385

SEA SURFACE TEMPERATURE MONTHLY AVERAGE AND ANOMALY CHARTS NORTHEASTERN PACIFIC OCEAN 1947-58

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FISH AND WILDLIFE SERVICE

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Fish and Wildlife Service, Clarence F. Pautzke, Commissioner
Bureau of Commercial Fisheries, Donald L. McKernan, Director

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by

James H. Johnson

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ABSTRACT

Sea temperature data in the area bounded by the west coast of North America and longitude 150° W. and latitude 20° N. to 54° N. and temperature data at four coastal stations along the west coast of North America are presented in two parts. Part I consists of 12 monthly average charts based on data from 1947 to 1958, and Part II consists of 144 monthly anomaly charts derived from the average charts.

INTRODUCTION

The U.S. Fish and Wildlife Service's Bureau of Commercial Fisheries Biological Laboratory, San Diego, California, is conducting oceanographic investigations on the causes and predictability of changes in availability of tunas of the eastern Pacific Ocean. One aspect of these investigations is the issuance of monthly sea surface temperature charts of the eastern Pacific (Branch of Market News, 1960). The preparation of these charts is a continuation and expansion of a similar program initiated in 1957 by the Bureau of Commercial Fisheries Biological Laboratory, Honolulu, Hawaii. The purpose of these charts is to provide current sea temperature information to the fishing industry and to marine scientists.

In addition to publishing current temperature information, scientists at the San Diego Laboratory are studying historical sea surface temperature data and fishing records to ascertain relationships between sea temperatures and the spatial and temporal distribution of the eastern Pacific tunas. My objective is to present, for use and information of others, sea temperature data of the eastern Pacific Ocean from 1947 to 1958 that have been compiled for these tuna environmental studies.

That the distribution of tunas in the eastern Pacific is influenced by sea surface temperatures is well documented. Hubbs and Schultz (1929) attributed the appearance of albacore *(Thunnus germo)* in 1925 and 1926 northward of their usual range off the west coast of North America to above-normal water temperatures. The development of the albacore fishery off the California coast in 1957 farther north than during the preceding 6 years likewise has been attributed to higher than normal temperatures (Radovich,

1961). Hester (1961)[1] has found that landings of bluefin *(Thunnus saliens)* and albacore taken off southern and Baja California are correlated to water temperatures at two coastal stations in southern California. According to Alverson (1959), movements of the tropical tunas, skipjack *(Katsuwonus pelamis)* and yellowfin *(Neothunnus macropterus)* into and out of regions off Baja California appear to be related to sea temperatures, and Blackburn (1960) suggested that skipjack and yellowfin ranged farther north than usual off the west coast of North America in 1957 and 1958, years recorded by Stewart, et al. (1958); Reid (1960); and others, as "warm years" in the eastern Pacific Ocean.

MATERIALS AND METHODS

The oceanic sea temperature data presented in this study are injection temperatures taken by merchant and naval ships cooperating with the U.S. Weather Bureau. These data were made available to the author by the Laboratory Director, Bureau of Commercial Fisheries Biological Laboratory, Stanford, California. By investigating broad-scale oceanographic changes in the Pacific Ocean north of latitude 20° S., scientists at that laboratory have obtained historical records of injection temperatures as well as other oceanographic and meteorological data from the National Weather Records Center, Asheville, North Carolina.

Coastal temperatures at Cape St. James and Kains Island, British Columbia, were extracted from a report by Hollister (1960). Temperatures at Hopkins Marine Station, Pacific Grove, California, and Scripps Pier, La Jolla, California, were obtained from a manuscript prepared under the direction of Margaret K. Robinson of Scripps Institution of Oceanography.[2] The locations of these stations are as follows:

Station	Location: Latitude	Location: Longitude
Cape St. James, B.C.	51° 56' N.	131° 01' W.
Kains Island, B.C.	50° 26' N.	128° 02' W.
Pacific Grove, Calif.	36° 38' N.	121° 55' W.
Scripps Pier, La Jolla, Calif.	32° 52' N.	117° 15' W.

Injection temperatures are subject to a wide range of error depending upon type, placement, and operation of injection systems and placement of recording thermometers in the systems. Intakes for these systems range approximately 10-30 feet below the surface of the water. Franceschini (1955) concluded, however, that the surface temperature distribution derived from injection temperatures in the Gulf of Mexico in 1951 and 1952 was not significantly different from that obtained from scientific oceanographic surveys.

An analysis of observations taken aboard five Military Sea Transport Service ships to obtain data on the difference between injection temperatures and surface temperatures (obtained through use of accurately calibrated thermometers contained in standard Scripps Institution of Oceanography holders or "buckets") has been made by Saur[3] of the Bureau of Commercial Fisheries Biological Laboratory, Stanford, in cooperation with the U.S. Weather Bureau. The bias was not consistent among ships but ranged from -0.5° to 2.2° F. Further observations from many ships are required before it will be possible to estimate a possible bias of reporting ships as a whole in relation to surface temperature.

Another study, still in progress at the Bureau's Biological Laboratory at Stanford, wherein a given ship's reported temperatures are compared with the temperatures reported by other ships at the same time and place (10-day period, 2° lat. by 2° long.) promises to give an estimate of bias based on data from a large number of

[1] Hester, Frank J. A method of predicting tuna catch by using coastal sea-surface temperatures. California Fish and Game (in press).

[2] Daily surface water temperatures and salinities at shore stations, California and Washington coasts, 1945-1959. University of California, Scripps Institution of Oceanography.

[3] Saur, J. F. T. On the difference between sea water temperatures from ship's weather observations and sea surface temperatures. Paper presented at American Geophysical Union, Southwest Regional meetings, January 26, 1961, Berkeley, California.

ships. The preliminary results from study of 6000 observations from some 300 ships suggest that about 12 percent of observations were from ships systematically reporting temperatures more than 2° F. higher or lower than the mean of the reporting fleet, with some ships departing as much as 5° F. Whether or not temperatures reported by the fleet average generally above or below the true temperature remains to be investigated (communication from O. E. Sette).

Individual injection temperatures used in preparation of this report were unedited, and the data presented here should be considered a first approximation for early use. The Stanford Laboratory is investigating editing procedures and will present edited data in the future for broader regions of the Pacific Ocean.

Monthly temperature summaries by 2-degree squares for the region bounded by the west coast of North America and longitude 150° W. and latitude 20° N. to 54° N. were used from the historical records to form 12-year (1947-1958) monthly averages, which are presented in Part I. Monthly temperature anomaly charts based upon the 12-year monthly averages are presented in Part II. Two or more observations were required before a 2-degree square summary from the historical records was used. In the 12-year monthly average charts, Part I, temperatures are listed only when 6 or more years of the 12-year period were represented. The number in the upper right-hand corner of each 2-degree square denotes the number of years that were included in the average. Each year's data were weighted equally.

Contour interval for the 144 anomaly charts, Part II, is 2° F. Hatching indicates regions colder than average. Where confusion could arise in the direction of the anomaly gradient, greater than (>) and less than (<) symbols are used. Isolated 2-degree squares were not contoured; that is, there must have been continuity through two or more squares before contours were drawn. Areas enclosed by dashed lines are regions where data were not available or were too limited to be of value.

Twelve-year (1947-1958) monthly means to the nearest 0.1° F. for the four coastal stations are presented in Part I. Monthly anomalies for the coastal stations (Part II) are based upon the 12-year monthly means. Plus anomalies indicate temperatures warmer than the 12-year mean, and minus anomalies colder than the mean.

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PART I

SEA SURFACE TEMPERATURE MONTHLY AVERAGE CHARTS, NORTHEASTERN PACIFIC OCEAN

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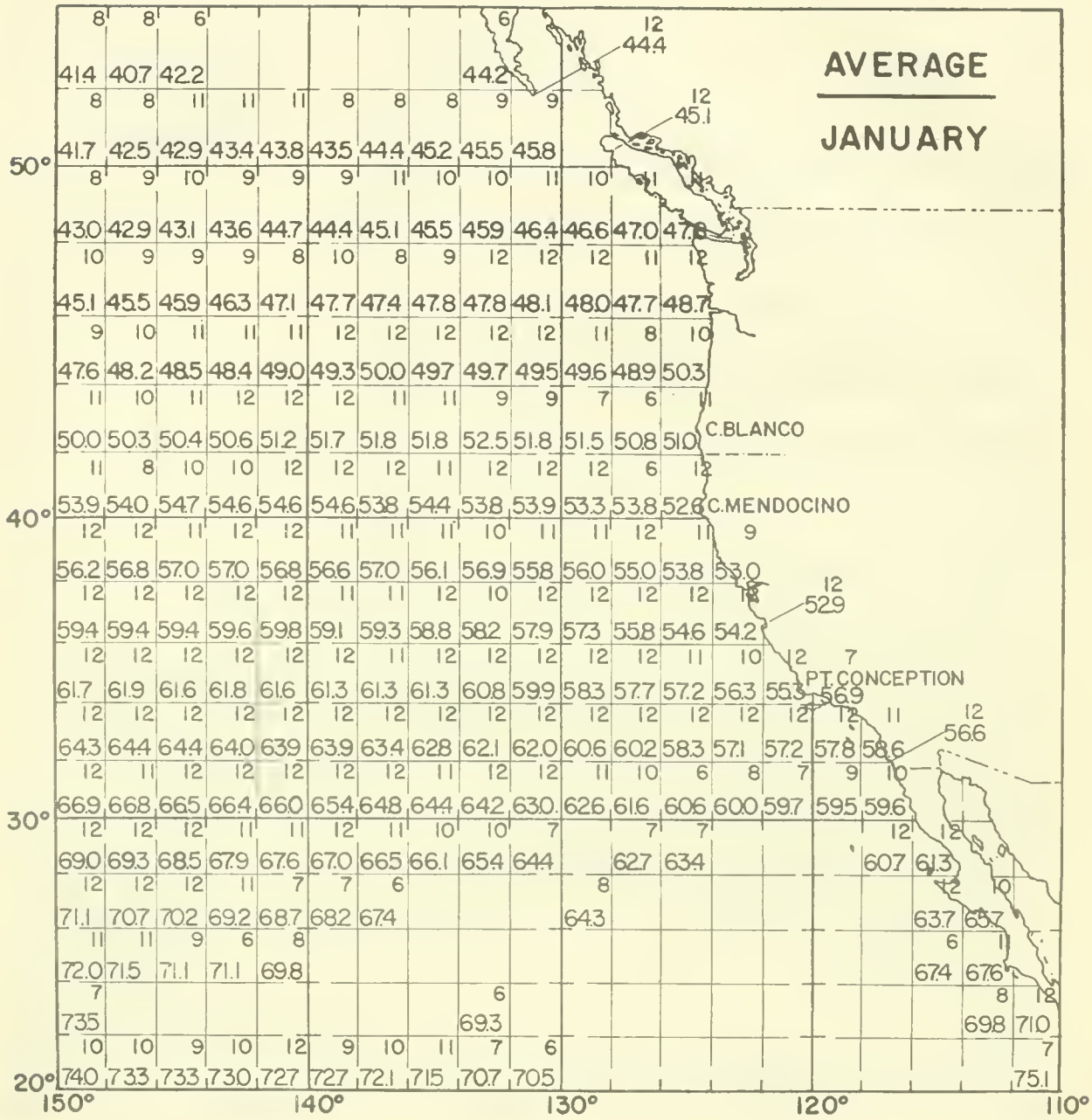
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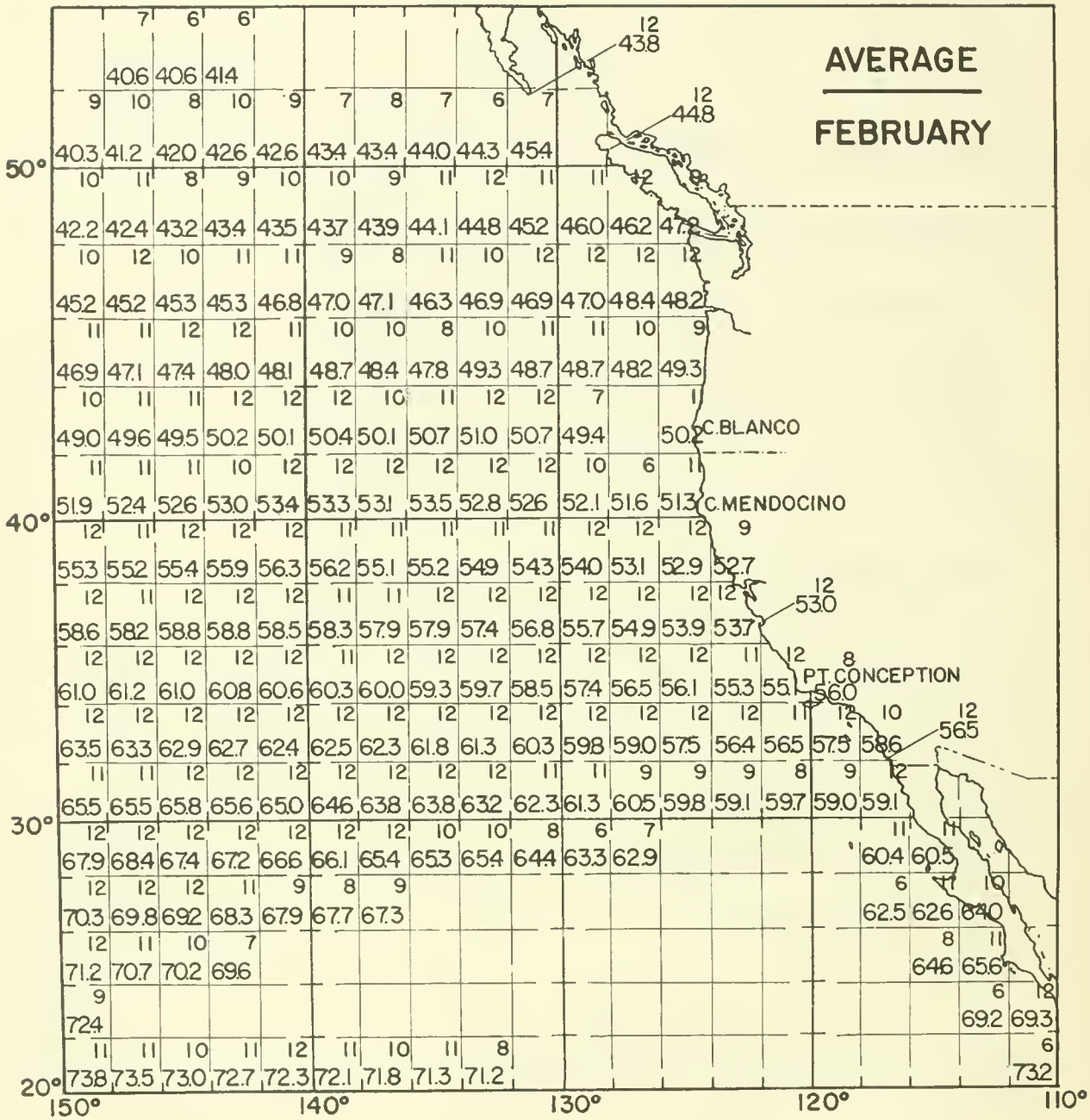
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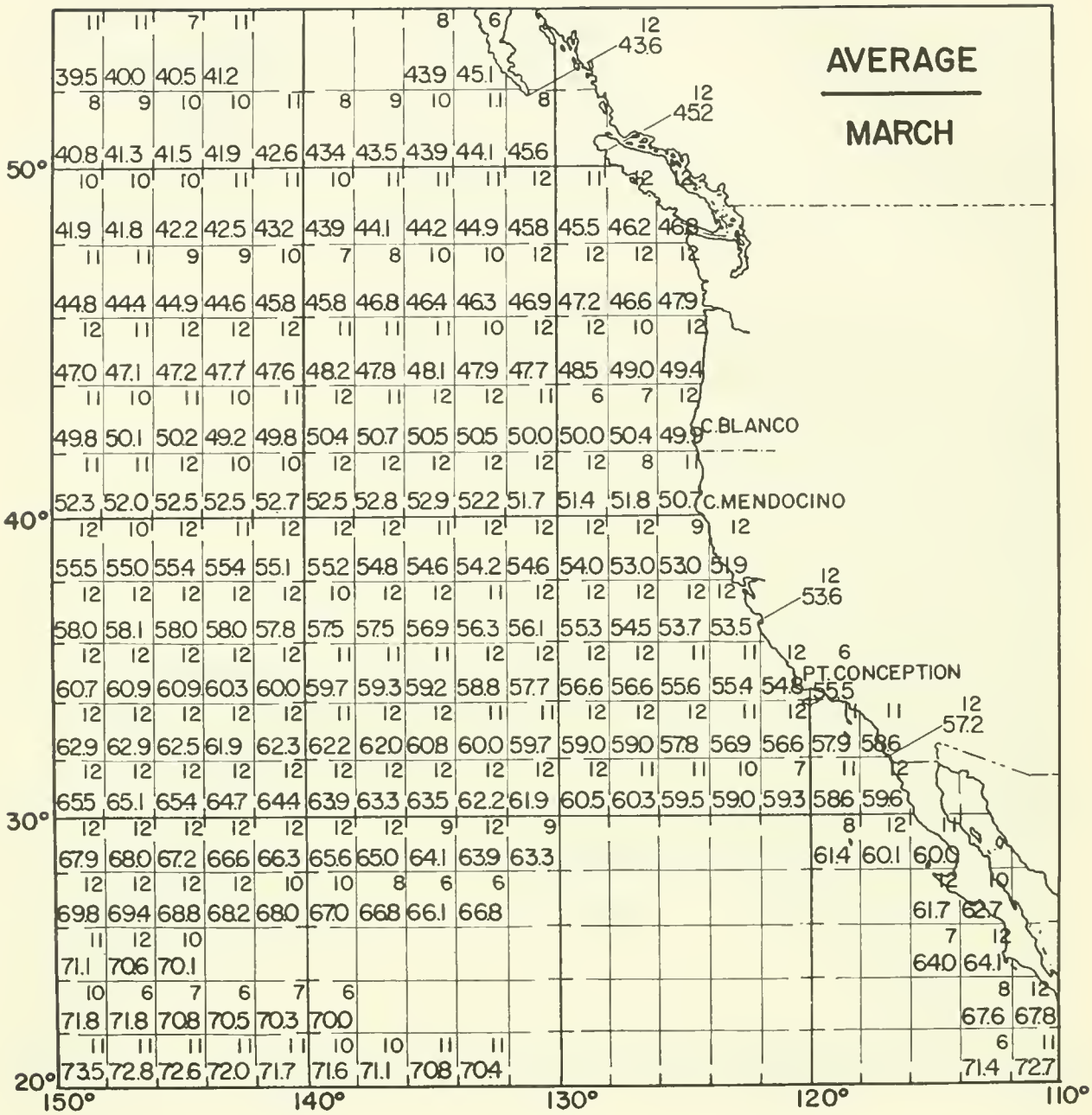
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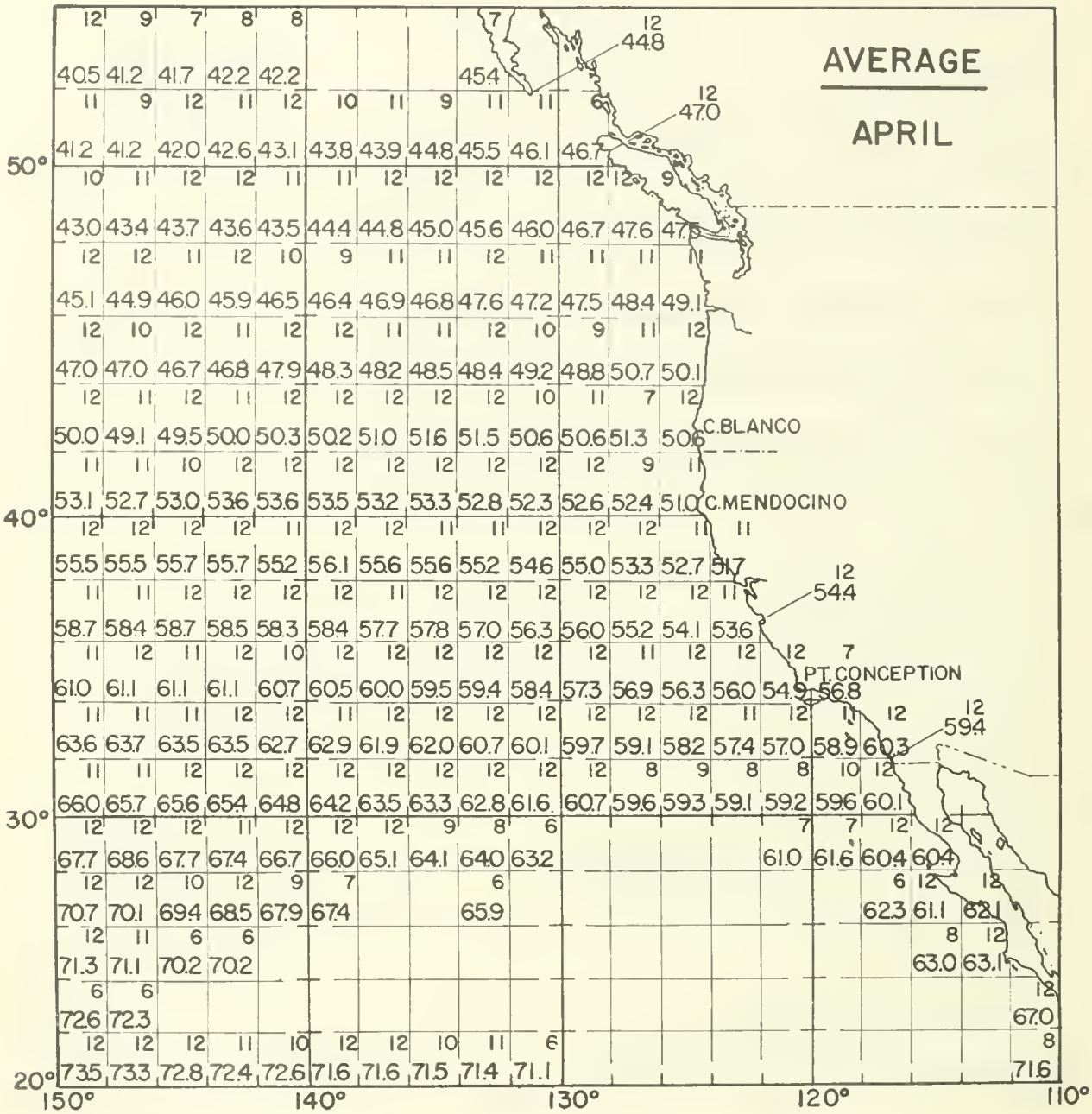
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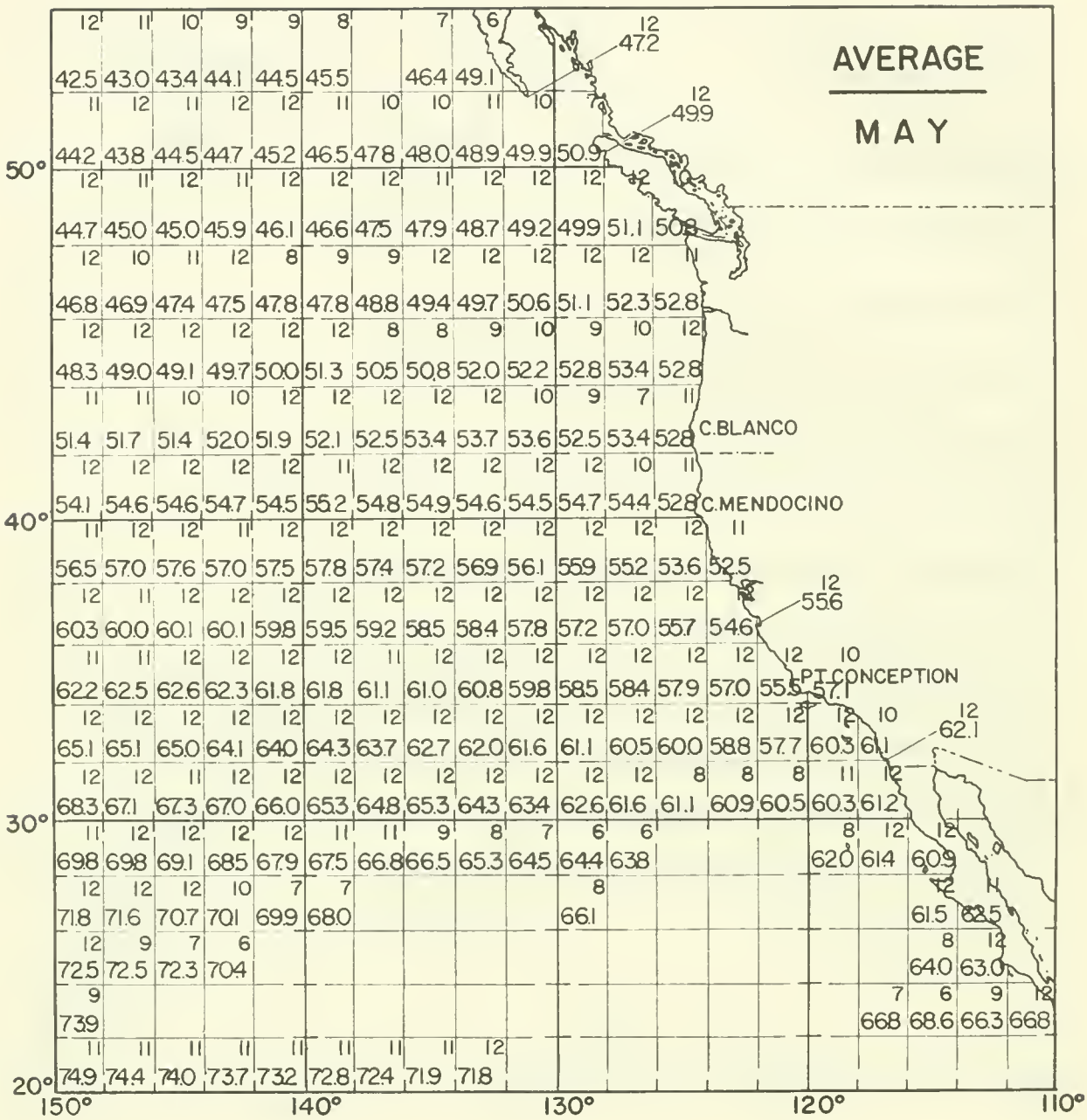
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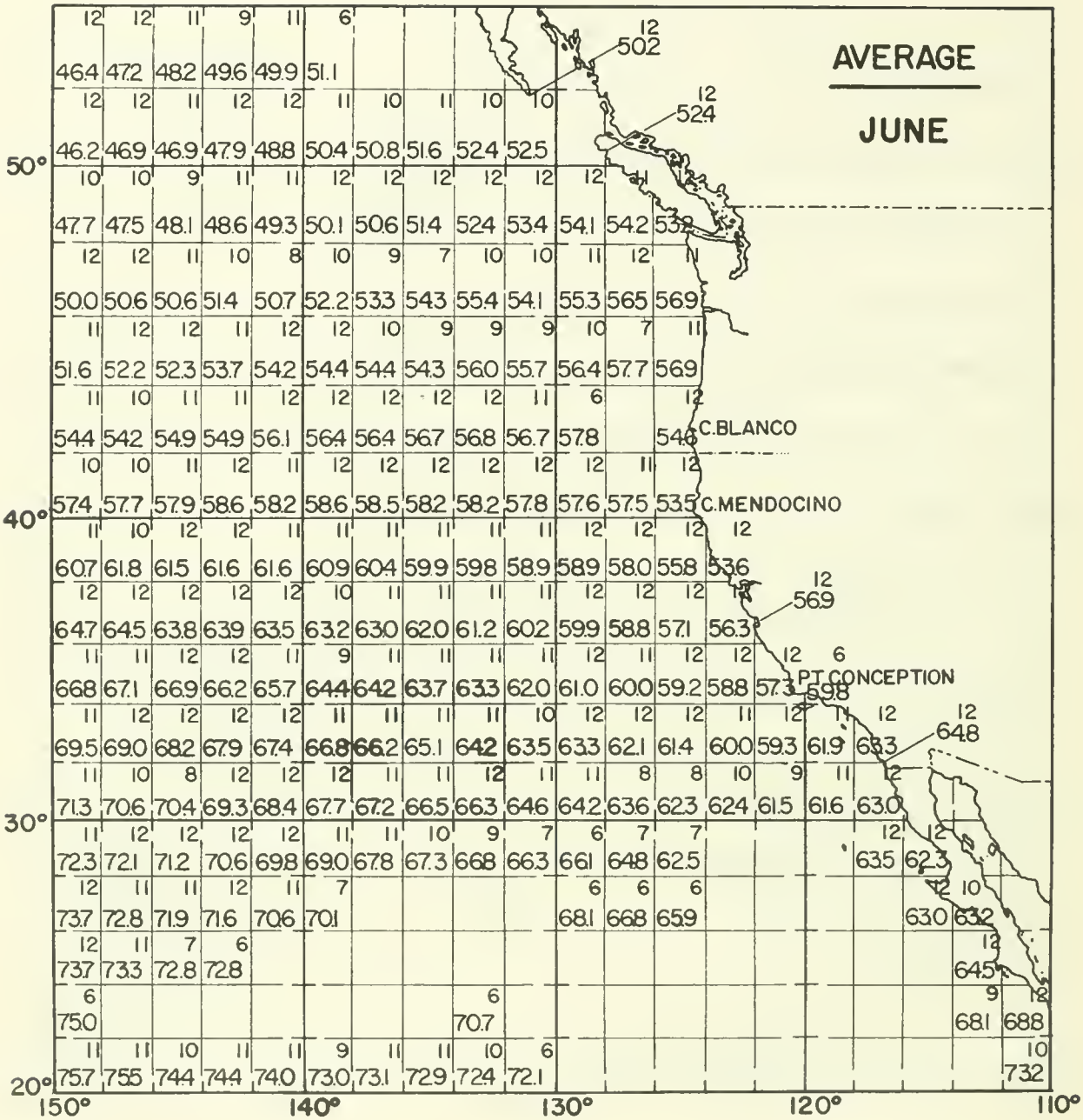
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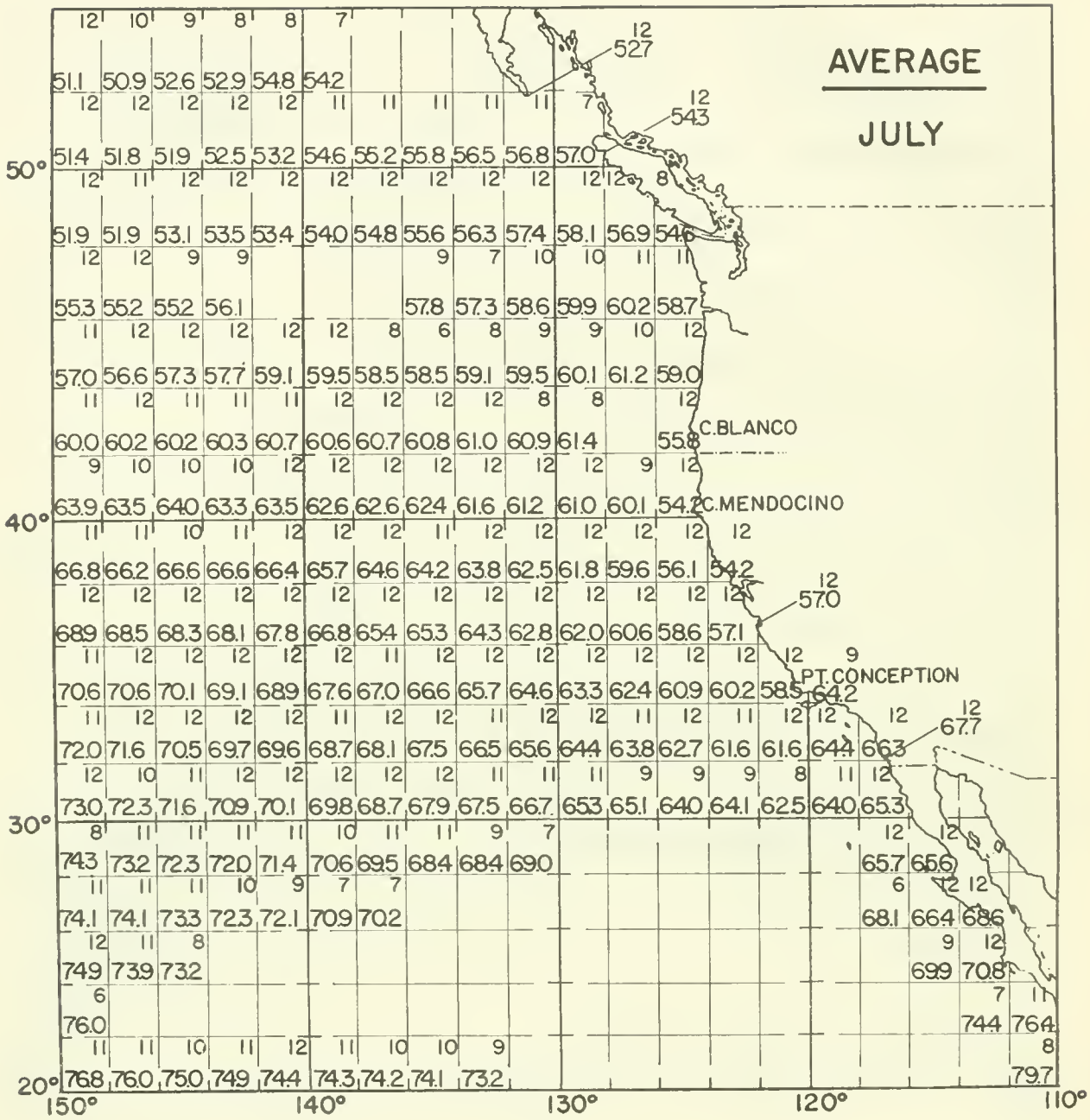
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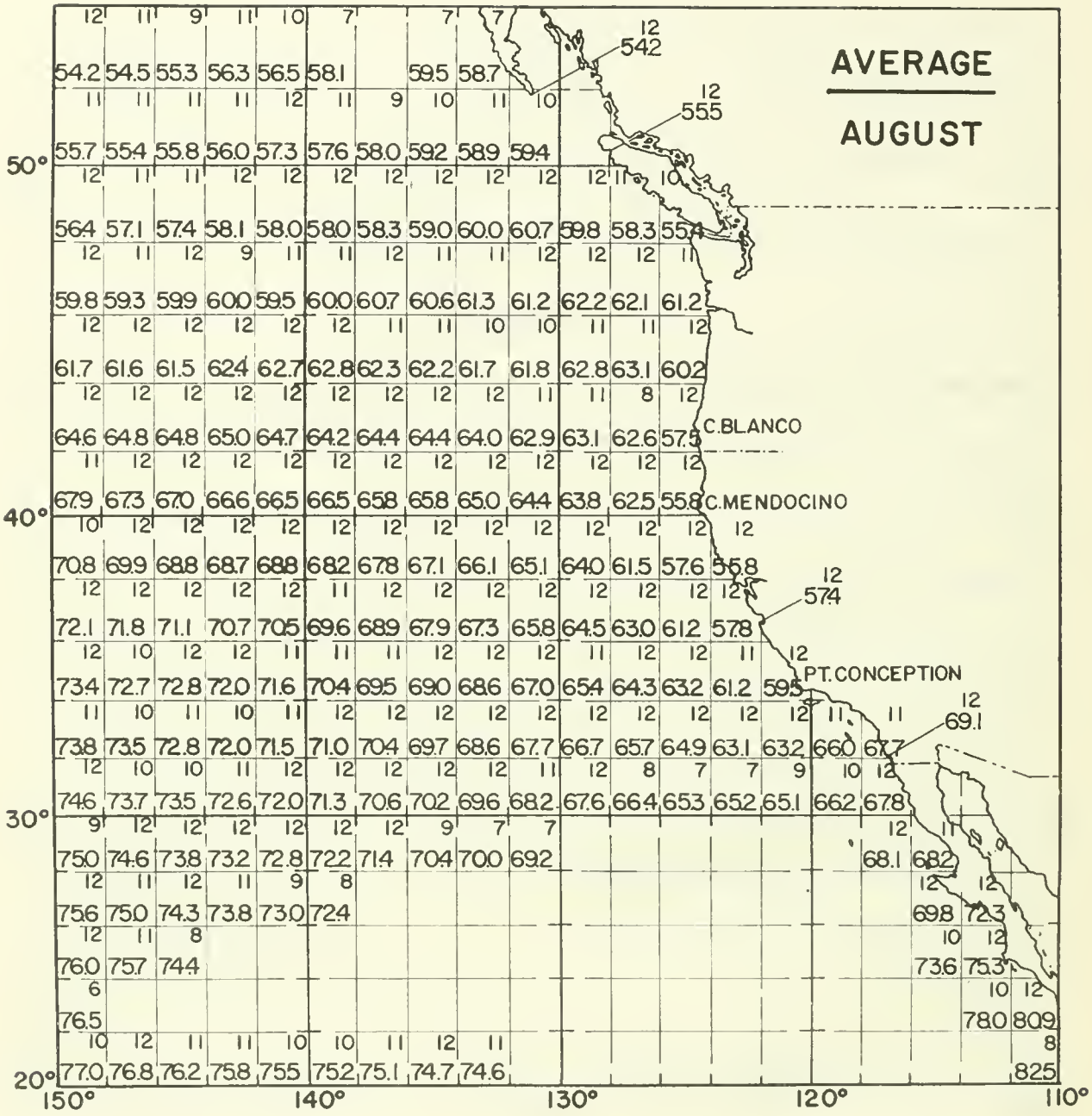
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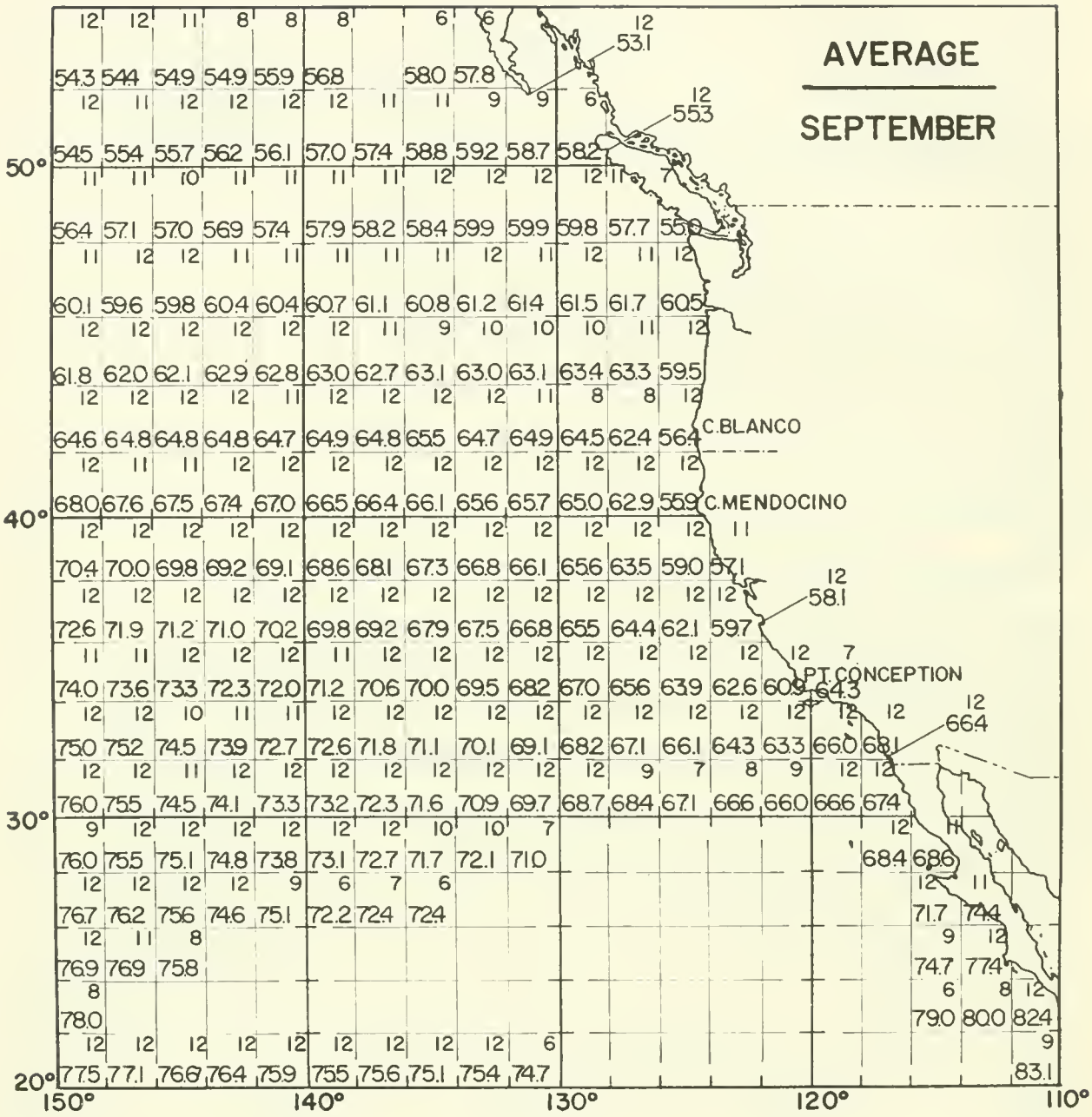
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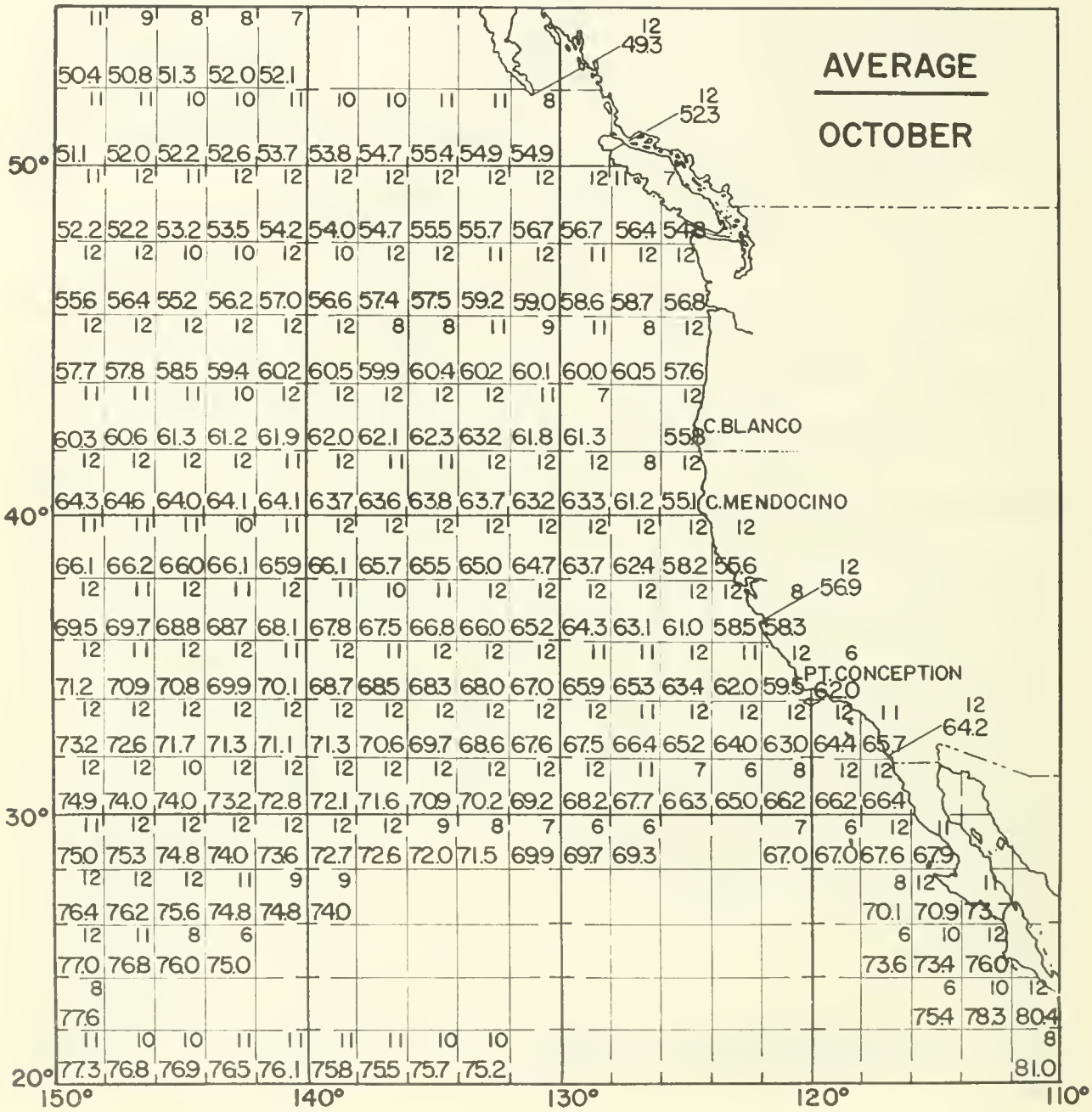
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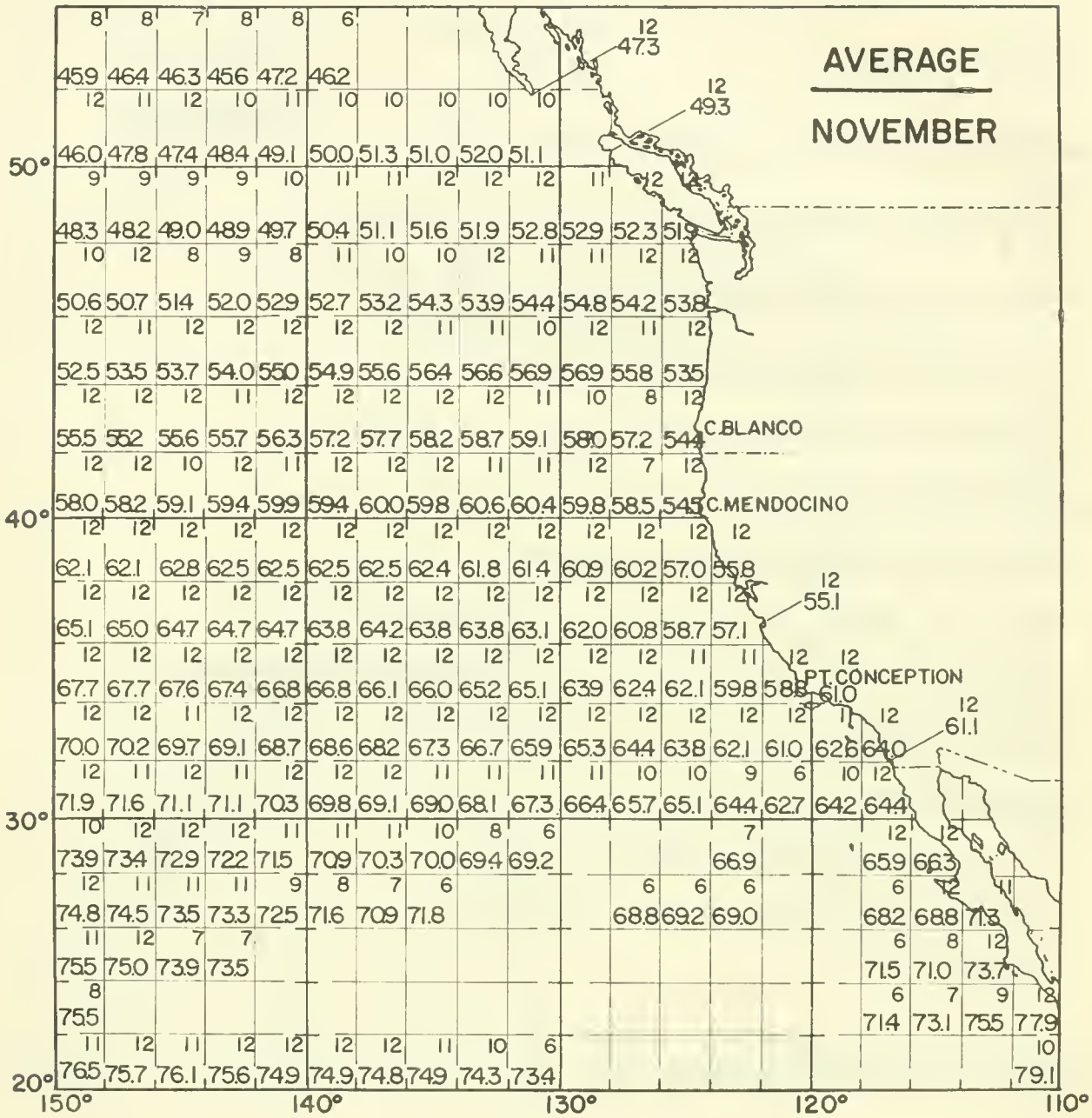
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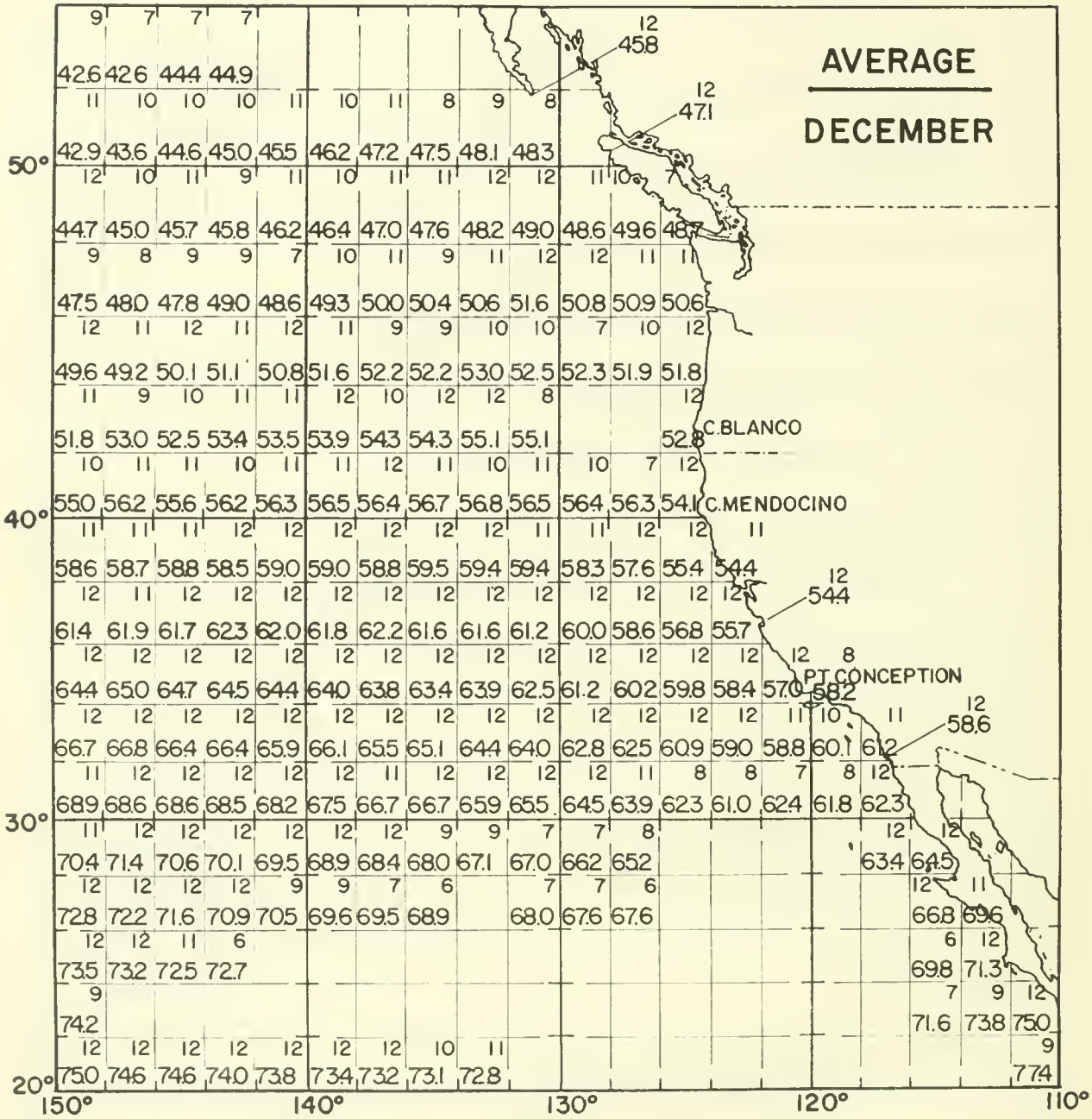
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PART II

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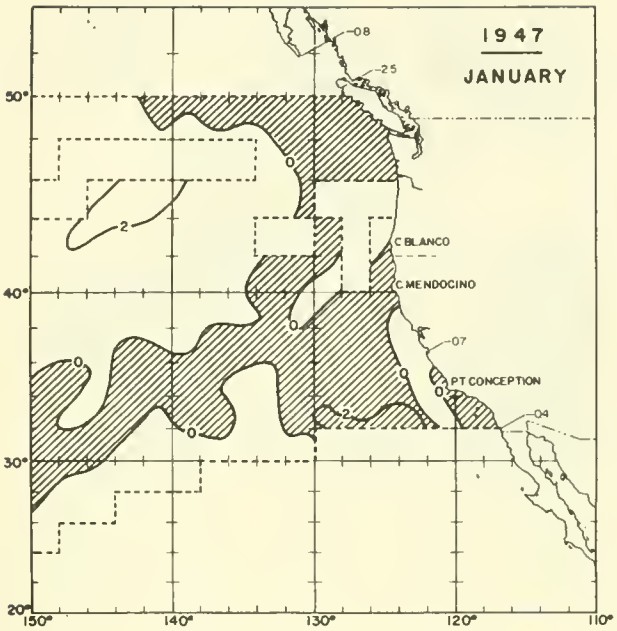
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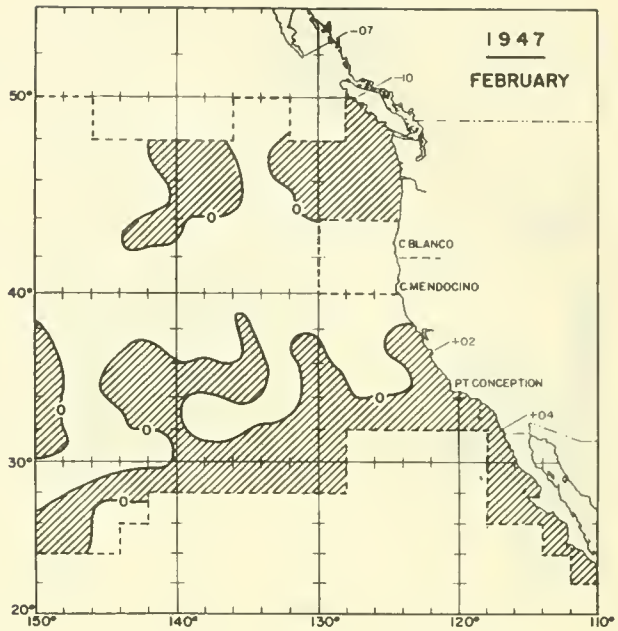
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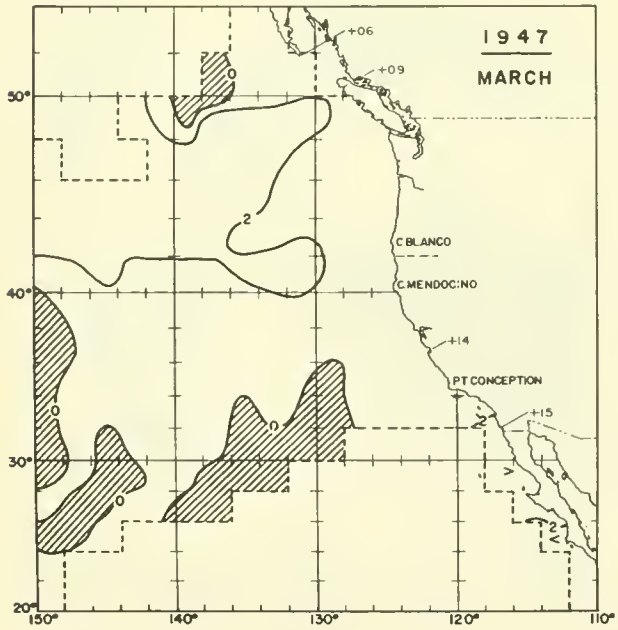
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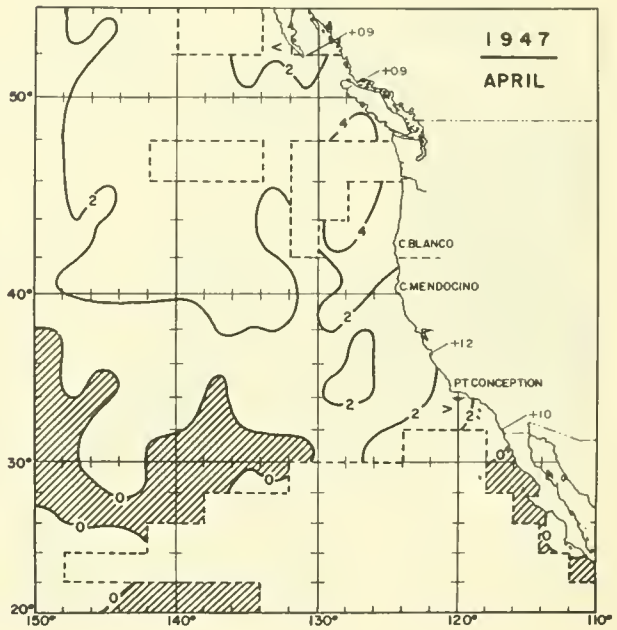
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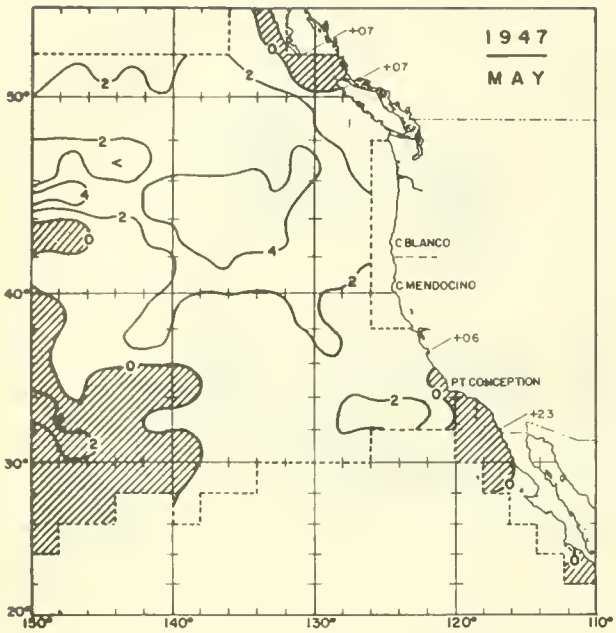
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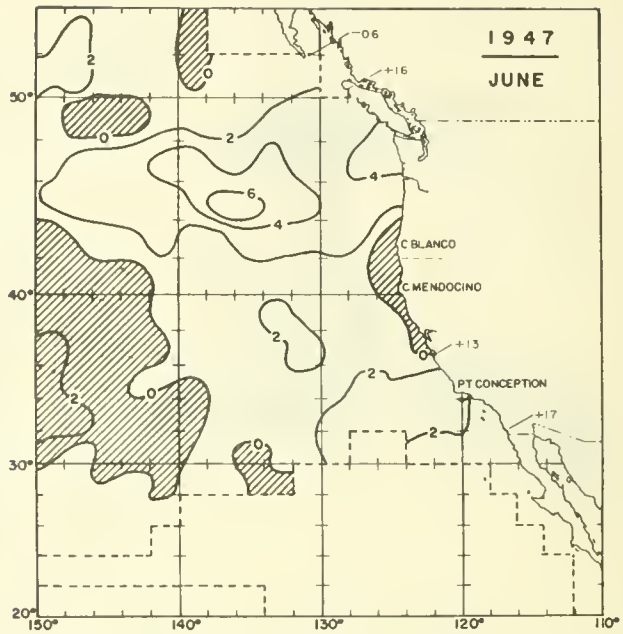
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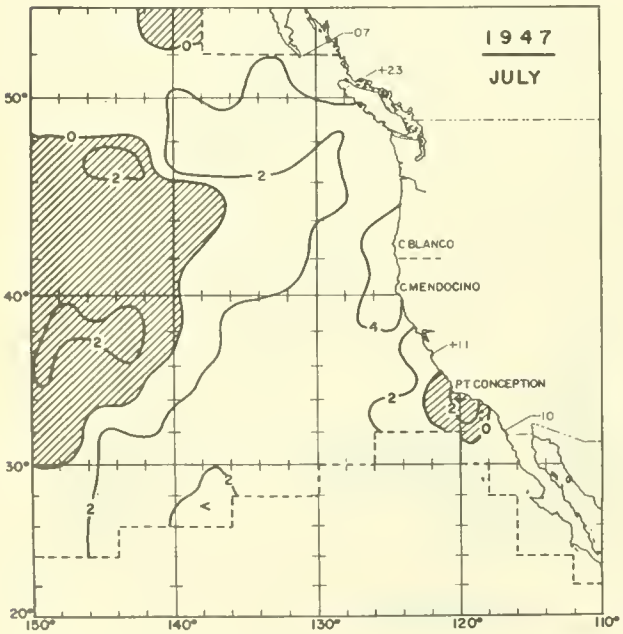
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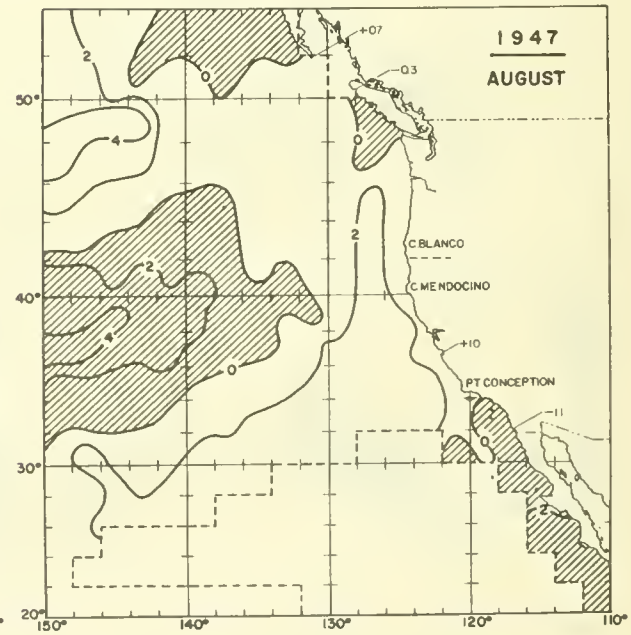
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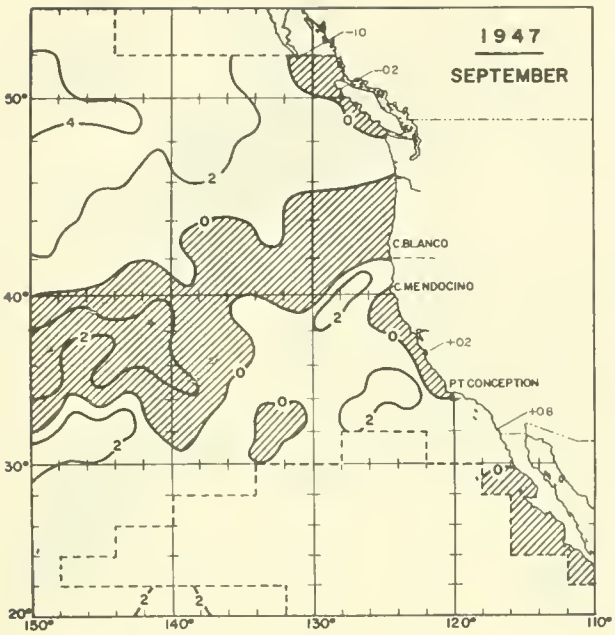
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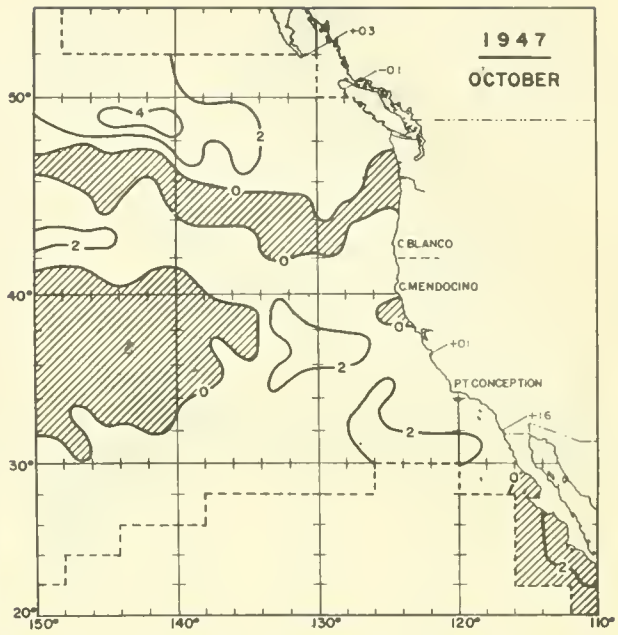
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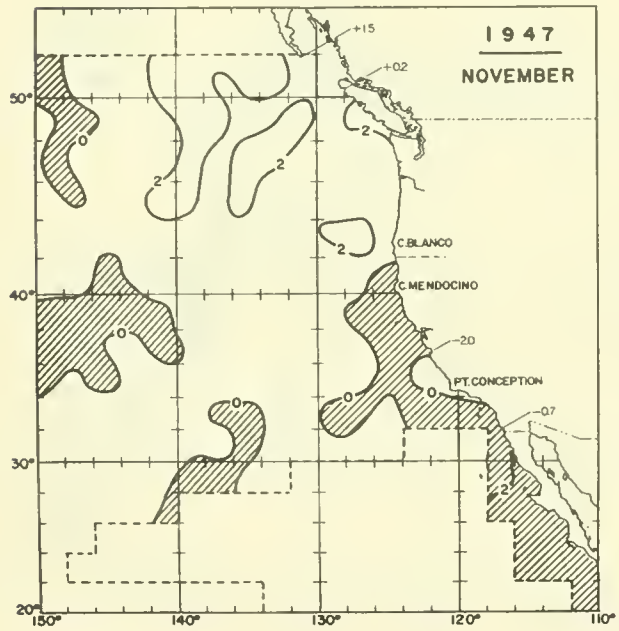
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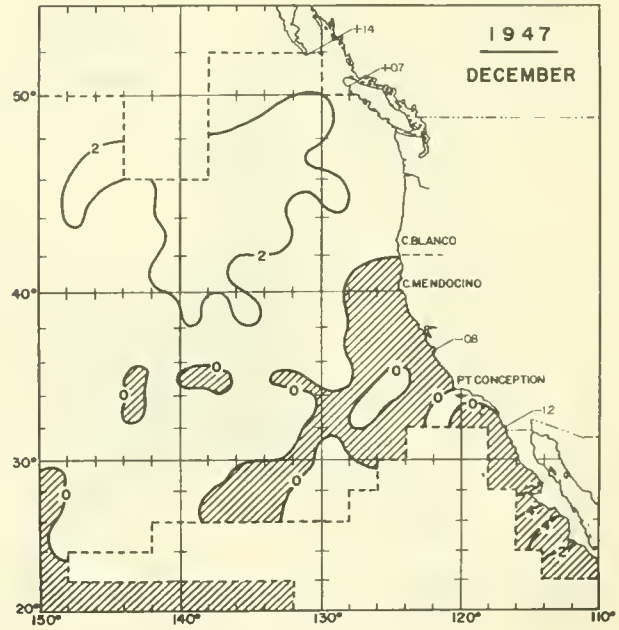
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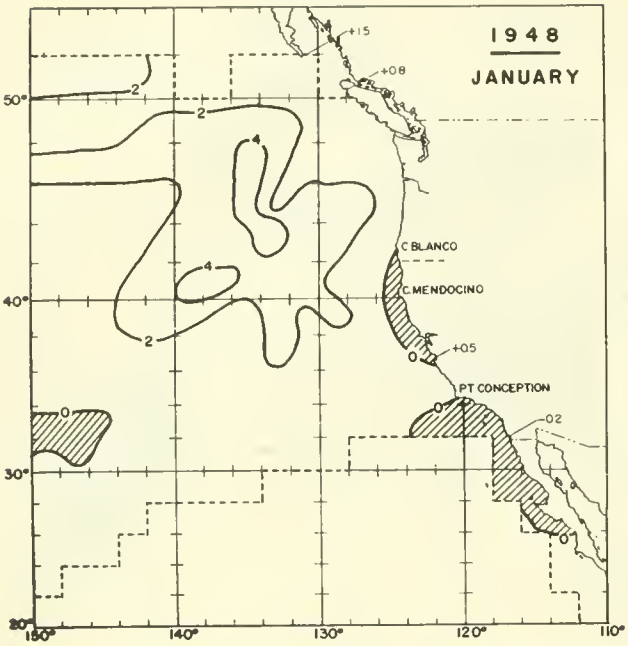
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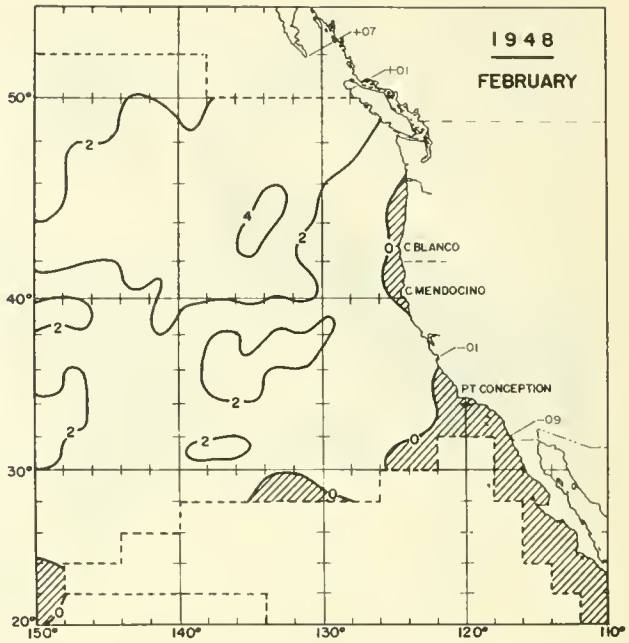
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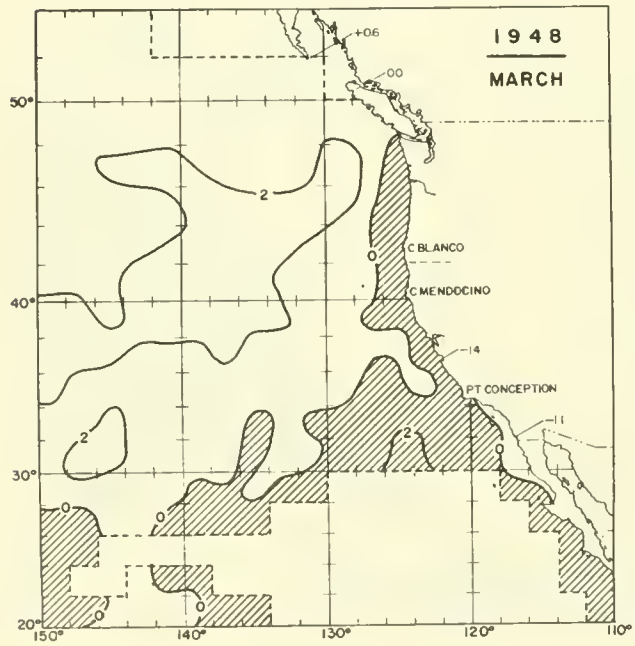
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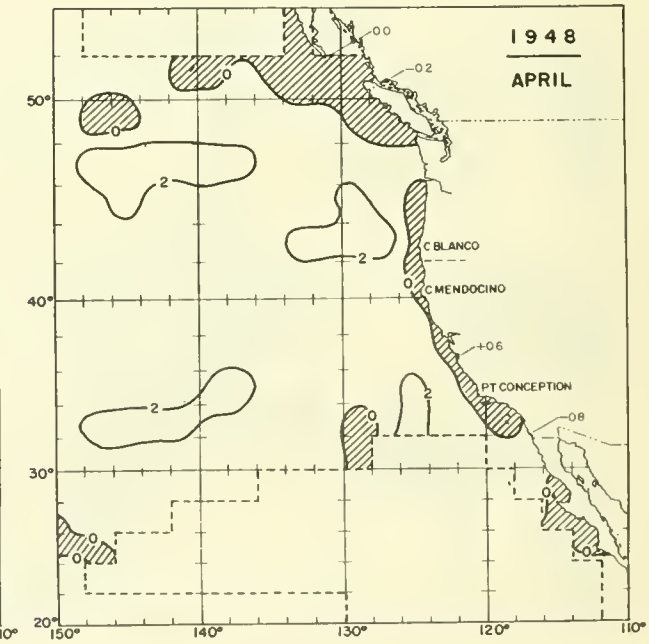
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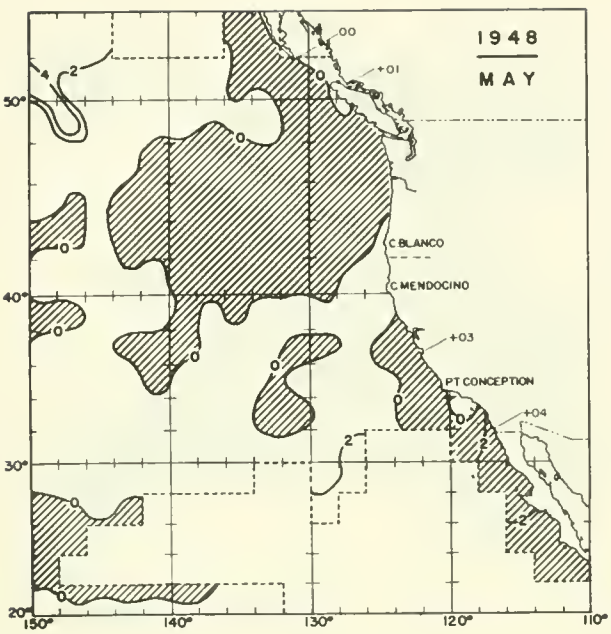
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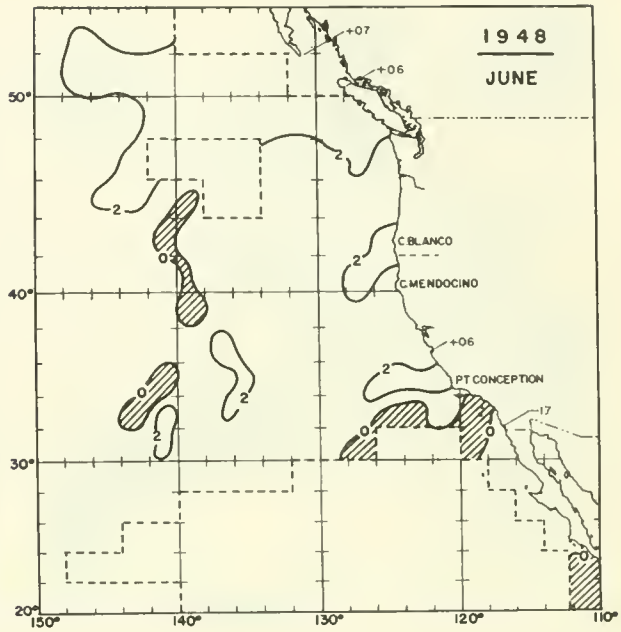
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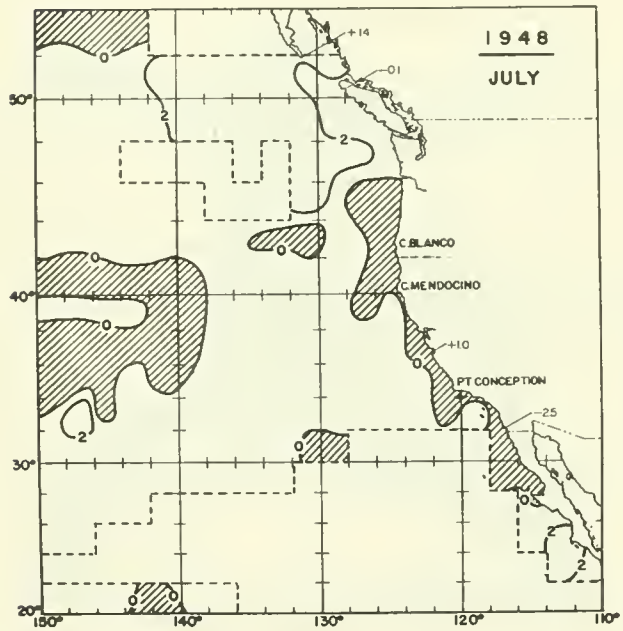
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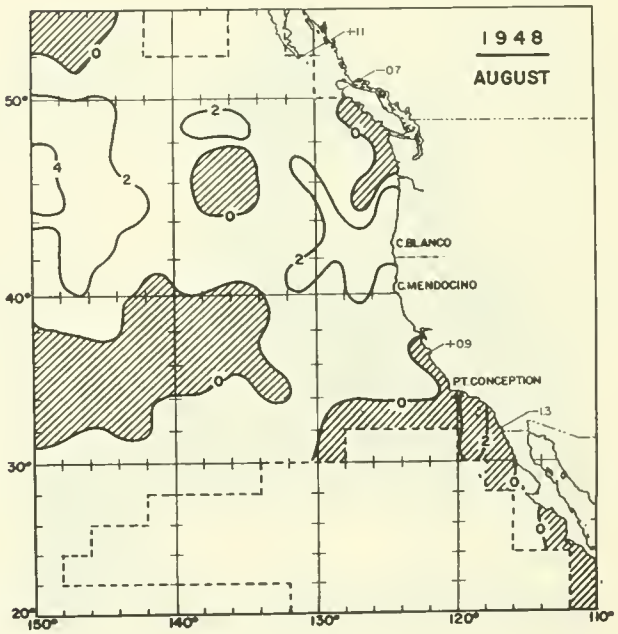
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C. BLANCO
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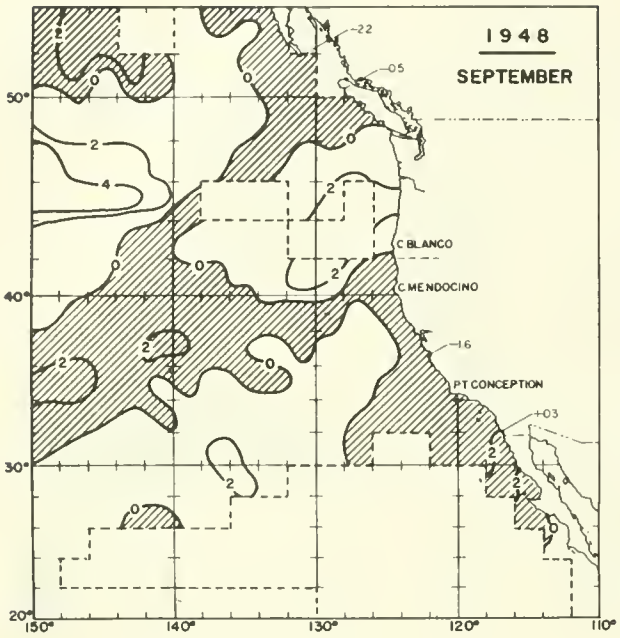
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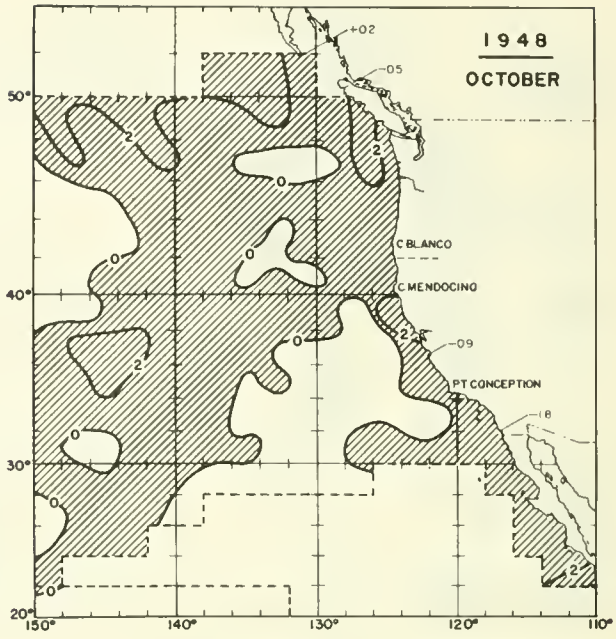
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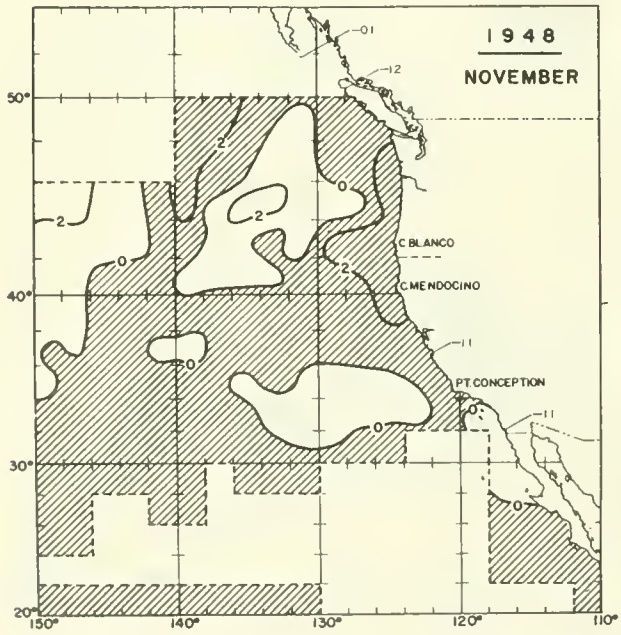
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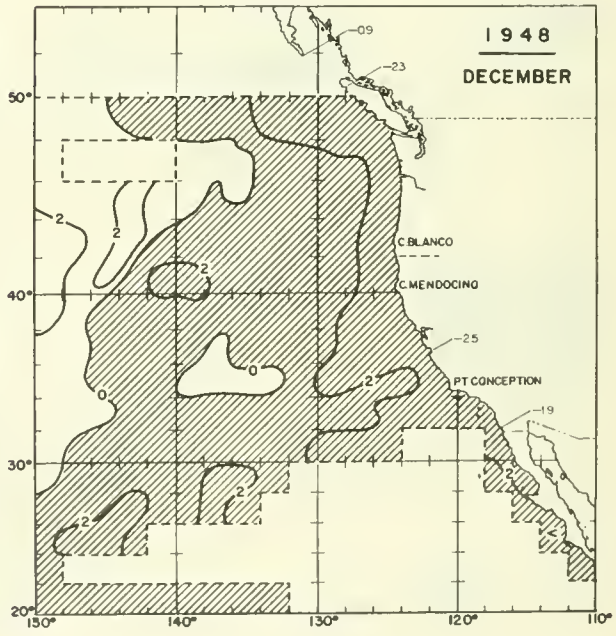
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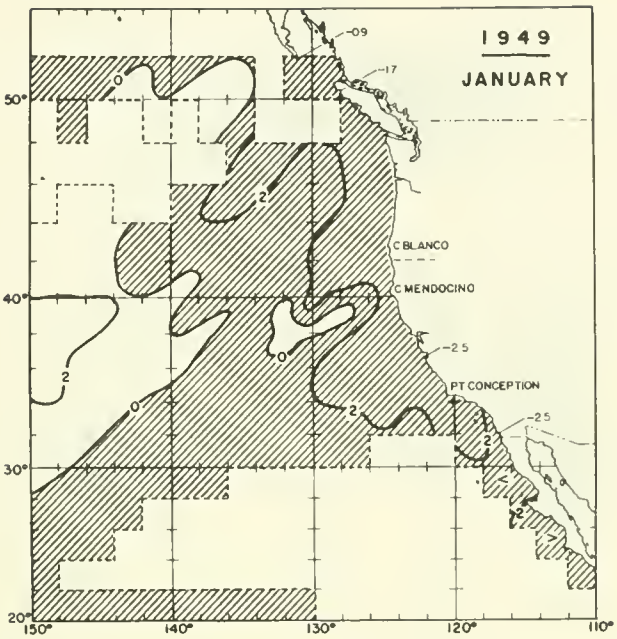
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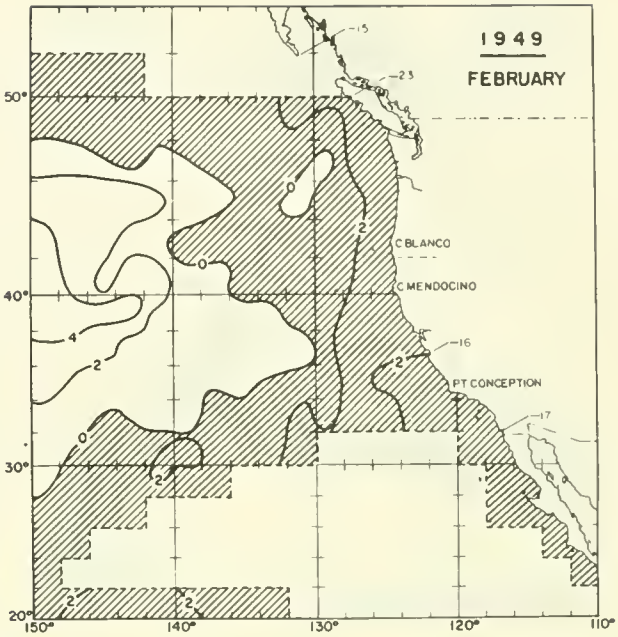
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C MENDOCINO
PT CONCEPTION
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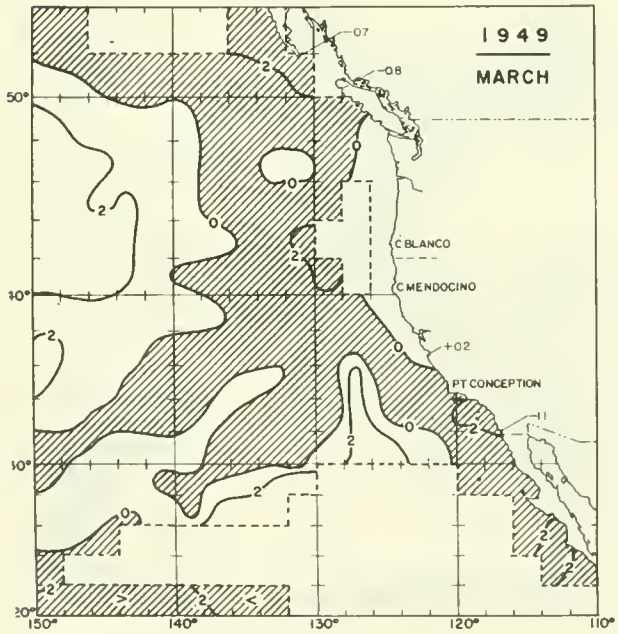
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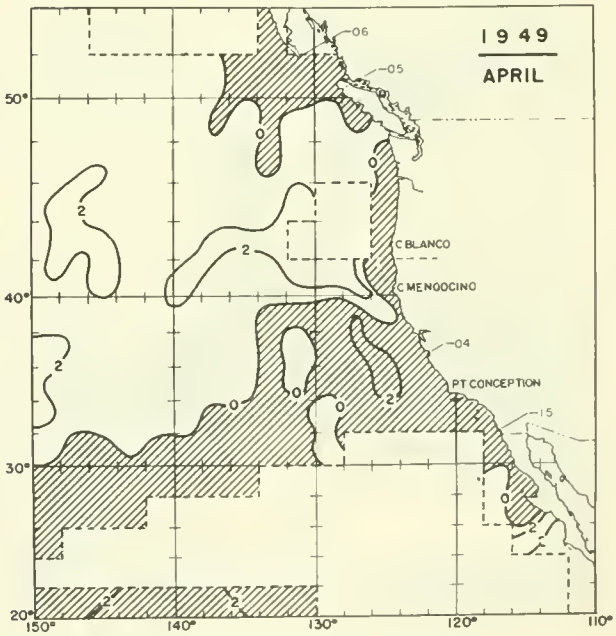
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C MENDOCINO
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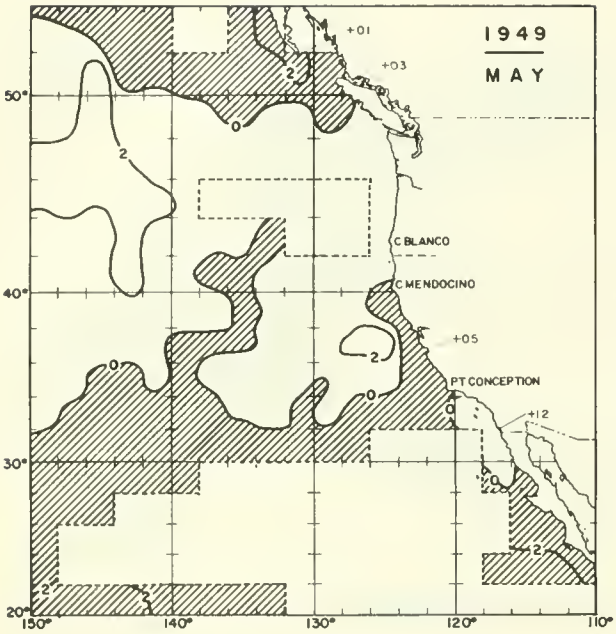
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MAY
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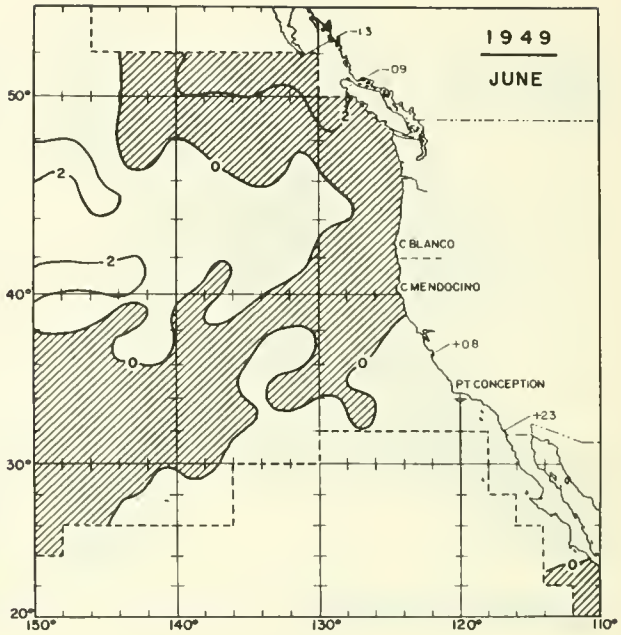
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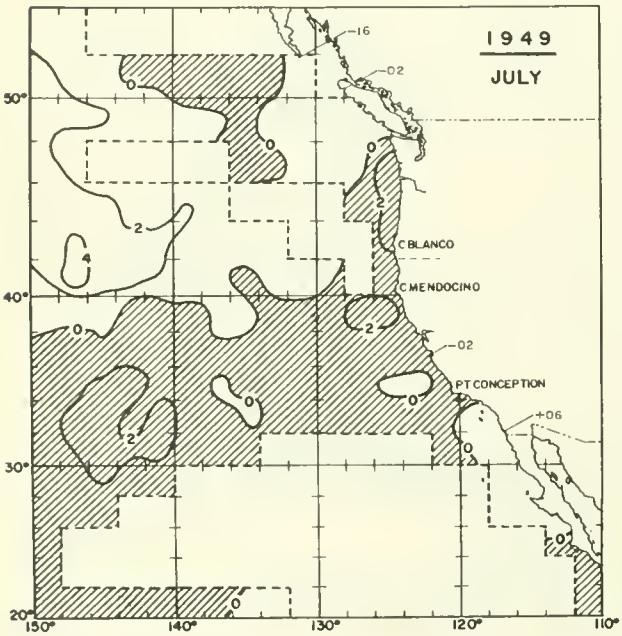
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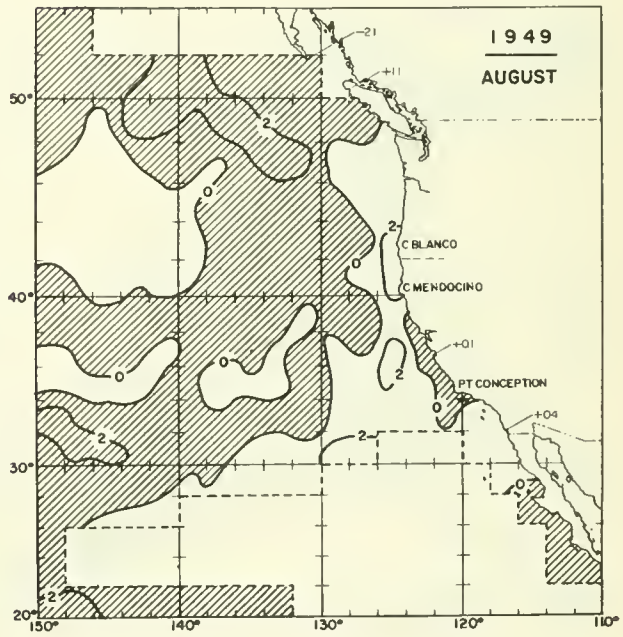
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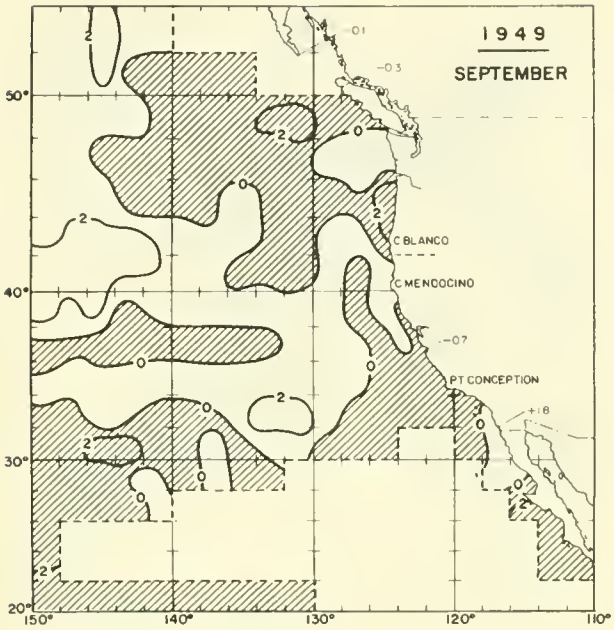
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SEPTEMBER
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C MENDOCINO
PT CONCEPTION
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1949
OCTOBER
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C MENDOCINO
PT CONCEPTION
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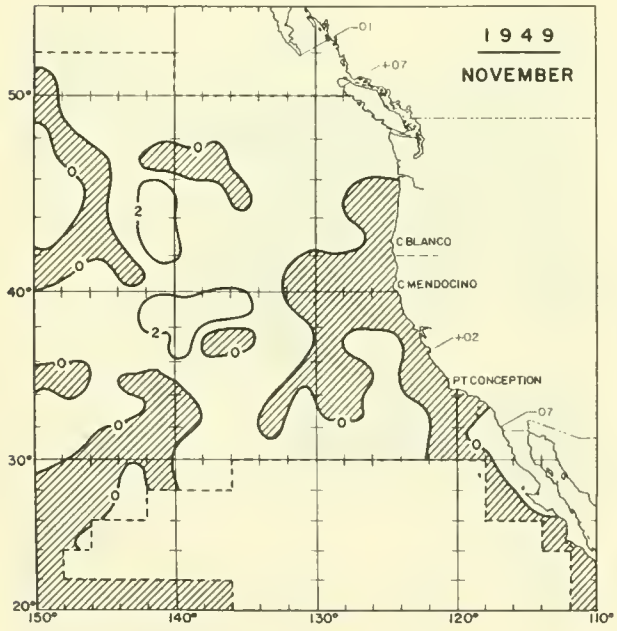
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C MENDOCINO
PT CONCEPTION
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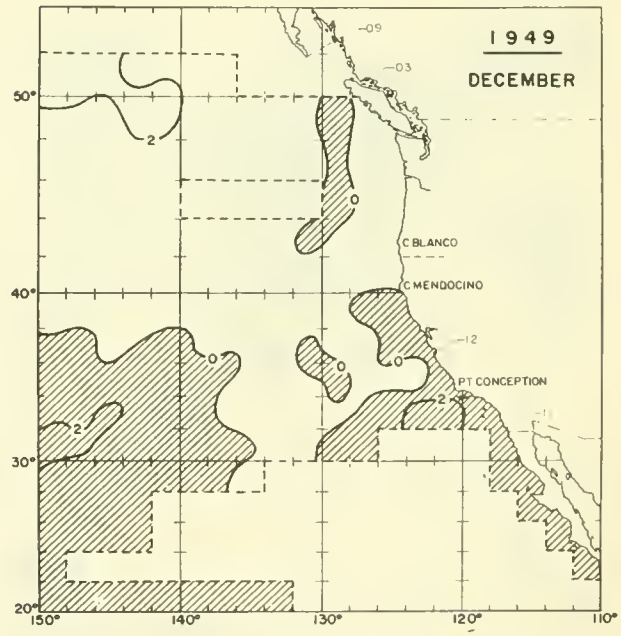
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DECEMBER
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110°

1950
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PT CONCEPTION
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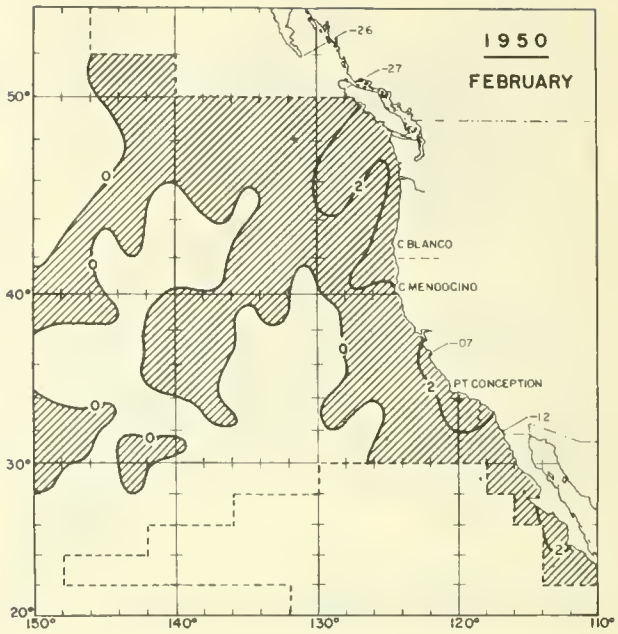
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C BLANCO
C MENDOCINO
PT CONCEPTION
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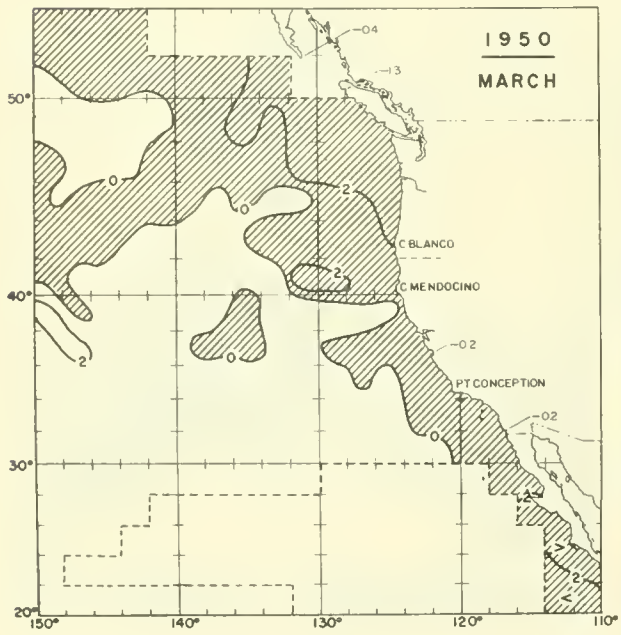
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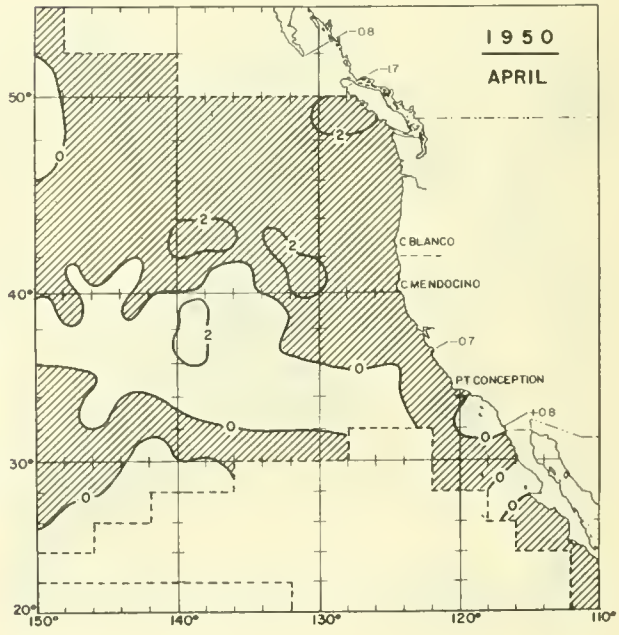
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C MENDOCINO
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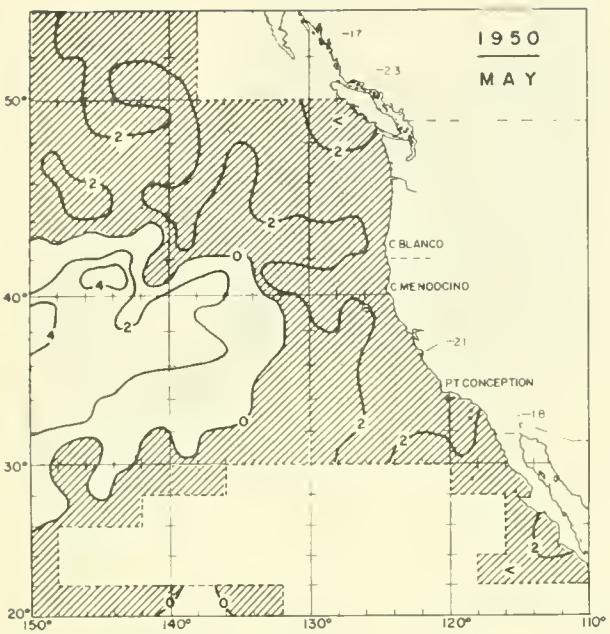
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C MENDOCINO
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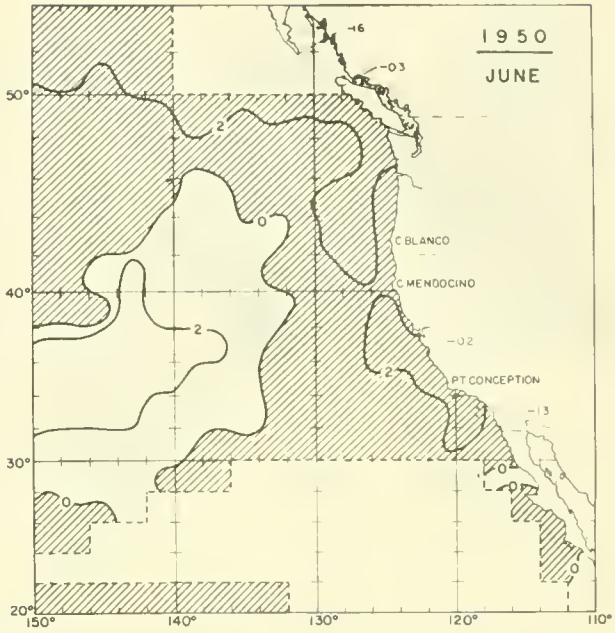
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C MENDOCINO
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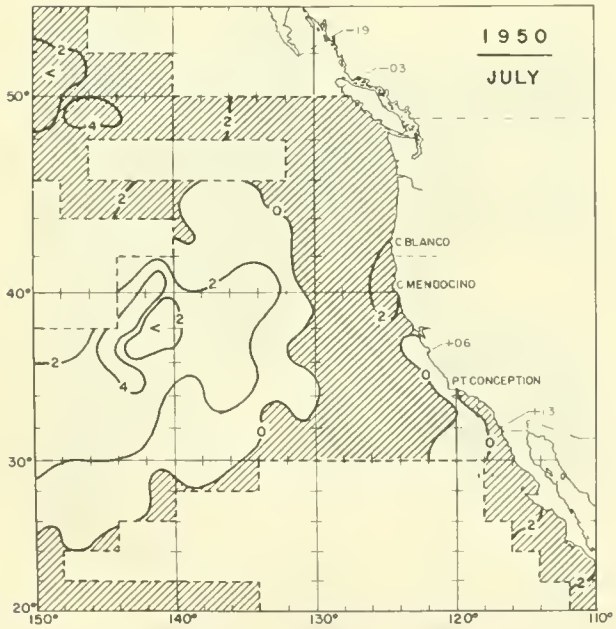
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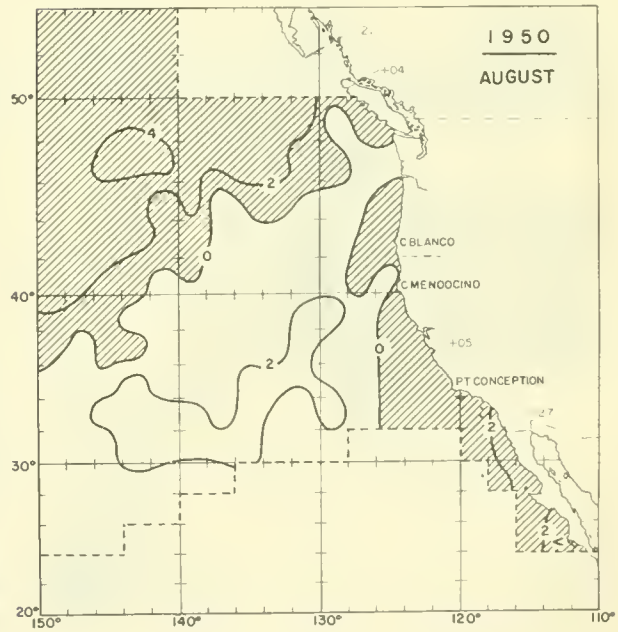
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AUGUST
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C MENDOCINO
PT CONCEPTION
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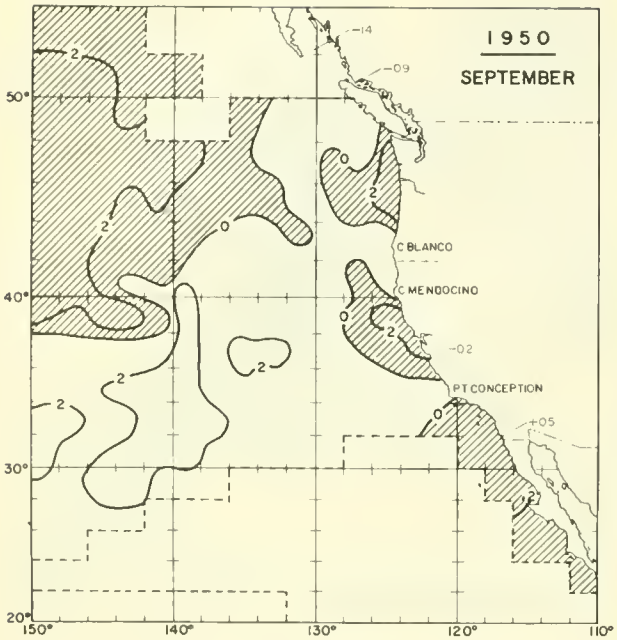
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SEPTEMBER
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C MENDOCINO
PT CONCEPTION
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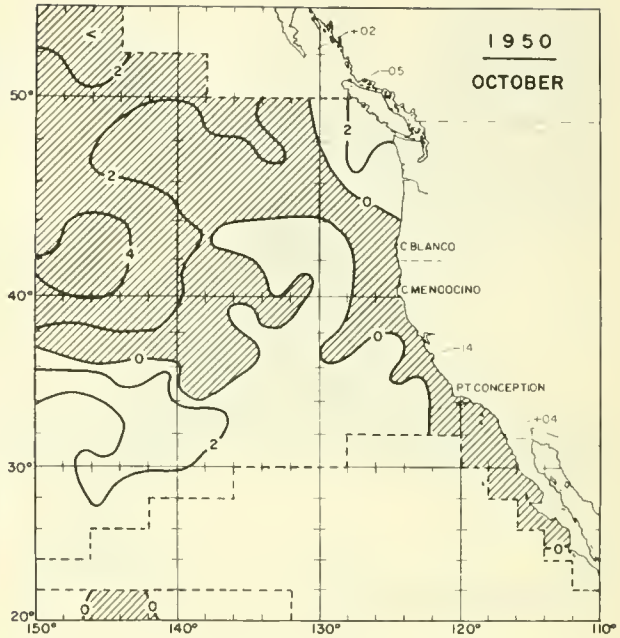
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OCTOBER
C BLANCO
C MENDOCINO
PT CONCEPTION
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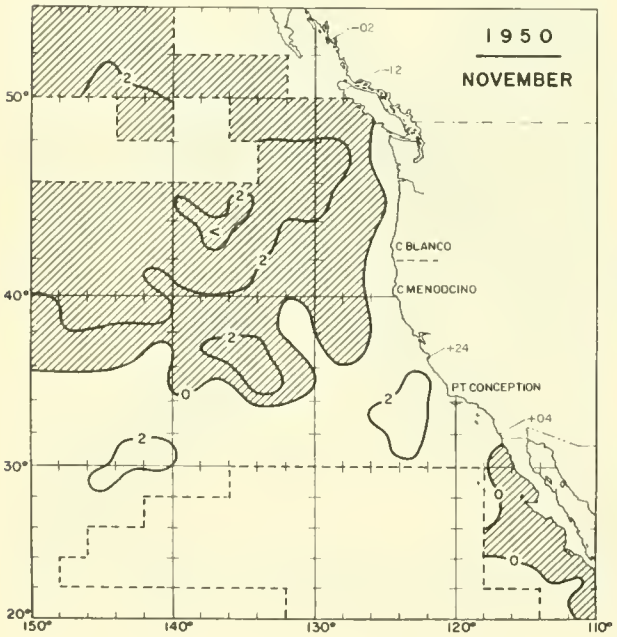
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NOVEMBER
C BLANCO
C MENDOCINO
PT CONCEPTION
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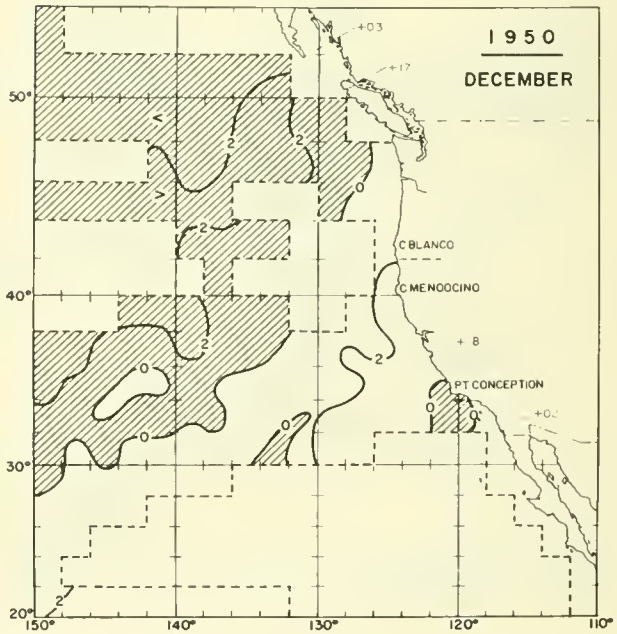
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DECEMBER
C BLANCO
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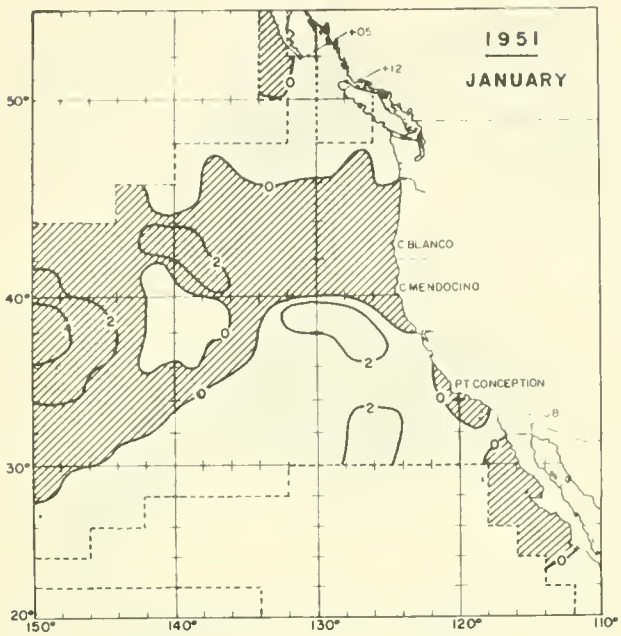
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JANUARY
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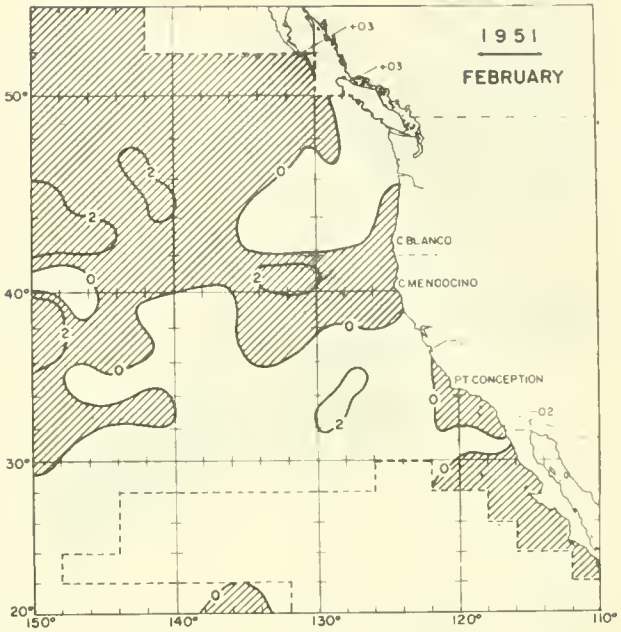
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FEBRUARY
+03
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C BLANCO
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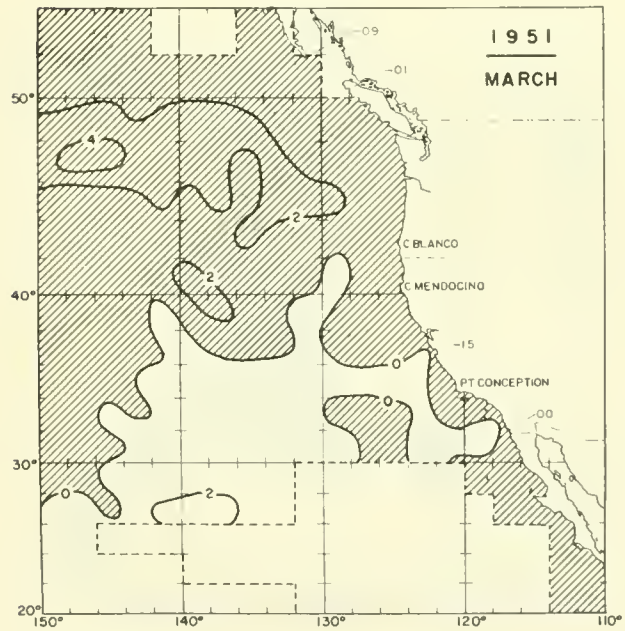
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MARCH
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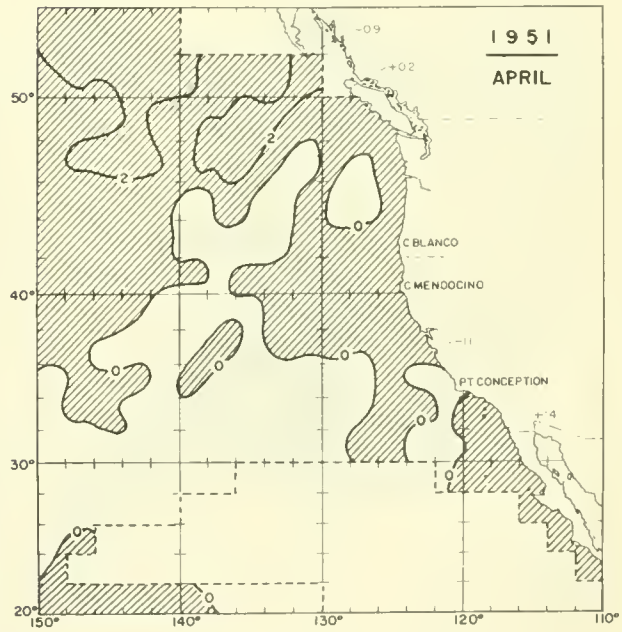
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APRIL
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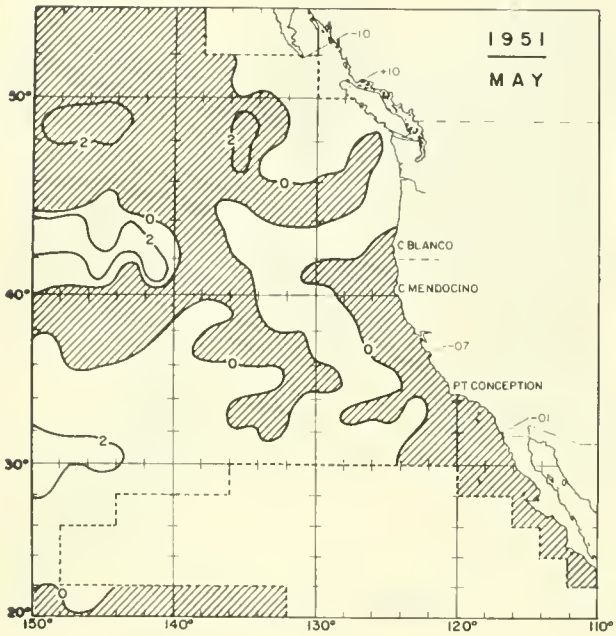
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MAY
C BLANCO
C MENDOCINO
PT CONCEPTION
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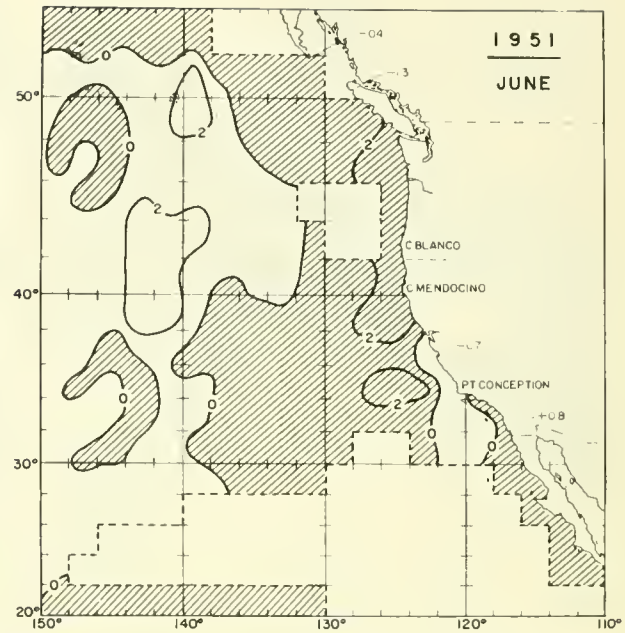
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JUNE
C BLANCO
C MENDOCINO
PT CONCEPTION
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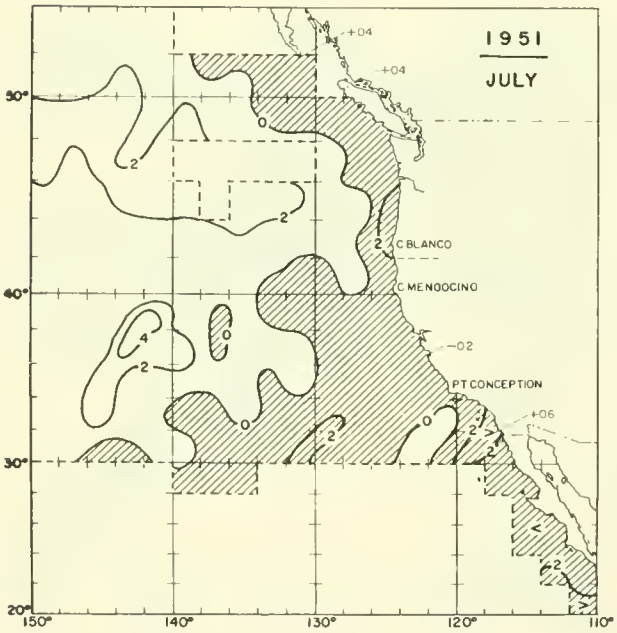
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JULY
C BLANCO
C MENDOCINO
PT CONCEPTION
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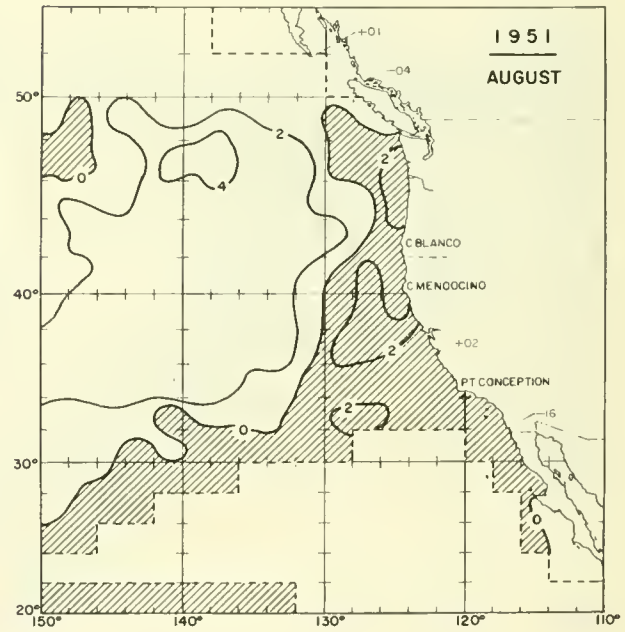
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AUGUST
C BLANCO
C MENDOCINO
PT CONCEPTION
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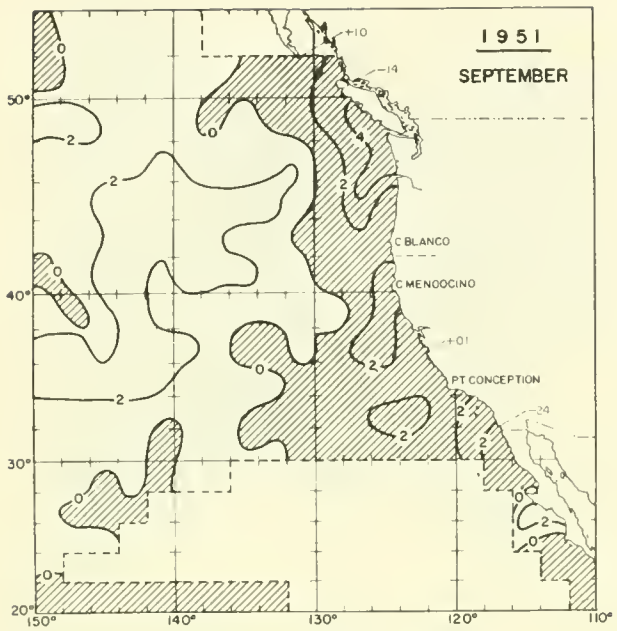
1951
SEPTEMBER
C BLANCO
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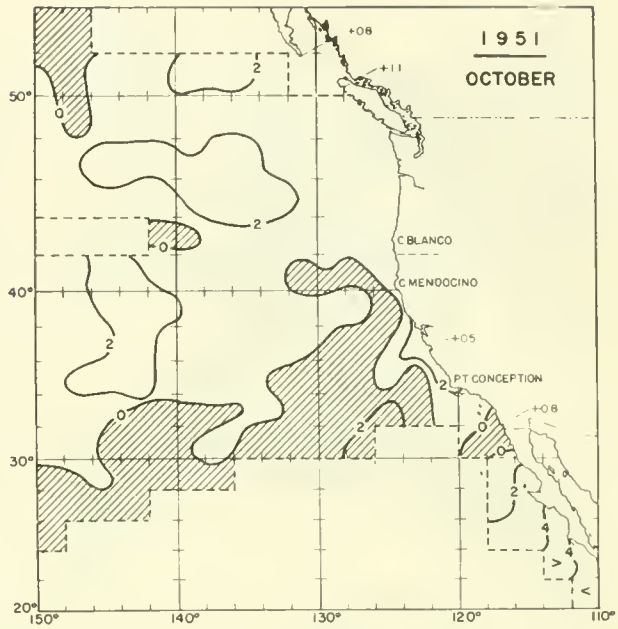
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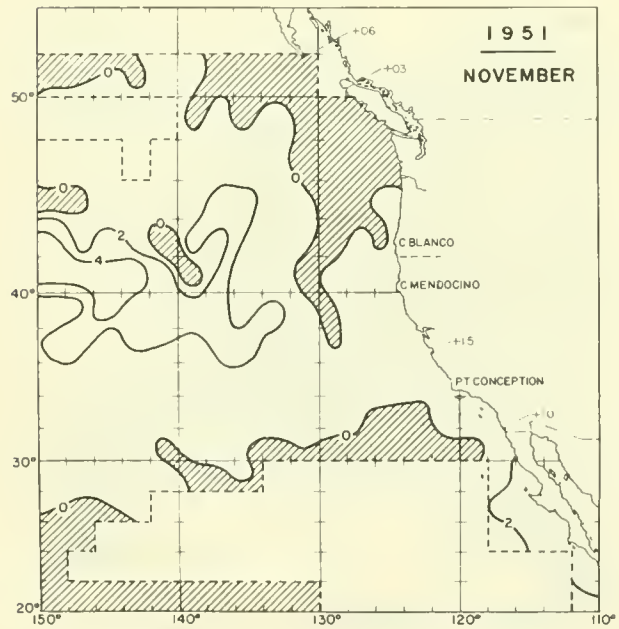
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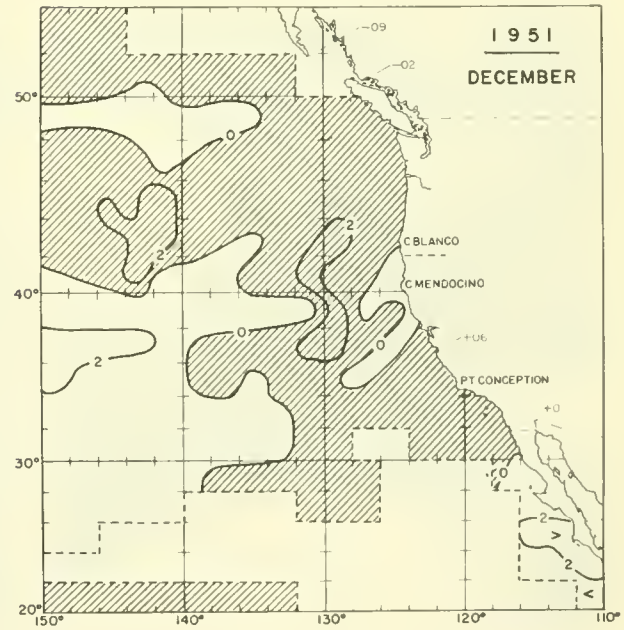
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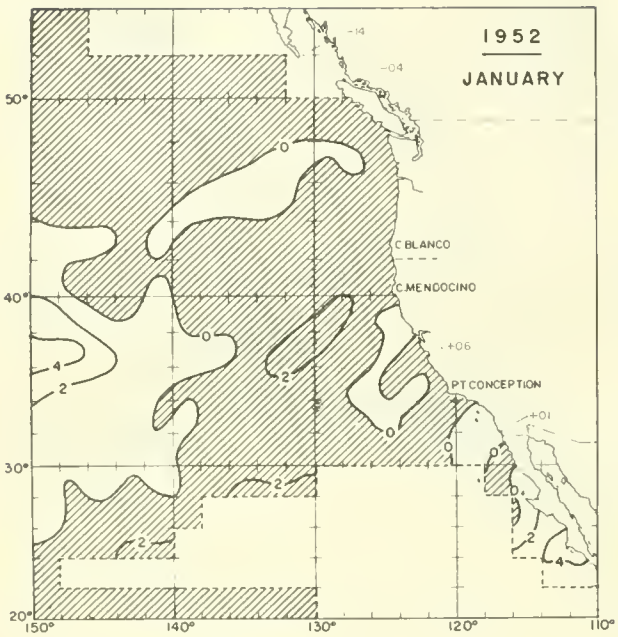
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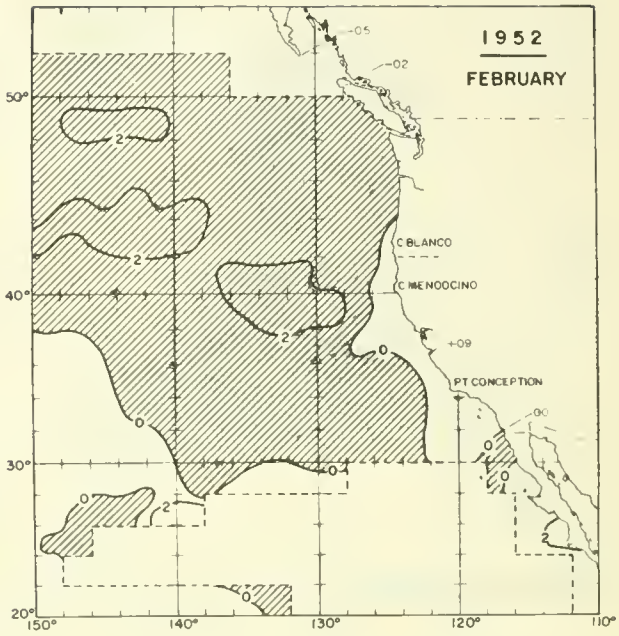
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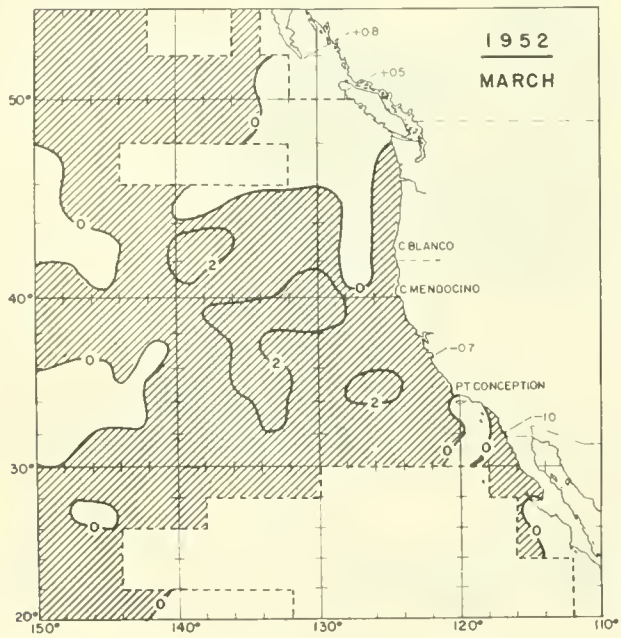
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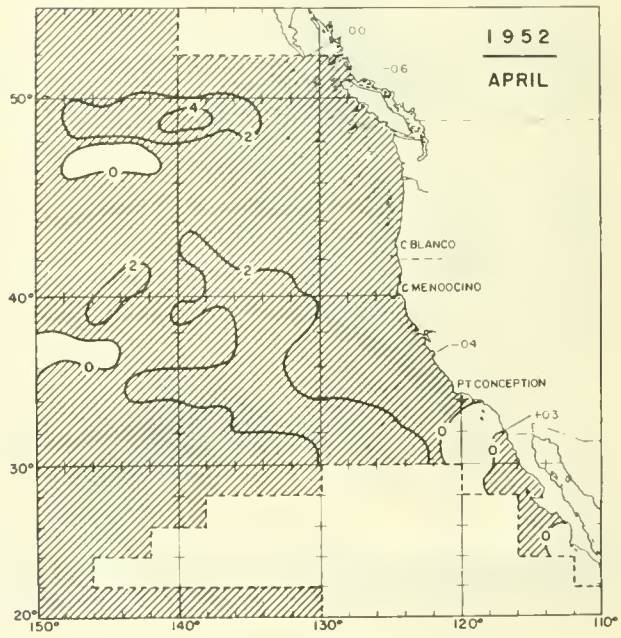
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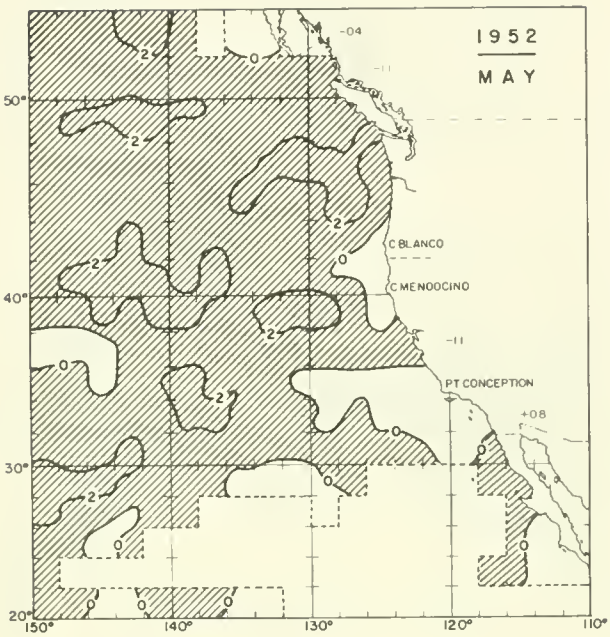
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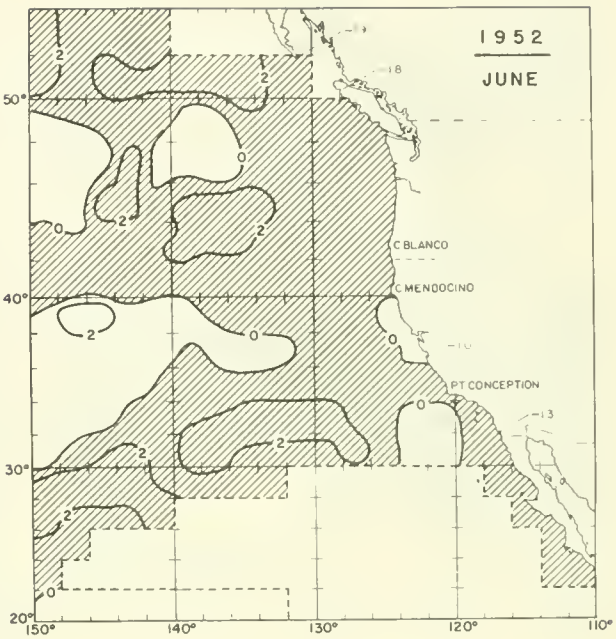
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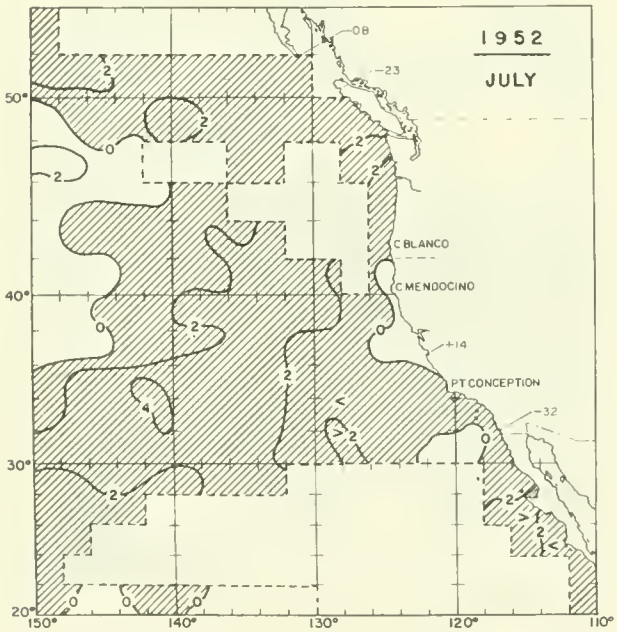
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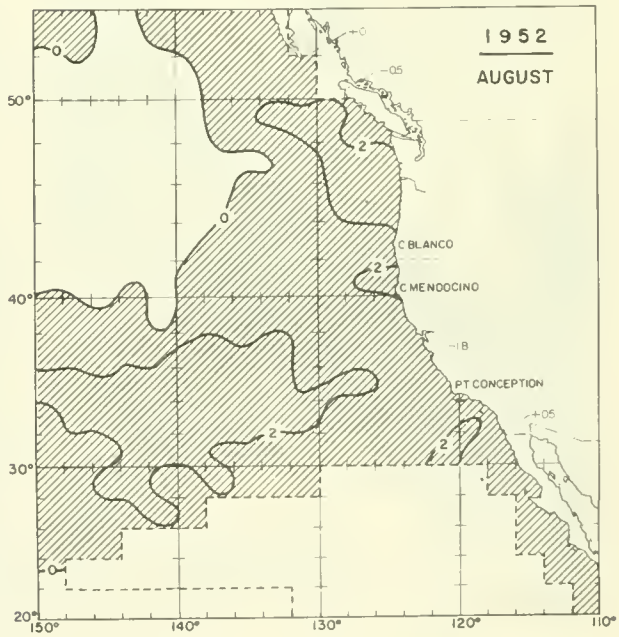
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AUGUST
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C MENDOCINO
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110°

1952
SEPTEMBER
C BLANCO
C MENDOCINO
PT CONCEPTION
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-09
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130°
120°
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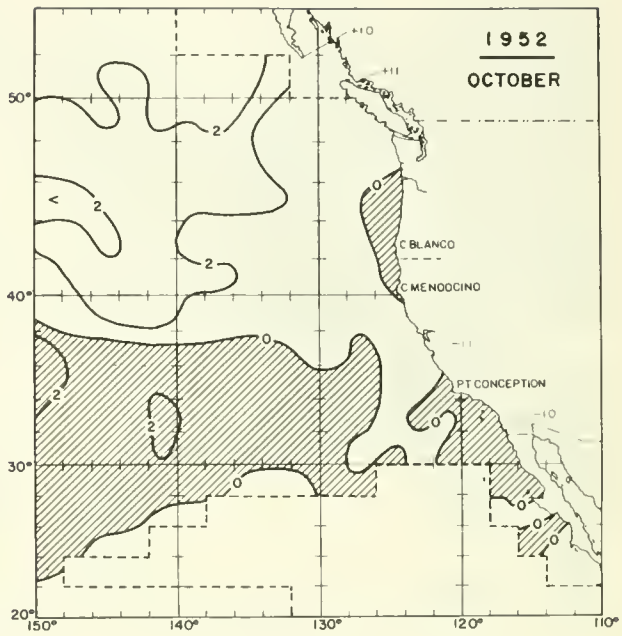
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C BLANCO
C MENDOCINO
PT CONCEPTION
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+11
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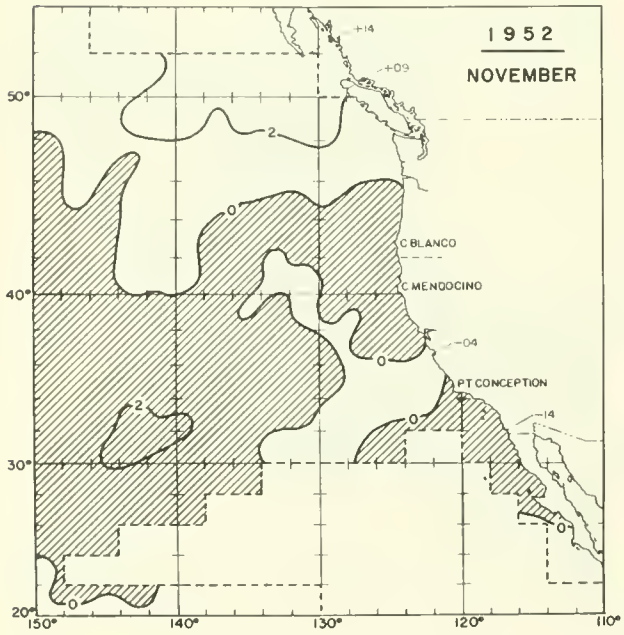
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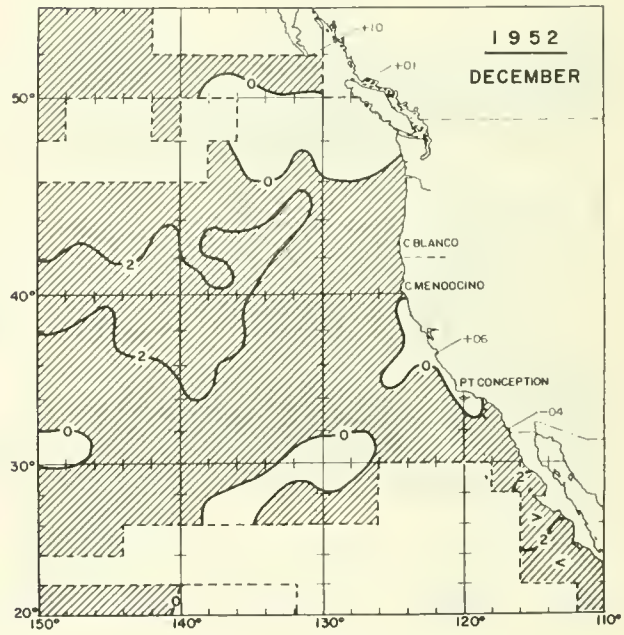
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C MENDOCINO
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+06
-04
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110°

1953
JANUARY
+06
+10
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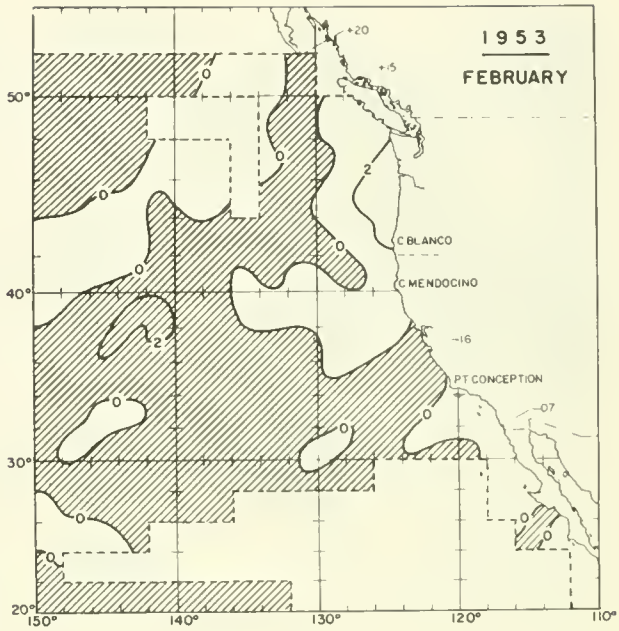
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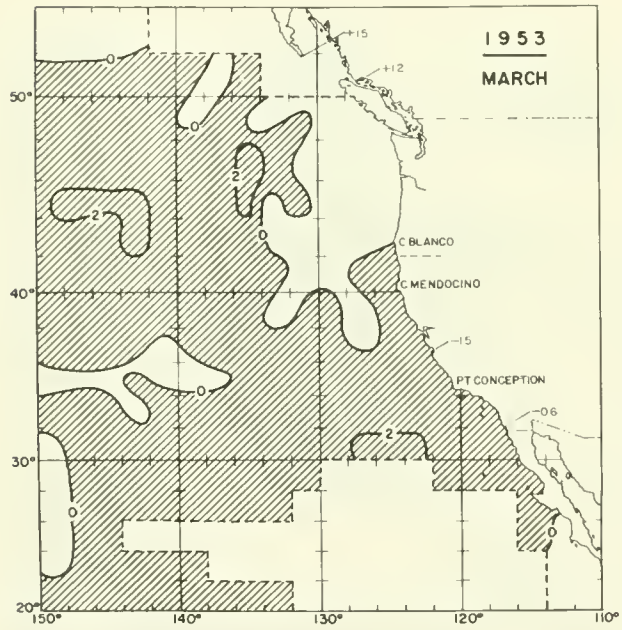
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MARCH
+15
+12
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PT CONCEPTION
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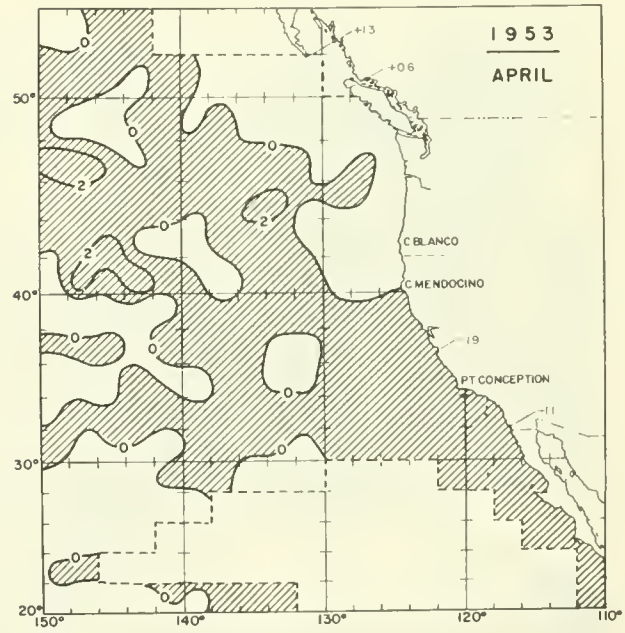
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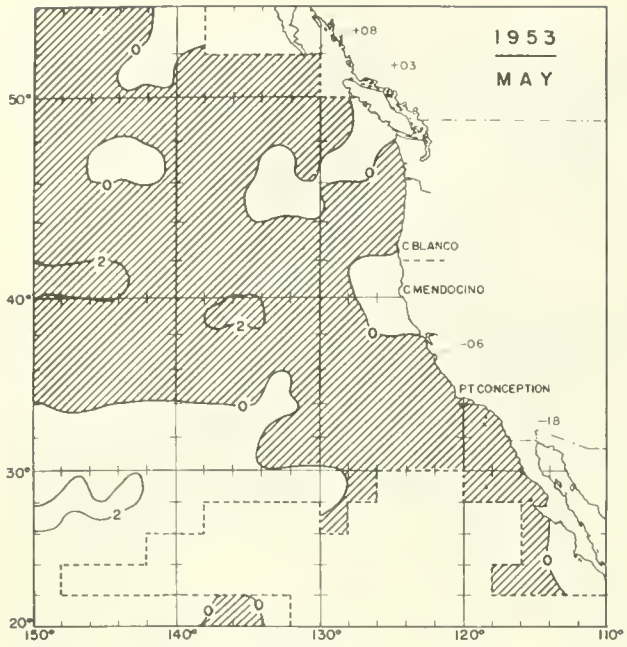
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MAY
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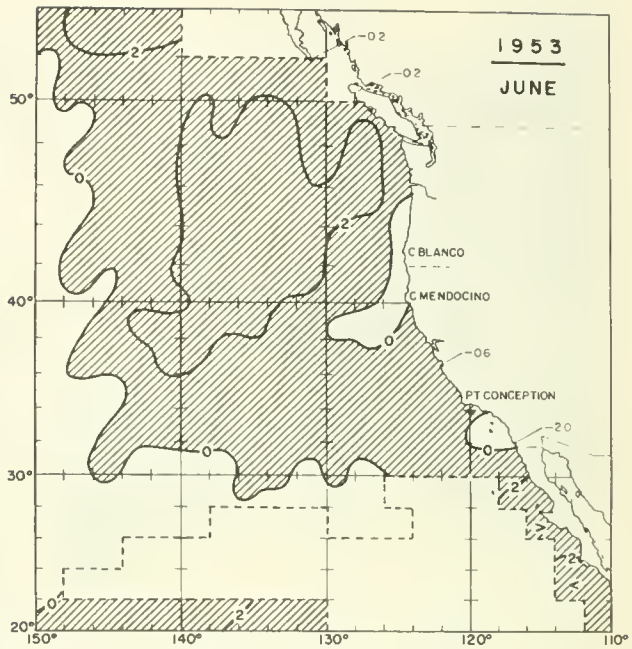
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JUNE
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-02
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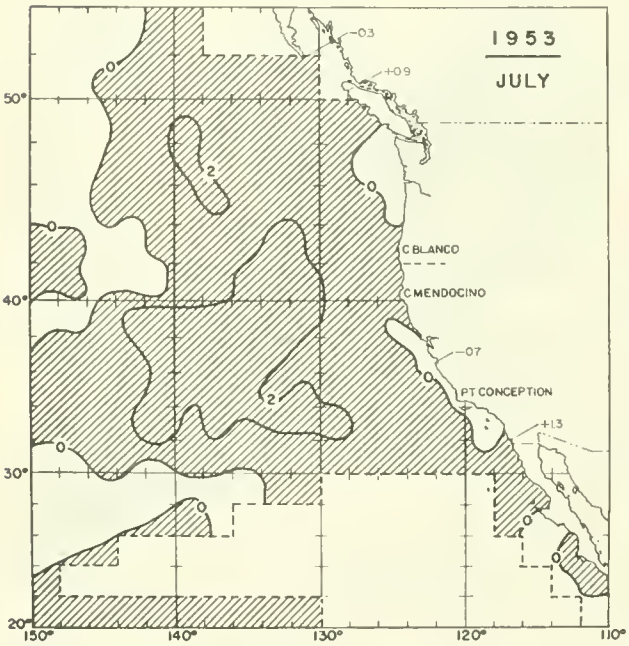
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JULY
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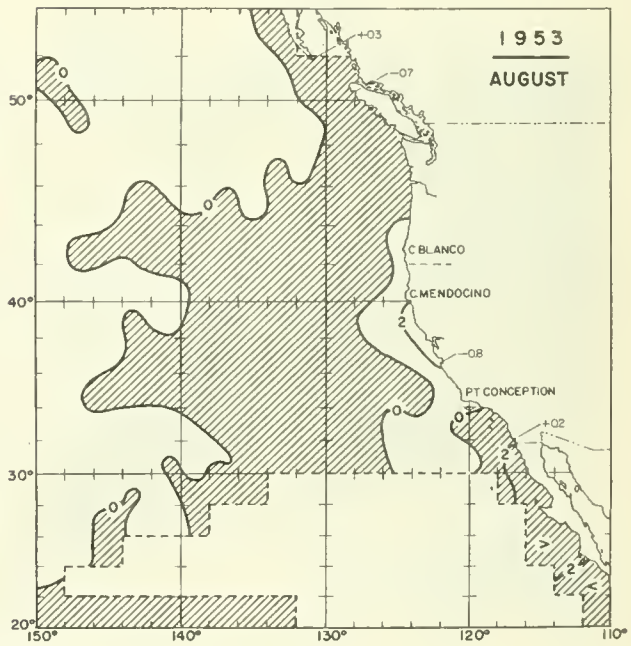
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AUGUST
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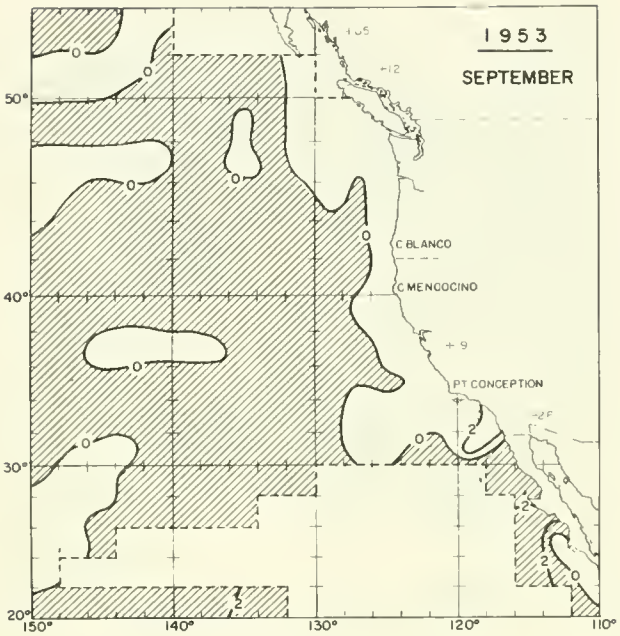
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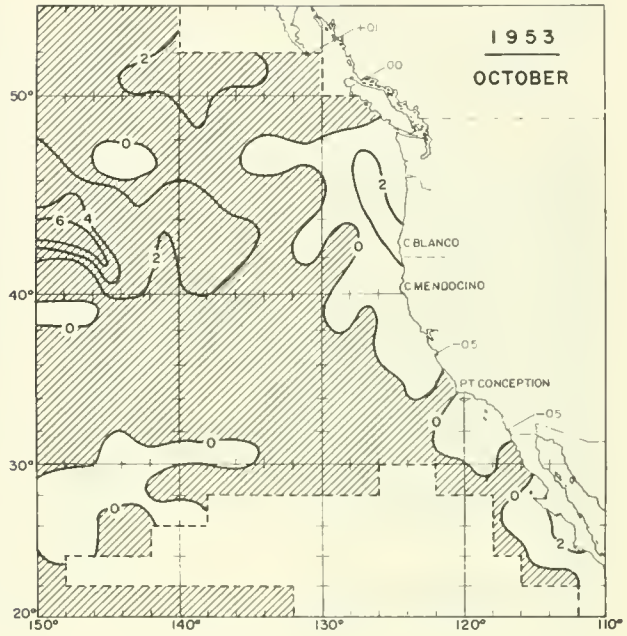
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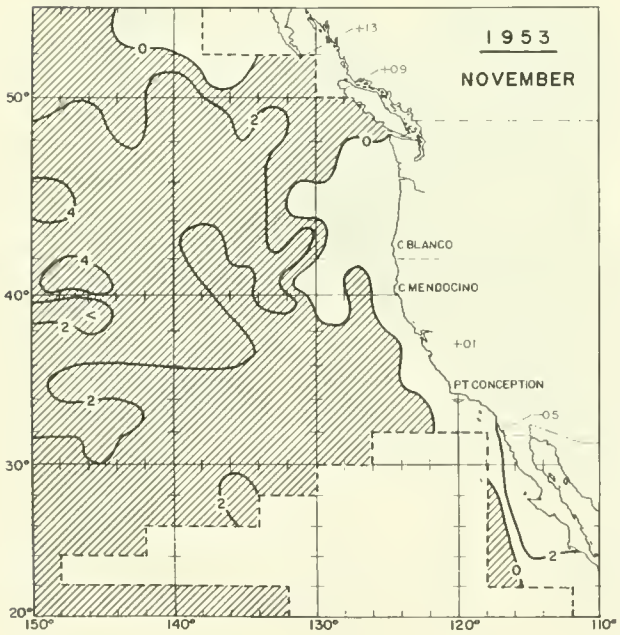
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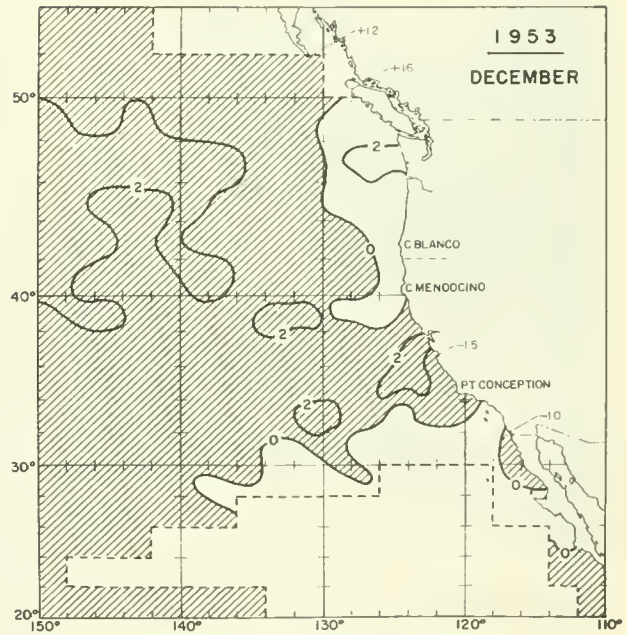
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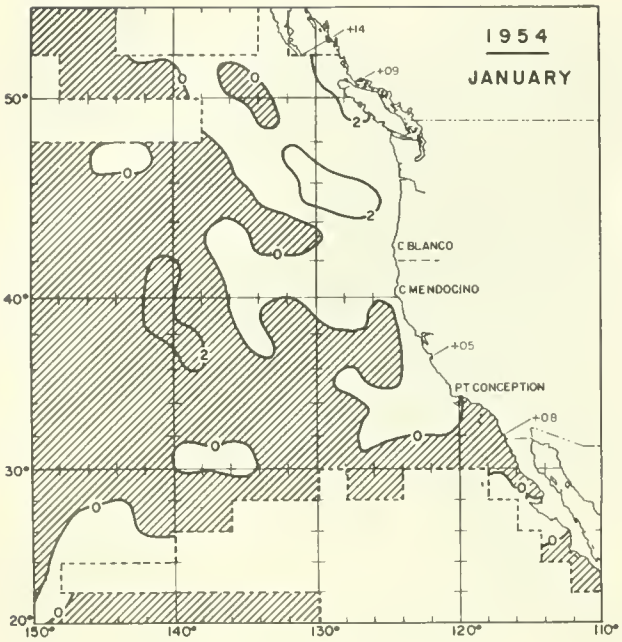
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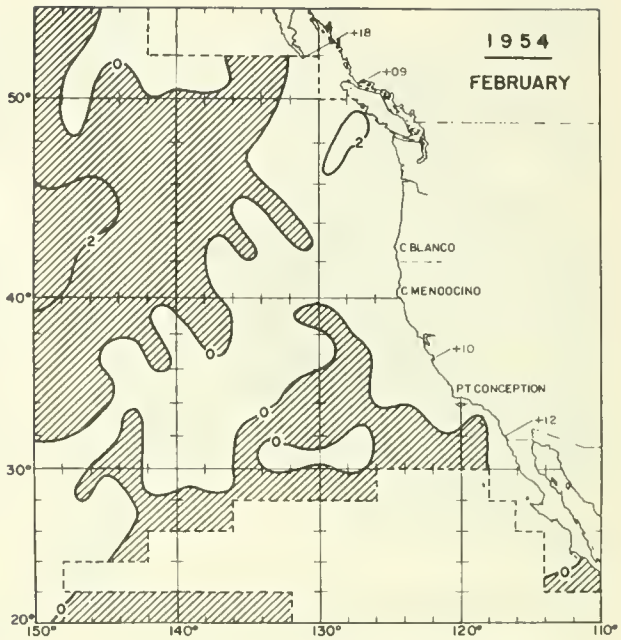
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FEBRUARY
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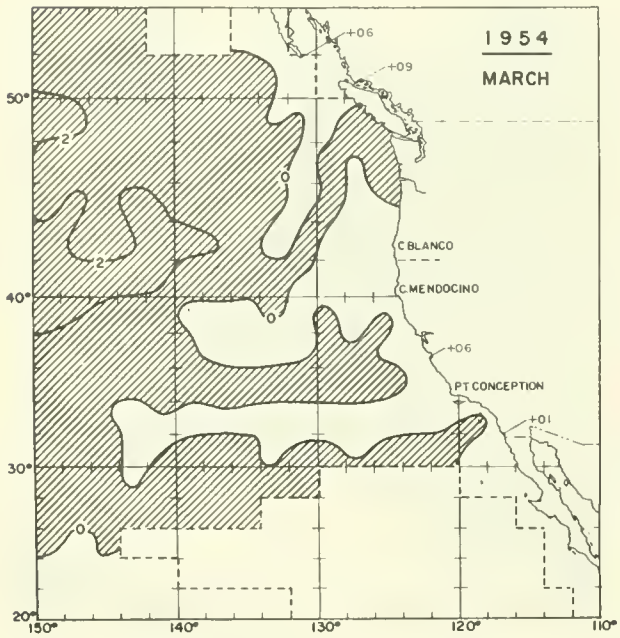
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+06
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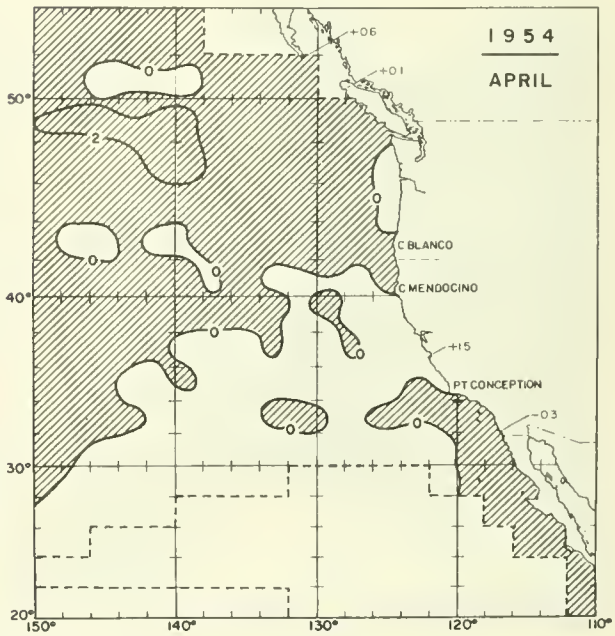
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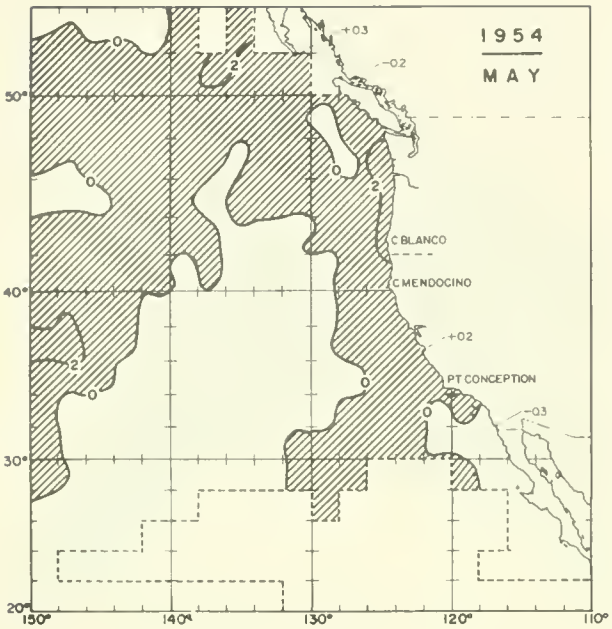
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MAY
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+02
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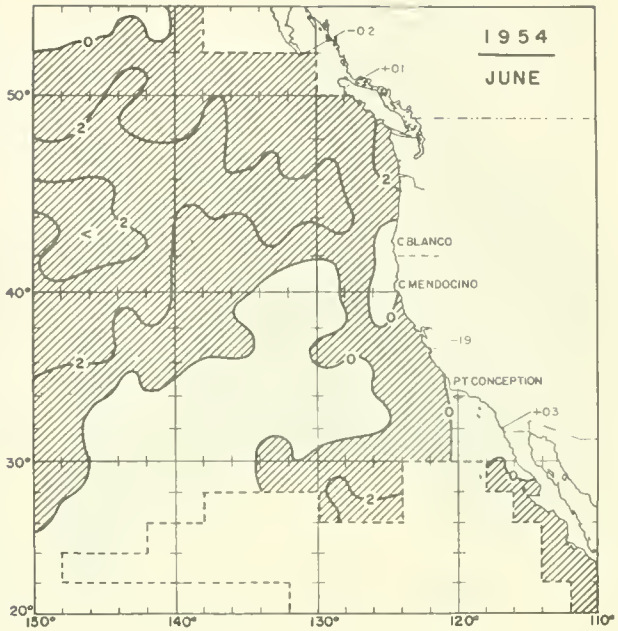
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JUNE
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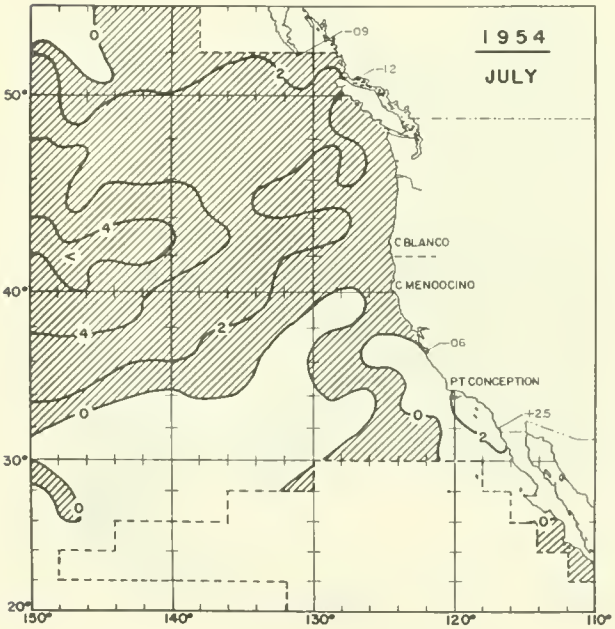
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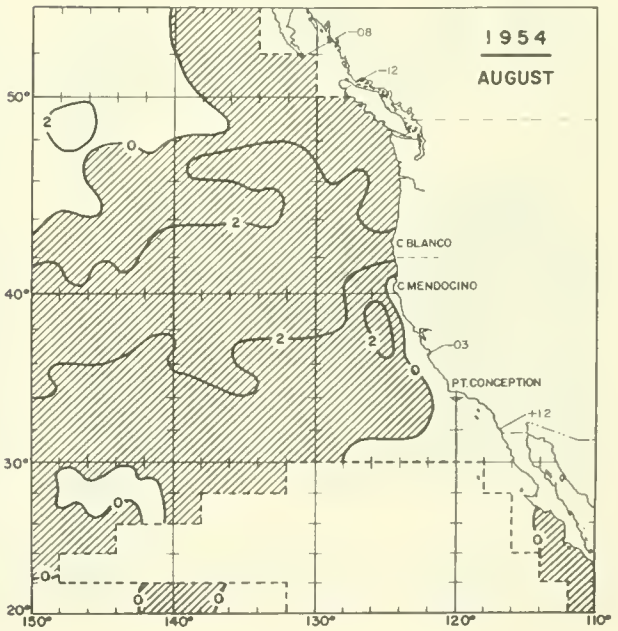
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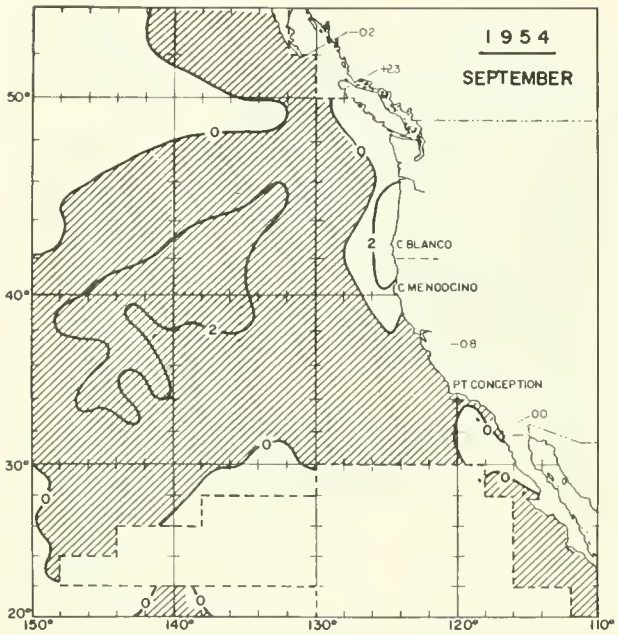
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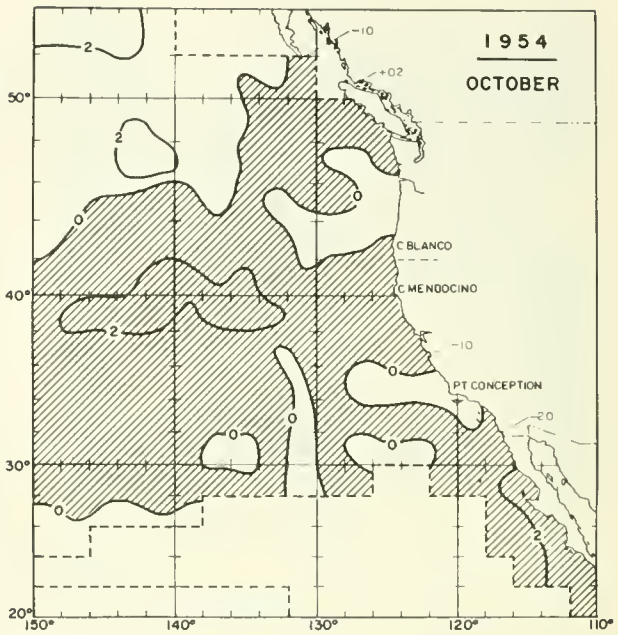
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C BLANCO
C MENDOCINO
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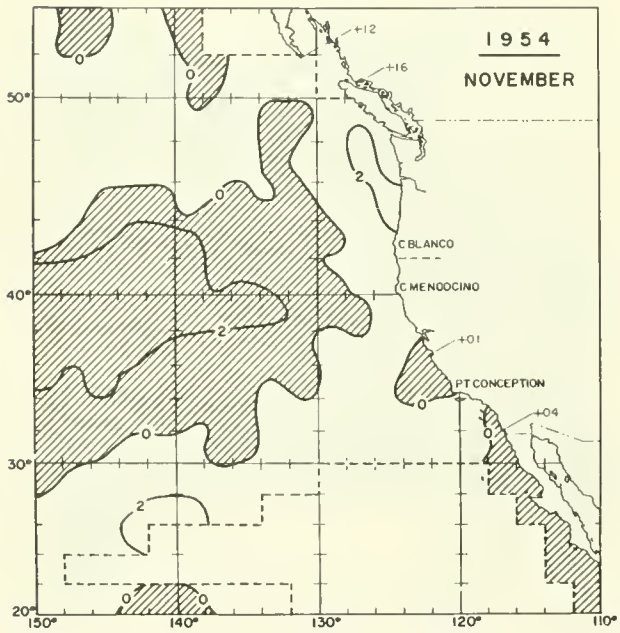
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C BLANCO
C MENDOCINO
PT CONCEPTION
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+16
+01
+04
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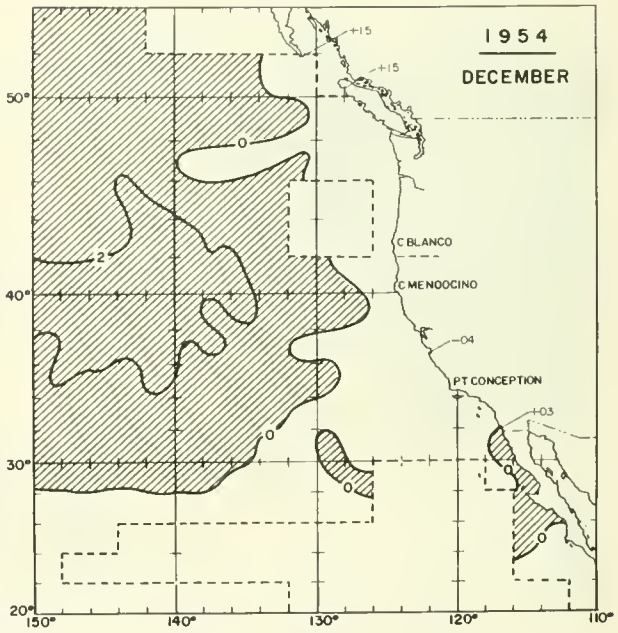
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DECEMBER
C BLANCO
C MENDOCINO
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-04
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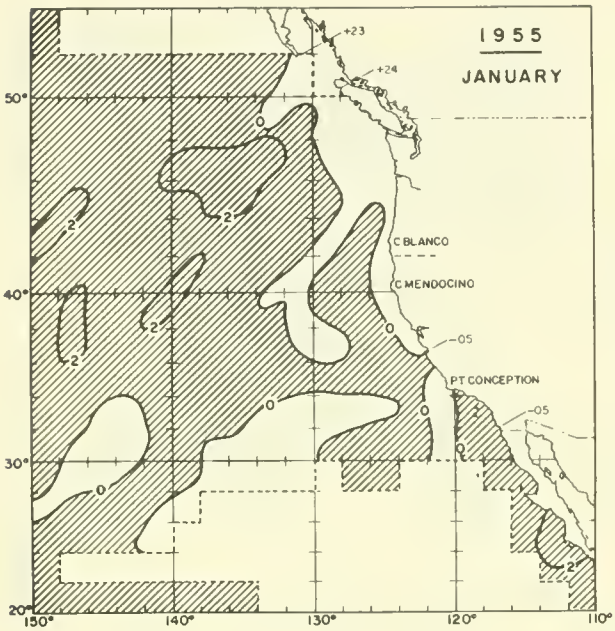
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PT CONCEPTION
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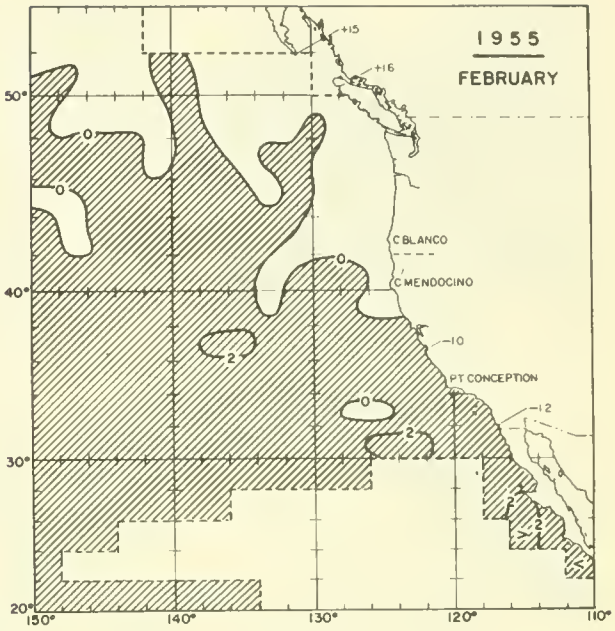
1955
FEBRUARY
+15
+16
C BLANCO
C MENDOCINO
-10
PT CONCEPTION
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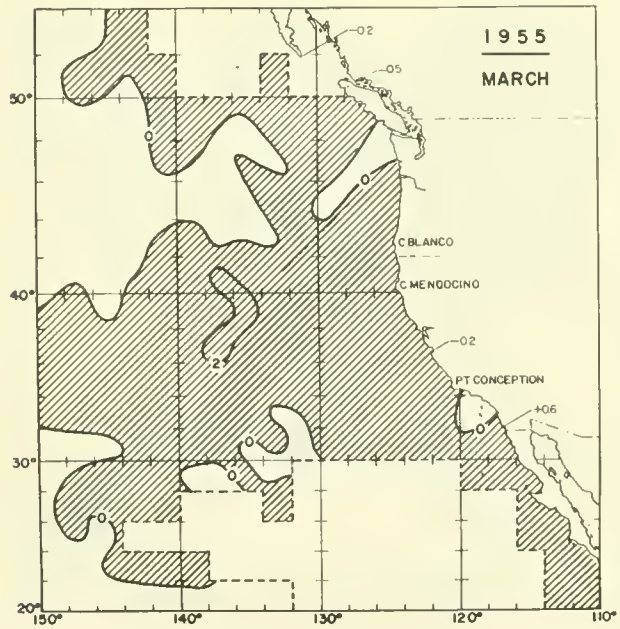
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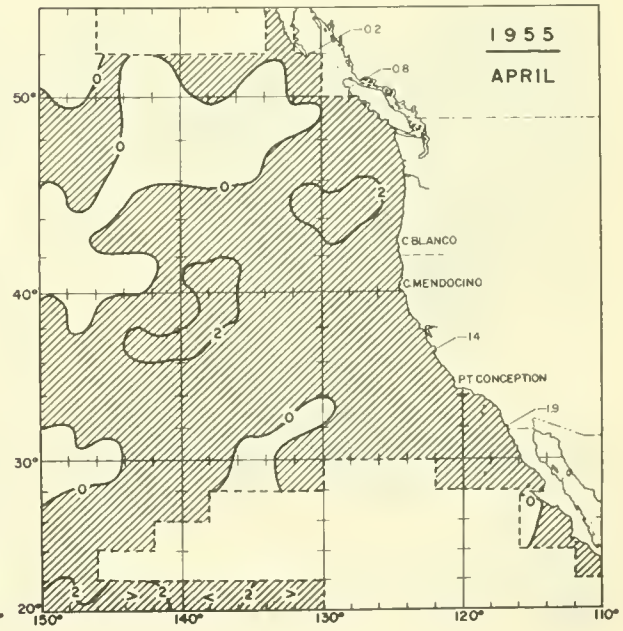
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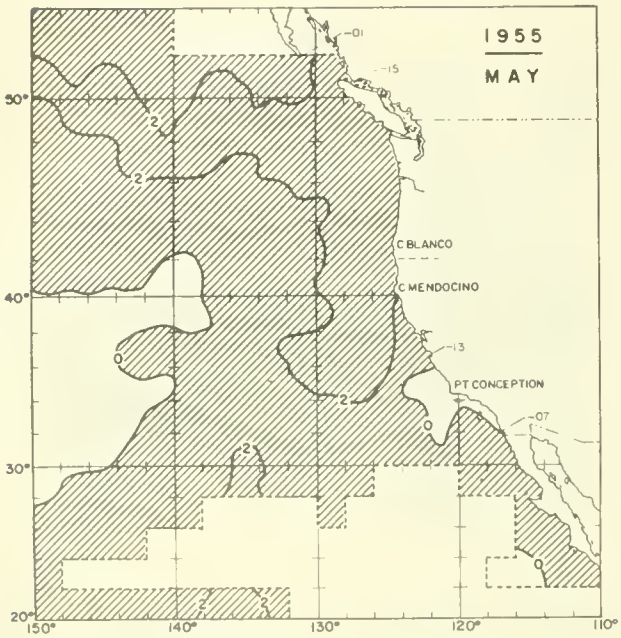
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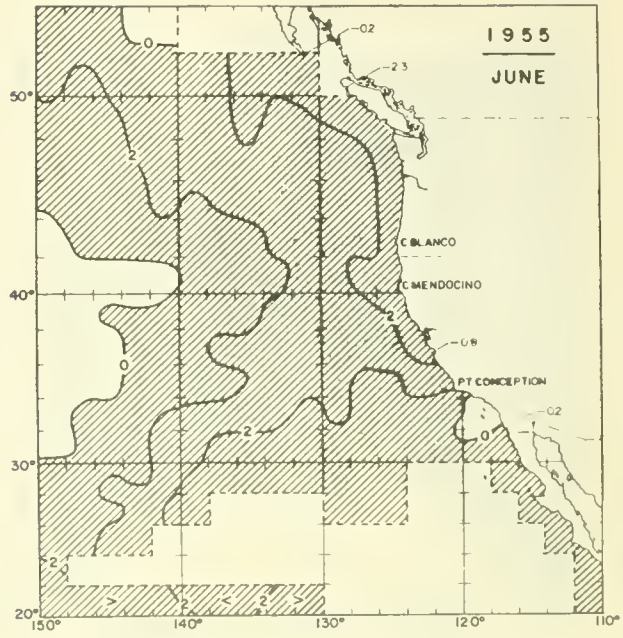
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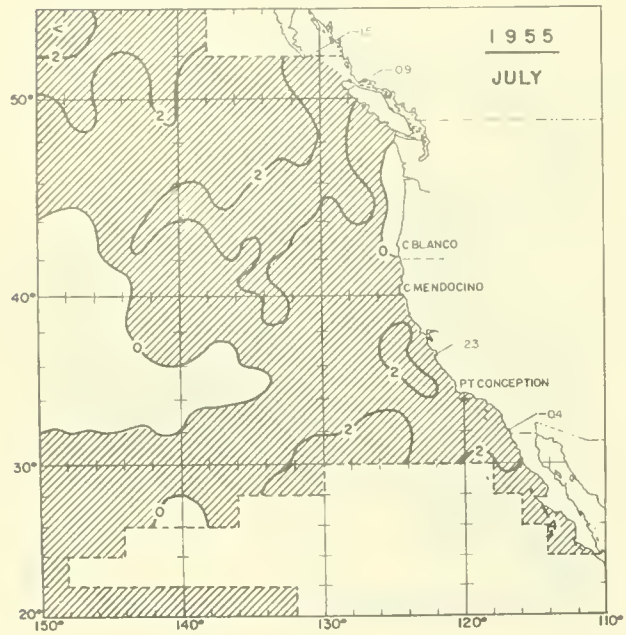
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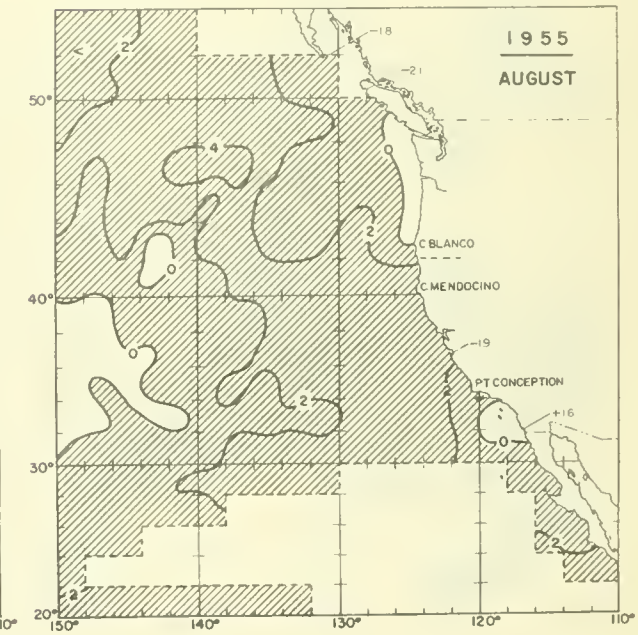
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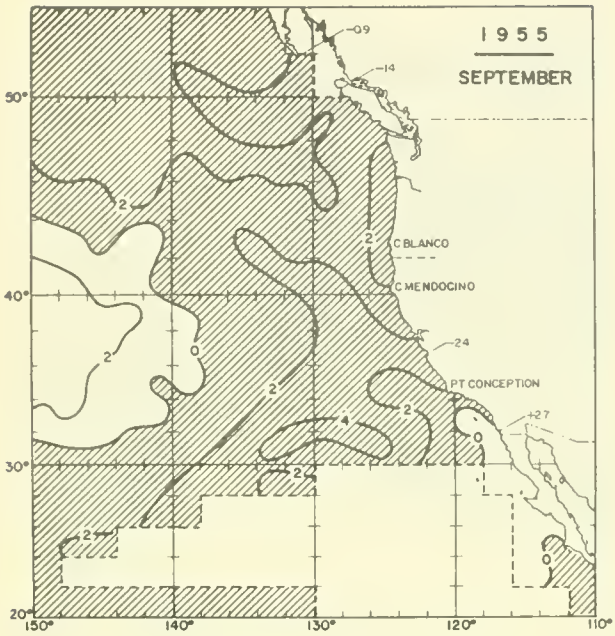
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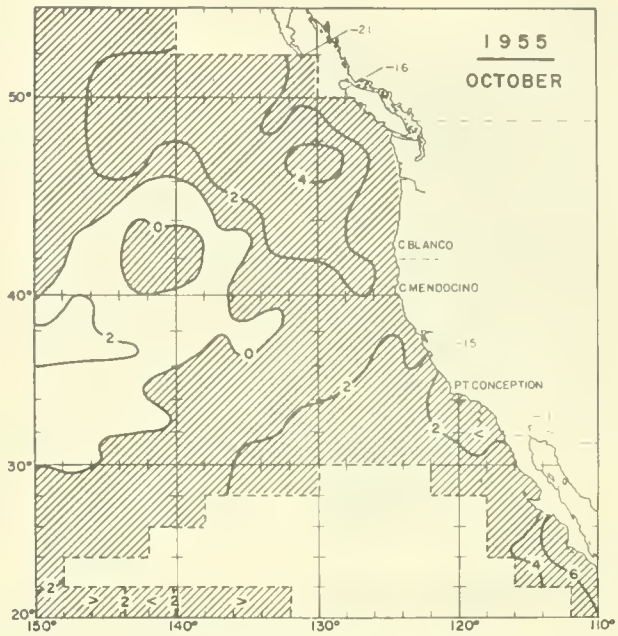
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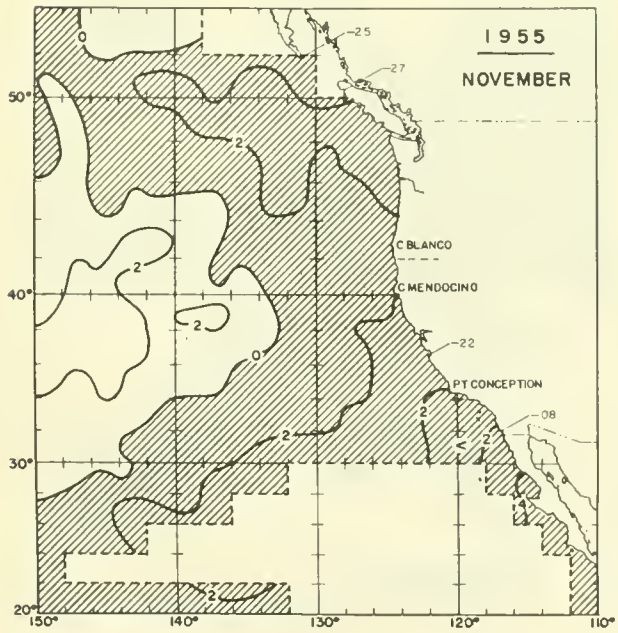
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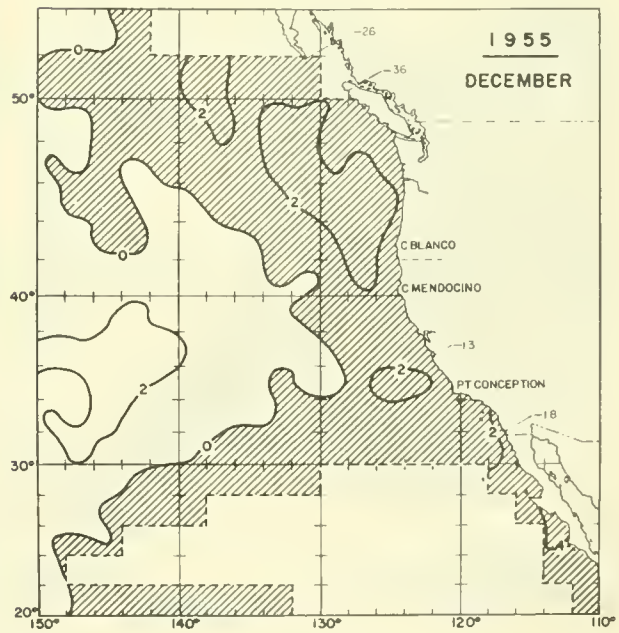
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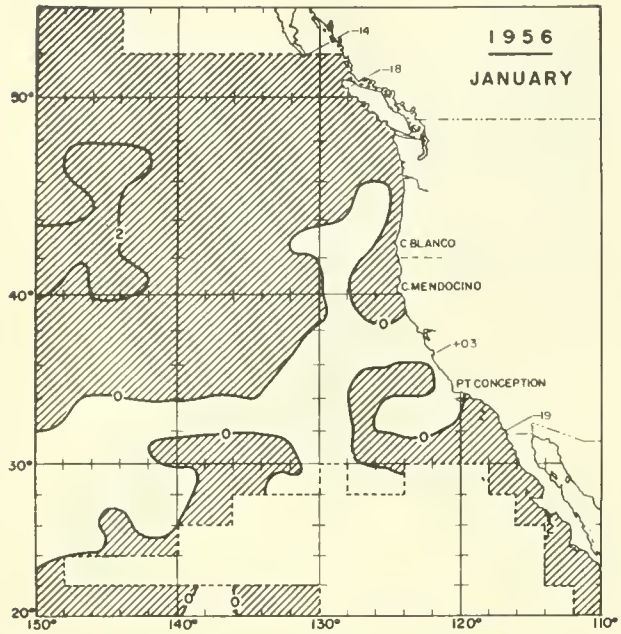
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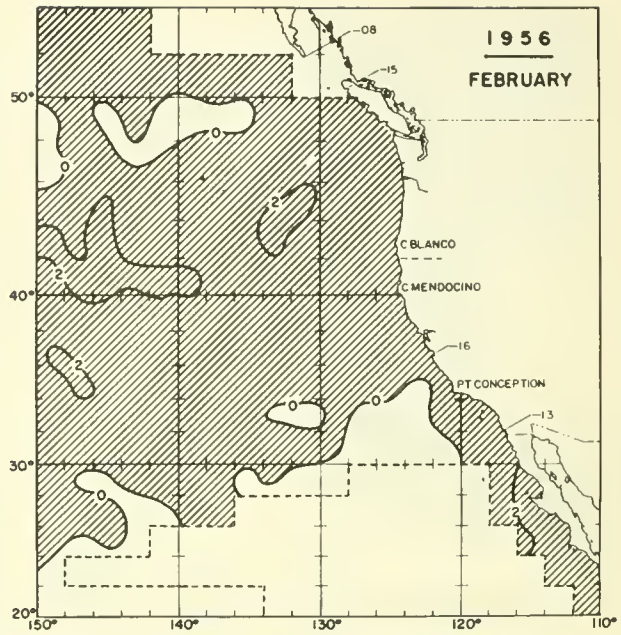
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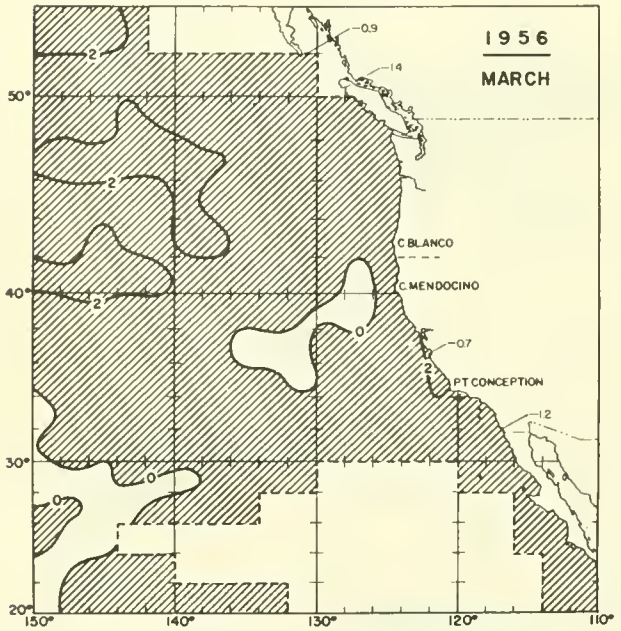
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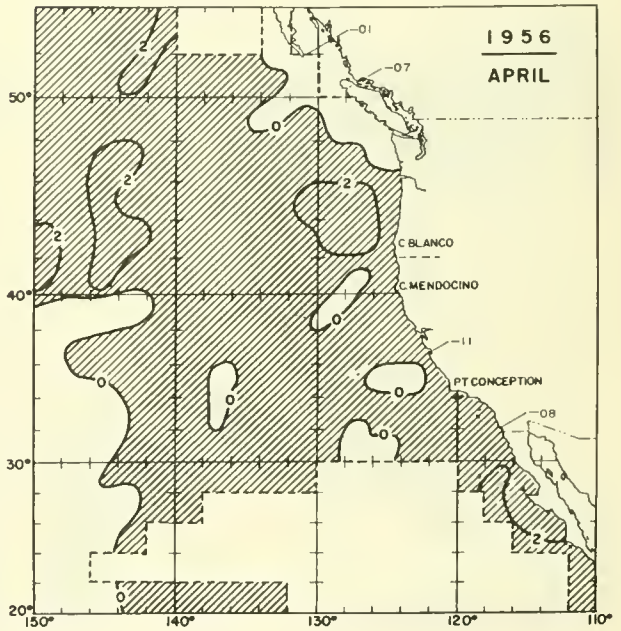
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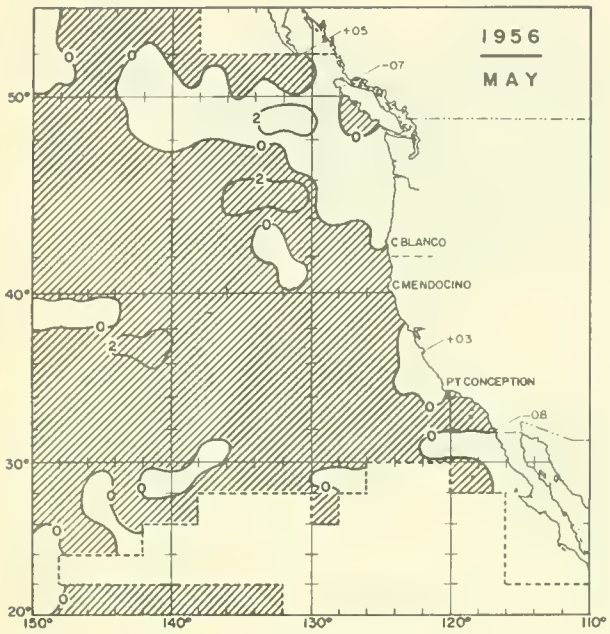
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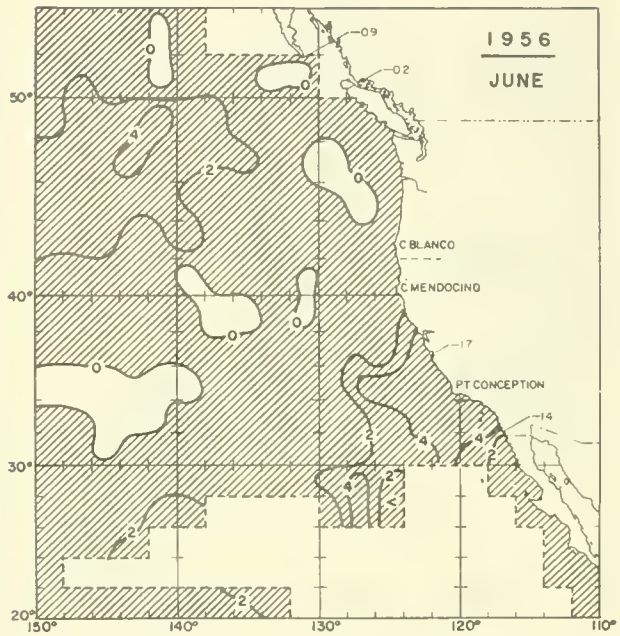
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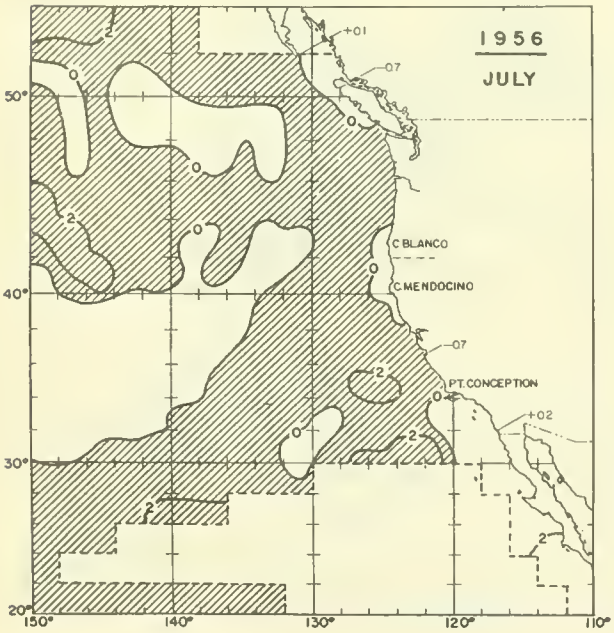
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1956
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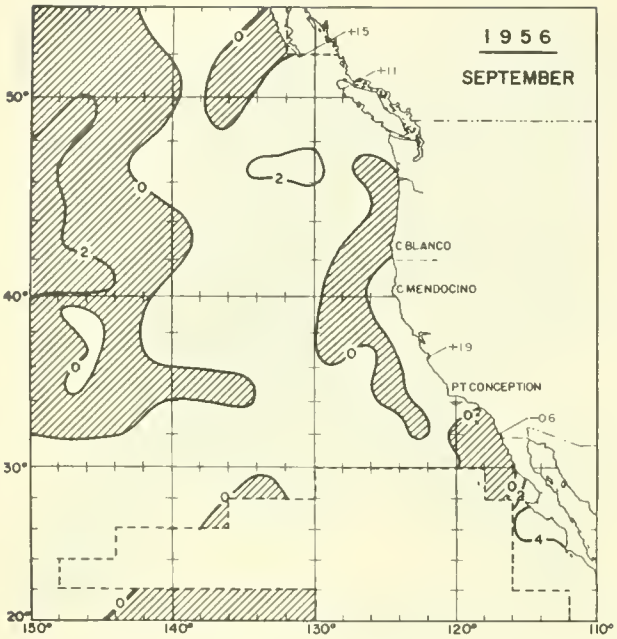
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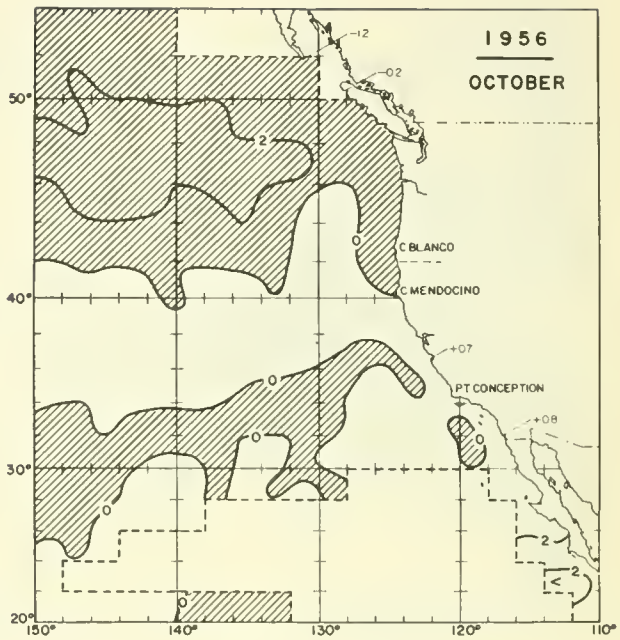
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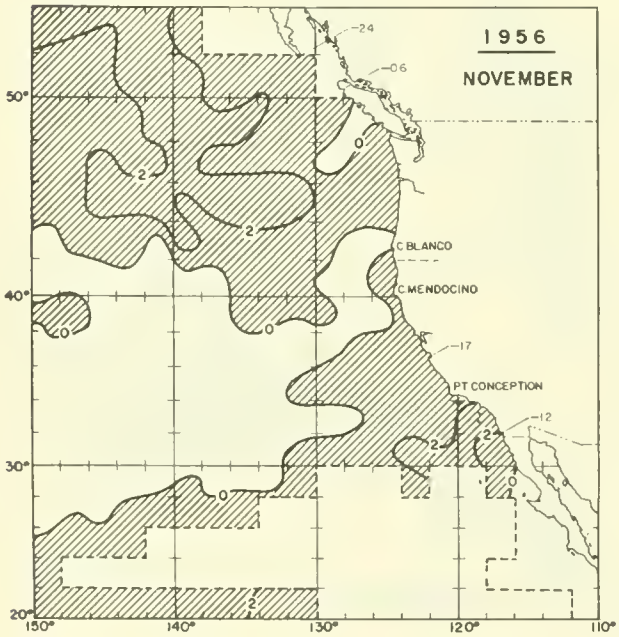
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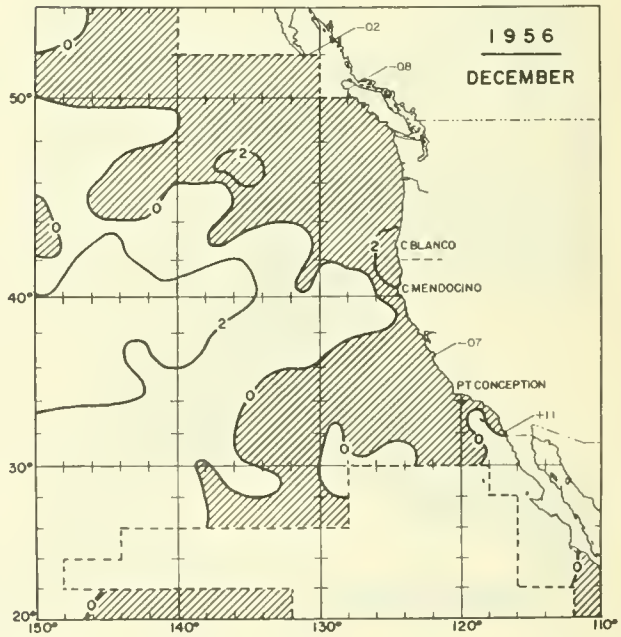
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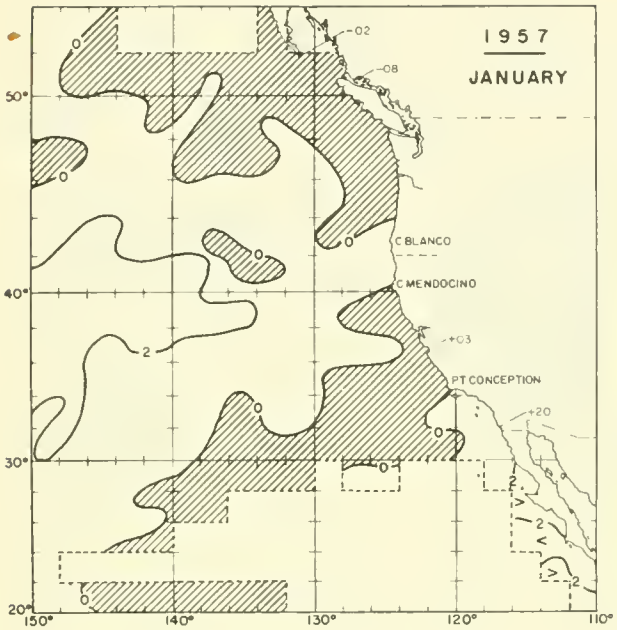
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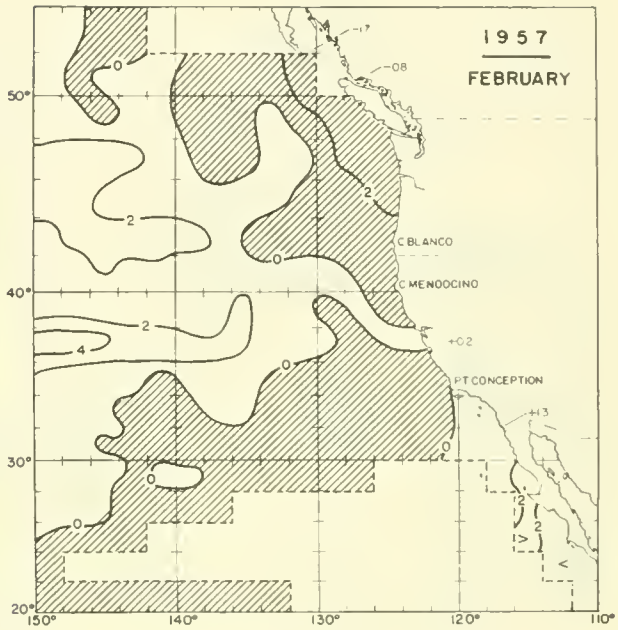
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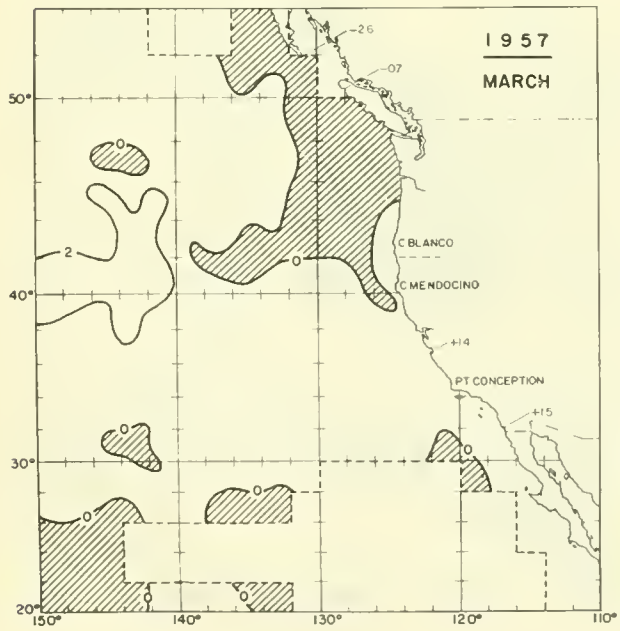
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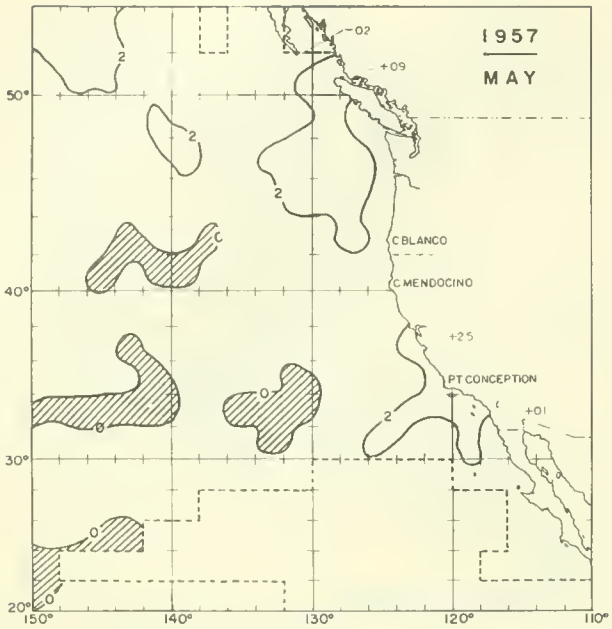
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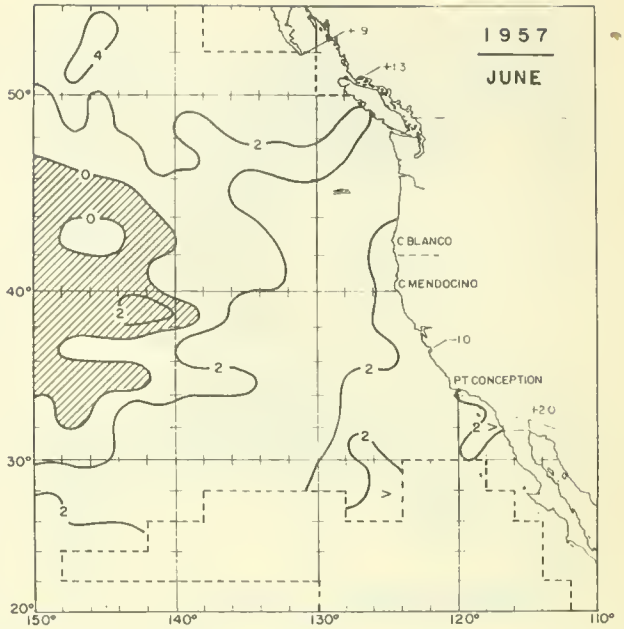
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1957
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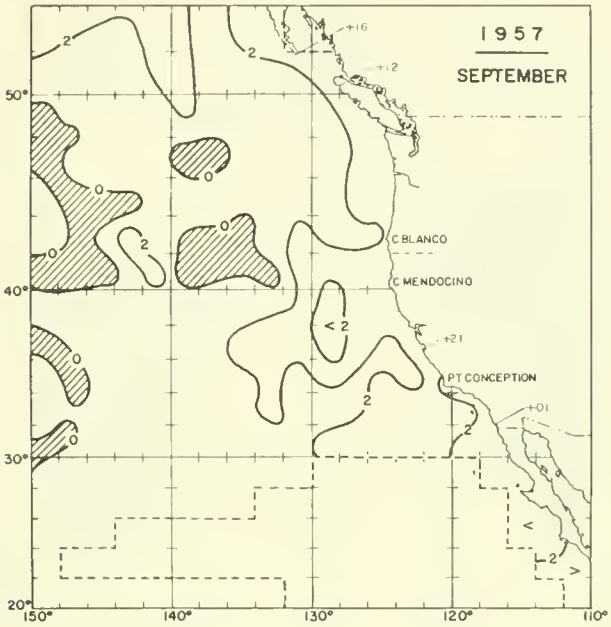
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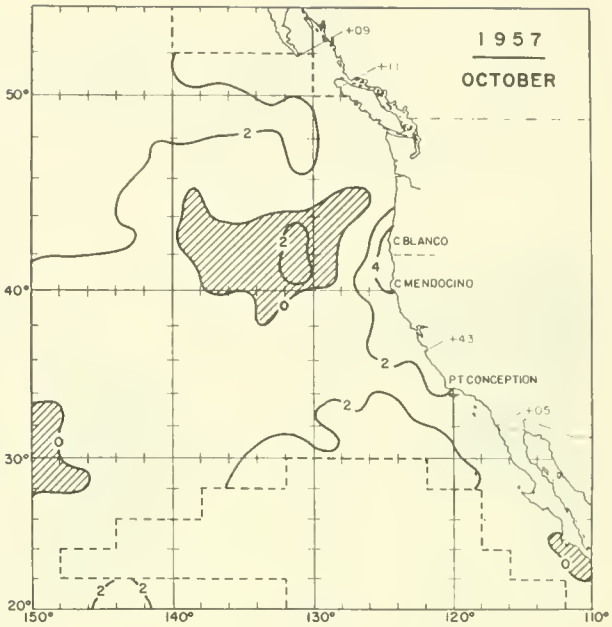
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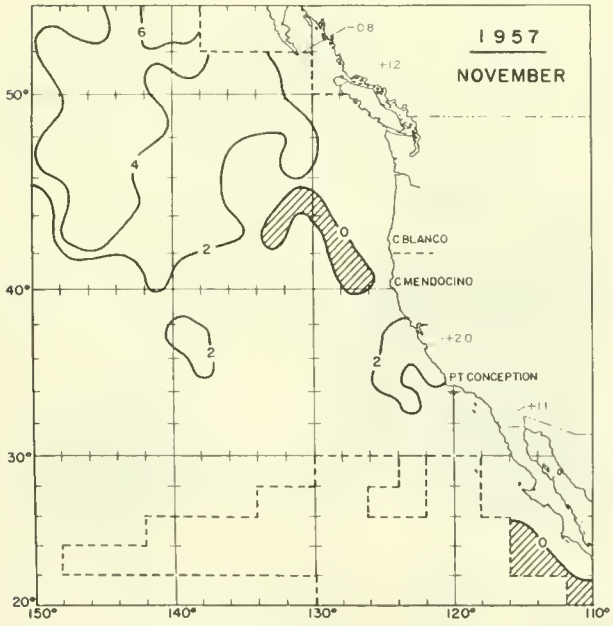
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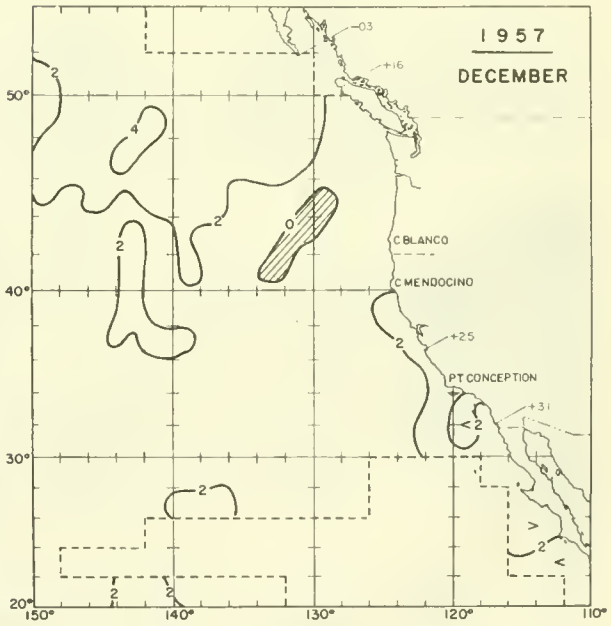
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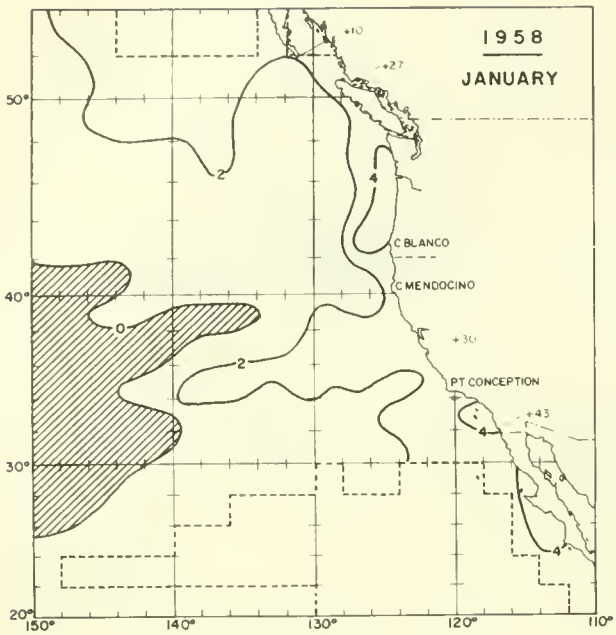
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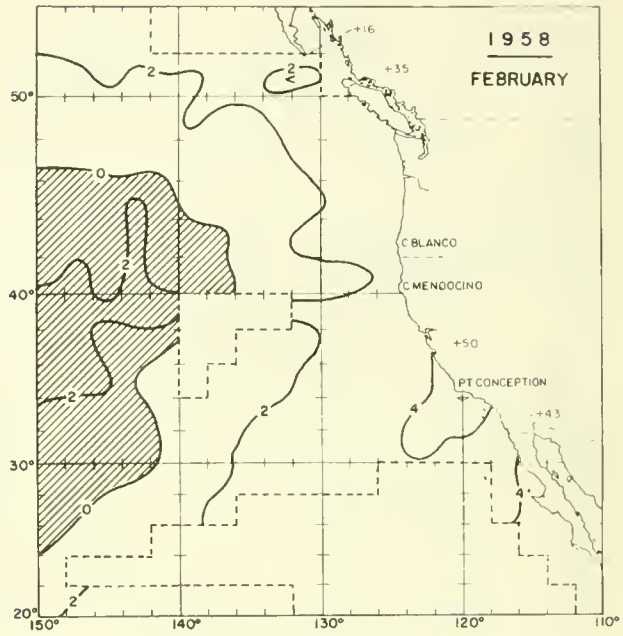
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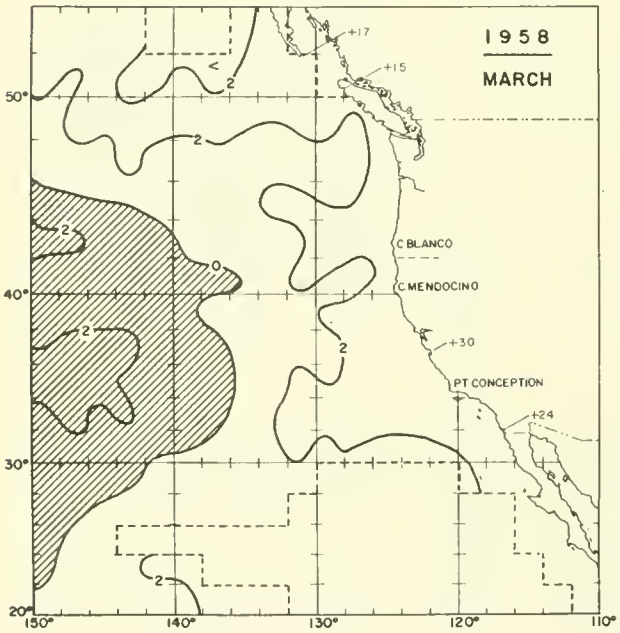
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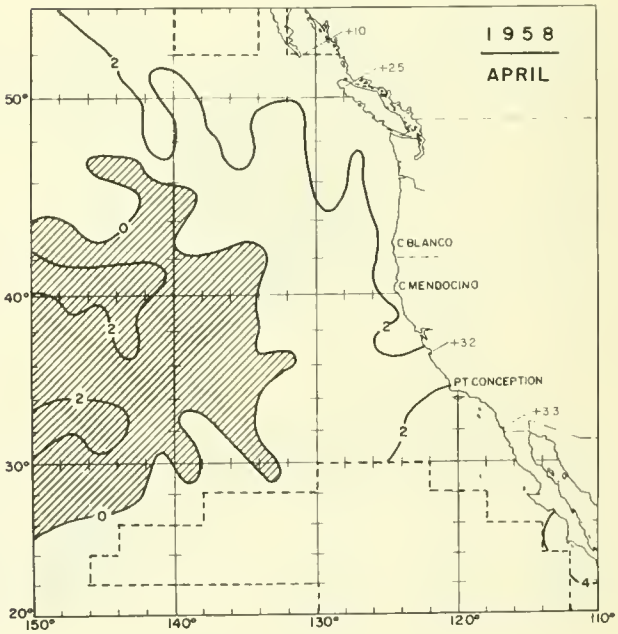
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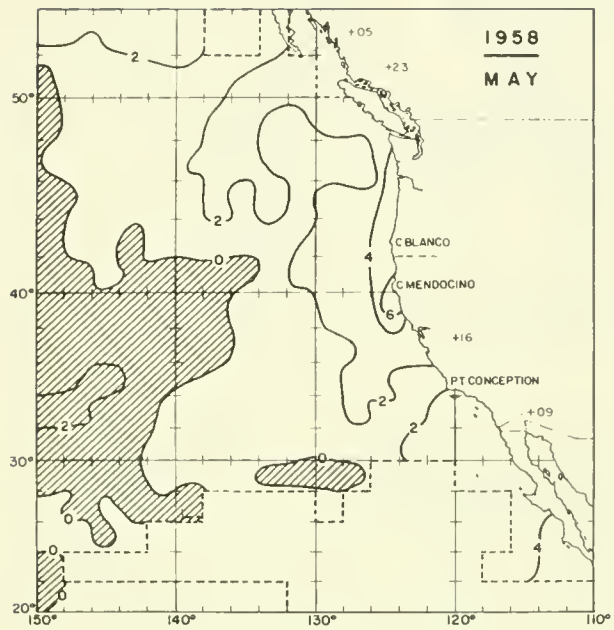
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1958
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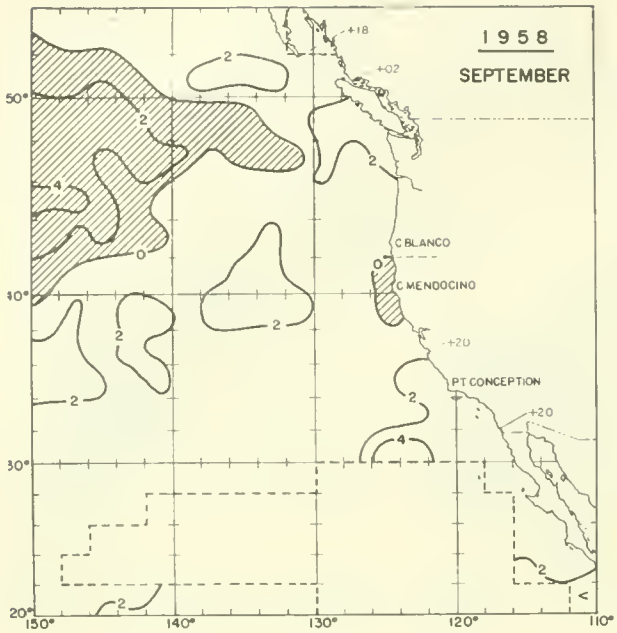

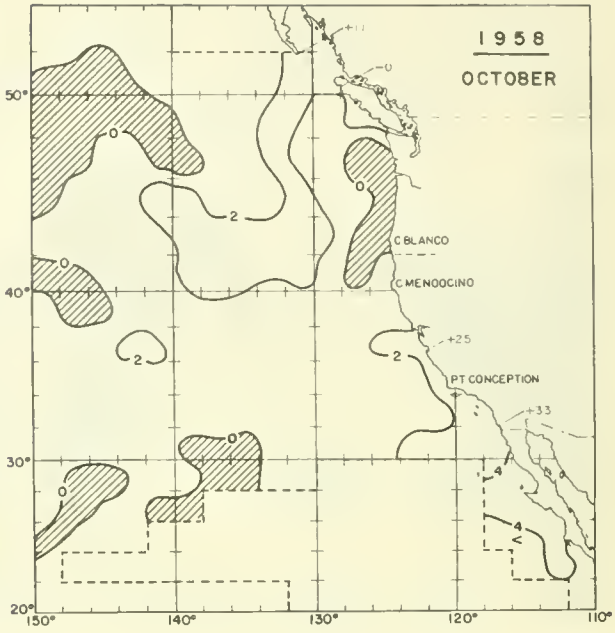

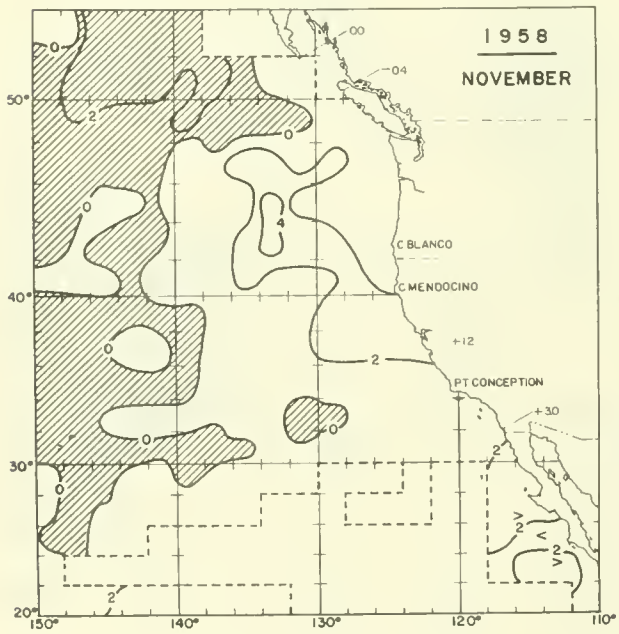

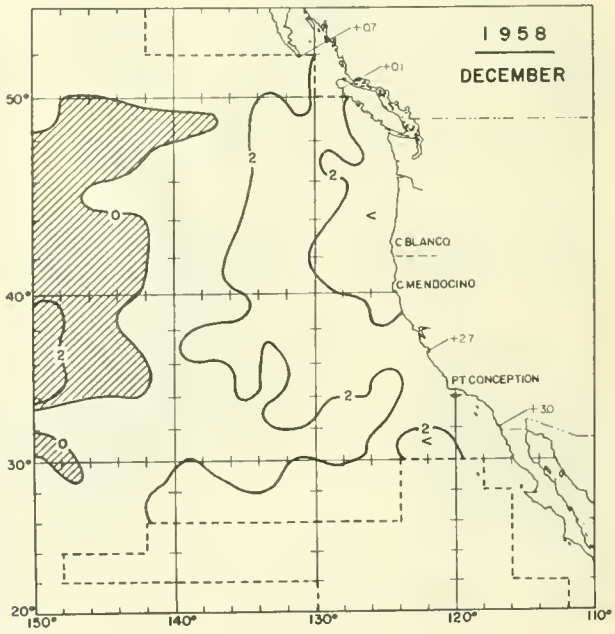

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