

ESTIMATE OF THE SPAWNING BIOMASS OF THE NORTHERN ANCHOVY CENTRAL SUBPOPULATION FOR THE 1980-81 FISHING SEASON

GARY D. STAUFFER AND SUSAN J. PICQUELLE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Center
La Jolla, California 92038

ABSTRACT

The spawning biomass of the central subpopulation of northern anchovies off the Pacific coast of the State of California and Northern Baja California was surveyed by four ichthyoplankton cruises during the period, February-May 1980. The extent of the 1980 coverage was about half of the four cruise surveys conducted in previous years. Using a modified larva census method, the estimate of the 1980 spawning biomass was calculated at 1,775,000 tons. The optimum yield (OY) for the 1980-81 fishing season within the U.S. Fishery Conservation Zone was 179,000 short tons as determined by the OY formulation adopted by the Pacific Fishery Management Council's Anchovy Plan. The 1980-81 U.S. reduction quota for the northern anchovy was set at 166,400 short tons. In the fall of 1980 the California Fish and Game Commission established an 80,000 short ton limit on the amount of anchovy that could be processed by shore-based reduction plants in California.

RESUMEN

La biomasa del desove para la subpoblación central de anchovetas del norte frente a la costa Pacífica del estado de California y de Baja California Norte fue estudiado durante cuatro cruceros de reconocimiento de ictioplancton durante febrero-mayo de 1980. El área cubierta en 1980 era aproximadamente la mitad de ésta cubierta en los cuatro cruceros de reconocimiento efectuados en años previos. Usando un método de censo de larva modificado, la estimación de la biomasa del desove para 1980 se calculó en 1,775,000 toneladas cortas. El rendimiento óptimo para la temporada de pesca 1980-81 dentro de la Zona de Conservación de Pesquería de los EE.UU. fue de 179,000 toneladas cortas, determinado por la formulación del rendimiento óptimo adoptada por el Pacific Fishery Management Council en su Plan para Anchoveta. La cuota de reducción de los EE.UU. para 1980-81 para la anchoveta fue fijada en 166,400 toneladas cortas. En el otoño de 1980 la Comisión de Pesca y Caza de California estableció un límite de 80,000 toneladas cortas para la cantidad de anchoveta

que podía ser procesada por las plantas de reducción basadas en las costas de California.

INTRODUCTION

Catch quotas for the U.S. anchovy fisheries are established each year on July 1 using the current estimate of the anchovy spawning biomass as specified by the formulation in the Fishery Management Plan (FMP) for the Northern Anchovy Fishery (Pacific Fishery Management Council 1978). This paper is the third in a series of reports that document the annual estimate of spawning biomass of the central subpopulation of northern anchovy from which the optimum yield for the coming season is established (Stauffer and Parker 1980; and Stauffer 1980). The 1980 estimate is based on anchovy larva abundance data collected on the 1980 California Cooperative Oceanic Fisheries Investigations (CalCOFI) egg and larva survey of four cruises that only partially surveyed the seasonal and areal range of the northern anchovy spawning period. This survey was conducted under the direction of the La Jolla Laboratory, Southwest Fisheries Center (SWFC), National Marine Fisheries Service. Other research institutions cooperating in this survey were the Scripps Institution of Oceanography, Instituto Nacional de Pesca, Mexico, and Pacific Research Institute of Fisheries and Oceanography, Soviet Union.

LARVA SURVEY

Anchovy spawning biomass was estimated from anchovy larva abundance using a modification of the larva census method developed by Smith (1972) and further documented in Appendix I of the FMP (PFMC 1978). The incomplete larva census estimates for winter and spring quarter, which resulted from the partial coverage of the survey, were expanded to an annual larva census based on a regression analysis of the historical CalCOFI data. The four cruises on the egg and larva survey were conducted within the geographic range of the central subpopulation of the northern anchovy (Vrooman et al. 1980) as outlined by the eight regions shown on the CalCOFI station plan given in Figure 1.

The regions of southern California and Baja

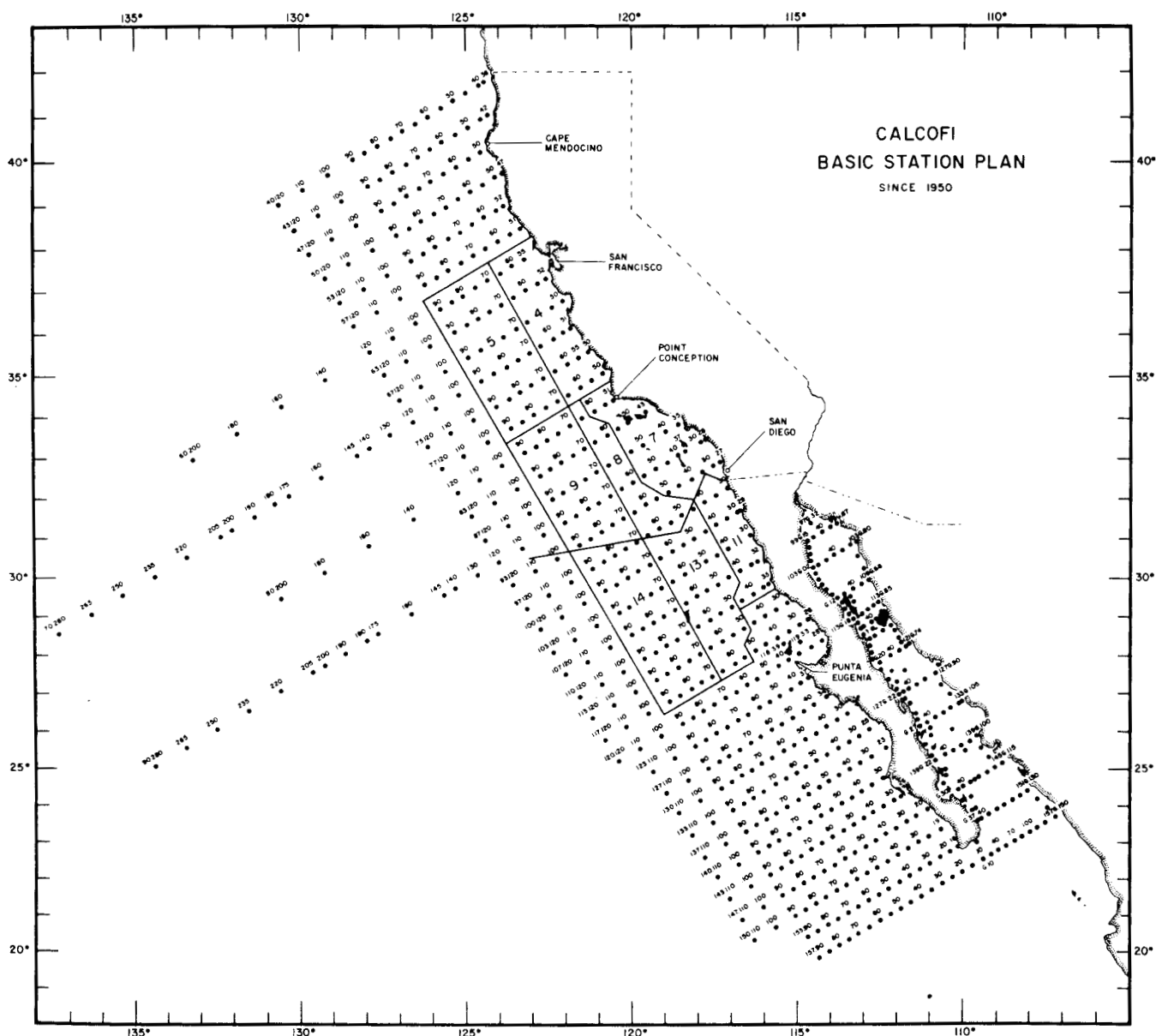


Figure 1. CalCOFI basic station plan. Geographic range of the central subpopulation of northern anchovy is within the light-numbered regions.

California were redefined so that the boundaries between the region group 7, 8, and 9 and the region group 11, 13, and 14 coincided with the U.S.-Mexico border as in 1979 (Stauffer 1980). The four cruises were 1) 8003 TK, February 21-March 17; 2) 8003 JD, March 20-April 10; 3) 8004 JD, April 11-19; and 4) 8005 JD, May 16-30. The first cruise was conducted by the Soviet R/V *Tikhookeanskiy* and the other three by the U.S. R/V *David Starr Jordan*. The stations occupied by each cruise are shown in Figure 2. The occupied stations off central California for cruises 8004 JD and 8005 JD are not shown. Only one cruise 8003 JD received a permit to conduct fishery research within Mexico's 200-mile zone.

Collection and processing of anchovy larva samples in 1980 were the same as for the 1979 CalCOFI survey as reported by Stauffer (1980). Plankton samples were collected with the paired CalCOFI bongo net. The data and samples were brought back to the Southwest Fisheries Center (SWFC) for processing and sorting. All of the plankton sample from the starboard net was sorted if the station was beyond 200 miles or if the plankton volume was less than 26 ml; otherwise, a 50% aliquot of the sample was sorted. The 1980 estimate includes station data from only the 118 standard stations defined by Smith (1972) to be those stations routinely occupied since 1951 and within the range of the central subpopulation.

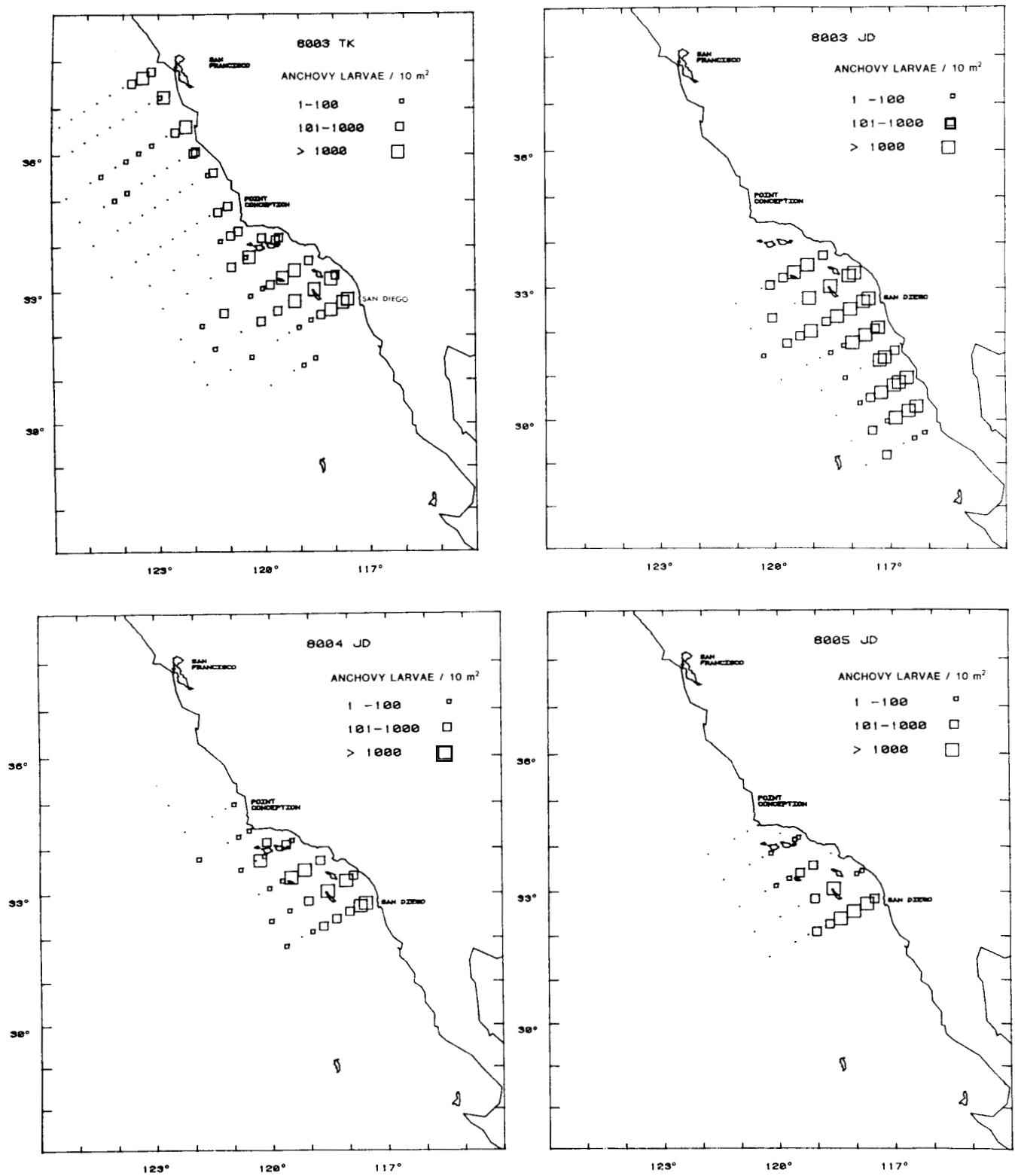


Figure 2. Pattern of occupied stations and geographic distribution of anchovy larvae for four CalCOFI cruises conducted during February-May period in 1980.

A decision was made in early winter 1980 to estimate spawning biomass also by the egg production method (Parker 1980) because of the limited coverage

of the CalCOFI cruises. To accomplish the task, the 8003 JD and 8004 JD cruises were designed to include the collection of anchovy egg samples and adult fish

with a midwater trawl net. Processing these samples in the laboratory was given first priority. There was insufficient time to process all bongo plankton samples to meet the July 1 deadline for announcement of the biomass estimate. As a result CalCOFI stations north of line 80 for cruises 8004 JD and 8005 were excluded from the processing and analysis.

In general the distribution of anchovy larvae for the central subpopulation was similar to that observed in 1979 for comparable regions and months (Stauffer 1980). The distribution of the standardized number of anchovy larvae per 10 M² sea-surface area is summarized in Figure 2 for the four 1980 CalCOFI cruises. For the Southern California Bight regions of 7, 8, and 9, larvae were within 140 nautical miles of the coast. The larva densities were highest in the Southern California Bight region 7 for the March and early April 8003 JD cruise with larva density tapering off by May similar to prior years. For central California regions samples were sorted for only the 8003 TK cruise conducted in early March. At this time anchovy larvae were distributed within 50 nautical miles of the coast. Examination of the anchovy egg samples from 8004 JD for central California regions found only a few anchovy eggs in Monterey Bay, suggesting that anchovy spawning had ceased in that area by the time of the 8004 JD cruise (Stauffer and Picquelle 1980). The distribution of anchovy larvae off northern Baja California extended about 100 nautical miles offshore, although the spawning apparently was concentrated

within 40 nautical miles of the coast (Stauffer and Picquelle 1980).

Because the 1980 egg and larva survey lacked a January cruise and samples for CalCOFI northern Baja and central California regions in the spring quarter were not sorted, the 1980 annual larva census estimate was derived from a regression analysis of the historical CalCOFI anchovy larva data recompiled to generate larva census numbers that matched the coverage of the 1980 egg and larva survey (Table 1). The historical larva data were summarized for CalCOFI regions 7, 8, 9, 11, and 13 (southern California and northern Baja California regions) for the second half of the winter quarter (15 February to 31 March) and for regions 7, 8, and 9 for the spring quarter. These regions and time periods corresponded to areas in which 1980 CalCOFI larva samples were collected and sorted. These winter and spring totals were summed to provide a modified larva census (L_m) for the CalCOFI time series which was comparable to the incomplete larva census for the 1980 survey. To expand L_m to an equivalent annual larva census values (L_a) as given in Appendix I of the FMP, the difference between these values, L_u (i.e. $L_u = L_a - L_m$) was regressed on L_m for the historical CalCOFI years in which there were sufficient data (see Table 1). The analysis excluded the 1979 census data which was also an expanded estimate from a partial survey. This regression is

$$L_u = 3.043 - 0.0107 L_m \quad (1)$$

TABLE 1
 Larva Census Data (10⁹ Larvae) for Estimating 1980 Spawning Biomass

Year	(1) 2nd half of winter (Region 7,8,9,11,13)	(2) Spring quarter (Region 7,8,9)	Sum (1)+(2)	Annual larva census ¹	Estimated biomass ¹ (1,000 tons)
1951	455	458	913	1,841	180
52	353	257	610	1,600	156
53	1,705	144	1,849	5,208	510
54	3,730	410	4,140	7,838	768
55	5,644	1,047	6,691	8,618	846
1956	3,506	816	4,322	4,944	485
57	4,192	4,027	8,219	11,960	1,172
58	5,203	3,620	8,823	15,087	1,479
59	3,825	4,843	8,668	15,440	1,514
60	10,527	4,804	15,331	15,713	1,540
1966	14,170	17,212	31,382	36,452	3,572
1969	32,852	3,496	36,348	30,594	2,998
1972	14,359	6,857	21,216	28,373	2,781
1975	27,563	387	27,950	36,768	3,603
1978	10,994	2,630	13,624	13,306 ²	1,304 ²
79	10,111	3,612	13,723	17,580 ³	1,723 ³
80	11,830	3,400	15,230		1,775

¹Source: Appendix I of Northern Anchovy FMP (PFMC 1978)

²Stauffer and Parker 1980

³Stauffer 1980

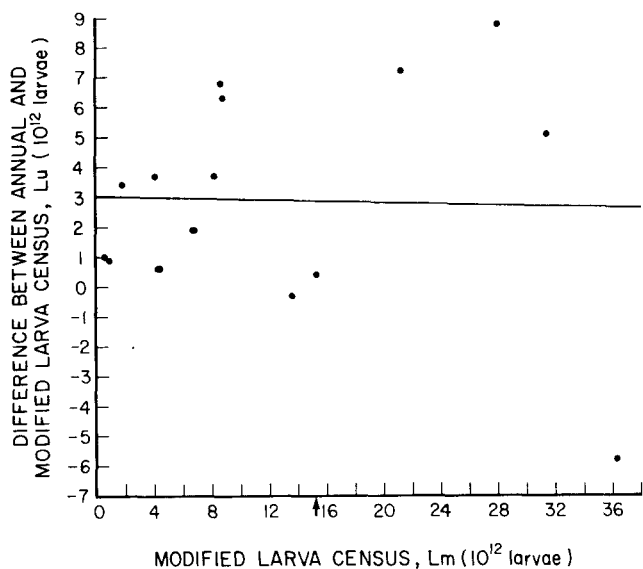


Figure 3. The regression model for expanding the modified larva census, L_m , to the annual larva census, L_a .

and is shown in Figure 3. Although the slope (-0.0107) is not significantly different from zero, equation (1) was used to estimate L_u for 1980. The incomplete winter and spring larva census numbers for 1980 were $11,830 \times 10^9$ and $3,400 \times 10^9$ larvae. These values are quite similar to the recomputed 1978 and 1979 larva census numbers. The sum of 1980 winter and spring numbers gives L_m value of $15,230 \times 10^9$ larvae. From (1) the 1980 value of L_u is $2,880 \times 10^9$ larvae. Approximate 95% confidence limits for $L_u \pm$ are 8.400×10^9 larvae. The equivalent annual larva census value, L_a , for 1980 is $18,110 \times 10^9$ larvae, the sum of L_u and L_m .

The estimate of the 1980 anchovy spawning biomass for the central subpopulation, using the larva census method developed by Smith (1972)

$$B = 9.8 \times 10^{-8} L_a,$$

is 1,775,000 short tons for L_a equal to $18,100 \times 10^9$ larvae. Stauffer and Picquelle (1980) using the new egg production method (Parker 1980) estimated the 1980 anchovy spawning biomass to be 942,100 short tons. However, the larva census estimate is the appropriate estimate for setting the 1980 harvest quota by the procedure set forth in the anchovy FMP, since the model used in the evaluation of the harvest policy was dependent on the historical larva census estimates of anchovy biomass. Based on the larva census method, the 1980 anchovy spawning biomass is relatively unchanged from the 1979 level of 1,723,000 tons (Stauffer 1980). Optimum yield for the central subpopulation during 1980-81 season as specified in the FMP was 255,750 short tons. Within the U.S.

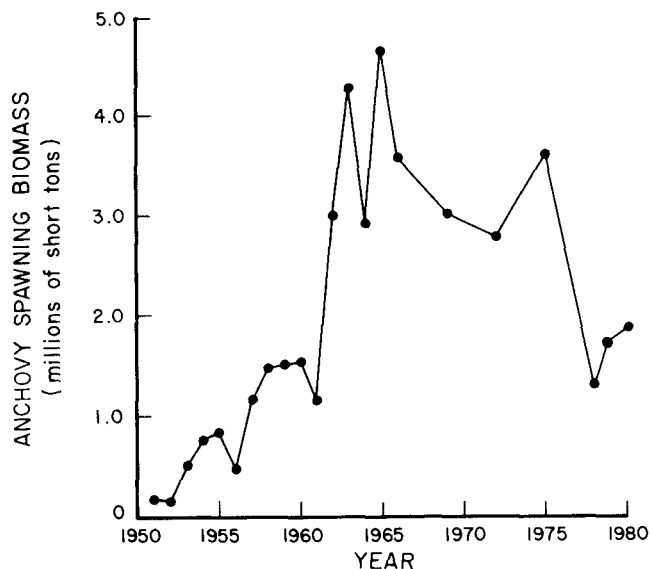


Figure 4. Estimated spawning biomass for the central subpopulation of northern anchovies, 1951-80.

Fisheries Conservation Zone the optimum yield was 179,400 short tons with a U.S. anchovy reduction quota set at 166,400 short tons. Because of the concern for the status of the anchovy resource arising from the egg production estimate of less than 1,000,000 tons, the California Fish and Game Commission in the fall of 1980 established an 80,000 short ton limit on the amount of northern anchovy that could be processed by shore-based reduction plants in California. The Commission's action included a provision for considering future increase if the reduction plants approach the 80,000 ton limit.

ACKNOWLEDGMENTS

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