PACIFIC MACKEREL

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THE FISHERY

The Pacific mackerel, *Pneumatophorus diego,* is a true mackerel. (The jack mackerel is a member of another family, the Carangidae, or jacks; the yellowtail and scad also belong to this family.) Like all members of its family the Pacific mackerel is a pelagic, schooling fish with erratic migratory habits. The range of the Pacific mackerel is at least from southern Alaska to the tip of Baja California into the Gulf of California, and along the mainland coast of Mexico to Banderas Bay. It is not readily distinguishable from either *P. peruanus,* found from Panama to Chile and at the Galapagos Islands, or *P. japonicus* in the western Pacific and its exact relationship to these is not at present completely understood.

Because of their erratic migratory habits mackerel are not continually abundant at any one spot, nor are they equally abundant at all times of the year. There are definite periods of abundance and scarcity which occur every season at about the same time. They are not abundant north of Monterey Bay and those occurring south of central Baja California probably are not important to the California fishery. The fishery is centered in Southern California with the great bulk of the catch delivered at ports in the Los Angeles region (Redondo Beach, San Pedro, Long Beach and Newport Beach). These ports have accounted for from 83 to 99 percent of the annual state-wide catch. Table 9 gives the total catch from 1926-27 to 1955-56, inclusive.

TABLE 9

PACIFIC MACKEREL LANDINGS BY SEASONS, 1926-27 TO 1955-56

Season	Catch (tons)	Season	Catch (tons)
1926-27	1,797.9	1941-42	35,877.3
1927-28	3,227.5	1942-43	24,110.1
1928-29	19,702.5	1943-44	38,926.5
1929-30	28,347.3	1944-45	40,392.7
1930-31	6,402.9	1945-46	26,001.4
1931-32	7,567.2	1946-47	29,448.9
1932-33	5,425.2	1947-48	19,813.7
1933-34	36,436.9	1948-49	19,101.4
1934-35	56,732.1	1949-50	25,030.8
1935-36	73,193.7	1950-51	16,945.0
1936-37	50,372.6	1951-52	15,952.4
1937-38	35,222.8	1952-53	9,380.9
1938-39	38,032.3	1953-54	3,806.3
1939-40	49,980.4	1954-55	13,359.5
1940-41	53,777.0	1955-56*	13,500.0

* Preliminary figures.

Of the nearly 25,000 Pacific mackerel for which ages have been determined, the oldest was in its 12th year when caught. Fish over eight years of age always have been extremely uncommon in the commercial catch and in recent years fish over six years of age seldom have been observed.

Although the fish grows rather rapidly, nearly three years must elapse before a mackerel reaches a foot in length and a weight of three-fourths of a pound. The largest Pacific mackerel on record, nearly 25 inches long and weighing 6⅓ pounds, may have been a freak. In general, one-, two-, and three-year-old mackerel have made up the bulk of the catch (see Table 10).

TABLE 10

NUMBER OF FISH EACH AGE FURNISHED FOR THE SEASONS 1939-40 THROUGH 1954-55

Age	Number of fish
0	29,663,000
1	273,246,000
2	329,778,000
3	212,694,000
4	92,991,000
5	23,340,000

Since 1938, three year-classes, 1938, 1941, and 1947, have made outstanding contributions to the fishery (see Table 11). Over 125,000,000 fish were taken from each of these groups. The smallest contribution was made by the 1950 year-class, which furnished only 2,800,000 fish. Preliminary estimates indicate that the 1951 and 1952 year-classes will be poor. Although data are not complete for the years prior to 1938, there is every reason to believe that during the 11-year period

TABLE 11

NUMBER OF PACIFIC MACKEREL FURNISHED BY EACH YEAR-CLASS 1934 THROUGH 1953

Figures for years prior to 1938 and after 1950 are estimates based upon over-all trends.

Year-Class	Number of fish
1934 more than	70,000,000
1935 more than	70,000,000
1936 more than	70,000,000
1937 more than	70,000,000
1938 more than	126,600,000
1939 more than	71,600,000
1940 more than	45,200,000
1941 more than	130,400,000
1942 more than	48,400,000
1943 more than	45,100,000
1944 more than	52,700,000
1945 more than	19,400,000
1946 more than	10,500,000
1947 more than	149,500,000
1948 more than	65,800,000
1949 more than	9,900,000
1950 more than	2,800,000
1951 less than	1,700,000
1952 less than	7,000,000
1953 less than	70,000,000
1954 less than	10,000,000

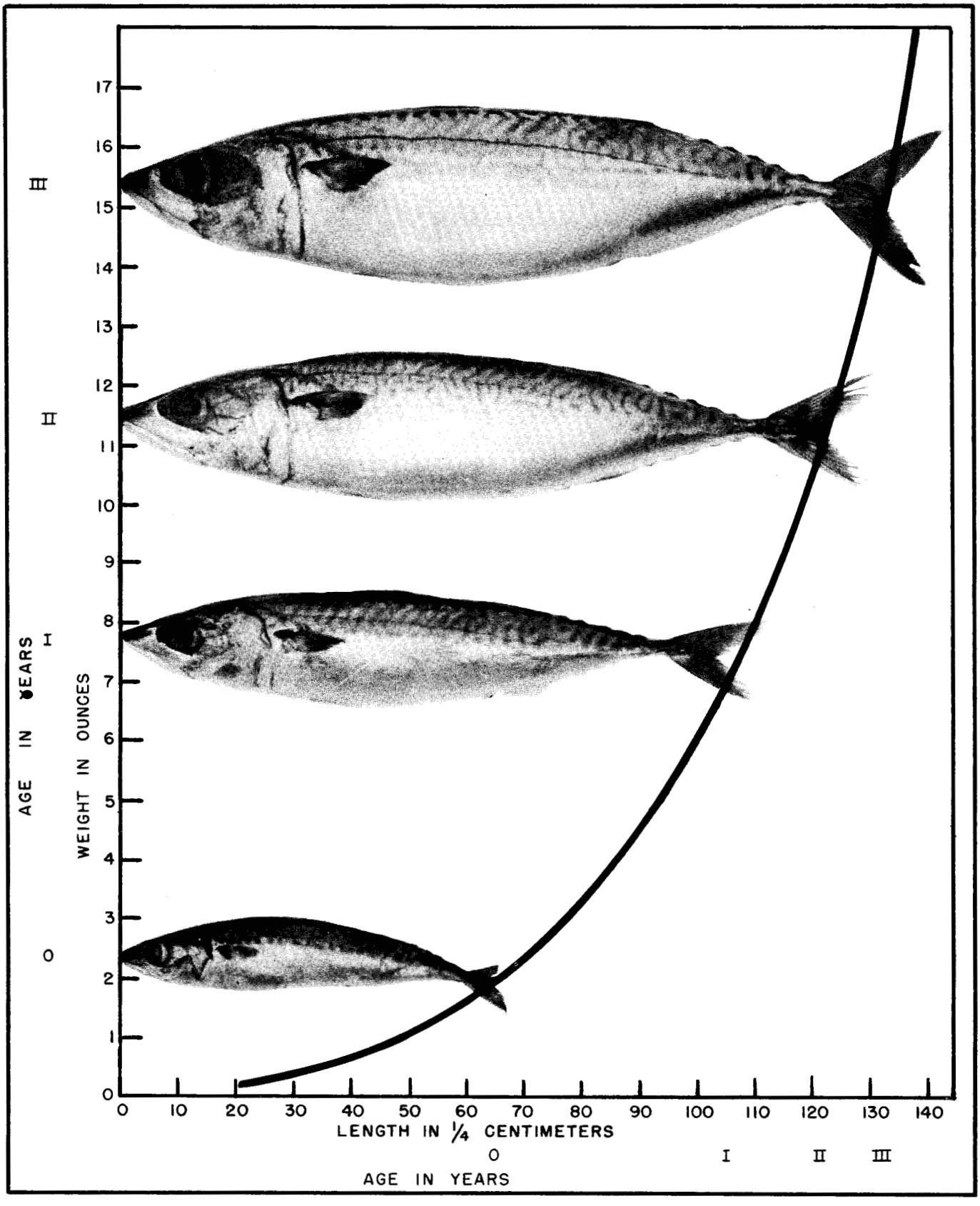

FIGURE 12. Growth curve of Pacific mackerel.

1934-44 no single year-class furnished fewer than 45,000,000 fish. Similarly, data are incomplete for the years succeeding 1950. Regardless, it is obvious that during the 11-year period 1945-55 only three year-classes, 1947, 1948, and 1953, contributed or will contribute more than 20,000,000 fish each.

A factor of prime importance in keeping the Pacific mackerel population at a low level is their capture for canning purposes at an early age. Nearly one-half of the 149,500,000 fish furnished by the 1947 hatch were caught before they had a chance to reach age two. The weight-length chart (Figure 12) graphically illustrates the potential economic loss to everyone concerned when Pacific mackerel are not permitted to reach an age of two or three. At age three they could have spawned once or twice and thus enhanced the possibility of maintaining a stable population level. Twofold or threefold weight increase (including the fish spawned) would mean an identical or similar increase in value. Additional important considerations are: consumer demand for larger, meatier fish, relative ease in handling larger fish on the packing line, etc.

Since 1947, between one-third and one-half of the total number of fish contributed by any single year-class were captured before they had reached an age of two years. Prior to 1947, fish less than two years of age contributed on the average about 35 percent of the catch, whereas since 1947 the contribution of these young fish has been about 45 percent. The 1949, 1950, and 1951 year-classes, which yielded 1,219,000 fish weighing 699 tons during the 1953-54 season, were able to produce only 279,000 fish weighing 162 tons during 1954-55.

TAGGING

Between July, 1935, and March, 1943, a total of 76,038 mackerel were tagged. These fish were captured and released at various localities from Magdalena Bay, Baja California, to Tillamook Head, Oregon (Figure 13). Though one of the 11 fish tagged north of Monterey Bay (Tillamook Head) was recovered in the Los Angeles harbor area, none of those tagged south of San Roque Bay, Baja California, was ever retaken. This tagging program showed that there was considerable interchange of fish from Central and Southern California. Recoveries were made in the Monterey-San Francisco area of fish tagged off central Baja California and one fish tagged in the Monterey area was retaken at Ensenada, Baja California.

Racial analyses indicate that within the range of the mackerel along our coast there might be as many as five reasonably distinct populations among which little mingling occurs. However, the tagging experiments demonstrated that many of the fish from the northern and some from the central Baja California groups ultimately entered the California fishing grounds.

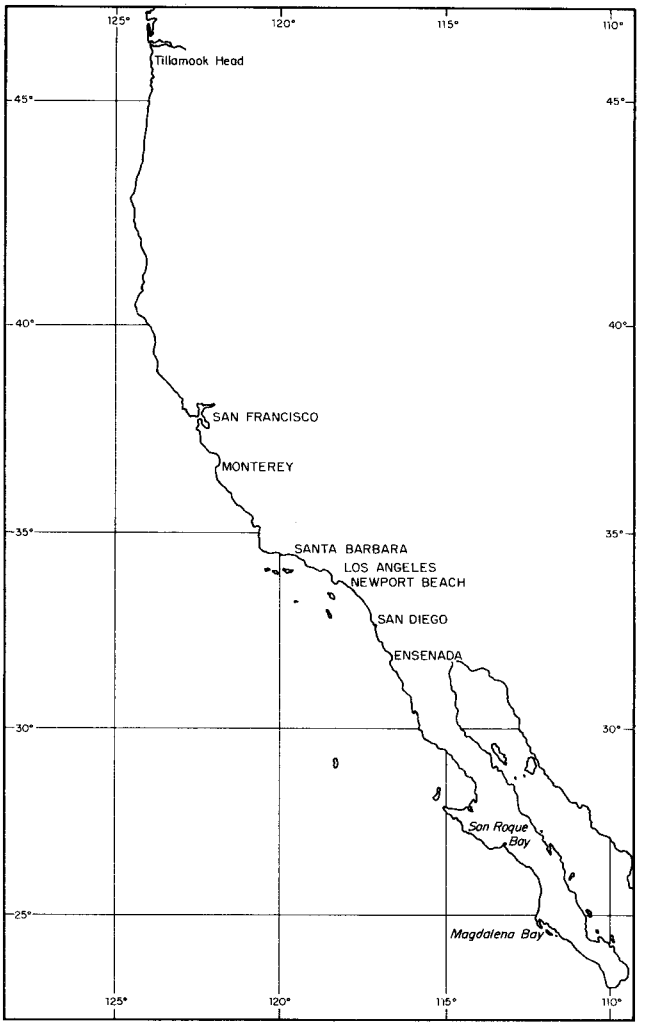

FIGURE 13. Extent of Pacific mackerel tagging program. Map shows localities at which fish were tagged or recovered.

From tagging it was calculated that the mortality rate for Pacific mackerel was between 74 and 78 percent per year for seasons 1940-41 through 1942-43. In the age work, mortality rates for fish two years of age and older were calculated for two separate five-year periods, 1938-42 and 1943-47. For the period 1938-42, the rate was calculated at 48 percent between ages two and three, 62 percent between three and four, and 70 percent between four and five. For the five-year period 1943-47 the mortality rate increased and was 55, 77, and 80 percent per year for two-, three-, and four-year-old fish.

Critical examination of 228 stomachs from Pacific mackerel collected between Point Conception, California, and Santa Maria Bay, Baja California, revealed larval and juvenile fish as the most important item. As much as 30 percent by volume consisted of

fish remains. Mysids, nereids, crab larvae, euphausiids, and copepods made up much of the remaining food. Squid were rarely found.

THE FISHERY

Although Pacific mackerel were canned on an experimental basis as early as 1904, it was not until 1928 that the present-day industry got its start. The fishery is and has been centered in Southern California. Commercial landings outside the Los Angeles area have been made at San Diego, Santa Barbara, Port Hueneme, Monterey, and San Francisco, but only at San Diego did these landings ever exceed 5 percent of the annual state-wide catch. Since 1944, deliveries to the Los Angeles region have exceeded 95 percent of the annual state-wide catch.

Fishing methods employed by Los Angeles region fishermen have changed greatly over the years and mackerel can be and have been taken by many types of gear. Prior to 1928, the fishery was conducted almost exclusively for the fresh-fish trade. Hook-and-line fishing could not, however, provide fish in bulk, and the canners' demands were met initially by lampara boats. With the expansion of the industry in 1933, purse seiners found the fishery profitable and by 1937 lamparas had virtually disappeared from the fishery. Catches by these net boats had fallen off by 1939 to the point of being unable to meet the demand. The gap was filled by a large fleet of small boats carrying crews of one to three men who employed the methods of striker fishing and scooping. This scoop fleet, numbering in its heyday into the hundreds, accounted for over half of the total mackerel catch between 1939 and 1952. Since 1952, purse seiners have again come into prominence in the mackerel fishery and the scoop fleet has faded into insignificance.

The price for Pacific mackerel rose from $10 per ton at the start of the 1933 season to $15 in 1935, $18 in 1936, $21 in 1937, and $21.50 in 1941. During the war years, 1942-45, the price was set at $40. Since 1945 there have been marked fluctuations within and between seasons. For a short period during 1953 the price rose to $85 per ton but for the most part it has remained below $60.

From 1916 until the 1927-28 fishing season the total annual catch of Pacific mackerel in California was less than 2,500 tons. Landings increased to about 3,250 tons in the 1927-28 season, to 19,750 in 1928-29, and 28,250 during the 1929-30 fishing season. The drop to around 5,500 tons in the next three years was generally attributed to a poor pack and the economic depression which affected the entire United States. By 1933-34 new canning methods came into use and consumer demand became practically unlimited. Although the catch jumped to over 73,000 tons in just three seasons it has never again attained such a poundage and has been dropping steadily ever since. The most recent low occurred during the 1953-54 season when the 3,800 tons composed the poorest landing in 26 years.

RESEARCH UNDER WAY

Food Studies

Qualitative and quantitative analysis of mackerel stomachs are being performed to determine exactly the items important in their diets. When the results of this study are eventually realized we should know the role that the Pacific mackerel plays in the ecology of marine fishes.

Fecundity Studies

These are being carried on to determine the number of eggs spawned by mackerel at any given size and age. Such information is necessary when attempting to determine the size of the population from egg surveys.

Routine Sampling of the Commercial Catch

This is carried on continuously. It is especially important in determining seasonal or other trends in size composition, catch localities, age composition, etc.

Determination of the Age Composition of the Commercial Catch

This is being carried on continously.

Races

Some effort is being directed at determining the differences if any between our California mackerel and those which are found off the tip of Baja California at the Revillagigedo Islands, those found off Central and South America, those found off Japan and other areas in the Indo-Pacific.

Abundance and Distribution

Abundance of mackerel schools is noted throughout their range during various cruises of departmental research vessels and during aerial surveys with departmental planes. Samples of these fish are taken for the various biological studies being carried on by the Department and cooperating agencies. These surveys are concerned primarily with sardines but distribution and abundance of anchovies and Pacific and jack mackerel is similarly worked out.

Statistical Studies

Catch statistics are being compiled continuously by the statistical section of the Department. These reports include records of catch by boat, day, locality, species, gear, etc.