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Annual Report of Chile to the SC – Squid

Chile

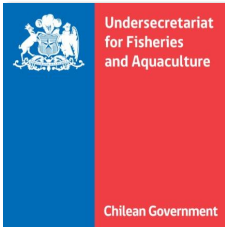


CHILE ANNUAL REPORT

SPRFMO-SCIENTIFIC COMMITTEE

Jumbo squid (*Dosidicus gigas*)

August 2024.



ABSTRACT

The jumbo squid fishery has the participation of both artisanal and industrial vessels. In 2023, the artisanal fleet landed 107,355 tons of this resource, representing 98.89% of the national total (108,550 tons). The artisanal fleet targeting this resource is made up of 1,807 vessels whose length is equal or less than 18 meters. However, the main fishing operation was carried out by vessels of length equal or less than 12 meters, which represented 97,67% of the total number of artisanal vessels, equivalent to 1765. This type of vessel ($\leq 12\text{m}$) altogether landed more 99.3 % of the total landings for the artisanal sector.

On the other hand, during 2023, the participation of the industrial fleet over this resource was developed as bycatch while targeting other resources, and represented landings of 1,195 tons, representing 1.1% of the total landings for jumbo squid in Chile during 2023 (108,550 tons). The industrial landings of jumbo squid involved 1 factory vessels and 38 vessels of which 17 landed more than 3 tons per fishing trip. Out of those 17 vessels, no factory vessels were involved: 13 operated with purse seines (76.47%), 3 (17.64%) with trawls and 1 with jigging (5.88%). Regarding the total tons landed by the industrial fleets, and its relationship with the fishing gear used, during 2023, 65.43% corresponded to catches performed with trawls, 34.01% with purse seine and only 0.55% with jigging. During 2023, bycatch of marine mammals, seabirds, or sea turtles was not observed for both fleets.

Finally, is important to note that all catches of jumbo squid were performed within the Exclusive Economic Zone of Chile (EEZ).

1 DESCRIPTION OF THE FISHERY

1.1 Composition of the Fleet.

As of 2020 and obeying to legal changes, in Chile, catches of jumbo squid as target species are carried out only by the artisanal fleet. The industrial fleet has continued to capture this resource, but only as a bycatch.

A TAC is established annually for jumbo squid, which in 2023 corresponded to 200,000 tons. This measure no longer establishes differentiated target allocations for artisanal or industrial sectors, being intended exclusively as an objective for the artisanal sector.

Artisanal Fleet

During 2023, the artisanal fleet landed 107,355 tons, equivalent to 98.89% of the national landings for jumbo squid (108,550 tons). A total of 1,807 artisanal boats of lengths equal to or less than 18 meters participated in this activity (Table 1). The largest volume of the artisanal fishing operation was performed by vessels of lengths equal to or less than 12 meters (1,765 vessels), representing 97.67% of the artisanal fleet altogether in 2023. These vessels ($\leq 12\text{m}$) landed more than 99 % of the total landings for the artisanal sector.

Amongst the artisanal fishing gears, where jumbo squid was caught during 2023, gillnet, longline, and jigging, among others were identified. However, the target fishery over this resource is carried out only with jigging, by a total of 1,804 vessels. The landings of jumbo squid by the artisanal fleet accounted for 99.97% of the landings for this resource in Chile during 2023. On the other hand, landings of jumbo squid with other gears only accounted for 0.03% of the total.

When analyzing the 2010-2023 period, it is identified that from 2011 onward the number of vessels operating on jumbo squid has exceeded 1,000 vessels, with 2012 being the year with the highest number registered. However, the increase in the number of vessels has not been related to a significant increase in landings (Table 1).

Table 1: Artisanal fleet composed of vessels equal to or less than 18 meters in length, which operated in Chile to capture *Dosidicus gigas* in the 2010-2023 period.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
N° Boats ($\leq 18\text{m}$)	706	1880	2180	1540	1747	1419	1657	2102	2056	1066	2079	1647	1787	1807
landing (t)	66049	138708	114955	97224	125396	104242	141576	113405	109296	17406	53967	52904	97612	107355

Source: SERNAPECSA

Industrial Fleet

Unlike before 2020, the fishing activity of the industrial fleet during the last four years (2020-2023) over jumbo squid was developed only as bycatch, accounting for a total of 1,195 tons in 2023 (table 2), which corresponds to 1.1% of the total landings for jumbo squid in Chile during this year (108,550 tons).

The industrial landings of jumbo squid involved 2 factory vessels and 38 vessels of which 17 landed more than 3 tons per fishing trip. Out of those 17 vessels, no factory vessels were involved; 13 vessels operated with purse seines (76.47%), 3 with trawls (17.64%), and 1 with jigging (5.88%). Regarding the total tons landed by the industrial fleets, and its relationship with the fishing gear used, during 2023, 65.43% corresponded to catches performed with trawls, 34.01% with purse seine and only 0.55% with jigging. The latter corresponds to the target catches made by only one industrial vessel that used jigging. Thus, 99.5% of jumbo squid landings were as bycatch in the operation over other fisheries.

During the 2010-2023 period it is observed a decrease in the number of industrial vessels operating in the jumbo squid fishery. 2010 and 2014 stand out as those years in which more tons were landed by the industrial fleet. Due to legal changes, during 2020-2023 period, landings of the industrial fleet corresponded mostly to catches as bycatch, therefore, the number of vessels in Table 2 reflect this condition. Prior to 2020, the number of vessels included in table 2 reflect the operation of the industrial target fleet over jumbo squid.

Table 2: Industrial vessels with landings greater than 3 tons of *Dosidicus gigas* per fishing trip, which operated in Chile within 2010-2023 period and total landings (t) of the industrial fleet per year.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
N° Ships	83	86	57	32	35	32	18	19	12	15	19	12	19	17
Total Landing (t)*	131095	23545	29597	9025	51206	39433	39338	39132	35350	40665	1039	663	674	1195

Source: SERNAPESCA

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

1.2.1 Catches

Since 2012, it has been established a catch quota for jumbo squid in Chile, which in 2023 corresponded to 200,000 tons.

When analyzing the 2012-2023 period, it is observed that landings of jumbo squid surpassed 100,000 tons until 2018. However, during 2019, the landings showed a significant decrease mainly explained by the sharp decline in artisanal landings. This responded to a low availability of this resource in the

fishing grounds targeted by this fleet. On the other hand, the industrial fleet landed the total of its allocated quota until 2019 (Figure 1).

During the 2020-2021 period, the jumbo squid landings reached total values of around 55,000 tons, with a predominance of the artisanal fleet and a low contribution of the industrial fleet. However, in 2022 the jumbo squid landings increased reaching values around the 100,00 tons, maintaining a predominance of the artisanal fleet and a low contribution from the industrial fleet (Figure 1).

2016 stands out as the year in which the artisanal fleet landed the largest volume of this resource for the 2012-2023 period.

Also, to note that all catches of jumbo squid have been conducted within the Chilean Exclusive Economic Zone (EEZ).

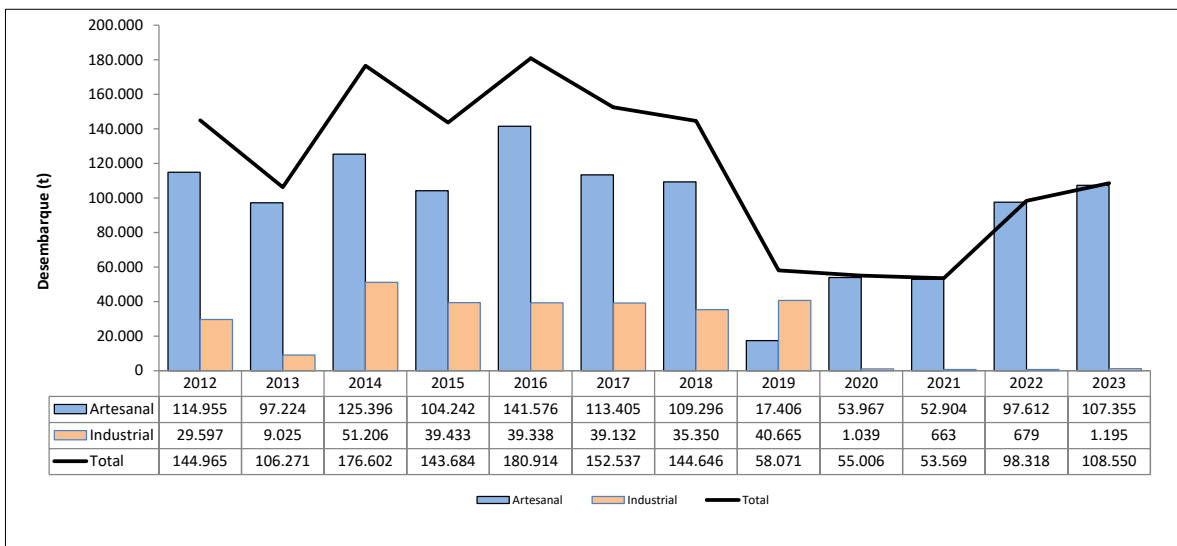


Figure 1. Landings (t) of *D. gigas* in the 2012-2023 period, by the artisanal and industrial fleets (Source: SERNAPESCA).

1.2.2 Temporality of catches during 2014-2023

In general, catches of jumbo squid are concentrated during the first 8 months of each year, decreasing from September-October. In this regard, the monthly seasonal variations recorded are driven by operational and economic aspects of the fishery (Figure 2). In the particular case of the 2023, the fishing activity on jumbo squid was mostly concentrated between March and July, with April showing the highest landing rate, corresponding to 18,895 tons.

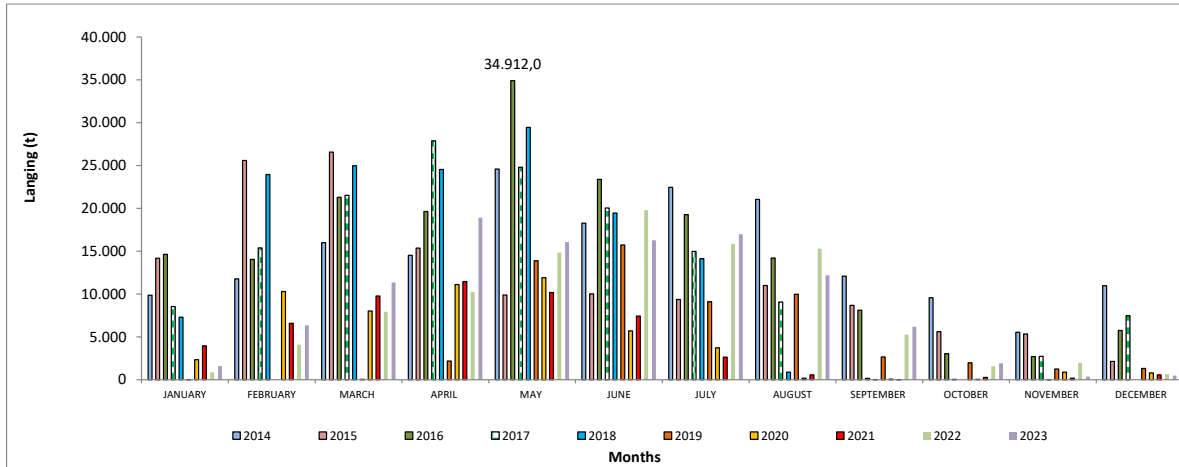


Figure 2. Landed tons of *D. gigas*, distributed monthly for the 2014-2023 period (Source: SERNAPESCA).

1.2.3 Spatial Distribution of Catches

Regarding the geographical distribution of the artisanal operations, and similarly to what was reported in 2022, they were concentrated mainly between 29°21'SL and 38°30'SL (Figure 3). However, the largest operations were registered in the Biobío Region (36° 00'-38°30'SL) and in the Valparaíso Region (33°00'-33°55'), and the Maule Region (35° 25'-35° 42').

During 2023 the geographical distribution of the industrial fleet that operated on this resource in 2023 was developed as bycatch. These were distributed mainly between 34°SL and 39°SL, (Figure 4). However, the highest operations were recorded in the Biobío Region, around 36°00'SL and 37°45'SL.

1.2.4 Fishing Grounds and Bycatch

Artisanal fleet

As in 2022, no bycatch of marine mammals, seabirds or sea turtles were observed during 2023 in the jumbo squid artisanal fishery. This condition is not new, and it relates to the high selectivity of the fishing gear used by this fleet.

Industrial Fleet

During 2023, the extractive activity on jumbo squid by this fleet was carried out mainly as bycatch for other target fisheries. These was developed as bycatch while targeting other resources, mainly Hake. In this context, the assessment of the interactions and incidental bycatch of marine mammals, seabirds and sea turtles is not applicable in this case. However, these other fisheries are subject to mandatory discard reduction plans, use of incidental bycatch reduction devices, and compliance control through electronic monitoring in 100% of the vessels, therefore the potential discards under control.

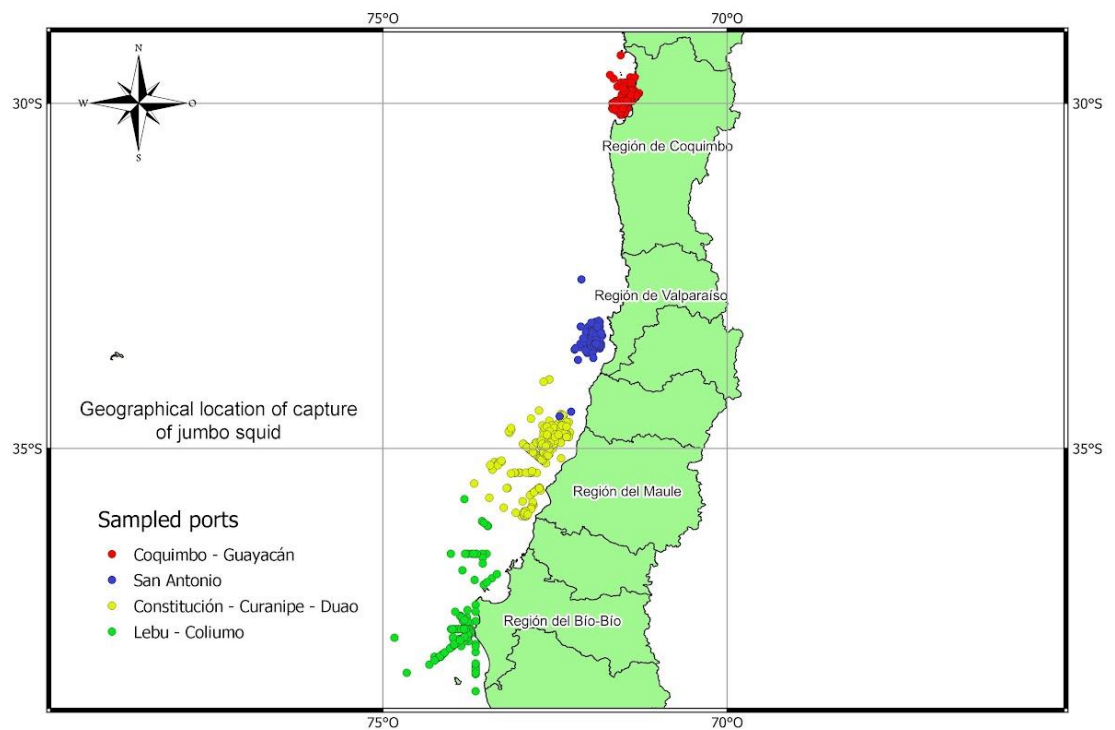


Figure 3.-Spatial distribution of monitored fishing sets with catches of *D. gigas* during 2023 in the artisanal fleet (Source: IFOP).

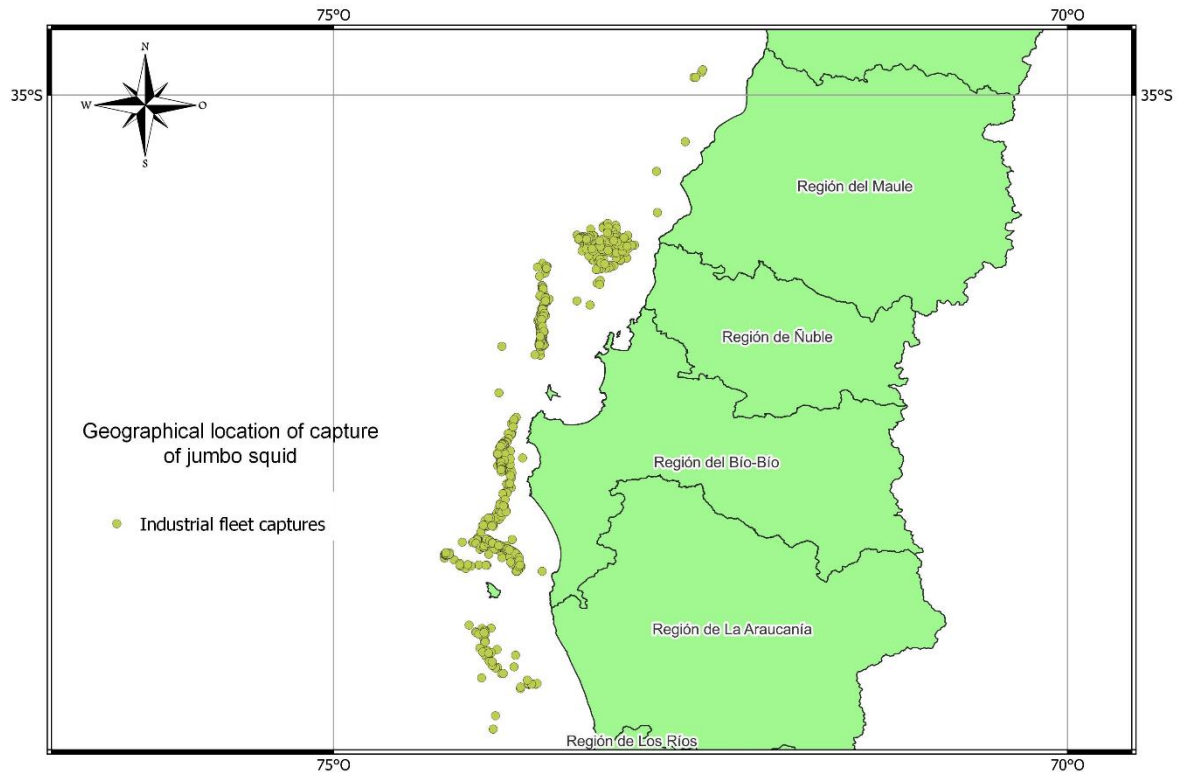


Figure 4.-Spatial distribution of monitored fishing sets deployed by the industrial fleet with catches of *D. gigas* as bycatch in the Hake target fisheries during 2023 (Source: IFOP).

2 EFFORT AND CPUE FOR *Dosidicus gigas* FISHERY

Artisanal Effort

As reported in previous years, the effective duration of fishing hours was considered as an indirect indicator of fishing effort for the artisanal fleet. In this context, this indicator has varied between 7 and 8 hours approximately from 2016 to date (Figure 5).

Industrial Effort

As in 2022 and since the catches of jumbo squid for the industrial fleet are performed as bycatch while targeting other fishing resources, during 2023 it was not possible to calculate effort for this sector, discontinuing what had been done until 2019. This situation will be permanent for Chile, in accordance with current legislation.

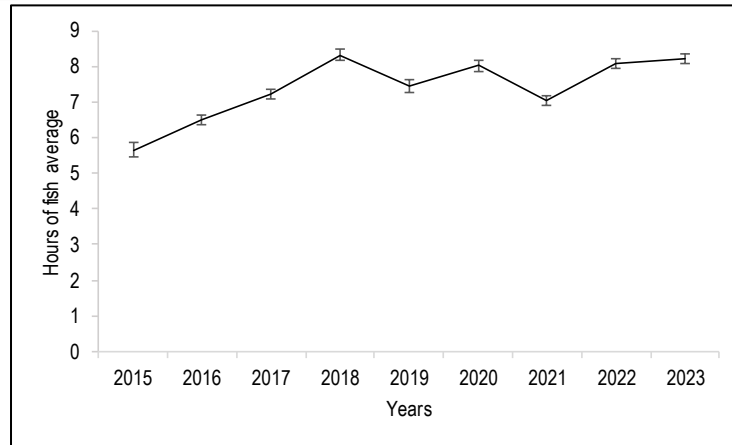


Figure 5.- Average fishing effort per trip, expressed in effective fishing hours, per year. Fleet of vessels smaller than 12 m in length. Coefficient of variation. The 2015-2023 period. Source: IFOP.

Artisanal Yield (CPUE)

The CPUE indicator for the artisanal fleet was obtained from the target fishing operation carried out with jigging fishing gear and expressed in kilograms (hours of fishing jigging). In this regard, the artisanal CPUE has shown a decreasing trend from 2015 to 2019 and a positive trend from 2020 to date (Figure 6).

The lowest values for artisanal CPUE in each annual series corresponded to the summer, possibly explained by a lower availability of jumbo squid on the coast of Chile at that time, related with a possible movement of this resource towards oceanic areas.

From the end of 2017 until 2019, the fishing activity on jumbo squid has shown an intermittent behavior, with periods the scant activity between September and February of each year, which may be related to a possible fall in either the fishing availability or the scant intentionality of the fleet on this resource during the spring-summer period.

In general terms, the performance of the artisanal fleet shows a negative trend from 2015 to 2019, the year in which the lowest average value in the series is recorder. However, in the last years (2020-2023) a progressive increase in this indicator has been observed, with higher values in the first half of each year, which by 2023 they were above to 78 kg / (hour * jigging) (Figures 6 and 7).

Industrial Yield (CPUE)

As indicated in the previous item "industrial effort", a CPUE indicator for the industrial fleet cannot be obtained to give continuity to the series of data reported until 2019, in accordance with the legislation in force in Chile. However, improvements are being made in order to establish some indicator that allows to report the change in the behavior of the extraction of jumbo squid as bycatch by this fleet.

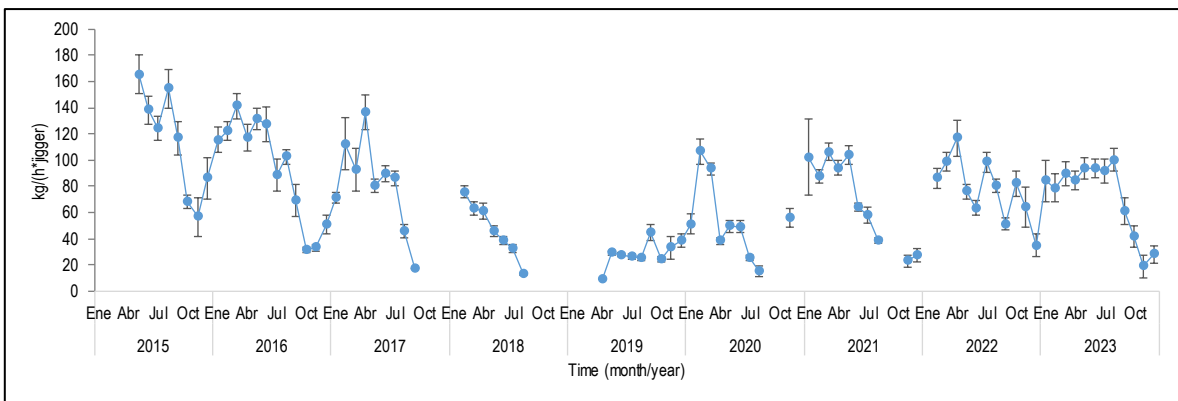


Figure 6.- Historical yield, expressed in kilograms/ (hours of fishing*jiggers) per year and month, of the artisanal fleet targeting jumbo squid, period 2015-2023. Source IFOP.

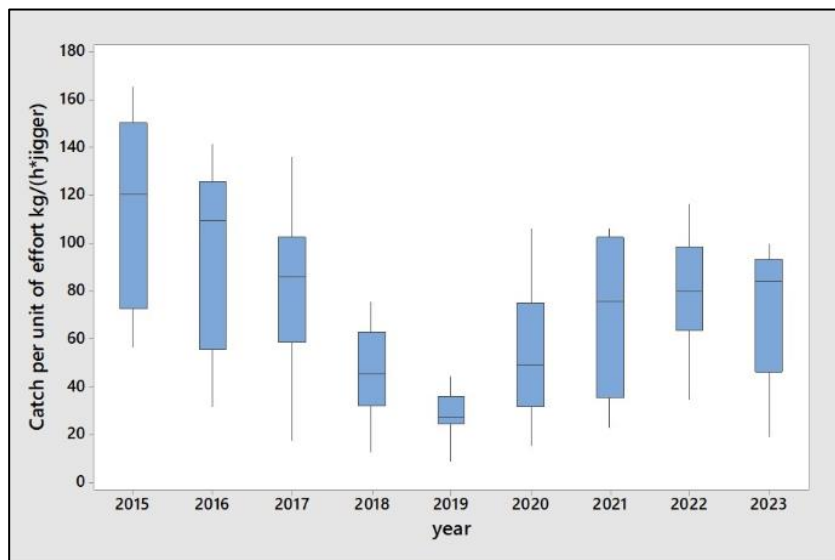


Figure 7.- Boxplot of fishing CPUE (kg / (hour * jigging)) between 2015 and 2023 in Chile. The center line in the boxes represents the median of the data, the bottom horizontal line represents the 1st quartile, while the upper horizontal line represents the 3rd quarter, the vertical lines represent the maximum minimum values and the points outside the "outliers" boxes of the data.



3 RESEARCH PROGRAMS

The research programs for the jumbo squid fishery during 2023 were mainly performed by the Fisheries Development Institute (IFOP) and complemented by other projects required by the fishing authority. The scientific and technical background provided by these projects provided advice to support decision-making process.

The projects developed annually by IFOP are:

- **Fishery monitoring of jumbo squid (*Dosidicus gigas*)**

This study allows the collection of information on the main biological and fishery dependent data and indicators associated with the jumbo squid fishery and its bycatch. Monitoring was concentrated in the regions of the country (Coquimbo, Valparaíso y Biobío) where the fishery is developed with a higher intensity.

- **Assessment of status and possibility of exploitation**

This project aims to provide the Technical Scientific Committee with the necessary technical advice, data, and information necessary for the analysis of status and exploitation possibilities, determining the levels of Biologically Acceptable Catch for the next annual extractive season in the jumbo squid fishery.

- **Research and monitoring program for discards and incidental bycatch.**

This project was aimed to diagnose and quantify discards as well as incidental bycatch and interactions of the jumbo squid target fishery with seabirds, marine mammals and sea turtles. The information was gathered by observers onboard and the results showed that this fishery has no issues in these matters, which is mainly explained by the selectivity of the fishing gear used. Despite the good results, according to legal requirements, a plan to reduce these practices must be established, which in this case will rather focus on maintaining the conditions that result in null or very low levels of discards and incidental bycatch.

Other projects developed:

- **FIPA PROYECT N° 2020-20: Population genetics of *Dosidicus gigas* present in national territory.**

The results of project of sequencing the mitochondrial genes COI and ND2 indicated that all the studied localities in Ecuador, Peru, and Chile, and as a whole, are characterized by low genetic diversity and an absence of spatial genetic structure. Therefore, it is suggested that there would be one genetic unit of *D. gigas* in the South Pacific Ocean. This low genetic diversity would be associated with a recent population expansion (~40000 - 50000 years ago) according to the analyses performed. The absence of spatial genetic structure is associated with the high vagility of both adults and eggs and paralarvae of jumbo squid.

- **FIPA PROYECT N° 2023-19: Molecular Diversity of the South Pacific *Dosidicus gigas* populations in the context OROP-PS.** Research project in development.

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

4.1 Biological sampling

The collection of all the biological data from the industrial fleet was carried out through scientific observers onboard, mainly in the Biobío Region, from catches of jumbo squid obtained as bycatch while targeting other resources.

Regarding the collection of data by the artisanal fleet, it was also carried out by scientific observers but mainly at landing sites and to a lesser extent onboard vessels when feasible. Specific biological sampling was carried out in processing plants or at landing sites when possible.

Tables 4 and 5 show the number of specimens sampled (length and biological) for the industrial and artisanal fleet, respectively.

Table 4.- Number of trips, sets and specimens sampled from the catches of jumbo squid as bycatch for the industrial fleet, according to the type of sampling in 2023.

Year	Type of sampling					
	Length			Biological		
	Fishing trips	Fishing sets	Specimens	Fishing trips	Fishing set	Specimens
2023	18	18	661	21	22	611

Fuente IFOP

Table 5.- Number of trips, sets and specimens sampled from the artisanal fleet targeting jumbo squid, according to the type of sampling in 2023.

Region	Type of sampling			
	Length		Biological	
	Fishing trips	Specimens	Fishing trips	Specimens
Coquimbo	25	733		
Valparaiso	109	3.543	2	60
Maule	80	2.516	7	210
Biobío	64	1.944	61	1.823
Total	278	8.736	70	2.093

Source IFOP

4.2 Length and age composition of catches

Artisanal Fleet

For the period 2015-2023 it is identified that the average size, except for 2019, was above the sexual maturity reference size of 63.8 cm, with lengths fluctuating from 65 to 85 cm. In 2023, the presence of sampled individuals among the 52.5 cm and 94.5 cm (Figure 8) is highlighted.

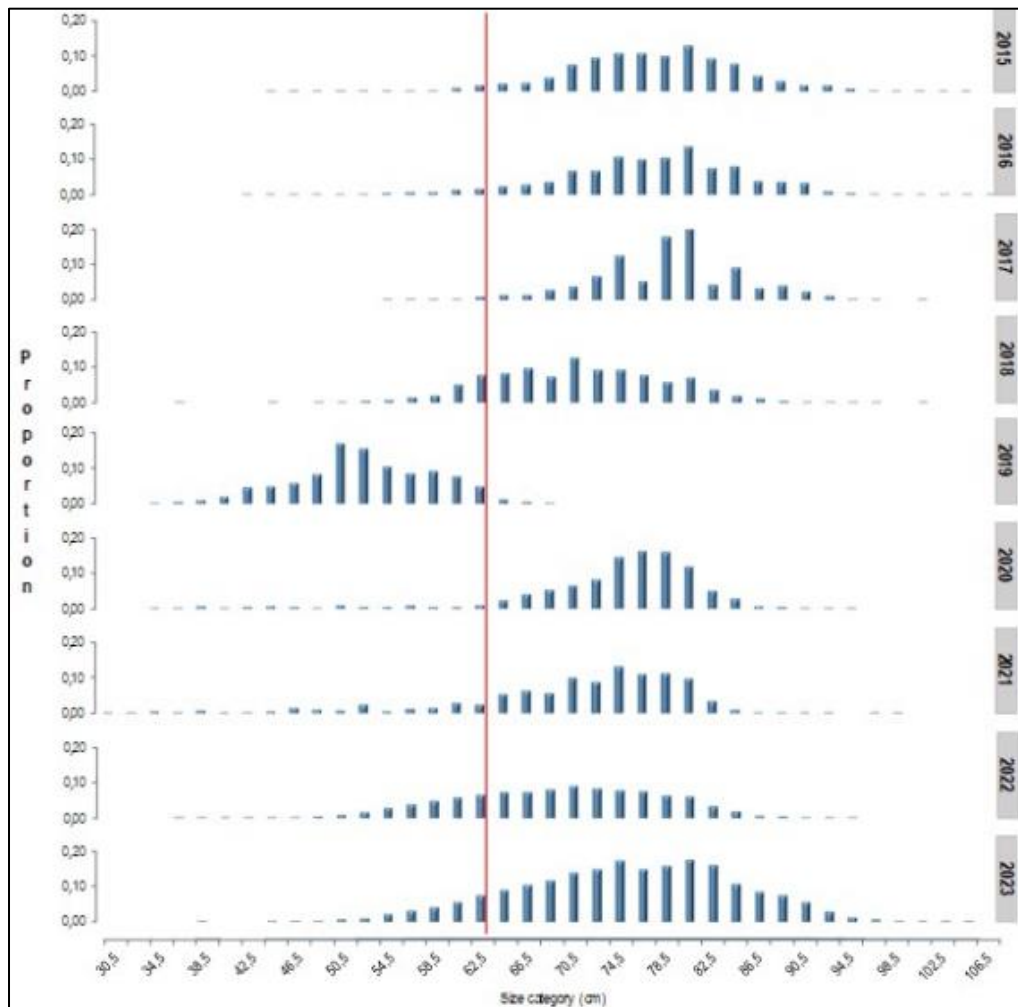


Figure 8.- Composition of mantle length (cm) weighted to artisanal catches of jumbo squid (both sexes combined) Period 2015-2023. Vertical red line corresponds to the sexual maturity reference size of 63.8 cm (Liu *et al.* 2010)¹. Source: IFOP.

¹ Liu, B., Chen, X., Lu, H., Chen, Y. & Qian, W. (2010). Fishery biology of the jumbo flying squid *Dosidicus gigas* off the Exclusive Economic Zone of Chilean waters. *Scientia Marina*, 74, 4.

Industrial fleet

When analyzing the length structures of the jumbo squid catches obtained by the industrial fleet in the 2014-2022 period, for both sexes combined and weighted to the catch, it is observed that the operation has been generally carried out on specimens of sizes above the sexual maturity reference size of 63.8 cm (Liu et al. 2010). However, during 2019, 52% of the specimens monitored were under reference size.

It is important to mention that from 2020 the length structures of jumbo squid in the industrial fleet were obtained from jumbo squid specimens caught as bycatch while targeting other resources.

The size structure of the industrial catch observed during the year 2023 had a distribution between class marks 34.5 cm and 88.5 cm ML, with a proportion of 0.6 over the reference size. On the other hand, it is identified that the greatest proportion of individuals is concentrated among the 50.5 and 84.5 cm ML (Figure 9).

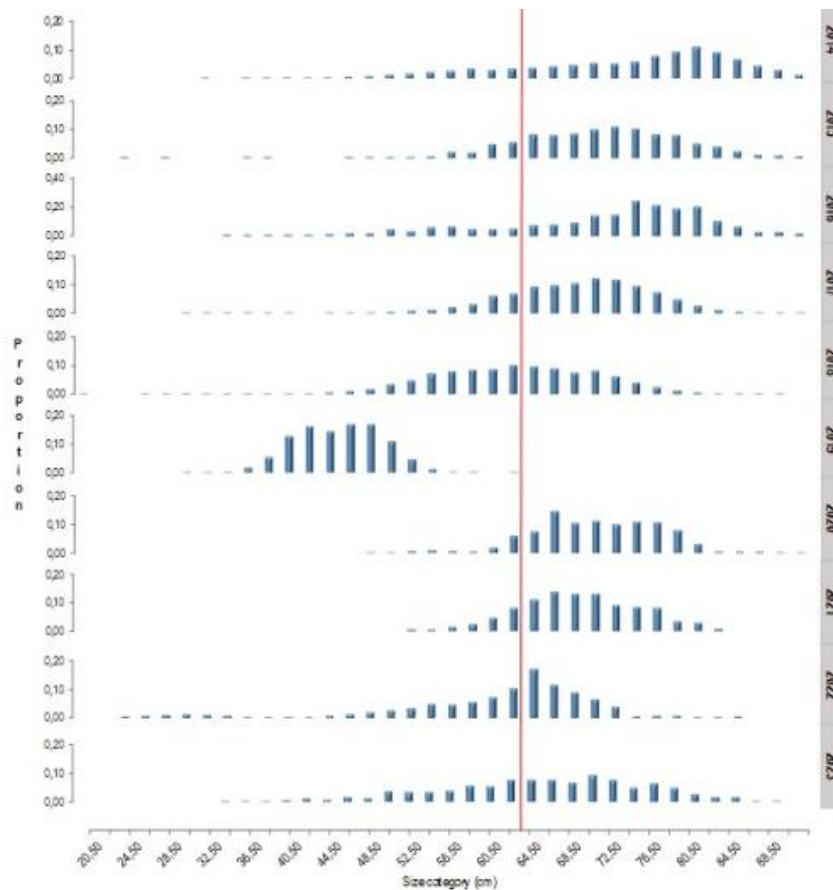


Figure 9.-Composition of mantle length ML (cm) weighted to industrial catches of jumbo squid (both sexes combined). Period 2014-2022. Vertical red line corresponds to the sexual maturity reference size of 63.8 cm (Liu *et al.* 2010)¹. 2020 -2023 corresponds to catches of jumbo squid obtained as bycatch while targeting other resources. Source: IFOP.

5. AT-SEA AND PORT SAMPLING PROGRAM

Sampling was carried out by Scientific Observers (SO) on board and in port. These monitoring activities covered both the artisanal and industrial fleets.

For the industrial fleet, no trips targeting jumbo squid were monitored during 2023, since the data collected for this fleet was obtained by observers on board while industrial vessels were targeting other resource; specimens sampled there corresponded to bycatch.

For the artisanal fleet, during 2023 there was sampling coverage in all the regions of significant activity for this sector, reaching 4.78% of the total fishing trips, a valor lower than 2022 (Table 6)

Table 6.-Number of fishing trips monitored by region (on land and at sea combined), total trips and monitoring coverage in the artisanal jumbo squid fishery during 2023.

Región	Fishing Trips		
	Monitored	Total	% coverage
Coquimbo	184	3.523	5,2
Valparaíso	151	8.356	1,8
Maule	373	3.721	10
Biobío	554	10.800	5,1
Total	1.262	26.400	4,78

6. MANAGEMENT MEASURES

Current Administration Measures

The administrative measures applied to the jumbo squid fishery date from 2012 and were established with the aim of maintaining the sustainability of the jumbo squid fishery. In this sense, the Undersecretary of Fisheries and Aquaculture declared this resource in a state of full exploitation; therefore, restricting the access to new users. On the other hand, in 2012 an annual global catch quota was first established along with the prohibition of using this resource as raw material for the production of fishmeal (Table 7).

Table 7.- Main management measures in course for jumbo squid fishery in Chile.

Management measure	Purpose	Regulations
Regime	Regime of Freedom of Fishing and General Regime of access, both assimilated to a state of full exploitation from the Arica and Parinacota Region to the Magallanes Region (The entire country).	Res. Ex. N° 3.974/2019
Access	Suspension of the registration of the resource in the Artisanal Fishing Registry (RPA), between the regions of Arica and	Res. Ex. N° 3.974/2019

	Parinacota to the Magallanes Region for having reached the state of full exploitation. Valid until Dec. 31. 2024.	
Annual Global Catch Quota (CGAC/ TAC)	The TAC of jumbo squid for the year 2024 was 200,000 tons;	D. Ex. Folio DEXE202300180 MINECON
By cash	Research and monitoring program of bycatch and incidental catch 2018-2020 period.	Res Ex. N°3048/2018
Fishing gear	It establishes that jumbo squid can only be extracted as a target fishery, using jigging or hand line as fishing gear. the capture of jumbo squid with other fishing gear is allowed only as a bycatch	Law No. 21.134/2019
Other measures	Jumbo squid (<i>Dosidicus gigas</i>) is banned as raw material for the production of fishmeal.	D.S N° 98/2012