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STATUS OF THE SPAWNING BIOMASS OF THE PACIFIC SARDINE, 1975-1976

by

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ABSTRACT

In order to initiate a fishery for the Pacific sardine, *Sardinops sajax caeruleus*, it is required that the spawning biomass be determined to have reached a minimum of 20,000 short tons. Data from ichthyoplankton surveys, night-light surveys, the anchovy bait fishery, and jack mackerel purse seine fishery are analyzed for evidence of an increase in population size. The present level of the spawning population of the northern stocks of sardines is determined to be far below the 20,000 tons required to initiate a fishery.

1/ Marine Resources, Administrative Report No. 76-4, January 1976.

2/ Marine Resources Region, 350 Golden Shore, Long Beach, California 90802.

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RECOMMENDATIONS

This report is presented in response to legislation requiring that the California Department of Fish and Game assess the status of the spawning population of the northern stock of Pacific sardines, *Sardinops sajax caeruleus*, on an annual basis. The California legislature expressed its intent that the sardine resource be rehabilitated, and that once the spawning population reaches 20,000 short tons, a small 1,000 ton fishery would be allowed.

The Department of Fish and Game has determined that the spawning population of the sardine at the beginning of 1976 is far below 20,000 tons; therefore, we recommend that no fishery be initiated in 1976 and that restrictions concerning incidental catches remain in force.

INTRODUCTION

The Pacific sardine has been fished off the Pacific Coast of North America since the late 1800's. Klingbeil (1975) briefly summarizes landings by port for the 1916-1917 through 1972-1973 seasons and includes a brief description of legislation enacted in 1967, 1969 and 1973. The primary purpose of this legislation was the reduction of fishing pressure on the sardine. The 1973 legislation requires a determination of the spawning population on an annual basis. While Department biologists have devoted considerable effort to monitoring pelagic fish landings in an attempt to collect the pertinent data, the present low level of the population coupled with the necessary cessation of a sardine fishery have rendered most classical techniques for estimating fish biomasses useless. Suffice to say that there remains no direct method of estimating the sardine on an annual basis. However, there are several avenues whereby

biologists can monitor the population on a continuing basis for the purpose of documenting any resurgence in the northern stock of sardines. These avenues include the collection and analysis of (1) icthyoplankton data, (2) live bait data, (3) sea survey cruise data, and (4) jack mackerel fishery data.

ICHTHYOPLANKTON DATA

As early as 1940, biologists first began to conduct egg and larval surveys in an attempt to learn more about the spawning behavior and biomass of the Pacific sardine. By the early 1950's, the California Cooperative Oceanic Fisheries Investigations (CalCOFI) agencies were conducting egg and larval surveys on a monthly basis. From 1961 to 1969, a reduction in cruises resulted in quarterly surveys. Since 1969, egg and larval surveys have been conducted every three years, (1969, 1972, and 1975) on a quarterly basis by National Marine Fisheries Service (NMFS) and Scripps Institution of Oceanography. Use of data collected during past surveys has resulted in biomass estimates for both northern anchovy, *Engraulis mordax*, and Pacific sardine (Smith 1972). The present survey schedule, coupled with the amount of time needed to sort, collate, analyze, and publish results, seems to have rendered these surveys useless as a tool for estimating sardine biomass on an annual basis (i.e., although the 1975 survey is completed, data requisite for estimating the sardine population may not be available for at least one year or more).

The last published estimate of the Pacific sardine biomass was from 1969 survey data. Smith (1972) reported a biomass of 27,000 tons for both southern and northern stocks of Pacific sardine. At least 50% of this estimate is contributed by the southern stock. Although a sardine biomass estimate from 1972 survey data has not been published, preliminary calculations have been made (Paul Smith, NMFS pers. commun.). A spawning

biomass of 10,000 tons was calculated for the entire CalCOFI survey area. Approximately two-thirds of this figure is attributed to sardines spawning in Sebastian Vizcaino Bay, one-third is attributed to spawners between Punta Eugenia and Magdalena Bay, and only trace amounts are attributed to sardines in the range of the northern stock.

The progeny produced by the miniscule amount of spawning throughout the range of the northern stock of sardines during 1972 became mature during 1974 and 1975. It is doubtful that they have contributed much in terms of biomass to an already drastically reduced stock. This is the most concrete and direct evidence we have that the spawning population of the northern stock of sardines is well below 20,000 tons. Other data also suggest the northern stock of sardines is still declining.

LIVE BAIT DATA

The live bait fishery in southern California inshore waters has been monitored intermittently since 1939. In recent years this monitoring has taken the form of close contact with bait dealers by riding their boats, observing catches, and frequently phoning them to encourage the submission of live bait logs to the Department. Although it is not required by law that these logs be submitted, and bait dealers do this only on a voluntary basis, the live bait log can be especially important in monitoring incoming year classes for certain pelagic species, i.e., anchovies, sardines, and mackerels.

In the case of sardines it is also possible with sufficient data to compare their incidence in the live bait catch to historical population estimates of the sardine stocks. The problem with this approach is that at the present low level of the population, few if any sardines are seen anymore in live bait catches. Since 1973, there has been no mention of sardines on live bait logs. Infrequent occurrences of trace amounts

of sardines apparently do not warrant mention on logs, because bait dealers have conveyed to Fish and Game personnel that they have seen a few sardines in the bait in the last 2 years. It is also a possibility, because it is illegal to use sardines as live bait, that some bait dealers would not record the occurrence of large amounts of sardines on an official log.

The apparent scarcity of sardines in the live bait catch is yet another piece of information which confirms a very low population level. The occurrence of sardines in live bait catches in more than trace amounts has been reported for five years (1967, 1968, 1969, 1970, and 1973) since 1966. Klingbeil (1975) states that it appears that the spawning biomass of the sardines [northern stock] fell below 20,000 tons sometime between 1962 and 1966.

SEA SURVEY CRUISES

The California Department of Fish and Game, as a part of its Sea Survey Program, conducts one night-light cruise each fall. During this cruise four to five night-light stations are occupied each night and the presence of all species attracted to the light is recorded. Similar cruises have been conducted since 1949, and during the 1950's and early 1960's they were conducted on a monthly basis as a part of the CalCOFI research program. Sardines were commonly observed at night-light stations in the 1950's and Klingbeil (1974) noted that the percentage of positive night-light stations (those where sardines were either noted or captured) seemed to be measuring the same relative abundance as the catch per unit of effort of the fishery for the period 1950 to 1961.

In 1975, the night-light cruise (DF&G Cruise 75A7) occupied 86 stations covering areas inshore, adjacent to islands, and over offshore banks between Bahia de San Quentin, Baja California, and Point Conception.

Only one (1) sardine was seen during the entire cruise at a station in Bahia de Todos Santos. The continued rare occurrences of sardines at night-light stations supports other evidence indicating an extremely small stock.

JACK MACKEREL FISHERY DATA

The only means available of sampling the sardine population for age composition and length frequency data on a continuing basis is the close monitoring of the landings of jack mackerel, *Trachurus symmetricus*. Sardines are known to school with jack mackerel and are found mixed in some jack mackerel landings. The California Department of Fish and Game presently employs two methods for keeping account of the landings of incidental species (primarily sardines and Pacific mackerel, *Scomber japonicus*) which are mixed with jack mackerel landings.

First, a biologist tries to observe as many landings of jack mackerel at Terminal Island canneries as possible during the actual offloading process. In conjunction with this he interviews skippers and fills out a log for each interview. This log is similar to the anchovy reduction log but is not required by law. The pertinent information the biologist tries to obtain for each landing is boat name and number, date and time of departure and return, number of sets made, an estimate of tonnage, location of capture, and an estimate of the percentage (by weight) of incidental species mixed with the load. The biologist is also responsible for sampling jack mackerel landings to include incidental species and for sampling the anchovy reduction landings. It is next to impossible for the biologist to interview every skipper or observe every landing of fish. As a result large gaps exist in the data available from jack mackerel logs. Klingbeil (1975) used the jack mackerel log data available from January through August 1974 to estimate a biomass range

(555 to 1,190 tons) for sardines schooling with jack mackerel.

The other method used by the Department in monitoring incidental species in jack mackerel landings is coordinated by the Wildlife Protection Branch of Marine Resources Region. It employs a "checker" from 7 to 9 months per year whose responsibility it is to monitor each jack mackerel landing at canneries on Terminal Island. He fills out a "checker's blue ticket" on which a rough estimate is made of the percentage by weight of each landing and also includes trace occurrences of incidental species (less than 1% by weight). When the checker is employed a much higher percentage of landings are observed, making blue ticket data versus log data much more useful for monitoring incidental species.

A biomass range was calculated for 1974 and 1975 using the data from blue tickets. These calculations are only rough measures, are dependent on estimates of the jack mackerel resource size, and assume the jack mackerel resource has not fluctuated greatly in recent years. Knaggs (1973) indicated that the total population of jack mackerel off southern California, available to round haul fishermen in 1972, was in the range of 0.7 to 1.5 million tons. By considering the percent tonnage of sardines landed with jack mackerel in 1974 and 1975, sardine population estimates of 1,600 to 3,500 tons for 1974 (Addendum 1) and 76 to 150 tons for 1975 (Addendum 2) were obtained. These biomass estimates only relate to that portion of the northern stock of sardines found schooling with jack mackerel. What portion of the total stock of sardines this represents is unknown.

In 1974, 21% of the jack mackerel landings checked had trace or larger occurrences of sardines. In 1975, through October, only 3% of the landings had sardines. These data support the hypothesis of a continuing decline in the biomass of the northern stock of sardines.

SUMMARY AND CONCLUSION

Data from four independent sources have been analyzed in an attempt to assess the spawning biomass of the northern stock of Pacific sardines. Although a direct estimate of the biomass during the 1975 calendar year was not accomplished, data from all four sources indicate a drastically reduced population size. These data suggest the northern stock of sardines is continuing to decline, even in the presence of a fishing moratorium. All evidence points to a stock far below the 20,000 tons required to initiate a harvest, therefore, restrictions concerning intentional fishing and incidental catch of sardines should remain in force.

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ADDENDUM 1.

Calculation of Biomass Range of Pacific Sardines That are Found Schooling with Jack Mackerel - 1974.

	Number of mackerel cannery landings	Tons of mackerel landed	Number of blue tickets received	Tons accounted for by blue tickets	Number of landings containing sardines	*Estimation of tons of sardines landed
January	11	339.7	11	339.7	8	1.505
February	16	727.1	11	489.6	4	3.781
March	3	52.0	1	24.5	0	-
April	24	353.9	0	-	-	-
May	43	1,339.4	0	-	-	-
June	12	216.4	0	-	-	-
July	66	2,298.8	40	1,404.2	10	4.553
August	57	1,809.7	0	-	-	-
September	5	208.6	0	-	-	-
October	53	1,542.7	47	1,292.0	5	.458
November	42	1,349.8	34	1,065.1	4	.434
December	55	131.0	1	29.5	0	-
Totals	337	10,369.1	146	4,644.6	31	10.731

$\frac{4,644.6}{10,369.1} = 0.448$ = fraction of tonnage landed for which blue tickets were received.

$\frac{10.731}{.448} = 23.953$ = estimate of sardines landed assuming there was the same percentage for landings without blue tickets.

$\frac{23.953}{10,369.1} = .00231$ = estimate of fraction of jack mackerel catch through August 1974 that consists of sardines.

$(.7 \times 10^6)$ $(.00231) = 1,617$ tons = estimate of biomass of sardines found schooling with $.7 \times 10^6$ tons of jack mackerel.

(1.5×10^6) $(.00231) = 3,465$ tons = estimate of biomass of sardines found schooling with 1.5×10^6 tons of jack mackerel.

*Trace occurrences of sardines were converted to tonnage by assuming that they accounted for 1/200 of the weight landed.

ADDENDUM 2

Calculation of Biomass Range of Pacific Sardines that are Found Schooling with Jack Mackerel - 1975.

Month	Number of mackerel cannery landings	Tons of mackerel landed	Number of blue tickets received	Accounted for by blue tickets	Number of landings containing sardines	*Estimation of tons of sardines landed
January	3	131.2	2	62.5	0	-
February	52	1,226.5	43	972.5	2	.293
March	13	200.5	7	88.2	3	.333
April	10	114.9	-	-	-	-
May	11	352.8	-	-	-	-
June	20	414.2	-	-	-	-
July	11	284.6	-	-	-	-
August	18	673.7	14	506.5	1	.030
September	91	2,907.4	51	1,434.2	0	-
October	114	3,869.8	83	2,930.6	0	-
Totals	343	10,175.6	200	5,994.5	6	.656

$\frac{5,994.5}{10,175.6} = 0.589$ = fraction of tonnage landed for which blue tickets were received.

$\frac{.656}{.589} = 1.114$ = estimate of sardines landed assuming there was the same percentage for landings without blue tickets.

$\frac{1.114}{10,175.6} = .000109$ = estimate of fraction of jack mackerel catch through August 1974 that consists of sardines.

$(.7 \times 10^6)$ $(.000109) = 76$ tons = estimate of biomass of sardines found schooling with $.7 \times 10^6$ tons of jack mackerel.

(1.5×10^6) $(.000109) = 164$ tons = estimate of biomass of sardines found schooling with 1.5×10^6 tons of jack mackerel.

* Trace occurrences of sardines were converted to tonnage by assuming that they accounted for 1/200 of the weight landed.