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**SC11 – Doc25**

**Annual Report of the Republic of Chile to SC11 – Jack Mackerel**

*Republic of Chile*



**CHILE ANNUAL REPORT**

**SPRFMO-SCIENTIFIC COMMITTEE**

**Chilean Jack mackerel (*Trachurus murphyi*)**

August, 2023

## SUMMARY

Since 2020, the fishing operations on Chilean Jack mackerel have been conducted exclusively within the Chilean EEZ. During the first half of 2023, the industrial fleet targeting this resource was made up of 44 fishing vessels using purse seines.

A progressive increase in the Jack mackerel catches has been observed in the 2013 - 2022 period, with a maximum reached in 2022. This trend is explained by the increase in the quota allocated to Chile plus quota transfers from other SPRFMO members to Chile along with the completeness of its extraction. Thus, until May 2023, 554,236 metric tons of Jack mackerel were caught in the Chilean EEZ, which corresponds to 77% of the national TAC.

Since 2016, size-structured Jack mackerel catches have shown a wide range of sizes, between 8 and 67 Fork Length (FL) cm, with main modes fluctuating between 26 and 41 FL cm, with higher values towards the end of the series. Thus, during the first semester of 2023, the size range includes individuals between 8 and 66 cm in FL, with a main mode of 37 cm in FL, due to a low participation of individuals belonging to the immature fraction of the Jack mackerel stock.

Similarly, since 2011, age-structured Jack mackerel catches according to the new age group allocation criteria have shown a wide range of ages, with main modes fluctuating between age groups I to IV in the period 2011-2018. Then, starting in 2019, the main catch mode became represented by age group V.

Finally, it is important to reiterate that, as of January 2020, Image Recording Devices (DRI) have been implemented to monitor compliance with Bycatch Reduction Plans and Fishery regulations in the entire fleet. In addition, during 2020, the mandatory use of Electronic Logbooks Systems (SIBE) has also been implemented in the industrial fleet to report total catches, bycatch and discards, the locations of sets and other operational information according to legal requirements on a set-by-set basis and in real time. To this date, the implementation of these Electronic Monitoring Systems (DRI and SIBE) in the Chilean industrial fleets have been focused on monitoring compliance with regulations applying to catches, discards and incidental bycatch of seabirds, marine mammals, sea turtles and chondrichthyes. However, the extension of the use of these tools beyond control, such as the scientific monitoring of fishing activities to gather fisheries dependent data, has begun to be explored recently with the aim complementing it with traditional human observation programs, in a near future.

## 1. DESCRIPTION OF THE FISHERY

### 1.1 Composition of the Fleet

During the 2016-2019 period, it is observed that the industrial purse seine fleet that operated in the Jack mackerel fishery has been deployed both in the SPRFMO area and in the Chilean EEZ; while from 2020 until to May of 2023, Jack mackerel fishing operations have been concentrated exclusively within the Chilean EEZ. Thus, the number of vessels that operated within the SPRFMO area during 2019 was reduced by 60% compared to 2016 (Table I, Table II).

Until May 2023, 44 fishing vessels were operating, which represents a decrease of around 39% of the fleet compared to 2019 and 49% compared to 2016 (Table I). This reconfiguration in the composition of the Chilean fishing fleet is mainly explained by a lower participation of vessels with a hold capacity of less than 600 m<sup>3</sup> as of 2019; while the number of vessels larger than 900 m<sup>3</sup> has remained stable during the same period.

**Table I.** Number of industrial purse seine vessels catching Jack mackerel in the Chilean EEZ and the SPRFMO (combined) area between 2016 and May 2023. Data were assembled by year and hold capacity (2023\* preliminary data).

Hold capacity (m <sup>3</sup> )	2016	2017	2018	2019	2020	2021	2022	2023*
0 ≤ 300	3	0	0	0	0	0	0	0
300 ≤ 600	57	57	46	42	42	27	23	18
600 ≤ 900	7	5	5	7	6	5	4	3
900 ≤ 1,200	1	2	1	1	1	1	1	1
1,200 ≤ 1,500	6	8	7	8	8	8	8	8
1,500 ≤ 1,800	9	9	9	10	10	10	10	10
1,800 ≤ 2,100	4	4	4	4	4	4	4	4
<b>TOTAL</b>	<b>87</b>	<b>85</b>	<b>72</b>	<b>72</b>	<b>71</b>	<b>55</b>	<b>50</b>	<b>44</b>

**Table II.** Table II. Number of industrial purse seine vessels catching Jack mackerel in the SPRFMO area between 2016 and May 2023. Data were assembled by year and hold capacity. (2023\* are preliminary data).

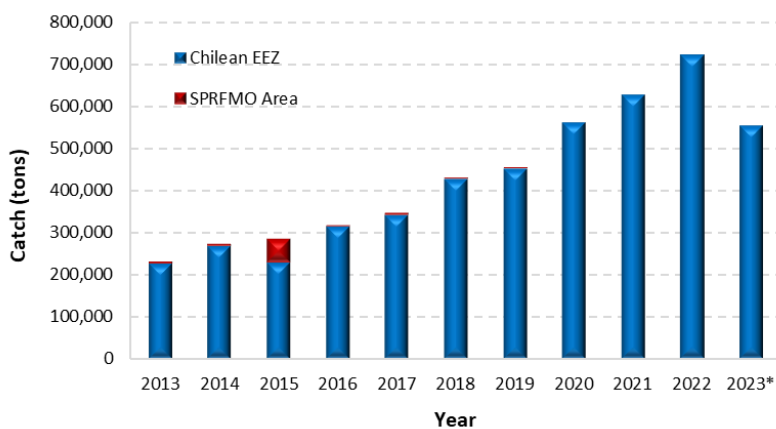
Hold capacity (m <sup>3</sup> )	2016	2017	2018	2019	2020	2021	2022	2023*
0 ≤ 300	0	0	0	0	0	0	0	0
300 ≤ 600	0	0	0	0	0	0	0	0
600 ≤ 900	1	0	0	0	0	0	0	0
900 ≤ 1,200	0	1	0	0	0	0	0	0
1,200 ≤ 1,500	0	0	1	0	0	0	0	0
1,500 ≤ 1,800	2	2	0	2	0	0	0	0
1,800 ≤ 2,100	2	0	1	0	0	0	0	0
<b>TOTAL</b>	<b>5</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

### 1.2 Catches, Seasonality of Catches, Fishing Grounds and Bycatch

#### a) Catches

During the 2013-2022 period, an increase in Jack mackerel catches has been observed, with a maximum reached in 2022 (Figure 1 and Table III). This trend is explained by the increase of the quota allocated to Chile and the completeness of its extraction, plus transferences of quota from other SPRFMO members to Chile. Thus, until May 2023, 554,236 metric tons of Jack mackerel have been caught in the Chilean EEZ,

which corresponds to 77% of the national TAC. It is highlighted that as of 2020 the catches of Jack mackerel come entirely from the Chilean EEZ.

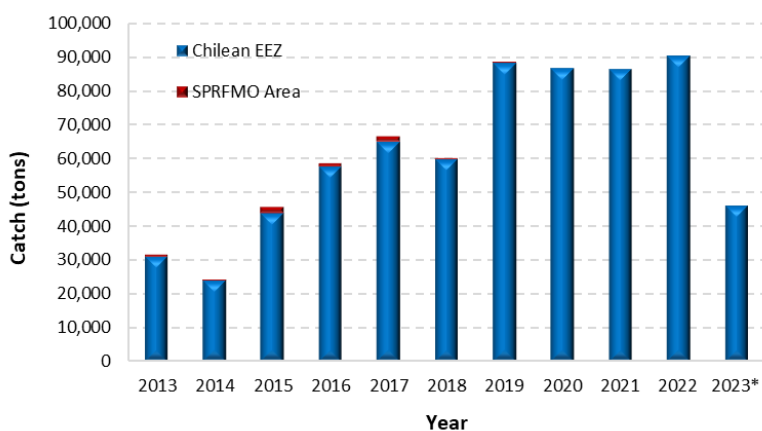


Year	Jack Mackerel landings by Chile (tons)		
	Chilean EEZ	SPRFMO Area	Total
2013	225,443	5,917	231,360
2014	267,615	3,983	271,598
2015	228,409	56,805	285,214
2016	313,403	3,159	316,562
2017	341,572	3,173	344,745
2018	425,426	975	426,401
2019	451,287	2,283	453,570
2020	561,824	0	561,824
2021	626,393	0	658,726
2022	722,622	0	722,622
2023*	554,236	0	554,236

**Figure 1 and Table III.** Total annual Jack mackerel catch within the Chilean EEZ and the SPRFMO area for the period 2013 – May 2023 (\*) preliminary.

The Chilean fleet dedicated to Jack mackerel also registered catches of Chub mackerel, which as of May 2023 totaled 46,157 metric tons, a value that represents 72% of the average catches of this resource in the period 2013-2022 (63 thousand tons).

The catches of Chub mackerel made until 2019 within the SPRFMO area have been very low (Figure 2 and Table IV), not exceeding 1% of the total, except for 2017 when accounted for 2.2% of the total catches. While from 2020 until May 2023, Chub mackerel fishing operations have been concentrated exclusively within the Chilean EEZ.

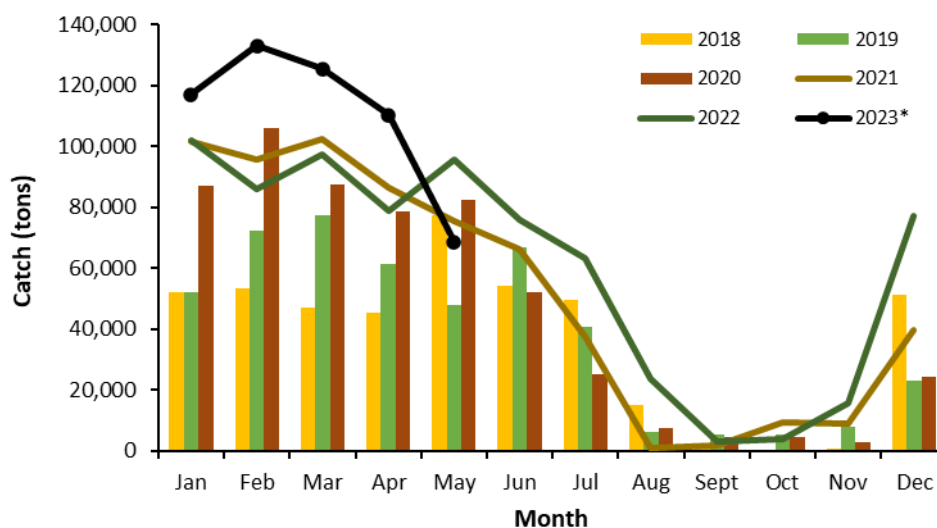


Year	Chub Mackerel landings by Chile (tons)		
	Chilean EEZ	SPRFMO Area	Total
2013	31,226	431	31,657
2014	24,127	31	24,158
2015	43,867	1,820	45,687
2016	57,769	814	58,583
2017	64,915	1,492	66,407
2018	59,774	61	59,835
2019	87,994	249	88,243
2020	86,455	0	86,455
2021	86,287	0	91,791
2022	90,115	0	90,115
2023*	46,157	0	46,157

**Figure 2 and Table IV.** Total annual Chub mackerel catches in the Chilean EEZ and SPRFMO area with purse seine nets for the period 2013 - May 2023 (\*) preliminary.

## b) Seasonality of Catches

The largest catches of Jack mackerel for the 2018-2022 period have been recorded in the first half of each year (80% on average). Thus, until May 2023, catches reached 554,236 tons within the Chilean EEZ, representing 77% of the national TAC.



**Figure 3:** Seasonality of the Jack mackerel catches by the purse-seine fleet for the period 2018 - May 2023. Source: IFOP, based in data from SERNAPESCA.

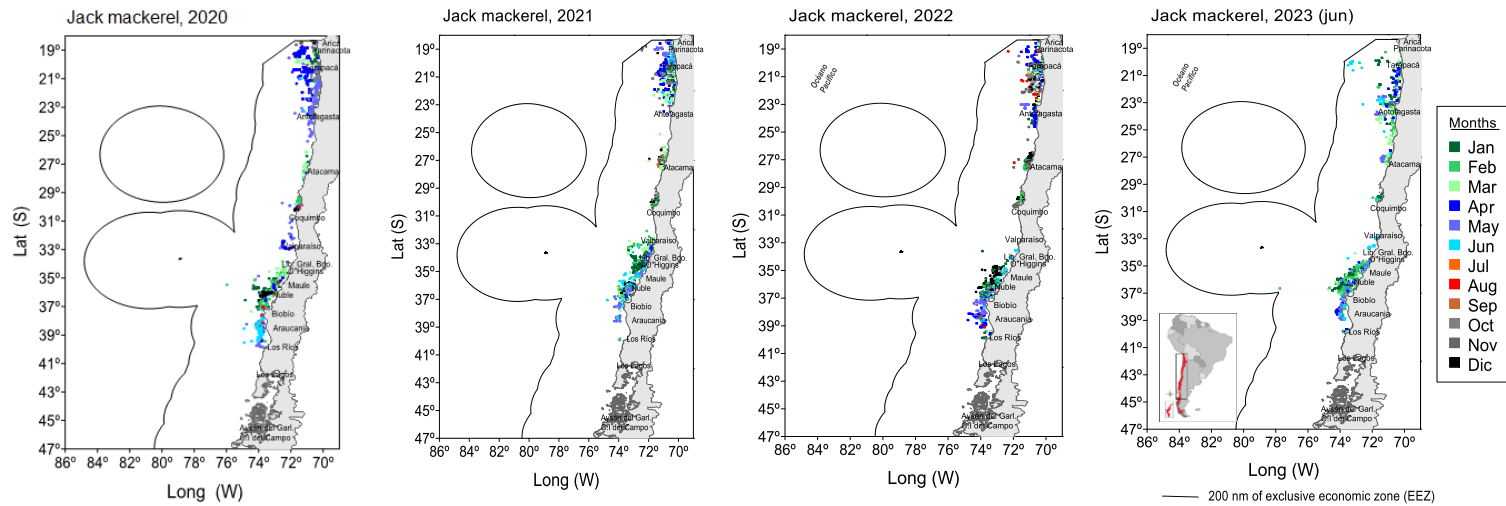
### c) Spatial Distribution of Catches

Since 2020, the spatial distribution of the Jack mackerel catches in the center-south zone of Chile have been concentrated near the coast, within 100 nm. Likewise, in the northern part of the country the captures of this resource have also been concentrated near the coast, on average within the first 50 nm, initially associated with the operation of the fleet directed to Anchovy, transiting to target fishing of Jack mackerel towards the most recent years (Figure 4).

### d) Bycatch

Chub mackerel has been the main bycatch species for the Jack mackerel target fishery. Other species caught as bycatch showed a negligible amount.

During 2023 in the northern part of the country and unlike previous years, the catches were more directed at Jack mackerel than bycatch of Anchovy, with Jack mackerel landings that doubled those of Anchovy.



**Figure 4:** Spatial-temporal distribution of the industrial purse seine fleet targeting Jack mackerel for the 2020-2022 and Jun 2023 period. Source: IFOP.

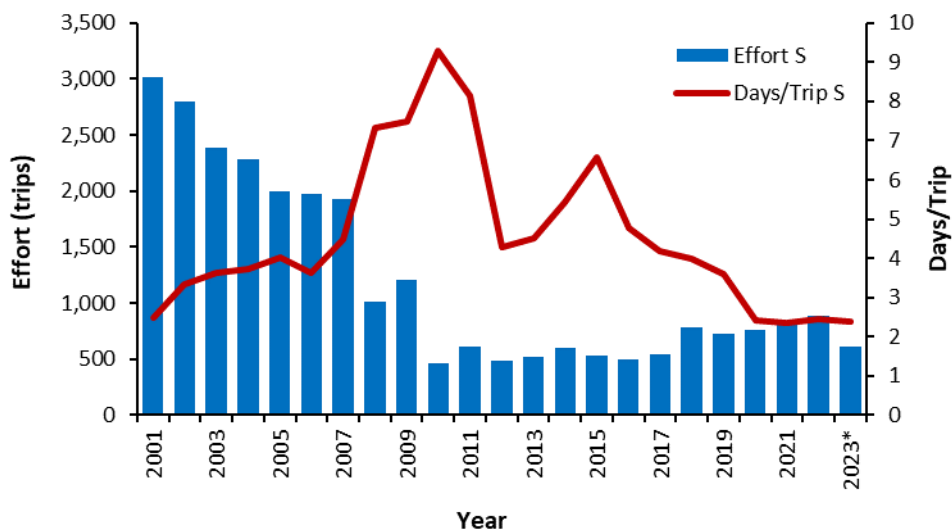


## 2. EFFORT AND CPUE FOR JACK MACKEREL FISHERY

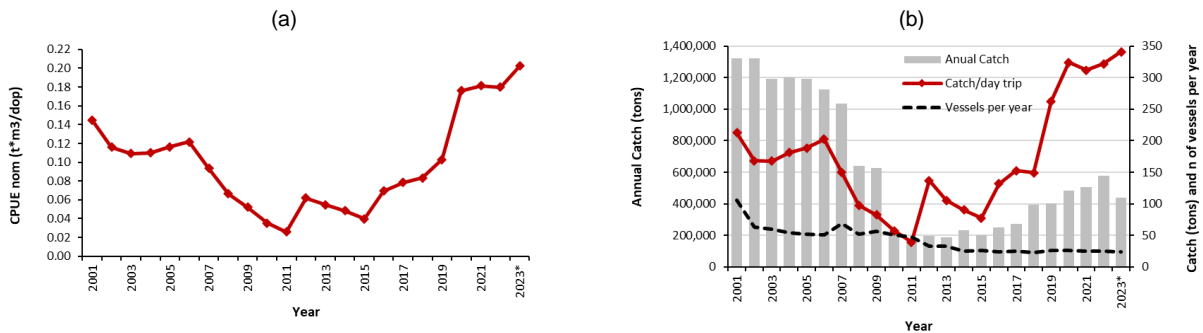
The information in this chapter is referred to the fleet targeting Jack mackerel that operates in the center-south zone of the country. Catches, effort and CPUE were calculated for each trip where Jack mackerel represented over 50% of the total catch's species composition.

Until 2010, an increasing trend in the average length of the fishing trips has been observed (Figure 5), which is explained by the distances of the Jack mackerel's fishing grounds from the coast. Later, during 2012 and 2013, the catches were concentrated within the Chilean EEZ, condition that reduced considerably the average length of the fishing trips by 50%. In 2015, the catches were again obtained outside the Chilean EEZ, increasing the average length of the fishing trips to around 7 days. For the period 2016 to May 2023, the total number of fishing trips showed an upward fluctuation, while the average length of fishing trips showed a downward trend and a relative stability towards the end of the series, because catches have concentrated near the coast, within the first 150 nm.

Regarding the standardized CPUE, measured as the rate of use of the fleet's carrying capacity (catch / (hold capacity displaced x length of fishing trip)), it has shown a decreasing trend between 2001 and 2011. Subsequently, in 2012, this indicator changed this trend, increasing over time. This condition is explained by a decrease in the average length of the fishing trips, as a result of changes in the spatial distribution of the resource (Figure 6a). This trend has continued (Figure 6b), and has become more evident in recent years, when a reduction in the number of vessels operating has been associated to an increase in both fishing yields and total landings.



**Figure 5:** Effort in number of fishing trips with catch (blue), and length of fishing trips in days (red) for the purse seine fleet in the center-southern zone targeting Jack mackerel, period 2002 to May 2023 (preliminary). Source: IFOP, based in data from SERNAPESCA.



**Figure 6:** a) Nominal CPUE for the purse seine fleet in the center-southern zone targeting Jack mackerels and, b) Total catch per year (grey bars), catch per day of fishing trips (red line) and number of vessels with catch of Jack mackerel for the purse seine fleet in the center-southern zone, period 2001 to May 2023 (preliminary). Source: IFOP-SERNAPESCA.

### 3. RESEARCH PROGRAMS

The research programs performed for the Jack mackerel fishery include permanent projects carried out annually by IFOP (Fisheries Research Institute) along with complementary studies and other projects.

#### Permanent projects performed by IFOP during 2022-2023 include:

- **Fishery monitoring**

This study allows obtaining information on the evolution of the main biological and fishery's indicators associated with the Jack mackerel fishery for both the industrial and the small-scale fleets. The monitoring is conducted between the northern boundary of Chile and 47°00' SL and includes information collected at sea and at landing points by scientific observers.

- **Bycatch research and Monitoring Program for Jack mackerel fishery**

Since 2015, this study monitors, through scientific observers onboard, the levels of bycatch and the interactions of the fishery with seabirds, marine mammals and sea turtles, as well as the associated non target species caught, and other ecosystem information used for management. The information collected by this project has been considered to establish mandatory bycatch mitigation measures and to certify the fishery against the MSC requirements (principle 2).

- **Hydroacoustic assessment of Jack mackerel between Arica-Parinacota and Valparaíso Regions, 2023.**

This research cruise took place from March 19<sup>th</sup> through April 29<sup>th</sup> 2023, and included an exploration area located between the north of Arica (18°25'SL) and Valparaíso (33°00' SL), unlike 2021 where

it was covered up to the northern limit of Antofagasta (23°25'SL). As usual, transects were made perpendicular to the coast, reaching up to 100 nm off the coast. As a result, the estimated jack mackerel biomass in the prospection area was 2,508,883 tons; which represents an increase of 31.74% compared to the survey of 2021 (Córdova et al., 2023).

- **Hydroacoustic assessment of Jack mackerel between Valparaíso and Los Lagos Regions, 2023**

This research cruise took place from June 10<sup>th</sup> through July 12<sup>th</sup> 2023, and included an exploration area located between the northern of Pichidangui (31°55' SL) and Corral (40°00' SL), in perpendicular transects to the coast, reaching up to 100 nm off the coast. As a result, the estimated jack mackerel biomass in the prospection area was 837,349 tons; which represents a reduction of 31,01% compared to the last survey carried out in 2021 (J. Córdova, pers. comm. pers., 2023).

- **Assessment of the total allowable catch**

Similarly, as done by the SPRFMO SWG, this study has used the Joint Jack mackerel (JJM) model. This project is aimed to set up the status of the resource, and to assess the biologically sustainable exploitation rates. The results are used by the Fishing Authority to update and/or improve the stock assessment, simulating different exploitation scenarios and conducting additional analyses.

### **Projects financed by the Fisheries and Aquaculture Research Fund (FIPA) during 2021-2023 include:**

- **Research project FIPA 2021-08 "Population genetics of Chilean jack mackerel (*Trachurus murphyi*) in the South Pacific Ocean"**

This project is in its final phase, and it aims to reduce the uncertainty in the management of the Chilean Jack mackerel (*Trachurus murphyi*) fishery by examining the genetic signatures of connectivity and the mixing ratios of this species, and also by developing the reference genome. These topics are essential to understand the population dynamics of this resource.

- **Research project FIPA 2021-21 "Updating information associated with age and growth of jack mackerel, in the context of the SPRFMO"**

The aim of this project was to improve the accuracy of age establishment and the precision of otolith reading for Jack mackerel, among the SPRFMO's scientists. Within their objectives were the homologation of methods and ageing criteria by means of an age protocol based on an otolith reference collection. This study is expected to conclude with a workshop to read the age of Jack mackerel by the end of 2023, as stated in "G31-2023 Otolith Reading Workshop Interim Programme (SPRFMO SC JMWG)".

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

### 4.1 Biological sampling

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

In 2022, a total of 64,580 specimens of Jack mackerel were sampled of which 18,559 were used to collect biological samples. For the industrial fleet, samples included at-sea sampling as well as port sampling, covering the entire range of activities reported for this fishery in Chile. The main landing ports were Antofagasta and Coquimbo in the northern area and, Talcahuano and Valdivia in the center-south area of the fishery. In relation to Chub mackerel, during 2022 a total of 13,778 specimens were sampled of which 1,447 were used to collect biological samples (Table V)

**Table V.** Number of Jack mackerel and chub mackerel specimens collected in 2022 for length and biological samples.

Landing Port	Jack Mackerel		Chub Mackerel	
	Lenght Sampling	Biological Sampling	Lenght Sampling	Biological Sampling
Arica y Parinacota	909	125	298	0
Iquique	4,081	589	9,346	681
Antofagasta	4,664	527	2,305	34
Caldera	3,272	777	761	99
Coquimbo	4,453	2,499	699	519
San Antonio	2,935	1,150	0	0
Talcahuano	39,850	11,842	369	114
Valdivia	4,416	1,050	0	0
Chiloé	0	0	0	0
Guaitecas	0	0	0	0
TOTAL	64,580	18,559	13,778	1,447

### 4.2 Length and age composition of the catches

#### Jack Mackerel

Since 2016, size-structured catches of Jack mackerel have shown a wide range of sizes, between 8 and 67 FL cm, with main modes fluctuating between 26 and 41 FL cm, and with larger values towards the end of the series (Figure 7).

During the first semester of 2023, the size-structured catch of Jack mackerel has ranged from 8 to 66 cm in FL, with a main mode of 37 cm in FL, and a low participation of immature individuals in catches, since operations in the northern part of the country have fluctuated in individuals around a main mode centered on 40 FL cm.

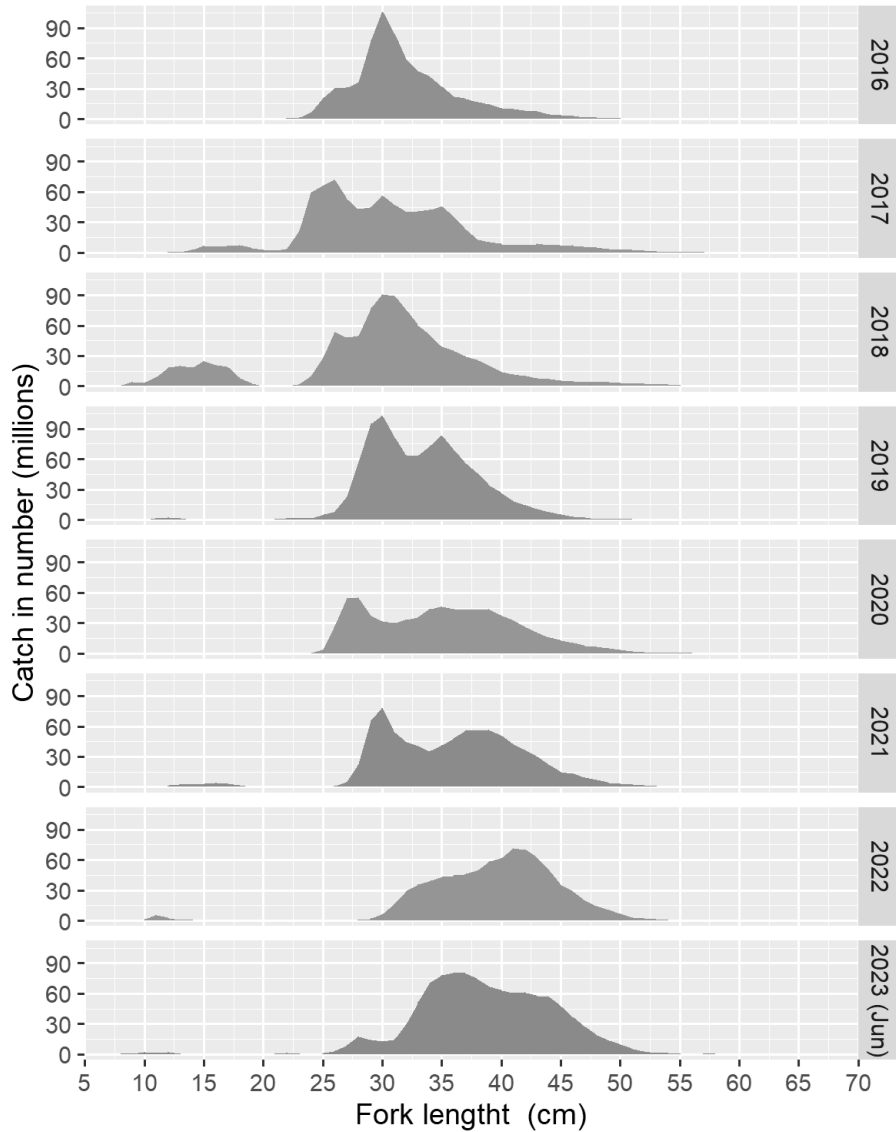
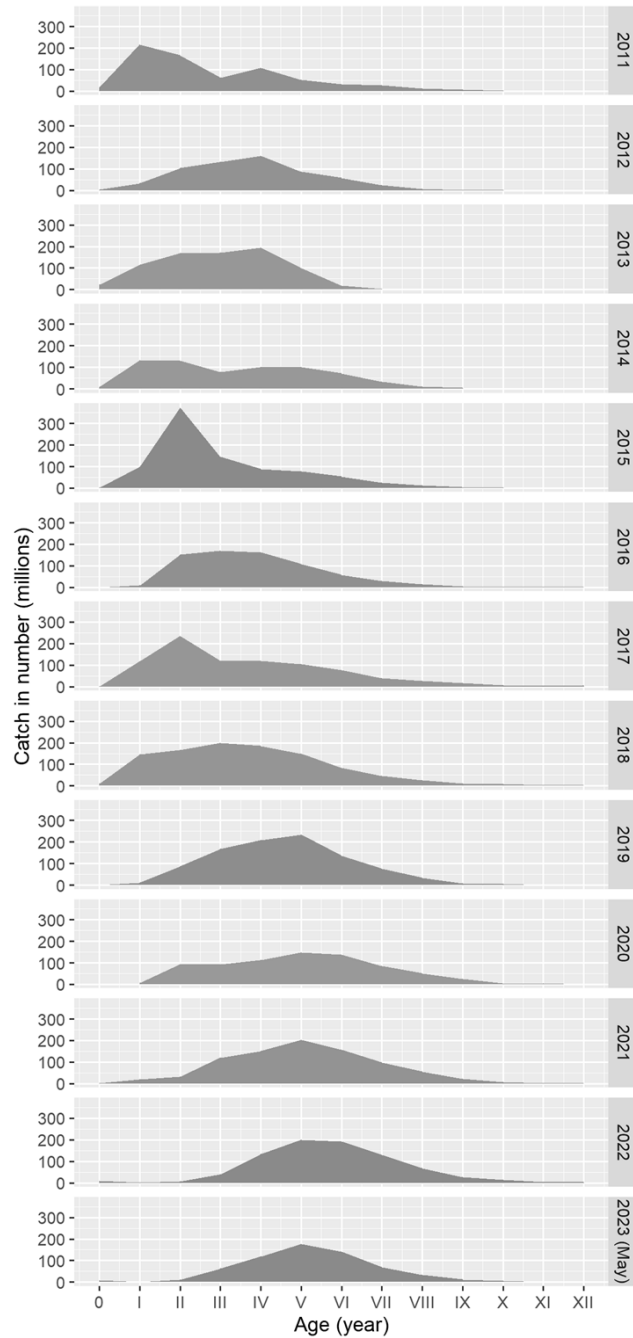


Figure 7. Length structure of Jack mackerel's catches for the period 2016 - June 2023. Source: IFOP.

Since 2011, age-structured Jack mackerel catches according to the new age group allocation criteria have shown a wide range of ages, with main modes fluctuating between age groups I to IV in the period 2011-2018. Then, starting in 2019, the main mode of catches shifted to age group V (Figure 8).



**Figure 8:** Catch age-structured in number of Jack mackerel (using the new age assignment criteria), period 2011 to May 2023. Source: IFOP.

## 5. Ecosystem approach considerations in the jack mackerel fishery

### Background

There is a growing concern that the levels of fishing mortality as a result of unmanaged bycatch and discards, threaten the long-term sustainability of many fisheries worldwide and the maintenance of biodiversity in different areas, compromising the food security and affecting the livelihood of people and countries that depend on fishing resources. However, the use and definition of these terms varies widely. Thus, in some countries the term bycatch is referred to the part of the catch that is retained and sold but is not the target species for the fishery. In others, bycatch consider species/sizes/sexes of fish that are discarded or returned to sea (dead or alive). On the other hand, the OECD defines bycatch as “the total fishing mortality, excluding that accounted directly by the retained catch of target species”. This last definition thus includes fish that dies as a result of the interactions with the fishing gears, even if they do not leave the water, and could include mortalities resulting from “ghost-fishing”. As a reference, FAO defines bycatch as “any catches conducted during the fishing process beyond species and sizes of the marine organisms targeted by the fishery, from sponges, corals, commercial or not commercial fish, seabirds, marine mammals and marine reptiles”.

In this regard, Chile has amended its General Law for Fisheries and Aquaculture in 2012 (through Law N° 20.625, known as “discard law”) incorporating the terms **discards** known as “the action of returning to sea hydro biological species caught (target and non-target)” and **incidental catch** as “marine mammals, seabirds and turtles caught during fishing operations”. The law N° 20.625 also incorporated penalties and modern tools to monitor compliance with the reduction measures at sea, for those engaged in these practices during fishing operations.

Consequently, the Chilean approach to understand, regulate and mitigate discards and incidental catch is broad in scope, encompassing the following groups of species: target and non-target fish, accompanying fauna (bony fishes, chondrichthyes, invertebrates, etc.), seabirds, marine mammals and sea turtles. However, in a stepwise approach to solve the problem, the Law N° 20.625 considered exceptions to the discard ban, conditional on a minimum of two years fishery-based research monitoring programs by observers on board in order to quantify and identify the causes of discards and incidental catch. This background would allow to develop, at a later stage, mandatory reduction plans for these practices, tailored for each fishery, that will be finally monitored and recorded at sea through the incorporation of new technological tools such as EMS (Image Recording Devices (DRI) and Electronic Logbook System (SIBE)).

In this context, from 2014 onward, information onboard commercial fleets, for a Nationwide Research Program on discards and incidental catch in small pelagic purse seine fisheries has been collected, in order to establish reduction plans for these practices, according to the new law (N° 20.625) requirements. For these purposes a team of trained observers from the National Observer Program has been used. At the same time, similar programs have also been developed in demersal fisheries.

In January 2015, a specific program for the Jack mackerel industrial purse seine fishery was initiated, which was concluded in April 2019 with the enactment of a mandatory reduction plan for the entire fleet, along with the stakeholders at the Management Committee of the fishery. Among other aspects, the reduction plan includes:

- Ban of discard for Jack mackerel and its accompanying fauna.
- Mandatory release of all the incidental catch of seabirds, marine mammals, sea turtles, and chondrichthyes caught during fishing operations, using handling protocols (some under current development).

- Management measures and technological means to eliminate discards of accompanying fauna and reduce incidental catch.
- A scientific and compliance monitoring program, through observers onboard and EMS, to evaluate the effectiveness of the measures adopted by the reduction plan.
- A training program for fishermen.
- A code of good fishing practices.
- Incentives for innovation in systems aimed at reducing discards and incidental catch.

It should be noted that the Chilean observer programs were extended with the Law N° 20.625, but with the sole objective of collecting biological and fisheries data to be used in scientific advice for management, without any jurisdiction with compliance. Therefore, the compliance with measures of reduction plan and handling protocols are being monitored remotely by electronic monitoring systems EMS (Image Recording Devices (DRI) and Electronic Logbook System (SIBE)) onboard all vessels of the industrial fleet, while artisanal boats longer than 15 m (total length) will be required to carry EMS in a later stage (2024). DRI specific regulations have been enacted and the system has been fully implemented in the entire industrial fleet as of January 2020. Also as of 2020, industrial vessel owners have the obligation to report, in real time and in a set-by-set basis, all catches, discards and incidental catch through the Electronic Logbook System (SIBE) tool that has been implemented by the National Fisheries and Aquaculture Service, according to the Law. The information that must be reported in the electronic logbooks includes:

- Geographic Location of the set.
- Time (beginning and end) of the set.
- Amount (weight) or number of specimens caught by species or species groups.
- Incidental catch by species or species groups.
- Additional information (notes).

In Chile the EMS are considered to be both; Image Recording Devices (DRI) and Electronic Logbooks Systems (SIBE). These monitoring and recording tools have been implemented to improve control of compliance with fishing regulations and fisheries sustainability. It should be noted that to this date, the EMS implementation has focused on monitoring compliance with regulations applying to catches, discards and incidental bycatch of seabirds, marine mammals, sea turtles and chondrichthyes. However, the extension of the use of these tools beyond control, such as the scientific monitoring of fishing activities to gather fisheries dependent data, has begun to be explored recently with the aim complementing it with traditional human observation programs, in a near future. For more detail review Cocas *et al.*, 2022.

It should also be highlighted that at its 8<sup>th</sup> Annual Meeting, the SPRFMO Commission selected MRAG as the SPRFMO Observer Program Accreditation Evaluator (see Paragraph 59 of the COMM8-Report). In 2020 the Observer Programs of 3 Members; Chile, New Zealand and Australia were evaluated and granted accreditation (CTC8-Doc10\_Rev2 SPRFMO Observer Program Implementation Report) in accordance with CMM 16-2021, which recognizes the high standard of the Chilean Observers Program.

## Report

In order to characterize the incidental catch and mortality of seabirds, marine mammals and sea turtles that occurred in the industrial purse-seine fishery for Jack mackerel, a total of 2,795 fishing sets were monitored by scientific observers onboard during January 2015 and December 2021. The results are presented for the entire period (combined) with the aim of showing better estimates and trends for both catch and mortality rates, which in this case also correspond to the average incidental catch and the average mortality per set.

As mentioned for previous reports, in the Jack mackerel fishery both, the incidental catch and resulting mortality for these groups of species are low, mainly due to the fact that the fishing operations are rather



oceanic (compared to artisanal fleets) and also because the crews are making efforts to release specimens alive whenever possible, through the use of handling protocols and the compliance with good fishing practices according to the mandatory bycatch reduction plans previously mentioned.

The species affected by incidental catch (% in relation to the total numbers of incidental specimens caught) are mainly marine mammals (71.8%), followed by Procellariiform seabirds including albatrosses, petrels, and shearwaters (14.9%), and coastal seabirds such as seagulls, pelicans, and penguins (13.2%). In addition, the capture of one specimen of Leatherback turtle was recorded in 2018, which was released alive by the crew. The only species of marine mammal affected is the South American sea lion (*Otaria byronia*), while the main species of seabirds caught incidentally were the Dominican gull (*Larus dominicanus*) and the Black-browed albatross (*Thalassarche melanophris*), both species altogether represented 58% of the total number of seabirds incidentally caught (Table VI).

It must be clarified that in the Chilean regulations, the term incidental catch does not necessarily refer to incidental mortality since it relates to specimens caught in the fishing gears that in certain cases can be released alive by the crew, using appropriate handling protocols. Considering these conditions, fisheries observers onboard are required to differentiate and register both, incidental catch, and mortality as a result. Consequently, in the Table VI the distinction is clearly made between N° of individuals incidentally caught v/s N° individuals dead as a result of incidental catch, to prevent confusions. In fact, incidental mortality resulting from interactions with this fleet is low, totaling 44 specimens out of 2,809 caught for the entire period (2015-2022), where the Pink-footed shearwater (*Ardenna creatopus*) and the South American sea lion represented 36.4% and 31.8%, respectively in relation to the total number of dead specimens as a result of incidental catch.

Regarding the spatial and temporal variability of the incidental catch and mortality of both, marine mammals and seabirds, its occurrence is mainly explained by the distance of the fishing operations from the coast in relation with the seasons of the year. During warm seasons (spring-summer) the fleet operates near the coast (40 nm in average), compared with cold seasons (autumn-winter) when operations become more oceanic with an average of 86 nm from the coast.

It has been seen that this pattern of spatial-temporal operation has a great effect on the intensity of interactions of the fleet, especially with foraging species restricted to terrestrial colonies or those of coastal distribution, such as the South American sea lion and some coastal seabirds (Sabarros et al., 2014; Baylis et al., 2008; Ainley et al., 2009). For these last two groups, the average incidental bycatch during the cold seasons decreased by 115% and 132% respectively, compared to warm seasons.

An opposite condition occurred with albatrosses whose interaction with the fishery increased by 183% during the cold seasons (autumn-winter). Records of incidental catch for albatrosses were mainly obtained at 100 nm or more from the coast (82% of the events), pattern which coincides with Spear & Ainley (2008) who reported, for the south-central zone of Chile, that albatrosses are much more abundant in oceanic than neritic waters during winter (Figure 9).

**Table VI.** Incidental catch and resulting mortality by species in the Jack mackerel purse-seine industrial fishery operating between Valparaíso and Los Lagos Chilean administrative regions, (32°10'23" - 43°44'17" SL) and in the international waters of the SPRFMO. Source: IFOP, data collected by scientific observers onboard from 2,795 fishing sets between January 2015 and December (Ossa *et al.*, 2023). Preliminary data (final annual report under evaluation).

Common name	Scientific name	N° of individuals incidentally caught	N° individuals dead as a result of incidental catch	Mort (%)	AIC	CV <sub>AIC</sub>	AIM	CV <sub>AIM</sub>
South american sea lion	<i>Otaria byronia</i>	1,870	13	0.7	0.8	542	0.005	1,639
Dominican gull	<i>Larus dominicanus</i>	244	1	0.4	0.1	1,426	0.0004	4,897
Black-browed albatross	<i>Thalassarche melanophris</i>	215	1	0.5	0.09	1,214	0.0004	4,897
Peruvian pelican	<i>Pelecanus thagus</i>	109	3	2.8	0.05	1,911	0.001	4,897
Unidentified albatross	<i>Thalassarche</i> spp.	61	0	0	0.03	2,049	0	-
Sooty shearwater	<i>Ardenna grisea</i>	47	2	4.3	0.02	2,531	0.0008	3,462
Grey-headed albatross	<i>Thalassarche chrysostoma</i>	36	0	0	0.02	2,105	0	-
Wilson´s storm petrel	<i>Oceanites oceanicus</i>	18	1	5.6	0.008	2,175	0.0004	4,897
Pink-footed shearwater	<i>Ardenna creatopus</i>	16	16	100	0.007	2,329	0.0067	2,329
Humboldt penguin	<i>Spheniscus humboldti</i>	13	1	7.7	0.005	4,536	0.0004	4,897
Cape petrel	<i>Daption capense</i>	8	0	0	0.003	3,569	0	-
White-chinned petrel	<i>Procellaria aequinoctialis</i>	8	1	12.5	0.003	4,328	0.0004	4,897
Southern giant-petrel	<i>Macronectes giganteus</i>	8	0	0	0.003	3,569	0	-
Unidentified storm-petrel	Hydrobatidae	1	1	100	0.0004	4,897	0.0004	4,897
Unidentified penguin	<i>Spheniscus</i> spp.	1	1	100	0.0004	4,897	0.0004	4,897
Wandering albatross	<i>Diomedea exulans</i>	1	0	0	0.0004	4,897	0	-
Leatherback sea turtle	<i>Dermochelys coriacea</i>	1	0	0	0.0004	4,897	0	-

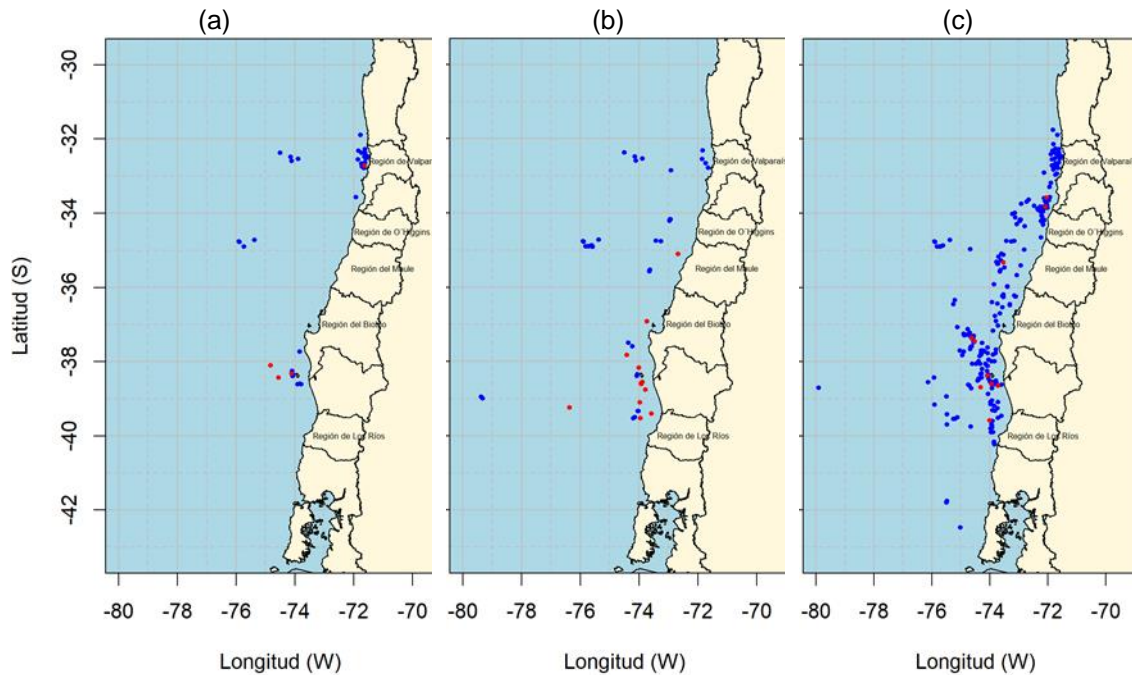
Mort (%) = Mortality: Number of dead animals / Number of animals of the same species captured

AIC = Average Incidental Catch: Number of animals caught / Number of sets observed

CV<sub>AIC</sub> = AIC Coefficient of variation

AIM = Average Incidental Mortality: Number of dead animals / Number of sets observed

CV<sub>AIM</sub> = AIM Coefficient of variation



**Figure 9.** Geographic distribution of sets with incidental bycatch (blue) and mortality (red) reported in the Jack mackerel purse-seine fishery that operated in the south-central zone off Chile during January 2015 - December 2021: a). coastal seabirds; b) Procellariiform seabirds; c) South American sea lion. Source: IFOP (Vega *et al.*, 2022).

Another aspect related to the ecosystem considerations of the Jack mackerel fishery is the monitoring of garbage management by the fishing fleet. In this regard, the observer program has monitored the handling of garbage generated on board the fishing vessels through the assessment of the level implementation of the Annex V of the International Convention MARPOL, whose main rule prohibits the dumping of plastics into the sea. The program has evaluated the improvement in the degree of knowledge of Annex V and behavior of the crews, and also the implementation of the regulations in the vessels between 2015 and 2023. Some aspects studied were: 1) the existence of written management plans, 2) the presence of informative material or posters in suitable and visible places on the prohibitions, 3) use of garbage record books and 4) presence of containers. The information was collected by observers using a specific form designed for such purposes, which was applied at sea during the fishing trips with a fixed frequency of time between trips of three months in order to allow a period of time to observe changes in behavior in the crew regarding the application of these regulations. To improve knowledge of the regulations, the observers were tasked to give talks to the crews about the main rules. A standard guide for observers was developed called "Dissemination of" Annex V-MARPOL 73/78 ": How and what to communicate to the crews on board purse-seine vessels". In addition, flyers, posters, calendars, and ecological bags with allusive messages were designed and distributed within fishermen and communities. Once the results were analyzed, recommendations for prevention or mitigation measures were made to improve the deficiencies observed.

## 6. Observer Implementation Report

### At-Sea and Port Sampling Program

In order to evaluate the sampling coverage within the SPRFMO Area, only fishing trips targeting Jack mackerel were considered for this report (i.e., trips with a Jack mackerel composition of more than 50% of the total catch per fishing trip). This report includes coverage data from fisheries observers onboard and/or at-port sampling.

During 2022 did not occur fishing activities by Chilean vessels in the SPRFMO Area, therefore sampling and monitoring were focused exclusively in the Chilean EEZ. Within this area, the sampling coverage conducted by scientific observers onboard fishing vessels was 22.3%, and at-port sampling coverage was 16.9%, with a total combined sampling coverage of 39.2% (Table VII).

During 2022, 291 fishing trips were monitored by scientific observers onboard and 221 fishing trips were sampled in port. This condition is partly explained by the smaller number of vessels conducting the fishing effort, on more coastal schools than in previous years. However, the total sampling coverage onboard and at landing points combined (39.2%), as mentioned above, is significant in relation to the total number of fishing trips.

**Table VII.** Sampling coverage by scientific observers at port and onboard for the Chilean Jack mackerel fishery 2022.

Sampling coverage	At-Port	On Board	Total
Chilean EEZ	16.9%	22.3%	39.2%
SPRFMO area*	-	-	-
<b>TOTAL</b>	16.9%	22.3%	39.2%

(\*) There was no activity of the Chilean fleet in the SPRFMO Area.

## 7. ADMINISTRATIVE MEASURES

### Total catch quota

In December each year, the Undersecretariat for Fisheries and Aquaculture establishes the catch quotas for each resource in full exploitation regimes to be implemented the following year. The Jack mackerel quota for 2023 established by the Undersecretariat for Fisheries and Aquaculture in December 2023 was 703,800 tons (Exempt Decree, N° 69-2022). Subsequently, according to the results of the OROP-PS Commission (February 2023), the annual Jack mackerel quota for the current year was increased to 716,758 (tons); as stated in Exempt Decree N° 30-2023.

### Bycatch Reduction Plan

Mandatory sets of measures to avoid bycatch and discards in the Jack mackerel fishery established through Exempt Resolution N° 16 of 2019; it can be found at [http://www.subpesca.cl/portal/615/articles-104138\\_documento.pdf26/2019](http://www.subpesca.cl/portal/615/articles-104138_documento.pdf26/2019).

### Annual list of species subject to the discard reduction plan for the Jack mackerel fishery

List of target species, non-target species and incidental species subject to the discard reduction plan for the Jack mackerel fishery, year 2023 Exempt Resolution N° 0119 of 2023 [https://www.subpesca.cl/portal/615/articles-117002\\_documento.pdf](https://www.subpesca.cl/portal/615/articles-117002_documento.pdf)

### Implementation of EMS in the entire industrial fleet

- **Image Recording Devices (DRI)**

As of January 2020, mandatory Image Recording Devices (DRI) to monitor compliance with Bycatch Reduction Plans and Fishery regulation in general have been implemented.

- <http://www.subpesca.cl/portal/615/w3-article-96157.html>
- <http://www.subpesca.cl/portal/615/w3-article-106392.html>

- **Electronic Logbook System (SIBE)**

During 2020, the mandatory use of Electronic Logbook Systems (SIBE) in the entire industrial fleet to report in a set-by-set basis, total catches, bycatch and discards, locations of sets and other fishery information according to the requirements of the Law have also been implemented.

- [http://www.sernapesca.cl/sites/default/files/res.ex\\_267-2020\\_0.pdf](http://www.sernapesca.cl/sites/default/files/res.ex_267-2020_0.pdf)

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