

El Niño and Its Impact on Ecuadorean Fisheries

Ecuadorean scientists report that an unusually powerful El Niño in the eastern Pacific is adversely affecting Ecuador's pelagic fisheries. El Niño is an oceanographic phenomenon associated with warmer than normal water temperatures which in the past have caused major reductions of fish, marine mammal, and sea bird populations.

El Niño means the "Christ Child" in Spanish and is so named because it often occurs during December. The phenomenon occurs when warm tropical water interferes with coastal upwelling and displaces the nutrient-rich colder water normally transported northward by the Humboldt Current along the western coast of South America. The declining availability of phosphates and nitrates, and a resulting decrease in phytoplankton primary productivity, is the first step in breaking the food chain that eventually affects species of interest to commercial fishermen.

The species most affected are the small pelagics like sardine, anchovy, and thread herring which are the species caught in greatest quantity by Chilean, Peruvian, and Ecuadorean fishermen. The impact can be particularly severe on larval and juvenile fish and, as a result, the effects of El Niño can last several years.

Previous El Niño drastically affected Peruvian and Chilean fisheries. Stocks off Ecuador have not been as severely affected. Peruvian researchers now report that the current El Niño may be one of the most powerful ever recorded. The area most severely affected lies off the coast of northern Peru. Surface water temperatures off northern Peru were a substantial 4°C above normal during January 1983. Ecuadorean officials report that the warming trend off

Ecuador was slightly less, only about 2-3°C above normal during January, but this was still apparently high enough to impair one of the country's major fisheries, the fishery for thread herring¹.

Pelagic Fishery

The largest fishery in Ecuador is for thread herring and other small pelagics in the Gulf of Guayaquil. The thread herring catch was 613,000 metric tons (t) in 1981 (Table 1), about 90 percent of the entire Ecuadorean catch. The thread herring catch is mostly reduced to fish meal, although some is canned. Other species, such as shrimp, are more valuable, but thread herring and other small pelagics are the species taken by Ecuadorean fishermen in the largest quantities.

Ecuadorean fishermen first reported declining thread herring catches in October 1982. By late January 1983 the country's thread herring catch had declined to almost negligible quantities. It is not known whether the catch is declining because El Niño has resulted in extensive fish kills or changed behavioral patterns which make it more difficult to find and catch the fish. Overfishing may also be at least partly responsible. Ecuadorean officials have for some time been concerned about the rapidly increasing fishing effort on thread herring.

Ecuadorean pelagic fishermen caught unusually large quantities of jack mackerel during October and November 1982 and Ecuadorean officials speculated that, as a result of El Niño, mackerel stocks moved closer to the coast. This concentration ap-

¹Referred to as pinchagua by local fishermen.

parently made schools of mackerel available to Ecuador's largely coastal fishermen, who because they could not find thread herring, concentrated their effort on mackerel. Reports received from Ecuador during January 1983, however, indicated that mackerel catches had also declined.

Ecuadorean researchers speculated that the current El Niño would last until April or May 1983. The impact on the pelagic fishery may last much longer. Thread herring mature in about 2½ years. If the El Niño has caused massive kills of larval and juvenile fish, then the impact will be felt well into 1985, or even beyond, if the spawning biomass has been affected.

Shrimp Fishery

Ecuadorean shrimp fishermen and pond operators speculate that El Niño may prove beneficial for them. Heavy rains, associated with El Niño, were reportedly washing unusually large quantities of nutrients into the coastal estuaries where the juvenile shrimp mature. Ecuadorean biologists speculated that, as a result, there was an abundant supply of postlarvae to stock Ecuadorean shrimp ponds. Some pond operators were projecting another record year for the country's booming shrimp pond industry, the world's largest. A few farmers, however, reported that the torrential rains in January had damaged some ponds. As a result the full impact of El Niño cannot yet be determined. (Source: IFR-83/19.)

Table 1.—Ecuador's fisheries catch, 1975-82.

Year	Catch (1,000 t)			Total
	Thread herring ¹	Shrimp	Other	
1975	132.0	5.8	90.0	222.0
1976	236.0	7.6	62.3	298.3
1977	370.0	9.5	64.0	434.0
1978	550.0	10.0	66.6	616.6
1979	574.8	10.4	69.5	644.3
1980	593.1	17.5	78.2	671.3
1981	613.0	20.1	52.6	685.7
1982				2725.0

¹Includes other small pelagic species (horse mackerel, sardines, etc.)

²Based on projections in late 1982. Because of El Niño, the actual catch may be lower than expected. Source: FAO "Yearbook of Fishery Statistics 1980" for 1975-80 data and various press reports for 1981-82 data.

El Niño and the Peruvian Fisheries

The powerful El Niño in the eastern Pacific is reported adversely affecting Peru's pelagic fisheries. The area most affected lies off the coast of northern Peru where water temperatures were 4°C above normal during January 1983. More recent reports suggest that the temperatures were attenuating and might return to more normal levels by May or June 1983. Some scientists warn, however, that sea surface temperature anomalies during El Niño events usually have double peaks. The 1982-83 El Niño event has been an unusual one and has not followed the previous pattern. As a result, there may not be the traditional double peak of temperature anomalies.

The long-term impact of the current El Niño is not known. The 1971-72 El Niño had a great impact on the Peruvian fishing industry because the stocks were already severely depleted by the intensive fishing effort. The 1970 Peruvian catch had reached an incredible 12.5 million metric tons (t), but declined to only 2.3 million t in 1973 after the 1971-72 El Niño. Even though the 1982-83 El Niño is more severe in terms of temperature anomalies and unusual precipitation levels, Peruvian fishermen are catching only about a third as many fish as they were catching in 1970. This implies that the impact on the country's fishing industry will be substantially less in relative terms. Even so, preliminary reports suggest that the impact on Peruvian fisheries is severe. Peruvian fishermen caught only 3.4 million t in 1982, 15 percent less than the 4.0 million t the Peruvian Government expected. The 1983 catch will be even more affected. The state fish meal company (Pescaperu) reports that deliveries to its plant totaled only 130,000 t in January 1983, a decline of over 45 percent from the 190,000 t delivered during January 1982. Many fishermen report that they are catching only one-third or less of what they caught in January 1982. Several other less important

species have also been affected, including sole, mullet, and spotted dogfish.

Anchovy

Peru's important anchovy fishery has been the one most impaired. The Ministry of Fisheries reports that anchovy had practically disappeared, except on a few small fishing grounds. Along the southern coast, anchovy was still found between the cities of Ite and Morro Sama and between Camana and Ocona. Off the northern coast, the anchovy was only found between Huacho and Sucre and between Salaverry and Isla Lobos. The Instituto del Mar (IMARPE) reports that the behavior of the anchovy had also changed and that schools had been found as deep as 200 m, making it impossible for Peruvian fishermen to catch them. The press reported in December 1982 that over 60,000 fish-

ermen and processing workers had been laid off. The 1982-83 El Niño has been a special shock to the anchovy fishermen. The Ministry opened a directed fishery for anchovy in 1982, the first time in 3 years, after IMARPE reported that the stocks had begun to recover. (Directed anchovy fishing had been prohibited since 1979 to protect the stocks.) Fishermen were reporting excellent catches until September 1982. The 1982-83 El Niño will almost certainly have a severe impact on anchovy stocks and may adversely affect catches until at least 1986.

Sardine

Preliminary reports suggest that while anchovy is severely affected, the sardine catch has been holding at 1982 levels when the sardine catch was almost 1.6 million tons. The January and February 1983 sardine catch was



0.4 million t, about the same as during the first 2 months of 1982. The impact, if any, on juvenile and larval sardine is yet to be determined.

Mackerel

IMARPE believes that the El Niño may have actually had a beneficial impact on the mackerel fishery. Most Peruvian fishermen cannot take advantage of this development, however, since only a few have vessels and gear capable of fishing mackerel. This may serve as an inducement for Peruvian fishermen to form joint ventures with foreign countries which are already fishing mackerel off Peru, outside the country's 200-mile limit. The increased availability of mackerel may reflect behavioral adjustments to changing oceanographic conditions. The long-term impact of El Niño on mackerel stocks is yet to be determined.

Shrimp

Peru's growing shrimp culture industry in the northern province of Tumbes has reportedly been heavily damaged by widespread flooding. The full extent of the damage is difficult to assess because the heavy rains have also damaged roads, but it is estimated that as much as 80 percent of the ponds may have been destroyed. Peru exported most of its shrimp catch to the United States in 1982 when shipments totaled 870 t worth \$5.7 million.

El Niño has also displaced some species. The unusually warm water along Peru's northern coast has allowed thread herring, usually found off Ecuador, to migrate southward. Peruvian fishermen have begun to fish the thread herring, but have had some difficulty, as it must be handled differently than the sardine and anchovy to which they are more accustomed. This displacement has especially hurt fishermen in southern Peru. Sardine and anchovy schools have reportedly moved south to the cooler waters off northern Chile which has not been as severely affected by the warming trend in the eastern Pacific.

The National Meteorological Cen-

ter (NMC) of the National Oceanic and Atmospheric Administration reports that sea surface temperature anomalies in the eastern Pacific had begun to decline slightly in early March 1983. Peruvian scientists believed that the El Niño was beginning to subside, but NMC officials believed that while there were some preliminary indications that this may be so, it was too early to know for certain. NMC scientists report that a forecast of El Niño's persistence was virtually impossible at that time. They believe that while the sea surface temperatures may return to normal by spring or summer, there is a possibility that anomalies could develop again in the fall.

Processing Plants Close

Peruvian officials estimate that as many as half of Peru's fish processing plants may have to close in 1983. Companies affected will include both the fish meal reduction plants of the state fish meal company, Pescaperu, and private canneries. Many companies, especially the ones which had to borrow heavily during 1981 and 1982, have reportedly accumulated huge debts which will be difficult to pay off at current interest rates. The 1982-83 El Niño has only added to their difficulties.

Pescaperu reportedly lost more than \$22 million in 1982. The declining anchovy and sardine catch—a result of El Niño—may cause even larger operational losses in 1983 which some estimate at close to \$100 million. Pescaperu officials estimate that they may have to close 16 of their 36 processing plants.

Many private processing companies also had losses in 1982. Government officials estimate that Peruvian canneries operated at only 15 percent of capacity during 1982. The companies have been hurt by a combination of rising production costs, falling international prices, and high interest rates. Not all the canning companies reported losses in 1982. Those with adequate working capital were able to avoid borrowing at high interest rates and could adjust better to changing

market conditions. Many companies which had to borrow heavily, however, are now reporting serious losses caused by large unsold inventories of canned fish. Peruvian canneries have reported difficulties in marketing their canned fish production. To help these companies, the Ministry of Fisheries has relaxed regulations restricting fish meal production. The troubled companies have found it much easier to market fish meal than canned fish. The Ministry had been restricting fish meal production for several years as a management measure designed to channel Peru's limited supply of fish into the production of edible commodities. The Minister of Fisheries, Luis Percovich, however, stresses that the relaxation of regulations on fish meal production is only a temporary measure designed to help companies deal with their current liquidity problems.

Emergency Credits

The Ministry of Fisheries has established a Commission at the Banco Industrial to ensure that the necessary funds are available, through commercial banks or the Central Bank, to establish a fund for troubled companies. The Ministry had planned to make \$30 million available to companies and envisioned repayment over a 7-year period, including a 2-year grace period. Peru's serious international balance of payments problem, however, is making it increasingly difficult to obtain the needed emergency funding.

Catch Quota

The Ministry of Fisheries plans to allocate a quota of 850,000 t of sardines in 1983 which will be shared by Pescaperu and private fish canning and freezing companies. The quota was recommended by IMARPE and will, according to Secretary Percovich, be "spread over the entire year." A scheduled rotation of fishing boats supplying Pescaperu fish meal plants and the privately owned canning and freezing plants were put into effect during March. (Source: IFR-83/37.)

Panama's Fisheries Down; El Niño Effects Unclear

The Panamanian fishing industry experienced two difficult years in 1981 and 1982. There is concern about the 1983 fishing season, but it was not believed that the temperature anomalies associated with the 1982-83 El Niño in the eastern Pacific would adversely affect fishing throughout 1983.

The major impact of the 1982-83 El Niño was being felt off Peru and Ecuador. Temperature anomalies along Panama's Pacific coast have not been severe; temperatures of only 1-1.5°C above normal have been reported in the Gulf of Panama. Because Panamanian fisheries are based on tropical species such as penaeid shrimp and thread herring, Panamanian officials do not believe that the small temperature anomalies will seriously affect stocks. Panamanian officials point out that in past years, El Niños in the eastern Pacific have sometimes actually had beneficial effects on Panamanian fisheries. Officials were at first hopeful that the same would happen again in late 1982. Preliminary reports from Panama, however, suggest that these optimistic projections did not materialize and that the 1982 catch declined.

Panamanian fisheries have been declining since a near record catch of 195,000 metric tons (t) was reported in 1980. The 1981 catch decreased to 132,000 t, mostly because of reduced catch of small pelagic fish which account for most of the Panamanian fisheries catch. Heavy rains may have affected the catch in 1981.

The catch continued to decline in 1982, but complete statistics are not yet available. The catch of small pelagics (primarily thread herring and anchovy) was only 75,000 t in 1982, a 25 percent decline from the reduced 1981 levels. The small pelagic catch generally constitutes about 90 percent of Panama's total fisheries catch. The continued decline of Panamanian fisheries in 1982 is not yet fully explained. Most observers believe that it was primarily due to the slackening of coastal upwelling. Southward winds

blowing offshore during the dry season (December to March), slackened. These winds normally cause seasonal upwelling along the country's Pacific coast, supporting the important small pelagic fishery for anchovy and thread herring in the Bay of Panama. Both Government officials and researchers from the Smithsonian Tropical Research Institute report that these offshore winds were substantially below normal levels during the 1982 dry season (December 1981 to March 1982).

Preliminary reports from Panama suggest that 1983 may be another bad year for Panamanian fisheries and that the 1983 small pelagic catch may be even lower than in 1982. Offshore winds have again been weak, an indication that the upwelling needed to sustain the small pelagics may not be taking place. The El Niño events are complex oceanographic phenomena which are not yet fully understood. The reported slackening of winds off Panama is probably related to the complex events taking place in the wider eastern Pacific. Even if the temperature anomalies off Panama have been minor, officials are concerned about the 1983 season which began in March.

Shrimp is Panama's most important fishery. Shrimp landings are small compared to landings of small pelagics, but far exceed their value. Government officials report that the 1982 shrimp catch declined slightly to 6,932 t, or 2 percent below that of 1981. While the total 1982 shrimp catch declined only slightly, fishermen reported that the catch of one of the most valuable species, white shrimp, *Penaeus occidentalis*, declined 14 percent. Panamanian officials do not believe that shrimp will be as severely affected by El Niño as the small pelagics. If the 1982-83 El Niño brings unusually heavy rains, as it has off several other countries, the shrimp season may even improve. Officials are more concerned about the increasing artisanal fishing for juvenile shrimp in coastal estuaries; this artisanal fishing has reached levels which are beginning

to affect the coastal catch of the trawler fishermen.

Panama's fishing industry plays an important role in the local economy. Fishery products are the country's third most important export commodity, after bananas and sugar. Shrimp is the country's major export product, earning \$61 million, or nearly 70 percent of the \$90 million worth of fishery products exported to the United States in 1982. Because of the declining catch of small pelagics, fish meal exports to the United States totaled only 4,500 t in 1982, a 40 percent decline from the 7,600 t shipped in 1981. Panamanian regulations require that a substantial proportion of the country's fish meal be marketed domestically, where it is used to support the country's pig and poultry industries, the major protein source for Panama's rapidly growing population. (Source: IFR-83/43.)

El Niño Workshop Explores Ocean Warming

The persistent warm water in the tropics and associated anomalies in the north Pacific Ocean, known as El Niño, were intensively discussed by some 100 oceanographers, meteorologists, and other scientists at a meeting held 24 March at Scripps Institution of Oceanography, La Jolla, Calif. The purpose of the workshop, sponsored by the California Space Institute (headquartered at Scripps) was to allow researchers from a variety of disciplines and several institutions to compare observations and share data resources.

While no conclusions were made as to the causes of this El Niño or its ultimate effects, according to Catherine Gautier, one of the conference coordinators and assistant director of Cal Space, the participants agreed that this event is one of the largest of its kind in the past 30 years, if not the century.

Scientists first noted the warmer than normal temperatures in large sections of the central equatorial

Pacific last year and it later appeared eastward toward Central and South America. By early this year, warm water indirectly associated with El Niño had reached northward along the coast of North America to the Gulf of Alaska, affecting the ecosystems of the equatorial region and coastal waters of California. Among the findings reported at the workshop were:

1) Surface waters were warmer by as much as 4°C (7.2°F) during October 1982 over much of the tropical Pacific.

2) The surface warming at the equator extended to at least 100 m (330 feet) in depth, and subsurface temperatures away from the equator indicated widespread changes in the region's ocean circulation.

3) Catastrophic changes in bird populations on Christmas Island in the Pacific were described by Elizabeth Schrieber of the Los Angeles Natural History Museum.

4) Warm, moist air, coming from the tropics, helped produce a wetter than normal fall in the southwest. According to Art Douglas of Creighton University, the stormy weather in California can be traced to vigorous mid-latitude storms steered towards the state by unusually deep and persistent low pressure in the east Central North Pacific.

5) Abnormally warm water was observed along the California coast, along with markedly reduced upwelling, the process by which deeper, colder, and nutrient-rich water rises to the surface.

6) Sea-surface heights were abnormally high off California, with a monthly sea level off the Scripps Institution pier of more than 8 inches above normal.

7) There has been a significant shift in marine life migrations during the winter, with a number of crabs, krill, and other marine animals inhabiting the waters off California that would otherwise occur more commonly in the warmer waters off Baja California.

8) Stormy weather and warmer surface temperatures during the winter

have dramatically decreased the size of kelp beds off California.

The last major El Niño event of this type off California was in 1957-58, and lasted more than 1 year. Scientists will be tracking the current El Niño to see if it diminishes during the summer of 1983 or persists through to next winter.

Production Begins at New Texas Redfish Hatchery

Texas' new saltwater redfish hatchery has produced its first dividends in the form of 3.4 million redfish fry, the Texas Parks and Wildlife Department (TPWD) reports. The event held special significance for TPWD biologists, since the fish represent the first tangible returns from a unique cooperative venture involving the state, a private organization, and an electric power company.

Construction of the \$1.2 million hatchery was made possible by funds raised by the Gulf Coast Conservation Association, and land donated by Central Power and Light Co. of Corpus Christi. The power company also permitted access to warm discharge waters which will keep the hatchery ponds usable virtually year-round.

The fry were stocked into nine ponds in April and were expected to reach stocking size (about 2 inches) by 15 May. "All the systems have functioned well, and we have had to make very few modifications along the way," said hatchery biologist Gene McCarty of the indoor tank rooms where critical light and water temperature adjustments are necessary to induce the fish to spawn.

The light/photoperiod manipulations "trick" the mature fish into believing it's time to spawn, which occurs in the fall for wild fish. Biologists collect the fertilized eggs in special containers and hold them for about a week, until the mouth parts develop and the fry are ready to be placed in rearing ponds.

The effort is aimed at restoring redfish populations which have been de-

clining for the past decade. Studies of redfish spawned and reared at the department's reasearch facility at Palacios have shown the fingerling-sized redfish have good survival rates when released into the bays. More work was still underway to get remaining spawning tanks operational. "We expect to get additional spawns in June, September, and October this year," McCarty said. Officials predict as many as 15 million redfish fingerlings produced at the hatchery would be stocked in Texas bays by the end of 1983.

New Herring Sac Roe Management Plan Set

A sac roe herring management plan released earlier this year establishes a standard method for calculating allowable harvest levels of southeastern Alaska herring stocks, the Department of Fish and Game (DFG) reports. In southeastern Alaska, herring stocks are harvested only when their size exceeds established threshold levels designed to protect the minimum spawning requirements for each stock.

Harvest levels from individual stocks are currently held within a range of 10-20 percent of the herring in each stock. The actual percentage taken from an individual stock depends on how much larger a stock is than its threshold level. Under the standard management plan now in effect, a 20 percent harvest level will be possible when a stock is six times as large as its threshold level.

Herring stock size in southeastern Alaska is measured through hydroacoustic surveys of overwintering populations and estimates derived from measurements of spawn deposition. Based on last year's spawning, harvests in 1983 will be allowed in only two areas: Kah Shakes, a gill net area near Ketchikan; and Sitka Sound, a purse seine area. Spawning populations in the other five sac roe fishing areas in southeast Alaska were not expected to reach the threshold level.