

2. THE COLLAPSE OF CALIFORNIA'S SARDINE FISHERY (Ueber & MacCall)

The California sardine fishery has become legendary in American folklore. The fishery began before the turn of the last century, peaked in the 1930s and began to collapse after World War II. It is a classic case of the rise and fall of a fishery dependent on a pelagic species, of overcapitalization of an industry, and of too many fishing boats using new technologies to harvest a fragile, if not dwindling, resource. Its collapse spawned the rapid development of similar fisheries in Peru, Chile and South Africa, each of which then underwent essentially the same kind of growth and decline as the California sardine fishery. This fishery can be used as

an analogy of potential changes that might accompany the regional consequences of a global warming of the atmosphere and could provide lessons for proactive as well as reactive responses to changes in abundance of a pelagic industrial fishery.

The canning of sardines (*Sardinops sagax*) along the California coast began in the late 1800s, and with intermittent successes and failures became the largest fishery on the West Coast by 1925. By then sardine catches were being used for reduction to fish meal as well as for food. The industry landed 173,000 tons of sardines off coastal California and an additional 1000 tons off the British Columbian coast in the 1925–26 season (Figure 6).

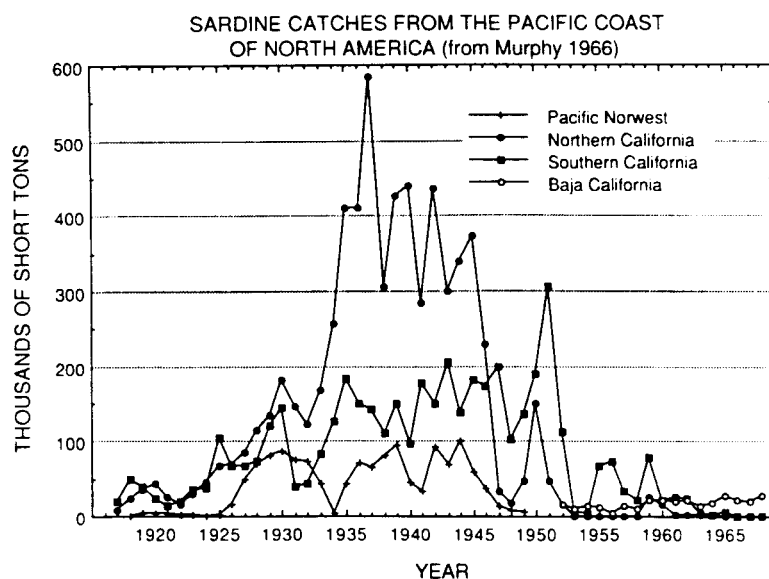


Figure 6. Sardine catches from the Pacific coast of North America. Pacific Northwest includes British Columbia, Washington, and Oregon. Northern California includes reduction ships, San Francisco, and Monterey (data from Murphy, 1966).

The sardine fishery began as a supplier of fresh whole fish in the 1860s; sardines had also been used as bait since the 1880s. The shift to the canning of sardines between the 1890s and 1920s actually created two new industries. The first of these produced a high quality, highly valued canned sardine for human consumption. The second produced a protein-rich feed for poultry as well as fertilizers for green plants. Poultry feed and plant fertilizer were produced from waste using a process called “reduction.” The value of this canned sardine by-product soon caused canneries to set up their own reduction plants. By 1920, increased demand for sardine meal and fertilizer prompted some plants to use the whole fish as well as canning waste to produce fish meal, flour, oil and fertilizer.

The California Department of Fish and Game became concerned about the increases in direct use of sardine for non-human consumption. In every year between 1920 and 1941 (excluding only 1923 and 1924), new laws were passed to curtail the use of whole fish for reduction. The law stated that only those plants that canned fish for food could legally reduce sardines. As a result, canned sardines were produced and sold at or below cost so that canneries could obtain enough waste and whole fish for reduction.

The high quality of canned California sardine assured an increasing demand for the product in the marketplace. Cannery also received another benefit from maintaining high quality; it enabled more by-product per ton of fish landed because there would be an increase in the amount of offal and unsuitable whole fish (the higher the canned quality).

Although state and federal governments were in agreement on the need to reserve the sardine resource for human consumption, the economics of reduction and the legal system dictated against conservation. A major loophole in the legal structure was uncovered that allowed for fish to be caught and processed outside the state's three-mile territorial jurisdiction. More specifically, the state's ability to assure that sardine be used for human consumption was challenged during the 1926-27 season, when a Monterey canner towed the concrete barge "Peralta" outside the state's three-mile jurisdiction in order to reduce whole sardine to fish meal. The economics of this operation failed but other similar ventures followed. In the early 1930s a few such ventures began to operate profitably. Floating reduction plants became a common sight off the major sardine ports from San Diego to San Francisco.

These vessels operated until the late 1930s (Figure 7), when prices for fish meal and fish oil fell and when an amendment to the California constitution was passed. This amendment provided California with the authority to stop the operations of offshore reduction plants. In the preceding nine seasons, which happened to have occurred during some of the most abundant years in the sardine fishery, reduction ships landed about 780,000 tons of sardine. At-sea sardine purchases made up about 16% of the sardine landings during this period.

Washington and Oregon entered the sardine fishery in the 1936-37 season and their landings, along with those of California and British Columbia, accounted for the largest one-season landings of any single fish species ever caught on the West Coast, more than 790,000 tons. As one author noted, this is enough ten-inch sardine, if laid end to end, to reach from the earth to the moon and back!

The twelve seasons from 1934 to 1946 could be considered the *pax sardinia* in the California fishing industry. World War II caused prices to rise for fish oil, meal, fertilizers and canned sardines. Landings averaged about 600,000 tons per season. However, State fishery biologists had been warning the industry that the sardine population could not sustain removals of more than 250,000 tons. Federal agencies as well as the industry opposed any such regulations in the



Figure 7. *Lake Miraflores*, the first reduction ship to operate outside the jurisdiction of the State of California, unloading sardines from a purse seiner in the early 1930s (Glantz and Thompson, 1981).

form of catch quotas. In his novel *Sweet Thursday*, John Steinbeck wrote that “The canneries themselves fought the war by getting the limit taken off fish and catching them all. It was done for patriotic reasons”

Between 1946 and 1952 annual landings averaged about 230,000 tons, about 40% of the previous 12-season average. During the next ten seasons (until 1962), recorded landings averaged 55,322 tons. The last six seasons produced a landings average of 24,000 tons. The fishery ended in 1968.

The search for causes for the demise of the California sardine fishery has focused at one time or another on overfishing, conflicting management schemes, climate variability or some combination of these. The loss of the sardine fishery had ramifications for the West Coast fishing community, the state of California and some Central American, South American and African nations.

The majority of canned sardines and fish meal production came from the Monterey and San Francisco areas, and from Southern California (Figure 8). The most famous of the sardine canning communities is Monterey, most likely because of the focus on the region in the writings of author John Steinbeck. It is important to note that Monterey products were considered top-of-the-line, also contributing to their recognition. Monterey did not suffer as much as most other areas in the US during the Great Depression, because sardine production remained high and even increased in the late 1930s. During the war years, fish oil was the big money-earner, not canning. Investing in reduction plants was a way for those involved in the fishery to prosper.

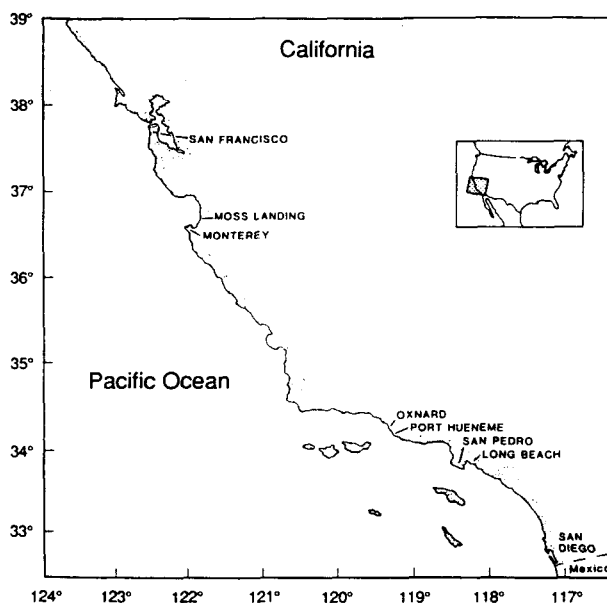


Figure 8. Location of California cities.

Although reduction plants had ceased to operate by 1950, Monterey canneries remained open until 1957. However, most of the fish canned there in the 1950s had to be trucked in from Southern California, with fishermen paying the shipping costs. By 1960 only the bait fishery remained in Monterey. In 1968 sportfishermen were paying one dollar per sardine. Sardine fishing ended in southern California that year. Thus, by 1968, the fishery was gone, eighty years after it had begun in San Francisco.

The collapse itself had occurred over twenty-two seasons. Fishermen had been witnessing declining catches for years with fewer and smaller schools of sardine appearing. Nevertheless, as late as the 1950s, fishermen spoke of the return of the sardine. With an occasional decent season, such as 1958/59 when 126,000 tons were landed, people kept hoping for the return for several more years.

A typical multi-fishery pattern consisted of fishing for salmon off the west coast of Alaska (June to September), sardine off the California coast (October to March) and squid near San Pedro and Monterey (April, May and sometimes September). Those who participated in this multi-fishery had some options. For example, smaller vessels fished market (Dungeness) crabs (*Cancer magister*) from November to February; others fished rockfish (*Sebastes spp.*), albacore tuna (*Thunnus alalunga*) and salmon (*Oncorhynchus spp.*). Shifts to other fisheries were often accompanied by crew reductions. Vessels that were unable to switch, for example, from lampara

or seine gear fished for squid, anchovy or tuna. None of the displaced American fishermen or fish processing workers received assistance or were retrained by the US Government.

Those who could no longer pay the mortgage or upkeep on their vessels sold them, often at prices well below their original costs. Some of the larger vessels went to Alaska to participate in the expansion of the king crab (*Paralithodes camtschatica*) fishery. The low cost of these vessels kept fixed costs down, affording the new owners the luxury of learning to fish and market different products while having to cover little more than operating costs.

At the same time that vessels were being sold and transferred to other West-Coast fisheries, idled vessels and canning and processing equipment were sold in the international marketplace to such countries as Peru, Chile and South Africa. The UN FAO and the UNDP assisted with these purchases.

Fish meal and oil reduction machinery constituted the majority of equipment to South America. This equipment was generally older and less costly than comparable equipment sold to the South Africans. The transfer of and low costs for this equipment, as was the case in Alaska, allowed for a rapid expansion of the sardine and anchoveta (*Engraulis ringens*) fisheries off the west coast of South America.

Funds supplied by these UN agencies were also used to obtain expertise in canning, reduction, and fishery management. Fishing expertise was also transferred to these newly developed overseas fisheries. For example, lampara fishermen from San Francisco and seiners from San Diego went to South America for up to a year to teach fishing methods or to work as contract skippers. Some sold their vessels, delivered them in South America and stayed on as skippers.

Fisheries scientists as well as managers from California and elsewhere became involved in the management of South American fisheries as a result of UN support for the development of the well-respected Instituto del Mar del Peru (IMARPE). Many of these scientists had been involved in the assessment and management of the California sardine fishery. Like many of the industry's workers, these scientists had gone to South America "to search for new raw material" for their scientific skills.

Lessons

In response to global climate change some fisheries may decline or collapse, while others may increase and prosper. The history of the collapse of a major fishery like the California sardine fishery provides a number of lessons on how local, national and international fishing activities might be expected to respond to the regional implications of a global warming. These lessons clearly indicate the path that a newly developed clupeoid fishery may be expected to take and, more importantly, they indicate that strong management is needed to counter destructive tendencies. Lessons suggested by this fishery case study are as follows:

- Overfishing can cause fishery collapse rather than a sustained low-level harvest.
 - Development-oriented government agencies can contribute toward delayed and ineffective fisheries management.
 - Non-market funding of equipment or expertise will cause the fishery to develop more rapidly than would be expected from purely market-driven development (for example, the use of the US Navy and Coast Guard to locate schools of sardine).
 - Fisheries management can behave like a subsidy because it encourages investment if its perceived presence engenders optimism or decreases the expectation of risk.
 - A substitute fishery will develop more rapidly than a newly developed independent fishery, because existing capital, labor, technology and markets can readily be transferred to the substitute fishery.
 - The instant availability of technology and expertise eliminates the “learning curve” and the rapid transfer of expertise, technology and processing capacity will exacerbate inherent instability in the fishery.
 - The political process of establishing management institutions and the scientific process of developing predictive fishery models are much slower than the processes associated with industrial development of substitute fisheries.
 - Internationally, governments and their fishery management agencies should be prepared to adopt politically difficult (and industry-resisted) management policies of deliberately constrained fishery development and should avoid politically popular but destabilizing subsidies.
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