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# SARDINES: CONSERVATION OR COLLAPSE?

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**T**he Pacific sardine is an incredibly important source of protein and omega-3 fatty acids in the marine environment, serving as a critical forage species for everything from whales to tuna to birds to humans. But between human fishing pressure and their naturally drastic population fluctuations, some fisheries scientists are worried that the current drop in sardine biomass is more than just a natural cycle. This ongoing decline in the Pacific sardine population is being monitored closely by NOAA (National Oceanic and Atmospheric

Administration) Fisheries and the Pacific Fishery Management Council (PFMC) in an effort to accurately assess this species to make sure catch limits are properly set and the current stock is not overfished.

Understanding the basics of the sardine boom-and-bust population cycle is not prohibitively complicated in theory, and is integrally linked to ocean temperature. Sardines naturally run in abundance in cycles of 20-30 years. In the Pacific, these periods are closely tied to an oceanic cycle called Pacific

Decadal Oscillation (PDO) that occurs on the same time interval. It has been less than two decades since PDOs were identified and it was not until several years after that they were linked with sardine populations. PDO cycles are still not completely understood, but it seems that the varying rotational speed of ocean gyres strongly influences them. For example, the speed of the whirlpool-like clockwise churning of the North Pacific Gyre spanning from California to Japan impacts the surface temperature shifts that are characteristic of PDO cycles. When the gyre spins faster, it pulls deeper, colder waters up through the ocean, cooling the surface layers and impacting reproductive rates of the sardines. Sardines are far more abundant when the water is warmer, so cooler surface temperatures generally indicate low productivity for sardine populations.

but the fact that this level of extraction occurred during a natural downturn in Pacific sardine biomass relating to cooler water temperatures, enhancing the effects of the overfishing. In order to avoid another total collapse, which some scientists fear we may already be in the midst of right now, a regulatory effort is being made to drastically limit the allowable catch of sardines until populations can tolerate the fishing pressure again. According to Geoff Shester, the California program director of Oceana, "When you fish in a natural decline there are three primary results. You make the natural decline a much more severe collapse. That collapse then drives down the population further than it naturally would have dropped to, and when conditions turn around again...it takes a lot longer for those stocks to rebuild themselves than it naturally would have."

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As predicted by this correlation between temperature and abundance, sardine biomass started dropping sharply in the late '90s along with ocean surface temperature. Then suddenly in 2003, a completely unpredicted spike in population density along the U.S. West coast occurred, resulting in a 3-year increase that culminated in a peak population of an unprecedented 1.3 million tonnes in 2006. Since then, the sardines have rapidly diminished to less than 400,000 tons, a 70 percent decrease in under a decade. While it is now clear that sardine numbers are dependent upon factors other than just sea surface temperatures, it is more important than ever to set proper catch limits in order to ensure sustainability so as to avoid another unnecessary and devastating crash.

The Pacific sardine fishery collapsed in the 1950s due to rampant overfishing brought about by the need to feed soldiers during both World Wars. In 1939 alone, 460,000 tons of these protein-packed, easily shippable fish were caught just off the coast of Monterey, CA, most of which were shipped out to the front lines. This heavy fishing continued until the Pacific sardine population could no longer sustain itself, and the fishery collapsed. The crash was attributed not just to strong industrial fishing pressure,

The sardine population around the tip of South Africa has been experiencing drastic declines similar to those in the northern hemisphere. Theoretically, sardine fishing in this part of the world is designed to be sustainable because the annual total allowable catch (TAC) of sardines is set at 10 percent of the population based on the annual recruitment from the previous year. This formula of course does not take into account the large amount of illegal, unreported, and unregulated fishing that occurs in South Africa that could play a strong role in explaining the dwindling numbers of sardines in the past decade. Sardines are also a common bycatch animal in the highly profitable anchovy fishery, another factor that could help in understanding why the sardine population is not recovering as expected.

Considering that U.S. fishermen did not even reach their extremely conservative allowable sardine quota last year, it may be possible that we are still removing too many sardines despite having a controversially low catch limit. Only time and progressive fishery management practices will tell, but human/sardine history may unfortunately be repeating itself. ○