Our Ocean Backyard — *Santa Cruz Sentinel* columns by Gary Griggs, Director, Institute of Marine Sciences, UC Santa Cruz.

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Climate oscillations and disappearing sardines

A half century ago, the city of Monterey changed the name of Ocean View Avenue to "Cannery Row", in honor of John Steinbeck's 1945 classic story. The sardine fishery made Monterey one of the largest fishing ports in the world through much of the first half of the 1900's, but by 1945, the fishery had collapsed and Cannery Row as it existed then, went with it. The Monterey Bay Aquarium was opened in 1984 on the old Hovden Cannery site, using parts of the old cannery as exhibits that have given us a glimpse of the past.

Following the collapse of the sardine fishery, which at its peak brought in about 650 million fish each year, there were several theories or explanations as to what caused this economic disaster. Foremost was perhaps the use of purse-seiners, the "Wolves of the Sea", with nets a quarter of a mile long that reached 200 feet down, that simply over-fished the population down to a point where the fishery wasn't sustainable. We have, unfortunately, now done this with many other fisheries as well, the cod, and many of our rockfish, for example. Another argument was that the increasing use of pesticides such as DDT, on the crops of the Salinas Valley had impacted Monterey bay by runoff and magnification up the food chain, which had seriously impacted the sardine population.

In subsequent years, the careful analysis of sediment cores collected from the sea floor off the southern California coast, as well as off Peru, revealed that there had been intervals of time, hundreds of years ago, well before commercial fishing was initiated, when sardine scales were common in the seafloor mud; during other time intervals the scales were virtually absent. It soon became apparent that sardine populations came and went over periods of several decades due to some cyclical ocean conditions. An early ocean observation system was set up in 1949, known as CalCOFI (the California Cooperative Oceanic Fisheries Investigations), to study the ecological aspects of the collapse of the sardine populations by regularly measuring such ocean variables as temperature and salinity off the California coastline. These measurements and many others are still being collected today (such as the CenCOOS ocean observation program, mentioned in last week's column) in order to provide a longer-term perspective on natural cycles and to help us answer these sorts of questions.

What we have now discovered from these long-term observations is that the ocean climate in the Pacific varies over time periods of several decades in what is now known as the Pacific Decadal Oscillation (PDO). Changes in ocean temperatures over large areas affect atmospheric pressures and subsequently wind patterns. The storm climate, ocean surface temperatures, as well as the intensity of upwelling and the availability of nutrients, all change in cycles that may last 20 or 30 years. It is these changing ocean conditions that influence which species thrive and which decline in abundance. So sardines come in cycles that may last 25 or 30 years, and in Monterey Bay they seem to alternate with anchovies. From about 1920 to 1945, in what is now known as a positive phase of the Pacific Decadal Oscillation, the sardines dominated, the fishery expanded and the number of canneries increased. Cannery Row was at its peak. In 1945 the climate shifted to the negative phase of the PDO, the sardines disappeared, replaced by anchovies. This negative phase continued until about 1978 when the sardines returned again, although the market for sardines was much different than it has been 30 years earlier. The period from 1945 to 1978 was also generally characterized by fewer large storms, cooler ocean water, lower rainfall, and less coastal storm damage. This all changed along the central coast in 1978 when we entered a period of more frequent and damaging El Niño years, which many of you will remember and which I'll talk about in my next column.