SWG-10-11

PERU

ANNUAL NATIONAL REPORT TO THE SPRFMO SCIENTIFIC WORKING GROUP

2010 - 2011

INDEX

1. DESCRIPTION OF THE FISHERY

1.1. Fleet composition

During last years, the operative jack mackerel fishing fleet in Peru showed low variability, reaching highest value in 2007 with 64 purse seine vessels (Table I).

On average operated 46 vessels on jack mackerel fishery, with a hold capacity between 301 to 900 m3. This fleet has made about 200 to 1000 trips per year (except 2010) and a total of 1022 fishing trips were made in 2006.

Table I. Number of vessels operating on jack Mackerel with purse Seine nets, per year and holding capacity strata (2004 – May 2011).

Year	N° Emb	CB (m^3)	N° of Fishing trips	Duration of Fishing trips (Hr)	N° of vessels per hold stratum (m^3)			
					101-200	201-300	301-400	401-900
2004	45	22265	509	87		1	4	40
2005	41	21592	322	117		4	1	40
2006	52	26825	1022	91	1		2	49
2007	64	32408	878	107	1	1	5	57
2008	56	29150	649	99		1	6	49
2009	57	29422	204	17			6	51
2010	2	241	2	31			1	1
2011*	51	26169	422	75			4	47

*up to may

1.2. Annual catch and fishing area

In the last eight years, annual jack mackerel catch volume in Peru fluctuated between 26 and 280 thousand tons, showing a gradual decrease from 2006 to 2010, year where the catch was only 300 tons, the lowest level historical. In 2011, from january to may, jack mackerel landing show a small recovery, getting 118 thousand tons.

During this period, it is remarkable the catch decrease in the northern area and their increase in the central and southern area off Peruvian coast, which are currently the main fishing areas (Table II, Figure 1).

Table II. Jack Mackerel catches with purse Seine nets, per area and year (2005 – May 2011).

Year	Total Catch (t)	Catch per area (t)		
		North boundary - 09º59' S	10º00' - 15º59`S	16°00' S - South boundary
2004	106270	0	85899	20371
2005	49476	720	16980	31776
2006	280269	65247	191637	23385
2007	188529	5286	132192	51051
2008	120748	64	50085	70599
2009	25912	100	25312	500
2010	300	270	30	0
2011	117833	59981	57816	36

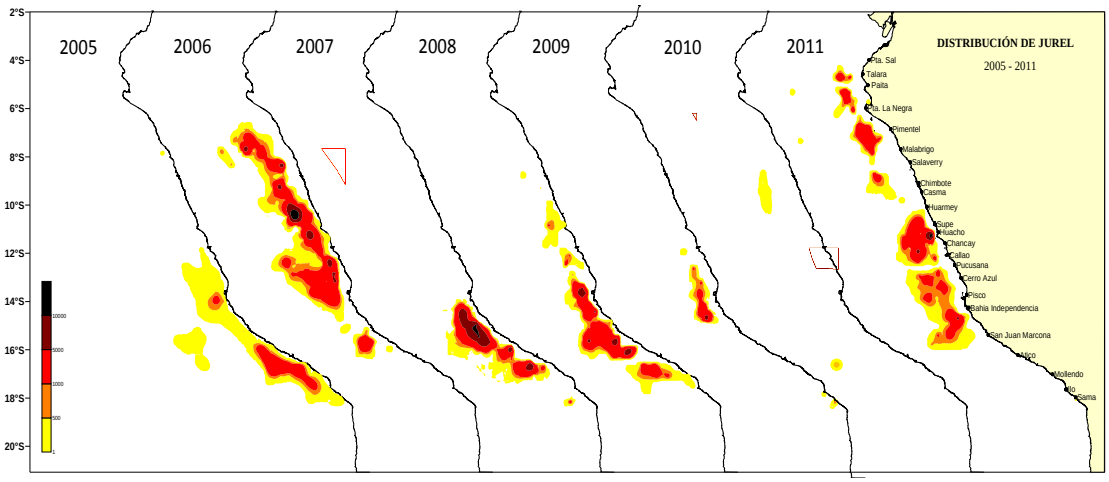


Figure 1: Jack Mackerel distribution, 2004 – 2011 period

2. CATCH, EFFORT AND CPUE IN THE JACK MACKEREL FISHERY

2.1. Trend in catches

The historical information about jack mackerel catches in Peru indicates that maximum levels were reached in 1977, 1995 and 2001, being both affected by the action of anchovy fleet, which temporarily aimed at jack mackerel fishing. Later on, jack mackerel catches reached between 50,000 and 280,000 tons per year, with peak values in 2006 (Figure 2).

Reports on annual landings of jack mackerel in the period January 2007 - May 2011 on the Peruvian coast showed a clear downward trend since 2008 and had a record minimum in 2010 due to low availability of jack mackerel, a situation similar to that observed throughout the Southeastern Pacific and has led to the adoption of measures to protect the population of mackerel in the framework of South Pacific Regional Fisheries Management Organization (SPRFMO). However, in the first half of 2011, highlights the increased availability of horse mackerel, which represents a change in the downward trend in abundance.

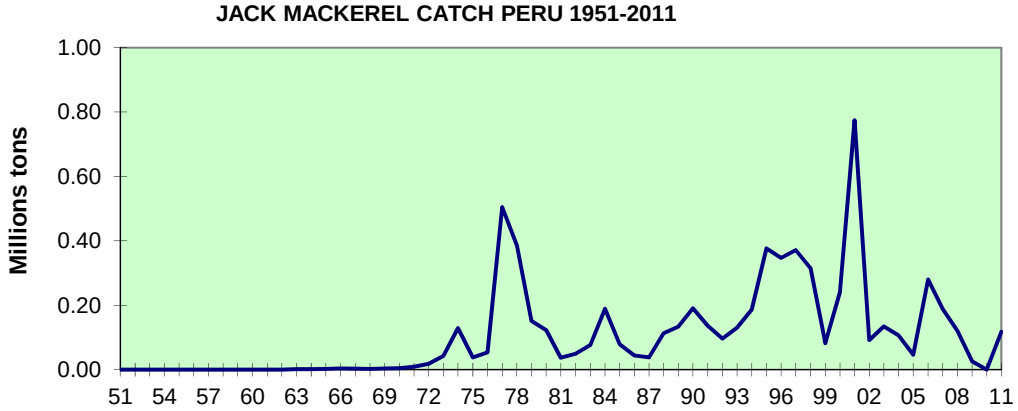


Figure 2: Annual Catch of Jack Mackerel in Peru during 1951 – May 2011*

2.2. Fishing effort trend

The fishing effort in jack mackerel fishery, measured as fishing trips and fishing hours, showed an increase in the number of trips from 2006 to 2008, decreased significantly between 2009 - 2010. From January to May of 2011, there have been 422 trips observed a gradual increase.

The duration of fishing trips did not show great variability in the period 2003 - 2008, reaching on average 100 hours per trip. From January to May 2011, the travel time averaged 75 hours (Figure 3).

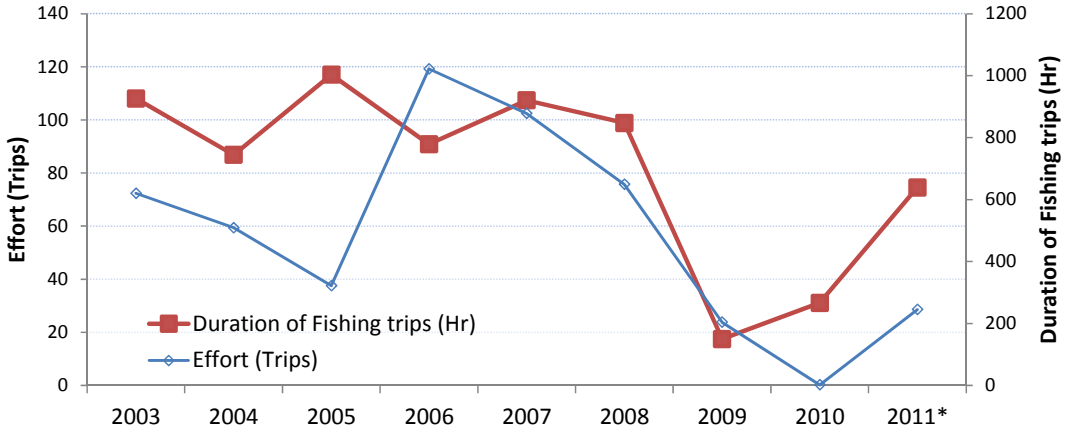


Figure 3: Number of fishing trips and duration of fishing trips with purse Seine nets, period 2001 – may 2011

2.3. CPUE trend

Two CPUE indicators are present in purse seine jack mackerel fishery in Peru. Both indicators: catches/ fishing trips and catches/trip hour showed the same trend, with highest values in 2006. However, a strong decrease has occurred until 2010, followed by small increase in 2011 (Figure 4).

Figure 4: Nominal CPUE; tons of jack mackerel by fishing trips and tons of jack mackerel by duration of fishing trips, using purse seine nets, period 2003 – may 2011.

3. RESEARCH ACTIVITIES AND DATA COLLECTION

Study area covers the entire Peruvian coast. The main pelagic species are anchovy (*Engraulis ringens*), sardine (*Sardinops sagax*), jack mackerel (*Trachurus murphyi*) and pacific mackerel (*Scomber japonicus*). Stock assesments of the main pelagic resources were made with the hydroacoustic method, using a SIMRAD echosounder - echointegrator EK 500 and EK 400 operating at 120 and 38 Khz to a depth of 250 m (IMARPE, 1997). In the present, a combination of direct and indirect methods is used.

All the research about jack mackerel includes the following projects:
Pelagic Resources Monitoring Program:
The main goal is the collection of daily information on species composition and size of catches that is later integrated in a large database which is the source for population's dynamics models construction.
Fishing Logbooks Program:
Is an onboard program of observers which supports the pelagic fish stock assessment and management in Peru. The program has evolved since its beginning and is now being updated to the framework of the Ecosystem Management. Currently, the monitoring issues are: effective effort, discards, biologic data collection, sightseeing of birds, mammals and turtles, collecting of water samples, taking pictures of acoustic records, among others.
Hydroacoustic direct assessments and application: To determine spatial distribution, relative or absolute abundance index to recommend management measures.
Satellite Monitoring of fishing fleet: This system is used to monitoring fishing vessels fleet activities in "real time".

The use of this kind of data allows the access to diary information on the main fishing areas where the industrial fishing fleet operates. Once this information is complemented with biological data obtained on board, it allows us to evaluate the magnitude of the fishery in a daily basis.

4. BIOLOGICAL INFORMATION

4.1. Biological sampling

The biological information is obtained through random two-stage stratified sampling, where 10 individuals from each size range are considered. With this sampling, information about length, weight, sexual maturity, gonad and weight length are obtained. Ovaries, otoliths and stomach samples are taken to perform ovarian tissues, age, growth and feeding diet analyses, respectively. Sampling is done twice a month at all IMARPE coastal laboratories.

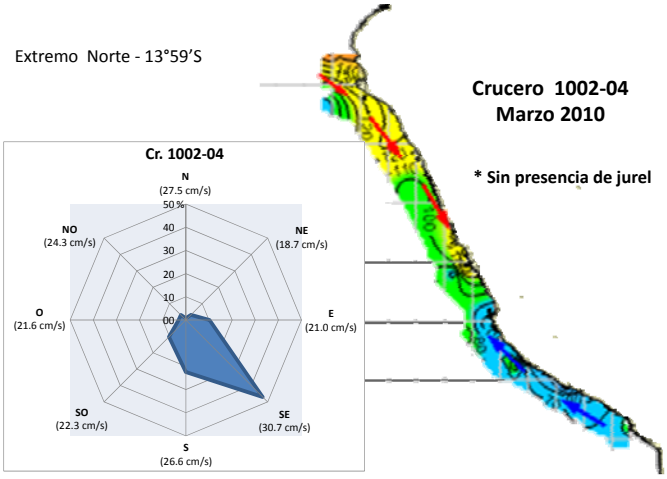
4,2. Changes on distribution of Jack mackerel in 2010

The lower availability of jack mackerel in 2010 was associated with highly variable environmental conditions, characterized by the presence of two extremes, very close together, which produced significant changes in the distribution and availability of jack mackerel in the Peruvian sea. Between December 2009 and summer 2010, we

recorded the impact of a weak El Niño (warm) and in the winter 2010 and early summer 2011 the impact of La Niña (cold).

A very important feature in the distribution of jack mackerel in the Peruvian sea is referring to the direction, speed and persistence of surface and/or subsurface currents that occur in a certain period of time.

The impact of El Niño in the summer of 2010 resulted in the absence of the resource during its period of greatest availability in the Peruvian sea (summer), it was associated with movements to the south supported a greater speed and current direction north - south, which in March reached a cruising speed of 30.7 cm / s in the direction of SE, the highest of all the observations made in 2010,
while the development of the event "La Niña" in the second half of 2010, led to the expansion of cold coastal waters (CCW), dispersing the resource and encouraging their northward movement, supported by greater speed and direction of currents south-north, which in august reached a maximum speed of 23.3 cm / s in the direction of NW, the highest of all the observations made in the second half of 2010. Considering that the La Niña event developed over a long period of time from June to December, it is likely that this environmental scenario would advance to jack mackerel, taking advantage of the formation of a road from south to north direction, reaching even to the degree 05 ° S (Fig. 5).



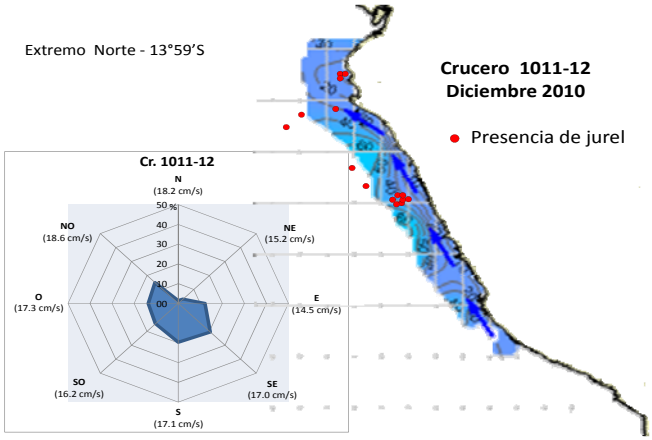


Fig. 5. Direction and Speed (cm / sec) of currents in relation to the presence of jack mackerel during cruises conducted in 2010

This shift in the distribution of mackerel to the central and northern regions of Peru is presented clearly associated with greater speed and from south to north direction of the currents, which occur during and immediately after an event La Nina.

Historical information obtained in the period 1980-2008, on similar scenarios, where we can analysis annual landings of Jack mackerel in Ecuador and Peru related to sea level anomalies along the coasts of Eastern south pacific (Fig. 6) indicates that in these circumstances, coupled with intense cold conditions, strong winds, increase upwelling, therefore, the availability of horse mackerel in northern and central regions of Peru is greater and consequently increase the levels of landing, where the level achieved in 1995 and 2001 the most significant, which was reached up to catch jack mackerel in Ecuador. This explanation can be seen in the landings made during 1995-96 (impacted by the action of La Niña classified as moderate, lasting 09 months), 2001 (La Niña event classified as weak, lasting 07 months) and 2006-2007 (event La Niña strong, lasting 09 months).

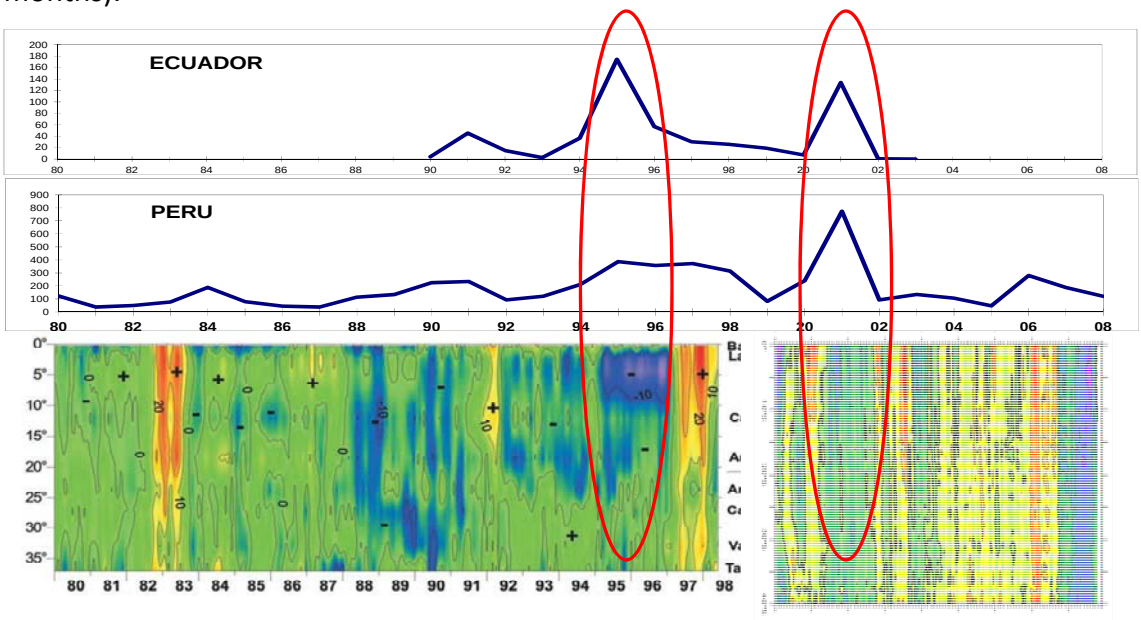


Fig. 6. Annual landings of Jack mackerel in Ecuador and Peru related to sea level anomalies along the coasts of Eastern south pacific (1980 – 2008)

In August 2010, observations made by a commercial vessel 200 miles off the coast between Bahia Independencia (14°30'S) and Atico (16°20'S), recorded the presence of specimens of jack mackerel with modal size between 19-20 cm total length (Fig. 7)

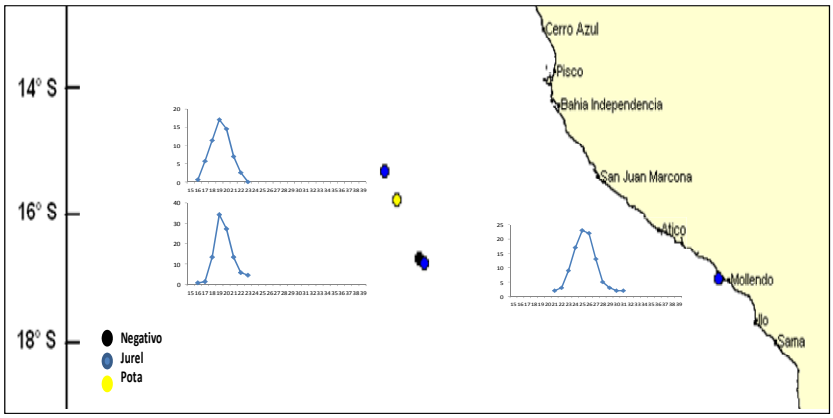


Fig. 7. Presence of Jack mackerel (modal size 19-20 cm) in august 2010 catch located between Bahia Independencia (14°30'S) and Atico (16°20'S), 200 miles off the coast

Is worth mentioning that during the research Cruise B / P Hakurei Maru No. 8 made between the second half of November 2010 and January 2011 (Fig. 8), jack mackerel was found in the stomach contents of giant squid to 200 miles offshore between the degrees 05°S - 07° S, during December 2010 (IMARPE 2011).

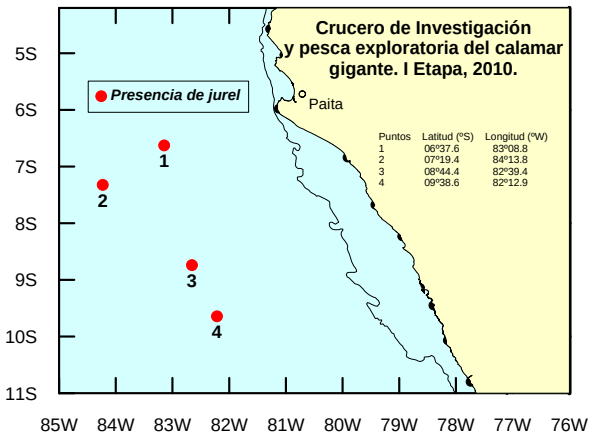


Fig. 8. Presence of jack mackerel in stomach contents of giant squid

4.3. Changes on distribution of Jack mackerel in 2011

During January to June the industrial fleet fishing for jack mackerel and mackerel, mainly operated between San Juan (15°S) y Paita (05°S) between 40 and 120 miles from the coast. During February-March the main fishing areas are located in 04° - 06° S (Paita - Pimentel) and 09° S (Chimbote). From April there was a shift of the main areas of concentration to south of Parachique, reaching 11°S and 12º S (Huacho-Callao). This shift was accentuated in recent months, associated with the Kelvin wave income (warm waters) in the northern region, localized fishing areas to south of Callao (Fig. 9).

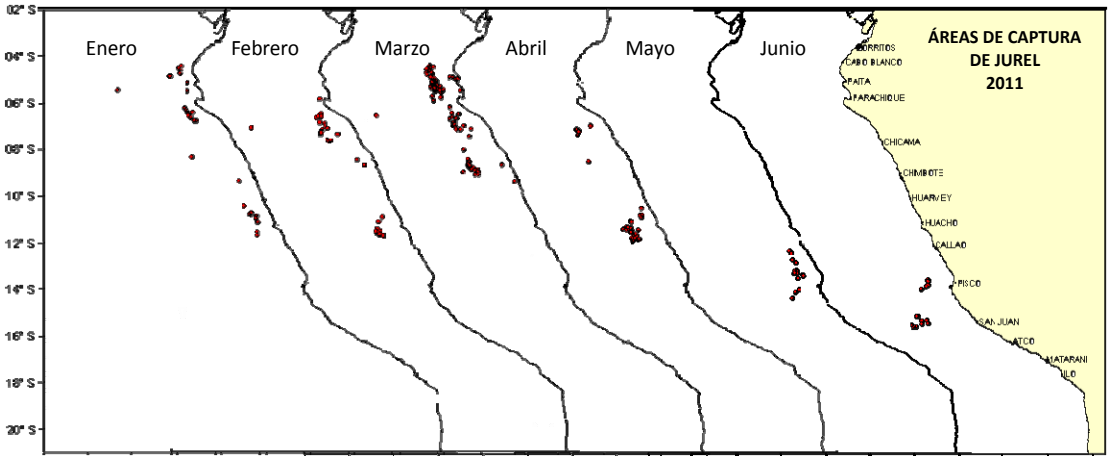


Fig. 9. Fishing areas of Jack mackerel during january – june 2011

4.4. Length and age composition of catches

The jack mackerel annual size structure during 2004 - 2011 had a polimodal structure. There is a remarkable presence of a high recruitment in 2005 and 2010, that they were consolidated in a high percentage of adult en el 2007 y 2011 which had a modal size between 33 and 35 cm of total length (Figure 10).

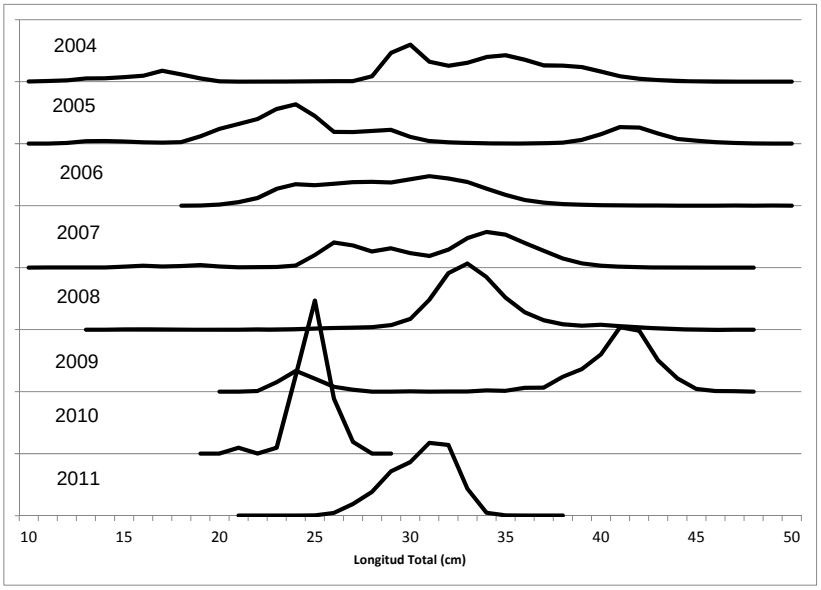


Figure 10. Annual Size structure of Jack mackerel (%) during 2004 – 2011

4.5. Biomass estimates and interdecadal changes

Jack mackerel biomass estimates for the period 1983- 2011, obtained by acoustic method in the Peruvian coast, clearly show two phases: a high biomass phase from 1983 to 1996 (average biomass= 4´800,000 tons) and a low biomass phase from 1997 (average biomass = 450, 000 tons), to present (Figure 11). These variations would be more related to interdecadal variations, whereas the effects of the jack mackerel fishery in Peru can not explain these observed changes.

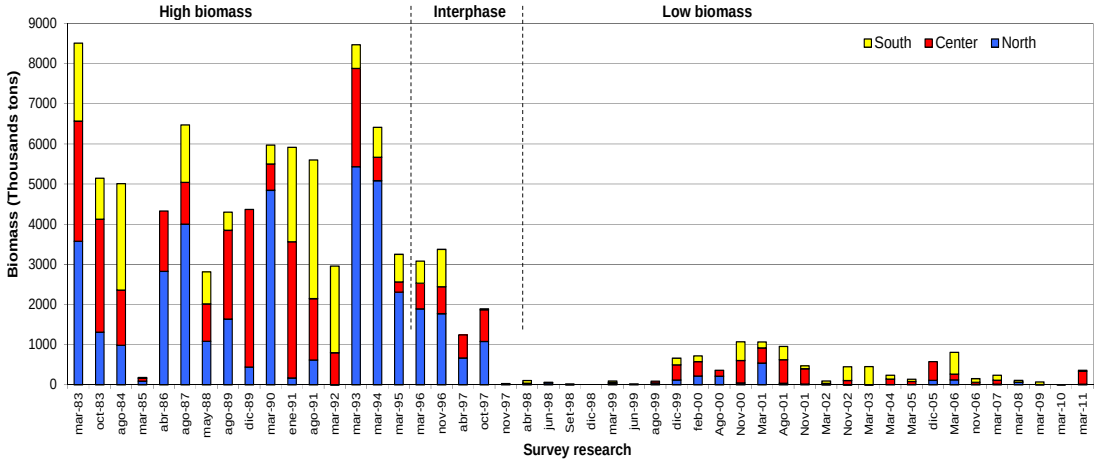


Figure 11. Jack Mackerel Biomass, according to hydroacoustic Assessment Survey (1983-2011)

There are also references about trend change in some environmental variables like the depth of the oxygen minimum zone that has become shallower since the 90's in the Peruvian sea, so we understand that climate has played a key role in the decreasing availability of jack mackerel off Peru.

Biomass estimates of jack mackerel by the acoustic method in 2010 and beginning of 2011 are presented in Table III.

Tabla III. Jack mackerel biomass during surveys doing in 2010 and 2011

Grado de latitud (°S)	Cr. Marzo 2010 Jurel	Cr. Diciembre 2010 Jurel	Cr. Marzo 2011 Jurel
03			
04	0	12	399
05	0	77	15 807
06	0	0	
07	1 239	0	
08	0	0	
09	0	21 642	
10	0	1 097	46 698
11	0	0	124 704
12	0	601	150 434
13	0	0	
14	0	0	
15	0	0	128
16	0	0	22 172
17	0		
18	0		2 435
TOTAL (t)	1 239	23 429	362 777

4.6. Stock assessment with age-structured models and Biomass Dynamic model

Virtual population analysis (VPA) model was implemented in order to estimate the available biomass of jack mackerel off Peru during the last ten years. Parameters supplied to models (growth, age-length key, M, maturity, weight at age) were estimated from fishery monitoring and surveys data.

On the other side, a biomass dynamic model, Schaeffer type, (Surplus Production Model – SPM) was adjusted with annual catch and CPUE data, available for the period 2001 to 2011. A maximum likelihood framework was developed in a MS Excel spreadsheet to estimate the parameters (K, r, q) of the model.

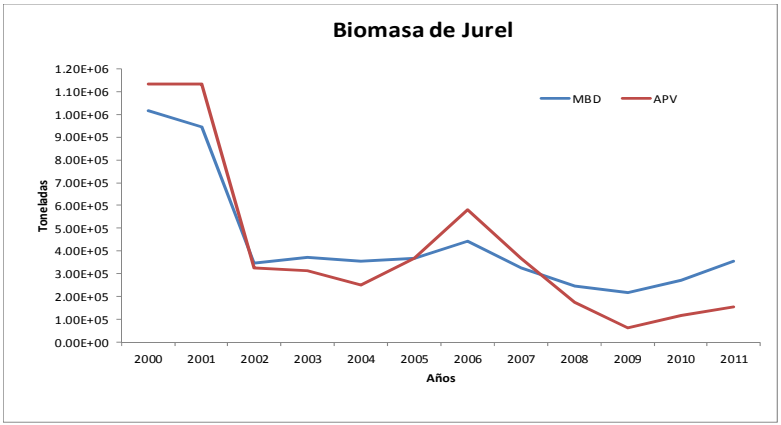


Figure 12. Biomass estimates of Jack mackerel in Peru by stock assesments models during 2000 – 2011

The available biomass off Peru estimated by stock assessments models (Fig. 12) showed comparable order of magnitude but some differences in the trend and the level of the last year. The highest biomass for the period 2000-2011 was observed in 2001(between 1 and 2 million t), after then, the biomass has kept at a level around 0.3 million t. The biomass dynamic model gave a more optimistic result, with an slight increasing trend since 2009 and a level around 0.35 million tons for the last year.

These methods can only estimate trends of available biomass of jack mackerel off Peru. In the past, purse seine fleet has only focused on this resource when seasonally available and mainly for fishmeal. Since 2002 the pressure on this resource has diminished because it is only used for direct human consumption. In consequence the results of the biomass dynamic model probable give a more reliable figure on the state of jack mackerel off Peru.

4.7. Assessments using data from commercial fleet

Abundance of jack mackerel was calculated using an analytical method mackerel (geostatistical) and a direct method (acoustic). The average weekly abundance yields as geostatistical methods were 168 000 tons with peaks at 639, 497 and 488 thousand tons. The Acoustic estimate indicated a mean abundance of 300 000 tons with peaks in 481, 460 and 435 000 t. However it should be noted that this evaluation is only representative of the areas where it operated the fleet (II Workshop, 2011).

5. SAMPLING PROGRAM AND DATA FROM LANDING POINTS

The goal of the sampling program targeting mackerel is to maximize the number of samples covering the largest geographical area where the fishing fleet is distributed, assuming that this coverage is related to the higher concentration of the resource. This increases the likelihood of obtaining representative samples of the study population. The main IMARPE head office is located in Callao (12°S). However, there are 8 laboratories in the Peruvian coastal region Tumbes, Paita, Santa Rosa, Huanchaco, Chimbote, Huacho, Pisco, Ilo and temporal stations in Chicama and Matarani.

6. IMPLEMENTATION OF MANAGEMENT RECOMMENDATIONS

6.1. Biological measures

Among the main regulative measures, we have:

- Mesh size 38 mm or 1½ inch.
- Minimum catch size: 31 cm.
- Juveniles limit in catch: 30% of total number.
- Jack and Horse Mackerel Fishery Law N° 011-2007-PRODUCE (12th April 2007), that promotes a rational exploitation of this fishery resources.

6.2. Fishing effort control

The legal rule D.S. 001-2002, since 2002 established exclusive use of these species for direct human consumption, which has restricted catches and allowed the development of industrial fleet with Refrigerated Sea water systems.

In the late '90s started satellite monitoring of vessels, and from 2003, the Government of Peru ordered the implementation of satellite-based vessels monitoring systems in both: large scale and wooden industrial fishing vessels (D.S. N° 031-2003-PRODUCE).

The aim was to promote the development of the national fishing activity in high seas, mainly in the South East Pacific Ocean area. On July 2009, a legal rule named D.S. 022-2009-PRODUCE established the regulatory provisions for the exploitation of highly migratory fishing resources, such as jack and horse Mackerel, by national large scale fishing vessels in high seas.

6.3. Quota control

Since 2006 catch quotas have been applied in certain monthly periods (Table IV).

Table IV. Total Allowable Catch (thousands tons) for Jack Mackerel during 2006 - 2011.

Year	Period	Total Allowable Catch (thousand t)		Legal Regulation
		Jack mackerel	Horse mackerel	
2006	Jan - March	60 (20/month)	S/C	R.M. 015-2006-PRODUCE
2007	28 JUL - 30 SET	40 (20/month)	S/C	R.M. 237-2007-PRODUCE
	21 OCT - 31 DIC	40 (20/month)	S/C	R.M. 310-2007-PRODUCE
2008	16 FEB - 31 MARCH	76 (38/month)	S/C	R.M. 355-2008-PRODUCE
2009	18 JAN - 31 MARCH	60 (20/month)	60 (20/month)	R.M. 019-2009PRODUCE
2010	February – March	30 (15/month)	30 (15/month)	R.M. 026-2010-PRODUCE
	April – May	30 (15/month)	30 (15/month)	R.M. 096-2010-PRODUCE
	18 august-18 october	30 (15/month)	30 (15/month)	R.M. 202-2010-PRODUCE
2011	27 jan – 31 march	30 (10/month)	45 (15/month)	R.M. 025-2011-PRODUCE
	25 feb – 31 march	Extensive to 45		R.M. 058-2011-PRODUCE
	25 march – 30 april	Extensive to 55		R.M. 107-2011-PRODUCE
	28 april – 30 june	Extensive to 120		R.M. 146-2011-PRODUCE