CLIMATE AND FISHERIES: A PERUVIAN CASE STUDY

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El efecto adverso que una anomalía climática puede tener en la sociedad es frequentemente exacerbado por decisiones económicas y políticas. Para ilustrar la dificultad de separar los efectos de anomalías climáticas de los efectos de decisiones socioeconómicas, se usa el caso del fenómeno meteorológico-oceanográfico El Niño y su efecto en la pesquería industrial de la anchoveta en el Perú.

Introduction

Adverse weather events by themselves can be devastating for society, but their effects are often exacerbated by economic, political, and social decisions made, in many instances, long before those events take place. For example, with respect to agricultural activities, the extent to which a drought affects the crop production of an area often depends on the kinds of crops grown in that area; the choice of crop, however, is frequently determined by economic, not agroclimatic, considerations. The climatological history of Eastern Colorado (U.S.A.), as one example, suggests that the land should not necessarily be used for wheat cultivation but, perhaps, for pastureland. The economics of cereal crops, however, has dictated otherwise. High prices for wheat often lure farmers into putting their land into wheat production, even if the climate of the region is not necessarily best suited to it. The same can be said to occur for other crops in other regions.

Many social predicaments have been blamed on weather anomalies. Some of these (among many others) include: the 1972-73 global food shortages, blamed on the 1972 drought in the USSR; the famines in the West African Sahel and in Ethiopia, blamed on the extended droughts in those areas in the 1970s; the near-collapse of the Peruvian anchoveta fisheries, blamed on the 1972-73 oceanographic-meteorological phenomenon, known as El Niño. The following map was used to depict the climate-related anomalies (not socio-economic impacts) occurring simultaneously with the major El Niño events of 1972-73 (McKay and Allsop, 1976).

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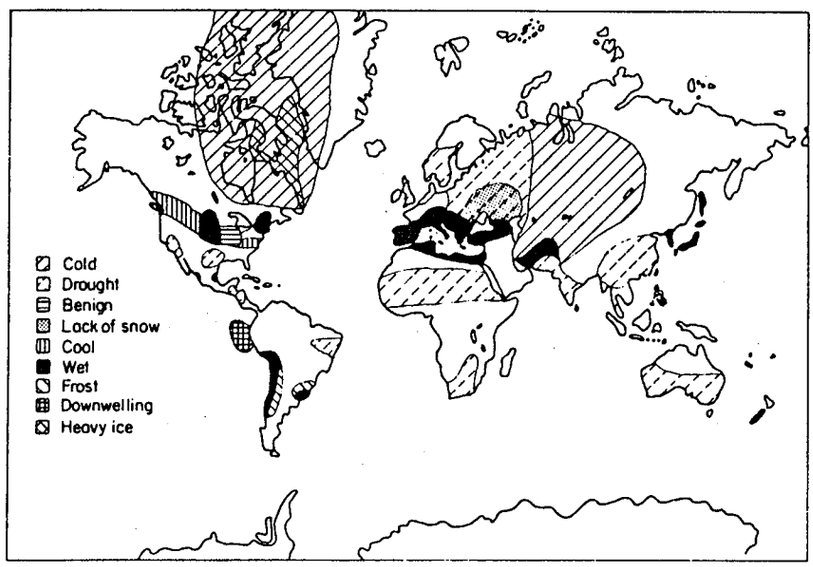
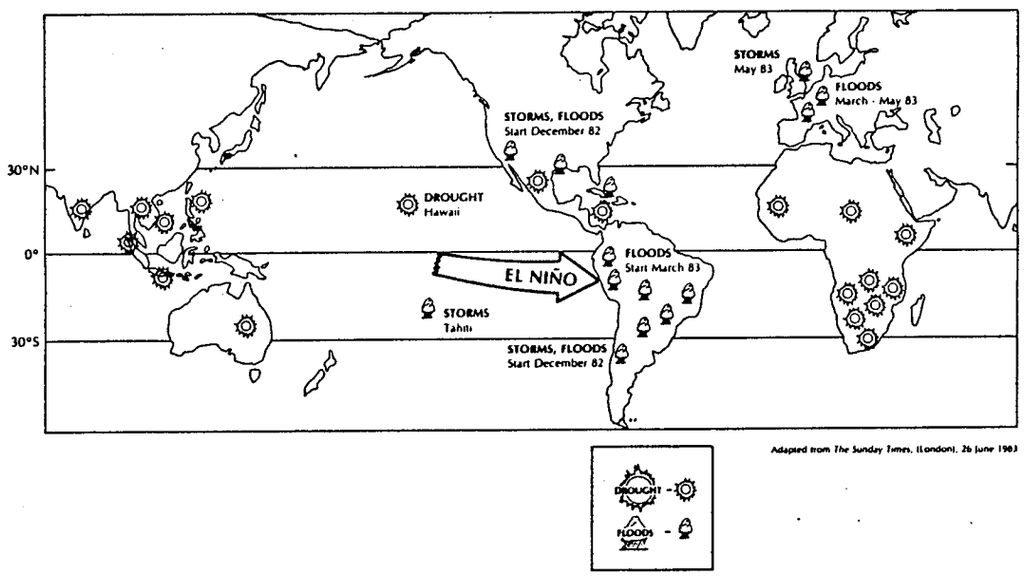


In 1982-83, there was yet another major El Niño event in the eastern equatorial Pacific. News articles linked that phenomenon to other meteorological and oceanographic phenomena as well as to their societal impacts on a worldwide scale, as can be seen in the following map.

IMPACTS MAP



Adapted from *The Sunday Times*, (London), 26 June 1983

While these linkages between weather and society are valid, there is a need to look at them more closely so that the impacts of climate-related anomalies on society can more accurately be distinguished from the impacts on society that are due to decisions by policymakers.

In a recent review of the literature, Cushing (1982) identified some of this century's key scientific research on climate and fisheries in general and singled out the El Niño phenomenon for special consideration. Other recent reports and conference proceedings have also addressed various aspects of the general topic of climate and fisheries, many of them devoting attention to the El Niño phenomenon (e.g., URI, 1978; IOC, 1980, 1983; Tropical Ocean-Atmosphere Newsletter, 1983). A relatively recent research activity involving climate and biological oceanography was completed by the International Decade for Ocean Exploration's (IDOE's) Coastal Upwelling Ecosystems Analysis (CUEA) Program. This six-year multinational, multidisciplinary research program had a stated goal "to understand the coastal upwelling ecosystem well enough to predict its response far enough in advance to be useful to mankind." One of CUEA's activities was to study the Peruvian upwelling ecosystems involving research on El Niño and its effects on the biological productivity in the eastern equatorial Pacific. While the CUEA project was considered multidisciplinary with respect to the physical and biological sciences (i.e., biology, chemistry, physical oceanography, meteorology), there appears to have been little effort to investigate the political, legal, economic, and environmental implications of upwelling processes or more specifically of El Niño events.

This paper focuses on El Niño events and their suggested impacts on the Peruvian anchoveta fishery. It attempts to identify some of the societal factors that might affect the implementation of rational management strategies for such fish stocks (oceanographic and meteorological factors having been identified in papers presented earlier in this technical conference). This paper is not an attempt to present new factual information, but to present a new way of organizing and evaluating existing information to understand better the different influences, stimuli, and constraints that affect fisheries management.

Shoaling fish are relatively easy to locate and catch, and with efficient gear large quantities can be taken in short periods of time. While some species are used as food fish, others are of industrial value for reduction to fishmeal. This particular fishery in Peru, based on the anchoveta, grew quickly beginning in the early 1950s, and its history is relatively well documented. An analysis of natural as well as societal factors affecting the exploitation of the Peruvian anchoveta can provide valuable insights into the management of fisheries based on similar stocks.

One can find views in the fisheries management literature that relate the successes and failures of renewable resource management to either activities at the international level ("international demands for fishmeal in combination with Peruvian import restrictions sparked the Peruvian contruction of fishing boats"), group behavior at the national level ("if you allow an industrial fishery to begin, it will destroy the guano resource"), or individual behavior ("fishermen want to sink every other boat but their own"). This paper treats these three levels, the international, the state, and the individual, as distinct categories of factors that affect rational fishery management. I selected categories in which to discuss different events or activities according to my perceptions of the most appropriate ones.

Coastal upwelling, El Niño, and the Peruvian Fishery

The Peruvian coastal upwelling ecosystem was rich in anchoveta which had great potential value as a commercial fishery. With an increase after 1945 in world demand for fishmeal as a poultry and livestock feed supplement, and with the failure of the California sardine fishery in the early 1950s, U.S. interest in fisheries shifted to Peru (Boerema and Gulland, 1973). By the late 1960s, the Peruvian fishmeal industry had developed into one of the most productive in the world.

El Niño has been defined as the invasion of warm water from time to time into the region of upwelling cold water of the eastern Equatorial Pacific. It adversely affects primary productivity and hence the anchoveta stock.[1] El Niño events vary in intensity, duration, and magnitude, and thus its ecological and societal impacts also vary (Paulik, 1971). The 1972-73 El Niño has been blamed by some for the near-collapse of the Peruvian anchoveta fishery and the resultant poor state of the Peruvian economy; others blame overfishing. The combined effects of overfishing and El Niño highlighted the need for some form of economic rationalization of the industry. In May 1973, the Peruvian government nationalized the fishing fleet and plant capacity, ostensibly to preserve the anchoveta fishery. A later decision to denationalize the fleet in 1976 resulted from the high cost to government of subsidizing the fishing fleet during years of poor fish catches.

As a result of the sharp decline in the productivity of the Peruvian fishery in the early 1970s and the consequent decline in the production of anchoveta fishmeal since 1972, alternative sources of feed (such as soybean) began to compete successfully with Peruvian fishmeal. Economic crises have plagued Peruvian leaders since the collapse of the anchoveta fishery in the early 1970s.

THE INTERNATIONAL LEVEL

Even when the international community is not directly involved in the exploitation of a national fishery, the fishery will be affected by factors that originate in other nations. At least some of these factors have been taken into account by most national fisheries. Such factors can affect the supply of fish and might include, for example, the transfer of technology (including technical advisers), jurisdiction over the coastal waters, the need for foreign exchange and loans from international development agencies. They can also affect the demand for fish products, and might include international market demands, competition from other fisheries, and international prices for fish products. A third set of factors might not appear to relate directly to fisheries management, but in fact can have a major impact on the development of a fishery. This

[1]The most recent El Niño began in the southern fall of 1982 and continued well into 1983.

includes, for example, reactions of the international community to the expropriation of foreign investment in sectors other than fishing or the seizure of foreign fishing vessels or the demise of a fishery thousands of miles away.

Underlying these international considerations are differing ideological beliefs. While the holders of such beliefs might agree, for example, that a specific action took place (e.g., the transfer of a particular technology), they would disagree about its causes or consequences (for an example of such a debate see Malpica, 1975 versus Tantaleán 1978).

Most coastal countries have had to cope with the exploitation of their fish resources by vessels from other nations. By claiming, in 1947, 200-mile territorial limits, Peru inadvertently protected itself from an important international aspect of fishing that was yet to become popular. Since foreign factory ships were barred from their waters, this territorial limit assured that Peru's coastal fish would not become yet another internationally overexploited common property resource.

In the absence of this troublesome international aspect, however, Peruvian governments have (collectively) had to bear complete responsibility for the successes and failures of the management of their anchoveta fishery. When the near-collapse came in the early 1970s, Peruvian leaders could blame neither foreign factory ships or other neighboring countries for the depletion of their anchoveta stock off the central coastal area. They could only blame nature and, more specifically, El Niño events (e.g., Tantaleán, 1978, p. 250), as the primary cause of the reduced productivity of their anchoveta fishery.

Another important international aspect of the development and management of the Peruvian fisheries is the origin of its fishmeal industry. The Californian Pacific sardine fishery had flourished for decades since the early 1900s (see, for a pictorial history, Reinstedt, 1978) and was in its heyday in the 1930s. By the mid 1940s, it became apparent to all but wishful thinkers that the future productivity of that fishery was in question (e.g., Radovich, 1981). Its apparent decline was manifested in the quantity and quality, as well as the southward shift in location, of the commercial landings. Despite a brief increase in recruitment in the late 1940s, that fishery had essentially collapsed as a viable zone of economic activity by 1952.

Caravedo (1977), and others (e.g., Horna, 1968), have suggested that the catalyst for development of the Peruvian anchoveta fishery came when the owners of the idle fishing vessels and processing plants in California decided to sell that capacity to Peruvian entrepreneurs, providing them with extremely advantageous financial arrangements. Some American companies joined with Peruvians to establish cooperative arrangements and subsidiaries to catch the anchoveta for reduction to fishmeal.[2]

Technology transfer is yet another international dimension that requires consideration. The development of the nylon net, for example, has been cited as a major technological breakthrough for entrepreneurs wanting to invest in fisheries (e.g., Roemer, 1970; Horna, 1968; Lee Smith, private communication, 1983). Although nylon nets were more expensive than cotton nets, they were also more durable. Given the favorable terms for the purchase of those nets that the Japanese and others offered, it became financially attractive for Peruvians to buy into the fishery (Horna, 1968). Included in technology transfer would be technical advice provided by foreign experts. As with technology itself, there are successes and failures here as well (see, for example, Schärfe, 1979; Kasahara, 1979; Glantz, 1980).

Another international aspect of the fisheries arises from Peru's adoption for many years of a strategy based on the export of primary resources in order to earn foreign exchange that can then be used to finance economic development. This development strategy does have important international implications. For example, fishmeal exports are affected by international price and demand or by currency exchange rates (e.g., Brown, 1965; Kuczynski, 1977). Export demand and price are also affected by the availability of similar or substitutable products from other countries with which Peru must compete for markets. A former government official in the 1960s (and again after 1980), recorded his belief that fisheries provided an unstable base on which to build a development program because of the highly variable nature of resource availability (Kuczynski, 1977).

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[2]It is important to note that idle Californian fleet and plant capacity was also sold to South African entrepreneurs in the early 1950s, providing an impetus to the development of that fishery as well as to Peru's (e.g., Dieuges, 1983; Marx, 1981; Lees, 1969; Culley, 1971).

Finally, some actions that seemingly affect only one sector of the economy might have effects on other, unrelated sectors, such as the Peruvian dispute with the American-owned International Petroleum Company (IPC) (see, for example, Kuczynski, 1977; Goodsell, 1974; Olson, 1975). The uncertainty that surrounded the outcome of an IPC settlement with Peru apparently led to restriction of U.S. development assistance to Peru from 1962-1975.

An aim of this section has been to dispel a belief that the collapse of one fishery is of little consequence, except in the marketing sector, to fisheries in other regions exploiting similar stocks. The rapid development of the Peruvian fishing industry was spurred by the collapse of the Californian Pacific sardine fishery, which was also a major factor in the development of the South West African pilchard fishery.

Today we see a repetition of that historical experience, only the roles of the actors have changed. Peru is now attempting to sell its surplus boat and processing capacity to the international community, and South West Africa, following the collapse of its own pilchard fishery in the late 1970s, has become directly involved in the exploitation of Chile's pilchard stocks.

THE NATIONAL LEVEL

This section focuses on the implications of political changes at the national level for fisheries management. In addition, we will discuss in general how conflicting objectives (goals, aims) for fishery management pursued by various groups in society affect resource management.

There are many national-level activities that take place in a given country that might affect the management of marine resources; for example, the issuance of government decrees related to agrarian reform as well as to fisheries, worker strikes in the mining sector as well as in the fisheries, policies toward exchange rates (encouraging or discouraging foreign investment), government nationalization of foreign investment in extractive industries (oil, copper, iron, for example) as well as in the fishing sector. The fishing sector is a subsystem embedded in a larger political and economic system. In order to understand how the fishery is managed, it is necessary to be aware of that larger context.

Competing interests can adversely affect the management and viability of a living marine resource in which these groups have an economic, social, or political stake. It is necessary to recognize that "... there are different classes of objectives - biological, economic, and social - as well as different time horizons over which objectives might be obtained" (FAO, 1979, p. 7). Each of these objectives, if followed, could lead to a different pattern of harvest and exploitation.

One of the earliest conflicts between groups over objectives related to the Peruvian fishery took place between those seeking to exploit the anchoveta and the Guano Administration Company's representatives, who saw a threat to their interests in any effort to exploit the anchoveta (e.g., Murphy, 1954; see also Kesteven, 1981).[3] The Guano Administration Company vigorously opposed any new attempts to establish a fishmeal industry. However, in the absence of scientifically-based stock assessments, there was little if any hard evidence on which to oppose the development of a potentially lucractive foreign-exchange-producing industrial fishery. In addition, there is enough uncertainty in scientific information about living marine resources that whatever the recommendations of the scientists, even foreign scientific advisers, their validity could be legitimately questioned by the entrepreneurs, fishery managers, and high ranking government officials. This makes it somewhat easier for the policymaker to give in to the pressure of the moment (political, economic or other) rather than act in accordance with the scientific advice.

Once the influence of the guano and agro-exporting elites had been overshadowed by that of the growing number of fishmeal entrepreneurs, there was little interference by government in industry operations until 1968. As one of the major Peruvian fishmeal producers commented, industry, not government, determined fishmeal production policy (Eleguera, 1964).

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[3]Guano is the excrement of anchoveta-consuming birds that inhabit the rocky barren islands along the Peruvian coast. It is a fertilizer that has been mined commercially since the 1840s and sold as an export as well as used within Peru.

Government agencies with different jurisdictions, too, established regulatory policies that tended to conflict with (and even cancel out) the policies pursued by other agencies. Tax credit policies, for example, formulated in the Finance Ministry tended to encourage expansion in fleet and processing capacity which contradicted the policies of those whose objective was the prevention of overfishing by the reduction of over-capacity. According to Hammergren (1981, p. 323), "fishing policy was not coordinated by any single office but was shaped by the diverse (and often conflicting) interests of the various agencies involved, agencies for which fishing policy was not a primary concern...." This was still true even after a separate Ministry of Fisheries was established in 1970 by President Velasco, who removed fishing from the jurisdiction of the Ministry of Agriculture, which at that time was preoccupied with land reform programs.

The national government is often the source of broad policy guidelines that establish ground rules by which various economic sectors in society, including the fisheries, might operate. To date, there have been a dozen changes of government in Peru since 1939. On several of these occasions new governments pursued policies affecting the fishery that were major (if not drastic) changes from those of their predecessors, especially in 1948, 1968, 1975, and 1980.

Changes in government can also directly affect high ranking personnel in ministeries related to the management of fisheries. For example, during the Belaunde administration [1963-68] there were seven holders of the Minister of Finance portfolio in slightly more than five years (four in the last year alone). This is an important consideration for why the same resources in the same country may have been managed in different ways.

How changes in national government come about may also be an important consideration for resource management (i.e., free elections or military coups). In 1945 Bustamante was elected president and attempted to maintain a "controlled economy" that discouraged exports. His experiment was ended by a military takeover of government led by General Odria whose regimes (1948-50 and 1950-56) developed conservative economic policies that opened up the Peruvian economy to direct foreign investment and market-oriented policies. Odria favored a policy of export-led development, relying on the export of traditional primary resources such as copper, silver, zinc, cotton, coffee, and sugar. His changes in economic policies came at what, in retrospect, seems to have been the right moment: the Californian sardine fishery was on the edge of collapse (international aspect), and there was an increase in demand for fishmeal as poultry feed (international aspect). Thus, the takeover by the conservative military government in 1947 set the stage for the eventual development of the anchoveta fishery.

The 1968 military coup by General Velasco brought to power a leftist military group bent on taking control of the economy away from the established elites. In 1970, the new government appointed General Tantalean as head of the newly established Ministry of Fisheries. Hammergren, (1981, p. 333) commented on one of the effects of the establishment of this new ministry on resource management:

> From the Ministry's side several factors encouraged a larger catch. One was the inexperience of the new administrators and the inevitable disorganization following the creation of the new Ministry which meant that the catch was not closely monitored and that decision-makers were less sensitive than they would be later to the problems of resource conservation... A second factor encouraging large catches was the desire of the new Fisheries Ministry and its Minister to demonstrate their competence.

In the relatively short period of time that the fishing industry underwent very rapid growth (1952 to 1972), Peruvian governments and their policies (and ideological underpinnings) changed frequently, making difficult the formulation, let alone enforcement, of a long-term, acceptable, "wise" management strategy for the coastal fisheries. This is an aspect that is seldom addressed explicitly at technical meetings on fisheries management, in part because of the separation of science and politics in many countries.

THE INDIVIDUAL LEVEL

Individuals have different, often conflicting, perceptions of events that take place around them and those perceptions become their reality. While they may not prove to be accurate reflections of reality, the actions taken based on them will be real, as will be the consequences of those actions. Three important considerations that relate to fisheries management at this level are (a) one's view of society's relationship to

nature, (b) one's view of the renewability of living marine resources, and (c) ideological perspectives.

(a) Man-Nature Relationship

There are many conflicting views about what the relationship between man and nature should be. Two major views emerge: man-over-nature and man-in-harmony-with nature. Most leaders in developed as well as in developing countries tend to pursue policies of development that are manifestations of the man-over-nature belief.

A central theme of the man-over-nature view is that nature is or should be subordinate to mankind. It is man's obligation to devise ways to surmount natural obstacles in the path of human activities. One way to do this is through reliance on technology; the replacement of cotton nets with nylon ones, the use of purse seiners, power blocks, vacuum pumps, echo sounders, and so forth. Each of these in its own way, enables fishermen to outmaneuver fish. The fish, of course, do not have the capability to outmaneuver these new technological applications. Thus, while the shoaling of fish reduces the effectiveness of natural predators (Murphy, 1977, p. 285), it has made the fishermen's catch techniques more efficient.

The man-in-harmony-with-nature view is based on the belief that there are limits to exploitation of the natural environment and that those limits must be respected. In the absence of restraint, resources being overexploited will ultimately disappear. Supporters of this view tend to advocate the application of appropriate, as opposed to high, technology. Believers in either of the two contending views tend to oppose the other view.

The perceptions held by the various individuals or groups of individuals in a society are not equally influential in the policymaking process. The beliefs that national leaders have about the relationship of man to nature constitute the dominant ideological perspective in the political system at a given point in time. Perceptions held by other groups in society can be considered subordinate. Changes of national leaders or of administrative personnel in relevant government agencies can bring about a change in dominant ideology.

With respect to resource exploitation, Peru's history has been one of rapid, almost sequential, development of several of its natural resources. At different periods of time during the past century, each one of these ventures could have been characterized as a boom-to-bust phenomenon.

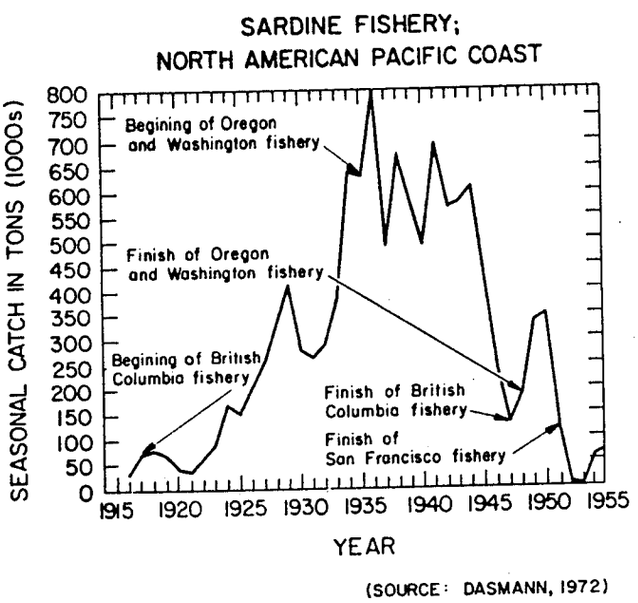
The anchoveta fishery was the latest resource to be exploited by Peruvians. Fearing a rapid growth of the fishmeal industry, as noted earlier, the Guano Administration Company hired an American scientist (Murphy, 1954) to assess the potential impact of a commercial anchoveta fishery on the guano birds' food supply, also the anchoveta. He explained his belief when he wrote that

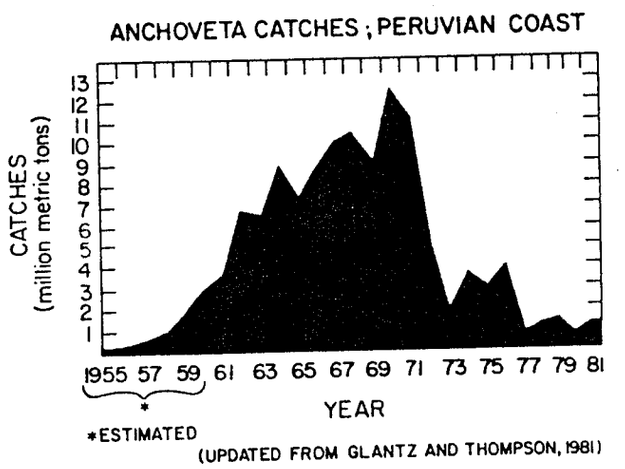
> Man ... is capable of depleting any readily attacked natural resource. Unlike a guano bird, man has no automatic checks and balances upon his operations... Only the slow and disastrous consequences of exhaustion and financial failure can end their campaign (pp. 226-27).

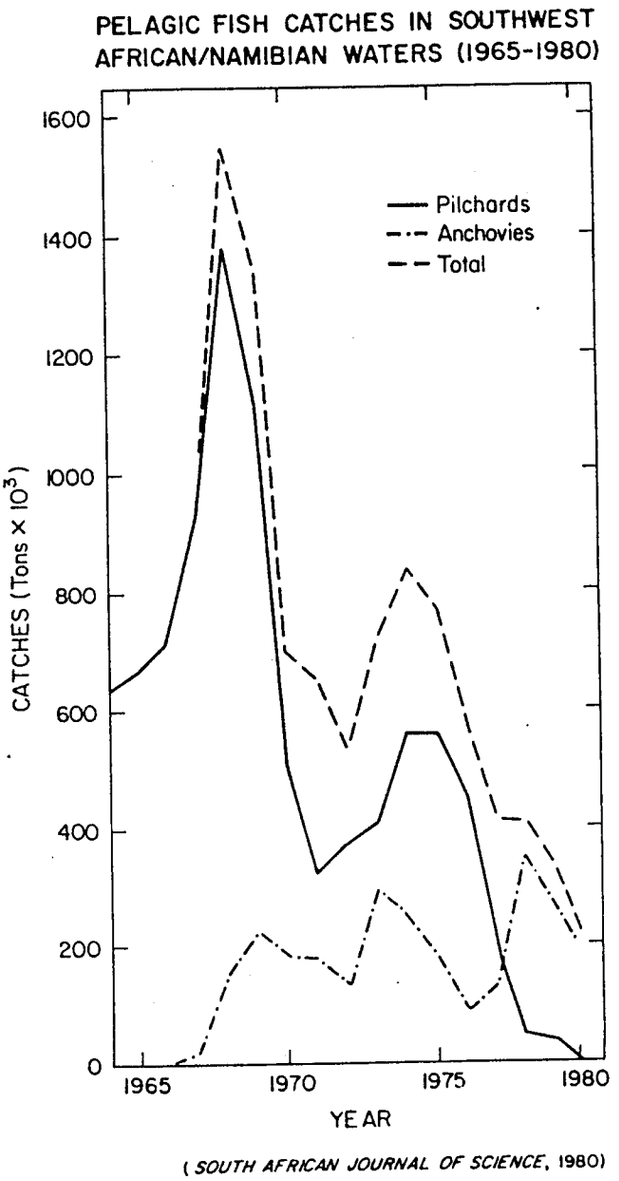
The fishery developed rapidly in the 1950s and nearly collapsed at (or by) the time of the 1972-73 El Nino, when anchoveta were being captured at rates that far exceeded the ability of scientists to assess those catches. The collapse gave everyone the uneasy feeling that the boom-to-bust phenomenon may have claimed yet another Peruvian victim.

(b) Renewability

Most observers (optimists and pessimists alike) categorize fish as a renewable resource. This perception of renewability most probably stems from the fact that fish are self-generating. The following graphs show commercial fish landings for three recent major pelagic fisheries; the Pacific sardine off the coast of California, the pilchard off the coast of Namibia (South West Africa) in the Southeast Atlantic, and the Peruvian anchoveta in the eastern Equatorial Pacific.







As the graphs suggest, each fishery collapsed or nearly did so. Interestingly, for each of these assessments of collapse or near collapse, there have emerged opposing schools of thought. Some observers suggest overfishing as the factor that led to the collapse (but may have different views about why the other two fisheries collapsed). In the absence of heavy fishing pressures, they contend, the fish population would probably have been able to cope with its fluctuating physical environment.

Other observers, however, contend with equal conviction, and often with equally convincing scientific information, that the collapse of the fish population was the result of changes in environmental variables and that while overfishing may have been implicated, the environmental factors set the stage for and were the major cause of the demise. Would it then be valid to assume that fish populations in specific regions can appear or disappear regardless of the intervention of man? Might fish populations of a particular kind, in a specific region, and during a specified period of time, be considered nonrenewable resources? Perhaps, if under unpredictable adverse conditions they can disappear, pelagic fisheries should be realistically treated as nonrenewable resources.

To the extent that the history of the three pelagic fisheries in three separate parts of the world might serve as examples of exploitation of such resources in other coastal areas, might it not be prudent to build the probable demise of the fishery into the planning of the development of a similar national fishery? By building in the consideration that pelagic species that take on a commercial value tend to collapse, fisheries managers may decide to develop the infrastructure to support that fishery at a lower level, knowing that if (or when) the collapse comes, the dislocations (unemploy-

ment, loss of foreign exchange, etc.) it precipitates will be at a much lower level than might have been the case had the resource been treated as unlimited.

Those who favored the development of a commercial fishery for Peru argued that the anchoveta existed in great abundance and for all practical purposes were limitless. By the mid 1960s, however, there was a realization that, while the resource was abundant, it was not limitless. Even in the period following the signs of limitations to exploitation, those involved in the fishery continued to be optimistic about the future availability of the resource. Much of this optimism appears to have stemmed from wishful thinking and was not based on scientific facts. "'The anchovetas are returning,' said a Peruvian last month, crossing himself for luck" (Downer, 1980).

(c) Ideological perspectives

Opposing ideologies exist and that existence must be accepted even if the contents of a particular ideology are not. Observers with differing ideological perspectives assess interactions between different groups and nations in profoundly different ways. For example, while one observer might note that foreign investment in a fishmeal processing factory was designed to yield profits for both the national and the foreign entrepreneurs, another might describe the same activity as exploitation of a developing country by a developed country.

CONCLUSIONS

It is all too easy to blame nature, especially climate, for the impacts of such anomalies; however, closer investigation usually uncovers societal factors that interacted with the climate-related anomaly to worsen the expected impacts. This case study shows the importance of investigating the societal factors that interact with climate-related anomalies such as El Niño events so that the impacts that climate-related factors have on society can more accurately be distinguished from those that are due to decisions by policymakers. While we may be unable to do anything to thwart natural phenomena such as El Niño events, we may be able to mitigate, or adapt to, their impacts on society.

The Peruvian case study was chosen to highlight these societal factors because it has been prominent in the scientific and popular fisheries literature since the middle of the 1950s. In addition, the parallels in the management of shoaling pelagic fisheries (notably between the Peruvian anchoveta fishery, the Californian pacific sardine fishery, and the South West African pilchard fishery) strongly suggest that they are worthy of additional comparative research. Such comparisons (e.g., Parrish et al., 1983), especially in the absence of perfect information about any one fishery, can offer a source of new insights for fisheries managers as well as for political and economic development decisionmakers--provided that the strengths and weaknesses of the particular comparisons being made are explicitly identified.

Finally, the use of comparisons between different fisheries based on similar but geographically distinct species (or even the same fisheries at different periods of time) can be an extremely useful approach to developing an understanding of how and why coastal living marine resources are managed as they are.

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