# El Niño in progress: A warmer Pacific and the winds of change

Brush fires sweep across eastern Australia as the country grapples with its worst drought on record. Starvation threatens a million Indonesians faced with drought-related crop losses. Torrential rains pelt Ecuador and coastal Peru, and floods along the normally arid coast have disrupted commercial fishing. In much of the United States, people have shucked their parkas in favor of the raincoats they need to deal with an unusually wet, mild winter. These diverse events, spanning half the globe, all are related to a massive climate upheaval called an El Niño. This El Niño, researchers fear, may be the worst in 100 years.

While no one knows precisely what causes El Niños, one of the first signs is a decrease in the trade winds that typically blow across the equatorial Pacific toward Asia. The steady winds exert force on the water, essentially piling it up in the western Pacific. When the trade winds slow — or as happened last summer, stop — winds from the west pick up and a massive internal wave called a Kelvin wave may be triggered. Warmer water from the west sloshes thousands of miles back toward the South American coast. The layer of warm water prevents the upwelling of cold, nutrient-rich water along the coast, drastically affecting marine life from the base of the food chain on up.

The name El Niño, the Spanish term for "The Child," refers to the usual yuletide timing of the event. Signs of this El Niño began in June, so far out of phase that at first researchers were reluctant to call it a true El Niño, cautiously preferring to describe the aberrant behavior in wind, air pressure, sea level and sea surface temperature as "El Niño-like." By October, no doubt remained. A special bulletin issued Feb. 14 by the National Oceanic and Atmospheric Administration's Climate Analysis Center in Camp Springs, Md., reports that surface waters in the eastern and central Pacific were abnormally warm, as befits a classic El Niño.

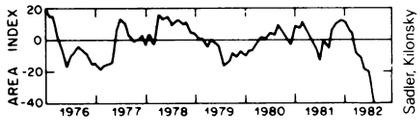
El Niños used to be considered regional events, but in the 1960s it became more evident that they are related to a global system of climate variations called the Southern Oscillation, notes Eugene Rasmusson of the Climate Analysis Center. The most prominent feature of this system is a seesaw of atmospheric pressure between the southeastern Pacific and the region of Australia and Indonesia. When pressure goes down over the southeastern Pacific, it rises over Australia and Indonesia, and climate varies in response, with dry conditions in Australia and Indonesia and rains all along the central equatorial Pacific. These fluctuations may be associated with the collapse of the trade winds.

"We began to understand that the El Niño warming is not just locally confined to the area near the South American coast," Rasmusson says. Over a period of many months, winds, currents, mixing of ocean layers and diminished upwelling cause the warming to spread back to or beyond the dateline, or over a quarter of the way around the world.

An early sign that an El Niño is developing is that marine birds shut off their reproductive cycles in response either to a change or decrease in food supply. When ornithologists Ralph Schreiber and Elizabeth Anne Schreiber of the Natural History Museum of Los Angeles County, Calif., visited Christmas Island in June, the coral island's bird population was breeding successfully. When the researchers returned to the mid-Pacific island in November, they write in the Feb. 1983 TROPICAL OCEAN-ATMOSPHERE NEWSLETTER, they discovered "virtually a total reproductive failure." The adult birds had fled from the island; the nestlings, abandoned, had starved. The exodus is a survival mechanism for the adult birds, who can return to breed again another year. But it is not known where the birds went or if they survived. Ralph Schreiber fears that a "major mortality" may have occurred because exceptionally strong winds from the west may have blown the birds off course, preventing them from reaching the haven of another island in the Pacific.

The impact of this warming event on marine life is still unknown. A major El Niño in 1972, combined with over-fishing, nearly destroyed the lucrative anchovy fishery in Peru. There is some concern that this El Niño is so strong that its effects on fish stocks will be felt for the first time as far south as Chile, which now has the largest fish catch in the world in terms of tonnage, says Richard Barber of Duke University in Beaufort, N.C.

Barber, a biological oceanographer, is studying the effects of El Niño on productivity at the primary level, or base, of the food chain. The current view is that the warmer water that wells up during an El Niño is deficient in nutrients, particularly nitrates, and that this causes the decline in productivity. However, he notes in the newsletter, in 1982 the upper 100 meters of water in the coastal equatorial regions were warmer, but still fairly rich in nitrates. At least in the present El Niño, the critical conditions affecting diatoms, tiny single-celled plants important at the primary level, appear to be changes in mixing and light, rather than nutrient poverty. These conditions, Barber says, favor other kinds of plankton than diatoms. The organisms that thrive in the changed environment are less useful to other consumers such as anchovies and sardines. When the fish population declines, birds have less to eat, and so on. For countries such as Peru, El Niño's effects on marine life can be crippling, with major losses in fish catch and production of fertilizer, which depends on droppings from guano birds living on nearby islands.




*Satellite measurements show precipitous drop in trade winds in 1982.*

California, too, is feeling the El Niño's effects. For instance, by warming the equatorial current, the El Niño has stimulated a wind system in the Aleutians that drives the air northward. The consequence is that less heat is extracted from the water, and in places like southern California, surface sea temperatures are warmer than recorded since the El Niño in 1957, and sea levels are high. Thus, says John McGowan of Scripps Institution of Oceanography in La Jolla, Calif., the El Niño has been involved in the heavy rains and, possibly, coastal floods that have afflicted southern California this winter. Plankton and southern fish species not usually seen in this season have been reported in California coastal waters.

Scientists can only speculate why this El Niño is so strong. Some researchers hypothesize that the volcanic cloud ejected by El Chichón last April (SN: 5/15/82, p. 326; 8/21/82, p. 120) may have warmed the upper atmosphere in tropical latitudes last spring, leading to the collapse of the trade winds. The connection, however, is difficult to prove. "When two spectacular events occur, it's easy to connect things up," says Jerome Namias, head of the Climate Research Group at Scripps. In seasonal forecasts for this winter in North America, the Scripps group and meteorologists at the National Weather Service (SN: 12/11/82, p. 375) anticipated the effects of the El Niño. Namias stresses that other factors must be considered because the El Niño's influence is modulated by other features in the atmosphere over the Northern Hemisphere. "The El Niño did enter in a way, but never independently," he says.

Meteorologists and oceanographers studying the biology and dynamics of the ocean/atmosphere system are scrutinizing the data collected during this El Niño in hopes that they can better understand the complex processes that culminate in the warming, as well as the warming's effects. Once it begins, the El Niño cycle, which normally lasts 18 months to two years, is usually predictable, so understanding it could enhance seasonal climate prediction, Rasmusson says. But much is still unknown. Says Namias: "The problem has all the complexity of the world atmosphere and the large oceans. When you get two nonlinear systems combining, it really makes it tough."

—*C. Simon*

*News of the Week continued on page 138*