El Niño Brought the Blues, But Bliss Too

When the 1982-83 El Niño episode engulfed half the world, it left a wake of devastation ranging from droughts in India to hurricanes in Tahiti. In Ecuador, where rainfall measured 1,000 percent above normal, and Peru, which was wracked by avalanches, the governments also faced economic crises of catastrophic proportions. States of emergency were declared in both countries, because El Niño had ravaged the fishing industry — anchovies, sardines, crabs, mussels and commercial fish died or migrated to waters out of reach of fishermen. These and other depleted animals also partially constituted the diets of sea birds, sea lions, crustaceans and sea urchins, which, as a result of the diminishing food supplies, washed up on beaches all along the South American coast.

But as the latest tallies of the effects of El Niño come in, another, more benevolent side of the phenomenon is coming to light. Researchers are finding that El Niño created conditions that favored and enhanced many forms of life, from the green algae that heartily smothered normally bare rocks to carpets of flowers that covered usually arid lands to a great diversity of fish and shellfish species that increased their range and abundance off the western coast of South America.

"What is catastrophic for one species is productive for another," says Jack S. Grove, an ichthyologist at the Los Angeles County Museum of Natural History. Grove found that while 12 species of fish were decimated by El Niño in the waters off the Galápagos Archipelago, where he lived before and during the latest El Niño, 19 other species increased in number and expanded their territory. Grove's findings are published in the November TROPICAL OCEAN-ATMOSPHERE newsletter along with similar reports from other researchers on species such as the dolphin fish, skipjack, shrimp and scallop that flourished in South American waters during the peak of El Niño.

The onset of El Niño was marked in the spring of 1982 by a reversal in the western Pacific trade winds. These winds usually blow east to west, and in so doing, pin a mass of warm water to the western Pacific (SN: 2/26/83, p. 135). The El Niño reversal released what is known as an internal Kelvin wave, which moved below the water surface along the equator toward the eastern Pacific. The Kelvin wave was trailed by currents of warm water. The end result at the South American coast was an increased sea level and a greater temperature and thickness of the warm surface layer of water.

For some forms of local marine life this was disastrous. Richard T. Barber, a biological oceanographer at Duke University Marine Laboratory in Beaufort, N.C., thinks that changes in the distribution of warm water may have prevented colder water containing nitrate, phosphate and other nutrients from reaching the top layers of water, closest to the sun, where plankton must be to photosynthesize. As a result, the production of plankton was diminished and there was less food for some kinds of fish to eat. Within months, shortages moved all the way up the food chain, he says.

Barber believes that for many fish the problem was compounded by an innate behavioral response that causes fish to swim faster in warm water until a cooler temperature, more to their liking, is found. In the so-called upwelling environment typical of South American coastal waters, this behavior enhances survival because cooler waters often contain the greatest abundance of food. El Niño reversed the rules of the game, however, and fish that escaped the invading warm currents by withdrawing deeper into colder water found less food, not more. Researchers report in the newsletter that some species such as sardine and mackerel disappeared during El Niño only to come back to the coast extremely thin and underfed. Barber says that slower-moving fish, especially anchovies, were wiped out when they became trapped against the coast in pockets of cooler water where they were more vulnerable to predators, starvation and perhaps the rising water temperature.

Yet South American scientists observed record numbers of tropical fish such as bonita and tuna — predators normally found 30 miles offshore, but carried by El Niño currents directly to the coast. El Niño not only increased their range, but also may have provided them with new, abundant prey. Juan Velez and co-workers at the Instituto del Mar del Peru in Callao note in the newsletter how the population of dolphin and skipjack fish blossomed as the sea surface temperature rose, while the number of silverside, a favorite prey, plummeted.

Invading predators were not the only animals that flourished, however. According to Velez's group, the total catch of shrimp in Peru was eight times greater in 1983 than in the previous year. Bottom-dwelling worms and the Peruvian scallop also did exceptionally well. Matthias Wolff from the Institute of Marine Research in West Germany believes that the scallop boom was caused by an increased concentration of dissolved oxygen on the sea floor, stronger winds and currents that kept the water from stagnating and the decline of the scallop's usual predators. He also thinks that this species, *Argopecten purpuratus,* does best at temperatures higher than normal, indicating that it may have evolved from a tropical species.

In the Galápagos, Grove also found that El Niño favored wide-ranging fish over endemic species that have adapted specifically to the islands' normal ecosystem. He discovered that *Chromis atrilobata,* a type of damselfish found all over the eastern Pacific, did better than its close endemic relative, *Azurina eupalama,* which hasn't been seen since El Niño began.

Positive effects of El Niño were seen on land as well. The episode brought rains and fogs to coastal deserts, causing an outburst of vegetation that enabled local settlers to raise cattle, sheep and goats. "Apparently, the seeds and bulbs of many plants survive in the desert for many decades until a strong El Niño creates appropriate conditions for the type of explosion observed this year," says Wolf E. Arntz from the West German Institute of Marine Research in a recent issue of OCEANUS.

Scientists say they are still far from understanding what triggers and drives El Niños, which recur every two to 22 years. But the 1982-83 episode, often cited as the most dramatic in this century, has been better documented than any other such event to date. Some progress is being made at ferreting out the mechanics of the phenomenon. This last El Niño, for example, enabled Roger Lukas at the University of Hawaii in Honolulu and David B. Enfield at Oregon State University in Corvallis to verify a model directly linking changes in the wind blowing in the western Pacific to fluctuations in the sea level and currents 10,000 kilometers away in the eastern Pacific. The researchers, whose work appears in the newsletter, observed changes in the sea level at five stations on the South American coast 50 days after similar oscillations occurred in the western Pacific wind while wind conditions in the east were normal.

In the course of scrutinizing the latest El Niño, scientists reaped a few discoveries not necessarily attributable to the event itself. For instance, in addition to the irregular El Niño-induced fluctuations in the sea level, Lukas and Enfield recorded a highly regular oscillation, with an amplitude of 5 centimeters and a frequency of 45 days, both before and during El Niño. These regular oscillations, observed for the first time, may be the sea's response to similar periodic changes found in the atmospheric pressure.

And Grove, observing fish in the Galápagos, told SCIENCE NEWS he found 14 species of fish never before observed around the Wolf and Darwin islands, seven of which are completely new to science.

—S. Weisburd