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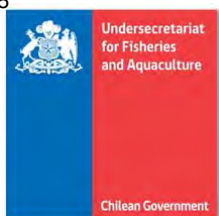
SC-03-14

Chile's Annual report
Subsecretaría de Pesca y Acuicultura



ANNUAL NATIONAL REPORT SPRFMO-SCIENTIFIC COMMITTEE

August, 2015.



1. DESCRIPTION OF THE FISHERY

1.1 Composition of the Fleet.

Between January and July 2015, the industrial purse seine fleet operating on jack mackerel fishery in both, the SPFRMO area and Chilean EEZ combined, consisted of 88 vessels. This number is slightly lower than 2014 (89 vessels) and represents a stabilization in the downward trend observed since 2009, when 129 vessels operated. The fleet contraction has been mainly associated with a reduction of the catch quota resulting from the resource's critical condition. The fleet observed in 2015 was constituted by 67% for vessels with a hold capacity not exceeding 600 m³ which operated mainly in the north area of the country (**Table I**)

Table I. Number of industrial purse seine vessels catching jack mackerel in both, the Chilean EEZ and SPRFMO area combined, between 2011 and July 2015. Data were assembled by year and hold capacity. (2015* are preliminary data).

Hold Capacity (m ³)	2011	2012	2013	2014	2015 (*)
0-300	2	0	1	0	2
300-600	67	60	60	60	57
600-900	10	8	8	6	7
900-1200	10	6	6	5	4
1200-1500	11	9	8	5	7
1500-1800	12	9	9	8	8
1800-2100	5	5	4	4	3
TOTAL	117	97	96	88	88

As a result of changes in the resource's distribution, between 2012 and 2014, the jack mackerel fleet operated mainly within the Chilean EEZ. Nevertheless this condition was reversed during 2015, with a 30% of the fleet operating in the SPRFMO, mainly represented in that area by vessels with hold capacities greater than 900 m³ (**Table II**).

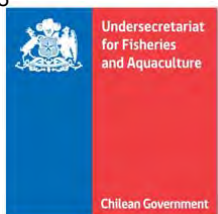


Table II. Number of industrial purse seine vessels catching jack mackerel in the SPRFMO area between 2011 and July 2015. Data were assembled by year and hold capacity. (2015* are preliminary data).

Hold Capacity (m ³)	2011	2012	2013	2014	2015 (*)
0-300	0	0	0	0	0
300-600	0	0	0	0	0
600-900	4	0	2	0	3
900-1200	4	2	1	3	4
1200-1500	9	1	3	3	7
1500-1800	10	3	3	4	8
1800-2100	5	3	1	1	3
TOTAL	32	9	10	11	25

1.2 Catches, Seasonality of Catches, Fishing Grounds and By-catch

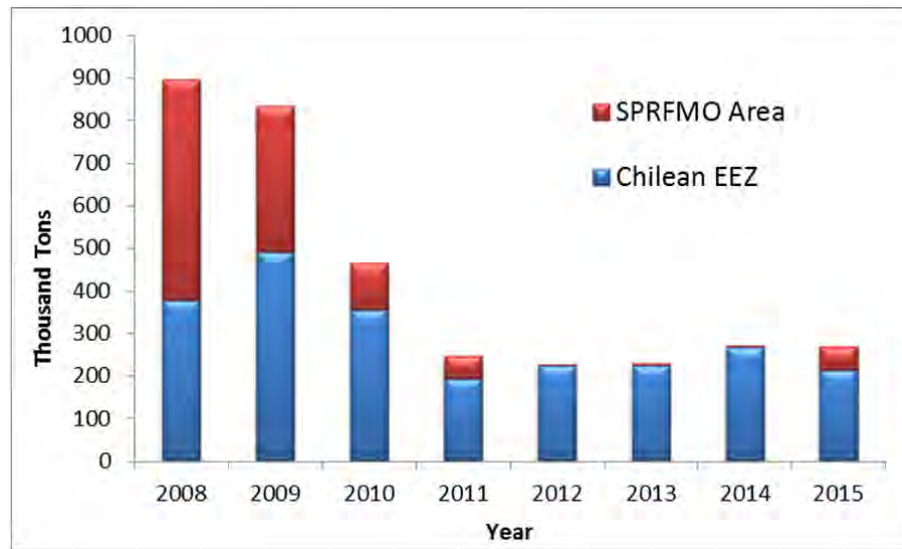
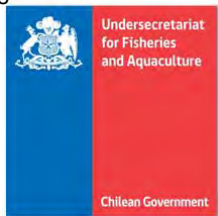
Catches

As observed from 2011 to date, the total catch of jack mackerel by the Chilean fleet has remained stable due to compliance with the catch quotas set by the SPRFMO.

The catch projection to August 2015 reached 269,893 metric tons, a value 2% lower than registered during the entire 2014. Unlike 2014, this year 56,223 metric tons have been captured in the SPRFMO Area, which represent near 20% of the total catch of the national fleet (Figure 1 and Table III).

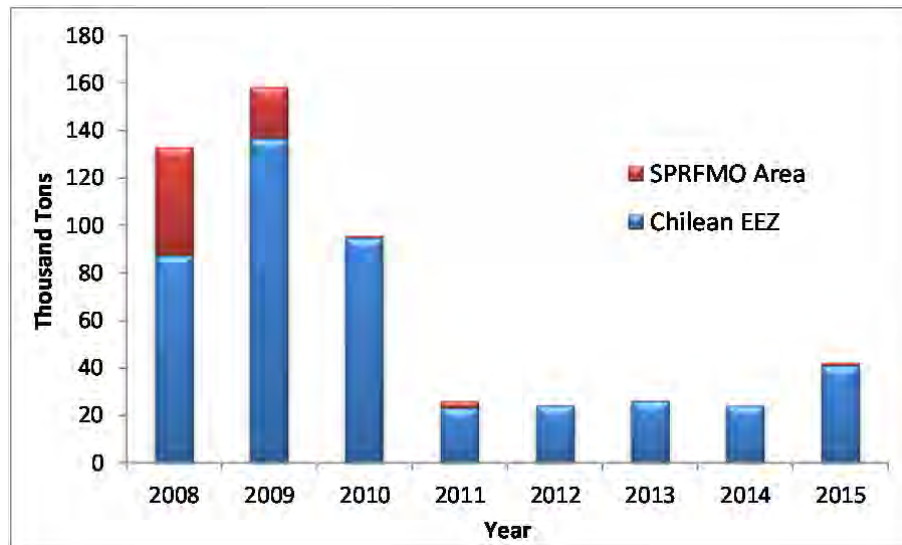
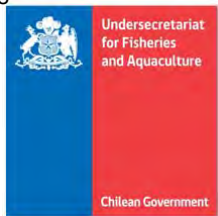
In spite of yet restricted fishing quotas, during 2015 catches of jack mackerel in the northern area of the country have been higher than those recorded in the past four years, totaling 35 thousand tons during the first half. These catches were mainly composed by jack mackerel caught as bycatch in the anchovy fishery.

Besides jack mackerel, the national fleet also captured chub mackerel, which totaled 40,198 by July 2015, value significantly exceeding the average registered for the period 2012-2014. However, catches of chub mackerel in the SPRFMO area did not exceed 1% of the total catch of this resource during the same period in 2015 (Figure 2 and Table IV).



Year	Chilean Jack Mackerel (t)		
	Chilean EEZ	SPRFMO Area	Total
2008	376,370	519,738	896,108
2009	491,792	343,135	834,927
2010	355,510	109,298	464,808
2011	193,722	53,573	247,295
2012	223,322	4,138	227,460
2013	225,443	5,917	231,360
2014	268,531	3,983	272,514
2015	213,670	56,223	269,893

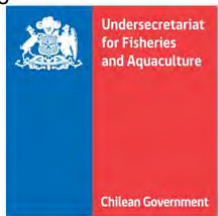
Figure 1 and Table III. Total annual jack mackerel catch in the Chilean EEZ and the SPRFMO area with purse seine nets for the period 2008 - August 2015 (31th august projection).



Years	Chub Mackerel (t)		
	Chilean EEZ	SPRFMO Area	Total
2008	87,316	45,702	133,018
2009	136,516	21,936	158,452
2010	94,723	936	95,659
2011	23,077	2,979	26,056
2012	24,120	199	24,319
2013	26,086	243	26,325
2014	24,135	31	24,166
2015	40,918	1,440	39,478

Figure 2 and **Table IV.** Total annual chub mackerel catch in the Chilean EEZ and SPRFMO area with purse seine nets for the period 2008 - July 2015.

Note: the total catch in 2014 was modified.



Seasonality of Catches

During the first half of 2015, monthly catches of jack mackerel fluctuated around 22 thousand metric tons (Figure 3), the lowest value recorded for period 2010-2015. This condition is mainly explained by low catches registered during February, when a high presence of juveniles was detected in catches. Nevertheless, contrary to the usually low catches observed during the months of April, May and June in the period 2012-2014, for 2015, a significant increase in catches occurred in those months, with 56,200, 41,700 and 52,800 metric tons respectively, which accounted for 71% of the cumulative total catch of jack mackerel this year.

Related to the historic pattern exhibited by the national fleet, the above reflects a slight shift in the fishing season, which extended in one month its operations this year.

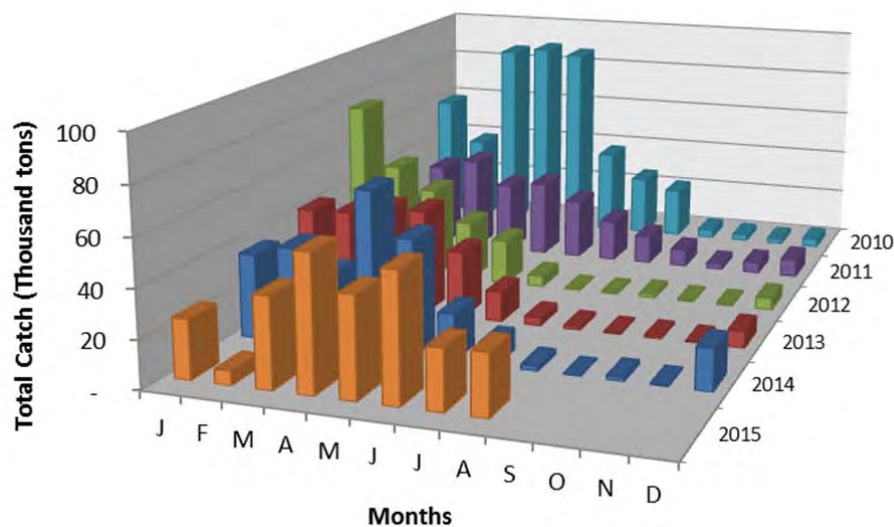


Figure 3: Seasonality of jack mackerel catches by the purse-seine fleet for the period 2010-August 2015. Source: SERNAPESCA.

Spatial Distribution of Catches

During 2013 and 2014, the fleet operating in the south-central area of the Chile exhibited a catch pattern mainly restricted to the EEZ, within the first 100 nm, not displaying the typical shift towards international waters during the second and third trimesters as observed in previous years.



For the first quarter of 2015, the spatial distribution of jack mackerel catches in the south central area of Chile were concentrated near the coast (first 100 nm) and between 29°- 37° SL and. Later in April and May, catches were concentrated further north-west, between 29°- 35° SL but still within the EEZ (Figure 4). Nevertheless in June 2015 the fleet exhibited a different pattern of operation compared with previous years (2013 and 2014) with catches obtained away from the coast, even outside the EEZ. These were concentrated further south, between 39°-43° SL.

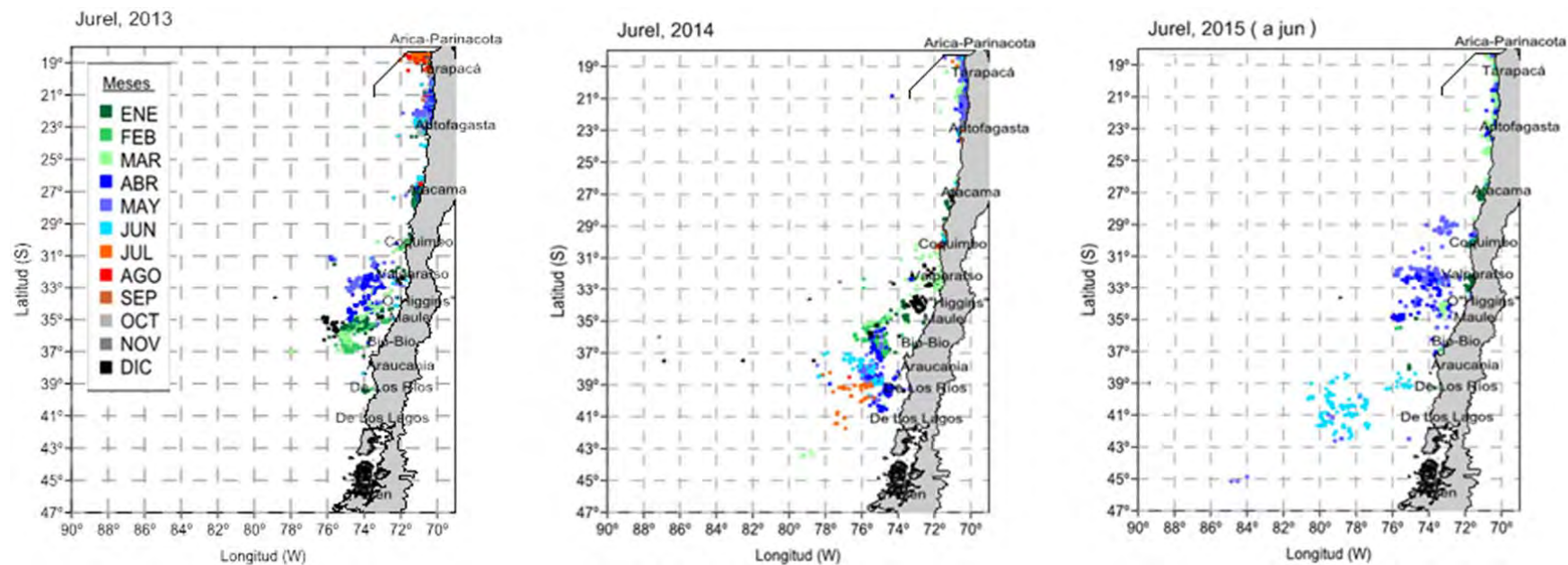


Figure 4: Spatial-temporal distribution of industrial jack mackerel purse seine fleet 2013, 2014, and Jun 2015. Source: IFOP.



National Landings of Jumbo Flying Squid

With the exception of 2010, when the industrial fleet increased its operation on jumbo flying squid, in recent years the national landings of this resource mainly came from the artisanal fleet (Fig. 5). At present, jumbo flying squid is being caught using jigging by the demersal artisanal fleet in Regions IV, V and VIII, and occasionally by the artisanal pelagic purse seine fleet in Region VIII. In the early years of this fishery, the industrial fleet caught this resource as bycatch, when targeting other pelagic and demersal species of higher economic value. However, from 2011 to date, this species has also become a target species and part of the fishing effort turns to its exploitation. This condition is a response to the declining abundance of other resources of higher value. In 2012 jumbo flying squid was declared in a state of full exploitation and a fishing quota of 180,000 metric tons was established, which later increased to 200,000 metric tons in 2013, 2014 and 2015.

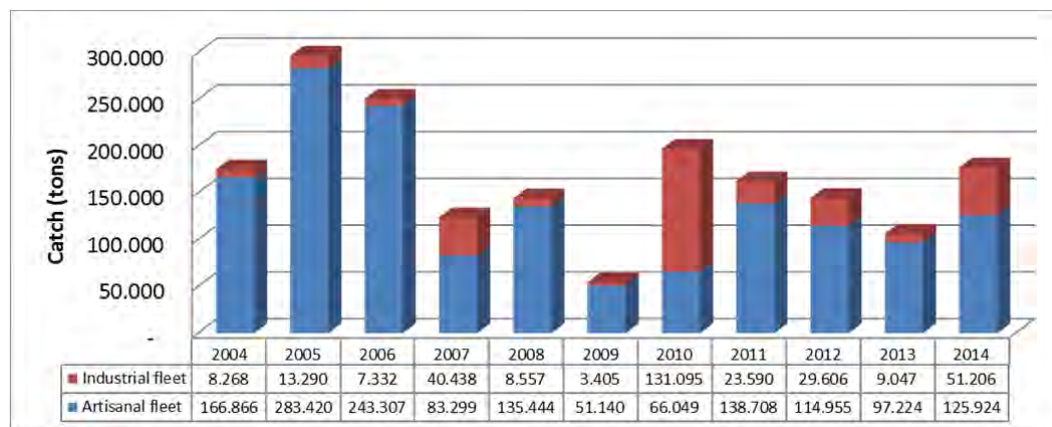


Figure 5: National Landings of Jumbo Flying Squid

Bycatch, Discards and Incidental Catch

In order to enhance focus on conservation, in September 2012 the Chilean Government enacted a discard (bycatch) law (N°20.625) establishing control measures and sanctions for those who discard at sea, and improving working conditions for fisheries observers, ensuring the collection of unbiased data. Provisions on the incidental catch of seabirds, turtles and marine mammals were also established through this law

Since discard and incidental catch were largely unknown, the law required a two-year research program, to gather basic information on these subjects (quantities, causes,



and spatial variations). On the other hand, to discourage atypical fleet's behaviors during the program, participating vessels were exempted from discard penalties.

The research program started with bottom-trawl fisheries, but was expanded to other fisheries and gears in 2014 and 2015 through increased budget.

In February 2015, through Resolution 524, the program was initiated in the industrial purse seine fleet targeting mackerel in both, the central south area (V-X Regions) and international waters. Data are being collected by observers on board and results will be of public domain once the study is finished in February 2017

Within 3 years of initiated the jack mackerel program, a reduction plan, containing technological and administrative measures, surveillance programs, codes of conduct, and incentives to improve selectivity, shall be established.

Discards and incidental catches shall be informed by vessel owners, and as of 2016 vessels ≥ 45 feet must install electronic monitoring systems to detect discard (observers cannot monitor compliance).

2. EFFORT AND CPUE FOR JACK MACKEREL FISHERY

The information contained in this section concerns the fleet of the central-southern area targeting jack mackerel. Catch, effort, and CPUE were calculated for fishing trips where jack mackerel represented more than 50% of the catch

Due to the remoteness of the fishing grounds, until 2010, the length of fishing trips for jack mackerel exhibited a growing trend (Figure 6). Subsequently, in 2012 and 2013, catches were concentrated within the EEZ, which reduced considerably (-50%) the average length of the fishing trips and stabilized the decrease off the fishing effort. In 2015, catches have been congregated southwestward, as evidenced by increased length of the fishing trips. Consequently, fishing effort, measured as the number of fishing trips with catch decreased progressively until reaching the lowest levels in 2010, then stabilized between 2011 and 2014, and recently exhibited a slight increase during 2015.

On the other hand, the standardized CPUE, measured as the utilization rate of the carrying capacity of the fleet ($\text{catch}/(\text{hold capacity displaced} \times \text{length of fishing trip})$) exhibited a decreasing trend between 2001 and 2011. Subsequently, in 2012, this indicator changed its trend toward higher values with a slight decreasing tendency between 2012 and 2015. The change in trend observed from 2012 onwards is explained by a decrease in the average length of the fishing trips as a result of changes in the distribution of the resource (Figure 7).

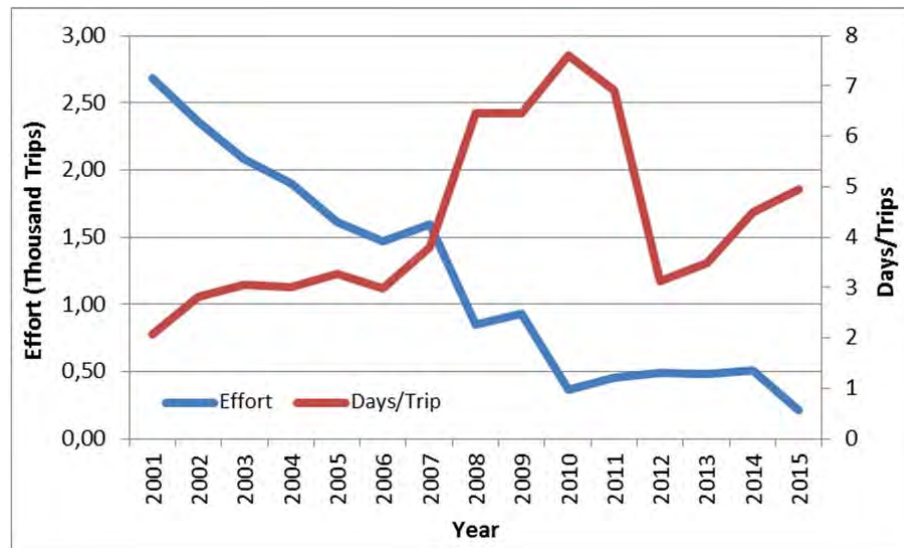


Figure 6: Effort in number of trips with catch (blue), and length of fishing trips in days (red) for the purse seine fleet in the center-southern zone, period 2001-2015 (preliminary). Data SERNAPESCA. Source: IFOP.



Figure 7: Nominal CPUE for the purse seine fleet in the center-southern zone, period 2001-2015 (preliminary). Source: IFOP.



3. RESEARCH PROGRAMS

Research programs for jack mackerel include standard projects carried out annually by IFOP (Fisheries Development Institute) along with complementary projects. The information obtained is used by the Fishing Authority to support the decision-making process.

Basic (standard) projects performed by IFOP during 2014:

- ***Hydroacoustic assessment of jack mackerel biomass between XV-IV Regions, 2014***

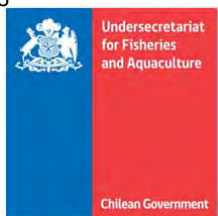
This research cruise took place from March 18st through April 24th 2014, and included an exploration area located between the northern boundary of the country and Coquimbo (30° 05' SL), where perpendicular transects reaching up to 100 nm from the coast, were prospected. As a result, in the prospected area, a jack mackerel biomass of 85,200 tons was estimated.

- ***Monitoring of the jack mackerel fishery***

This study allowed gathering real-time information on the evolution of the main biological and fishing indicators, associated with the jack mackerel fishery and its bycatch. The monitoring was carried out along the entire maritime space between the north boundary of Chile and 47°00' SL, and included information gathered at sea from both the small-scale, and the industrial fleet as well information from disembarking points.

- ***Assessment of total allowable catch***

Similarly as done by the SWG, this study used the Joint Jack Mackerel (JJM) model. This project was aimed to set up the status of the resource, and also to assess biologically sustainable exploitation rates. The results were used by the Fishing Authority to improve the stock evaluation, simulate different exploitation scenarios and conduct additional analyses.



- ***Protocol for otolith reading in jack mackerel***

This project aims to develop a protocol for determining the age of jack mackerel, by validating the identification of the first annual ring and the assessment of the age of jack mackerel through standardized reading of annual rings.

- ***Population structure and assessment of recruitment indices for Jack mackerel based on biophysical models (Phase I).***

This study aims to implement a spatially explicit biophysical model that allows predicting areas of recruitment for juvenile jack mackerel as well as connectivity relations between all the spawning areas of the resource.

- ***Discard and incidental catch research program for industrial fleet targeting jack mackerel in V-X Regions and International Waters***

This study began in February 2015 and is intended to quantify the discards of target species and the incidental catch of seabirds, turtles and marine mammals. Additionally it has to identify the causes of these practices and how they occur. The study should include a proposal of measures aimed at the reduction of discards and incidental takes which will be implemented through a reduction plan by 2017. Data are being obtained through both observers on board and self-reporting by skipper or vessel owners.

4. BIOLOGICAL SAMPLING, AND LENGTH AND AGE COMPOSITION OF THE CATCH.

4.1 Biological sampling

Biological information is obtained on a regular basis from samples collected along the Chilean coast for jack mackerel and its associated species. Sampling are conducted on a daily basis, mainly at landing sites/processing plants, but are also complemented with information gathered by fisheries observers on board fishing vessels. The information collected includes fork length measurements, otolith collection, total weight, gutted weight, gonad weight, and sex and maturity stages.

The amount of length and biological samples obtained for jack mackerel during 2014 added up 191.524 y 18.734 specimens, respectively. For the industrial fleet, samples included at-sea sampling as well as port sampling, covering the whole range of activity reported for this fishery in Chile. The main landing ports sampled were Caldera and Coquimbo in the north area, and Talcahuano in the central-south area of the fishery (Table III).



Chub mackerel, the main bycatch for jack mackerel, was also sampled during 2014. A total of 12.153 and 740 specimens for length and biological samples were collected respectively.

Table III. Number of Jack mackerel and Chub mackerel specimens collected in 2014 to gather biological and length samples.

Landing Port	Jack Mackerel		Chub Mackerel	
	Lenght Sampling	Biological Sampling	Lenght Sampling	Biological Sampling
Arica	6.796	94	1343	
Iquique	18.753	293	3779	
Antofagasta	24.598	351	4953	139
Caldera	46.619	2384	1521	129
Coquimbo	58.944	906	476	39
S. Antonio	11.224	3.897	25	183
Talcahuano	16.306	6.989	37	225
Valdivia	7.766	3.761	19	25
Chiloé	518	59		
Guaitecas				
TOTAL	191.524	18.734	12.153	740

4.2 Length and age composition of catches

a.- Jack mackerel

Unlike the observed between 2012 and 2014, during the first half of 2015, the size structure of jack mackerel showed a multimodal distribution, with a shift of the main mode toward smaller individuals.

In 2015, the main mode was 26-27 cm FL, followed by a secondary mode of 35 cm FL. These modes belong to fish caught in the south-center area of the fishery, where juveniles have been present during most part of this year.

It should be noted that a smaller mode occurred at 14-15 cm FL, which belongs to juvenile fish caught as bycatch in the purse seine fishery for anchovy in the north area of the country (Figure 8)

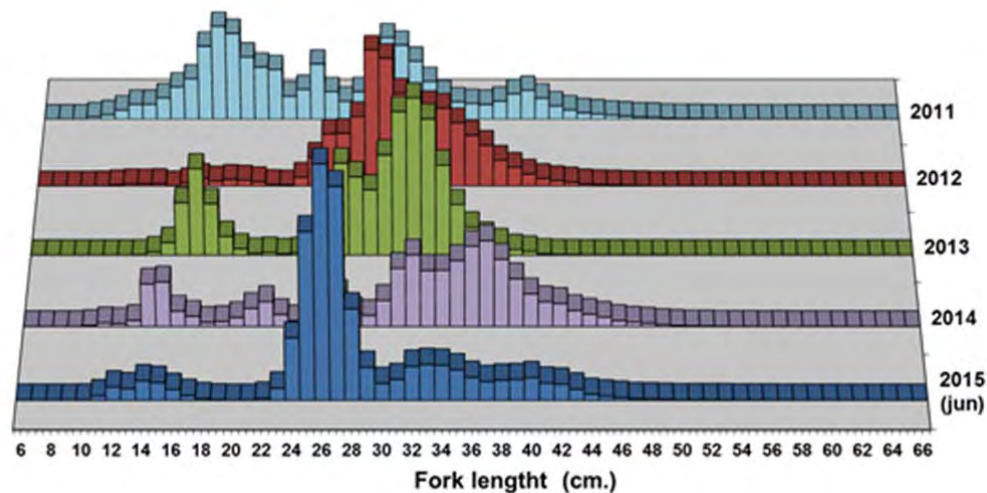


Figure 8. Length structure of jack mackerel, total catch in number 2011 - June 2015. Source: IFOP

During 2014, the age structure for jack mackerel was constituted by 20 age groups, where ages V and VI (caught in the central south area), and age II (caught in the north area) represented the main modes. Similarly as observed in 2013, an important contribution of juvenile fish (age II) was detected in 2014, differing from 2012, when juvenile were almost absent in the fishery (Figure 9).

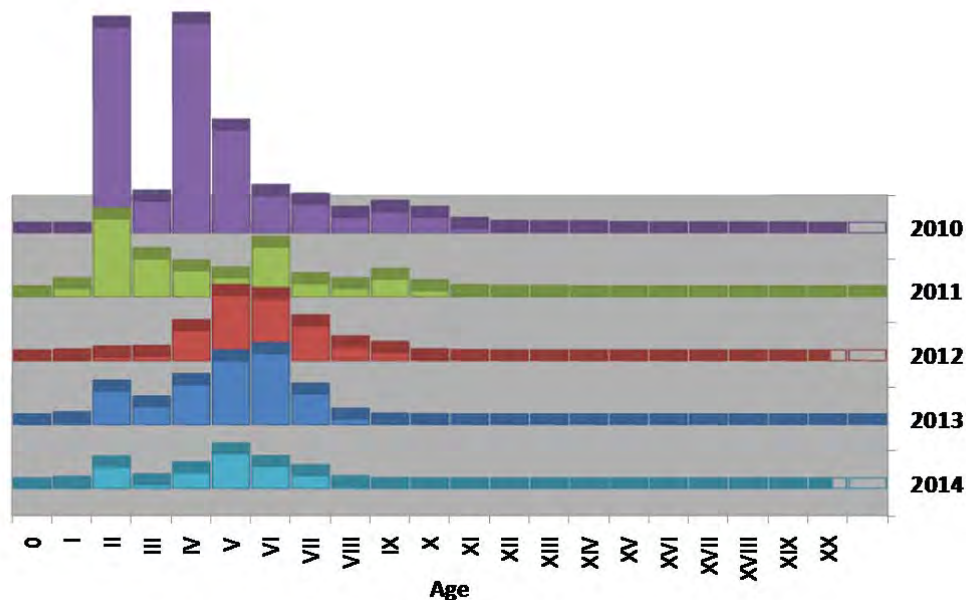


Figure 9: Age structure of jack mackerel, total catch in numbers, 2010-2014. Source: IFOP.



b. – Chub mackerel size composition

Restricted by small catches of chub mackerel during the last three years (2012-2015), the numbers of samples obtained have not been representative enough as to establish an age structure. However, as a reference point, it is possible to indicate that samples obtained between 19° - 24° SL during the first half of 2015, exhibited a multimodal structure with a main and a secondary mode at 33 and 36 cm FL respectively. In the southern area of the country (33 °-40 ° SL), the size structure for this resource exhibited of a main mode of 33 cm FL.

c.- Jumbo Flying Squid

Research carried out in recent years by the Institute for Fisheries Development have indicated an adjustment of the length-weight ratio for Jumbo Flying Squid according to the following relation

$$P = 0.0000254 L^{3.0771664} ; \text{ see also Figure 10}$$

The above has allowed to estimate a growth model based in mantle length and body weight as exhibited in Figure 11.

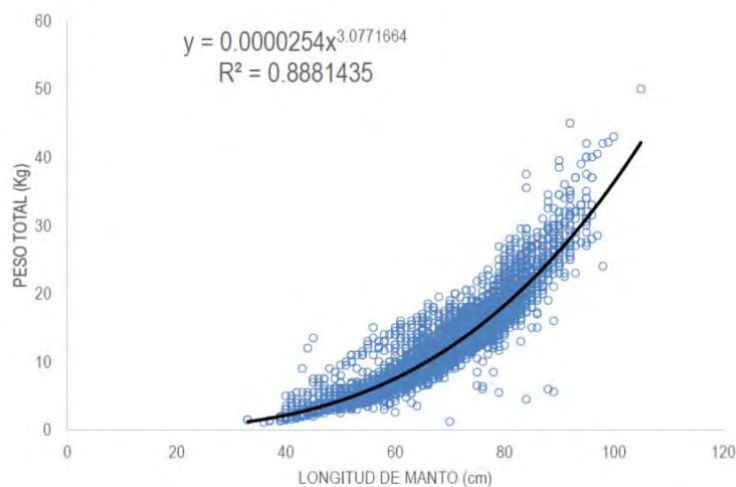


Figure 10: Adjustment of the length-weight ratio

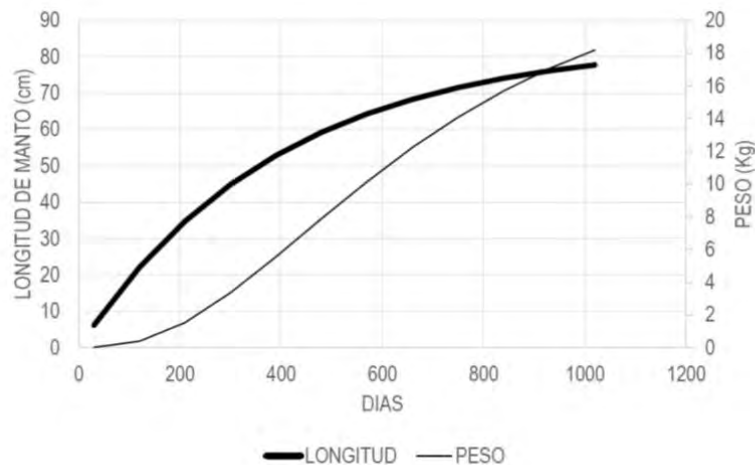


Figure 11: Growth models in mantle length and body weight for Jumbo Flying Squid in central Chile.

5. AT-SEA AND PORT SAMPLING PROGRAM.

To assess the level of sampling coverage in the SPRFMO area, only fishing trips targeting jack mackerel (i.e. over 50% of the total catch per fishing trip) that also carried fisheries observers on board and/or included at-port samplings by observers, were considered in this report

Due to a more costal pattern of the jack mackerel fishery during the last years, it has been difficult to cover the operations of the fleet in the SPRFMO area with observers on board, since fishing trips have become infrequent and unpredictable there and not planed in advance as to guarantee the presence of an observer. In spite of the restrictions, onboard sampling coverage and at-port sampling coverage for fishing trips in the SPRFMO in 2014 was 19.5% and 18.5% respectively, with a total combined sampling coverage of 38%. (**Table V**).

Inside the Chilean EEZ, on board sampling coverage by observers was 12,2%, and at-port sampling coverage was 13,9%, with a combined total sampling coverage of 26%.



Table V. Sampling coverage by observers at port and observers onboard in the Chilean jack mackerel fishery

	At-Port	On board	Total
Chilean EEZ	13,9%	12,2%	26%
SPRFMO	18,8%	19,5%	38%
Total	15,1%	13,9%	29%

6.- ADMINISTRATIVE MEASURES

Total catch quota.

Each year, by the month of December, the Undersecretariat for Fisheries and Aquaculture establishes catch quotas for every resource in full exploitation regime, to be applied in the next year. The quota for jack mackerel proposed by the Undersecretariat and approved by the National Fishing Council in December 2014 was 310 thousand metric tons.

Subsequently and according to agreements reached in February 2015 during the third Meeting of the SPRFMO in Auckland, New Zealand, the annual quota for jack mackerel (including high seas and EEZ catches) was reduced to 297,000 tons (Exempted Decree N° 204/2015), which is close to be fully consumed.

Discard Law and Discard Research Program

In 2012 Law N°20.625 established control measures and sanctions for those who discard at sea. In February 2015, through Resolution N° 524, a research program to study discard was initiated in the industrial purse seine fleet targeting mackerel in both, the central south area (V-X Regions) and international waters.

Seamounts measure protect

The General Law on Fisheries and Aquaculture includes the protection of the vulnerable marine ecosystems within the Exclusive Economic Zone (EEZ), defining Vulnerable Marine Ecosystem (VME) as a *“natural unit consisting of fragile geological structures, populations or communities of low biological productivity invertebrates that shows low or poor recovery against anthropological disturbances, such as **seamounts**, hydrothermal vents, cold-water coral formations, or submarine canyons”*.



Chilean legislation defines **seamounts** as *elevations of the ocean floor that do not emerge to the surface and with heights over 1,000m measured from the surrounding sea floor that constitutes their base*. Likewise, it states that *in the case of seamounts, bottom fishing shall not be allowed, unless there is scientific research conducted in accordance with the protocol and regulation demonstrating that fishing activities do not have negative consequences on the vulnerable marine ecosystems within the area*. Therefore, seamounts are acknowledged as VMEs and protection measures to be adopted are established, in the case that fishing operations could be conducted.

A piece of research conducted in 2006 (Yañez *et al.*, 2008), allowed the collection and systematization of the existing knowledge regarding the geographical distribution of seamounts, identifying 118 seamounts within the Chilean EEZ (see figure). A recent review of this information allowed to identify one of them outside the EEZ and four of them located near Easter Island, within the Motu Motiro Hiva Marine Park (Figure 12).

In order to comply with the protection of seamounts in accordance with the law, areas associated to them were determined, considering a circular area estimated from the 3,000 m isobath of depth next to it. In such areas and in accordance with the law, bottom fishing is prohibited.

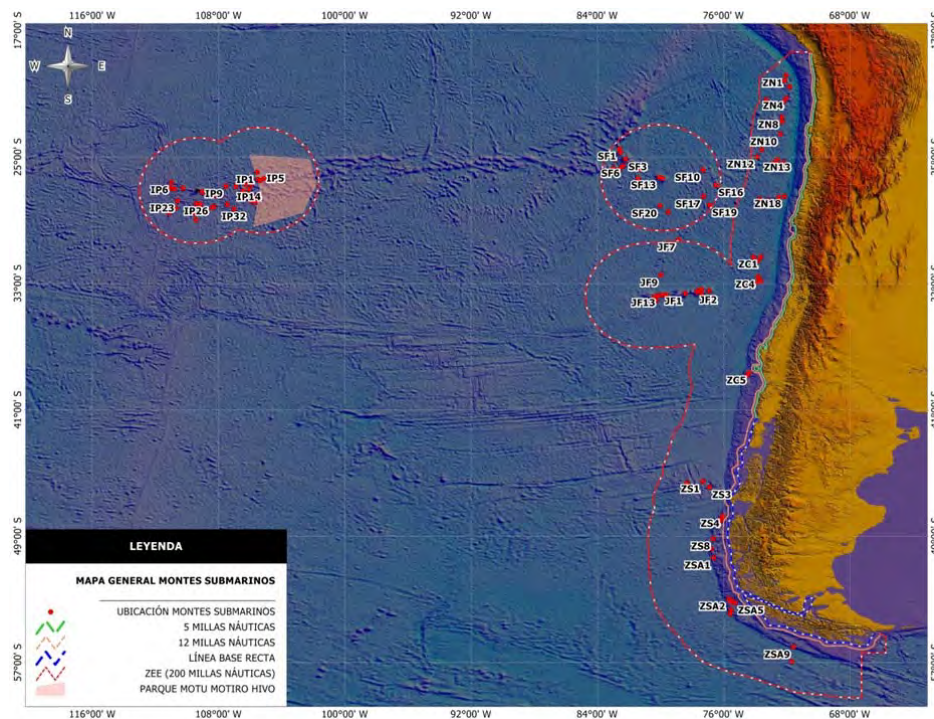


Figure 12. Chile seamounts protect areas.