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Fishing for Anchovies off California

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The recently adopted Anchovy Fishery Management Plan (Pacific Fishery Management Council [PFMC], 1978) mandated by the Fishery Conservation and Management Act of 1976 which established the 200-mile fishery zone for the United States, provides a formula for setting an annual optimum catch of the northern anchovy, *Engraulis mordax*, by U.S. and foreign fishermen off the California coast. Like the Peruvian anchoveta and the Atlantic menhaden, the northern anchovy is mostly reduced to fish meal and oil and provides an important protein supplement for poultry and other animal feeds.

The last two triennial surveys for fish eggs and larvae (1975 and 1978) by the California Cooperative Oceanic Fisheries Investigations (CalCOFI) provided data from which spawning biomass estimates were made. They showed that there was a significant decline in the total anchovy spawning biomass over the 3-year period, from 3.3 million metric tons to 1.2 million metric tons. Natural variability in the size of the anchovy central stock is well documented and this spawning stock size, 1.2 m tons, was last recorded in 1961 (PFMC, 1978). Information obtained from the fishery showed that the 1974 and 1975 year classes were very poor and

contributed to the decline in the whole anchovy population, although the 1976 year class was better than average. Until 1978, fishing on the anchovy was regulated by the Fish and Game Commission of the State of California and was held to a modest take, approximately 163 000 tons in 1975. With the advent of an unregulated Mexican fishery on the same stock south of the border, the 1977 catch totalled approximately 257 000 tons (Mexico, 157 000; U.S., 100 000).

A combination of heavy fishing on the spawning stock with the coincidence of a number of successively poor year classes has depressed other clupeoid stocks (Murphy, 1977). Whether a 257 000 ton fishery can be considered to be 'heavy fishing' is unknown for this stock, but the Anchovy Plan would have restricted this much fishing if the spawning biomass had been known to be low for 1977; no assessment cruise was made in 1977, nor was the plan in effect at that time. So far Mexico has not adopted the U.S. plan, and fishes this stock without restriction. While fishing can be regulated in each country by political means, the causes of natural fluctuations in population size remain largely unknown although the so-called 'stock and recruitment problem' is an active area of research throughout the world.

Briefly stated, the following questions are asked: 'What are the major factors controlling reproduction and larval survival, and what is the impact of reduced stock size on the strength of future recruitment into a year class?'

Studies at the Southwest Fisheries Center of NOAA (National Oceanic and Atmospheric Administration) have shown that food of first-feeding larval anchovies becomes limiting when storms or drastic upwelling occurs and dilutes food aggregations. A complicating factor is that often nutritionally inadequate larval fish food can be overwhelmingly dominant in the larva's environment despite otherwise favorable oceanographic conditions (Lasker 1975, 1978; Scura & Jerde, 1977). This suggests that several conditions must be met for survival of first-feeding larvae; stability of the water column and aggregation of nutritionally suitable food organisms coinciding with the production of anchovy larvae in time and space.

As part of a study on DDT and PCBs, Scura & Theilacker (1977), using the low chlorinated hydrocarbon levels found in seawater, demonstrated that in the food chain leading to anchovy larvae, there is very small magnification of concentration. Rather they discovered that any bio-accumulation in larvae seems to depend on the direct partitioning of the chlorinated hydrocarbons between sea water and the larvae. Thus these chemicals probably have little direct effect on larval anchovy mortality in

the sea. While the main spawning habitat of the northern anchovy is in the coastal waters adjacent to Los Angeles and the rest of heavily urbanized southern California, there is no evidence that dissolved pollutants of any kind affect the northern anchovy's reproductive success. On the other hand, studies by Hunter, Taylor & Moser (1978) at the Southwest Fisheries Center suggest that increased ultraviolet radiation due to slight reduction in the earth's ozone layer may be extremely deleterious to anchovy larvae.

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