

SOME SHARED FISH STOCKS OF SOUTH EASTERN PACIFIC

Prepared for

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Introduction

This paper is designed to serve as an overview about some shared fish stocks and their fisheries in the South Eastern Pacific-SEP. It was prepared to present at the FAO Expert Consultation and attempt to review the status of small pelagic fish stock that will have the condition of transboundary or shared stocks according with the theoretical definitions by FAO and others. Also to show their main biological aspects, legal status and to describe the Regional efforts to integrated studies that are currently conducted by Peru and Chile, mainly as the most important regional fishing countries. Finally, it will attempt to outline the scope and magnitude of the future relevant resource management issues in the Region towards cooperative task.

Shared fish stocks.

According with the definitions contained in the Discussion paper of Munro, the term "shared fish stocks" is understood, by the FAO and others, to include the following:

- a) Fish resources crossing the EEZ boundary of one coastal State into the EEZ(s) of one, or more, other coastal States – transboundary stocks.
- b) Highly migratory fish stocks, which, due to their highly migratory nature, are to be found, both within the coastal State EEZ and the adjacent high seas
- c) All other fish stocks (with the exception of anadromous/catadromous stocks) that are to be found, both within the coastal State EEZ and the adjacent high seas – straddling stocks
- d) Fish stocks to be found exclusively in the high seas

The Norway-FAO Expert Consultation on the Management of Shared Fish Stocks will focus its attention on categories (a) and (c) stocks, which means, on transboundary and straddling stocks, and since this paper refers only to these fish stocks.

Also we take account for John Caddy (1997) definition of transboundary stocks, which, Munro mentions can be extended, with minor modification, to cover straddling stocks:

A group of commercially exploitable organisms, distributed over, or migrating across, the maritime boundary between two or more national jurisdictions, or the maritime boundary of a national jurisdiction and the adjacent high seas, whose exploitation can only be managed effectively by cooperation between the States concerned ----

Transboundary fish stocks in SEP

The reports on the fishing activities of the Pacific Southeastern countries show several species that are common for two or more EEZ, where it can be identify Transboundary Fish Stocks that inhabit

the South Eastern Pacific (**Annex I**).

Of all those species, some of them have severe implications on the future of the regional management as shared fish stocks, and others at this time are regulated by Regional Organizations like main tuna fish species by IATTC.

So that, the focus by the Expert Consultation would be on pelagic resources shared by two or more countries. Where we can specially account for: Jack Mackerel (*Trachurus picturatus murphy*), Anchovy (*Engraulis ringens*), Sardine (*Sardinops sagax*), Giant or Jumbo flying squid (*Dosidicus gigas*) and swordfish (*Xiphias gladius*). Since those species occurring in the EEZ of two or more states of the SEP Area and in some cases they also occur in the adjacent high seas.

Biological aspects of main fish stocks

- **Jack Mackerel** (*Trachurus picturatus murphy*)

It is a migratory pelagic specie, which moves in large schools of similar size throughout the coast and beyond 200 nautical miles off the coastline. In some cases, it can get a length of 70 cm. The oceanfront is its habitat and is composed by colds coastal and subtropical surface waters, however it can be found as deep as 300 m., below the surface. They approach the coast in the summer or in warm years.

Its first maturity is reached when it gets a length of 21 cm., although its average maturity is reached after it gets a length of 31 cm. The spawning process intensifies in the months of October and November. Length at 31 cm. is the minimum catch size.



- **Anchovy** (*Engraulis ringens*)

Specie that occurs from Punta Aguja, in Peru (5° 50'S) to Lota, in Chile (37° 04'S. L.). It is a pelagic and mostly coastal fish (within 50 nautical mile), although sometimes it can be found beyond 100 nautical miles, off the coastline, particularly during winter. The specie move in large schools the displacement of which, between the surface and 50 m. in depth, is associated with temperature (14,5°C and 21°C) and water salinity levels of 34,5 and 35,1 UPS. Anchovies swims into deeper waters rarely (more than 70 m.) when there are weather-ocean alterations. Under normal environmental conditions, their first sexual maturity is got when attaining a 9 to 10 cm., length, that is when they are near one year-old. Their maturity average is got when attaining a 12 cm., length. They can live, between three and five years and can be from 18 to 20 cm. length.

They spawn throughout the year, although spawning season occurs intensively between August and October. There is a secondary spawning period between February and March. The beginning and the end of the spawning period greatly depend on weather conditions and the maritime region. The Peruvian anchovy spawns at 6°S, mostly in the areas of Chicama-Chimbote, Huacho-Callao and Tambo de Mora-Pisco, close to the coast.

Exploratory fishing for this species was started in the early seventies in several areas along the Pacific coast of America. While the operations by Japanese vessels off Chile were discontinued because of insufficient landings. Mexican catches increased from 14 t in 1974 to over 19 000 t in 1980, and subsequently were deteriorated, to near 10 000 t in 1981 (FAO, 1983) and to even lower levels in the 1982-83 fishing season. Under a joint venture scheme most of those catches are taken by Japanese jigger boats and by Mexican shrimpers that switch to squid fishing during the closed season for shrimp fishing. Best catches are got during summer time, but the season has been gradually expanded, so that fishing now occurs throughout the year. Jigging operations are enhanced during the night by light attraction. Fishery sport for the species of the southern California has a quite limited importance. This squid is mostly used as bait, some of it is dried for human consumption, and in Chile, small amounts are marketed canned. A market for frozen filets has recently been developed in the western USA. Total catches reported for this species to FAO for 1999 was 134 773 t. The countries with the largest catches were Mexico (57 985 t) and Peru (54 652 t).

- **Swordfish**² (*Xiphias gladius*)

Is a relevant resource supporting large fisheries in all oceans of the world. Significant of the Pacific catch is taken incidentally in longline fisheries targeting tunas. Recent landings average around 34,000 metric tons. Japan, Taiwan and the U.S. account for about 70% of current reported production, with Mexico, Ecuador and Chile providing the remainder. In the eastern Pacific, swordfish are primarily harvested using longlines, driftnets and hand-held harpoons.

The status of swordfish in the Pacific is not clear and assessment results are often conflicting. The most recent assessment suggests swordfish comprise a single, continuous stock throughout the Pacific with areas of high and low abundance. Genetic evidence indicates swordfish off the western coast of the Americas mix with fish from the central and western North Pacific. A second theory suggests the possibility of three or more stocks exist based on areas of high abundance but somewhat continuous over areas of low abundance.

Both hypotheses conclude Pacific stock(s) of swordfish are relatively healthy and being fished at levels below maximum sustained yield although recent fishery statistics have not been available.

Management, current assessments are based on an old and incomplete data. New assessments using updated and standardized fishery statistics are needed to determine stock condition and to validate existing levels for maximum sustained yield. International conventions are currently being developed.

Current status of SEP small pelagic fisheries

At present these stocks are managed isolated by each country of the PSE. However, Peru and Chile the main fishing countries have each one specific regulation about their fisheries. Follow up a brief description of the state of the fisheries and regulations:

² Fisheries Resources Division, Southwest Fisheries Science Center. (<http://swfsc.ucsd.edu/>)

In Peru, according of its General Law of Fisheries, the purpose of management is to regulate fishing activities in order to promote their continued development as a staple food, employment and income source. Ensuring a reasonable exploitation of the natural resources and optimizing economic benefits as well as the preservation of the environment and biodiversity.

The State, according to the type of fishing ground and situation of the exploited resource shall establish a system of regulations which harmonizes the principle of protection and preservation of fishing resources in the long term, with the attainment of the best economic and social benefits.

The regulations referred shall include, if applicable: access regulations, total allowable catch, fleet capacity, fishing and closed seasons, minimum size of the species, prohibited or reserve zones, fishing techniques, equipment and fishing systems. As well as the necessary monitoring, control and surveillance procedures.

The provisions adopted by the State to ensure the preservation and rational exploitation of fishery resources shall be applied beyond the 200 nautical miles to resources of different areas that migrate towards adjacent water or move from these water towards the coast due to food, reproduction or breeding habits similar to those of other marine life.

Peru encourage with other states the execution of agreements and international treaties in order to ensure compliance with the provisions of the General Law of Fisheries, subject to the principles of responsible fishing.

Jack Mackerel

In Peru, artisanal and industrial fleets catch jurel. The first one uses small boats, which operate in areas near the base ports. Industrial fleet uses purse seine nets and is constituted by "bolicheras" with hold capacity bigger than 30 tons, some of them have refrigeration system on board. These boats capture jurel incidentally, since normally are dedicated to sardine or anchovy fisheries.

From 1990-2000 the captures had an average of 200 thousand tons annual. Nevertheless, from 1995 up to 1998 the captures were superior to the 300 thousand tons, due to a greater availability of the resource and an increase of the fishing effort of the boats with RSW, that are dedicated to the fishing of this species. Within the main management regulations are the size of mesh (38 mm or 1½ inch.) and the minimum size of capture (31 cm).

Anchovy

Anchovy catch sustained the Peruvian pelagic fishery in the decade of 60', diminishing drastically in 1972, staying in low levels for more than ten years. Beginning to be increased after the El Niño 1982-83, with a maximum registry of 9.7 million tons in 1994, number that in the last constitutes the greater historical capture twenty-three years after the fishery collapse of this species in 1971 - 1972.

Recently catch diminishing by effect of El Niño 1997-98, followed by a fast recovery in 1999 and 2000.

This specie have been declared in state of plenty exploitation, the main measures of fisheries management are Total Allowable Catch, minimum size of capture and reproductive close seasons.

Sardine

Historical series analysis of sardine catch and the anomalies of seawater temperature indicate fluctuations in catch yields between cold and warm periods. In warm periods the sardine yields are increased and those of anchovy decline.

In the global environmental, the populations of sardine and anchovy have displayed great changes in their abundance, in each one of the regions where they coexist and they have been fished strongly. Frequently the anchovy population was abundant, when the sardine populations declined and vice versa. Raising the existence of an alternancy of these populations, to which they denominated "Changes of Regime" which are associate to the warm and cold environmental periods.

In Chile, according with the General Law of fisheries and Aquaculture. In each fishing ground, independent of the access system to which it is subject. The Ministry, by means of a well-founded executive decree, based on a technical report from the Undersecretariat and subject to communication with the appropriate Zonal Fisheries Council and other reports and approvals required may establish one or more prohibitions or measures for managing hydrobiological resources.

These measures shall be: Biological ban by species in a specific ground. The bans shall be applied seeking the due concordance with the policies applied by neighboring countries. Prohibitions of temporary or permanent catch of species protected by international agreements which Chile takes part in. Setting annual catch quotas by species in a specific ground. Declaration of specific, delimited grounds that shall be called Marine Parks, intended to preserve ecological units of scientific interest and to safeguard areas that assure the maintenance and diversity of hydrobiological species, as well as grounds associated with their habitat. Establishment of percentage of landing of species as accompanying fauna.

Also, In every fishing ground, independent of the access system to which it is subject. The Undersecretariat, by well-founded resolution, based on a technical report from the appropriate Zonal Fisheries Council, may establish one or more of the following prohibitions or measures for managing hydrobiological resources: Set minimum sizes for extraction by species in a specific area and their tolerance margins. In no case the minimum size shall be smaller than the critical size. Set dimensions and characteristics of fishing gear and devices. It is prohibited to carry out extractive fishing activities in violation of the provisions in these regulations.

Extractive fishing activities are prohibited with gear, devices and other fishing implements that affect the bottom of the sea, in the territorial sea within a strip of one marine mile, measured from the baselines from the northern limit of Chile to the 41° 28,6' latitude south. And in the Inland Sea, as the regulations determine, except for the one-marine-mile strip of sea measured from the low tide line of the continental coast and around the islands.

Since 2001 the main fisheries in Chile was with global quota of capture. In February 2001, were gotten up to the system of Maximum Limit of Capture, within the frame of the application of Law 19.713.

Jack Mackerel

The resource jack mackerel is under regime of plenty exploitation between I and X regions, corresponding this macro area to the fishing units of III, III-IV, V-IX and X regions.

The total landings of jack mackerel to December of the 2001, reached to 1,64 million t. registering an increase of a 32,7% with respect to the accumulated ones in the same period of the

2000 and contributing 39,9% of the total landing catch.

Anchovy:

The resource was declared plenty exploited between the I and X Regions, The accumulated landings of anchovy to December 2001, reached 734,6 thousands t. displaying a diminution of 56,8% with respect to 2000 and contributing 17,6% of the disembarked total of the country. The main fraction of the landings took place in regions I and II, with 598,3 thousands t. that represents 81,5% of the total landing catch of anchovy, being observed a diminution of 50,2% with respect to equal period of the 2000

Sardine

The total landings of sardine in 2001, reach at 13,2 thousands t, quantity that shows a diminution of a 77,4% in relation to equal period of the 2000, presenting a marginal participation respect to the total of the pelagic resources (0.4%). 81,1% of the landing was realizing in the regions I and II, and one fall in the levels of disembarkation of 77,8%. Regions III and IV in as much, registered a thousands disembarkation of 1,2 t, number superior a 20,4% to the same period of the 2000.

The consumption of annual global quota of capture for III and IV the regions corresponding to the industrial fraction (1,961t), reached to 32,1%, whereas in the artisanal sector, the consumption of the same one (1.277t) reached to a 41,8%.

Experience in Cooperation.

▪ **CAPMAD-SELA Project.**

A working Party on Marine and Fresh Water Products, convened en august 1978 under the auspices of CAPMAD-SELA with experts from Ecuador, Peru and Chile to consider a joint study of the pelagic resources in the East Pacific Ocean. The working party defines the term of reference for an investigation referred to as "Assessment of Sardine, Jack Mackerel and Horse mackerel Resources in the East Pacific Ocean". A convention between the International Development Bank (BID) and the Permanent Secretariat of SELA acting on behalf of the three international governments concerned was consumed in 1981.

The work commenced in October 1982 with courses in acoustic stock estimation and populations dynamics in order to standardize methodology and data reporting. Field studies and data analysis culminated with a plenary session in Lima in June 1984 which produced a final comprehensive report. A shorted report was published which address the main problems in management of the pelagic resources in the South Eastern Pacific Ocean and present the principal results of this three nation cooperative study.

It can be remarked that it was the first time that such a coordinated study was underwritten by three nations spanning a coastline from about 1° N to 30°S.

The report presents a fairly broad description of the oceanographic features and circulatory pattern of the area investigated with the full realization that climate and oceanographic conditions drive the biological production systems along the prescribed coastline. It also presents a synopsis of all contemporary knowledge on the three species; sardine (*Sardinops sagax*); jurel (*Trachurus murphyi*) and Mackerel (*Scomber japonicus*). Some of their vital parameters are included, like total biomass and its distribution and patterns of entry into the

fishery, which represent some of the central elements of a real-time management system.

Great emphasis was placed on Synoptic acoustic surveys of the prescribed coast line, one distinct contribution of this project was completion of a software package for analysis of acoustic signals regardless of whether these originated from analog or digital integrators.

Part of the report was devoted to population dynamics of the three species in question with special emphasis on mortality rates, natural as well as fishing mortality, yield calculation and some first approximation to a safe minimum spawning biomass. Finally, a flow chart was presented with algorithms, which enable any manager to reach the established goals by adjusting fishing time throughout the season.

So that, the basic structure of a real-time management system was produced, and was appointed like a main contribution of the SELA/BID investigations to a first attempt to create a unified management system and to present this in the open literature.

One significant observation that was added, is the decision making process that was based only on biological evidence and was necessarily in a real life situation to account by constraints represented by economic, social and political objectives formulated by the respective national governments.

- **Galapagos Agreement.**

CPPS countries in behalf of those have administered some of the world's biggest fishing grounds and have adopted effective measures to promote the long-term sustainability of the living marine resources there. And because they have a special interest in ensuring that the measures applied on the adjacent high seas are no less strict, than those in the zones under their jurisdiction. They signed an agreement called "FRAMEWORK AGREEMENT FOR THE CONSERVATION OF LIVING MARINE RESOURCES ON THE HIGH SEAS OF THE SOUTHEAST PACIFIC" or 'Galapagos Agreement'.

The stated objective of the Agreement is the conservation of living marine resources in the high seas zones of the Southeast Pacific, with special reference to straddling and highly migratory fish populations. Despite applying to the high seas, however, the Agreement is not currently open to signature by non-coastal States.

The Agreement applies "exclusively" to the high seas of the Southeast Pacific. Encompassed by the outer limits of the coastal States' national jurisdiction zones and a line traced along the complete length of the 120-west meridian of longitude, from the 5-north parallel of latitude to the 60 south parallel of latitude. It does not apply to the zones under national jurisdiction corresponding to oceanic islands belonging to any of the coastal States, but is shall also include the areas of high seas surrounding and adjacent to these oceanic islands, within the limits described.

The agreement applies to straddling and highly migratory fish stocks. Particular species have to be identified as being of "high-priority" at the first Meeting of the Parties.

An organization have to be set up under the Agreement, consisting of a Commission, charged with adopting the necessary decisions for the fulfillment of the Agreement's provisions. A Scientific-Technical Committee, to serve as a consulting body for the Commission on these matters; and a Secretariat. And any other subsidiary body that the States Parties or the Commission decides to establish in support of the Agreement's implementation.

Currently this agreement was not entry in force but signify an important step towards an effective framework for the conservation of the resources in the South Eastern Pacific Ocean.

▪ **Working Group on small pelagic fishery. (IMARPE-IFOP)**

Peru and Chile, according with the need to know more about the main shared resources, established a regional co-operation at scientist level. In that sense IFOP and IMARPE organized the joint stock evaluation of sardine and anchovy for Southern Peru and Northern Chile regional workshops, the latest evaluation took place in November 1999. IFOP is Chile's Fisheries Research and Development Institute. IMARPE is Peru's Marine Research Resources Institute.

These workshops were attended by senior scientists and in some cases also by industry and resource managers from both countries. The following case study is a result of the latest workshop in 1999 and shows the state of the resources and their fisheries at that time, situation that is not quite different than now.

The case of Sardine and Anchovy Stocks

The fishing off southern Peru and northern of Chile is supported by small pelagic fish like sardine and anchovy. This area is one of the most productive marine areas of the world, and it's located within Fishing Area N° 87 FAO. The Peru-Chile fishing area owes its high productivity to a system of oceanic currents known as the Humboldt Current which is associated with the upwelling of nutrient rich water process. These stocks are harvested by vessels of Peru and Chile separately in each ZEE and direct like raw material to fishmeal processing plants of both countries.

In the fishing areas of each country anchovies are distributed in the coastal edge within 20 nautical miles of the coast, while sardines frequently are found into the area from 20 to 80 nautical miles off the coast.

At present Peru and Chile are implementing fishing policies to manage their living resources independently mainly in base of biological aspects. But, since 1992 they decided to establish an agreement to conduct joint investigations of stocks of sardine and anchovies. The results of the last Workshop, realized in 1999 allowed us to have an idea of the development of these fisheries.

Sardine Fishery

The resource sardine distributes between the latitudes 15°S (South of the Peru) and 24°S (North of Chile) is considered that constitutes a stock unit. This stock with the anchovy stock sustains the main fisheries of both countries in this area. The sardine landings in both countries show an increasing tendency until 1985, as much in the total catch as by each country landings. Later the catch diminishes in remarkable form until 1997, presenting a slight increase in 1998 and 1999.

In the last 5 years the annual volumes of catch of sardine have fluctuated in the south of Peru between 254 t. and 44 thousands t. corresponding these values to years 1997 and 1998, respectively. On the other hand in the north of Chile the smaller landings happened in 1997 with 4 thousands t. and the greater one is registered in 1999 with 306 thousands t. An important fraction of this capture is constituted by small fishes mainly in the first semester of every year (fig 1)

Anchovy Fishery.

In 1996-1999 period, remarkable environmental changes occurred in the coasts of Peru and Chile, like the event "El Niño" 1997-98 and "La Niña" in 1996 and 1999, both affected the population of anchovies and their catch in the region.

In 1997 in the South of Peru were registered the largest landing of anchoveta of the last 25 years, surpassing one million t. Whereas in 1996 was registered the smaller one of the last fifteen years (table 2, fig 2).

In the North of Chile the catch of 1997 was one of the greater ones of all the time series, whereas the catch of 1998 was the minor one of the last 10 years.

The fishing administration in the south of Peru has not been applied close seasons since August of 1997. While Chile regularly establish recruitment and reproductive time close seasons. Besides them, in period 1996 - 1998, the duration of prohibitions was increased from 37 to 147 days per year.

Analysis of geographical distribution of captures of anchovy by purse seiners fleet in the south of Peru, indicates that in 1997 the greater percentage of the catch was made between Ilo and the Southern end, whereas in 1996 and 1999 the distribution was ampler, inverse of occurred during "El Niño" 1997-98.

Also in the North zone of Chile, in 1997, were detected changes in anchovy's distribution concentrating this specie within the 20 nautical miles of the coast. In 1998 Peruvian and Chilean fleets fished in the first 20 nautical miles of the coast while in the rest of the coast was observed an absence of fish shoals.

The hydroacoustic cruises off the north of Chile in 1998, stated a change in the distribution of the resource this change was similar to the happened in Peru. The shoals of fish were located below the 20-m. depth and reached up to 45 m. of depth in July 1997 (fig 4).

The biomass estimates of anchovy by means of the acoustic method in 1996-1999, shows to an important increase of biomass in the south of Peru between April 1997 - July 1998, and in the north of Chile between November of 1996 and January of 1998, followed a progressive diminution that has stayed until April of 1999 in both countries (fig 5). The increase of the biomass in the South region of Peru, registered a maximum of 1,5 million t. In April 1997, probably this change was related to migratory processes of the stock from north-center of Peru towards the South zone of the Peruvian coast.

The fishing effort indicators showed an increasing behavior during 1984-1999, reaching their maximums values in 1995 and 1997, having diminished during the last years. The standardized index of catch by trip displayed a maximum in 1985, decreasing until 1991, since that year becomes stabilized between 40-70 t/v with a minimum value in 1998 (fig 6).

Managing Transboundary Stocks of Small Pelagic Fish: Problems and Options.

(World Bank Discussion Paper No. 329; by Exequiel Gonzalez, Max Aguero)

For these fisheries this important analysis tests the hypothesis, that appropriate joint management of transboundary fish stocks can help avoid to over exploitation of these resources while increasing rents and benefits. The study focusing on the industrial pelagic fisheries of northern Chile and southern Peru, present various quantitative models for identifying industry

characteristics and calculating benefits, from this study we can conclude several issues about the benefits of a joint management scheme.

From this work and in support of the scope of present paper, we extract the following items, which explain the conceptual framework of the Agüero and Gonzales analysis:

- Model specification.

A mathematical programming model is employed to estimate the order of magnitude of the potential benefits for Chile and Peru, under different management alternatives. The basic components of the model were:

- The transboundary stock (Spanish sardine and anchovy)
- The fishing industry (fleet and processing plants)
- The socioeconomic and technological setting.

The dynamics of these components introduced in the model used:

- The population dynamics function (state equation)
- The behavioral objective function of the industry
- A set of coefficients and parameters describing the characteristics of the market variables, technology, socioeconomic behavior and institutional parameters.

Five management scenarios were analyzed. The first three represent possible management policies that each country could follow in the absence of cooperation. The last two represent potential management options to be undertaken by both countries in the presence of a cooperative agreement.

In the absence of cooperative agreements, the fish management alternatives were fishing under open access conditions, a unilateral search for a maximum sustainable yield, and unilateral maximization of net benefits from fishing.

All three scenarios assume that each country has access to a fixed fraction of the entire transboundary shared fish stock. This assumption reflects the fact that a geographic boundary is enforced for political reasons.

In the presence of cooperative agreements, the management alternatives were joint maximization of net benefits recognizing the existence of a national boundary, and joint maximization of net benefits in a common fishing zone.

- Main Conclusions

This study aimed to determine the net benefits generated under alternative management strategies for sardine and anchovy boundary shared fish stocks and to evaluate the socioeconomic impact of these management alternatives in order to show that:

- Smaller net benefits are generated in the absence of a cooperative agreement than in the presence of a cooperative agreement.
- With cooperative agreement the optimal level of joint exploitation of the fishery yields higher net benefits, when a common fishing zone is maintained, than when a national boundary is enforced.

- Whether or not there is a cooperative agreement, a management strategy that seeks to maximize net benefits yields higher benefits than a management strategy to maximize the fishery's physical yield.

The first analysis showed the socioeconomic impact of different management strategies in the absence of cooperation, and a main conclusion was that management intervention is better than no intervention.

Also concluded that total net benefits for the Chile-Peru fishing area under a management policy seeking to unilaterally maximize physical yield and one seeking to unilaterally maximize net benefits are higher than total net benefits at open access equilibrium. In addition, for the country undertaking the management policy, total fishing effort and fishing fleet size are reduced.

A comparison of the impact of a management policy seeking to maximize physical yield with the impact of one seeking to maximize net benefits showed that the second yields significantly higher total net benefits.

The study underlined the effect, that the harvesting by the country that remains under open access, would have on the end results sought by the country undertaking the management policy. For both types of policy, any unilateral reduction in harvest rates implies an increase in the shared fish stock. The country remaining under open access would take advantage of this increase in fish stock, increasing its fishing effort and harvest rates, and would end up better off compared with the original open-access bioeconomic equilibrium. The country undertaking the management intervention would achieve smaller benefits than expected. In terms of harvest rates, the country undertaking the intervention ends up worse off than at open-access equilibrium.

These results show that, despite the secondary effects not considered by unilateral management interventions and according to resource economics theory, the management policy seeking to maximize net benefits is clearly superior both to the policy seeking to maximize physical yield and to no intervention at all.

A comparative analysis showed that, the management in the presence of a cooperative agreement and the enforcement of a geographic border yields higher benefits, than even the best management strategy in the absence of cooperation.

Although unilateral maximization in the absence of cooperation has a positive economic impact in terms of total net benefits for the CPFA, it induces exit from the fishery for the country remaining under open-access conditions. This would not occur under joint maximization in the presence of a cooperative agreement and the enforcement of a geographic border. Furthermore, the implementation of a unilateral maximization strategy, has the same effect as a bargaining situation in which one of the countries involved has all the negotiating power, making it potentially unfeasible politically.

The comparison of the two management strategies that seek to jointly maximize net benefits in the presence of a cooperative agreement shows that enforcing common fishing zone (CFZ) yields significantly higher total net benefits than enforcing a geographic border. Moving from MAXJ to CFZ would increase total net benefits. Even though stock size decreases and fishing effort or fleet size decreases.

The fundamental question to be answered in this analysis was whether the difference between the points on the bargaining frontier for the two management alternatives, MAXJ and CFZ, and the threat points (open-access status quo) is sufficiently large to motivate the two countries to attempt to negotiate an agreement. Results from running both scenarios showed that both management strategies would yield better results than the open-access status quo. And that a joint maximization management policy may have a higher probability of being followed under a common fishing zone than under an enforced geographic border.

The results also showed the socioeconomic impact of the cross-effects of enforcing the two management alternatives in the presence of a cooperative agreement. The differences between the countries' fleets in bioeconomic efficiency would lead to different results for the two countries when moving from joint management with an enforced geographic border (MAXJ) to joint management with a common fishing zone (CFZ). This situation, in the presence of either of the two management alternatives, would induce one of the countries to attempt to move toward the management alternative that appears more favorable to it.

Finally, authors resume the results for the five management strategies modeled in the following conclusions:

- Seeking to maximize net benefits is a better strategy than seeking to maximize physical yields.
- Joint maximization yields higher net benefits in the presence of a cooperative agreement than in its absence.
- A management policy that seeks to maximize net benefits over time and that maintains a common fishing zone is optimal for the management of a transboundary shared stock.

Current situation of shared stocks.

Although the results of Agüero and Gonzales paper shows that is better option a joint management strategy with both countries in cooperation. The study probably will be need to re-assess their estimates in order to include last years fisheries result, because last assessment indicate a fall in population estimates, particularly in sardine biomass, this according with data from last IMARPE-IFOP workshop.

This opinion surge from the analysis of the results of last meeting of the Working Group on small pelagic fisheries of anchovy and sardine that occur in the area south of Peru and North Chile³.

Sardine fishery

Fishing index of this fishery like catch landings and fishing effort describe a fishery in development process between 1974 to 1985 years, in a second phase since 1985, it is observed that both indicators decrease continuously until 1999 when was observed an slight growth. The catch landings reach a minimum level of 22 thousand t and 4 thousand t in 1996 and 1997 respectively these figures are the low in all fishing time.

Stock indices, total biomass by age, the spawning biomass and recruitment are parameters that characterize the stock situation. The results of the sequential population analysis (SAP) show that the abundance of the sardine increase from 1974 to 1980 and later it diminish in continuously way.

³ 6° Workshop Report of Working Group on small pelagic fisheries. IMARPE-IFOP.

Exploited indexes show the variation of the intensity of the fishing and its effect on the stock (Fglobal) was analyzed by means of global fishing mortality and by age (Fc), these show the high level of resource exploitation. The fact that Fc increases while the landings and biomass along with effort is explained by the density dependence relationship between capturability with resource abundance.

Although was observed an slight increasing tendency of recruitment in last years, the sardine stock recovery in the medium term requires of a favorable environmental and a precautionary management.

Anchovy fishery

Annual pattern of catch and fishing effort indicates that fishing activity between 1984 and 1999 has been pulsating, with an increasing tendency in period 1984-94, where maximums in 1986, 1989, 1994 and 1997 appear, diminishing in last years due to unfavorable environmental conditions. The interannual pattern of anchovy catch between countries shows a high synchrony, being high its association.

Recruitment of anchovies stock shows an increasing tendency until 1995, with three maximums in 1987, 1993 and 1995 with magnitudes greater than 4,5 million tons. These strong annual classes made possible the recovery of the stock, after the "El Niño" 1982/83. This strong recruitment increased the level of abundance of the stock. In period 1996-99 the recruitment displayed a descendent tendency with low magnitudes than average of the analyzed series. But recruitment estimations with the Sequential Analysis of Population (ASP) in general are uncertain for the last year and depend on pattern used.

Average biomass of anchovy stock presents variations that are correlated with the recruitment, which is responsible for its level. In period 1984-1993, the average biomass of the stock displayed an increasing tendency, with a maximum in 1993 considered in 14.9 million tons.

The spawning biomass shows an increasing tendency from 1984 to 1996 and increased strongly in 1993 and 1996 product of the entrance of the strong annual classes of 1991, 1992 and 1995. The increase of the spawning biomass generated a great stability in anchovy stock. In period 1997-1999 a reduction of the spawning stock was observed, quantifying the reduction in an 82% in relation to the maximum value of 1993. For 1999 a spawning biomass of a million tons has calculated.

Main conclusion of analysis was that in 1999 the rate of mortality by fishing of the anchoveta stock is high which allows indicating that the stock is plenty exploded still. Nevertheless the biological indicators and evolution ecosystem show a favorable condition for the recovery of the biomass of anchoveta in the short term.

The Future of collaboration.

The Humboldt Current Large Ecosystem Project.

The Humboldt current ecosystem is recognize as one of the major upwelling systems of the world, the Humboldt current system is predominantly an equatorward flow of cold, low salinity water with complex flows and counter-flows out to 1,000 km from the Peru-Chile coast. The Humboldt Current LME is considered highly productive ecosystem and the upwelling that occurs in this region is almost exclusively responsible for its productivity.

Peru and Chile, the countries bordering this LME, are aware to establish a close regional co-operation. In this way a regional workshop for the joint stock assessment of sardine and anchovy for Southern Peru and Northern Chile were organized by IFOP and IMARPE in November 1999. IFOP is Chile's Fisheries Research and Development Institute. IMARPE is Peru's Marine Research Institute.

Recently it was approved the Project "Integrated Management of the Great Marine Ecosystem of the Current of Humboldt" It will be executed by IMARPE, and IFOP of Chile; and it will have the financing of GEF, the participation of the United Nations for Industrial Development (ONUDI), and the scientific support of National Oceanic Atmospheric Administration (NOAA).

General aim of this project is to improve the national and regional efforts that allow advance towards the integrated management and sustainable use of Humboldt Current Large Marine Ecosystem.

Specific objectives are:

- Establishment of a mechanism of Regional Cooperation.
- Revision of the state of the knowledge on the Humboldt Current Large Marine Ecosystem.
- Development of a diagnosis and Transboundary Diagnostic Analysis - TDA.
- Development of a Strategic Action Program - SAP to take care of the deficiencies as much as the threats, essential for a sustainable management of the Ecosystem, and
- Development of the institutional capacities with respect to the integrated management of the Ecosystems.

Conclusion

This brief revision, on aspects of joint investigations about some recognized transboundary resources in Southeastern Pacific Region drives to a very clear conclusion, which is the great will of Regional countries to collaborate in establishing a management frame, that allows them, the sustainability in the exploitation of shared resources. Emphasis is made about the necessity to have a better knowledge of factors that impact those resources and its fisheries, as much as its particular environmental where they inhabit. Also must be included, economic and political aspects of sharing those resources. It is still required to develop a suitable institutional capacity of the region to confront the challenges, one is due to work much in harmonizing future policies and fishing legislation. It must do within the framework of Convention on the Law of the Sea with the participation and in consensus with all stakeholders to develop an effective capacity of management from monospecific level to ecosystem level. So future fisheries management will be based more on a solid scientific base and of mutual interest of countries stakeholders. In order to reach that objective and to be stable all the participants must be seen the cooperative regime to be fair and equitable. And this is a task that even there is need to develop in the Region of the Southeastern Pacific.

ANNEX I

TRANSBOUNDARY FISH STOCKS IN THE SOUTH EASTERN PACIFIC⁴

A. FISH

1. Argentinidae Family		
2. Bathylagidae Family		
3. Bramide Family		
<i>Brama japonica</i>		
4. Gonostomatidae Family		
5. Alepocephalidae Family		
6. Myctophidae		
7. Exocoetidae		
<i>Cypselurus heterurus</i> (R)	Pez Volador	Flying Fish
<i>Exocoetus volitans</i>	Pez Volador	Flying Fish
<i>Hirundichtys</i> spp	Pez Volador	Flying Fish
8. Scomberessocidae Family		
<i>Scomberesox saurus scombroides</i>	Agüjilla	
9. Scombridae Family		
<i>Scomber japonicus</i>	Caballa	Horse Mackerel
10. Carangidae Family		
<i>Caranx</i> spp.	Jurel	Green Jack
<i>Decapterus</i> sp.	Cocinero	
<i>Elagatis bipinnulata</i>	Jurel Fino, Jurelillo	Shortfin scad
<i>Seriola peruana</i>	Cola Amarilla	
<i>Seriola rivoliana</i>	Fortuno	
<i>Trachurus murphy</i>	Fortuno	
Ma	Jurel	Southern Jack
11. Coryphaenidae Family		
Coryphaenidae	Dorado o Perico	Mahi Mahi
12. Gempylidae Family		
<i>Gempylus serpens</i>	Caballa culebra	Snake Mackerel
<i>Lepidocybum flavobrunneum</i>	Escolar	Escolar
<i>Ruvetus pretiosus</i>	Pez aceitoso	Escolars,
Oilfishes		
<i>Thysites atun</i>	Sierra Sur	
13. Trichiuridae Family		
<i>Lepidopus caudatus</i>	Basurero negro	
<i>Lepidopus xantusi</i>	Basurero	

⁴ Doc. 006/04-98-SGC/CPPS.P.Alta Mar.- Segunda Reunión del grupo de Trabajo de Evaluación y Ordenación Pesquera en el Pacífico Sudeste y de Especies Transzonales y Altamente Migratorias. (Callao-Perú, abril 1998)

14. Nomeidae Family	Nomeidos	
B. SHARKS		
1. Cetorhinidae Family		
Cetorhinus maximus	Tiburón Canasta	
2. Carcharhinidae Family		
Carcharhinus falciformis	Cazón o Tiburón	
Carcharhinus galapagensis	Cazón	
Carcharhinus limbatus	Cazón	
Carcharhinus longimanus	Cazón	
Galeocerdo cuvieri	Tiburón Tigre	Tiger Shark
Proinace glauca	Tintorera	
C. Quelonios		
Chelonía mydas	Tortuga carey	
D. Cefalópodos		
Argonautidae Family		
Argonauta cornuta		
Ommastrephidae		
Dosidicus gigas	“Pota o calamar gigante”	
Symplectoteuthis oualaniesis		
Nototodarus sp.	“Jibia o Pota Cárdena”	
Todarodes filippovae	“Calamar Pota”	
	“Jibia antártica”	
Symplectoteuthis luminosa		
Ommastrephes Bartrami	“Pota luminosa”	
	“Pota saltadora”	
E. CRUSTACEOS		
1. Aristidae Family		
Benthesicymus tanneri		
Gennadas scutatus		
2. Sergestidae Family		
Sergestes phorcus		
3. Pasiphaeidae Family		
Pasiphaea Magna		
Pasiphaea americana		
4. Oplophoridae Family		
Systellapsis cristata		
Acanthephyra curtirostris		

5. Pandalidae Family
Plesionika martia

6. Ariesteidae Family
Benthesicymus tannen
Gennadas scutatus

F. Medusas o Malaguas
Hidromedusas or Malaguas
Hidromedudas
Esciforrmedusas