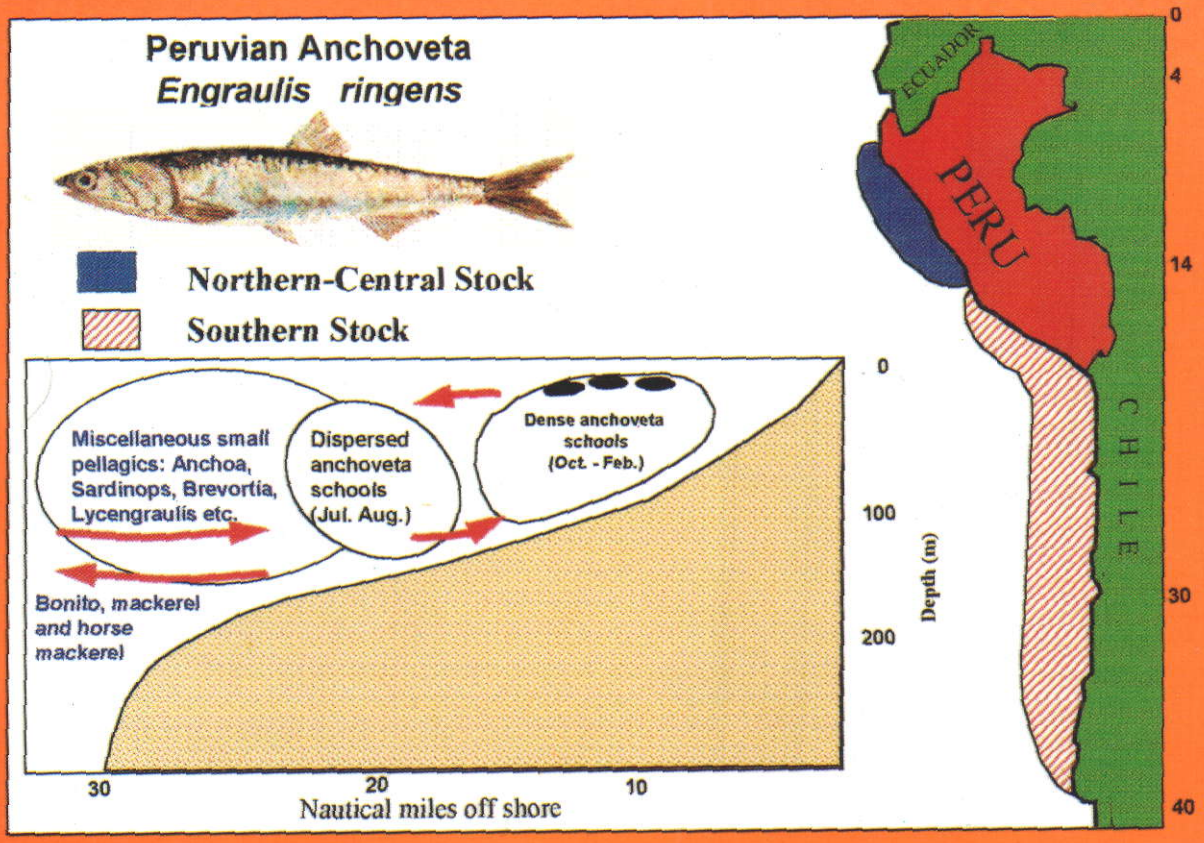
INSTITUTO DEL MAR DEL PERU
IMARPE

ASIA PACIFIC ECONOMIC COOPERATION **APEC**
7th FISHERIES WORKING GROUP MEETING
SANTIAGO, CHILE
MAY 28 - JUN 2, 1996

PERUVIAN FISHERIES



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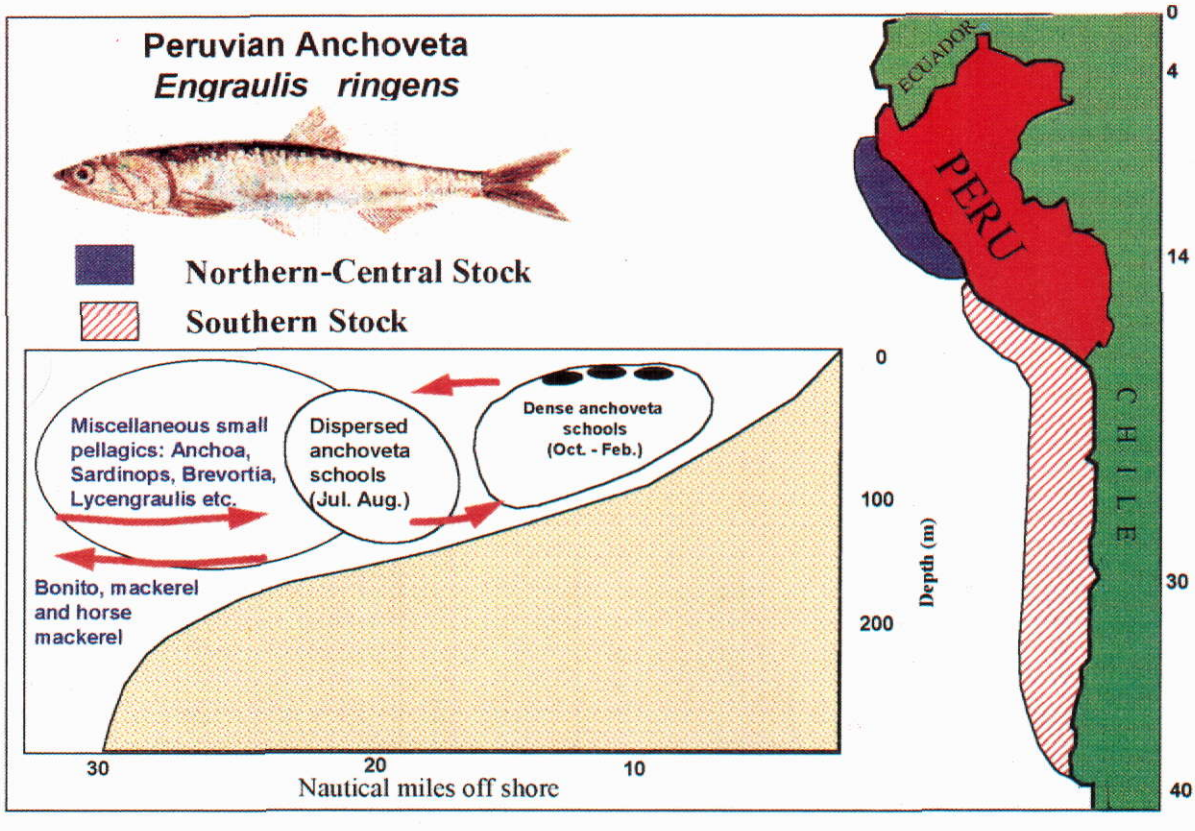
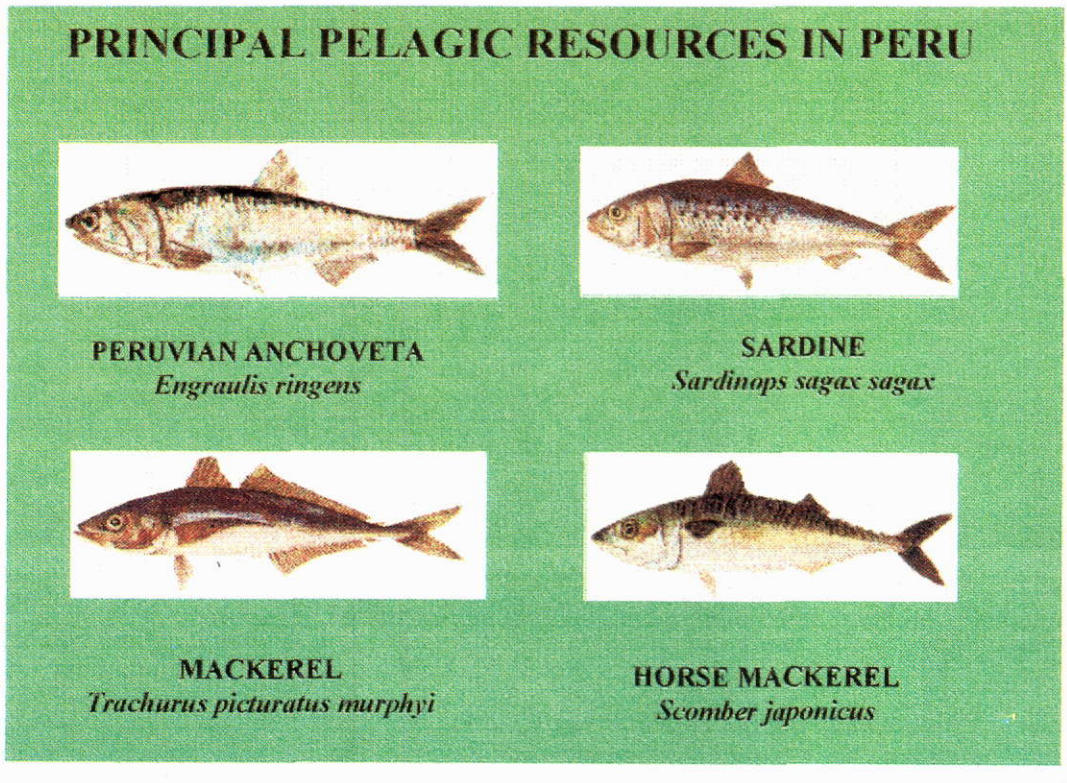


DEVELOPMENT OF PELAGIC FISHERY IN PERU

The Peruvian coast presents an extension of 3 100 km, a continental shelf of 87 200 km^2 and a 617 500 km^2 of Maritime Domain (until 200 nautical miles, off shore), characterized as one of the most rich in the world with a great natural productivity that sustains various and plentiful fishing resources.

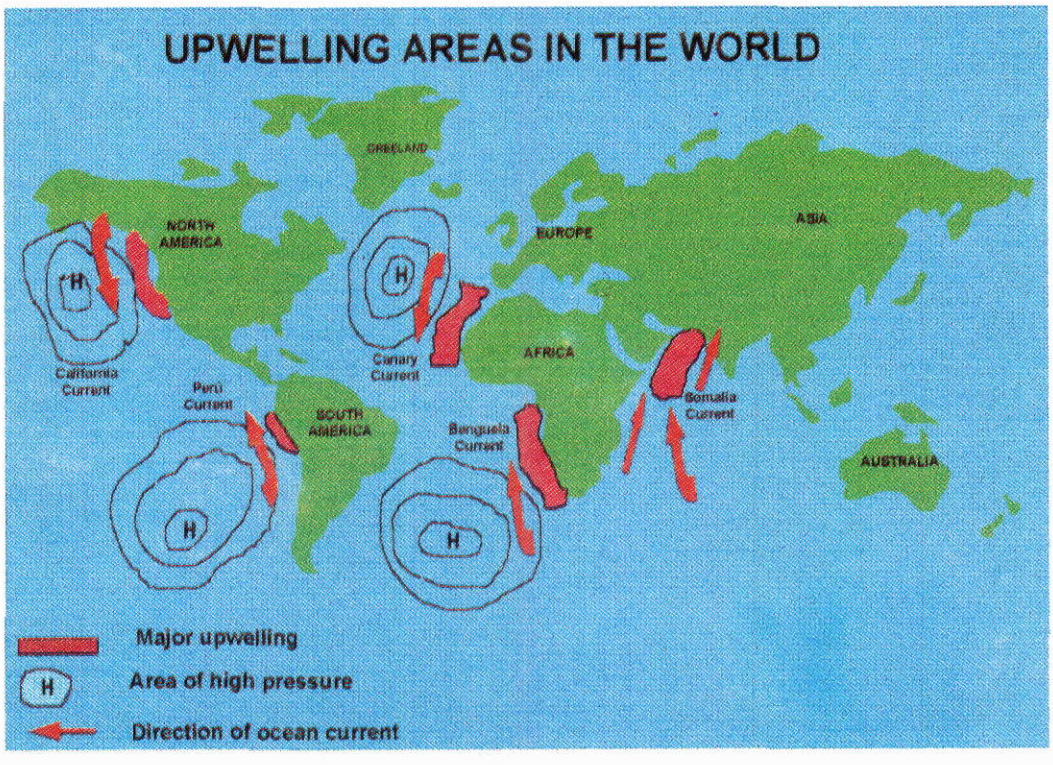
It is one of the most intense upwelling zones and is also influenced by various climatic, geological and biological factors. The fish biomass in the Peruvian sea is very high, fluctuate and diverse, based mainly on the following resources predominates:



Peruvian anchoveta and Peruvian pacific sardine account for approximately 90% of national landings and are mainly coastal

resources, while mackerel and horse mackerel are present in areas off the coast, especially the mackerel that exceeds the 200 miles of our Maritime Domain.

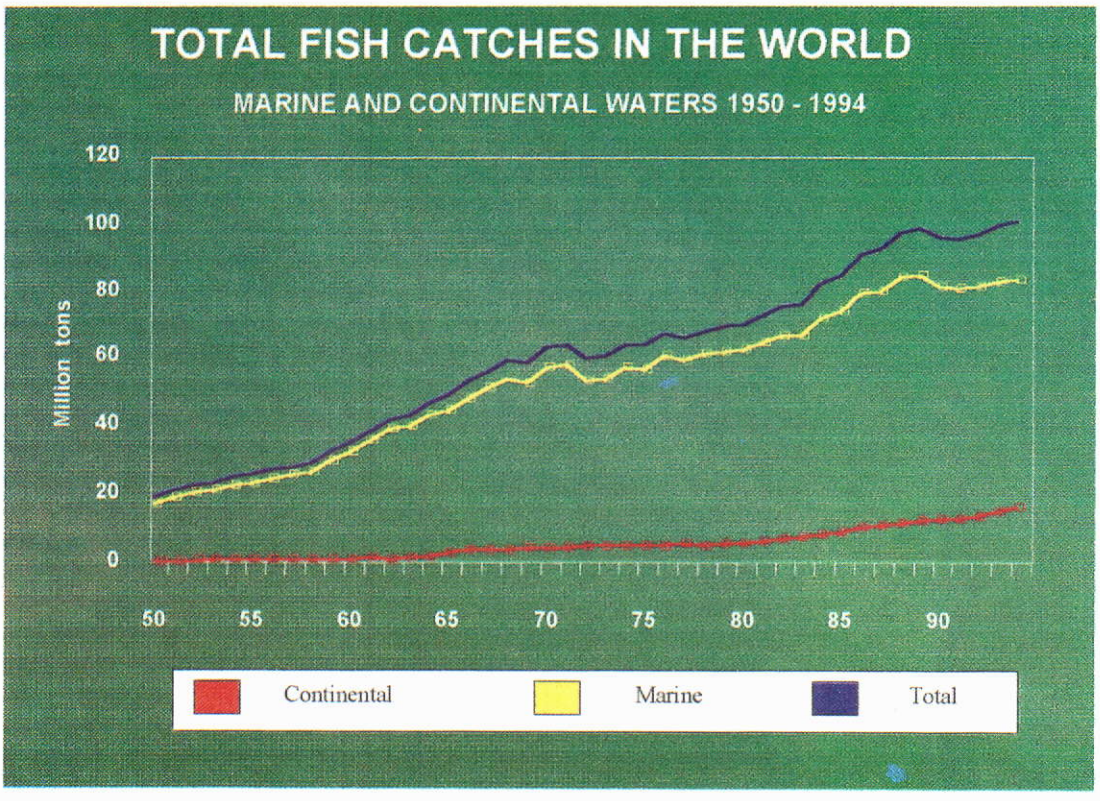
The ecological system of the peruvian sea is located in a highly dynamic area with frequent environmental changes, that generate fluctuations in recruitment and other biological-population parameters, as well as distribution, behavior and migration patterns.



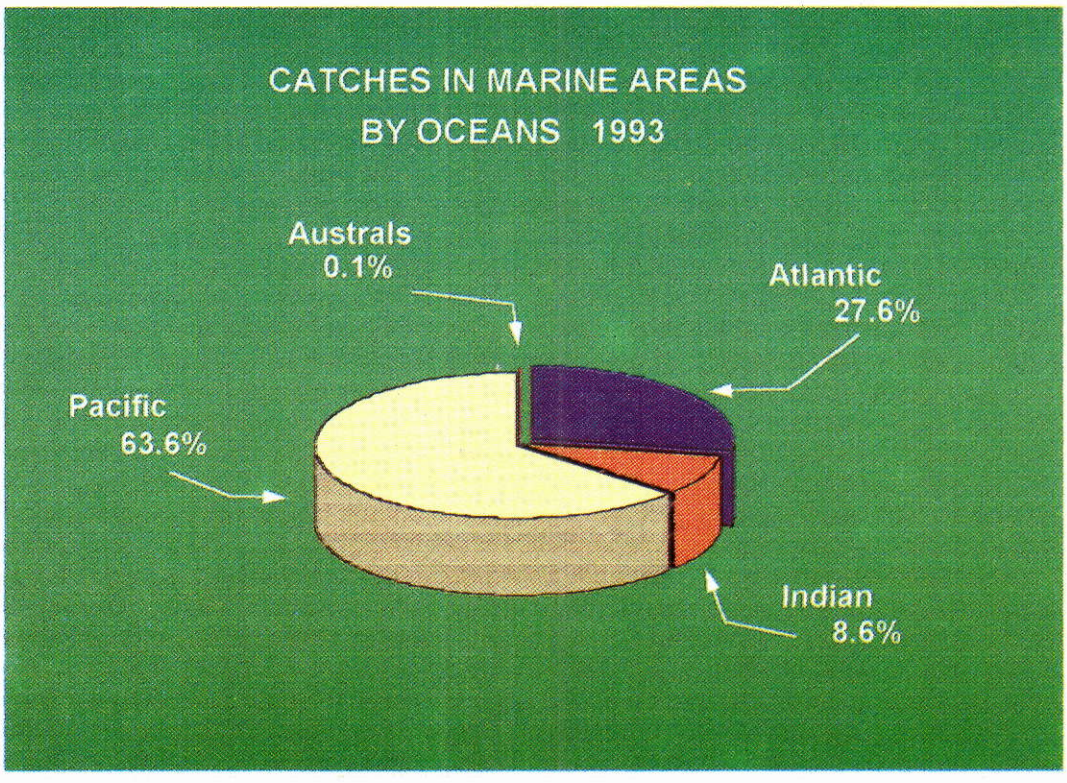
Rich nutrients waters upwells in the eastern boundaries of all continents where cold currents are present, due to the effect of constant winds over the sea surface, creating the main upwelling areas. As we can see, this occures in Benguela and Canarias currents in the Atlantic, Somalia in the Indic Ocean, California and Peru currents in the Pacific Ocean.

These upwelling areas presents similar pelagic species composition.

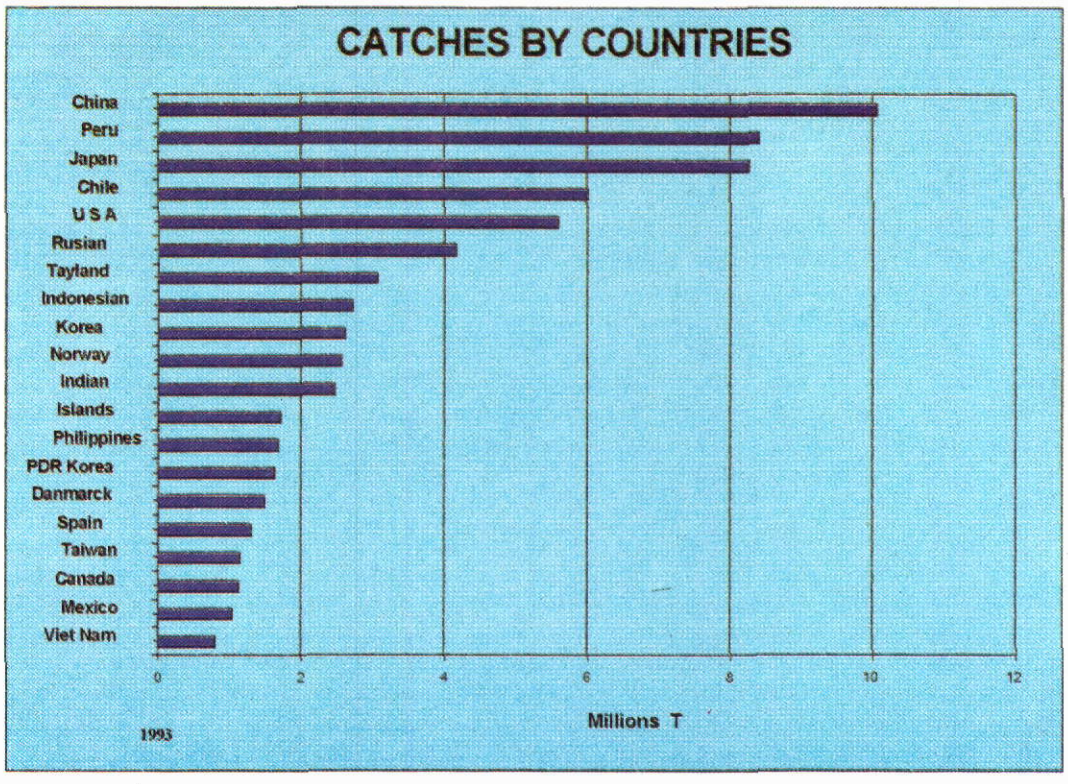
WORLD FISHERY OVERVIEW



In the global context, we can observe that total fish production has attained a stable level during the 90's, indicating that we are reaching the maximun production that the oceans can support. In 1994 the total reached was 103 million tons. The slight catch increments during recent years are mainly due to the contribution of continental fishery, aquaculture and the increment of the Peruvian Anchoveta fishery.



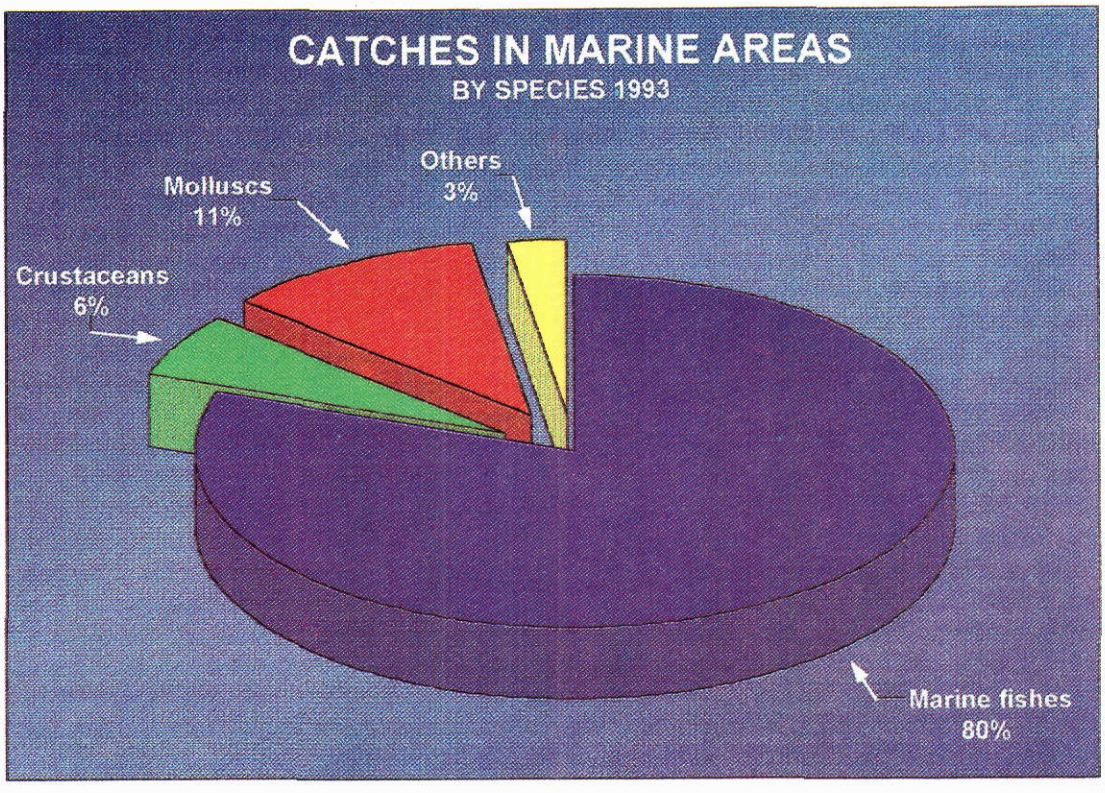
We can also observe that Pacific Ocean has the best performance yielding 64% of marine resources, followed by Atlantic Ocean with 28%, Indic with 9% and southern seas with 0,1%.



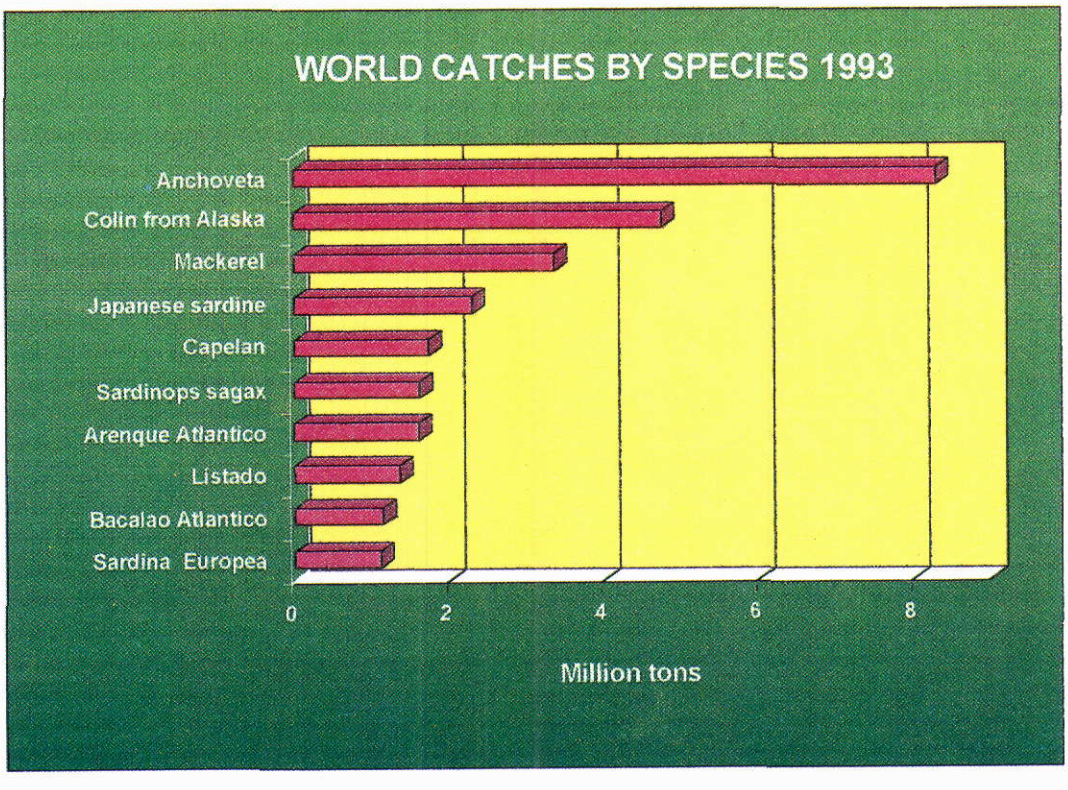
In a worldwide context, Peru was placed second with 8 410 000 tons, accounting for 10% of the total (84 262 000 tons), as reported by FAO in 1993 in the issue titled "World status of fishery and aquaculture".

The leadership was held by China, that caught 10 066 000 tons, and if we consider the catch in inland waters and the aquaculture production, China keeps the leadership with 17 567 907 tons.

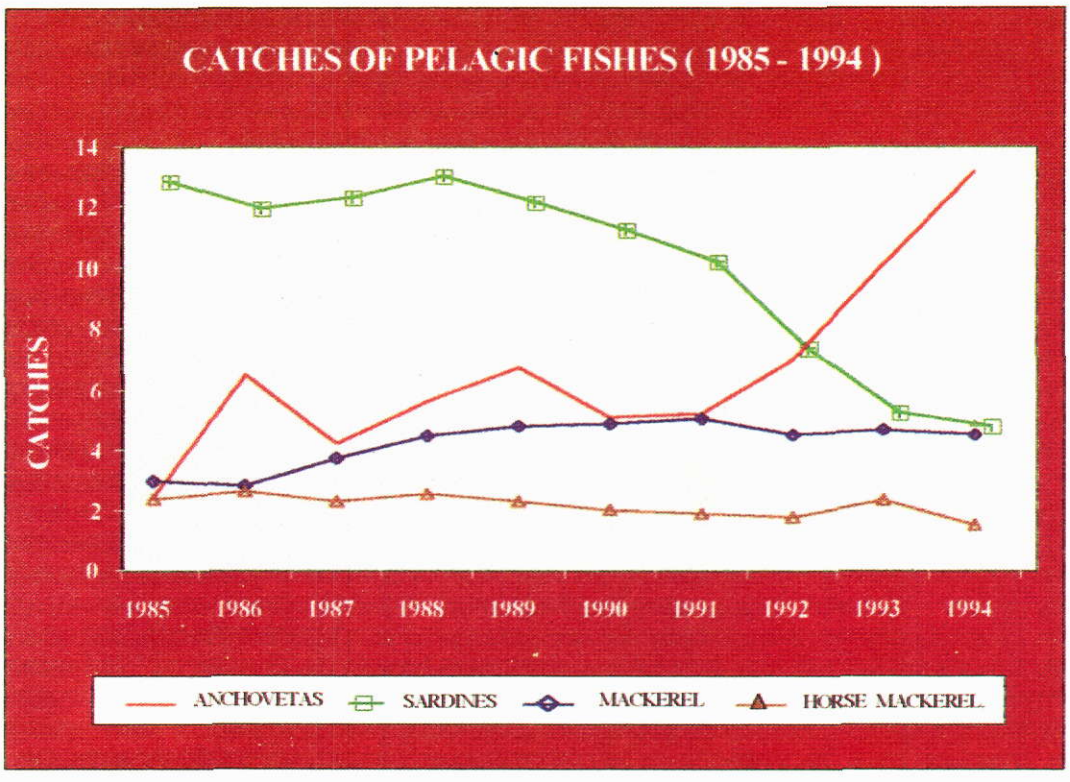
Japan and Chile were ranked third and fourth, with 8 273 000 and 6 037 985 tons, respectively.



By taxonomic groups, fish represents about 80%, molluscs 11%, crustaceans 6% and other groups 3%.

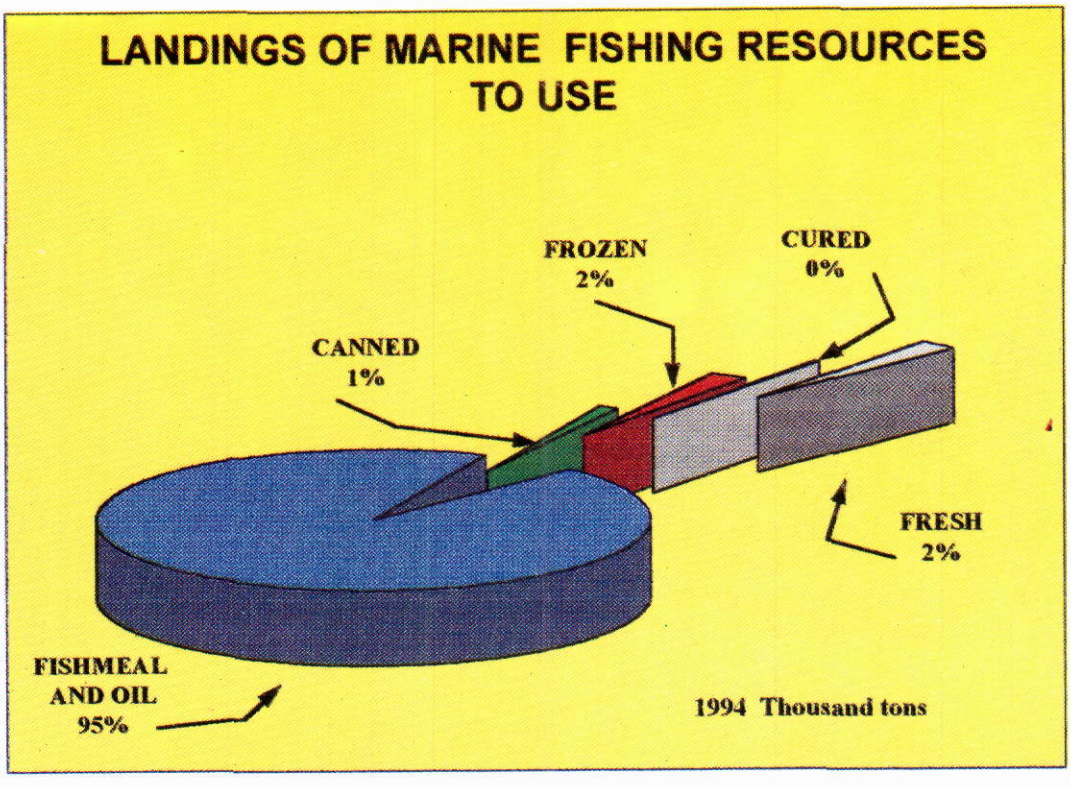


The main fish species of world catches were: Peruvian anchoveta, colin of Alaska, south jack mackerel and japanese sardine.



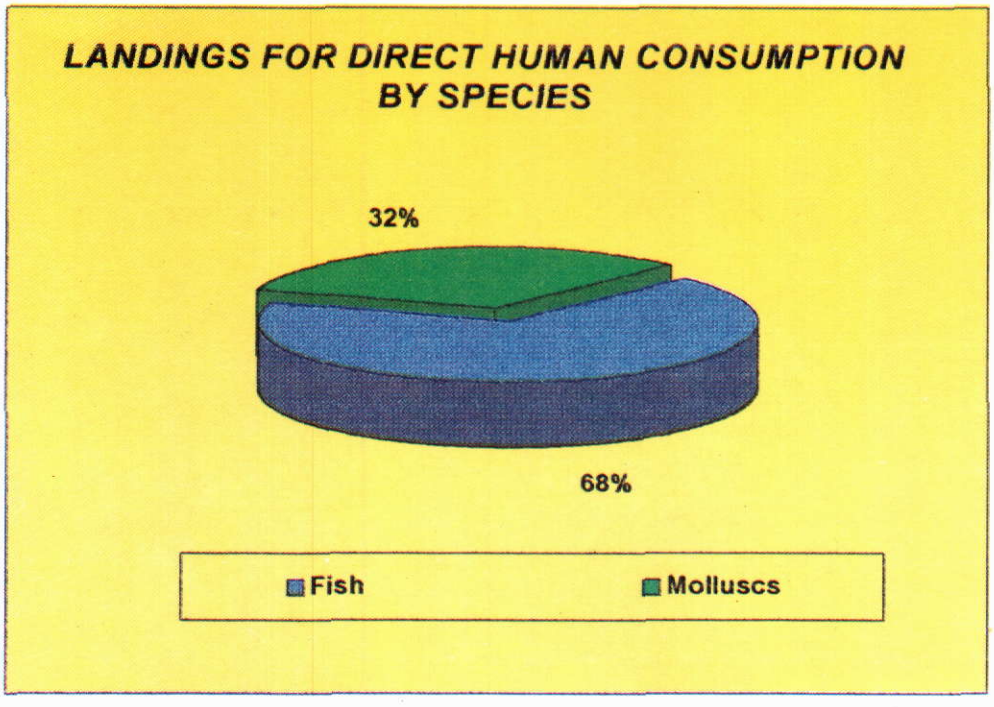
It is worth mentioning that among the top six species, we can observe three of our main pelagic species: Peruvian anchoveta, mackerel and pacific sardine.

USE AND DESTINATION OF FISHING RESOURCES

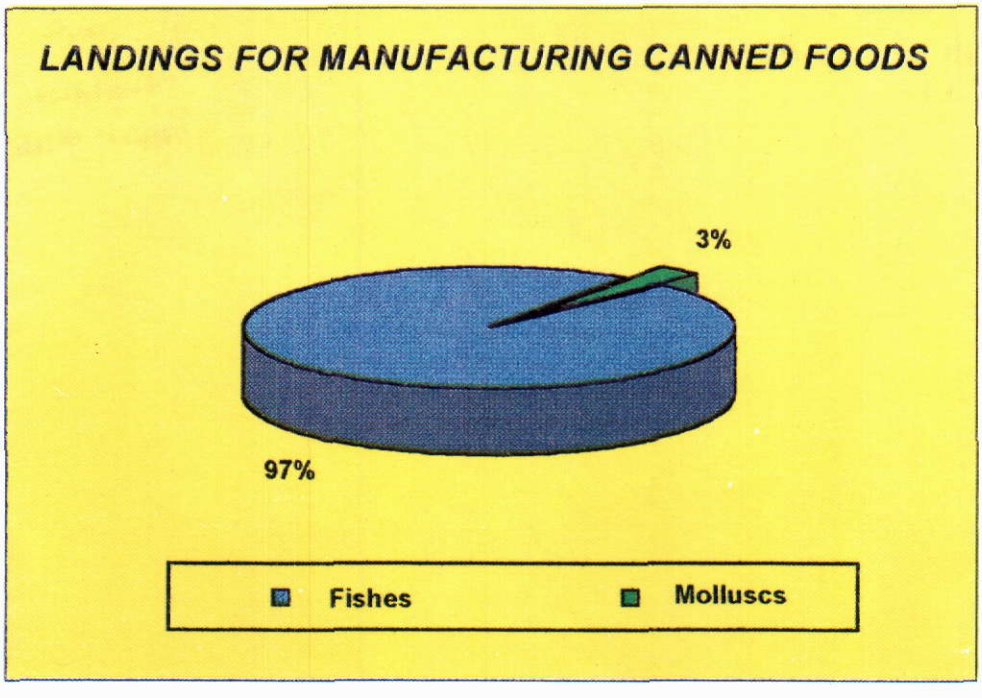


The landings of marine fishing resources mainly have an industrial usage: 95% for production of fishmeal and oil, 1% for canned food, 2% for cured products and 2% for fresh consumption.

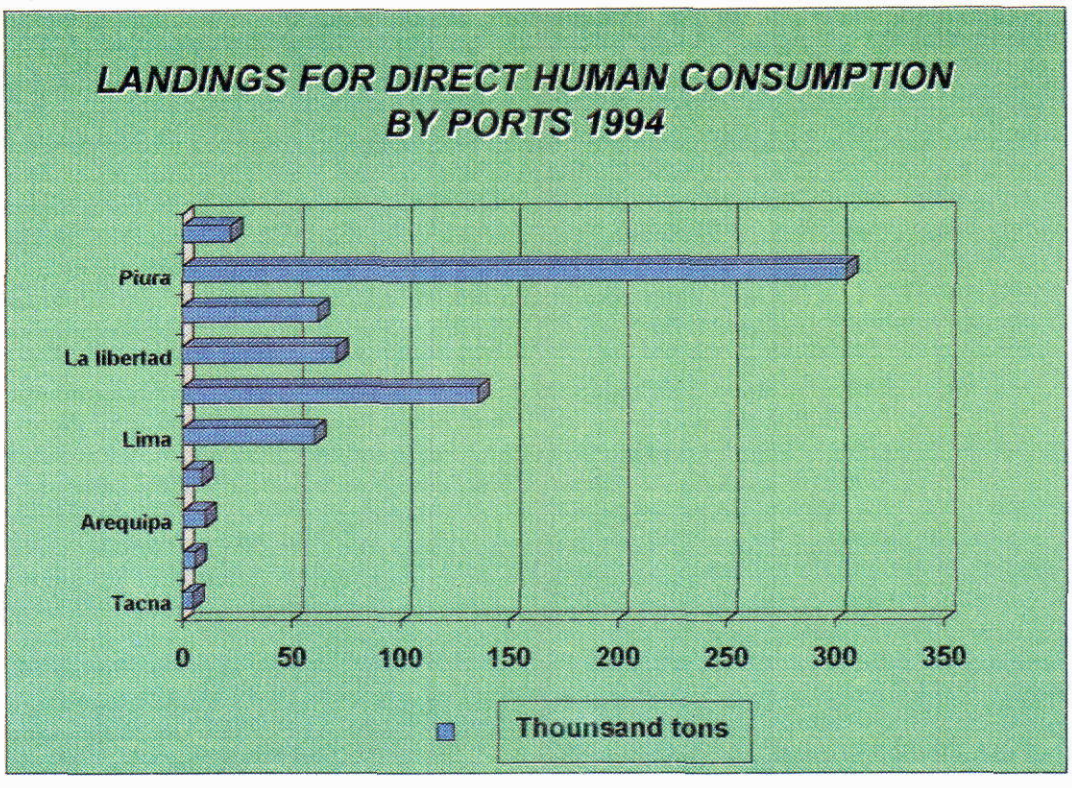
It means that only 6% is destinated to direct human consumption.



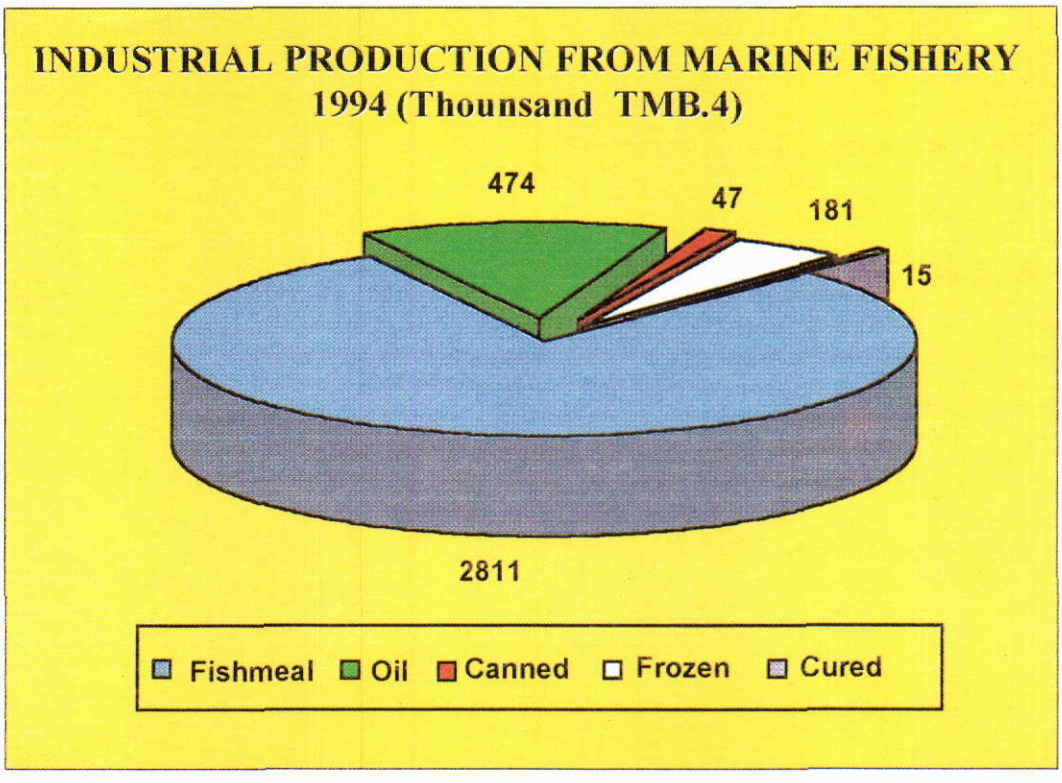
These landings for direct human consumption are mainly constituted by fishes.



Also, this taxonomic group is used for manufacturing canned foods.

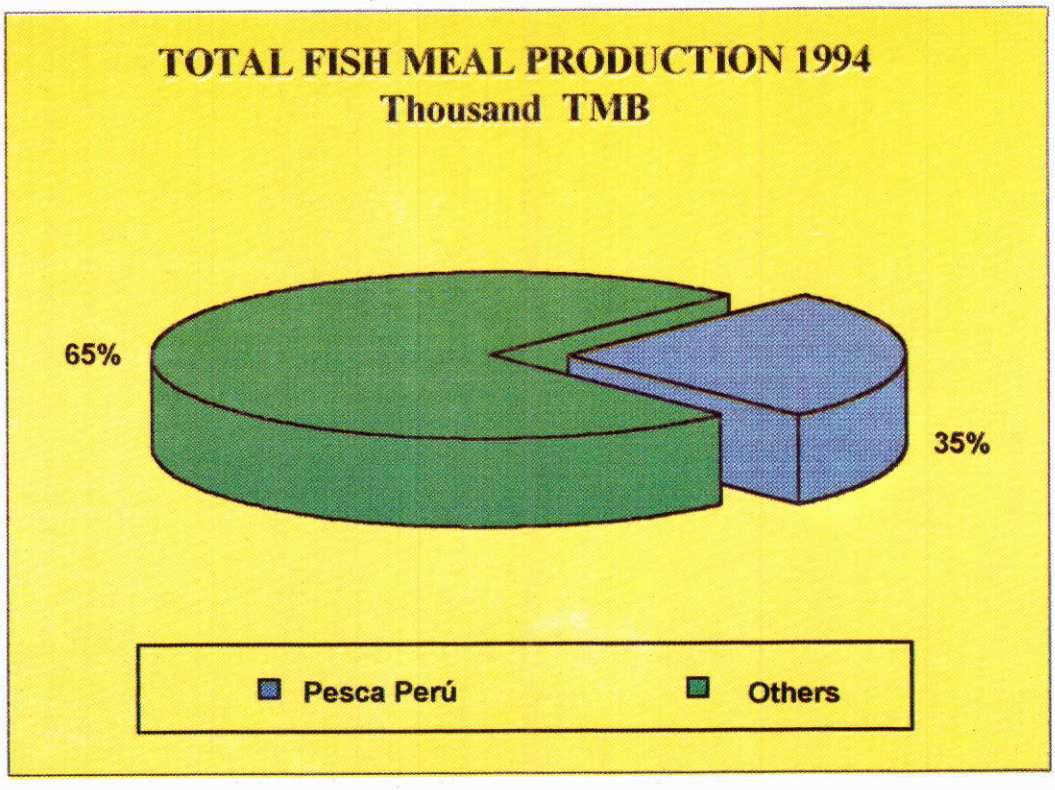


In Peru, the principal fishing ports to land fishing for human consumption are located in Piura, Ancash, La Libertad, Lambayeque and Lima.

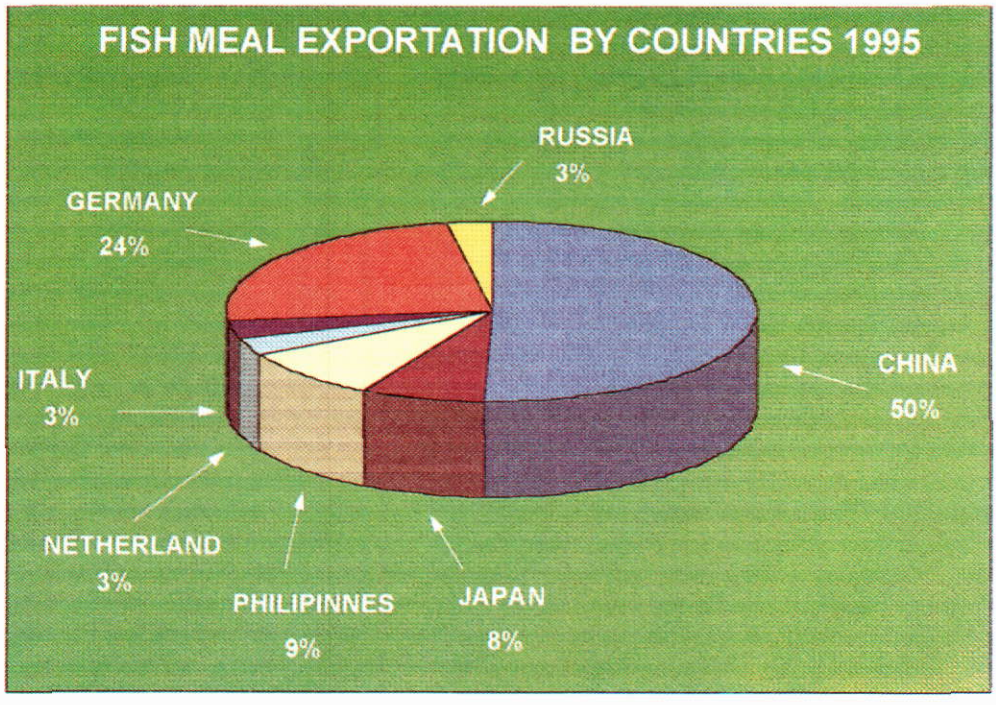


During 1994, the Industrial Production from marine fishery was distributed in the following products (quantities expressed in thousand for tons):

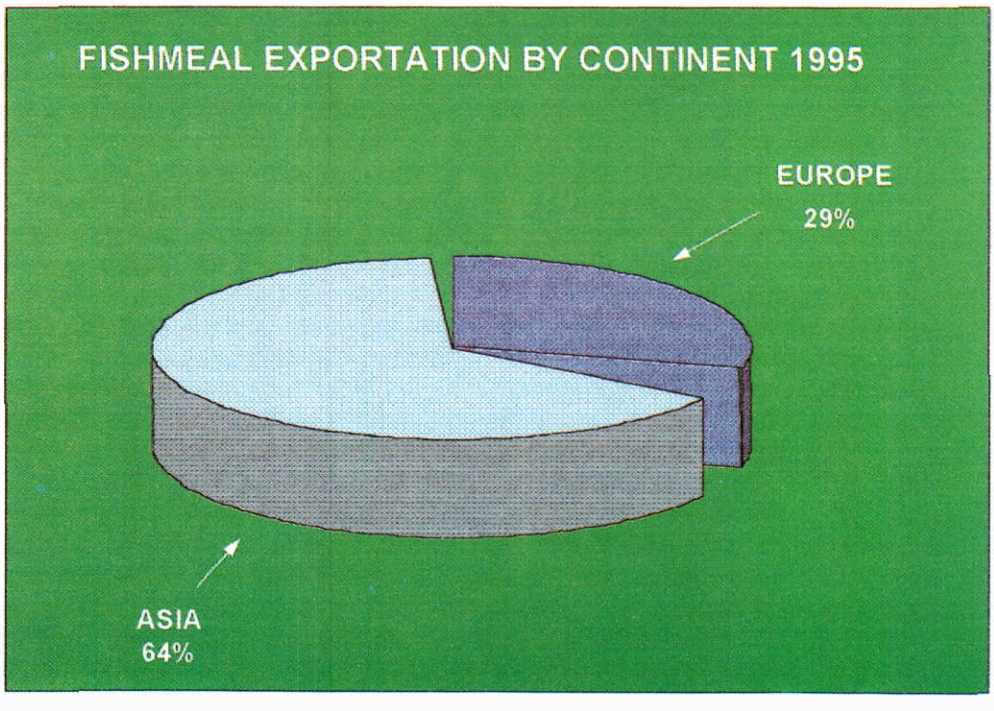
<u>From Indirect Human Consumption:</u>	
Fishmeal	2337
Oil	474
Total	2811
<u>From Direct Human Consumption</u>	
Canned	47
Frozen	181
Cured	15
Total	244
Total Production	3055



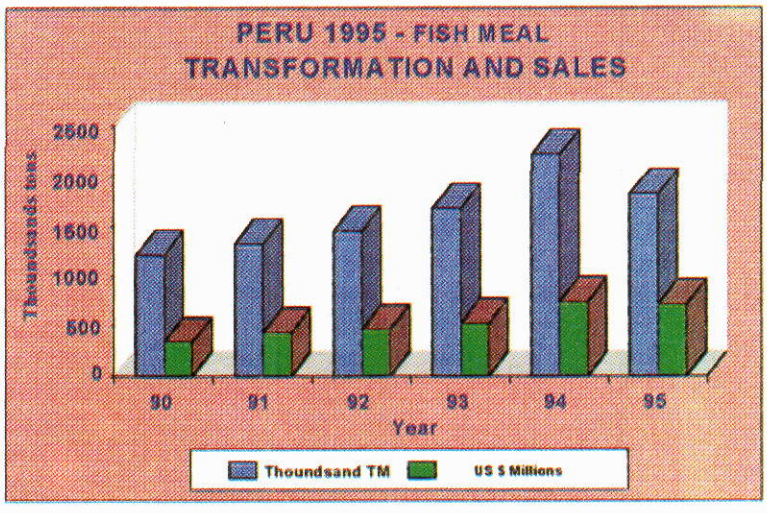
Fishmeal production of PESCA PERU, a government factory, was 598 000 tons (35% of the total) while the private sector produced 1 739 000 tons (65%).



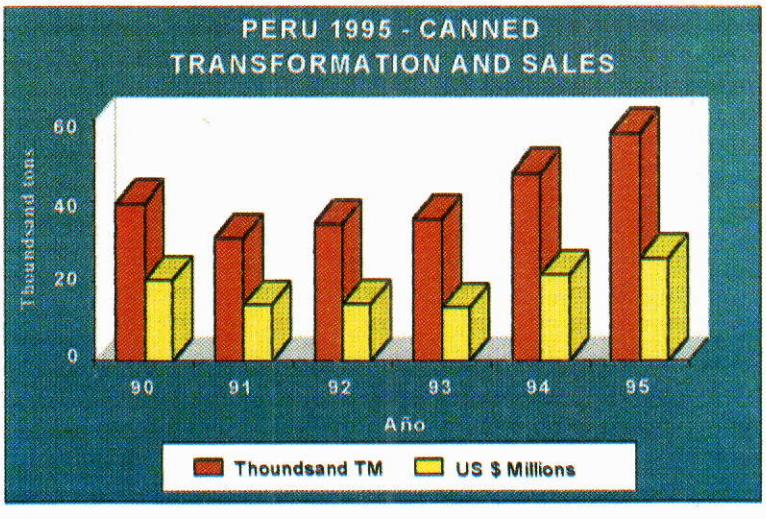
Fishmeal exports, have been addressed to China (50%), Germany (24%) Philippines (9%) and Japan (8%). Other consummers of Peruvian fishmeal are Italy, The Netherlands, and Rusia.



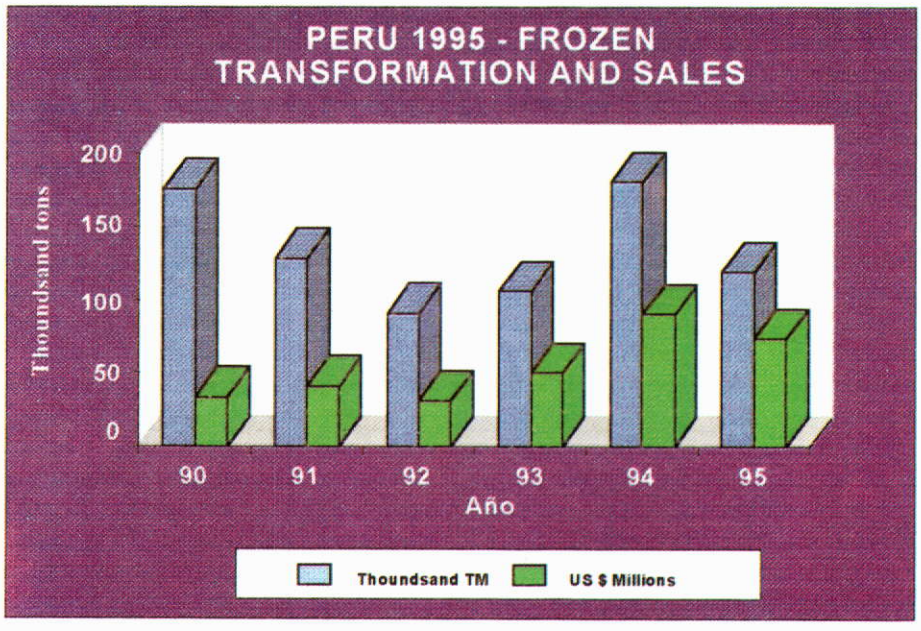
By continents, 64% was addressed to Asia and 29% to Europe.



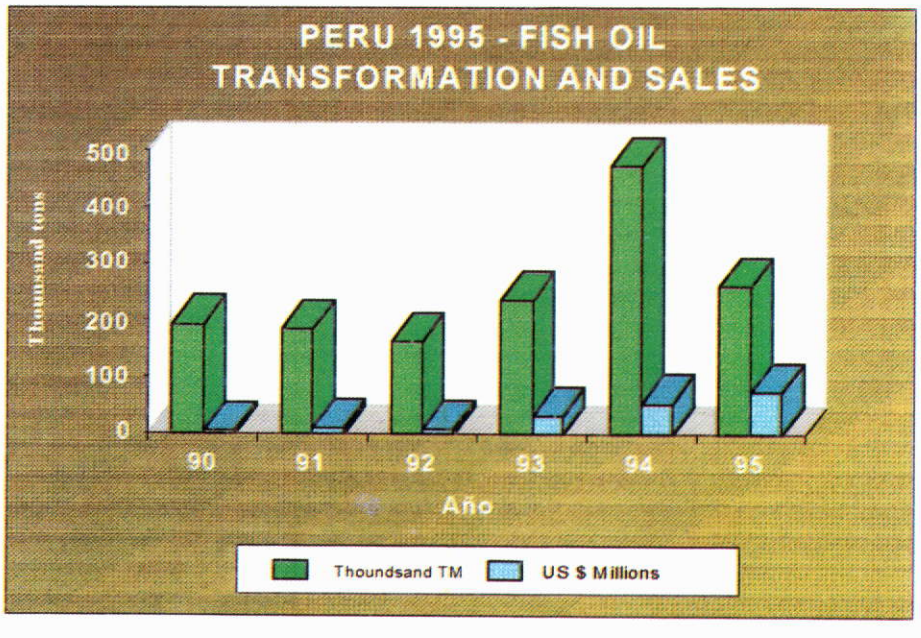
It is interesting to observe the fluctuation in fishmeal production levels and the revenues, because although production was reduced during the last year (1995), the total amount of the foreign exchange was stable due to the high prices of the fishmeal in the world market and also to a better quality of the product.



Regarding the canned item, we observe a constant growth in production since 1991; which is indicated by the increase of sales amounts.



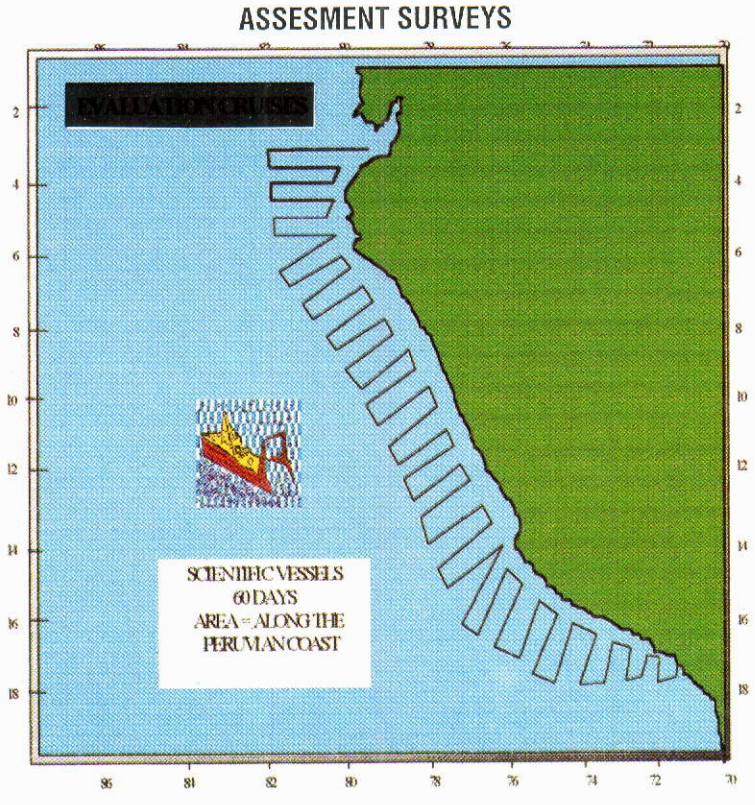
The frozen item also increased in a similar way but decreased the last year, changing the sales amount.



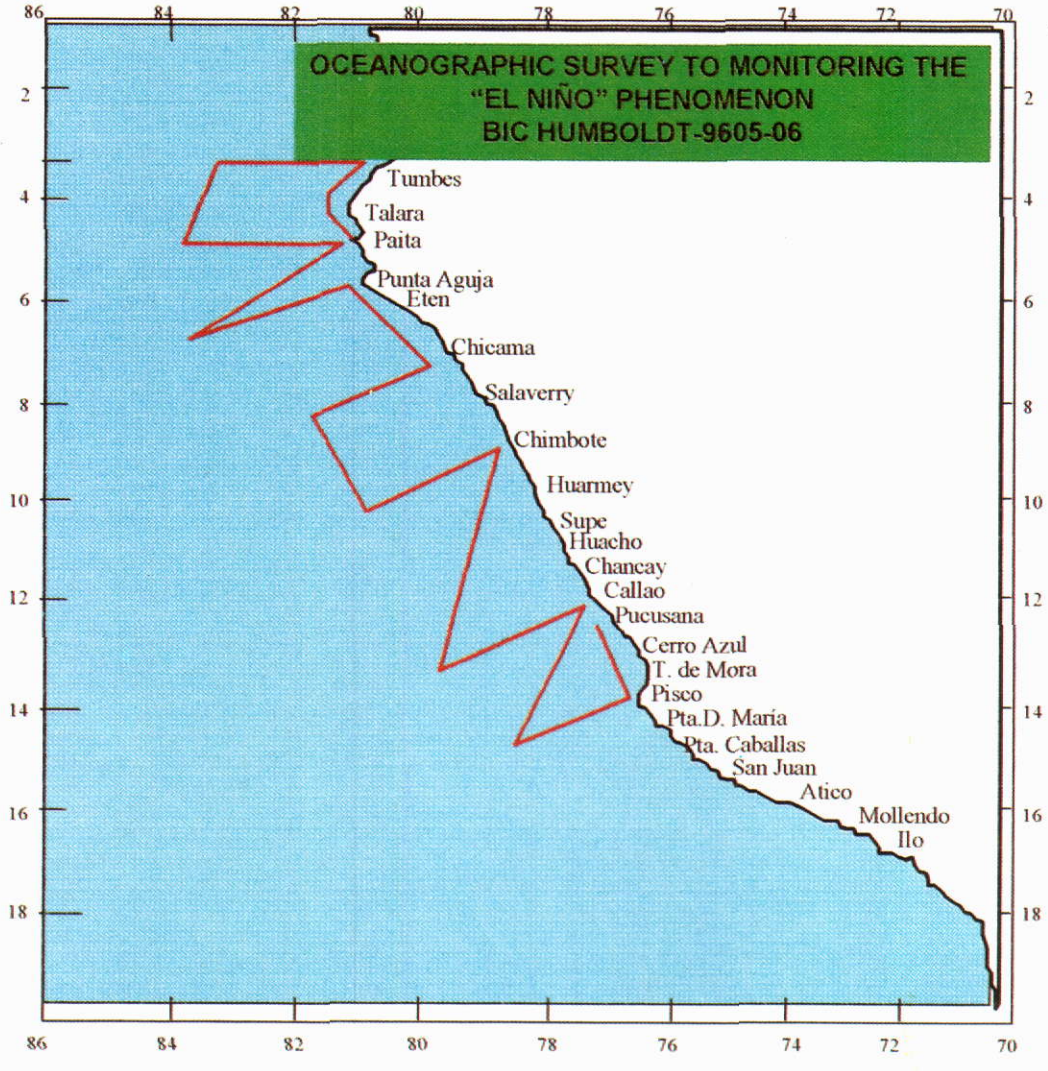
Finally, the production of fish oil shows a continuous rise having a maximun level production in 1994 and decreasing in 1995. The amounts of foreign exchange indicates a lower variation than the production.

PELAGIC RESOURCES AND THEIR FISHERY IN PERU

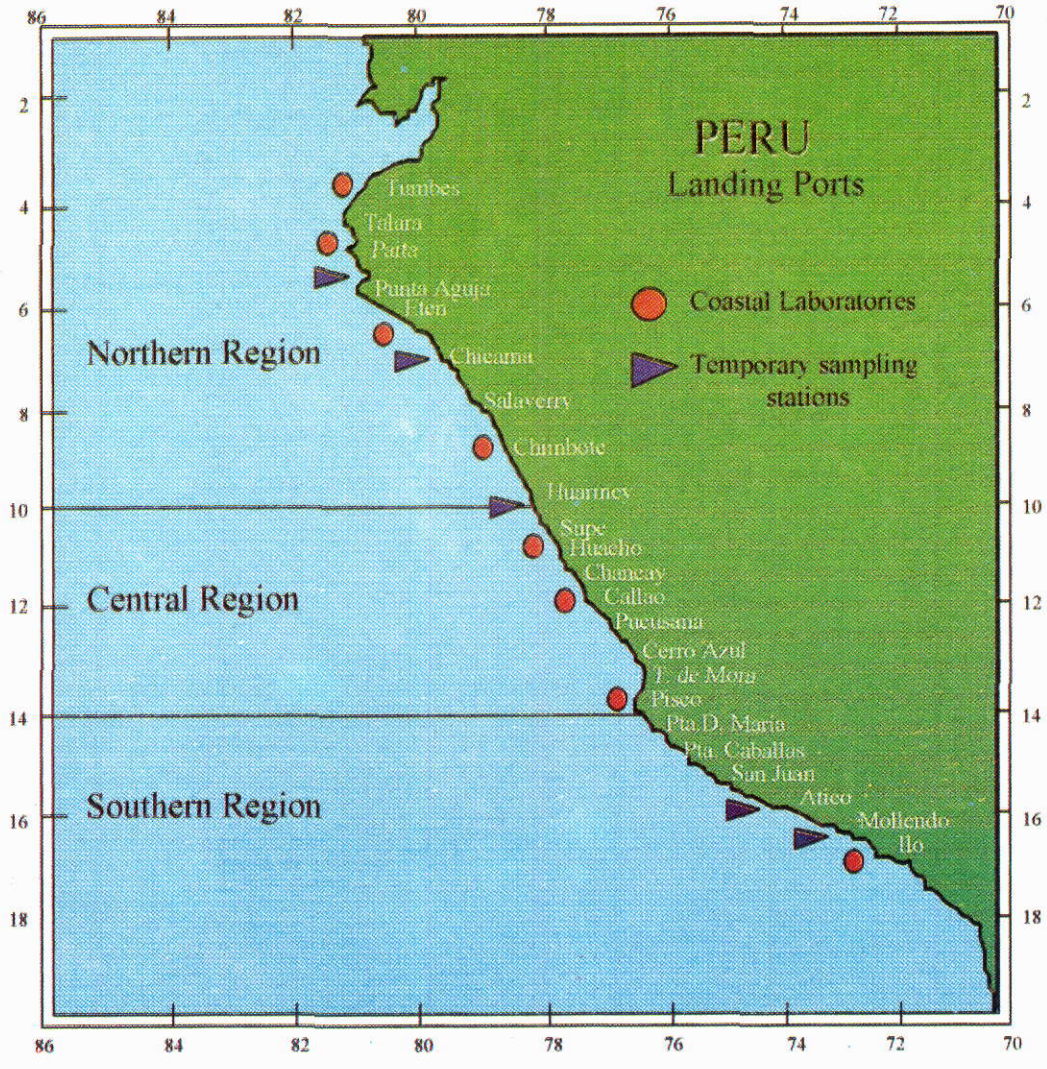
Peruvian Anchoveta and sardine are considered fully exploited resources, while mackerel and horse mackerel are underexploited.



IMARPE (Instituto del Mar del Perú, Peruvian Marine Research Institute), is the leading scientific institution for research of these pelagic fish resources, recording periodic information at sea. Acoustic surveys are conducted with research vessels (BIC SNP-1 or BIC Humboldt) along the Peruvian coast following a systematic sampling design for one or two months approximately.

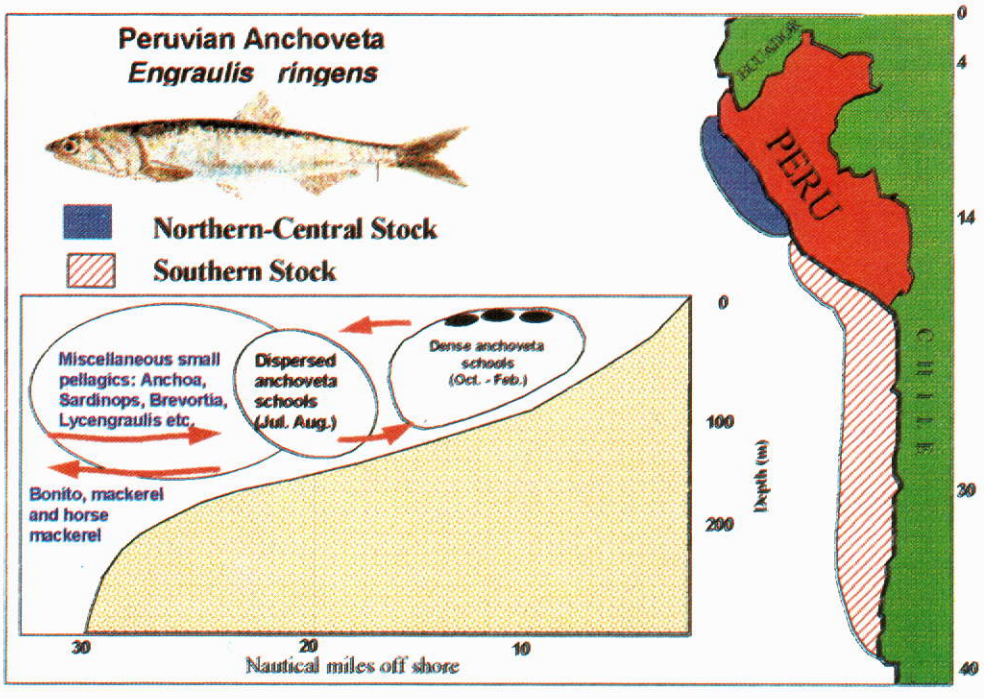


At this time, an oceanographic survey is being conducted onboard BIC Humboldt, from Callao to Puerto Pizarro (northern boundary), to monitoring the presence of the "El Niño" phenomenon.



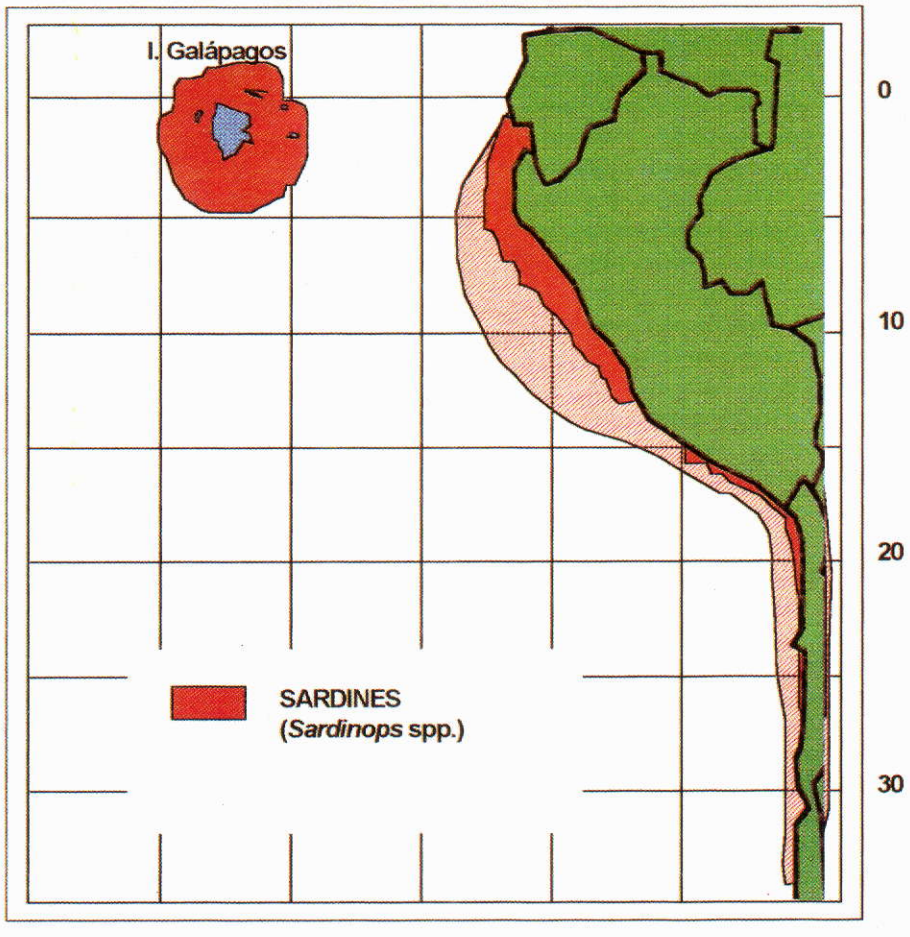
IMARPE has 8 observation stations along the coast (coastal laboratories): Tumbes, Paita, San José, Chimbote, Huacho, Callao, Pisco and Ilo, for periodic monitoring of fishery in the main ports. At the same time has 10 temporary sampling stations located at: Parachique, Chicama, Huarmey, Supe, Chancay, Pucusana, Tambo de Mora, Atico, La Planchada and Mollendo.

STOCK IDENTIFICATION AND DISTRIBUTION



The peruvian anchoveta (*Engraulis ringens*), inhabits the cold water strip of the Peruvian Current, characterized by a great renovation of nutrients in superficial layers and high biological productivity. Its distribution is mainly coastal and the best concentrations are within 50 nautical miles offshore and occasionally further away.

The geographical limits of anchoveta distribution include the Peruvian and Chilean coasts between Latitudes 03°30'S and 37°00'S. According to recent scientific literature related to stock identification on the basis of meristic, morphometric, parasitic and genetic studies, the Peruvian anchoveta has two sub-populations or substocks: the northern-central stock between Latitudes 04°00'S and 14°00'S that accounts for the larger concentrations and the southern stock between Latitude 14°01'S and the southern boundary of the Peruvian coast, that extends towards the northern part of Chile.



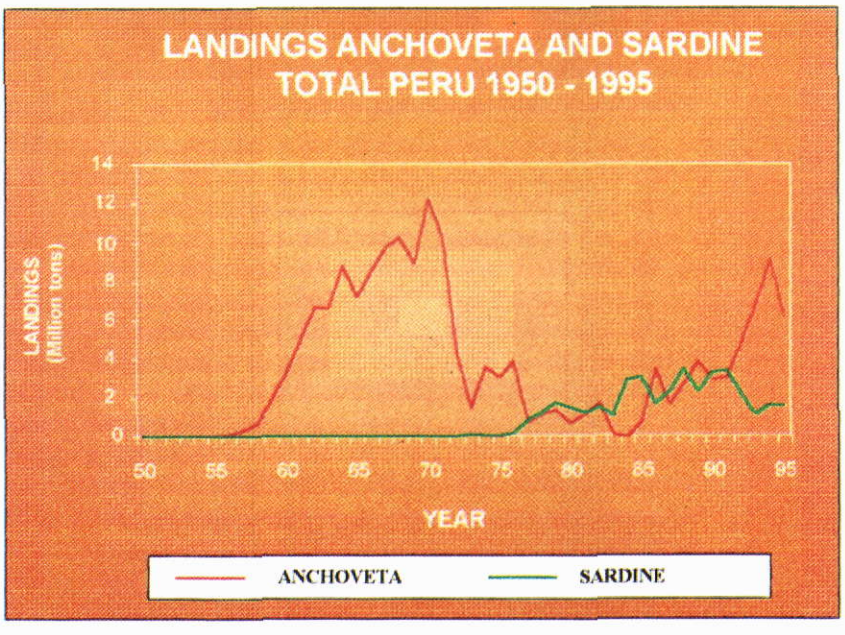
According to FAO, sardine distribution in the south-eastern Pacific extends from Ecuador (Latitude 01°39'N) to Chile (Latitude 37°00'S). In Peru its population is divided in two substocks: the first one extending from the northern border as far as Latitude 14°00'S and the second one in the southern part from Latitude 14°01'S as far as the northern coast of Chile. A third sub-stock is located around the Galapagos Islands.

The offshore distribution of sardine reaches 200 nautical miles and even exceeds such distance. This information was reported by the international fleet operating off the 200 nm of the national jurisdiction of Peru and Chile.

This scientific background is considered for fishery management purposes of anchovy and sardine resources in our sea.

PELAGIC FISHERY INDICATORS

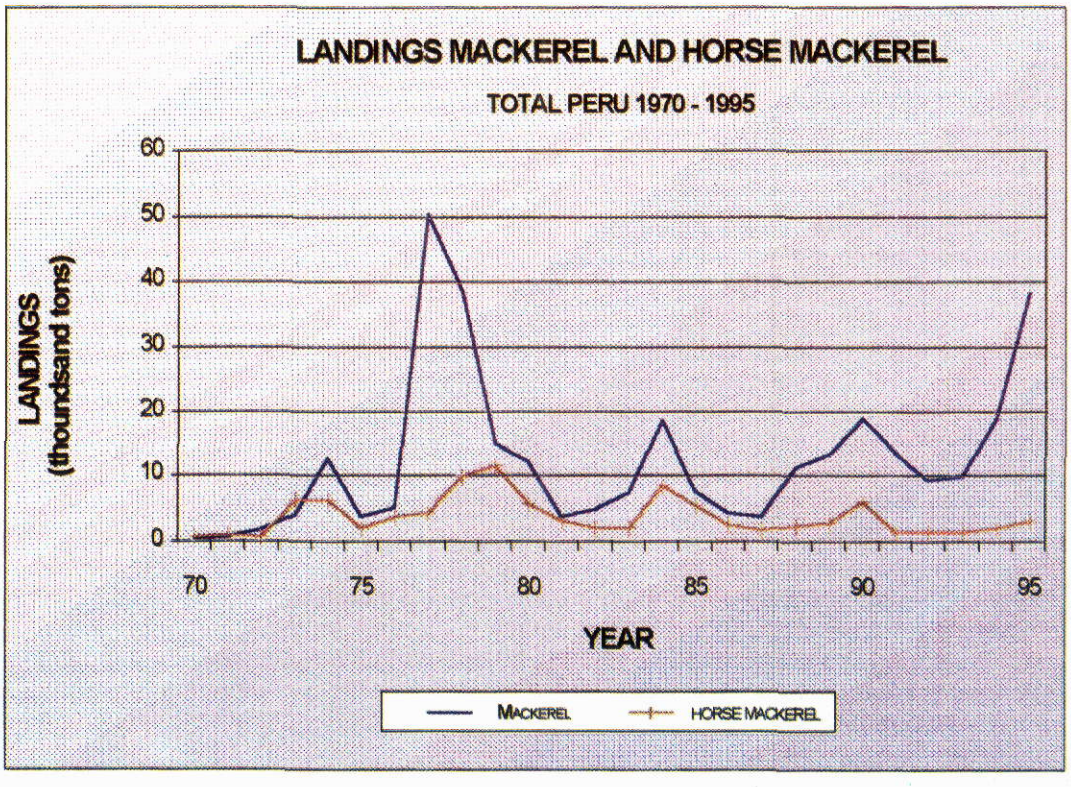
In Peru fishery dates back to pre-inca ages, since man had always recurred to sea as a food supplier.



The landings of pelagic fishery are based mainly in the catch of anchoveta and sardine, and their associated variability due to the natural environmental fluctuations.

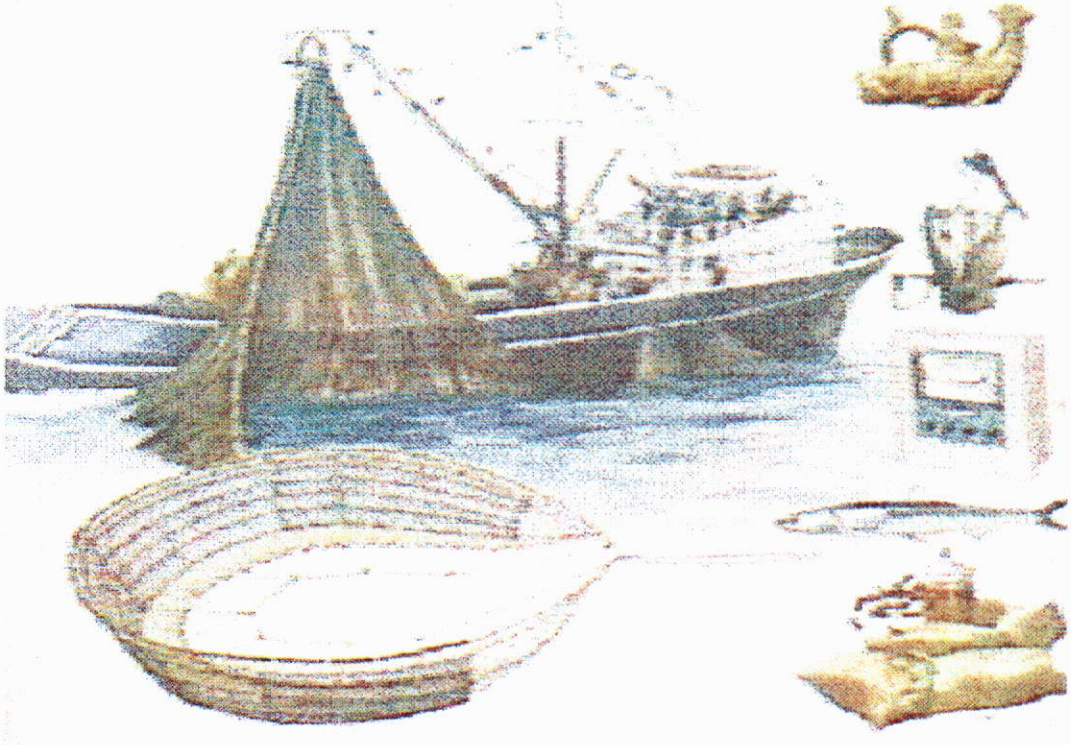
Since the mid 80's the landings have been rising at a fluctuant rate until reaching 9,17 million tons in 1994. This high figure was attained by the growth of anchoveta biomass due to a series of successful recruitments, which increased the surplus production of this resource.

Populational analysis point out that anchoveta is in a transition stage up to a higher level biomass (change in population regime). In this new stage, the surplus production (allowable catches) may vary between 5,0 and 9,5 million tons, depending on high or low recruitments.

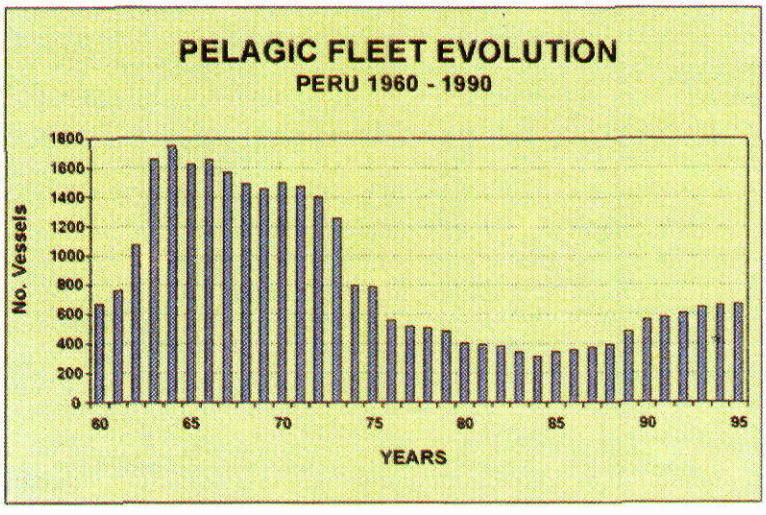


The catches of mackerel and horse mackerel have started to increase since 1973, reaching a maximum catch of 500 thousand tons in 1977. Catch fluctuations for both species have been related to the variation in the size of foreign fishing fleets. During recent years, this fishery is developed by a national purse-seiner fleet, that recorded in 1995 a top catch of mackerel close to 400 thousand tons, mainly in the northern region (Paita - Chimbote).

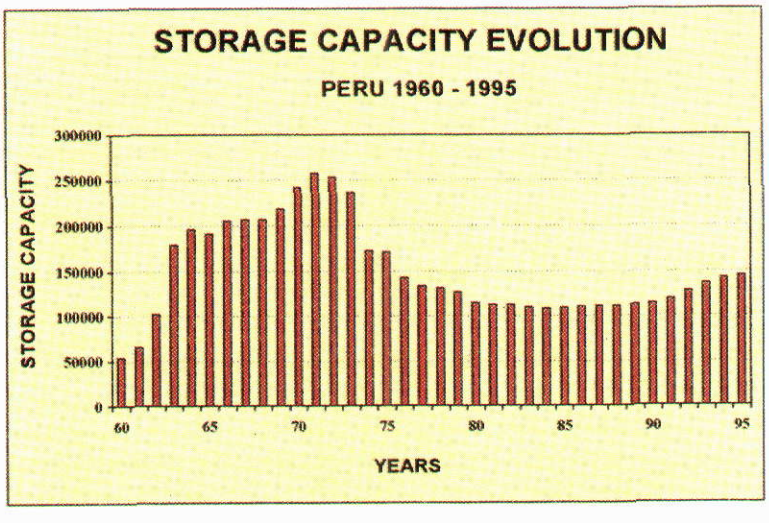
INDUSTRIAL FISHING FLEET



The fishing units for the extraction of anchovy and sardine are the traditional purse seiner vessels that use mesh openings of 13 mm ($^{1}/_{2}$ inch) for the anchovy catch and 38 mm (1 $^{1}/_{2}$ inches) for the extraction of sardine, south jack mackerel and pacific horse mackerel.

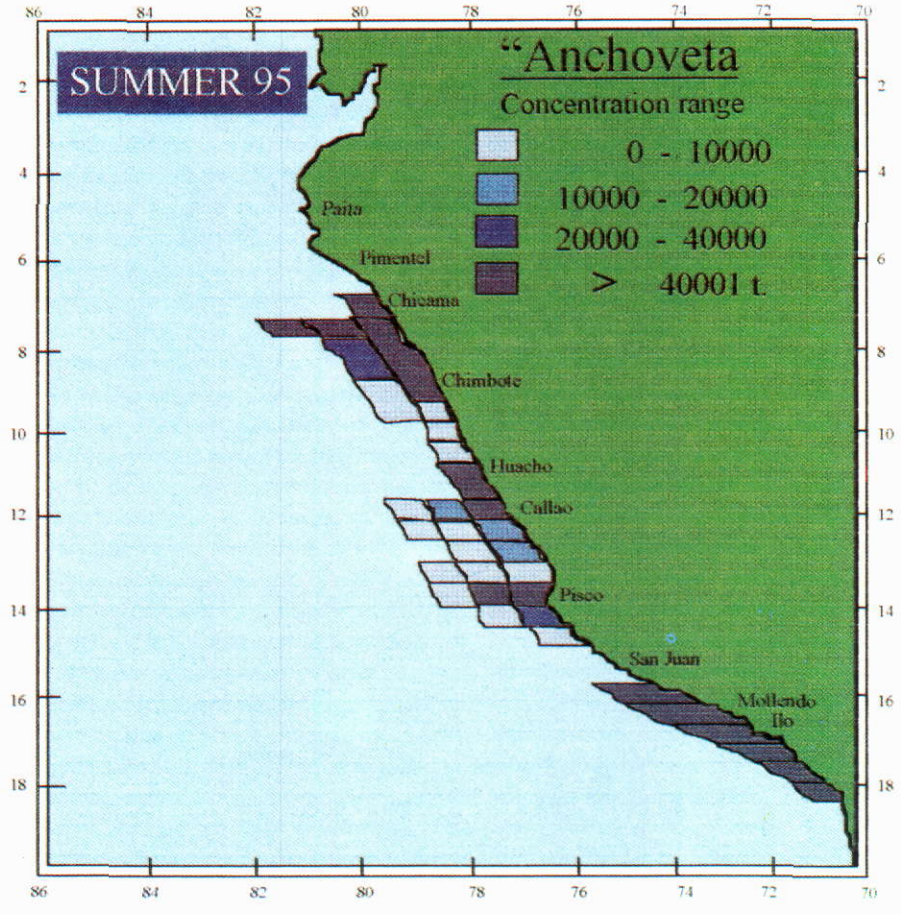


The evolution of the pelagic purse seiner fleet in the 1960-1995 period shows an irregular behavior, sub-divided in two phases: before and after 1994. In the first phase there was a outstanding growth that reached a 1 800 vessels, and in the second phase there was a considerable decrease that started to revert in 1985, with the incorporation and renovation of vessels. Actually there are approximately 664 vessels.

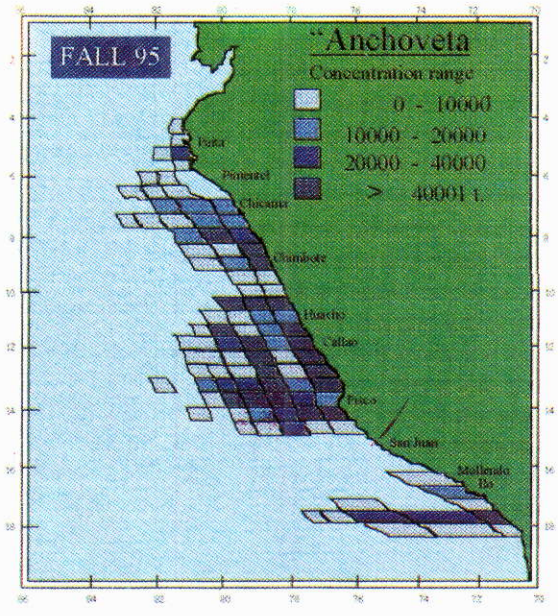


This increase in the number of vessels is also reflected in the increasing holding capacity. During the 70's it surpassed 250 thousand tons and actually it is estimated in approximately 145 thousand tons.

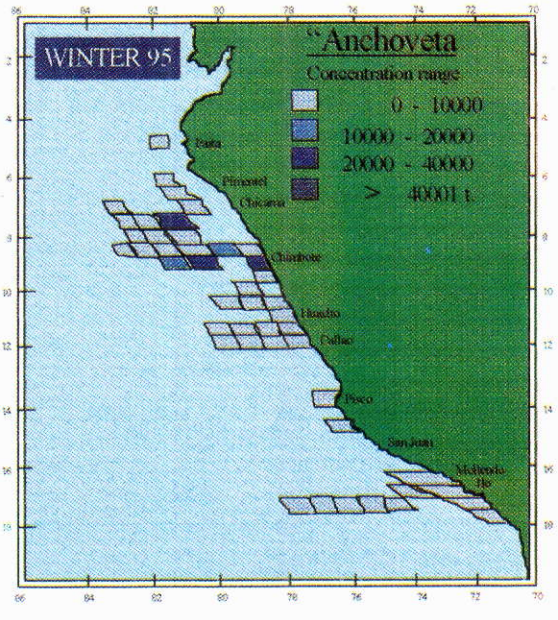
FISHING AREAS



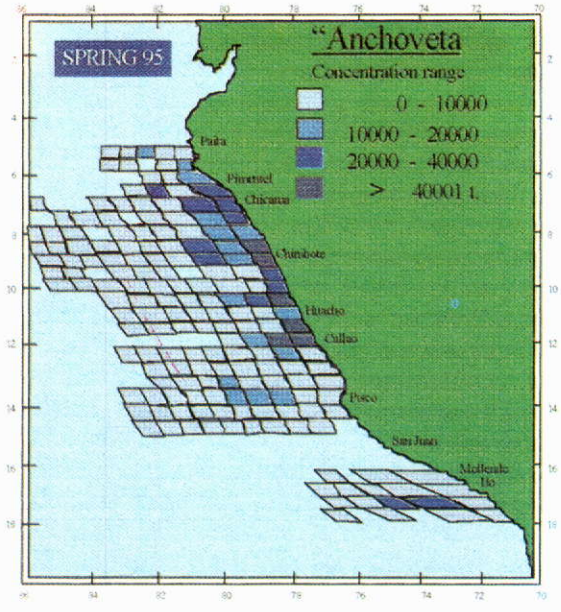
In 1995, distribution and concentration of anchovy showed a coastal behavior during the summer with the main nuclei of concentration within 10 miles off Chimbote, Huacho, Pisco and Ilo.



This distribution was extended up to 30 miles offshore during the fall, mainly in the central region between Callao and Pisco,



During the winter time the distribution was wide and spread along the entire coast.

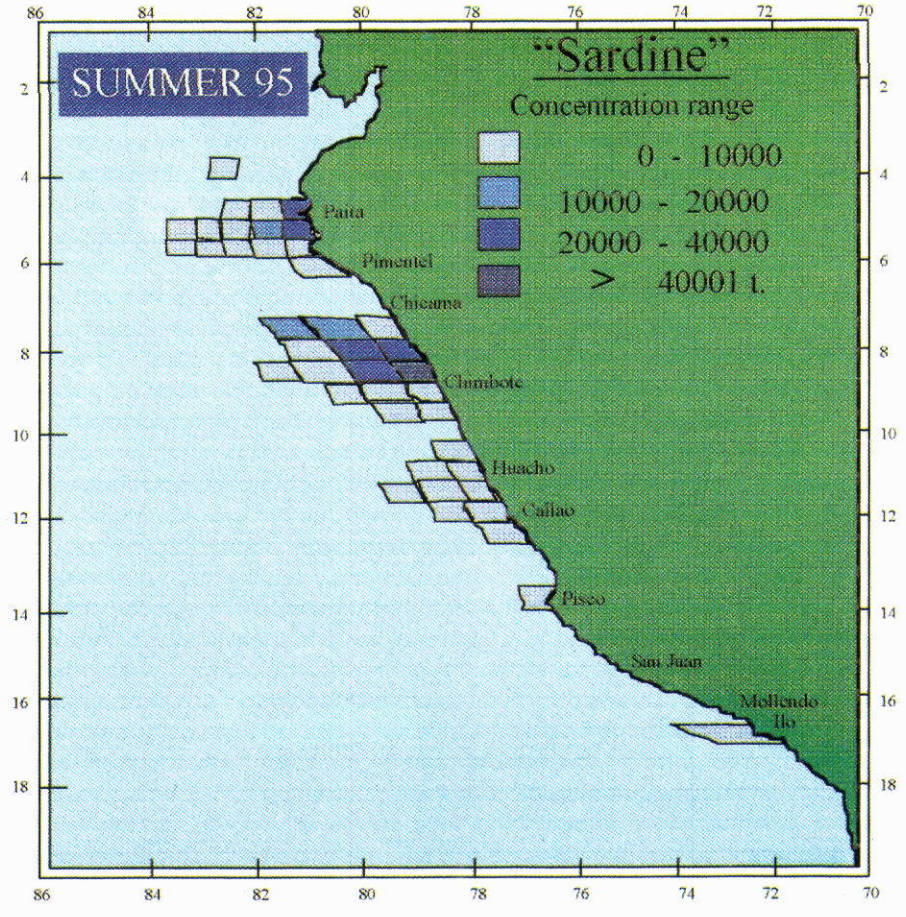


Surprisingly in spring the wide distribution of the resource continued with coastal nuclei close to Chimbote and Callao.

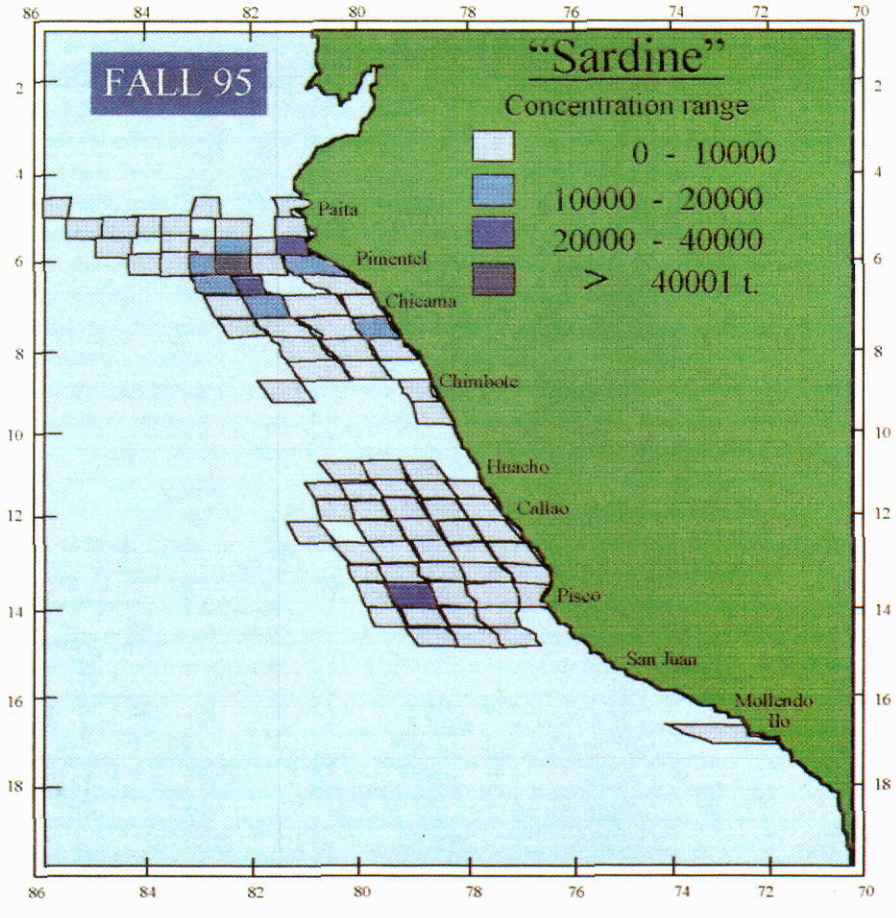
This distribution of anchoveta in 1995 was atypical, conditioned by colder sea surface temperatures related to seasonal patterns. In the southern zone the banks were located up to 70 miles offshore (winter), during the spring in the northern-central region the resource extended up to 150 miles off the coast approximately.

This wide distribution reduced the resource availability, mainly constituted by spread shoals, affecting the catch rate of fishing fleet, and generating a smaller catch in 1995 that approached 6,3 million tons.

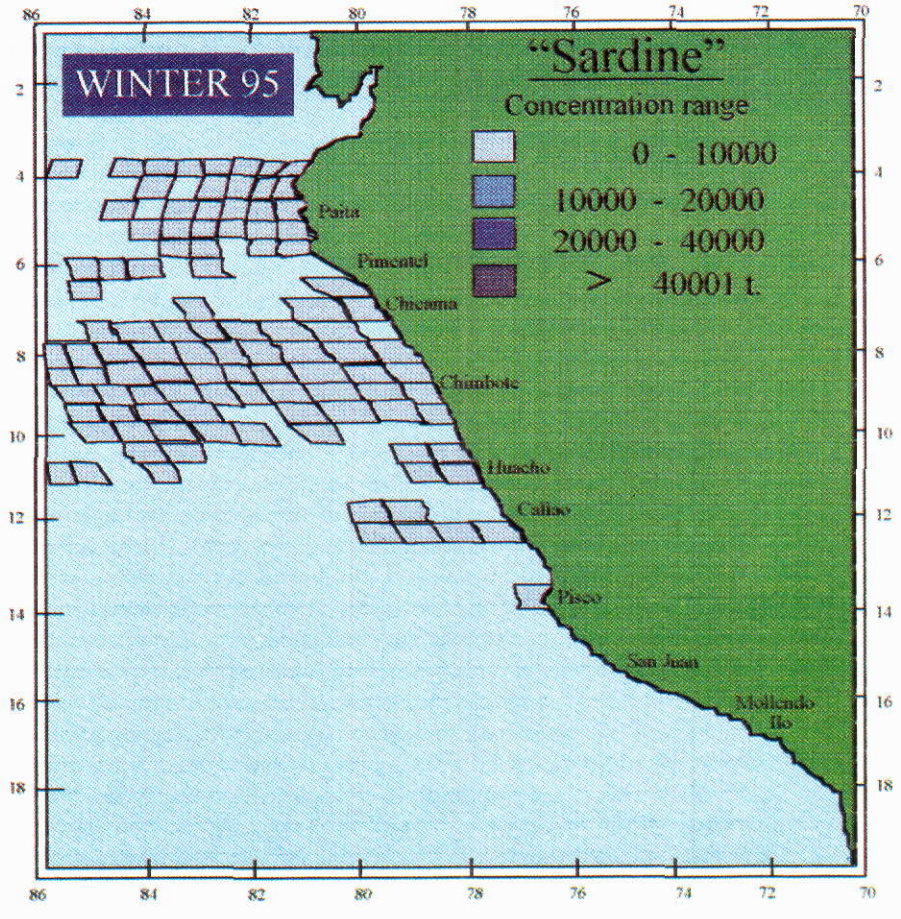
In the case of the sardine, its distribution was also wide and spread. It was mainly located in the northern-central region.



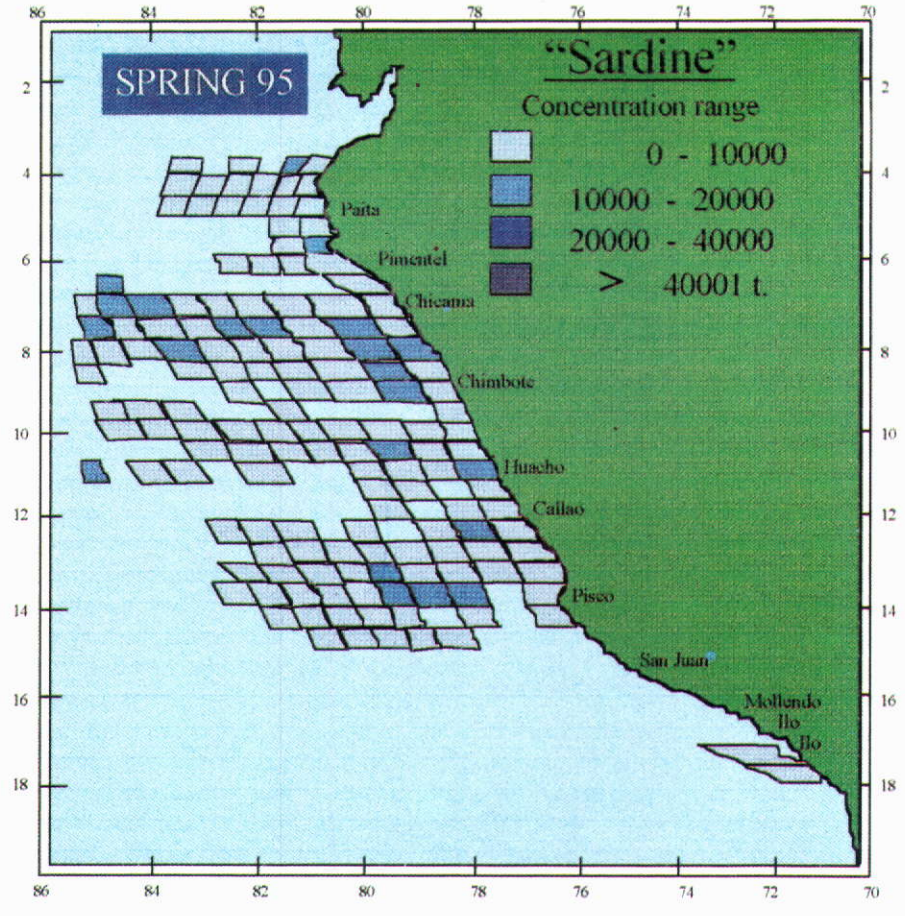
During the 1995 summer it was located in the coastal area within 30 miles offshore, with an important concentration in Chimbote,



then during the fall the distribution was extended to 40-50 miles offshore.



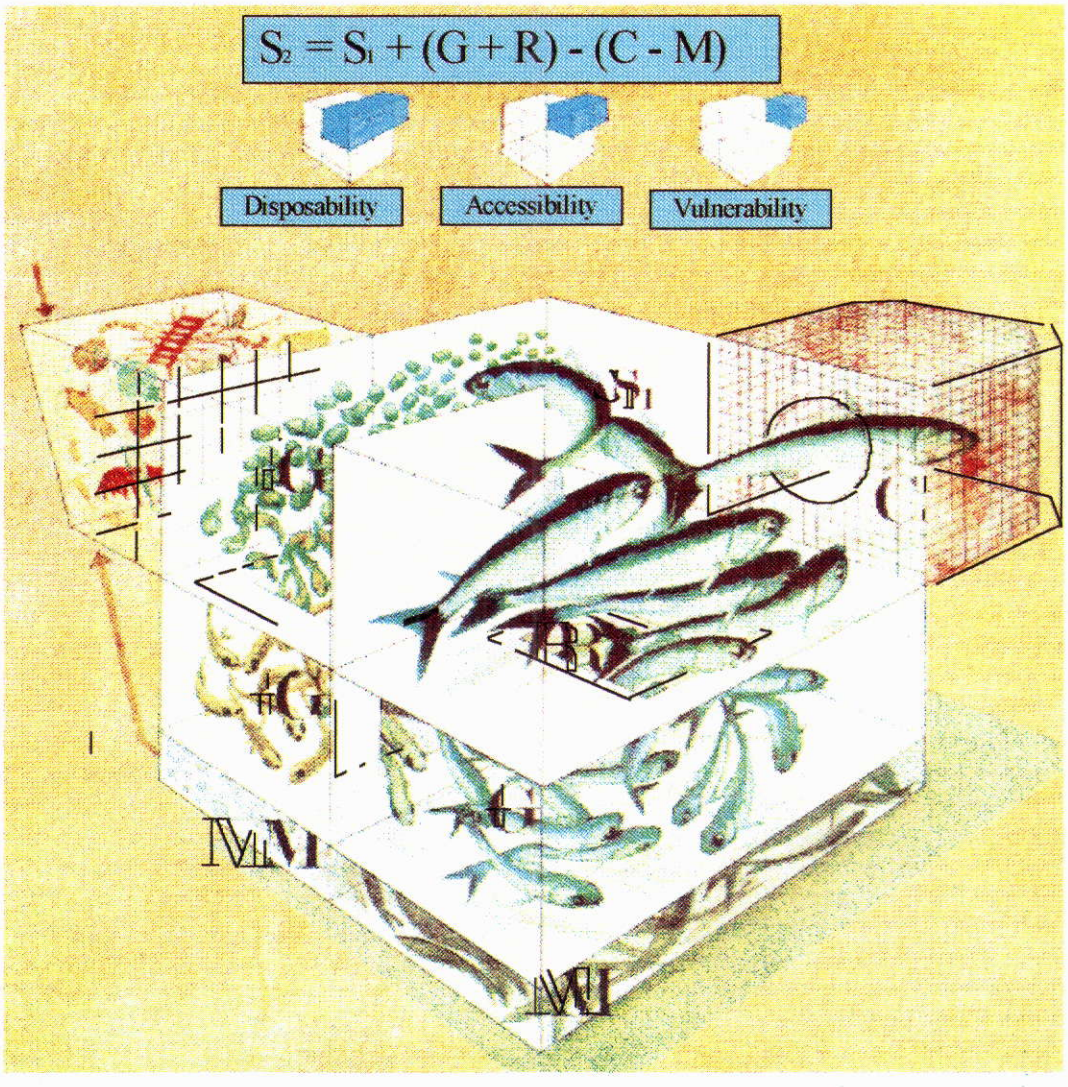
and even more in winter up to 100-120 miles offshore mainly between Chicama and Chimbote.



Finally in spring, the distribution was completely wide and disperse along the northern-central region up to 200 miles from the coast.

In contrast to anchoveta, sardine catches in 1995 were similar to those of 1994, which may be attributed to a significative increase of its catches in northern Peru, during the last three months of 1995. This event coincided with the reappearance of sardine in southern Ecuador since 1990.

POPULATION DYNAMICS



One of the first scientists that described the factors of the dynamics of a population of exploited fish was Russell in 1931.

This model summarizes the general concept of the population dynamics in a simple equation such as the one shown in the

figure, where $\mathbf{S_1}$ and $\mathbf{S_2}$ represent the total existing biomass at the beginning and at the end of a determined period, **G** represents the growth in weight of the individuals in the population, **R** represents the amount of recruits or new individuals that become part of the population, **C** represents the mortality due to fishery or amount of fish caught by fleets and **M** the natural mortality or amount of dead individuals due to other causes.

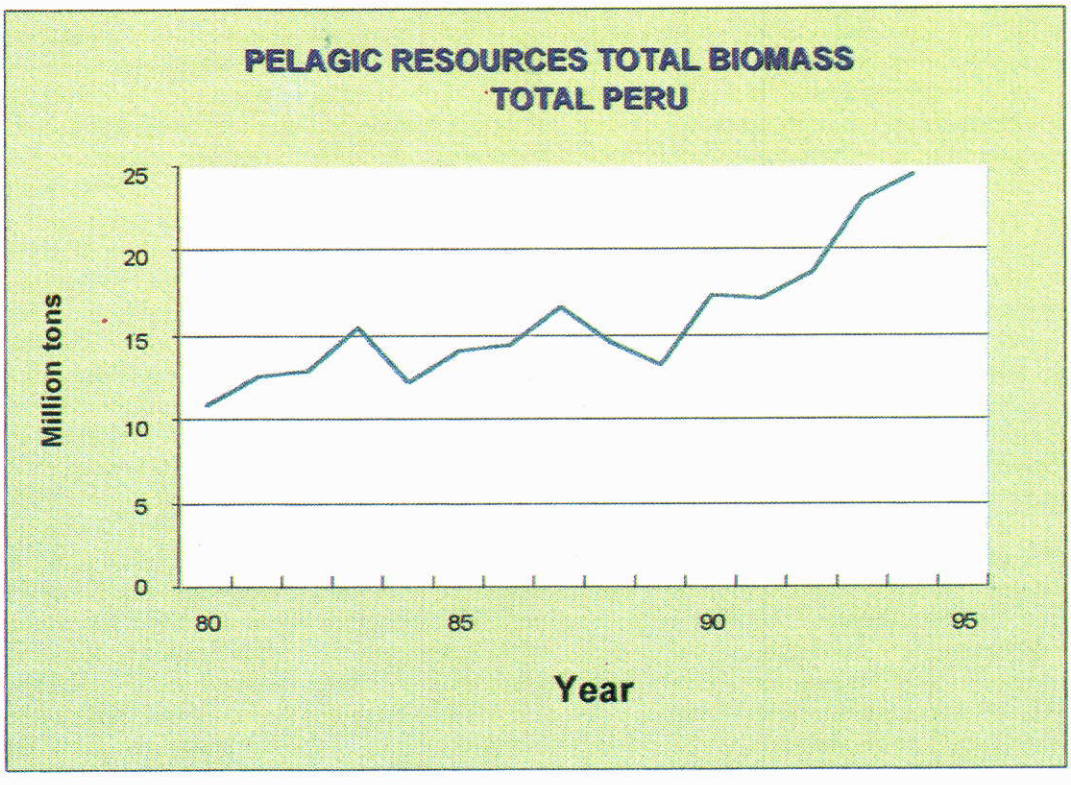
The growth (G) and recruiting (R) are elements that increase population, whereas mortality due to fishery (C) and natural mortality (M) make the population decrease.

Consequently, the biomass or amount in weight of the resource, in a defined moment, depends on the variations of each factor.

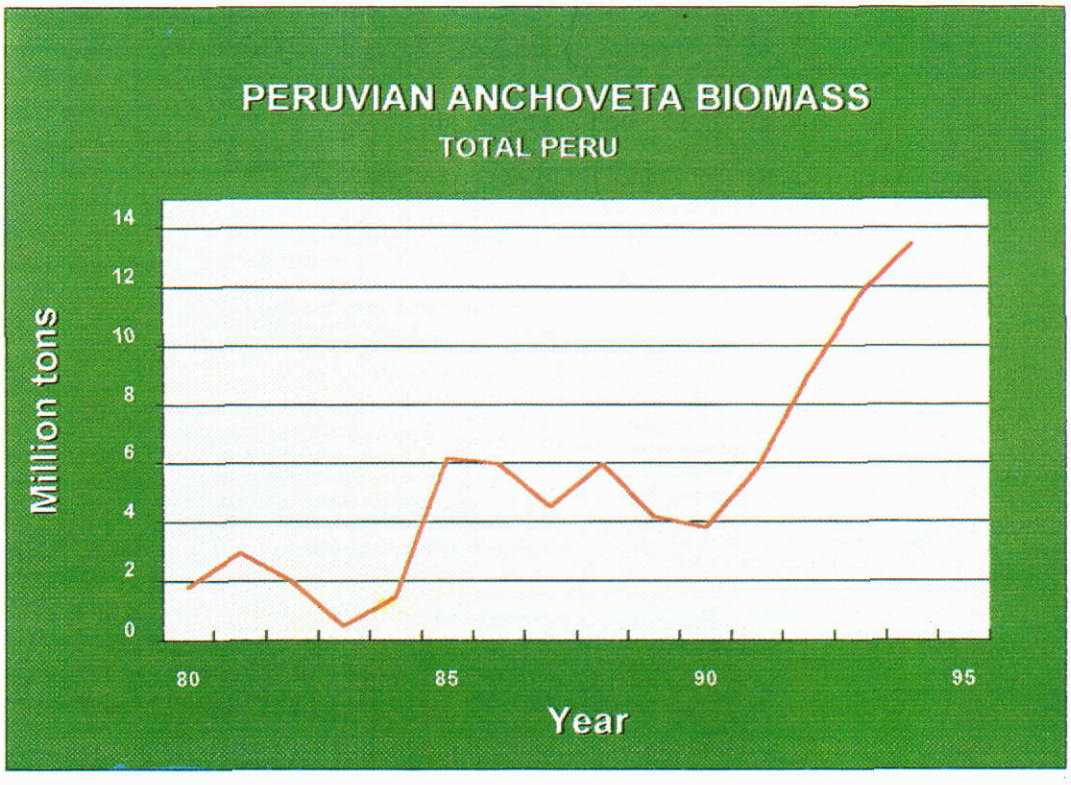
Thus, once the spawn takes place, many little eggs remain unfertilized or serve as food for other organisms, and not all larvae, post-larvae and young fish become adults, because part of them die previously.

The great mortalities occur between the egg and the post-larvae stages, and even in later stages of development under certain adverse environmental conditions.

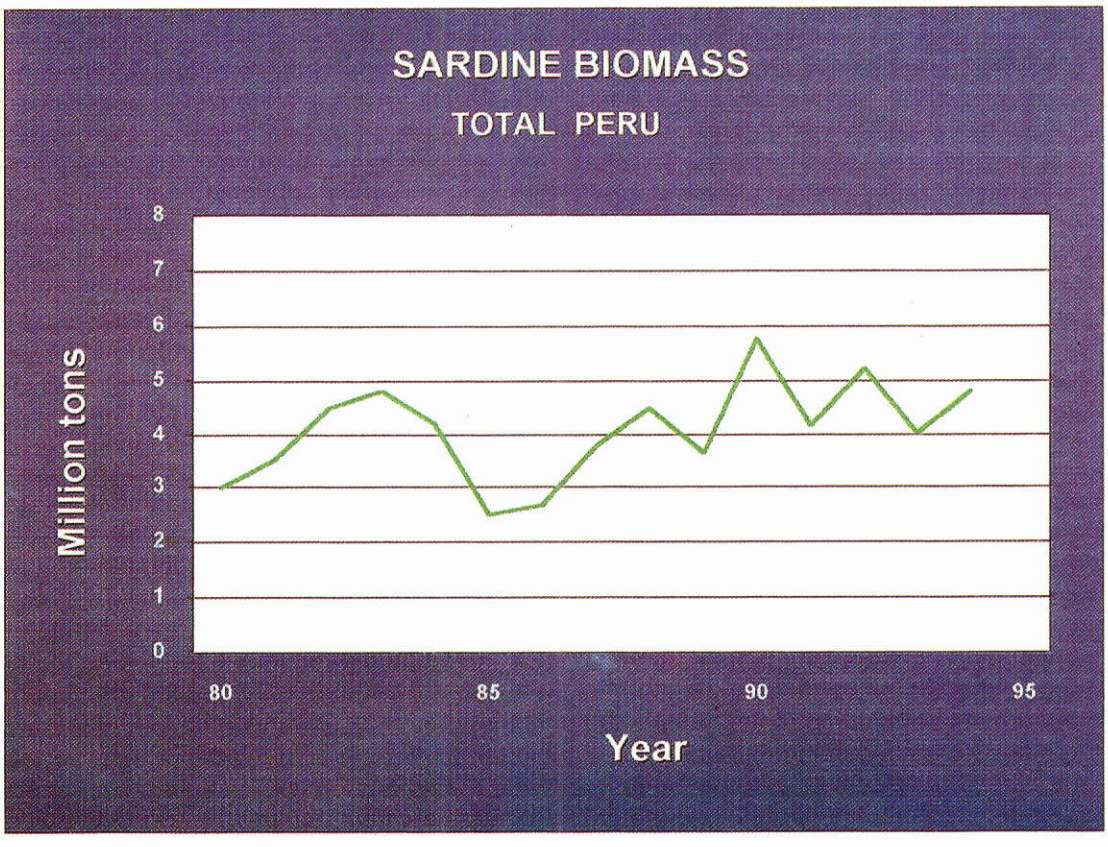
BIOMASS



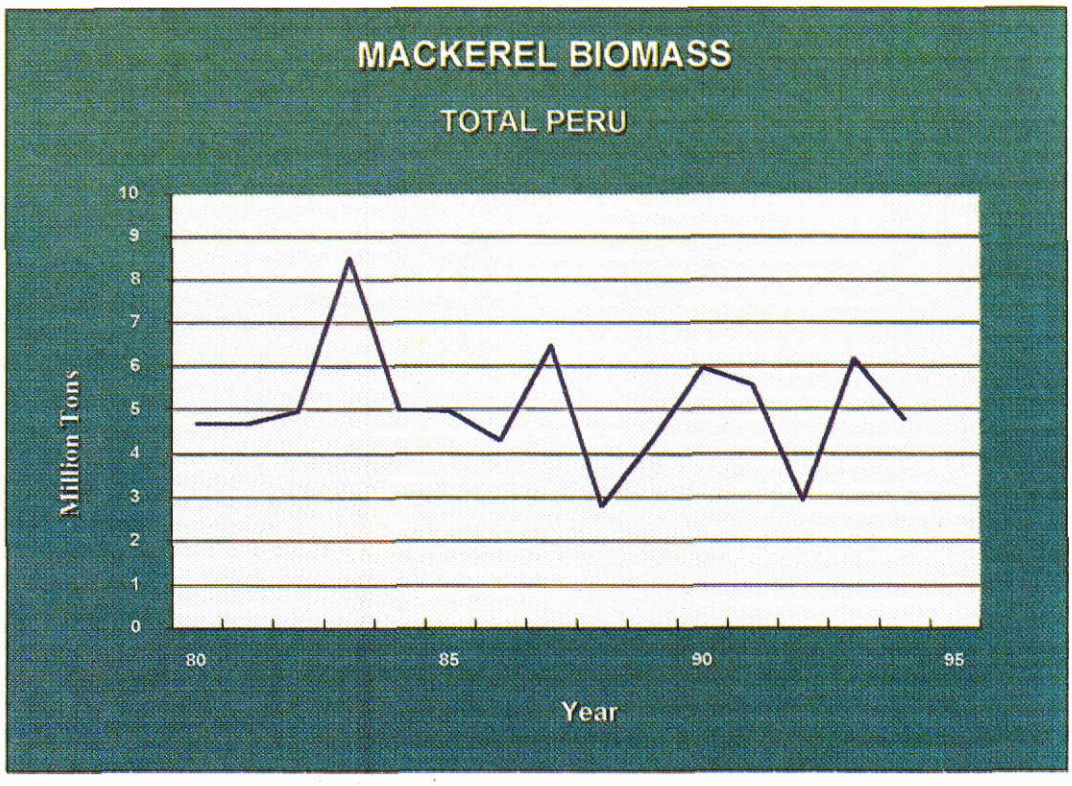
The evolution of the total biomass of pelagic resources during the last 15 years shows an increment that became evident during the earlier 90's.



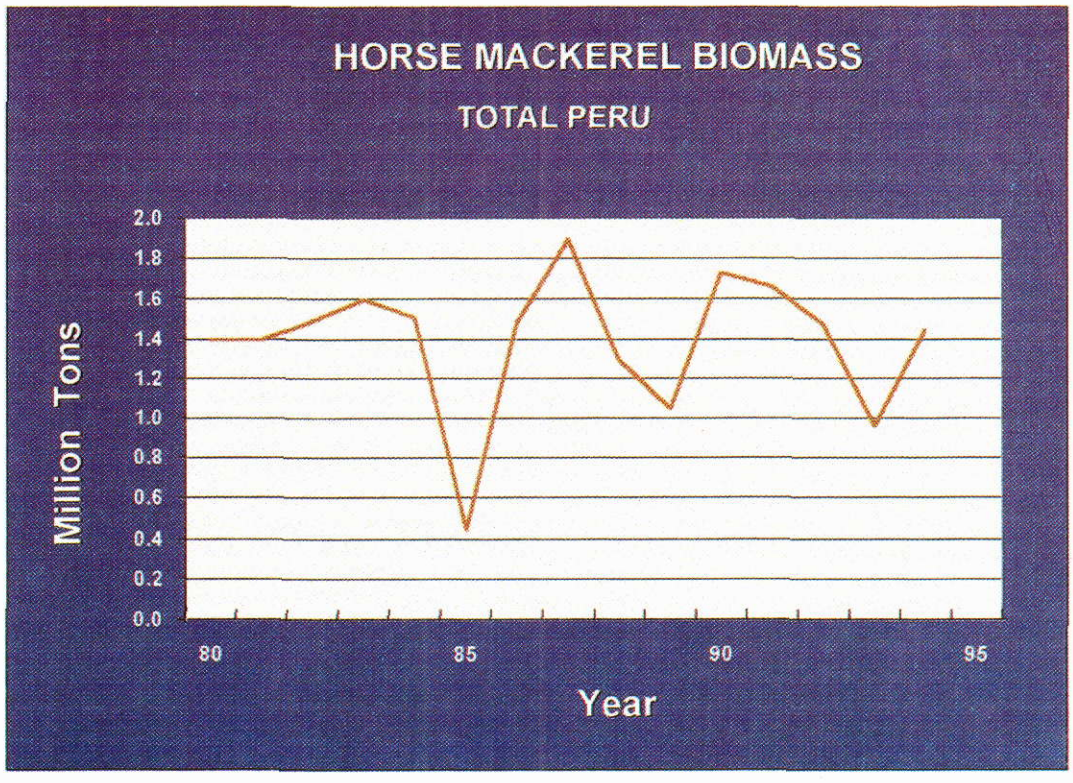
This increment was determined by the sustained increasing trend of anchovy, to about 14 million tons, after a recorded minimum during the El Niño event of 1982-83.



The sardine biomass shows its maximum in 1983 and 1990 with a stable trend during recent years, that fluctuates around 5 million tons.



During recent years, mackerel biomass oscillates around 4 to 5 million tons, after a maximum greater than 8 million tons recorded during the El Niño of 1983. It is worth to mention that this transzonal species is also distributed beyond the 200 miles offshore. Therefore the observed biomasses in the last years do not reflect the real biomass of this resource within the Peruvian Maritime Domain because the surveys covered only a 100-mile strip. The maximum biomass of 8 million tons observed in 1983 is attributed to an advection to the shore of oceanic (warm) waters were this species inhabits.

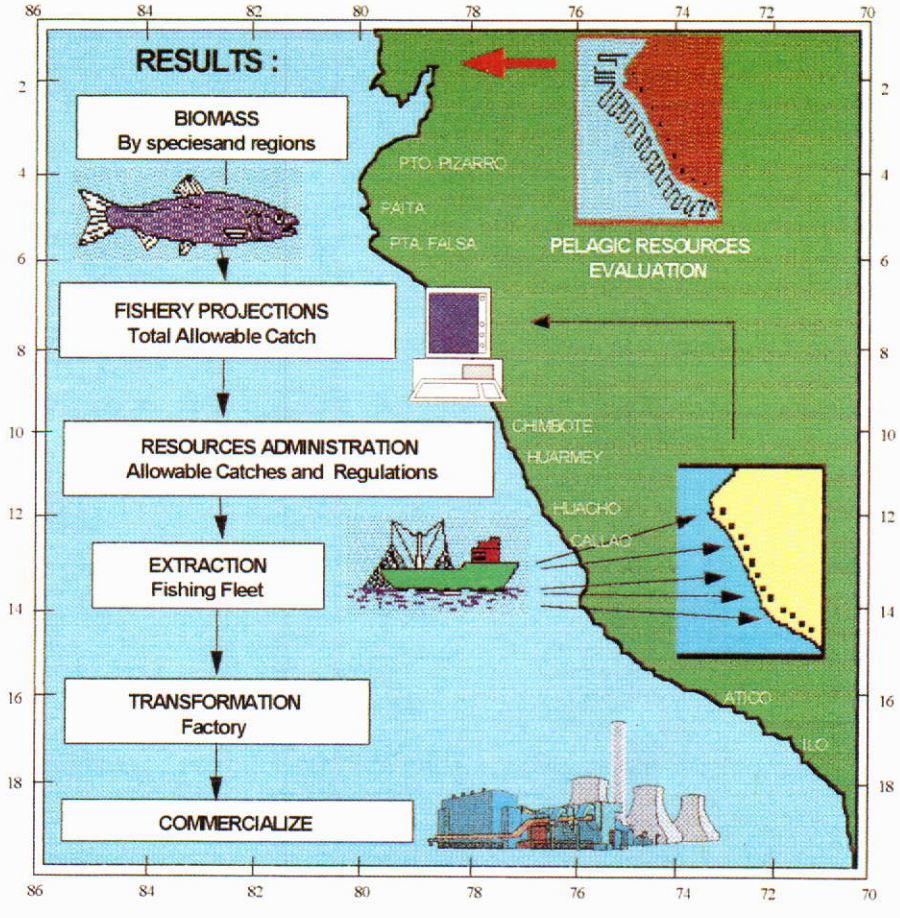


The pacific horse mackerel biomass after a recorded minimum of a half million tons in 1985, fluctuates during recent years between 1,5 and 1,8 million tons.

The increasing trend of the observed biomass in recent years, mainly the anchovy resource, may be attributed to a better conditions of the marine environment and also due to the management guidelines adopted by the end of 1991, such as: reproductive close seasons in adequate periods, establishment of allowable catches and catch prohibition of young fish.

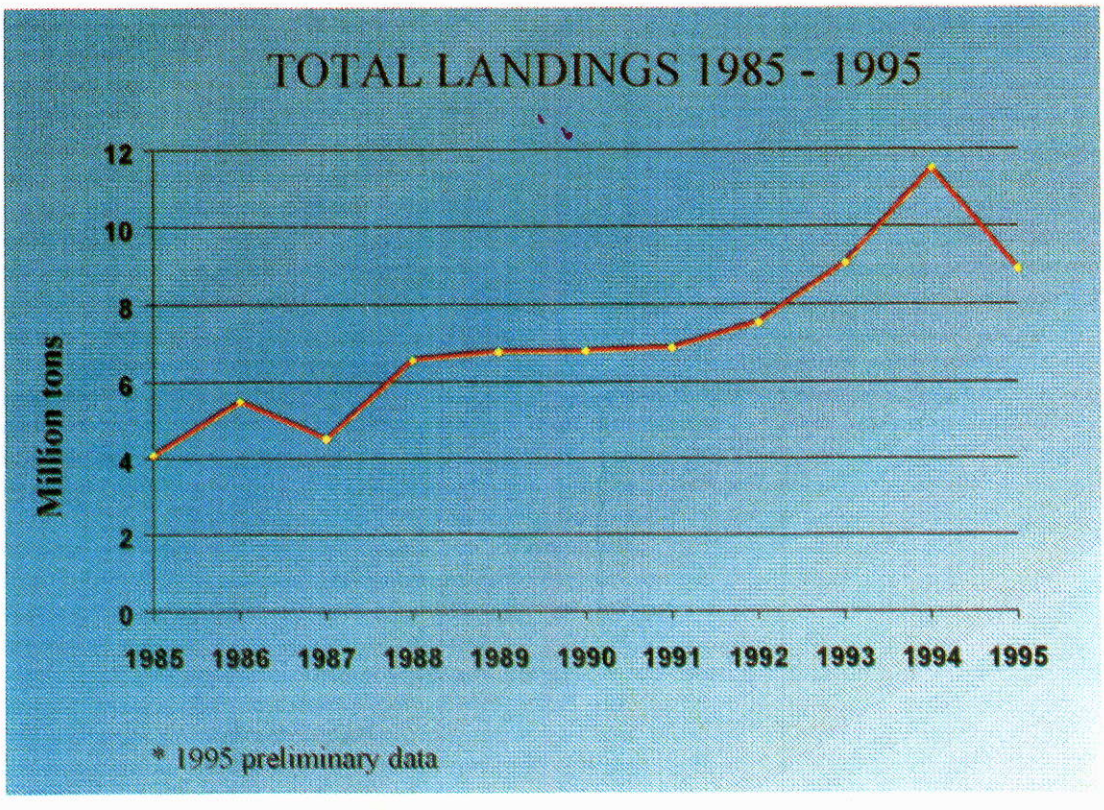
In the case of the sardine, its biomass shows yearly fluctuations, oscillating around 4 to 5 million tons, sustaining an important fishing activity for indirect and direct human consumption. However its trend is in contrast to that of anchoveta. It is worth to mention that in Chile, where constituted the main fishery resource for various years, this resource has decreased.

RESOURCE MANAGEMENT



The biomass estimates and fishery projections of these main fishing resources are important elements in the fulfilling of the biological objective of preservation of marine biomass in order to achieve sustainability of this activities and the consequent economical and social benefits for the nation.

TOTAL LANDINGS 1985 - 1995

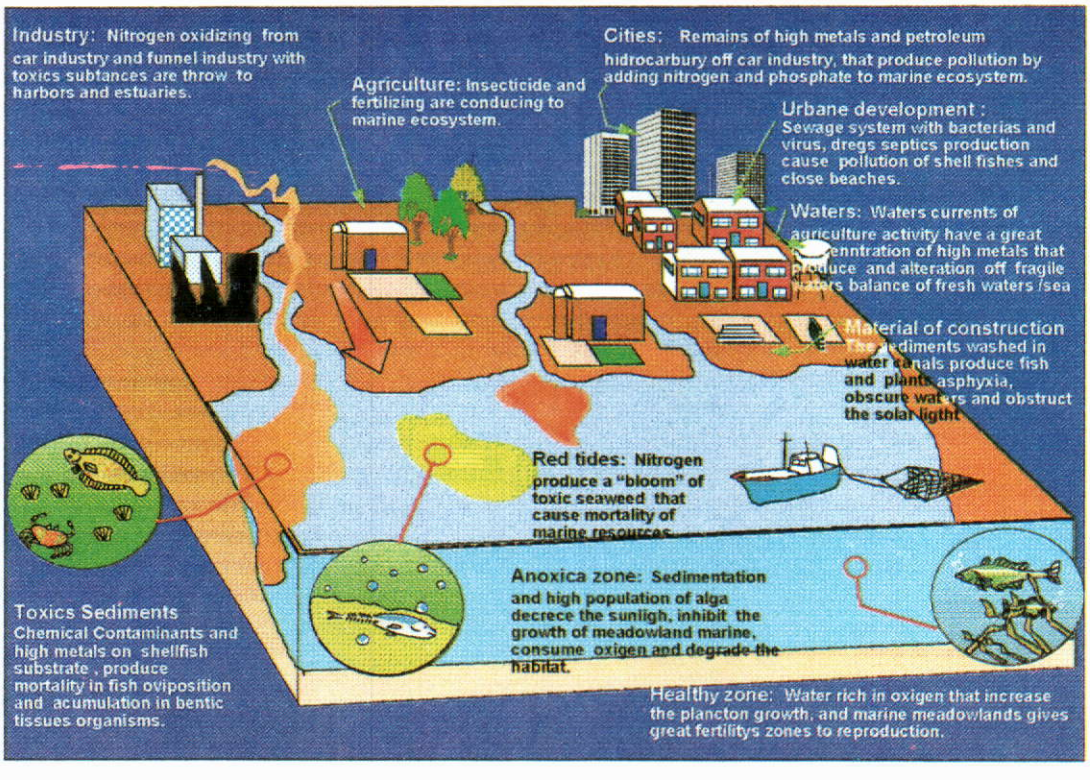


During the last ten years, it has been observed a recovery of total catch of pelagic resources, based on the raise of Peruvian anchoveta resource.

POLLUTION

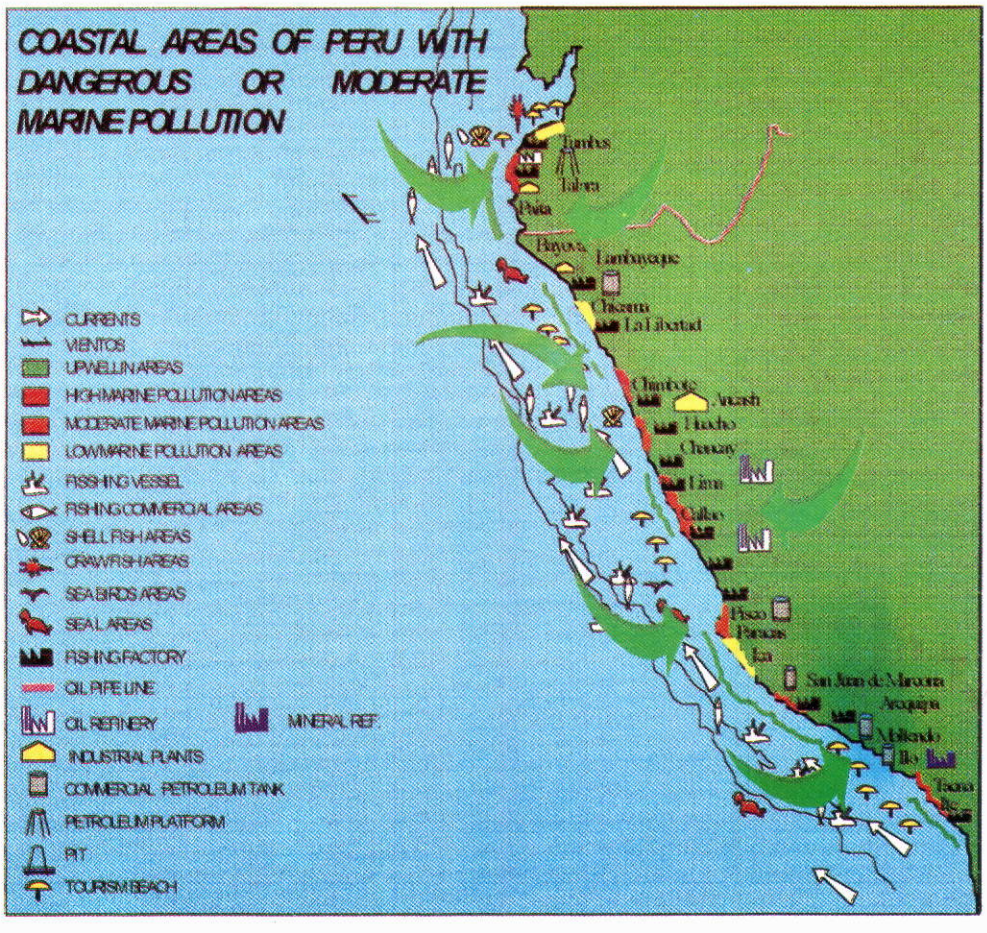
The marine environment is a significant source of resources, however it is also the final **reservoir** of demoforic residues produced by the human activity.

The marine pollution is produced by introduction of pollutant substances or energy that are directly or indirectly incorporated in the environment. These substances are result of mining and agriculture activities (pesticides and fertilizers), heavy metal accumulation and domestic human residuals, throwed away into the sea without any treatment.



As a rule, all the pollutant agents damage sea activities, such as fishing and aquaculture activity that also constitute serious risks for the human health.

The pollution studies conducted by IMARPE have established the pollution sources in several geographical zones. For example: At Talara's bays, the pollution is produced by the exploration and the operation of petroleum companies.



The Paita's and Chimbote's bays receive the fishmeal residuals of industrial plants. The central coast (from Supe to Pucusana) receive besides domestic residuals and the pollutant agents of the industrial and agricultural activities.

At Paracas's bay, the liquid and solid residuals come from the industrial fishmeal and the agriculture activities.

At Ilo's bay the pollution has been reduced notably due to the convenient treatment of the domestic an fishing factories residuals before they are throwed a way into sea.

From the assessments and regulations proposed by IMARPE, a slight recovery of marine enviroment is evident observing the reduction of the oxygen biochemical demand. The regulations are not based on the reduction of the industrial activity, but on the reduction of the total solids emisions, obtaining in consequence a better environment quality.

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