

SEASONAL AND GEOGRAPHIC CHARACTERISTICS OF FISHERY RESOURCES

California Current Region--III. Pacific Hake

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This third report of a series (Kramer and Smith, 1970a, b) describes the characteristics of the resource of the Pacific hake (*Merluccius productus*). It emphasizes predictions of the time and localities of adult spawning and suggests the potential for production of the resource.

The data of the California Cooperative Oceanic Fisheries Investigations (CalCOFI) for hake larvae (summarized for the decade 1951-60¹) indicate that the major center of spawning (50 percent or greater occurrence of larvae taken in standard plankton tows) appear first in December in a small area just south of Point Conception (fig. 1). In January and February, the major centers extend from Point Conception to Magdalena Bay in a widening band, not delimited in their southernmost extent. In March and April, the last months of peak spawning in the CalCOFI pattern, the centers spread offshore and northward until they extend outside the survey pattern except off central Baja California.

The Pacific hake is variously distributed from the Gulf of California (Starks and Morris, 1907) to Alaska (Clemens and Wilby, 1961). A number of investigations of seasonal and annual distributions have led to the hypothesis that adult hake are migratory (Alverson and Larkins, 1969; Nelson and Larkins, 1970). These reports hypothesized that the fish migrate southward in late fall and winter to spawn from central California to southern Baja California--and migrate north in late spring, summer, and fall to concen-

trate chiefly in inshore waters from California to northwest Washington (fig. 2).

It is in the latter season, and in those locations, that the fisheries must limit themselves because, as stated by Nelson and Larkins (1970), attempts to locate spawning hake in commercial quantities usually have met with little success. They attributed this, for the most part, to insufficient knowledge of the behavior and dispersion of hake during spawning. They stated further that all present data indicate that, in winter and early spring, spawning adult hake were located beyond the continental shelf off California and Baja California. This fact was reflected particularly in the relative scarcity of hake landings in the California animal food fishery and the absence of hake from December to April in the Vancouver Island-Oregon region. The latter corroborates, in part, the hypothesis of migration cited above.

In November 1969, a meeting of fisheries specialists of the U.S. and the U.S.S.R. was held in Seattle, Washington, to discuss the status of fish stocks of mutual interest. Preliminary estimates of the size of the hake stocks were as follows:

1. U.S.S.R. estimate from hydroacoustic surveys for all hake in the area between 37° N. and 52° N.--1,200,000 metric tons.²
2. U.S. estimate from hydroacoustic surveys for all hake in the area between 44°40' N. and 49°12' N.--283,000 metric tons.³

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¹ Organizations, area of investigation and treatment of the data were presented by Kramer and Smith (1970a).

² Verbal information only. Cited in the Report of the meeting of fisheries specialists of the United States of America and the Union of Soviet Socialist Republics concerning the status of fish stocks of mutual interest in the northeast Pacific Ocean, and on plans for joint and coordinated research of their biology, held in Seattle, November 17 to 22, 1969 (mimeo. report--copies available from BCF Biological Laboratory, Seattle, Wash. 98102).

³ Smith, Paul E. 1969. Calculations of hake spawning biomass from egg and larva surveys, 1951-69. In Spawning Biomass of Pacific Hake, 1969 (Report on Cooperative USA/USSR Hake and Larva Surveys, 1969), compiled by Staff, Fishery-Oceanography Center, BCF, La Jolla, Calif., pp. 6-41 (mimeo. report).

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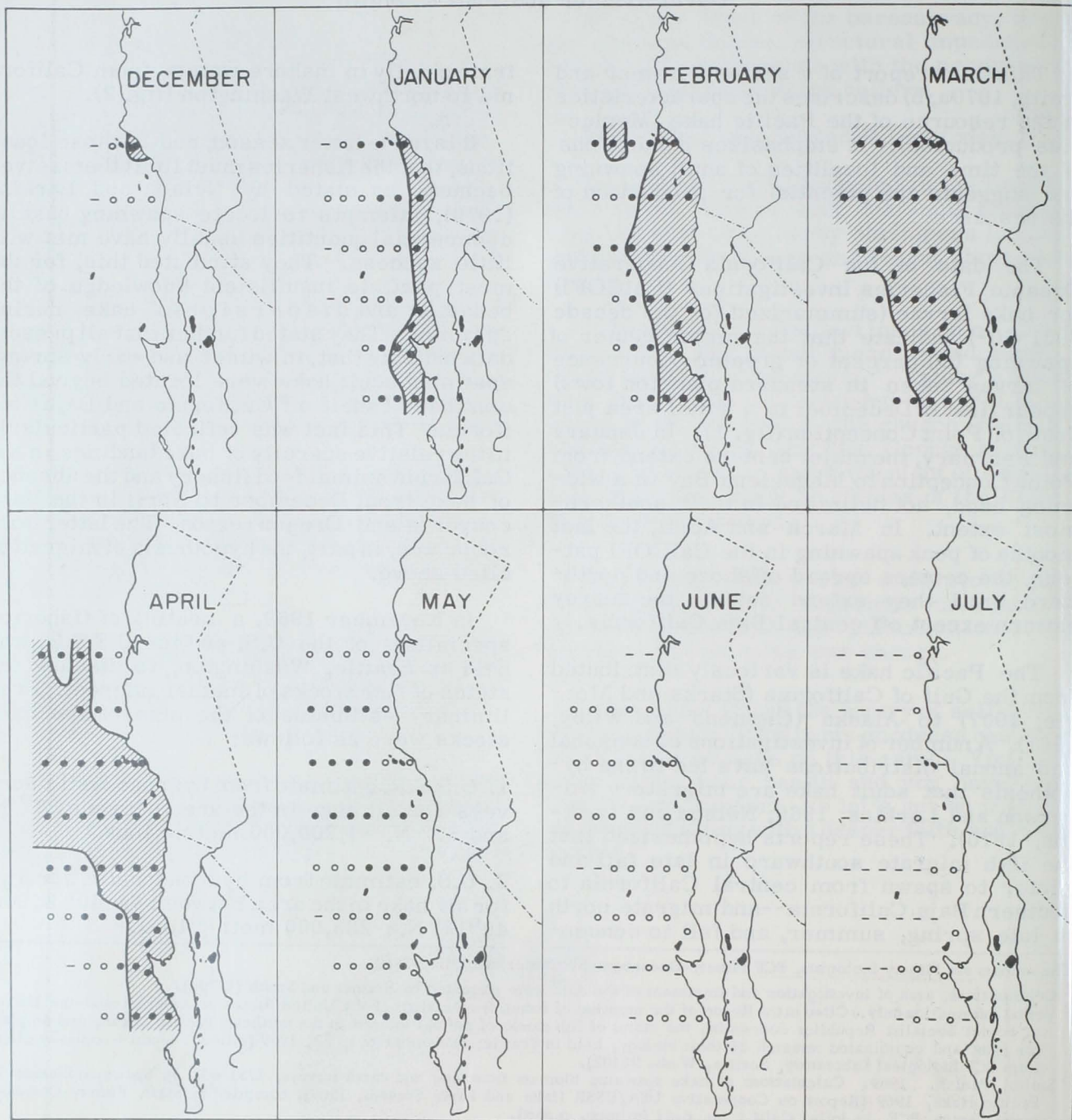


Fig. 1 - Percent occurrences of hake larvae, from summarized data for 1951-60, on the survey pattern of the California Cooperative Oceanic Fisheries Investigations (CalCOFI). Each line, circle or dot represents a pooled statistical area (see text footnote 2). (o) - equal to or less than 25 percent occurrence; (●) - greater than 25 percent occurrence; shaded area - greater than 50 percent occurrence; (-) - area occupied with no occurrences.

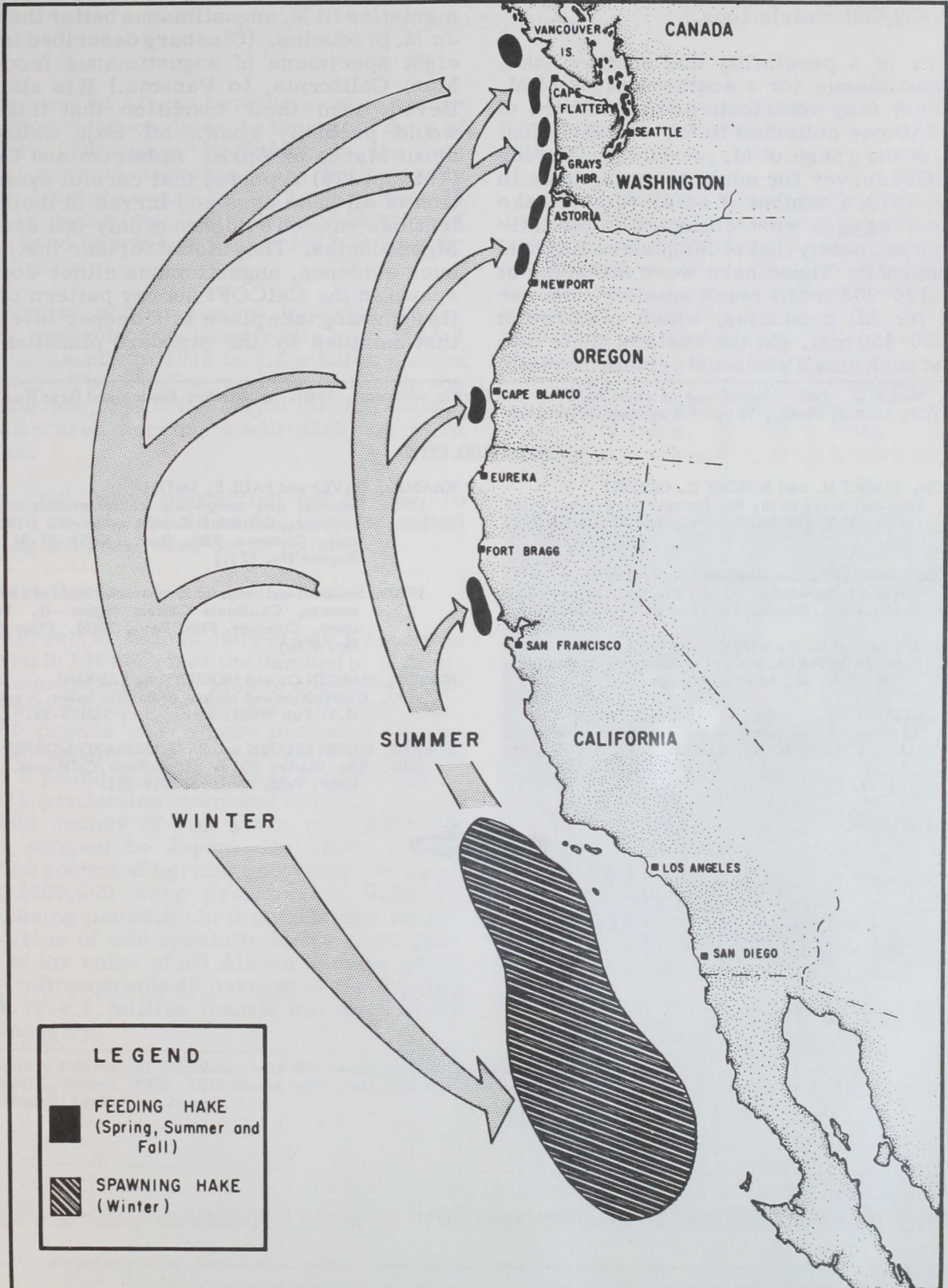


Fig. 2 - Seasonal migration and distribution of Pacific hake (fig. 6 of Alverson and Larkins, 1969).

3. U.S. estimate from egg and larvae surveys for adult hake over the entire range of species--2,630,000 metric tons.⁴

There is a possibility that another hake, *M. angustimanus* (or a southern stock of *M. productus*) may contribute some numbers of larvae to those collected in the southernmost extent of the range of *M. productus*. During a CalCOFI survey for adult spawning hake in January 1970, a number of small female hake with ripening eggs were collected in the latitude approximately that of Magdalena Bay and just north of it. These hake were maturing at sizes (126-202 mm.) much smaller than expected for *M. productus*, which matures at about 400-450 mm. On the basis of their maturity at such small sizes and certain meristic

characters, it is believed that these are a separate stock or a different species--the meristics fit *M. angustimanus* better than they do *M. productus*. (Ginsburg described in 1954 eight specimens of *angustimanus* from Del Mar, California, to Panama.) It is also believed from their condition that this hake would probably spawn off Baja California about March or April. Ahlstrom and Counts (1955, p. 329) reported that careful examination of all hake eggs and larvae in their collections showed evidence of only one species, *M. productus*. They stated further that, from such evidence, *angustimanus* either does not spawn in the CalCOFI survey pattern or that its spawning takes place at a deeper level than that sampled by the standard plankton haul.

⁴ Nelson, Martin O. 1969. Abundance of adult hake off the Pacific northwest, 1969. Exploratory Fishing and Gear Research Base, BCF, Seattle, Wash., 13 pp. + 3 appendices (mimeo. report).

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