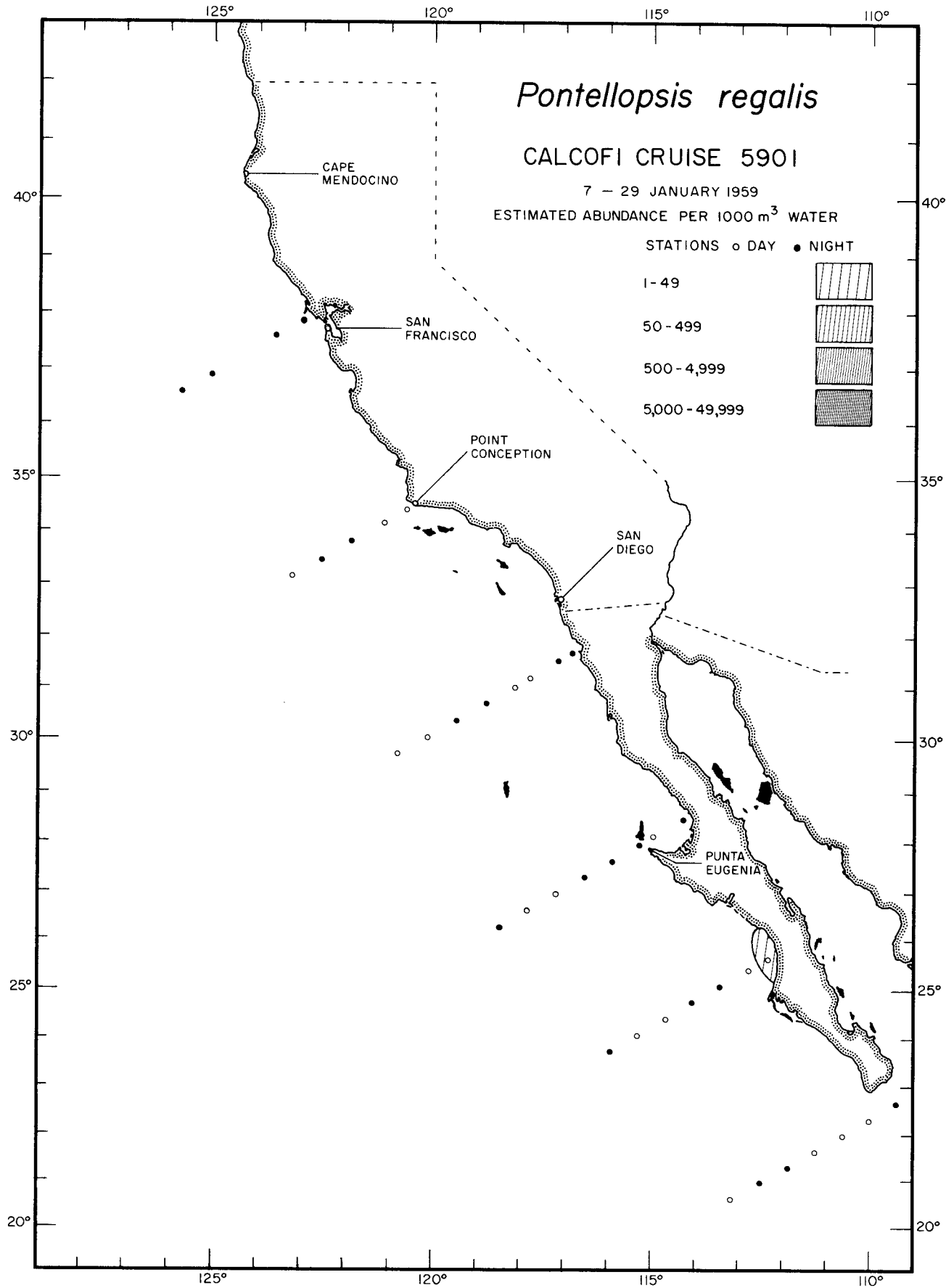
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Pontellopsis occidentalis
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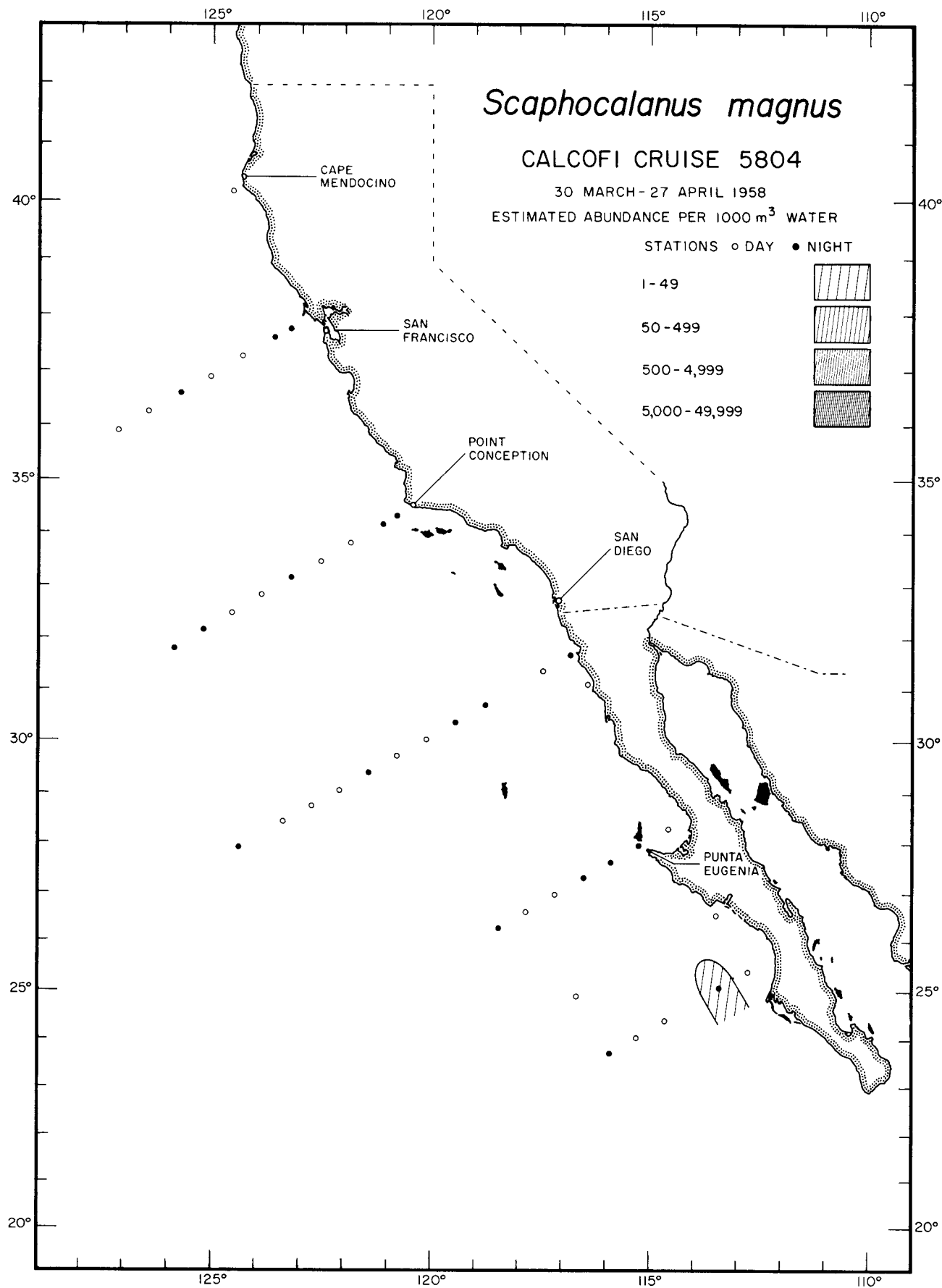
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Pontellopsis regalis

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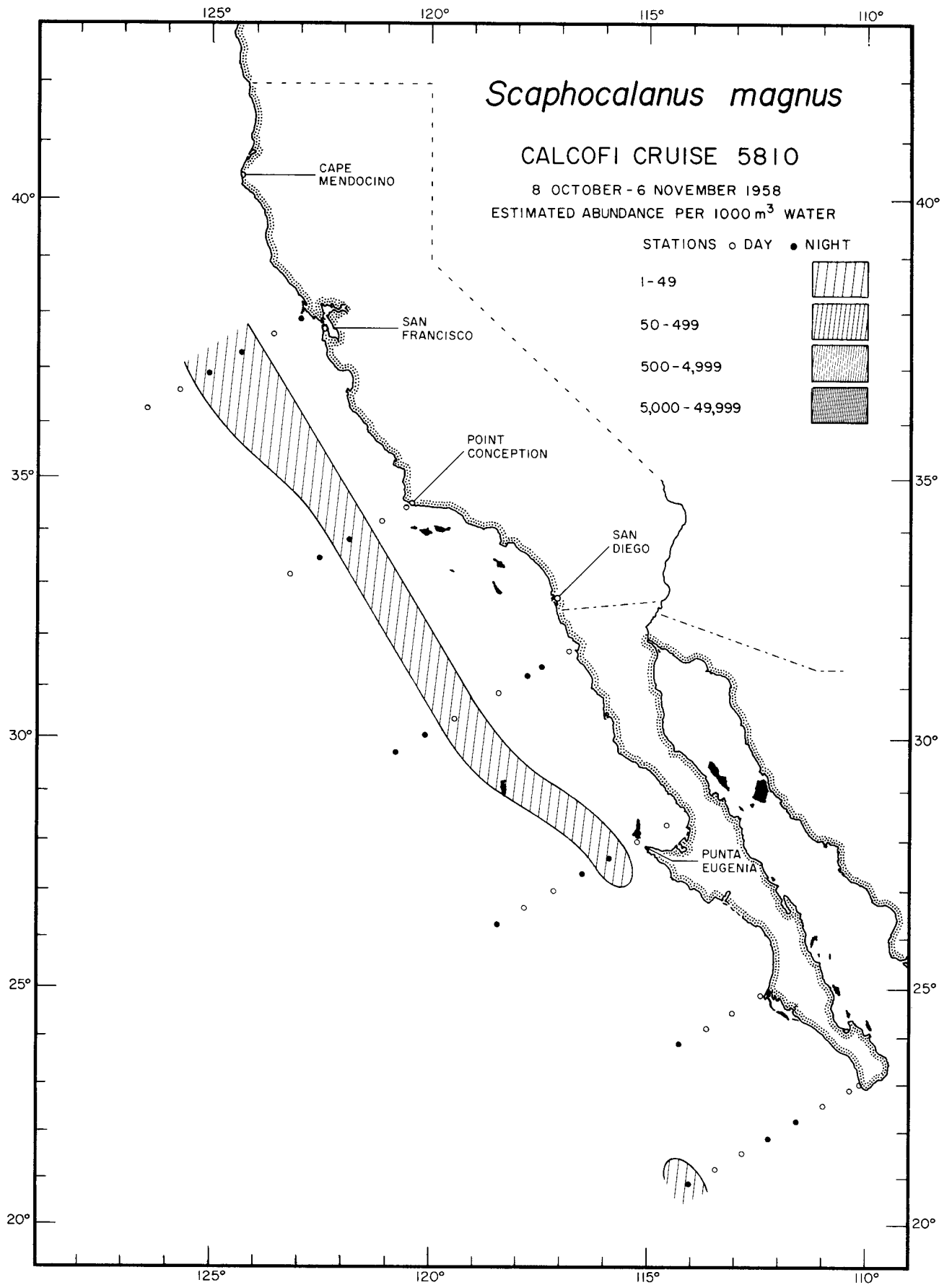
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Pontellopsis regalis
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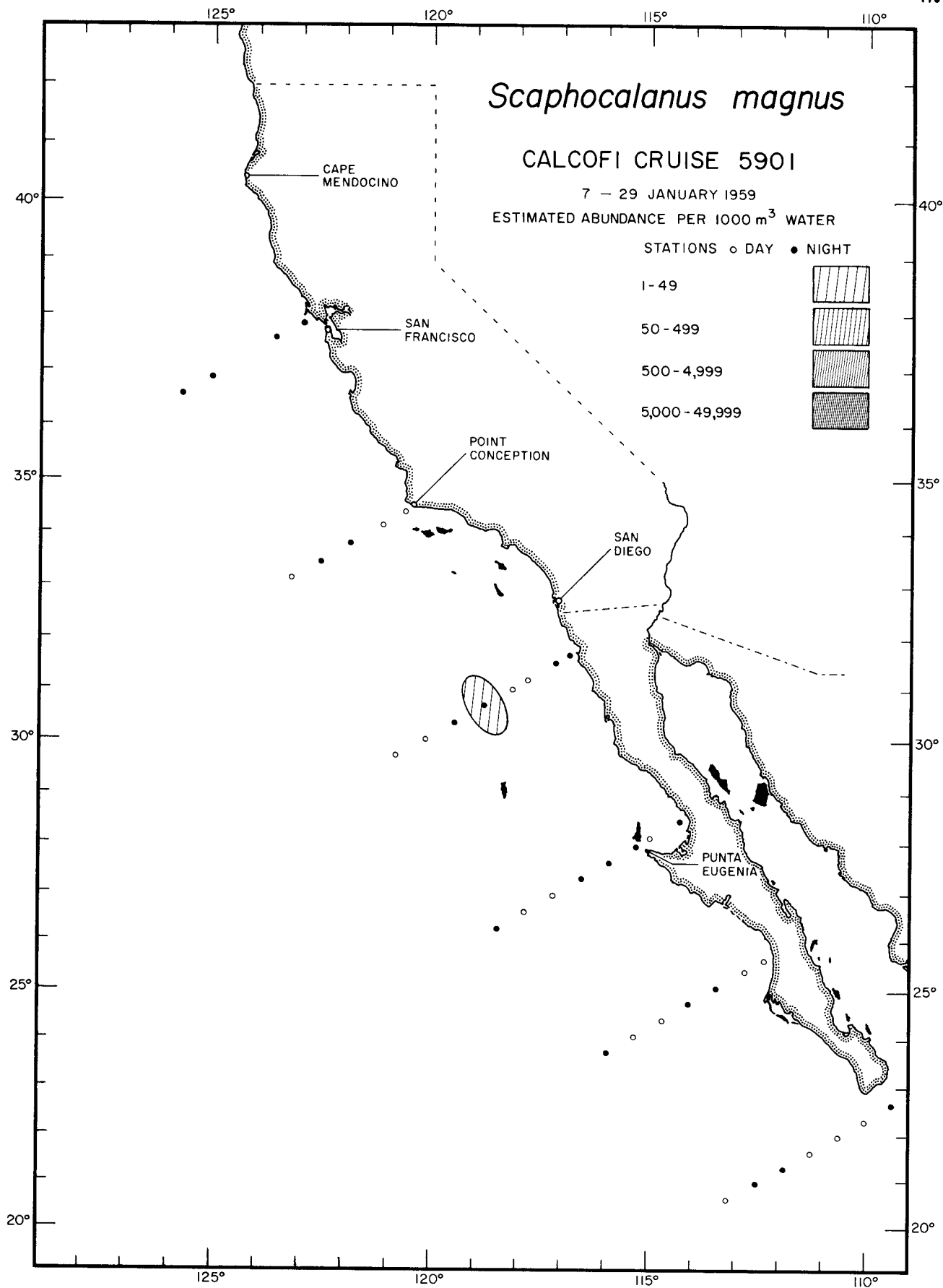
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Scaphocalanus magnus

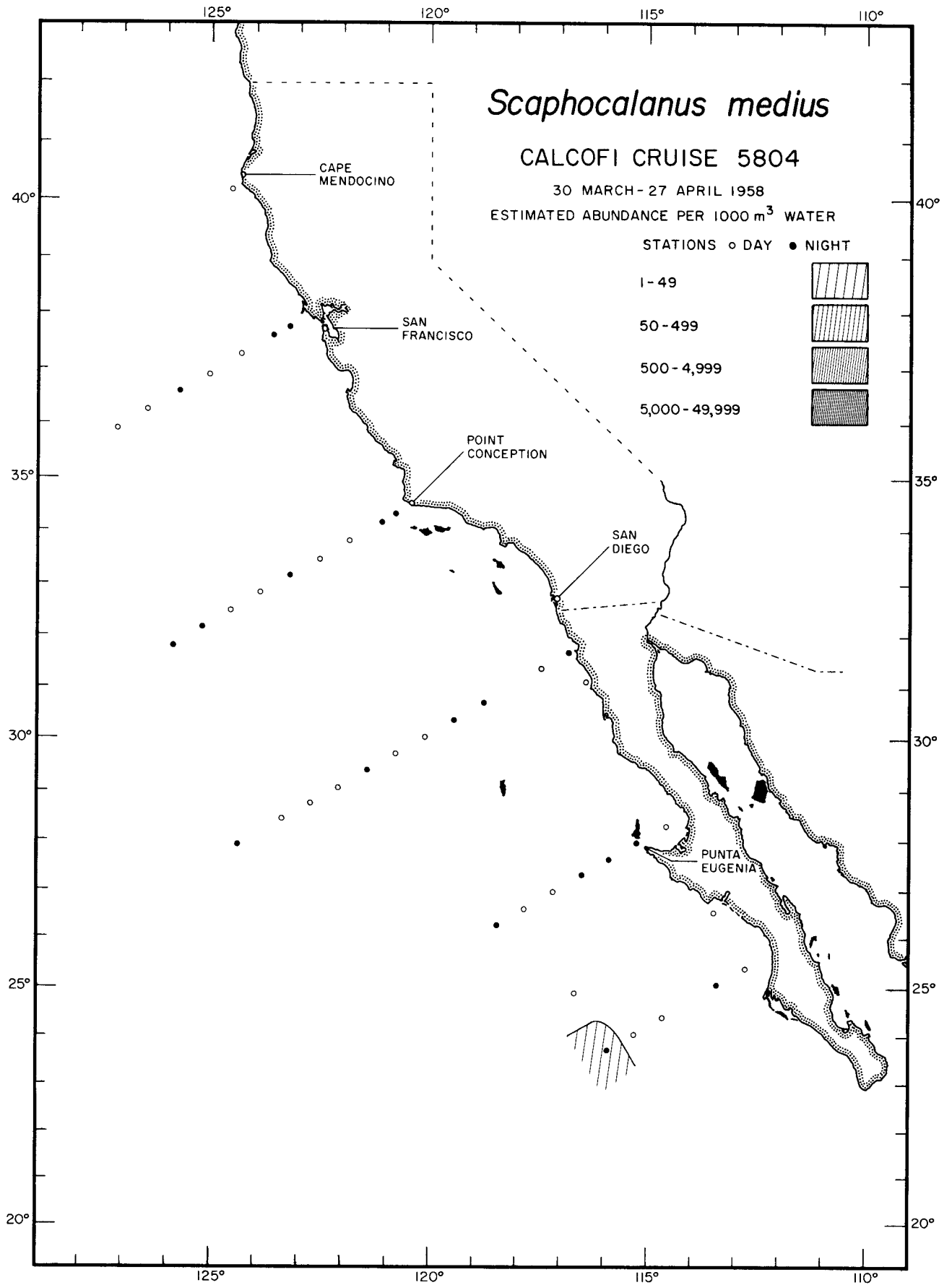
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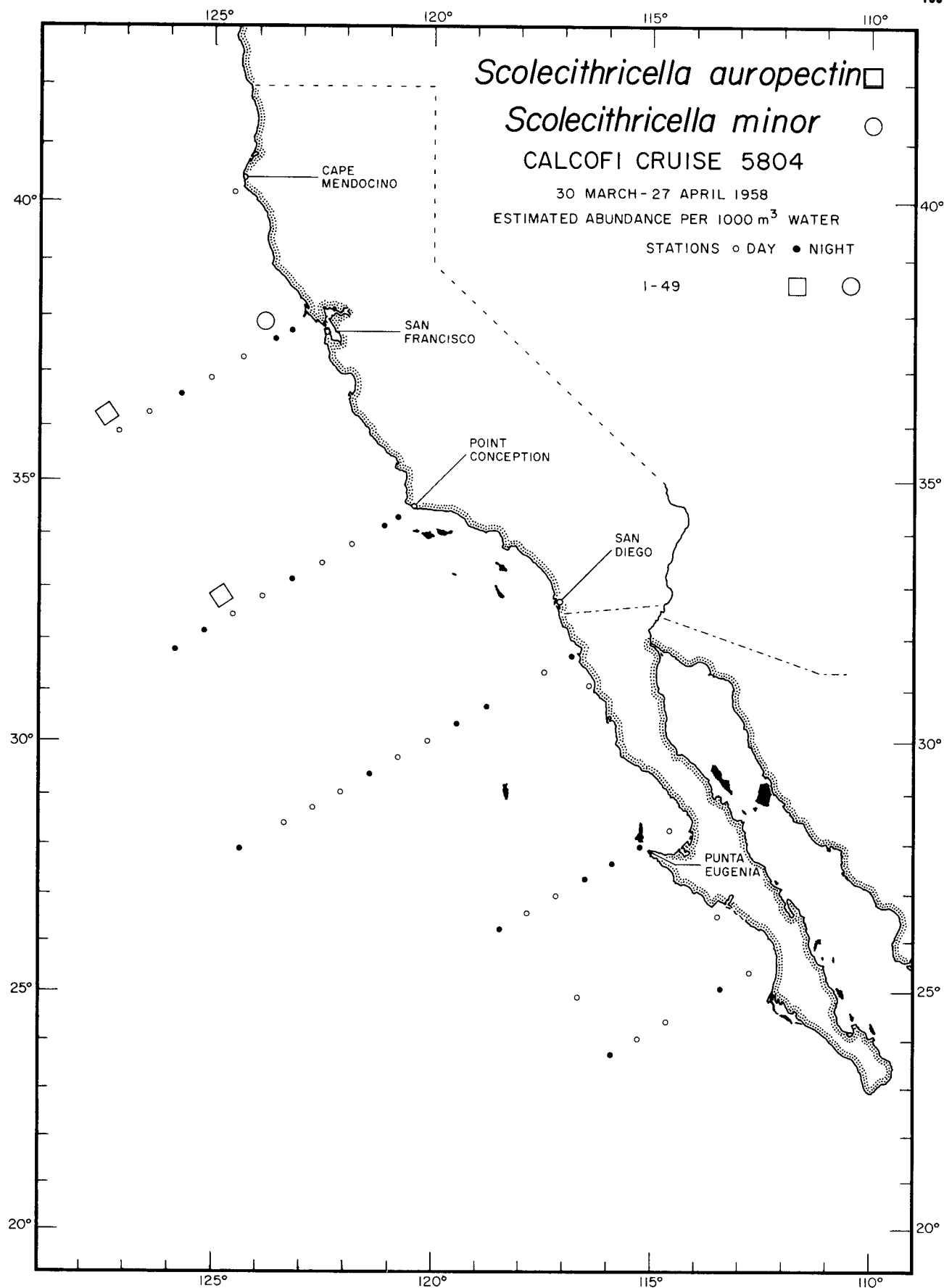
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Scaphocalanus magnus
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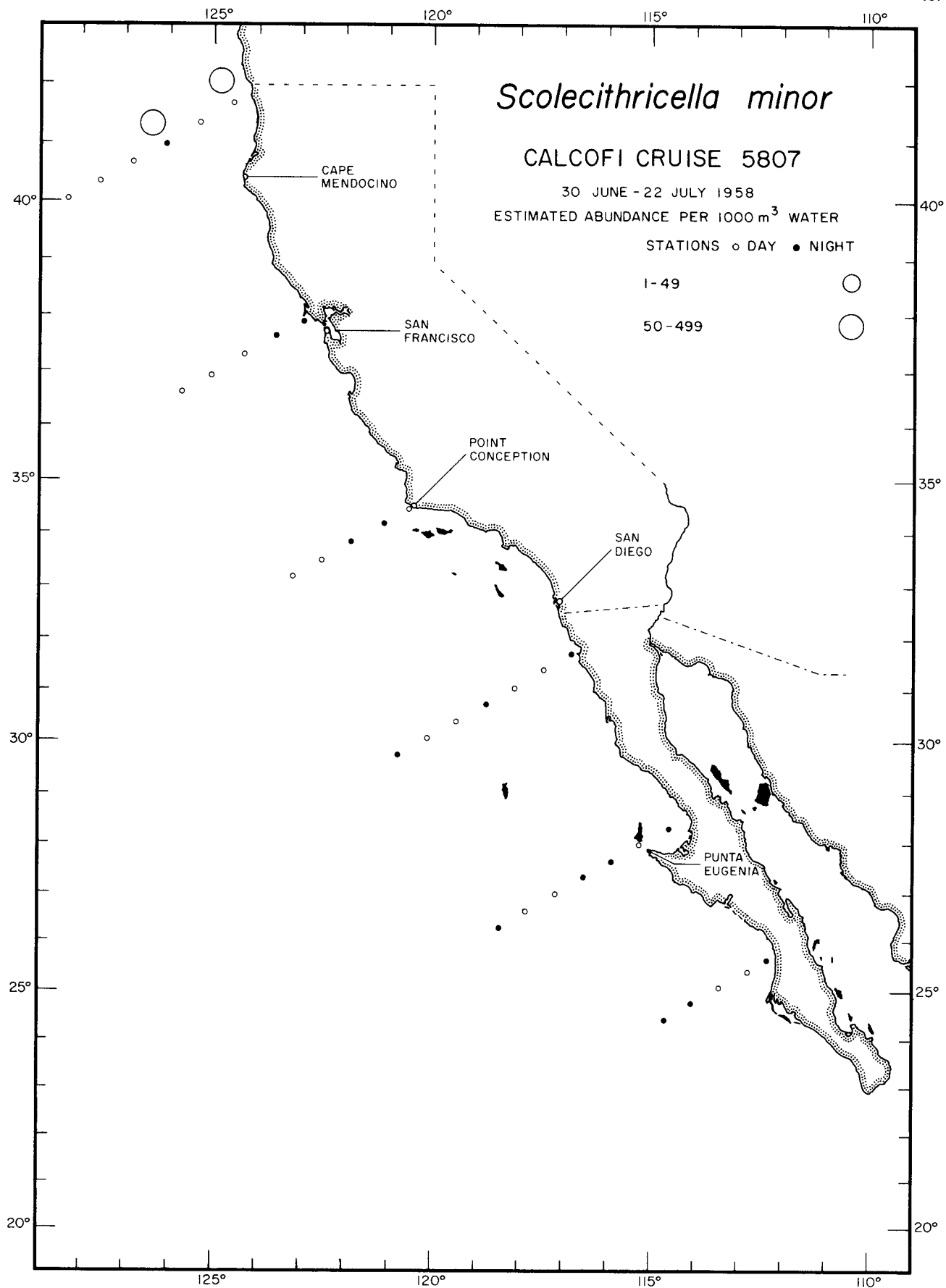
Calanoida
Scaphocalanus magnus
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Calanoida
Scaphocalanus medius
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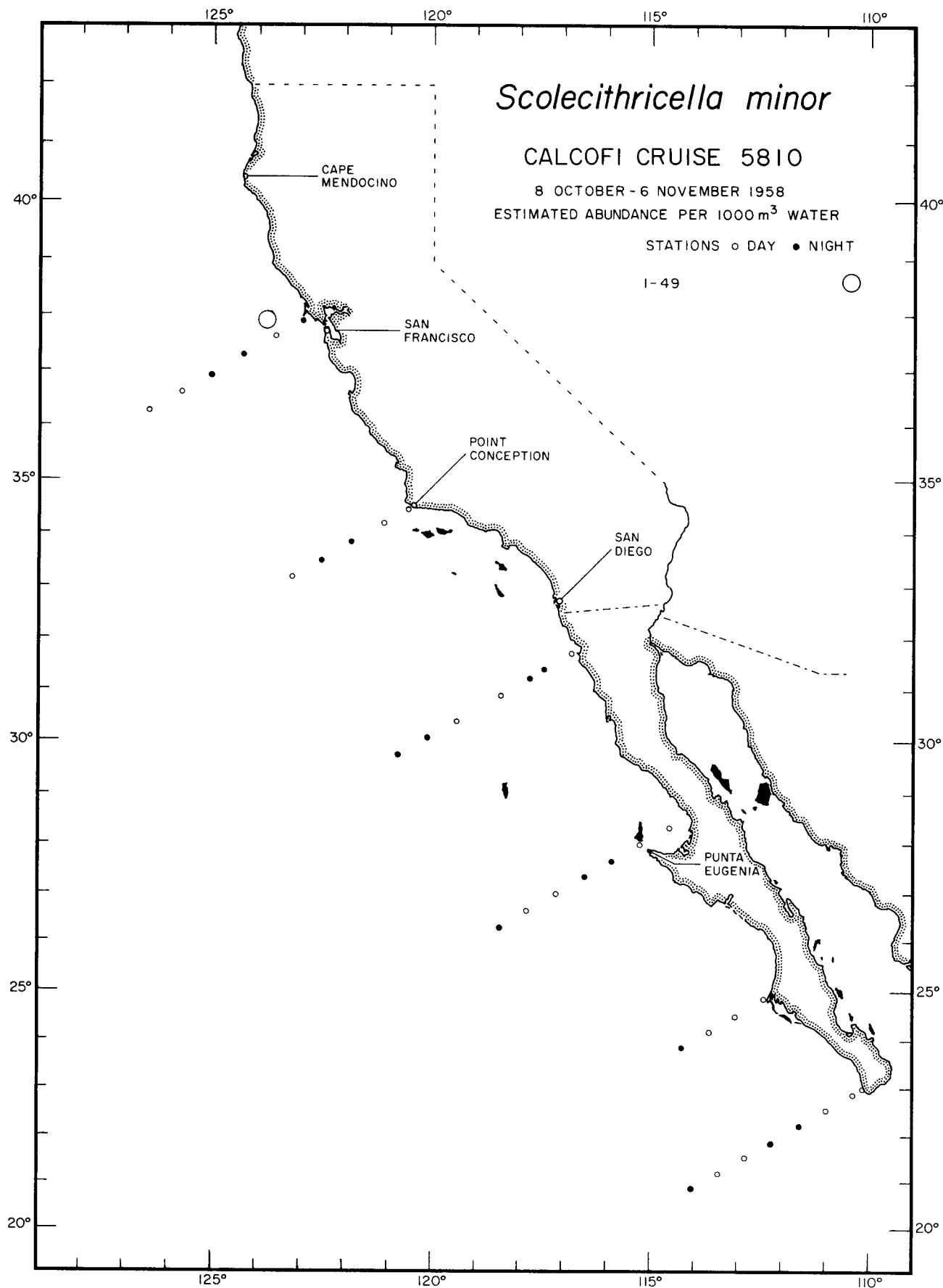
Calanoida
Scolecithricella auropectin
Scolecithricella minor
 5804



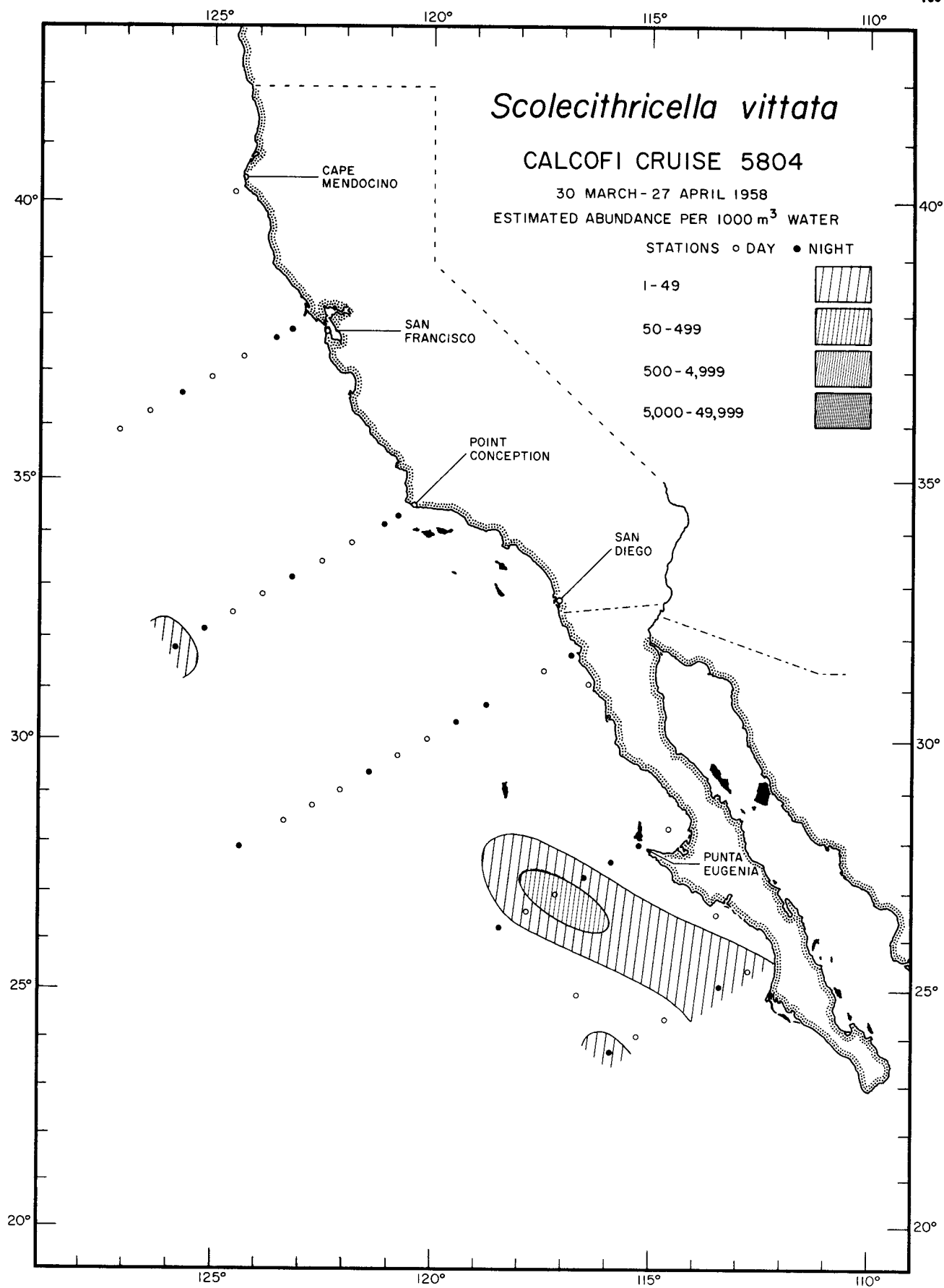
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Scolecithricella minor

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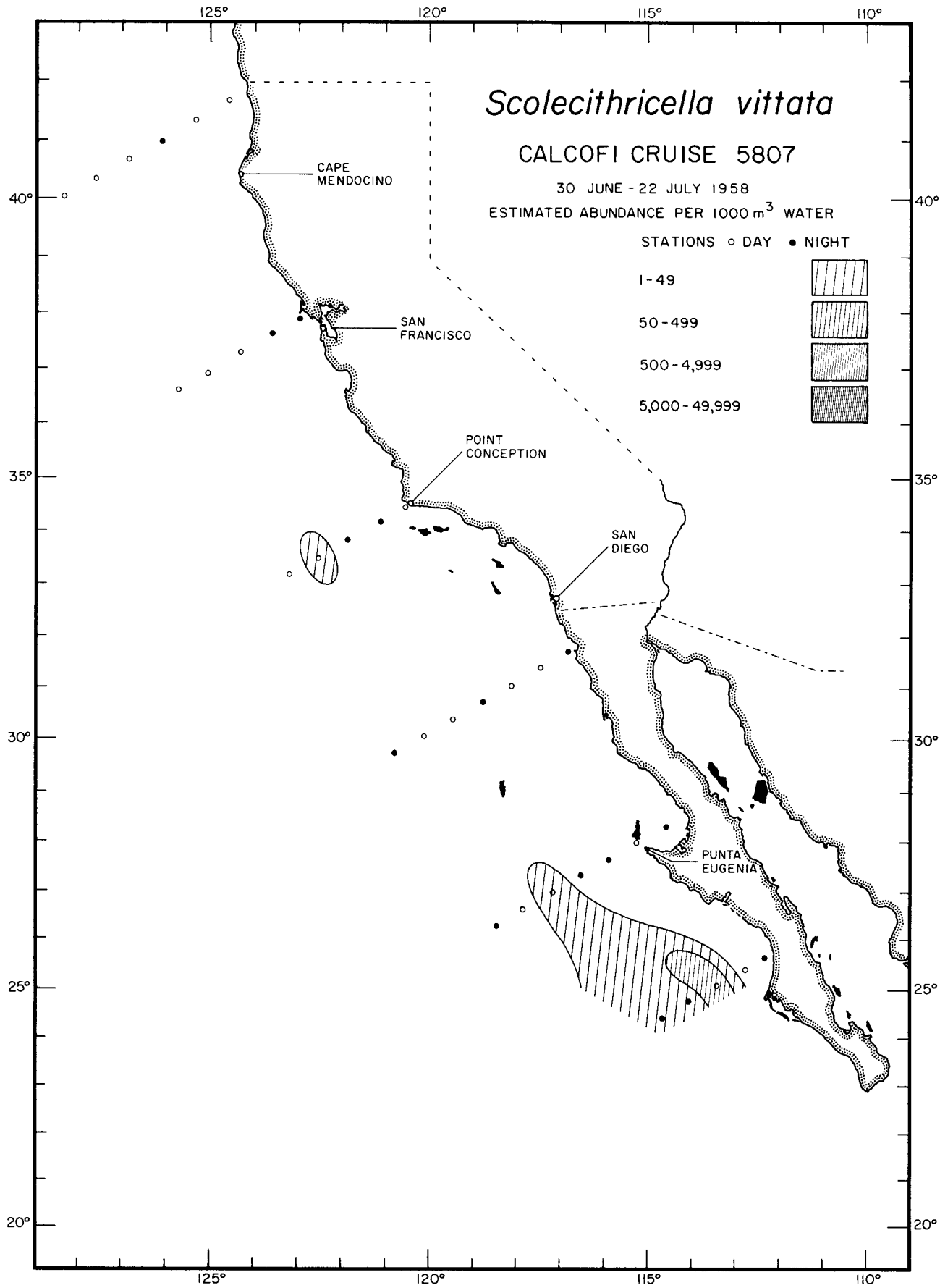
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Scolecithricella minor
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Calanoida

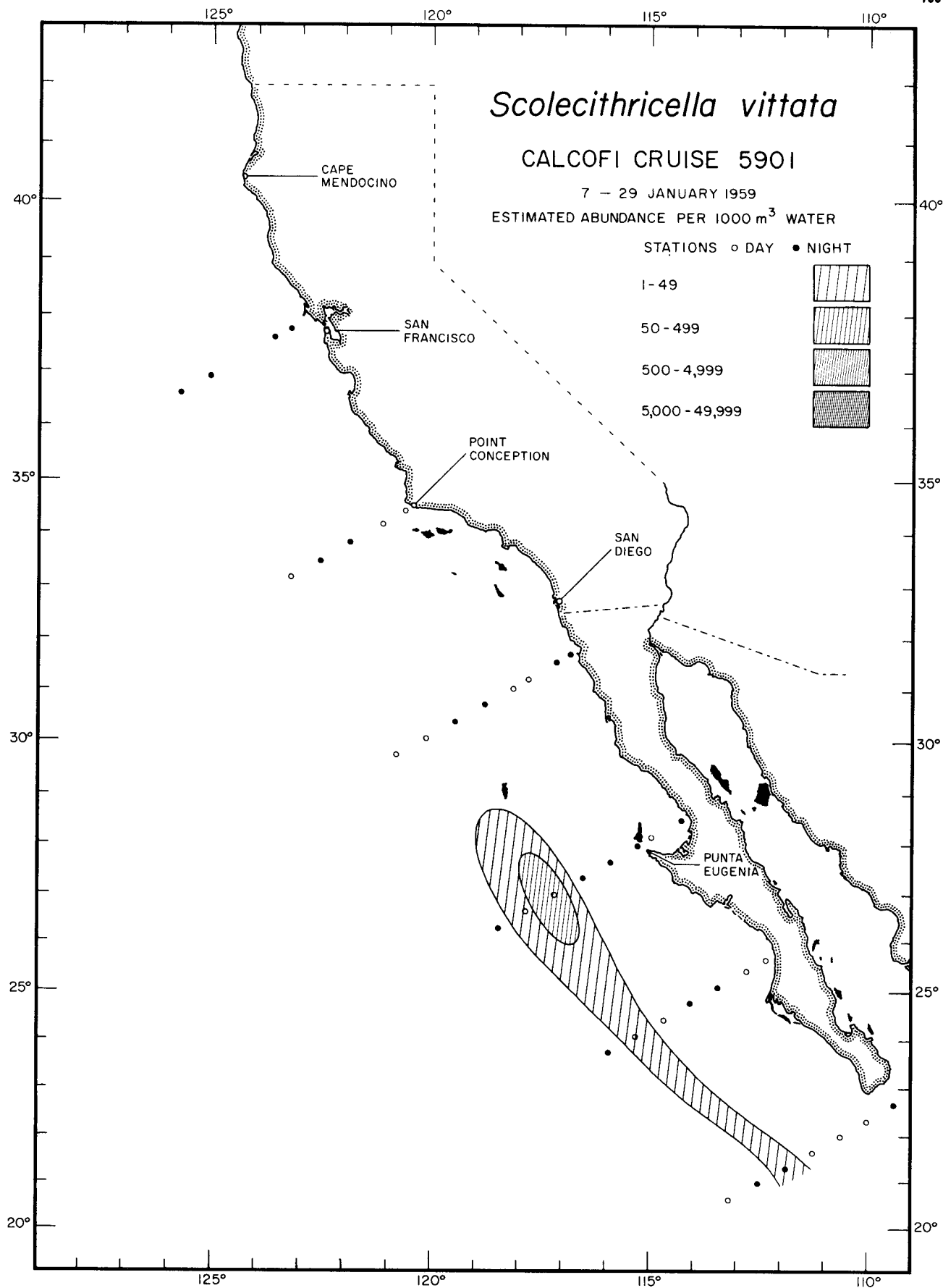
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Calanoida

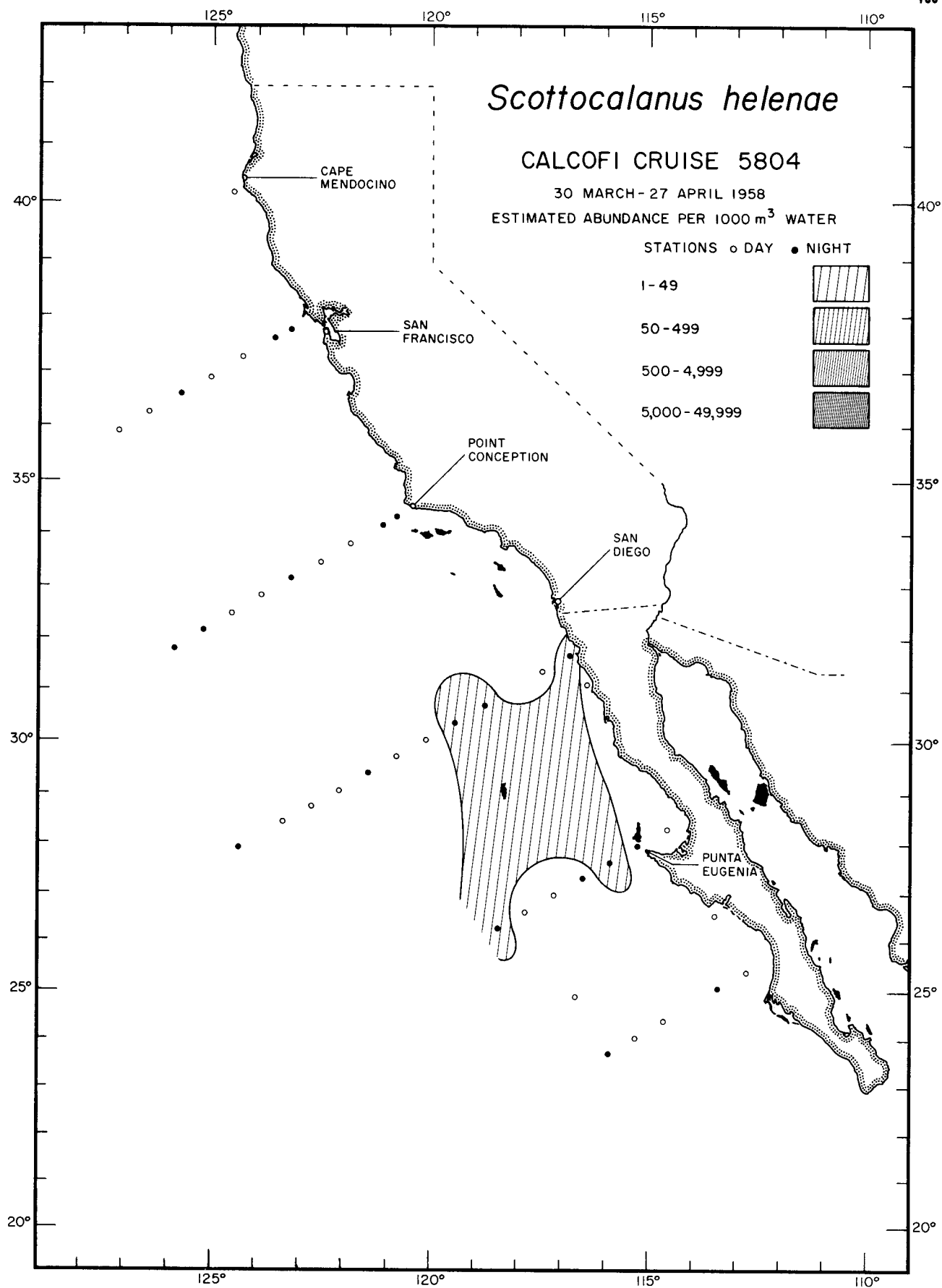
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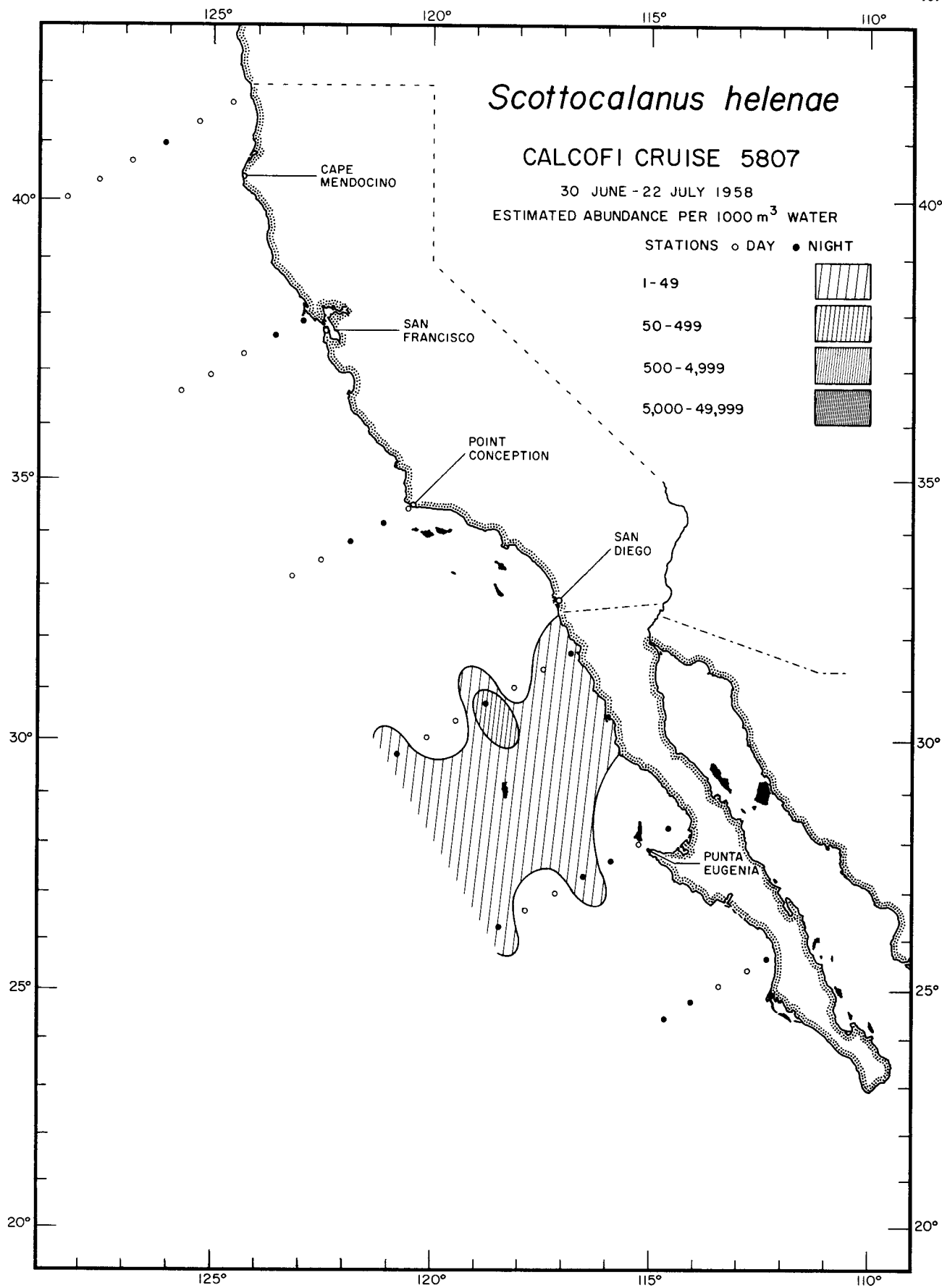
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Scolecithricella vittata

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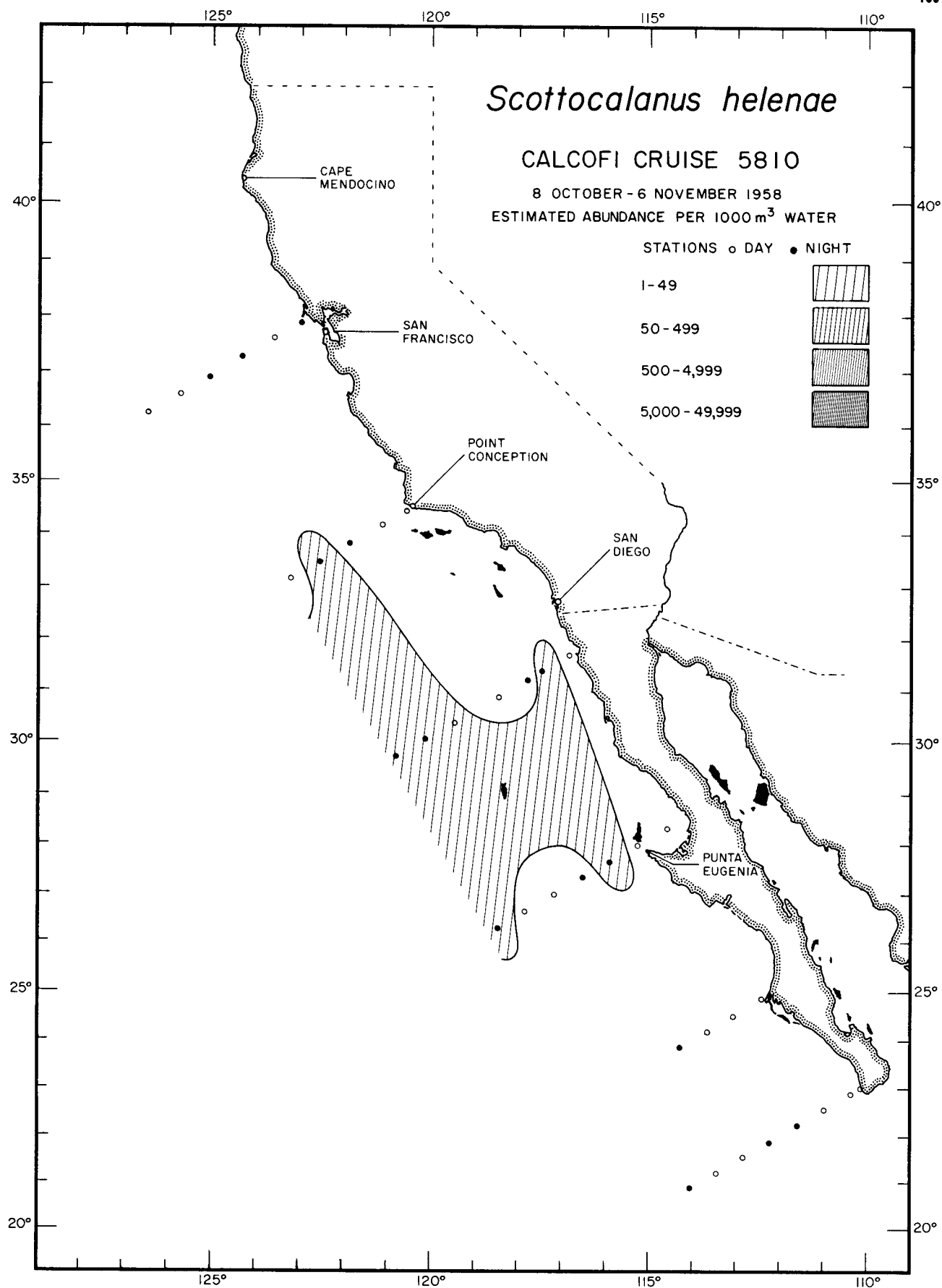
Calanoida
Scottocalanus helenae
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Calanoida

Scottocalanus helenae

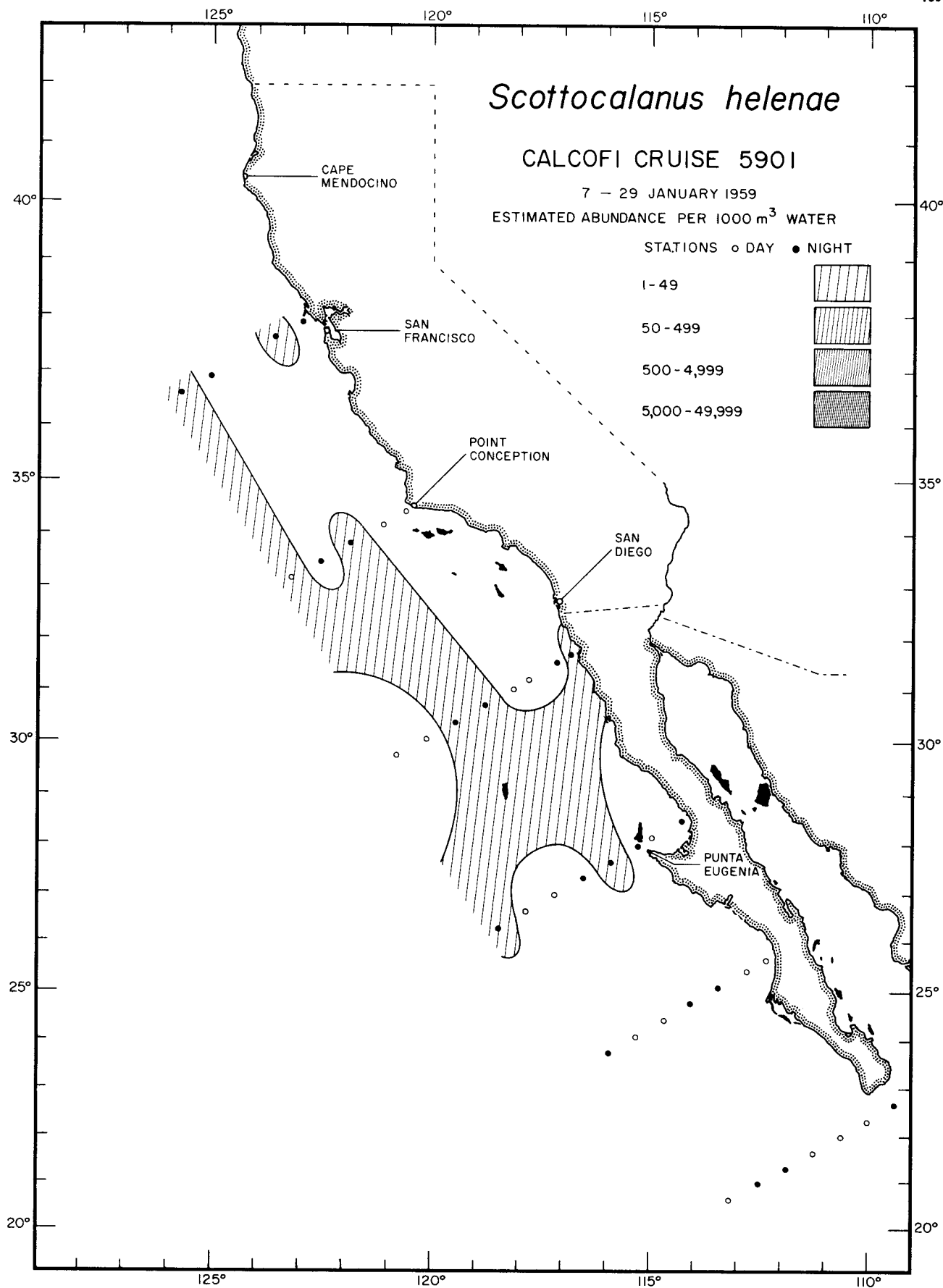
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Calanoida

Scottocalanus helenae

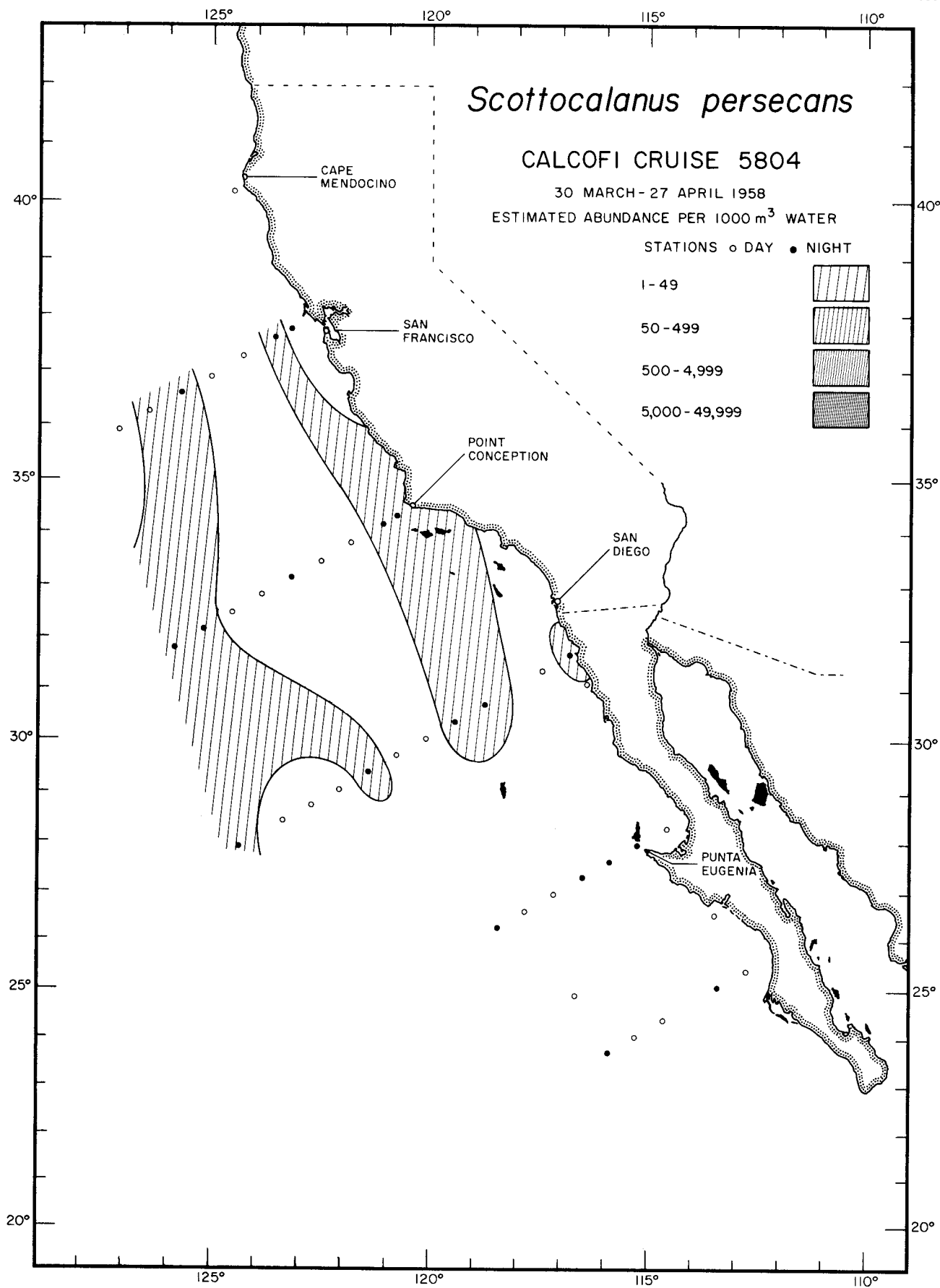
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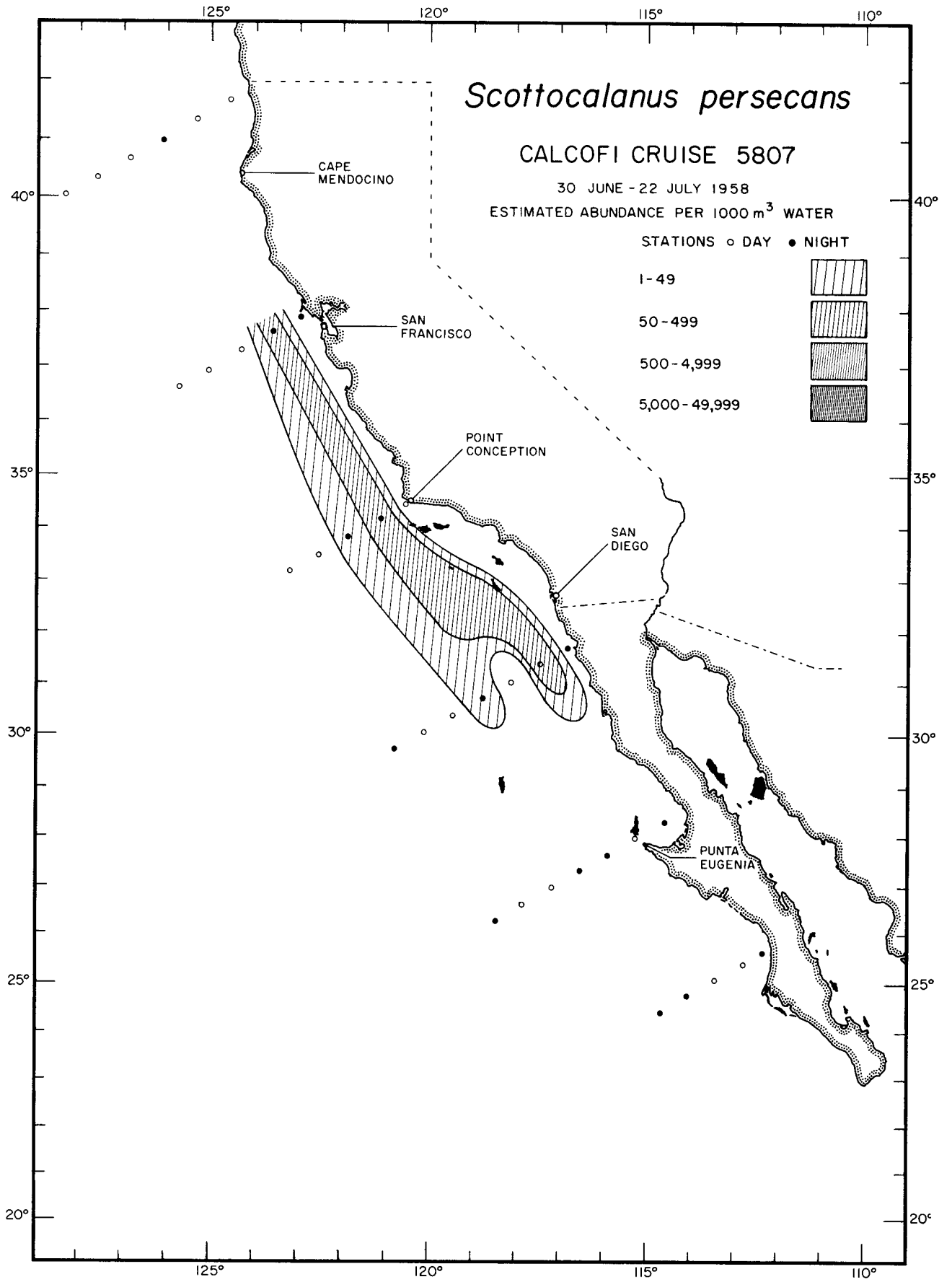
Calanoida

Scottocalanus helenae

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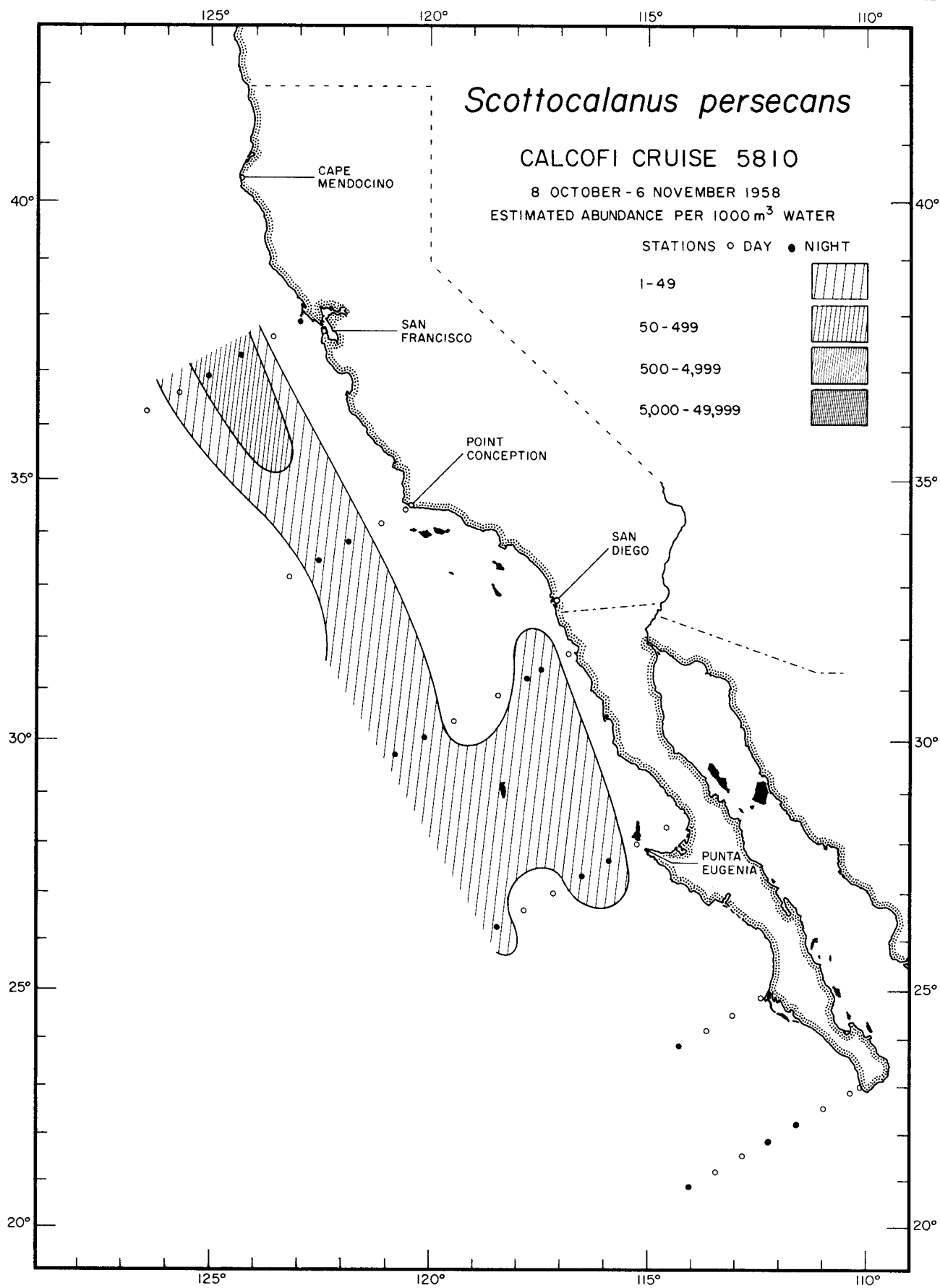
Calanoida
Scottocalanus persekans
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Calanoida

Scottocalanus persecans

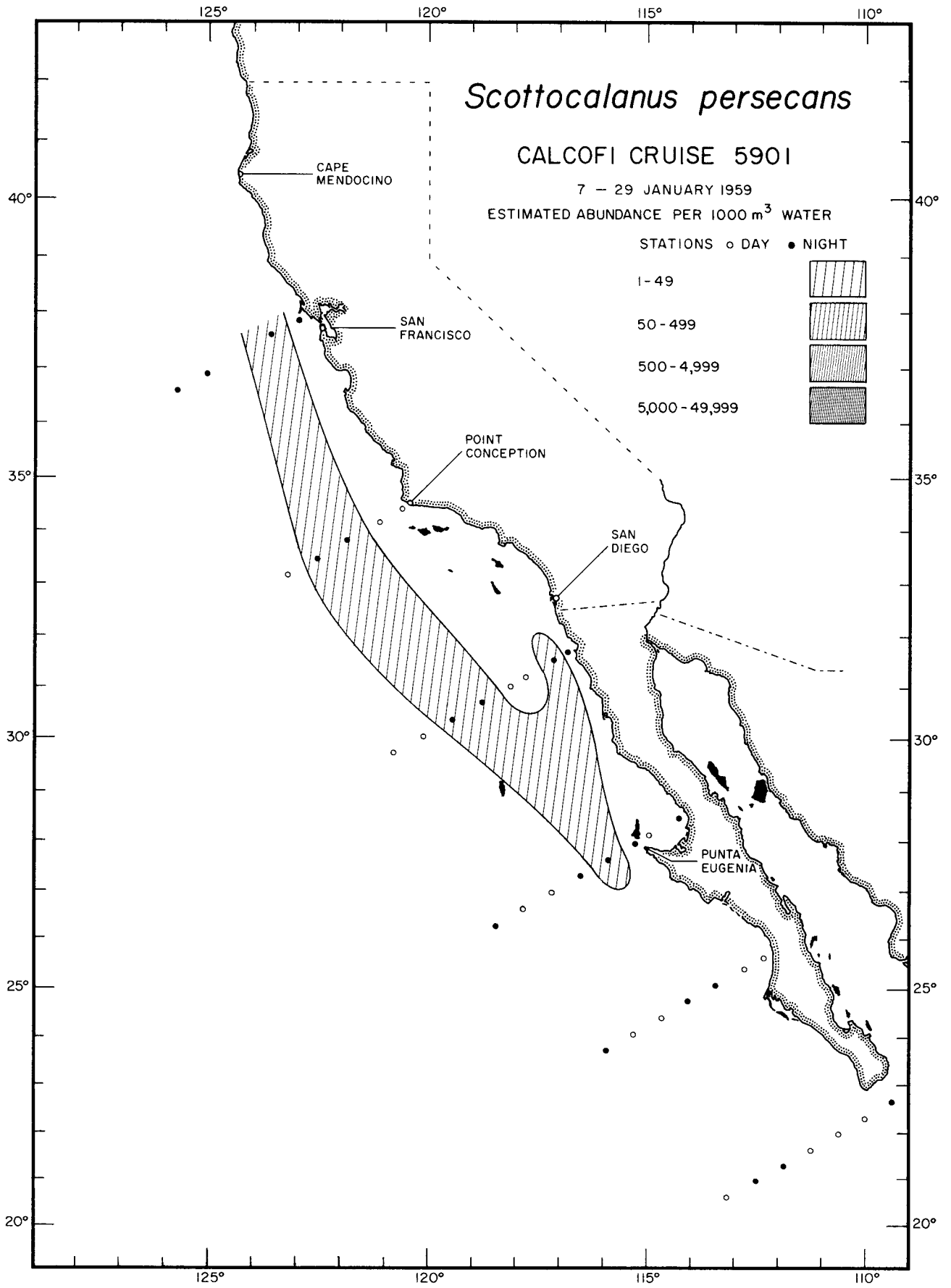
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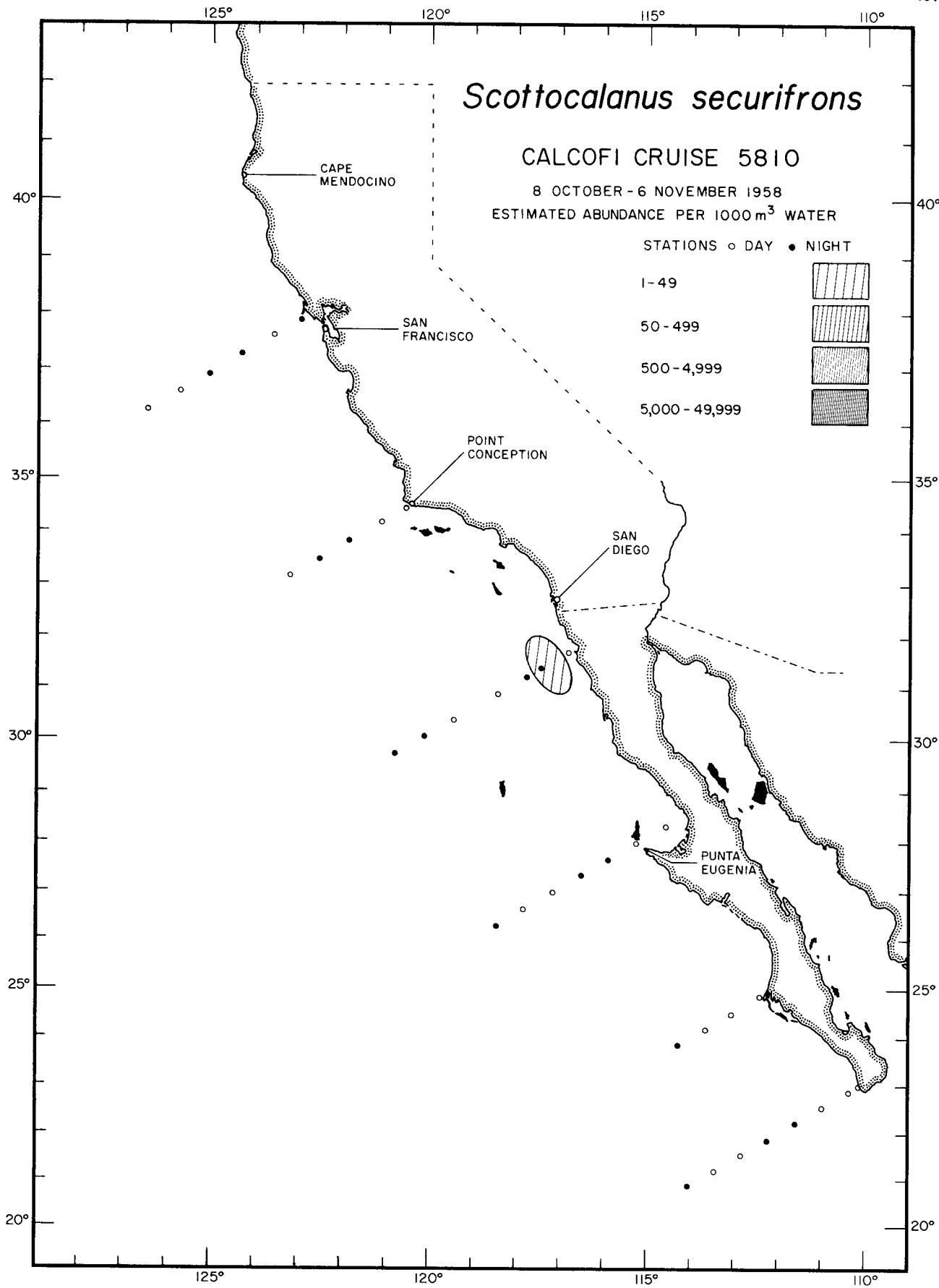
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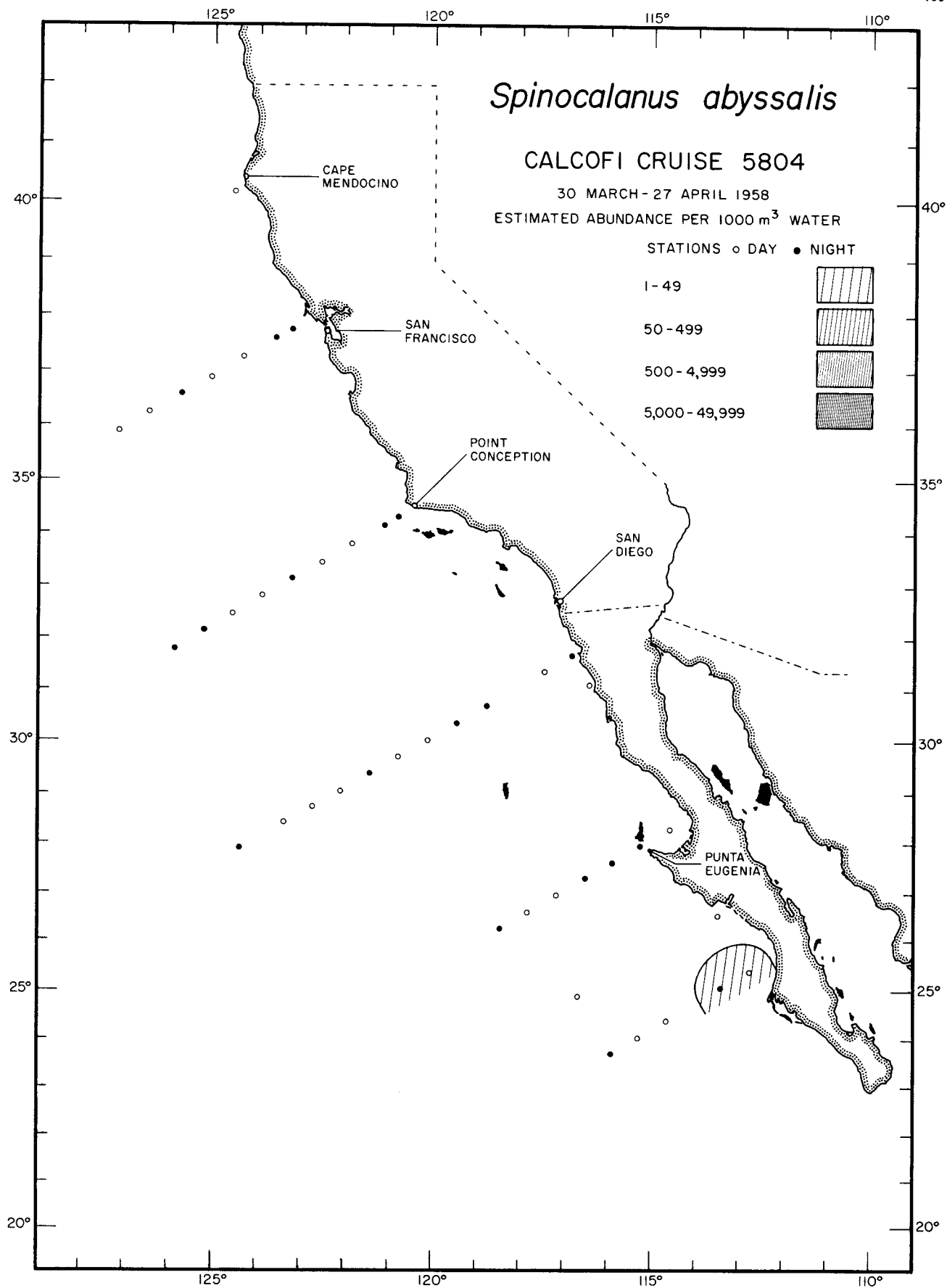
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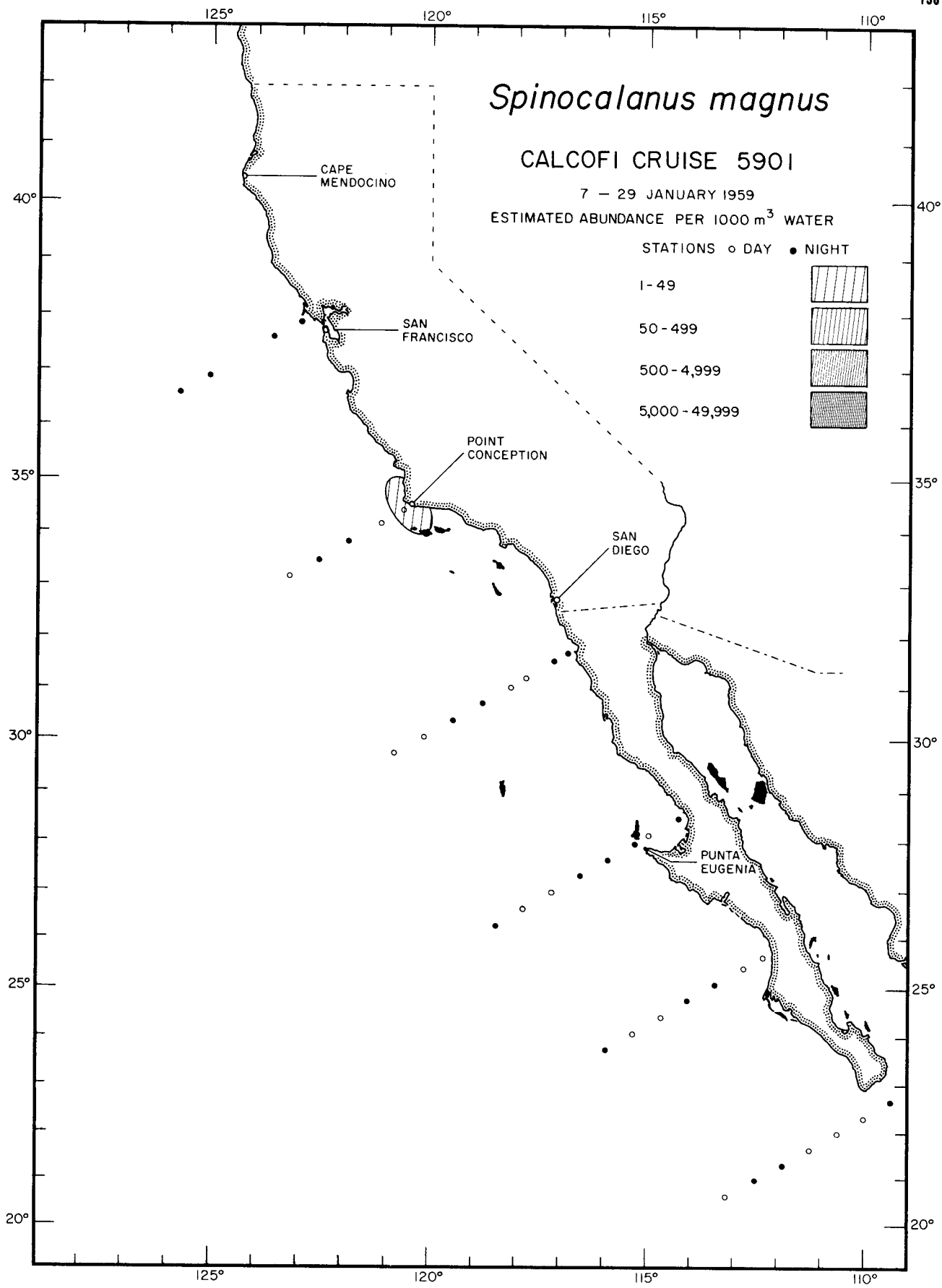
Calanoida
Scottocalanus persecans
5901



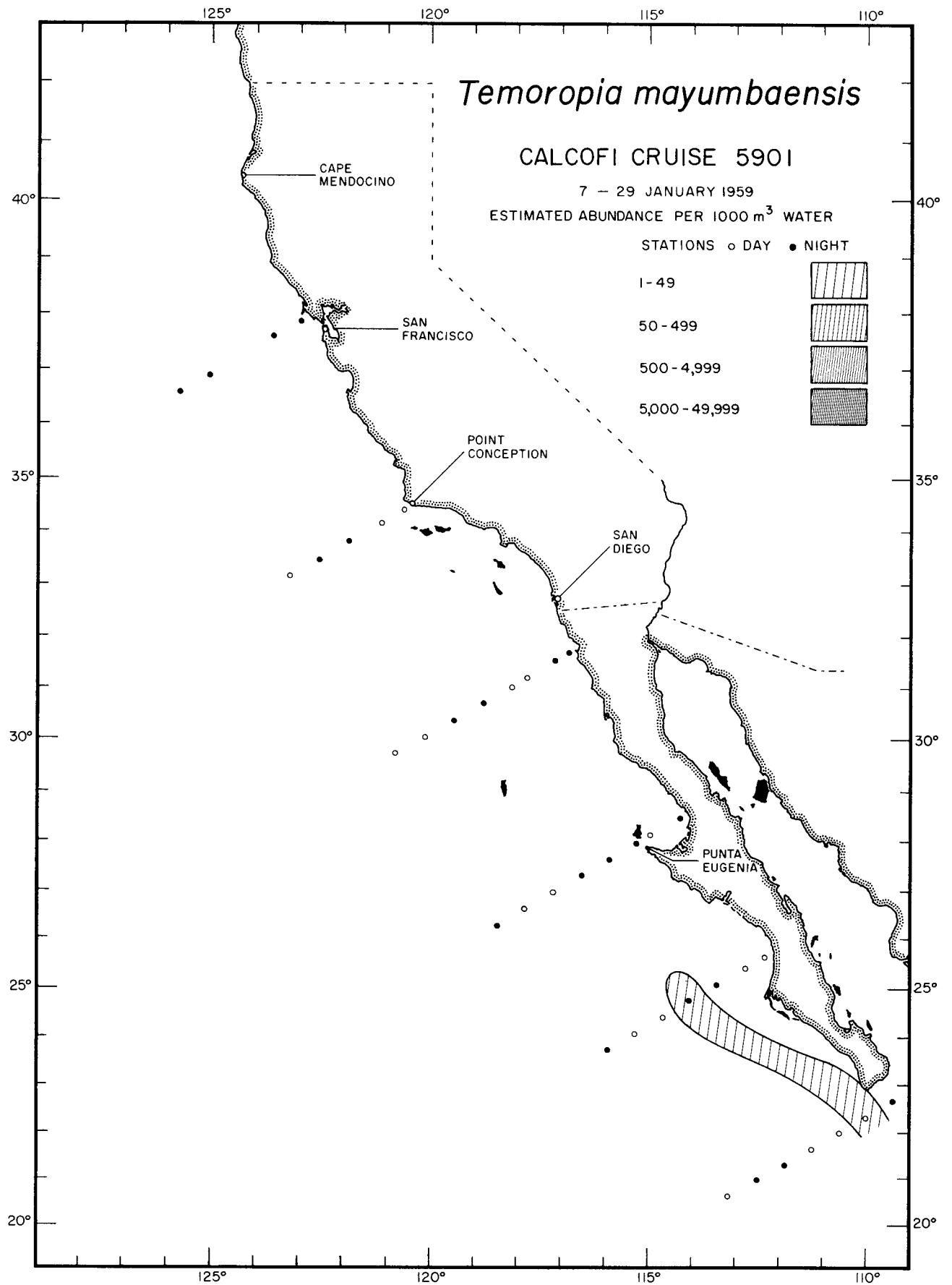
Calanoida
Scottocalanus securifrons
5810



Calanoida
Spinocalanus abyssalis
 5804



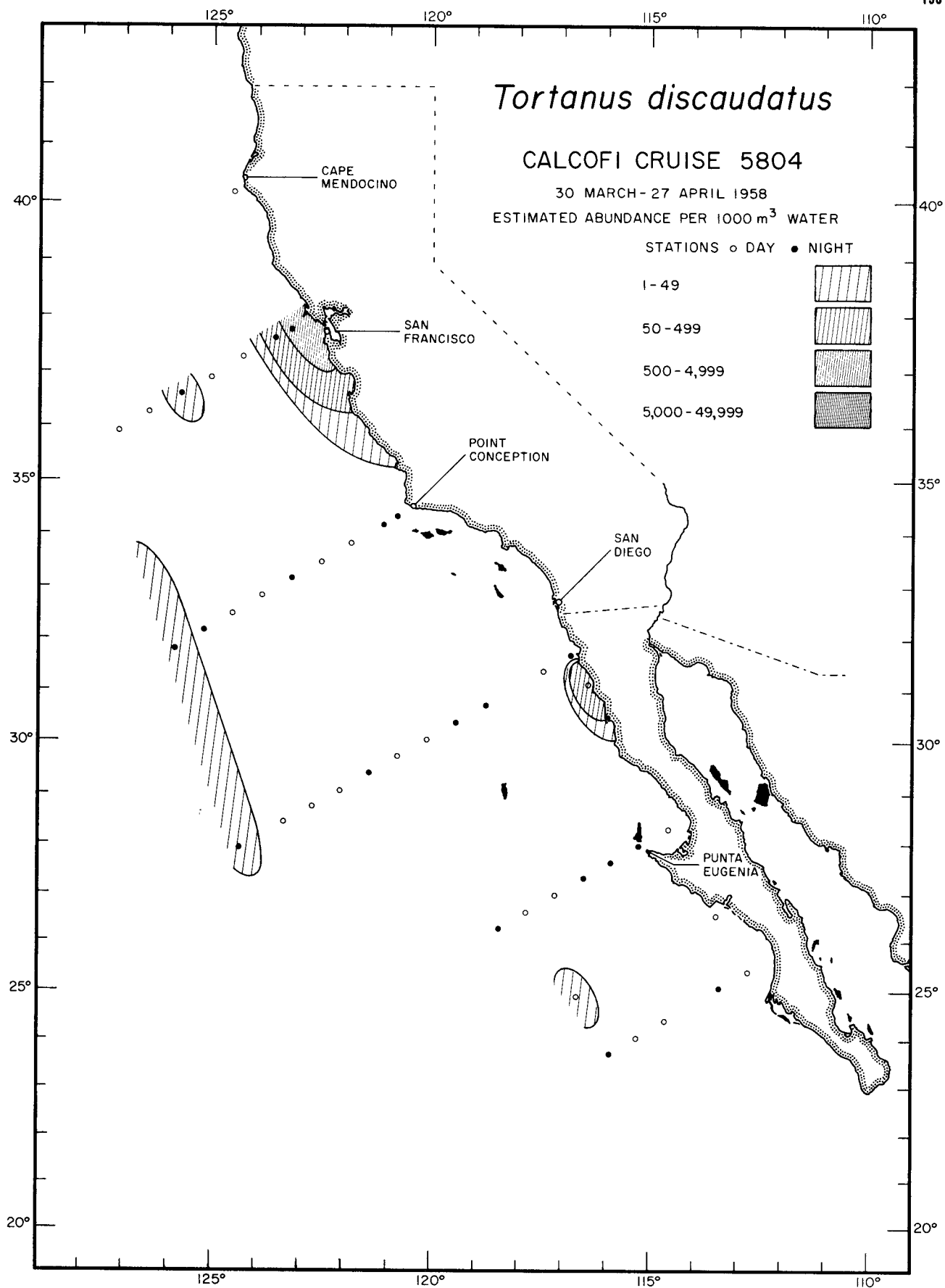
Calanoida
Spinocalanus magnus
5901



Calanoida

Temoropia mayumbaensis

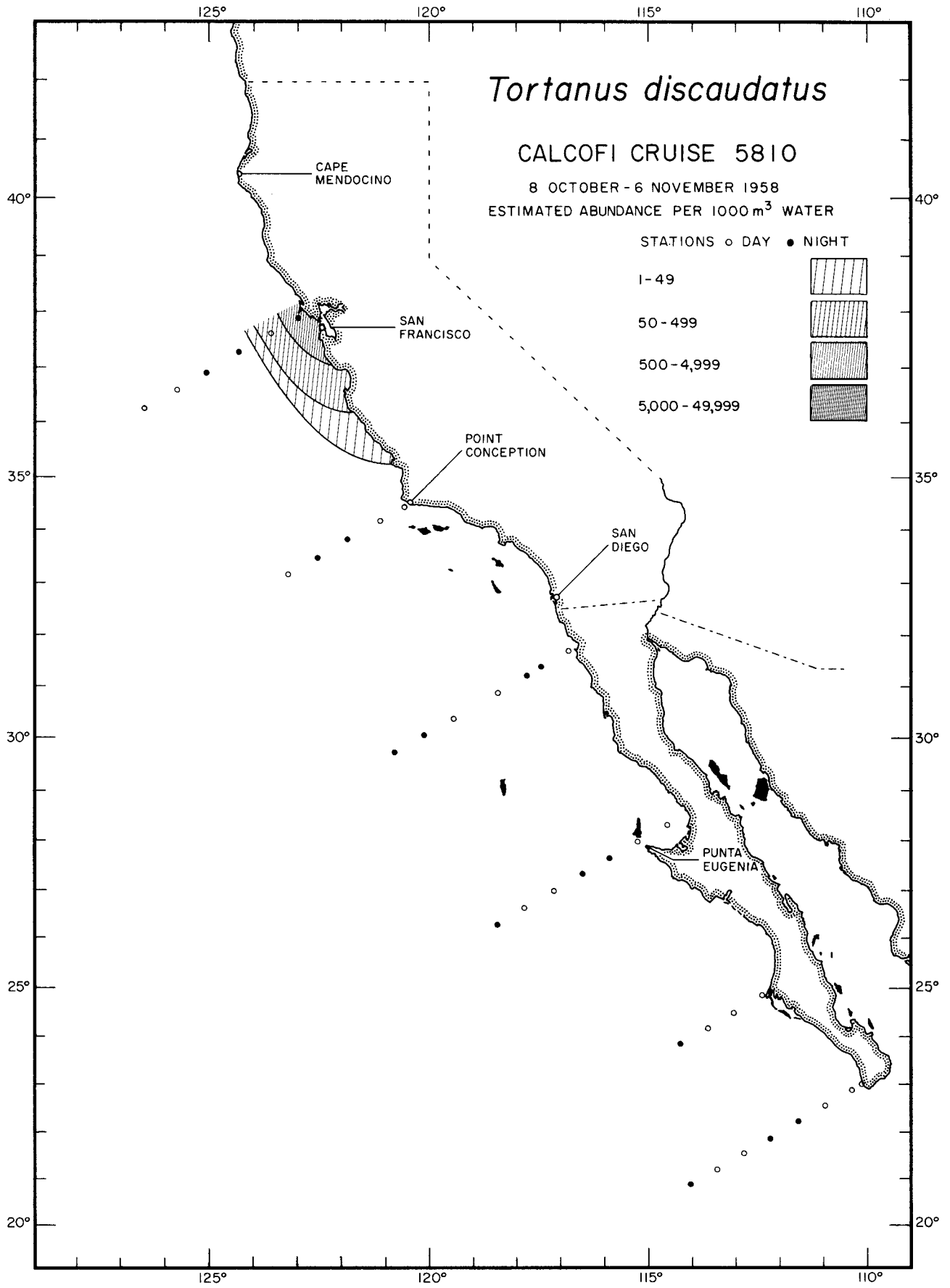
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Calanoida

Tortanus discaudatus

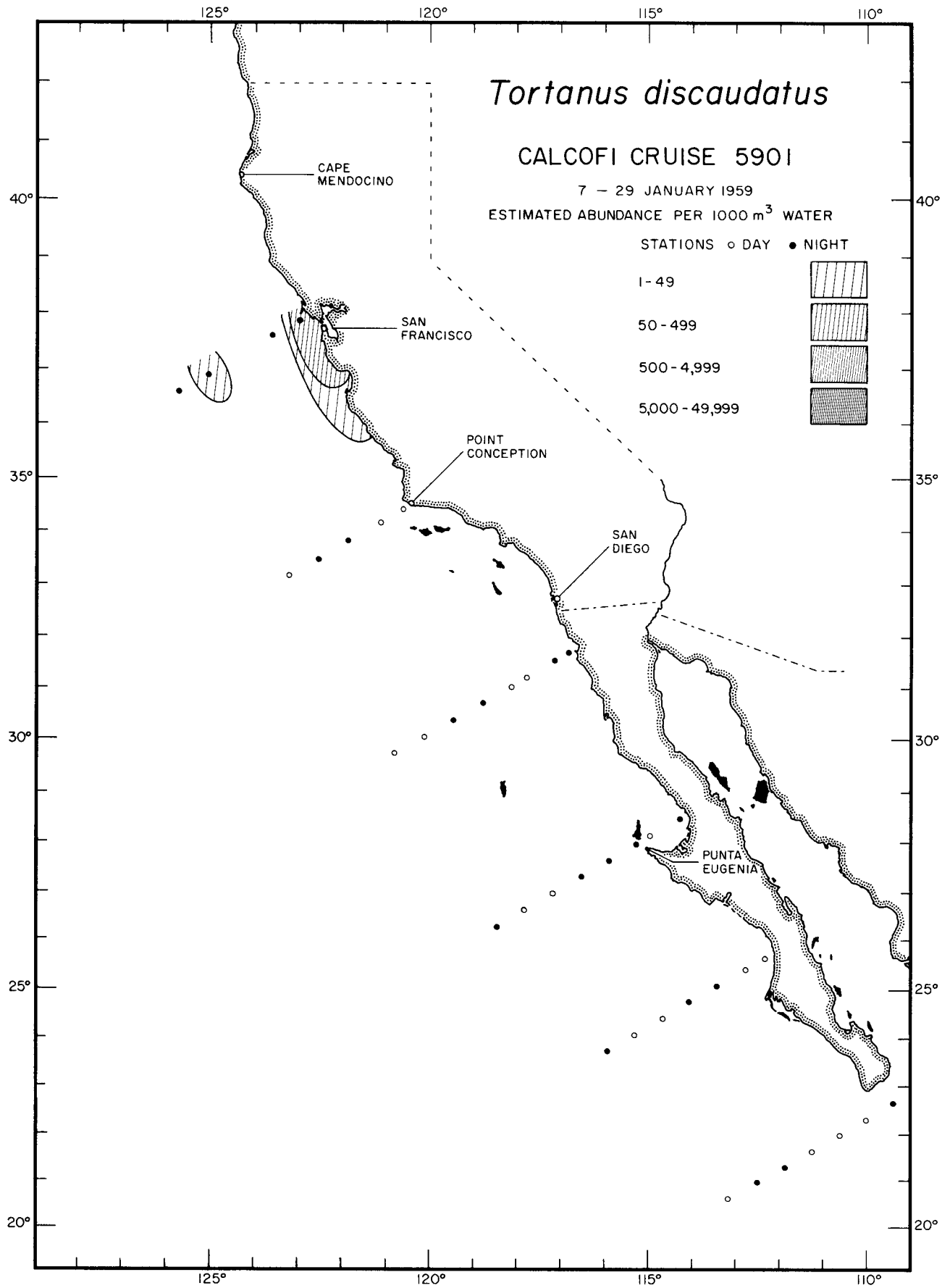
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Calanoida

Tortanus discaudatus

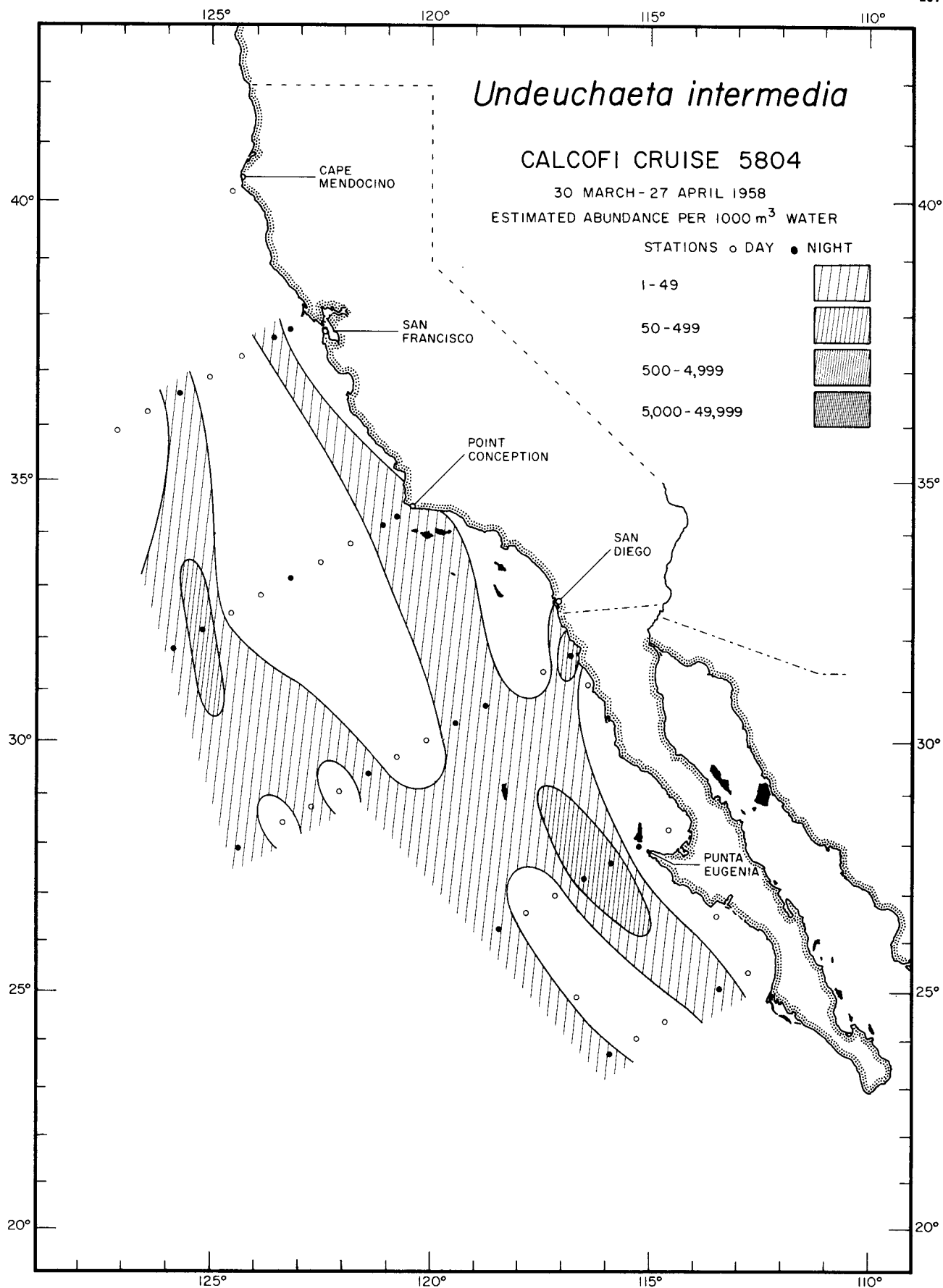
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Calanoida

Tortanus discaudatus

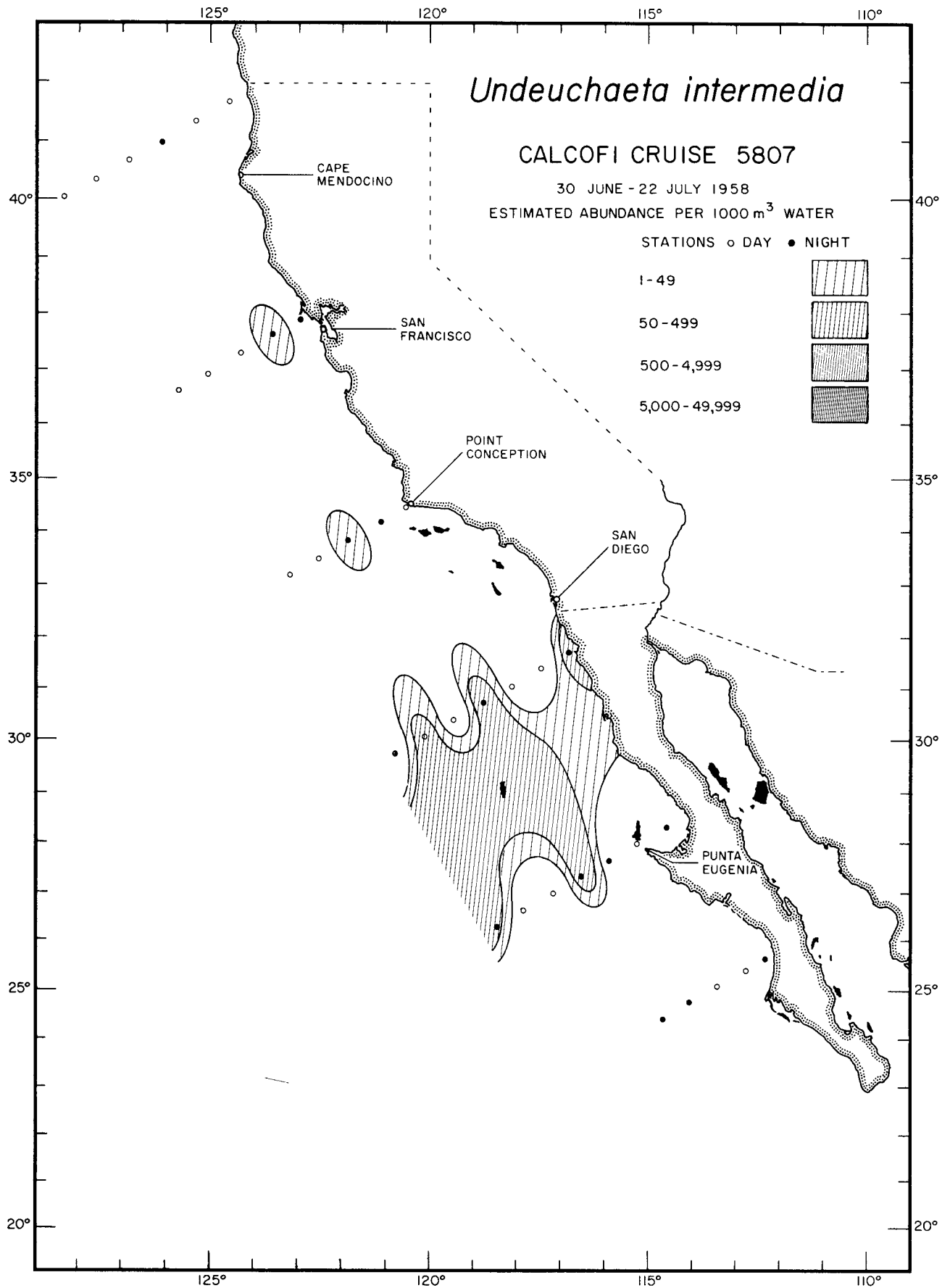
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Calanoida

Undeuchaeta intermedia

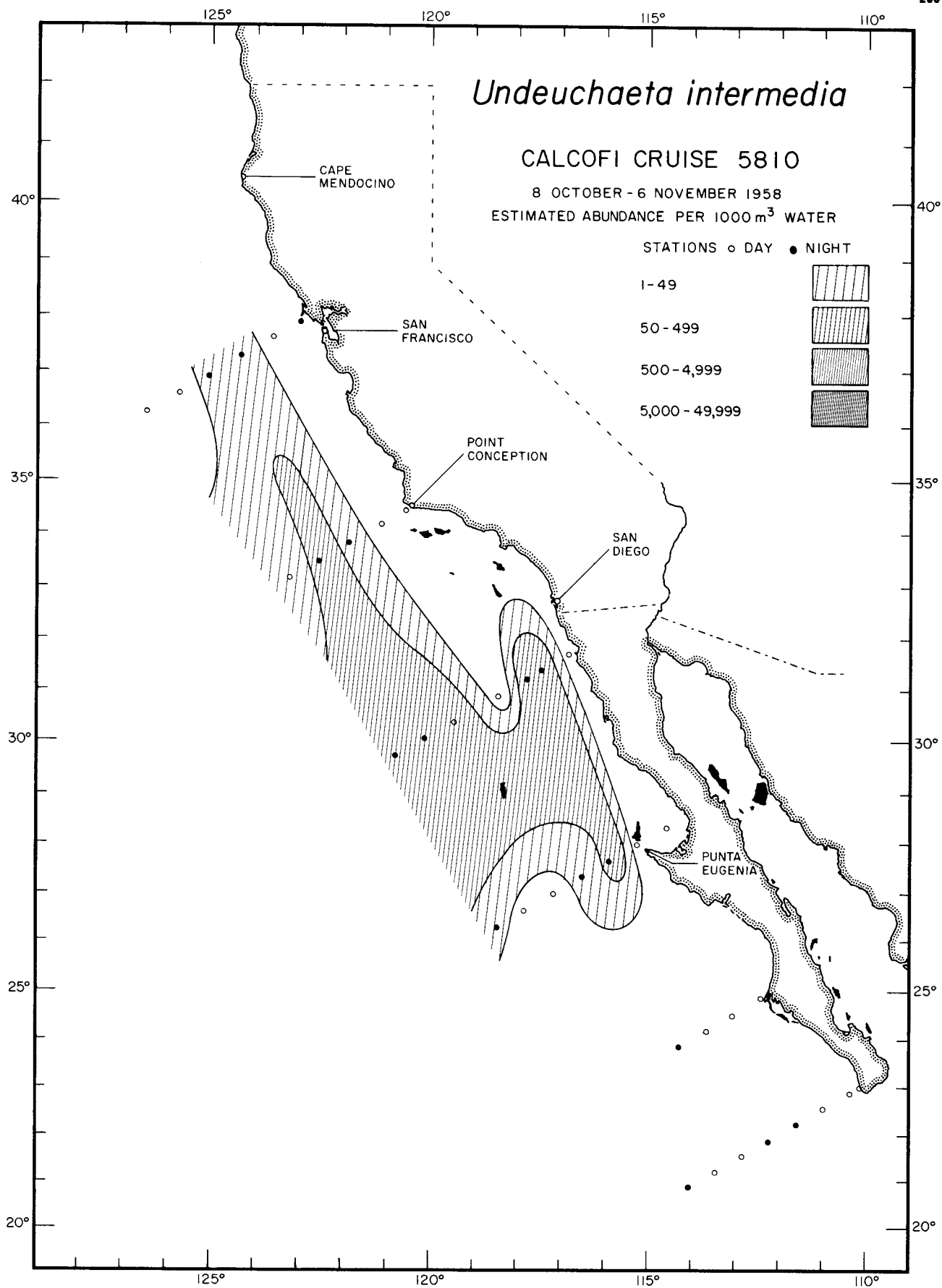
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Calanoida

Undeuchaeta intermedia

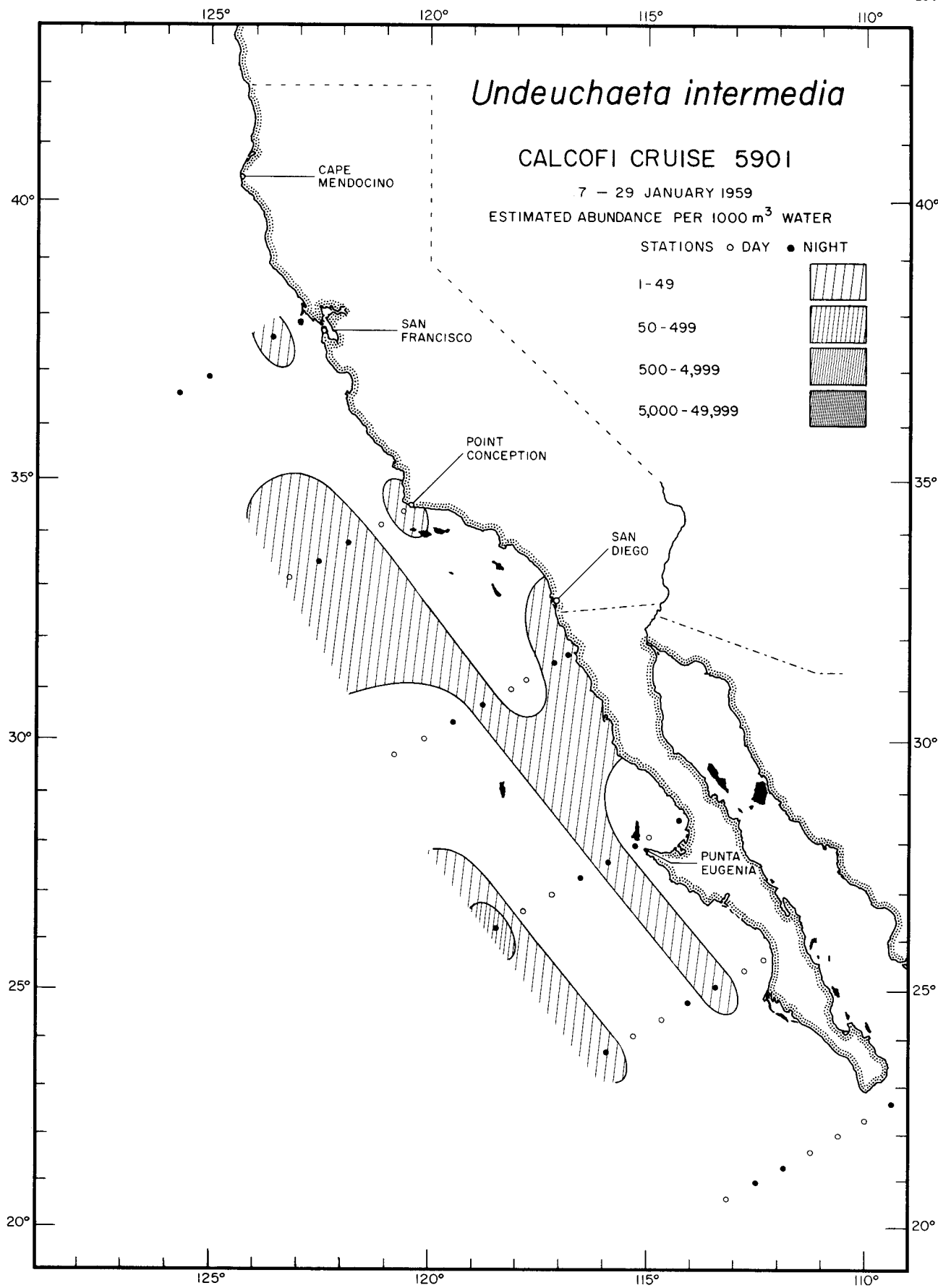
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Calanoida

Undeuchaeta intermedia

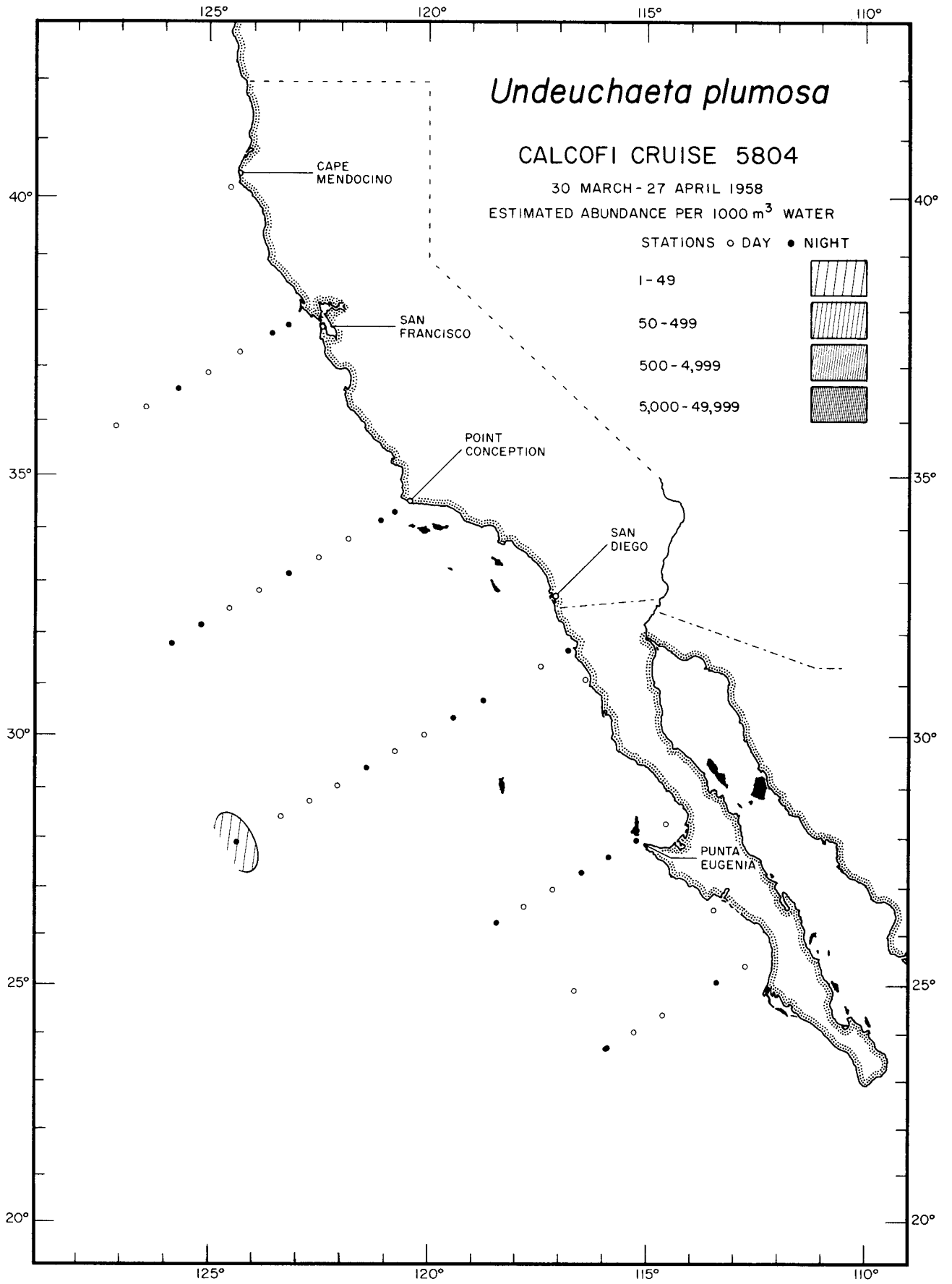
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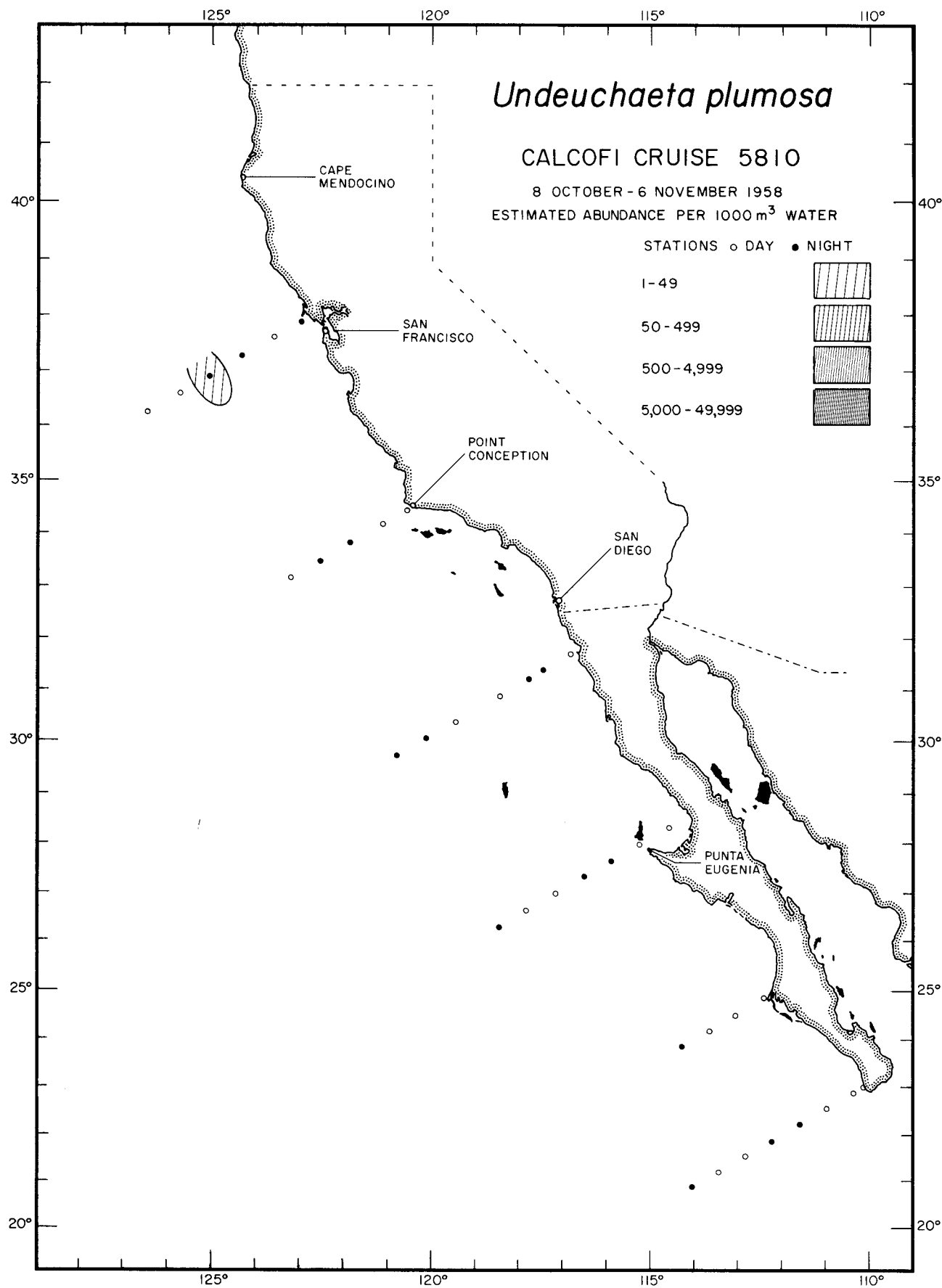
Calanoida

Undeuchaeta intermedia

5901



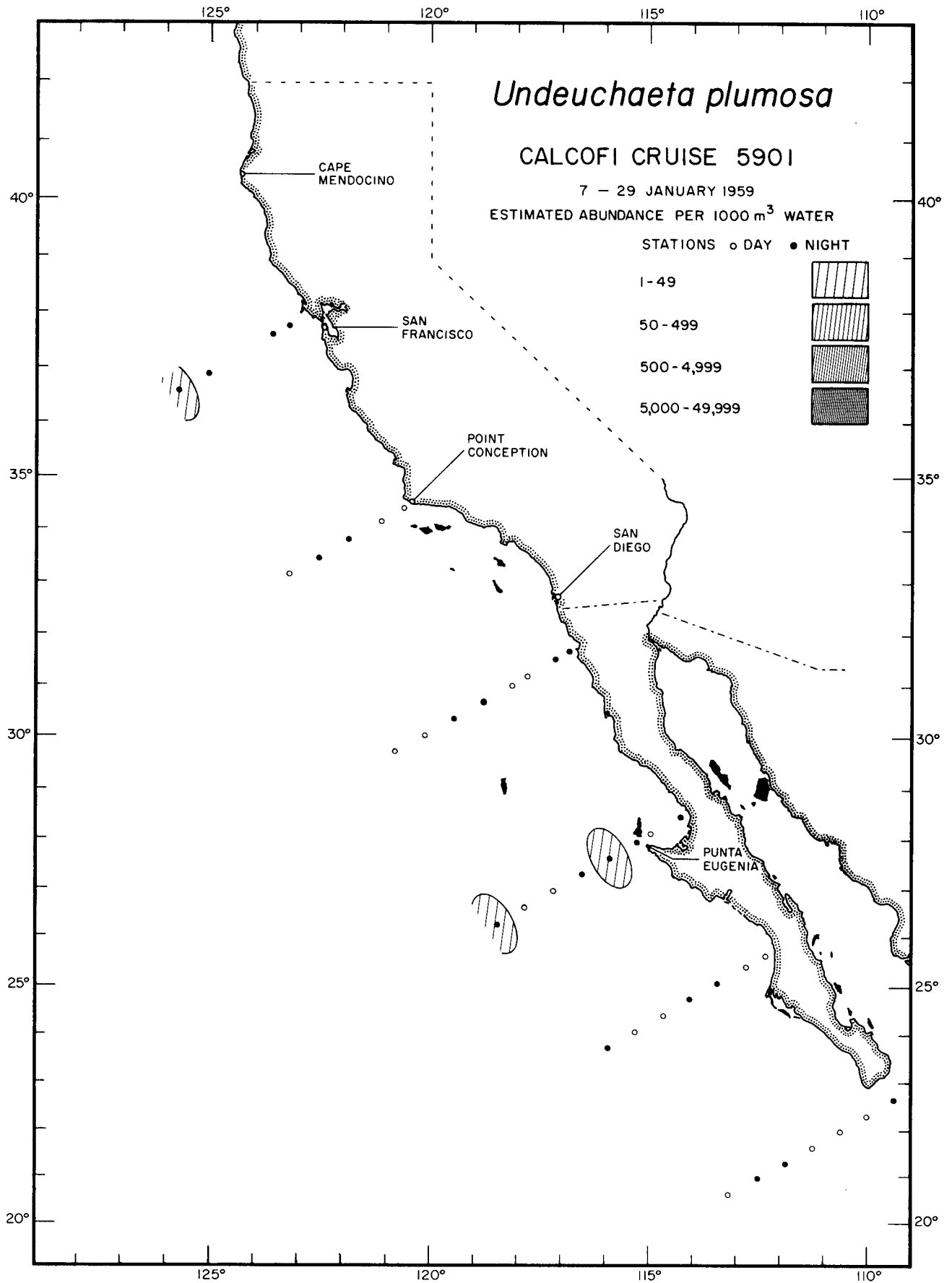
Calanoida
Undeuchaeta plumosa
5804



Calanoida

Undeuchaeta plumosa

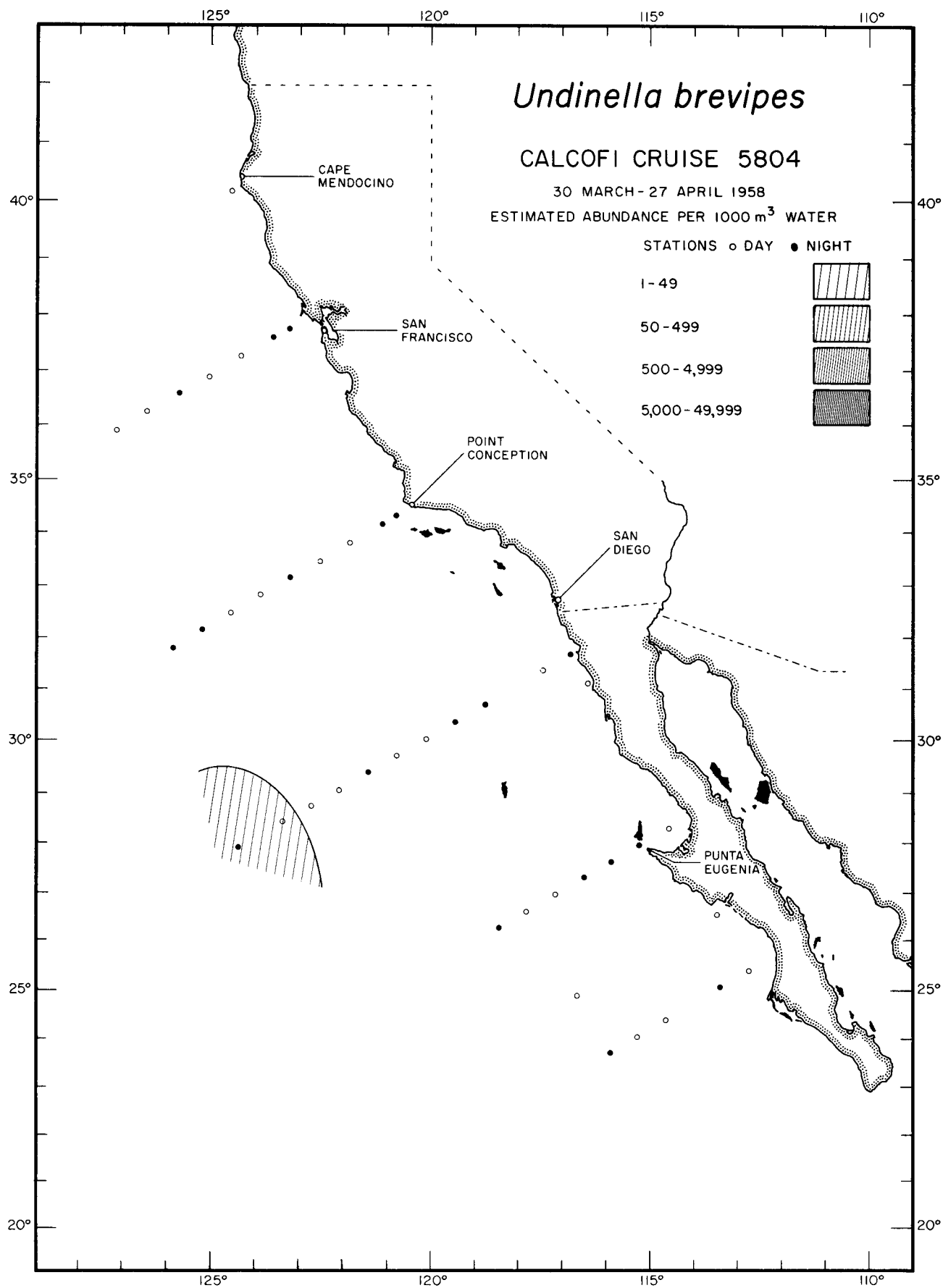
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Calanoida

Undeuchaeta plumosa

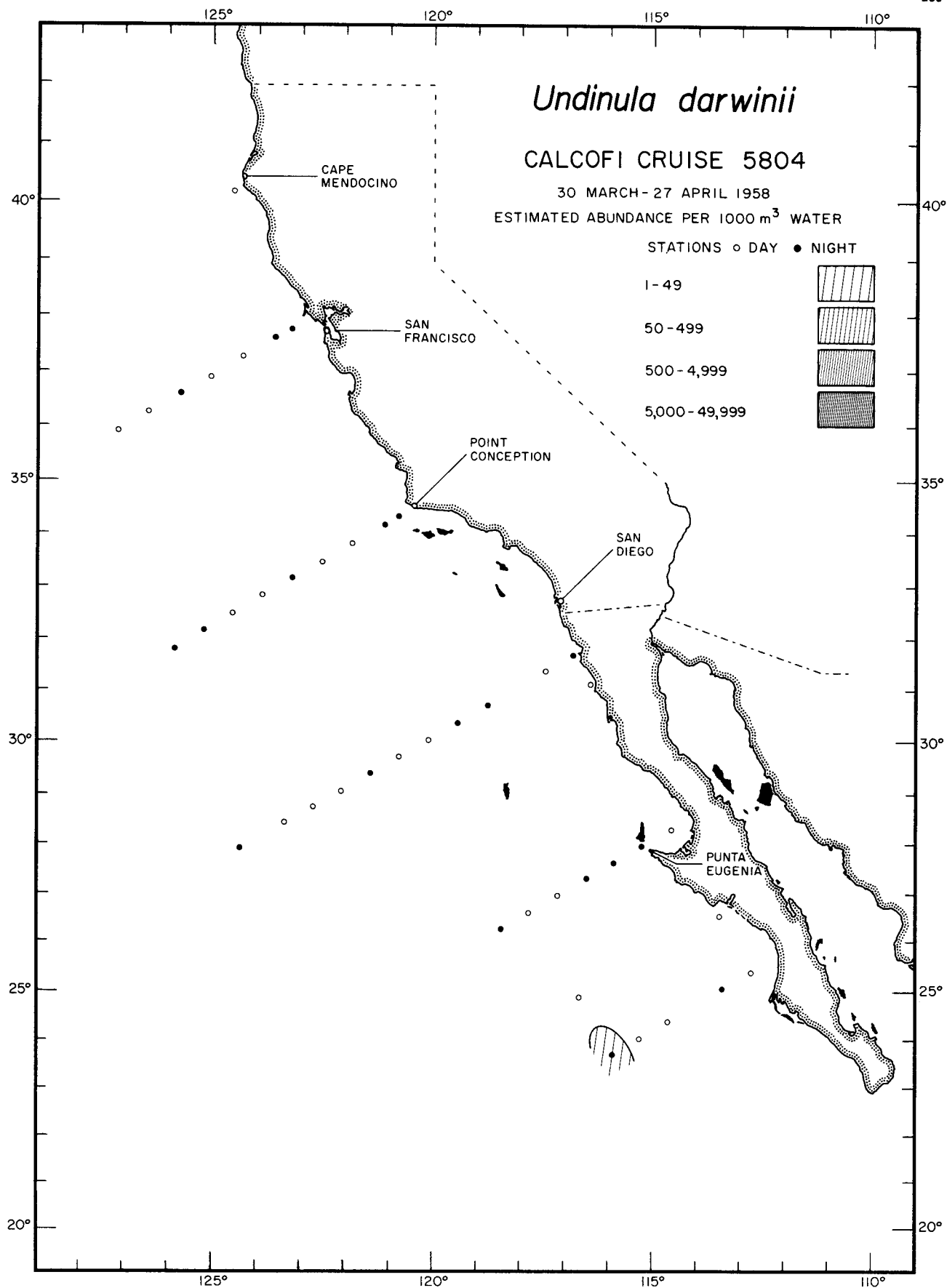
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Calanoida

Undinella brevipes

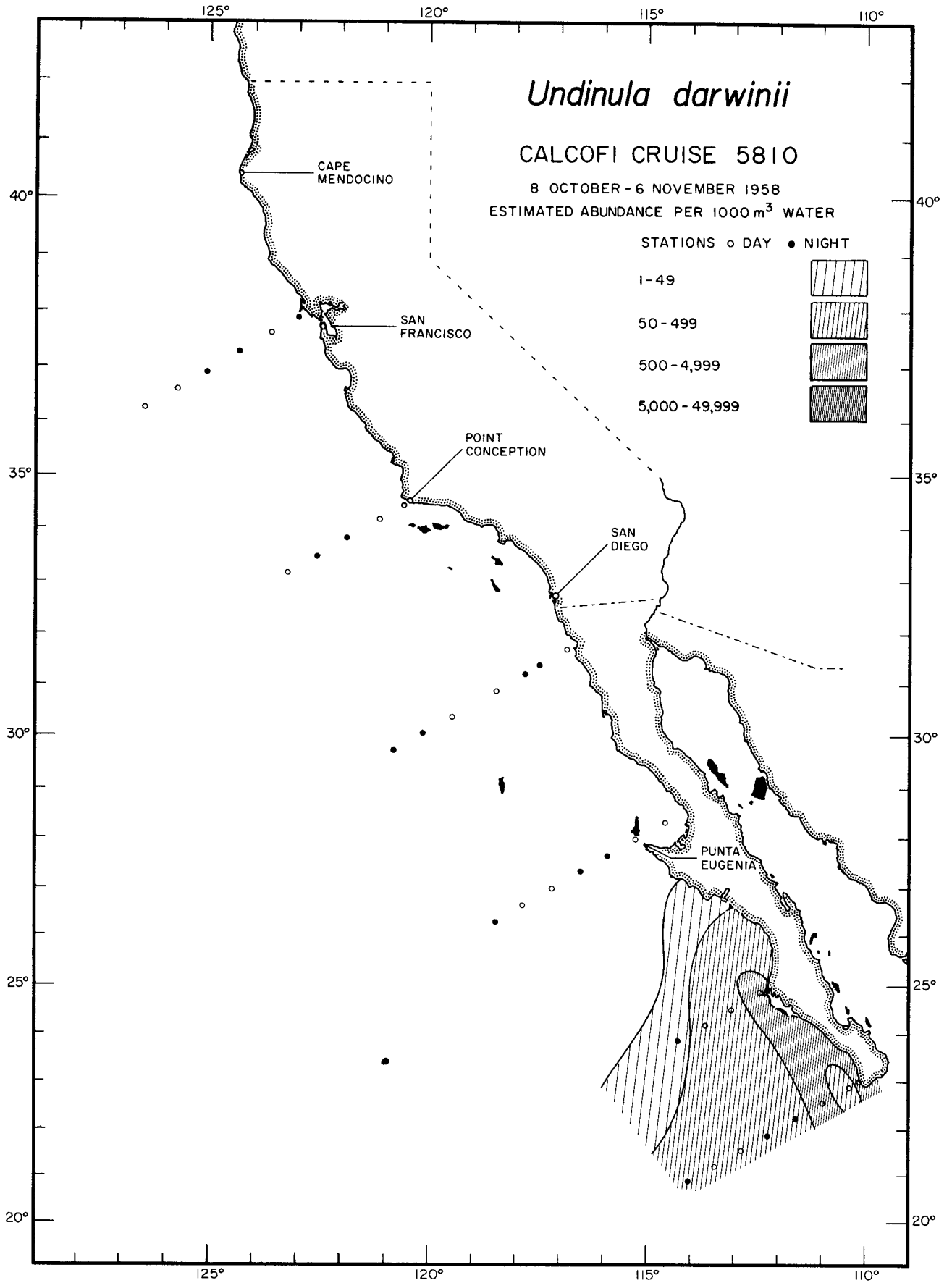
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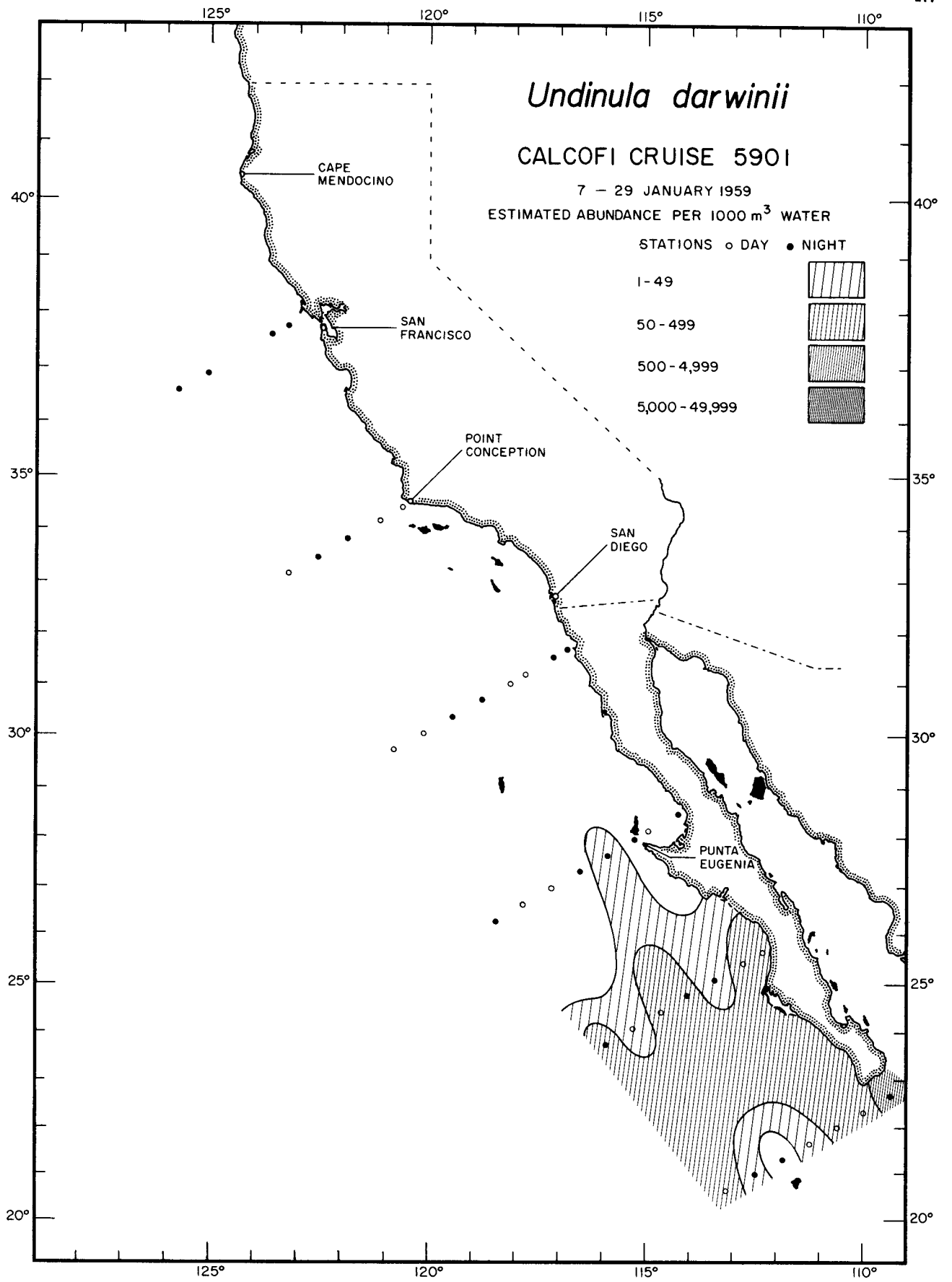
Calanoida

Undinula darwinii

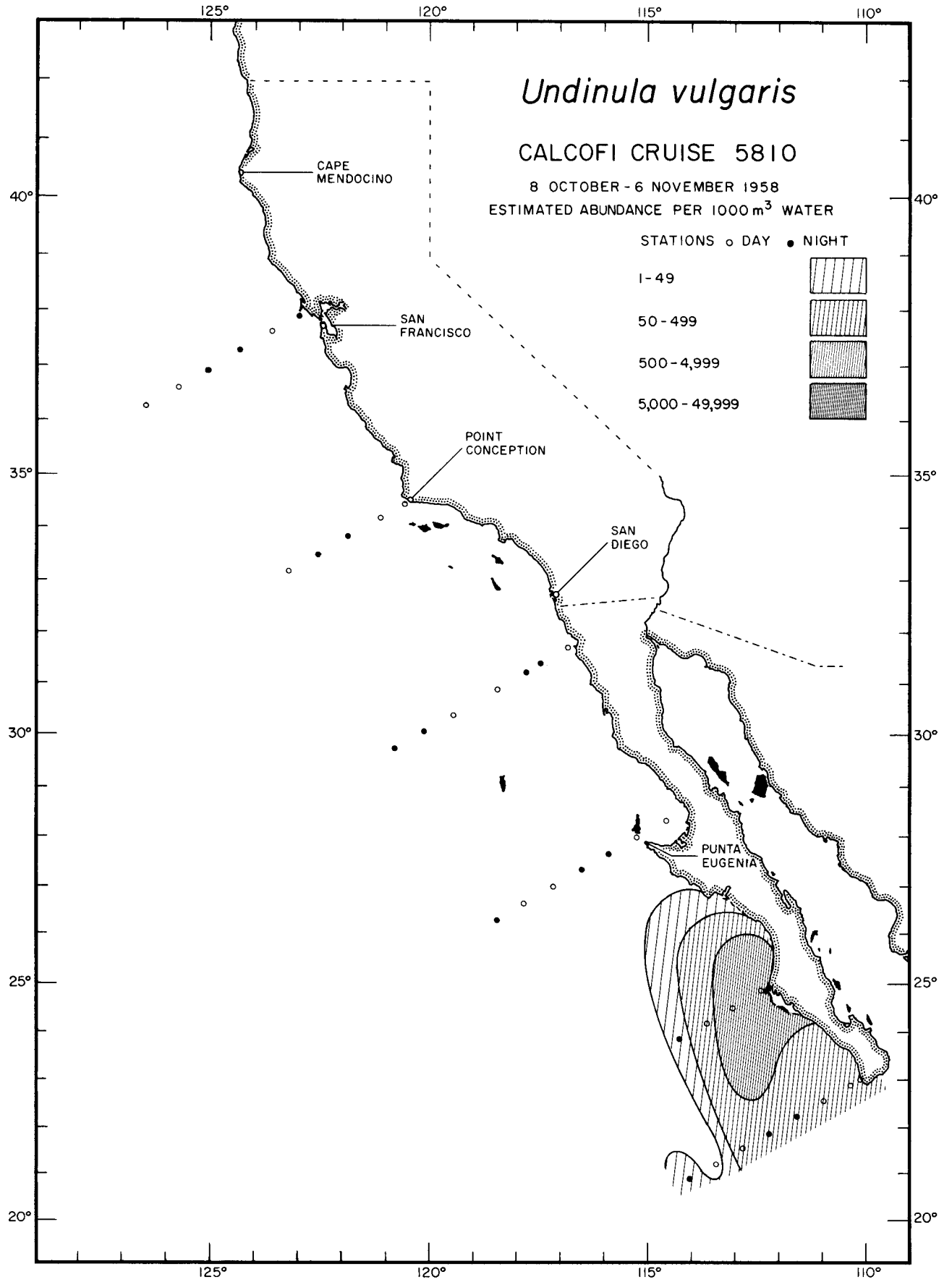
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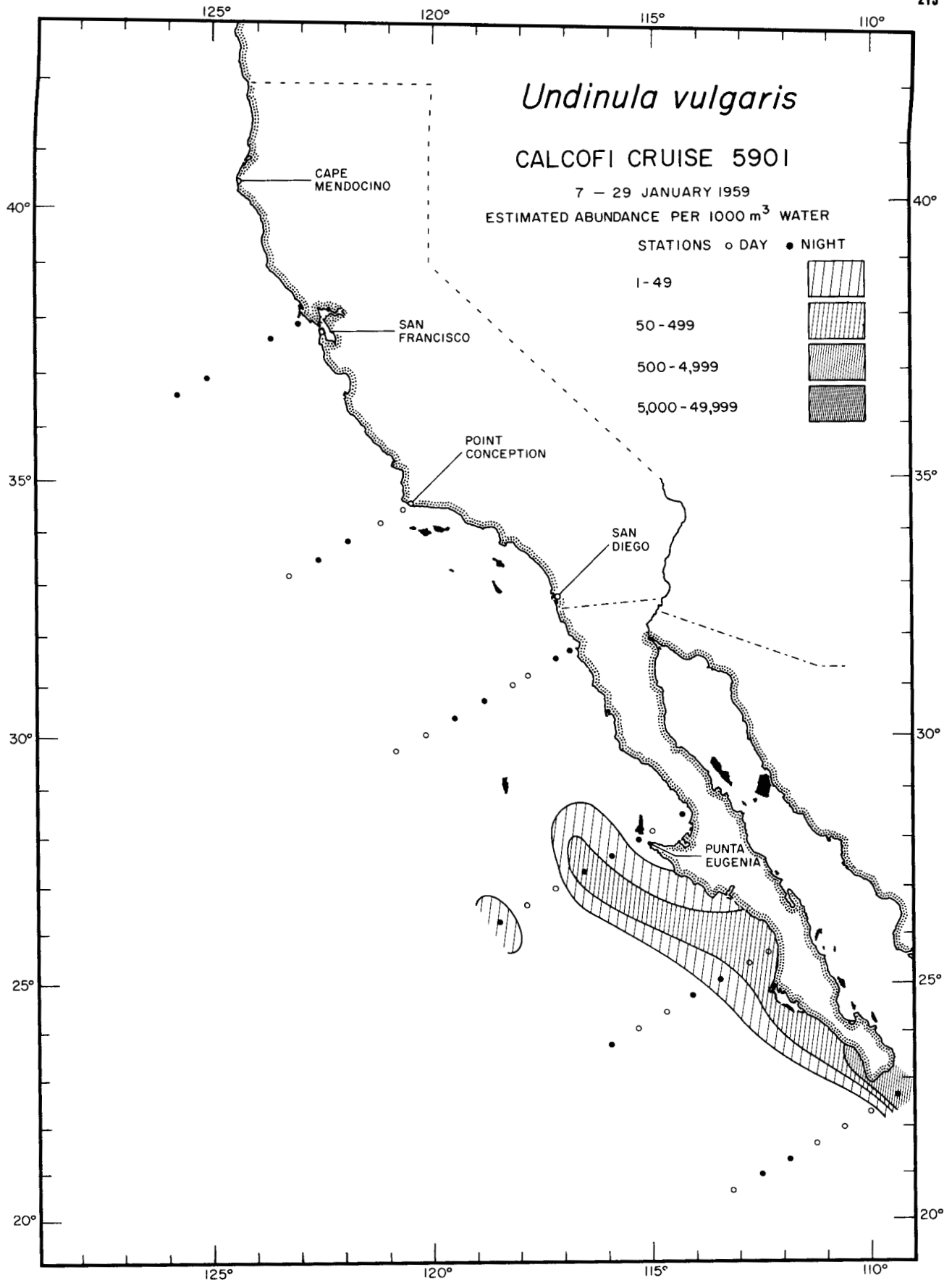
Calanoida
Undinula darwinii
5810



Calanoida
Undinula darwinii
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Calanoida
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