Recent Developments in the Fisheries of California

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THE LAST TWO YEARS have seen great activity among scientific, administrative and political bodies concerned with the marine fisheries of California, for nearly 20 years of scientific study on the California Current System culminated during these recent months. The findings have led to a new interest by California-based industry, long oriented toward distant-waters and the high-seas tuna fishery, for they have disclosed resources of considerable magnitude lying virtually latent off our coast.

The program which brought this about was organized originally to determine what happened to the Pacific sardine *(Sardinops caeruleus)*. The story of the rise and fall of that once-great fishery has been told many times; the cause of its collapse and the effects of this collapse on the ecosystem have only in recent years become evident.

It took considerable managerial and scientific effort to mount the augmented program which produced this knowledge.

Studies made between the two world wars by the California Department of Fish and Game had provided much basic data on sardine biology and on the fishery, but these could not be conducted on a broad enough scale to answer the question to everyone's satisfaction.

In 1948 the California Legislature established within the Department a body known as the Marine Research Committee (MRC), charged with ". . . financing research in the development of commercial fisheries of the Pacific Ocean and of marine products susceptible to being made available to the people of California." The landing tax supporting the Committee produces relatively little income ($60,000-$180,000 per year) but MRC has generated expenditures of far greater sums by sponsoring and providing modest financial support to a coordinated research effort. The major partners are the U. S. Bureau of Commercial Fisheries, University of California (Scripps), and the California Department of Fish and Game, with Stanford University and California Academy of Sciences filling important but lesser roles. Among them, they spend perhaps a million dollars a year on research pertinent to problems of the California Current System.

Over the years the Bureau of Commercial Fisheries has concerned itself chiefly with egg and larval surveys, Scripps with obtaining oceanographic data, and the Department with studies of juvenile and adult fish and the fisheries themselves.

Since 1959, a full time Coordinator has chaired a committee consisting of the working heads of the appropriate research activities of the three agencies.

This body is California Cooperative Oceanic Fisheries Investigations Committee, and it is CalCOFI that has led the recent advances.

Studying the ecosystem rather than sardines *in vacuo* was apparently a rather unique idea in 1948, at least in our area where research was traditionally species-oriented. The dividends have been great.

The most significant single result has stemmed largely from the systematic egg and larval surveys. These have shown that over the years, as the sardine population was driven to lower and lower levels, the northern anchovy *(Engraulis mordax)* population increased tremendously. Some of the scientists theorize that the anchovy was an active mechanism in driving the sardine down. Others believe that it simply filled the gap left by the sardine. Regardless, the anchovy population is now at a very high level, with the biomass off Mexico and California between 2½, by the most conservative estimate, and 5 million tons.

The Department's initial sea survey work dealt with estimating sardine abundance, and sampling with a blanket net proved extremely effective and permitted preseason catch predictions which proved gratifyingly accurate. This net does not sample all other species adequately and we have turned to a midwater trawl dragged fairly near the surface. This appears to be an excellent sampling tool for anchovies, as well as other inhabitants of the upper layers. The program will be augmented substantially in 1966 better to delineate the magnitude and distribution of the resources off the coast.

The CalCOFI surveys have also demonstrated a huge population of hake *(Merluccius productus)* off California and Mexico (perhaps 3 million tons) as well as a large and very widespread population of jack mackerel *(Trachurus symmetricus)*. Interestingly, six of the dozen most common eggs and larvae are those of bathypelagic fishes.

These results have poured out at a tremendous rate recently and much of the data remains to be published. However, Murphy in his doctoral thesis[1], submitted this year, touches on many of these matters and most importantly concludes that overfishing played a prominent role in the collapse of the sardine fishery (long the Department's contention)—this combined with a series of years of poor spawning success. Thus, some 18 years later, he has answered the initial question.

Based upon the tremendous increase in the anchovy population, CalCOFI recommended in 1964 that a carefully controlled scientifically planned experimental harvest be instituted[2]. Theoretically, a selective fishery for anchovies might permit the sardine to resurge. Further, one might manage the combined resource at any ratio of anchovies to sardines desired, from a virtually pure anchovy fishery to a virtually pure sardine fishery.

This stimulated public interest not only in anchovies but hake as well. People saw fisheries aggregating hundreds of thousands of tons a year lying unused at their doorstep. Using the most conservative figures, the potential annual anchovy harvest off California is on the order of a quarter of a million tons. Estimates of the maximum sustainable yield range from at least a half million to perhaps as much as a million tons a year for California and Baja California combined. Hake data indicate a potential of perhaps three hundred thousand tons.

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[1]Murphy, Garth I. 1965. Population dynamics of the Pacific sardine *(Sardinops caerulea)*, Univ. Calif., San Diego, Doctoral Thesis, 169 p.

[2]Murphy, G.I., J. D. Isaacs, J. L. Baxter and E. H. Ahlstrom. 1964. Requirements for understanding the impact of a new fishery in the California Current System. *In* Mar. Res. Comm., Minutes, 6 Mar. 1964, document 12, 5 p. Terminal Island, Calif. Dept. Fish and Game.

It now becomes necessary to consider the interaction of politics and fish on the California scene as well as to consider the economics of exploiting these resources. California, like every state, manages its own living marine resources and exercises some control in international waters through laws governing landings. There is nothing, of course, to prevent fishermen from another state or from a foreign nation operating in the adjacent high seas and delivering their catches elsewhere. The fact that these resources extend off Mexico cannot be ignored, nor can the apparently growing interest of the USSR and Japan in the waters off our coast. But, for better or worse, California can, for the moment, control its destiny and manage fisheries for hake and anchovies with reasonable effectiveness.

Control mechanisms are awkward, for the State Legislature has delegated partial authority over commercial fisheries to the California Fish and Game Commission (such as controlling the use of whole fish in a reduction process) but has retained the balance to itself. The result is divided authority, and a very complex group of institutional problems.

California's recreational fishermen play an exceedingly important and effective part politically. Ocean sport fishing is very popular and its followers fear that the anchovy may go the way of the sardine. Their concern with anchovies is twofold. First and most importantly the anchovy forms the greater portion of the live bait used by ocean fishermen. Secondly, it plays a major but undetermined role as a forage organism for the primary game fish. It is most important that this question be resolved, and the Department is instituting a food habit study with Federal financial assistance under PL 88-309 (Bartlett Act).

Feelings on hake are less pronounced. If anything, the recreationalist might favor a hake fishery as the hake is believed to be a rather heavy predator on anchovies. But fundamentally the sport-commercial conflict is a most serious impediment to rational exploitation of California's marine resources and one which many of us are actively attempting to resolve.

The State is presently engaged in a major planning effort and the Department has made a policy recommendation which, if adopted, should have a profound effect in this area. This policy says that first priority shall go toward satisfying the reasonable and legitimate demands of sport fishermen, and that commercial fishermen shall be encouraged to harvest any surplus consistent with the principle of maximum sustainable yield.

What as to economics? The only feasible use of anchovies and hake at this time is as fish meal, though clearance of fish protein concentrate by the Food and Drug Administration is a hoped-for possibility which would open a new avenue.

Interest in hake is low at present though there has been limited processing on a pilot basis and future prospects are encouraging.

The anchovy situation is quite different. The rising price of fish meal on the world market and the situation in the Peruvian anchovy fishery coupled with aggressive pro-anchovy fishery action by boat owners and by smaller processors in central California has changed the major producer's attitudes from one of indifference to varying degrees of enthusiasm. A bill providing a reduction fishery of 115,000 tons per year passed the State Legislature this year. It was pocket-vetoed by the Governor because of possible constitutional defects (the

bill called for a limited entry fishery) and because he felt this was a proper area for Commission action.

Early in November, the Commission authorized a closely regulated 75,000 ton reduction fishery for 1965-1966. Whether this will be sufficient to bring about detectable permutations in the population remains to be determined, but the Department has a scientific monitoring program, including a tagging experiment, ready to be put into effect in cooperation with CalCOFI.

We know of no other instance in which so much has been known about a fish in advance of a fishery or where there had been so much opportunity for advanced planning prior to commencement of a fishery. The scientific input for management will be available here if it ever is to be available, and given some resolution of managerial problems it should be possible to test the theory that fishing for the anchovy will permit the sardine to resurge. Even if this does not happen, or if economically an anchovy fishery seems best—the State will still have a fishery where none existed before and one which we would hope to sustain indefinitely.