

Dr. McHUGH. I would like you to consider the problems of the tuna fisherman. Incidentally, I am confining my remarks to tuna because it is impossible to cover our entire program and I thought tuna was particularly applicable worldwide. It illustrates practically all the problems of the fisheries.

Consider the problems of a tuna fisherman based in San Diego. As I will indicate on the first chart, he must decide whether to fish off Washington and Oregon for albacore, off Baja California for bluefin, off Mexico or South America, or perhaps the Marquesas Islands for yellowfin or skipjack, in the Hawaiian Islands region for skipjack, in the Atlantic, off our eastern seaboard for skipjack or bluefin, or off the west coast of Africa. Up until recently, our tuna fisherman had to make his decision pretty much by rule of thumb. Sometimes he would simply go out and seek the fish at random or sometimes simply by long experience from learning where the best fishing grounds are.

A modern purse seiner may cost \$1.5 million and require a crew of about 15 to operate it. Investment is high and risks are great in the highly competitive world of high-seas tuna fishing. The uncertainty of supply of raw materials also creates a serious problem for processors. They cannot be certain from one month to the next how much fish will be available.

The second figure gives us an example of what happens under certain conditions. This is the history of the albacore tuna, which is the white meat tuna and the most valuable one.

There was quite an important fishery off our west coast which began shortly after the turn of the century. After about 10 years the catch dropped off to a low point and for a period of 10 years there was hardly any catch at all. Then the fish began to show up again and there has been a substantial catch in the last 25 years with rather large variations. There have been tuna off our coast every year since the late 1930's. This is an example of the kind of problems the tuna fisherman faces. In the period from 1925 to 1935 they did not do very well. The industry was in rather bad shape economically.

Let us go on to the next chart. This gives some ideas on the general reasons why the variations occur. This chart of the North Pacific Ocean represents the water conditions in 1957. The area outlined in red was much warmer than average over a period of years before this, and the blue area off the western side of the Pacific extending out from Japan represents an area several degrees colder than normal at this time of year. We call the years 1957 to 1959 the warm years, for on our side of the Pacific the water temperatures were as much as eight degrees higher than normal. The whole circulation had changed.

To understand the fluctuations in the tuna fisheries, it is helpful to know something of the circulation of the North Pacific Ocean. This circulation is characterized by a large clockwise gyre, essentially similar to the atmospheric circulation. The North Pacific drift to the eastward splits off the Oregon-Washington coast into a northward flowing current which forms the Alaska gyre and a southeastward flowing cold California current which turns to the westward off Baja California. The current flows past Hawaii as California current extension waters, becomes part of the north equatorial current, passes northward as the warm Kuroshio current and mixes with the cold southward Oyashio to complete the clockwise pattern.