Contributions of marine capture fisheries to the domestic livelihoods and seafood consumption of Chile

Final Draft

Camila Vargas e Ignacia Rivera

Methods

Data sources

1. The Chilean National Service of Fisheries (SERNAPESCA) is the main entity in charge of keeping track of landings and other fisheries and aquaculture related data in Chile. Most of their data is available on their website but we also obtained databases upon request. We accessed their databases on landings from wild-caught and farmed fisheries, first transaction prices for artisanal fisheries, and landings used in different types of sea products. These databases provided information at the species and regional level. We also downloaded their data on the geographical distribution of production facilities and the types of sea products they produce.

We issued data requests on SERNAPESCA's portal to obtain more detailed information. Via this method, they provided us the national record of artisanal fishers (RPA), which lists current registered fishers and boats, and the national record of industrial vessels (RPI), which lists current registered industrial vessels. The RPA informs the region, gender and age for each artisanal fisher as well as the species-specific permits they hold. Together the RPA and RPI provide information of artisanal and industrial vessels like lenght and storing capacity. SERNAPESCA also provided us the number of employees of each gender per processing facilities.

2. The Chilean Costumes (ADUANAS Chile) is the main entity in charge of keeping records of imported and exported goods in the country. We accessed their exports and imports data per product and region via their website. Each product in the original exports and imports data-sets is identified through an id number that matches the name of the product in a code known as the *Arancel Aduanero*. Most products provided detail of the species or groups of species involved.
3. The Fisheries development institute (IFOP) is a private entity that advices fisheries management based on permanent biological, environmental and economic monitoring, and scientific reasoning. Although most of the data collected by IFOP pertains to stock assessments and biological indicators, they also generate economically relevant statistics. We reviewed their most recent annual report on the economic monitoring of Chilean fisheries for 2015. It includes databases and estimates for employment. We also extracted data from their monthly reports on exports of fisheries products, which are based on ADUANAS's data.
4. The Chilean Central Bank (Banco Central de Chile) is the entity in charge of estabilizing the Chilean currency. To fullfill its function it monitors the main economic indicators per economic sector. We accessed their data on sectorial GDP for each region per industry.
5. DataChile (www.datachile.com) is an online plataform that integrates, visualizes and distributes public available data from Chile. They also inform their visualizations with data from the ADUANAS Chile and national surveys. Using their visualization tools we extracted information on fish products imports for different municipalities.
6. We reviewed several reports from other national agencies like the Undersecretary of Fisheries (SUBPESCA), NGOs and scientific publications to complement our analysis.

Specific methodologies

Any conversion from chilean pesos to dollars was done by first converting the amount in chilean pesos to its value in Chilean Units of account (UF, a monetary unit corrected by inflation) of the respective year. Then, transformed to the equivalent in 2018 Chilean pesos using the 2018 UF value and finally, converting the 2018 value in chilean pesos to its equivalent in 2018 US dollars, based on the conversion for Dec, 2018 (1 US dollars corresponds to 676 Chilean pesos).

Fisheries context

To evaluate the volume contirbution of specific fisheries over the last five years, we used records of landings and aquaculture harvests from SERNAPESCA (2013-2017). Using monthly data published by IFOP, we identified the most exported fish products in terms of volume. To identify the participation of different species in exported volumes we generated a new database linking types of products listed in the *Arancel Aduanero* with the names of the fished and farmed species listed by SERNAPESCA. We searched for all the products ids that refer to the species scientific name, common name or genus name as listed by SERNAPESCA and aggregated them under the species name.

Estimating National Seafood Supply

We combined data from ADUANAS Chile and SERNAPESCA to generate two main databases on the number of tons that are catches, harvested, exported and imported for all marine species in Chile.

The specific data-sets we used are:

- Catches: annual tonnes per marine species landed in each region (SERNAPESCA, 2013-2017).
- Species contribution to different types of products: annual tons per marine species used in each region to elaborate each type of product (i.e. fish meal, oil, canned products, freeze products, dried products, smoked products, agar, col-agar, carragenina) (SERNAPESCA, 2012-2016).
- Aquaculture: annual tonnes per species harvest from aquaculture centers in each region (SERNAPESCA, 2012-2017).
- Exports: quantities of all the products exported from each Chilean region to other countries. (ADUANAS, 2013-2018).
- Imports: quantities of all marine products imported into the country. (ADUANAS, 2013-2018)

Each product in the original exports and imports data-sets is identified through an id number that matches the name of the product in a code known as the *Arancel Aduanero*. This document was only available to us in .pdf format. Thus, to identified the id of products containing domestically fished and harvest marine species we searched for the names of the fished and harvested species listed by SERNAPESCA in the document with the *Arancel Aduanero*. We searched for all the ids that refer to the species scientific name, common name or genus name as listed by SERNAPESCA and aggregated them under the species name.

We included a column that indicates the number of tonnes of each species that were used in products that are not directly ingested by humans. For this, we assumed that the following categories of products are not for direct human consumption: fish meal, col-agar, agar, carragenina, oil and alginato. Finally, to aggregate all the data at comparable levels we generated broad categories of species based on the imports-data set, which is the one that has less detail at the species level.

Because imports-data is not available at the regional level we generate two databases, (i) one describing tons landed, harvested, exported and imported at the national level per groups of species and (ii) one containing tons landed, harvested and exported at the regional level per species.

We used the R software to clean and format all the available information in long-form databases. All the scripts for replicating our work are available in "scripts/cleaning_data".

We determine the domestic human consumption of marine products through this general model: (Catch - Products not directly for human consumption) + Aquaculture + Imports - Exports. We assumed that all the products that are no exported or are not used in other elaboration process are consumed by the local population. For this report we explore database i mention above, because it has import quantities.

Estimating National Economic Participation

We use data from Banco Central de Chile to reconstruct the percent of the regional GDP that comes from fisheries and calculate the mean percent between 2013 and 2016.

To estimate most important fisheries in terms of economic value, we used data on first-transaction prices per species per month and location (requested to SERNAPESCA) and computed the national average price per year. We used two different approaches, one considers the total revenue generated by different fisheries while the other considers how valuable they are based on their price. To estimate total revenue we multiplied price by the landed tons per year. We converted Chilean pesos to 2018 dollars. Data on price at first transaction at the level of species was only available for the artisanal sector since data on industrial transactions is not recorded officially.

We collect information from several sources to reconstruct employment estimates for different stages in the supply chain of marine products. IFOP, 2015 found that 1.57 indirect employments are generated by each direct employment in the manufacturing fishing sector. We apply this multiplier to our most recent estimate ofnumber of people employed in the manufacturing fishing center to find an estimate of indirect employment. We then qualitatively related the geographic distribution of employees in different stages of the supply chain with the most important fisheries in a given region to find the most important species in terms of employment contribution.

We also obtained data from SERNAPESCA detailing the number of people working in each processing facility. However, some of the values were clearly wrong (because they exceeded the entire Chilean population) making it impossible to use this information to generate reliable estimates. Thus, we relied of information from (IFOP (2015)) to study the manufacturing sector.

Results

Fisheries context

** Main wild-caught fisheries in terms of volume**

According to landing records from SERNAPESCA over the last five years, the artisanal sector lands on average 1.6 $\pm$ 0.58 million annual tons of marine species while the industrial sector lands around 0.9 $\pm$ 0.16 million tons per year. Is worth noting that the artisanal sector includes landings of algae and benthic species that are not targeted by the industrial sector. Both sectors have among their most landed species the Peruvian anchoveta (*Engraulis ringens*) and the Araucanian herring (*Strangomera bentincki*) two species that are mostly used as inputs for fish meal and oil (**Figure 1**). Other important species in artisanal landings are the Giant grey kelp (*Lessonia nigrescens*), exported mostly as dried algae, and the Jumbo squid (*Dosidicus gigas*), mostly commercialized fresh or frozen for HC. The Chilean jack mackerel (*Trachurus murphyi*) is also an important fishery in terms of volume for the industrial sector, which is also mostly use in the production of fish meal and oil and to a lesser extent use for direct HC smoked or canned. Other important species are the mote sculpin and different algaes for the artisanal sector (*Table App.1*). The South pacific hake (*Merluccius gayi*) and the Chub Mackarel (*Scomber japonicus*) are also important for industrial landings (*Table App.2*).

Over the last years the catch composition of the artisanal sector has presented no major changes except from one species of algae (Giant brown kelp, *Lessonia trabeculata*) replacing other (Red algae gracilaria, *Gracilaria spp*) within the top 5 landed species as for 2013. In the case of the industrial sector, composition of the main three species seem to be stable over the last five years. Yet, the South pacific hake (*Merlucius gayi*) stoped being one of the specied most fished by the industrial sector after 2013. This can be explined by the reduction of the total allowable catch for this species given its risk of collapse in those years (SUBPESCA (2013)). After 2013, the industrial sector introduced the Jumbo squid (*Dosidicus gigas*) among its top 5 landed species. As for 2016 the Chub mackerel (*Scomber japonicus*) has entered the top 5 for the indutrial sector replacing Patagonian grenadier (*Macruronus magellanicus*).

** Regional Diferences in volumes of wild-caught fisheries **

Landed tons for 2017 shows that the amount of landings varies widely along the coast of Chile for both artisanal and industrial sectors. **Figure 2** show the mean total landing per sector and region the color of the bars represents the most landed species in 2017. We observe that the VIII is by far the region with most landings from both sectors. The industrial sector also concentrate landings in the north of the country while artisanals are more spread. The most landed species in 2017 also varies by region but has changed little over the last five years (**Table App.3** and **Table App.4**).

** Main farmed fisheries in terms of volume**

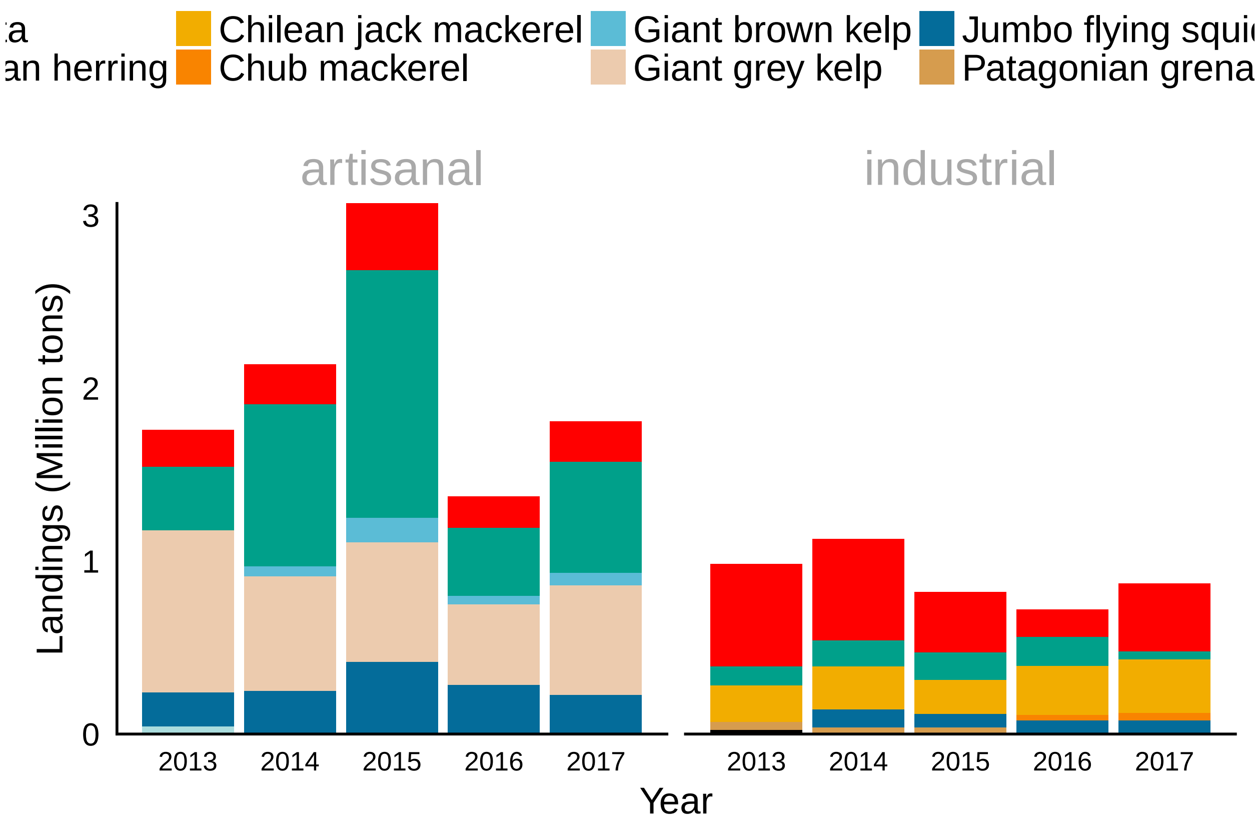


Figure 1: Top 5 species landed in Chile by the artisanal (left pannel) and industrial sector (right pannel) between 2013 and 2017. Data source: Landing records from SERNAPESCA, 2018.

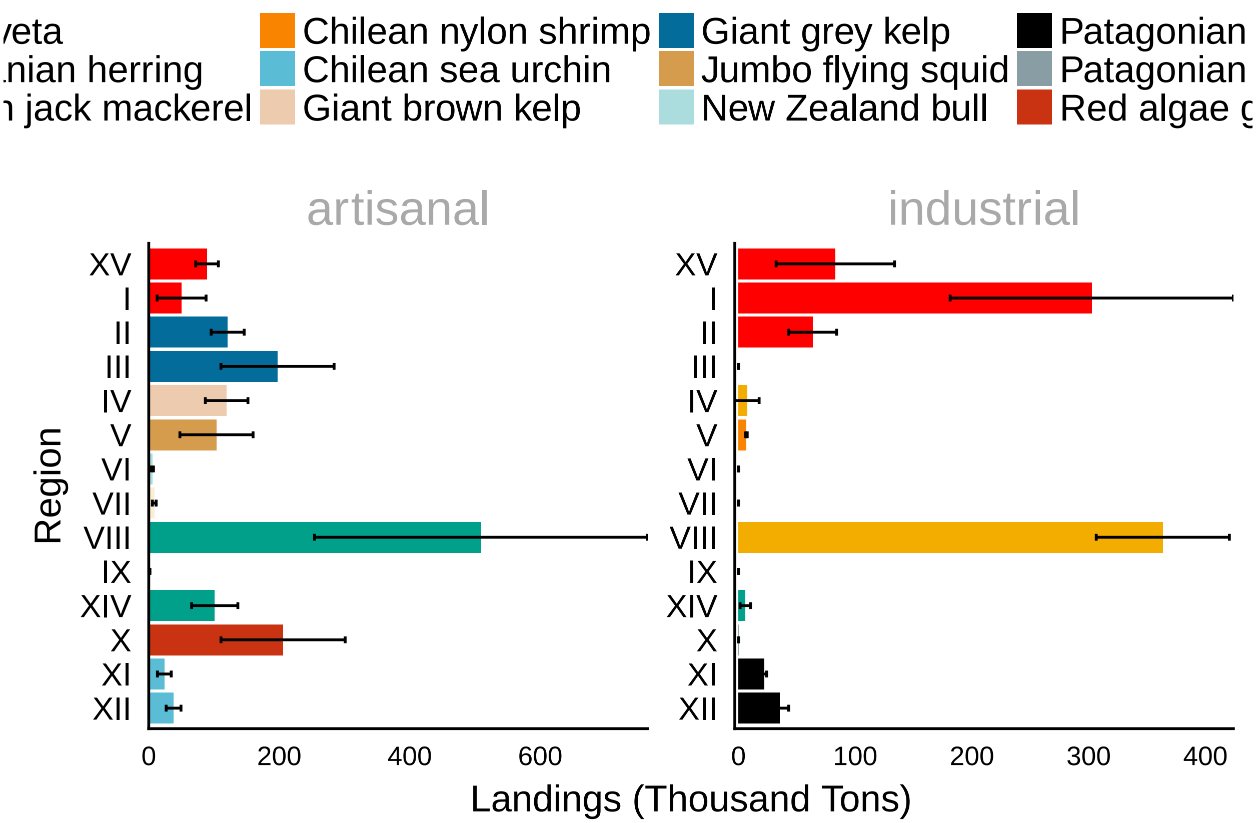


Figure 2: Mean annual total landings per region for the artisanal (left pannel) and industrial sector (right pannel) between 2013 and 2017. The color represents the most landed species in 2017. Error bars represent one standard deviation. Note that scales are different between pannels. Data source: Landing records from SERNAPESCA, 2018.

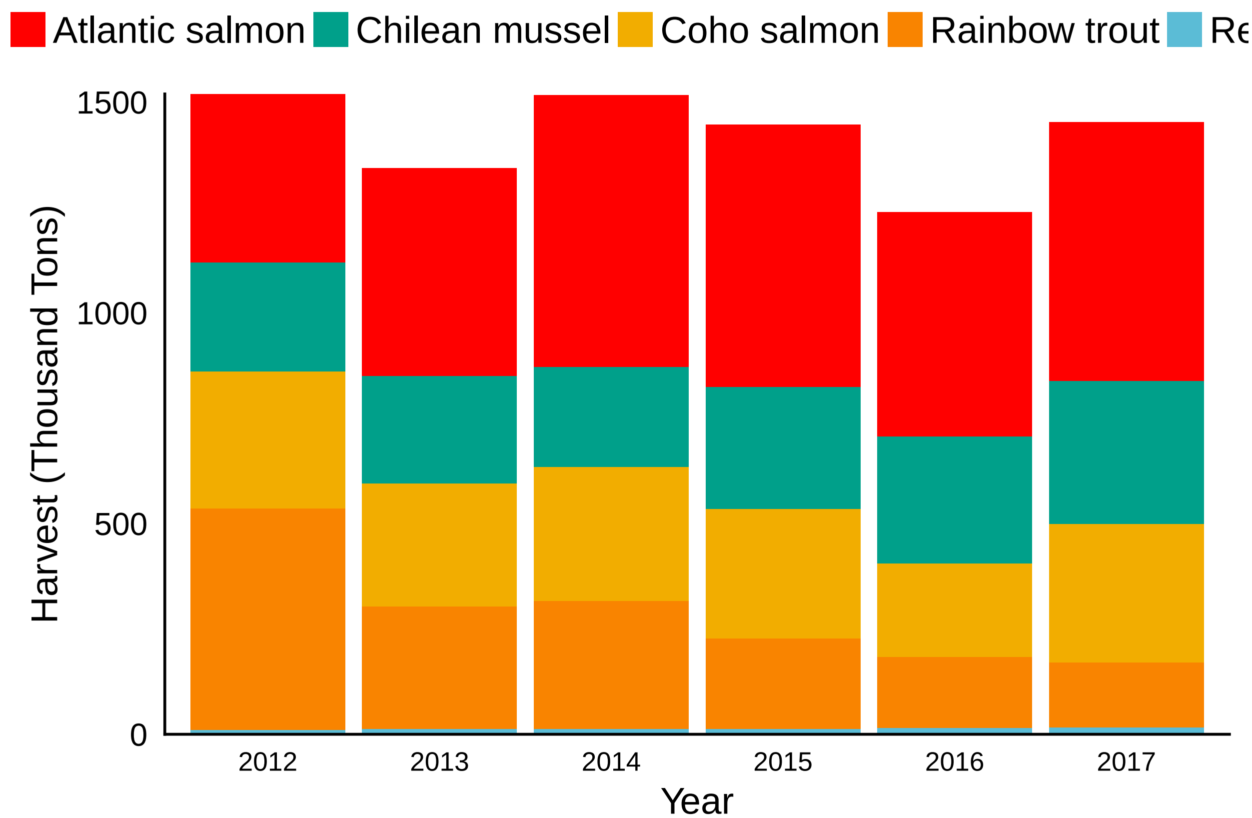


Figure 3: Top 5 species farmed in Chile between 2013 and 2017. Data source: Harvest records from SERNAPESCA, 2018.

The main species harvested from aquaculture centers in the last 5 years have been the Atlantic salmon (*Salmo salar*), Coho salmon (*Oncorhynchus kisutch*), mussels (*Mytilus chilensis*) and the Red algae gracilaria (*Gracilaria spp.*) in descending order (**Figure 3**). Overall, the composition of the most farmed species and its volumes have been stable over the last 5 years. However, the Raibow trout (*Oncorhynchus mykiss*) seems to be becoming less important over recent years.

** Regional Diferences in farmed fisheries **

Aquaculture production is concentrated in the South of the country, between the X and the XII regions (**Figure 4**). From the I to the IV region the most farmed resources are algaes and scallops (*Argopecten purpuratus*) (**Table App.5**). The red abalone (*Haliotis rufescens*) became the most farmed in 2013 in the V region, replacing the Turbot (*Scophtalmus maximus*). Towards the south salmons and trouts are the most farmed species along with some algaes and mussels (*Mytilus chilensis*). The most farmed species in the austral south are the Atlantic salmon (*Salmo salar*) and the Chilean mussel (*Mytilus chilensis*).

** Main Traded marine species **

Around 72% of the landings from fisheries and aquaculture are exported outside the country (IFOP (2015)).

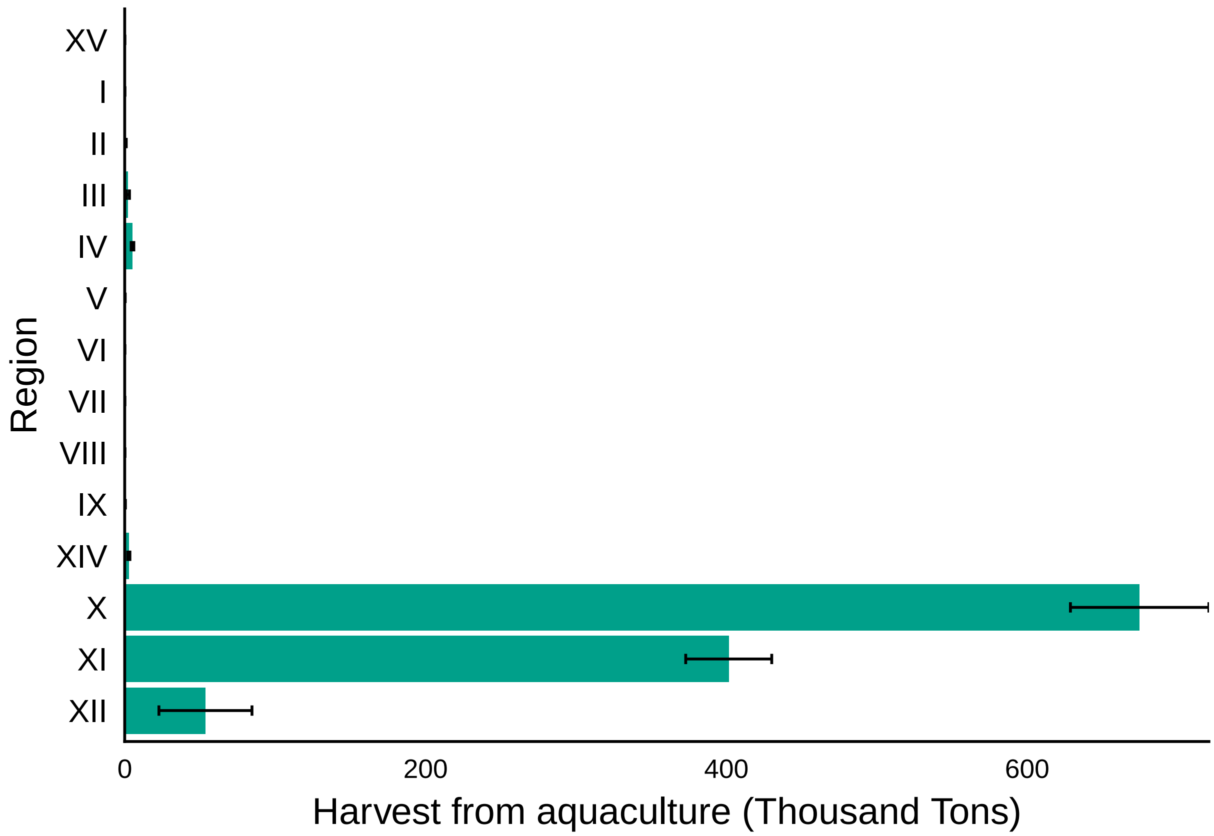
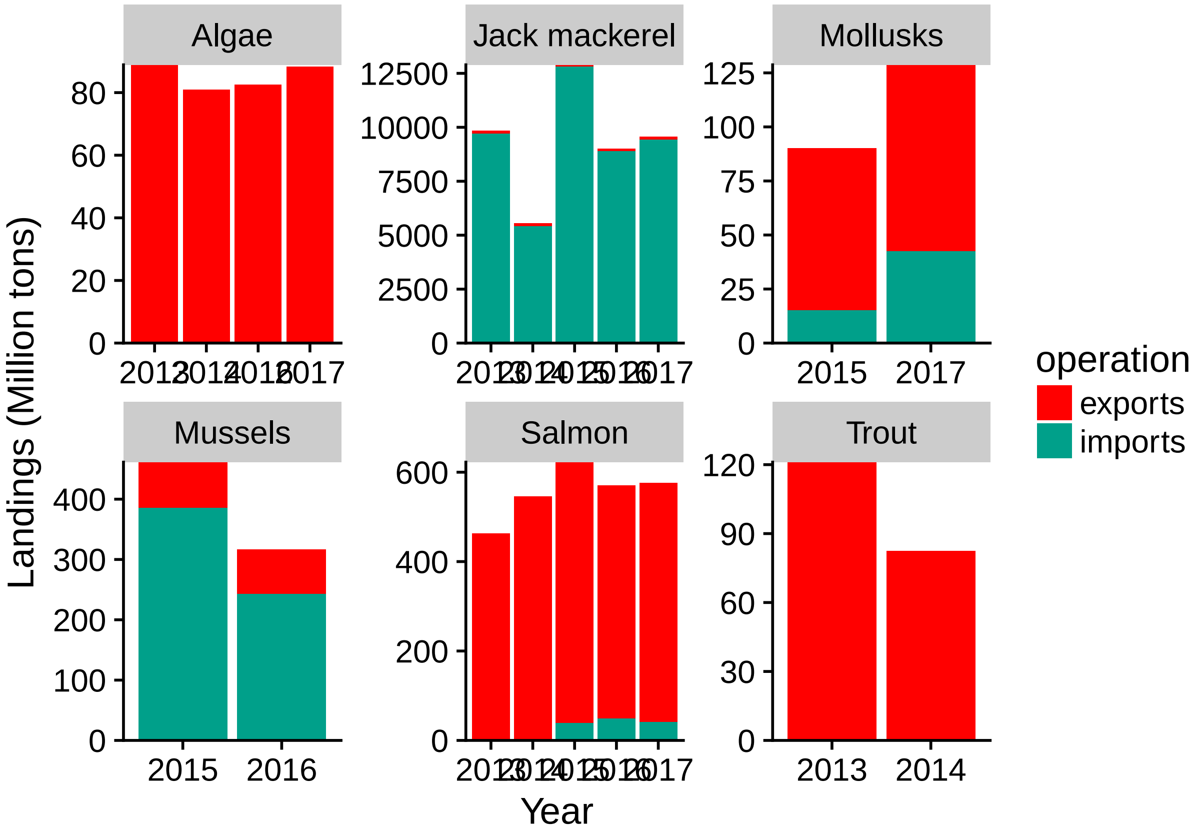


Figure 4: Mean annual harvest per region from aquaculture centers between 2012 and 2017. Error bars represent one standard deviation. Data source: Harvests records from SERNAPESCA, 2018.



National Seafood Supply

** Main fisheries for food supply   Total and per capita food consumption in the country   Regional differences in per capita and total consumption **

National Economic Participation

Fisheries, as an economic sector in Chile, considers activities of extraction and farming of marine and freshwater products. This sector contributes to around 0.4% of the national GDP although it is a highly variable sector (Central (2017)). An estimate of 2014, indicates that 90% of the sales of the sector came from farmed products (SENCE (2015)). What reflects the relevance of aquaculture in economic terms relative to wild fisheries. Yet, the extractive sector has a higher number of firms, 58% of the total (SENCE (2015)). Manufacturing is the sector most linked to fisheries. Based on the last input-output matrix for the country's economy, for every 100 US dollars spent in the fisheries sector, another 52.2 dollars are generated in the manufacturing sector. Other sectors affected by fisheries are the financing sector (24.8 dollars generated every 100) and transportation and comunication (13.4 dollars generated every 100).

The contribution of fisheries to regional GDP suggests that the economic importance of the sector to regional economies varies widely. Ranging from almost 30% in the XI region to 0% in the metropolitan (RM) and IX region (*Figure 5*).

Seafood products are one of the most important exports of the country. IFOP valued the exportation of fisheries-related products in $6,280 million dollars in 2017 (IFOP (2017)). This corresponded to ~ 9 % of the total value of national exportations. The most important exported species are the Atlantic salmon (*Salmo salar*), the Rainbow trout (*Oncorhynchus mykiss*) and the Chinook salmon (*Oncorhynchus tshawytscha*)(*Figure 6*). All three produced via aquaculture. Mussels, specifically the Chilean Ribbed Mussel (*Aulacomya ater*)

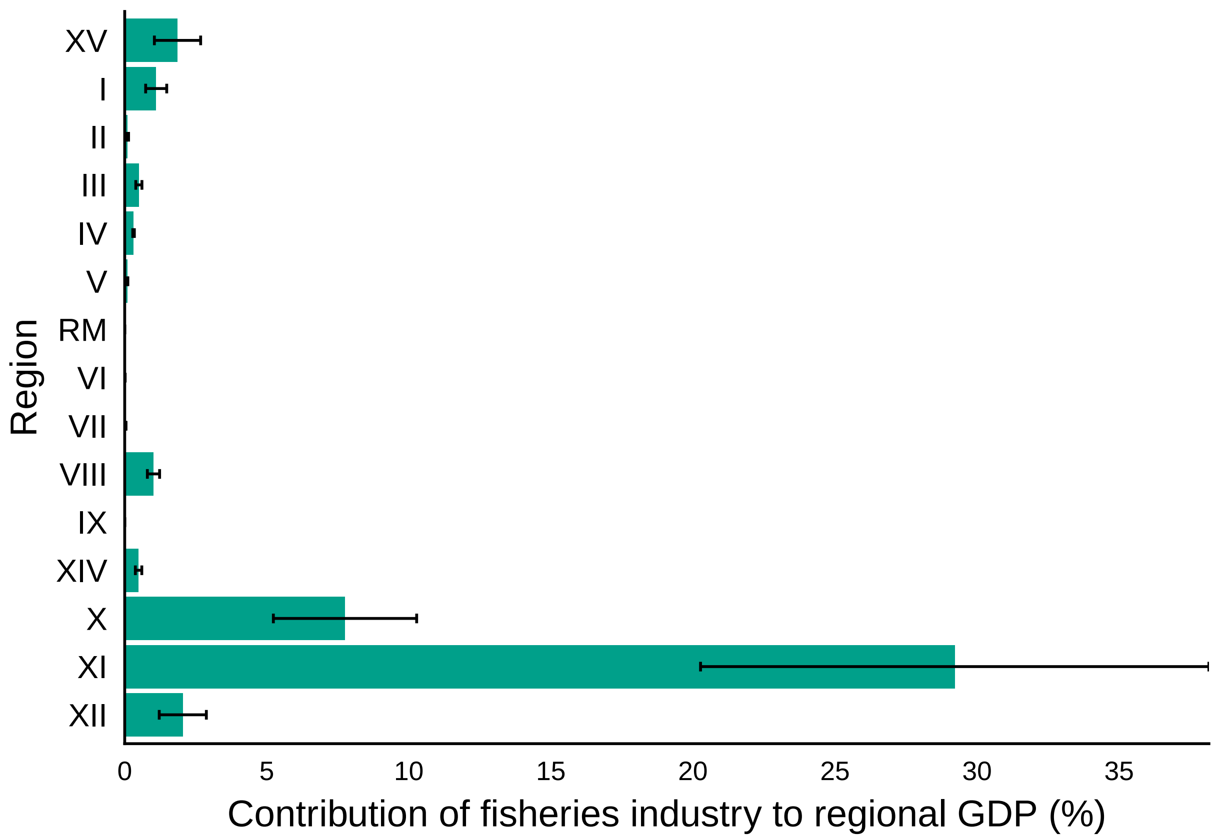


Figure 5: Percent of the regional GDP contirbuted by the fisheries sector averaging data between 2013 and 2016. Data source: Banco Central de Chile.

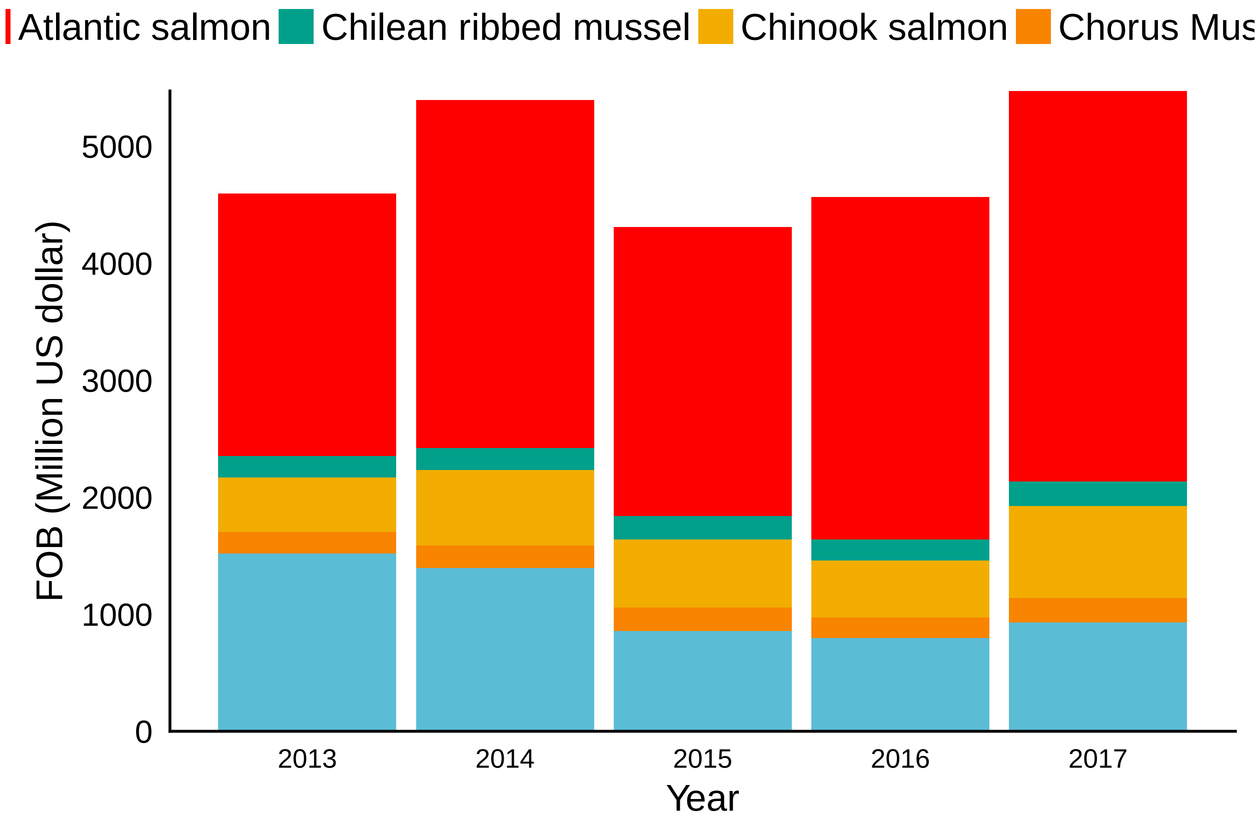


Figure 6: Main exported species in terms of econmic value. Source: Export data from Aduanas Chile, 2018

and the Chorus mussels (*Choromytilus chorus*) are also among the most valuable exports. These are landed by artisanal fishers and to a lesser extent produced in aquaculture centers.

The most valuable sea products in terms of exports are frozen and fresh followed by fish meal and dried algae (IFOP (2017)). In 2016, fish fillets were the fourth most exported product by Chile. This commodity generates around 2 billion US dollar per year and is mainly made of farmed salmon (DataChile (2016)).

Based on our estimates of species-specific revenue the most important species for the artisanal sector are the Southern king crab (*Lithodes santolla*) and the Chilean sea urchin (*Loxechinus albus*) (*Figure 7*). Nontheless, this varies across years. In 2017 the Patagonian toothfish (*Dissostichus eleginoides*) and the Southern rays bream or Corvina (*Brama australis*) were the species that provided more revenue followed by the Pink cusk-eel (*Genypterus blacodes*) in the artisanal sector.

Some of these species are among the most expenssive (*Table App.6*). The Patagonian toothfish (*Dissostichus eleginoides*) has the highest mean ex-vessel price in the artisanal sector what explains in part why is one of the top 5 in term of revenues. We should notice that the fishing costs for different types of species could vary widely and we are not accounting for this in our analysis. Yet, we can qualitatively consider the costs of different types of fishing. For example, some of these species are fished by diving near the shore like the Chilean abalone (*Concholepas concholepas*) and the Chilean sea urchin (*Loxechinus albus*) while others like the Patagonian toothfish (*Dissostichus eleginoides*), the Southern king crab (*Lithodes santolla*) or the Swordfish (*Xiphias gladius*) involve offshore fishing, which tends to be much more expensive. The gathering of algae from the shore is arguably one of the less costly extractive activities for the artisanal sector but it is not among the ones that generate more revenue. We could not generate similar estimates for the industrial and aquaculture subsectors due to lack of data.

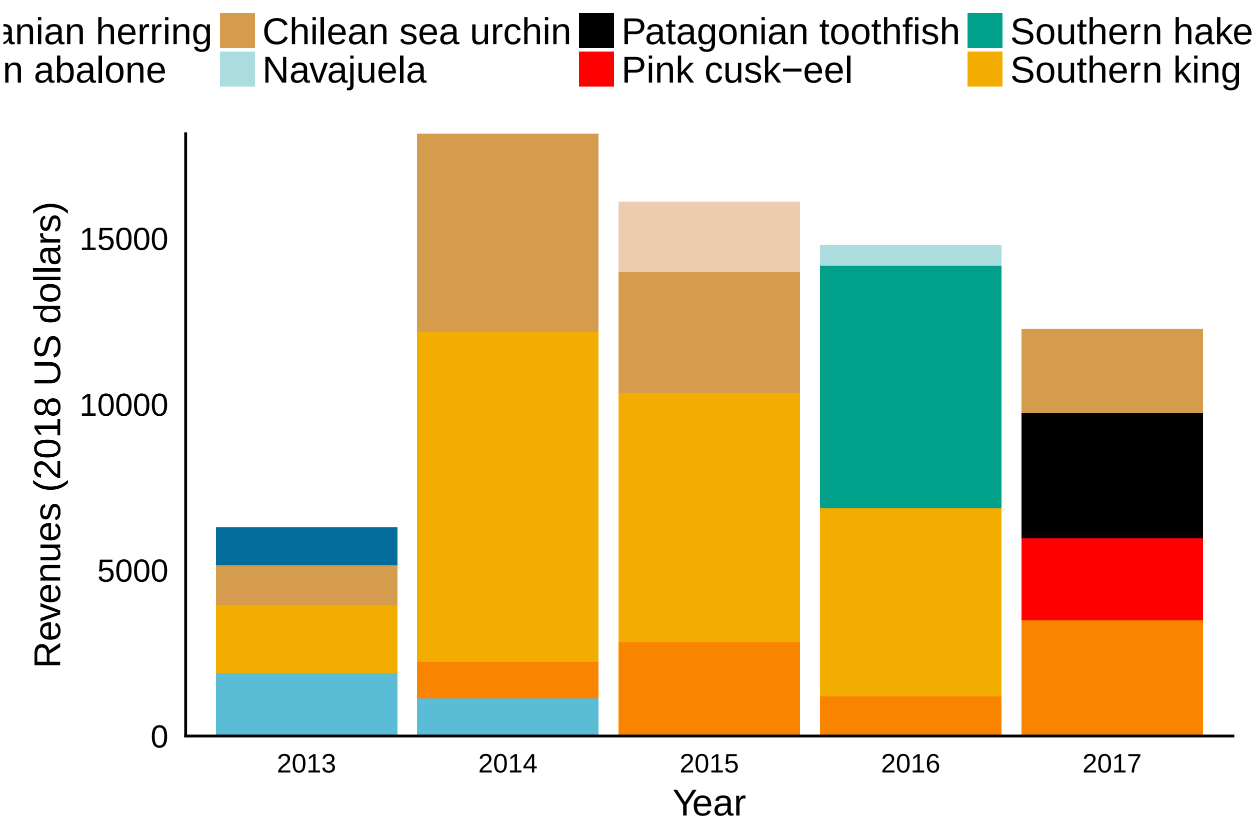


Figure 7: Species that generated the most revenue for the artisanal sector over the past five years based on records on landings and ex-vessel prices. Source: records from SERNAPESCA, 2018.

Fisheries and aquaculture are considered to be the activities that provide less direct employment in the country after agriculture ((**???**)). Yet, the number of people employed in the sector has been on the rise since 2010 (SENCE (2015)). We estimated a total of ~ 278,000 job positions generated by fisheries and aquaculture. This estimate considers artisanal and industrial fishers, workers in processing facilities and aquaculture centers and indirect jobs generated by the manufacturing sector (*Table 2*). It does not include other indirect jobs generated by the extractive activities and its commercialization. Thus, the number of total people directly and indirectly employed by fisheries and aquaculture in Chile could be higher.

Table 1: Most recent estimates of people employed in different stages of the supply chain of sea products in Chile. Note that the estimate of indirect employment only considers indirect employment generated by the manufacturing stage.

Stage of the supply chain	Employees	Year of the estimate	Source
Artisanal Extraction	88,968	2018	RPA (SERNAPESCA, 2018)
Industrial Extraction	3,525	2018	RPI (SERNAPESCA, 2018) and SUBPESCA website (20
Aquaculture Centers	17,631	2017	Maturana et al., 2017 (SERNAPESCA, 2018)
Manufacturing	65,451	2017	Maturana et al., 2017 (SERNAPESCA, 2018)
Indirect employment	102,758	2018	Own estimate based on IFOP,2015 multipliers

People employed in the fisheries and aquaculture activities has an average monthly income of 579 US dollars, the lowest mean income in the country after the one generated by the agricultural sector (SENCE (2015)). This value ranges from 258 US dollars for people working independently and part-time to 1,160 US dollars for full-time employers (*Table App. 7*).

On average, people employed in the fisheries and aquaculture sector are a younger and less educated relative to the national average and are mostly men (*Table App. 8*). However, there is high variation within subsectors, for example, artisanal fishers tend to be older Tam et al. (2018). Based on estimates from the New national survey of employment (NENE, 2015) only 57.7% of the people employed in the sector is formaly employed by an employer, the rest work independently ((**???**)).

The artisanal sector corresponds to fishing activities performed by vessels equal to or smaller than 18 meters in length and by collectors in the inter-tidal zone ((**???**)). Based on the current RPA, there are around 89,000 artisanal fishers along with 12,700 vessels in Chile. *Figure 6*, shows the number of artisanal fishers per region and gender. They are concentrated in the X and VIII regions and are mostly men. The main activity in the artisanal sector is harvester or collector, this mostly corresponds to algae collection on the shore. All regions present similar composition of fishing activities (*Figure 7*). However, the X region seems to rely more on benthic resources for employment than the others since they have a greater share of divers and algae collectors.

The industrial sector comprises activities performed by vessels larger than 18 meters. Currently, there are 475 industrial vessels and 164 vessel owners according to national industrial records (RPI), from which only 25 are individual owners and the rest are firms (Maturana et al. (2017)). Besides, 3,500 jobs are generated through vessels operations (SUBPESCA (2018)). We could only find information on the distirbution of vessels (*Figure 8*). We observe that most industrial extractive activities occur in the VIII region, as suggested by landings estimates discussed above. Still, vessels are registered along the etire coast. Some of the firms that own industrial vessels also own processing facilities whose employees are considered as part of the manufacturing stage.

A rigourus study by IFOP estimated a total of ~50,000 job positions in the manufacturing of marine products in processing facilities in 2014 ((**???**)). However, a more recent report form SERNAPESCA reports a total of 65,451 jobs (Maturana et al. (2017)). *Figure 9* displays the geographic distribution of people employed in the manufacturing sector per gender and type of product for 2015. Employment in the processing facilities is dominated by human consumption (HC) products, with ~ 40,000 job positions. Products for animal consumption (AC) generated around 5,000 positions while algae products employed less than 3,000 people.

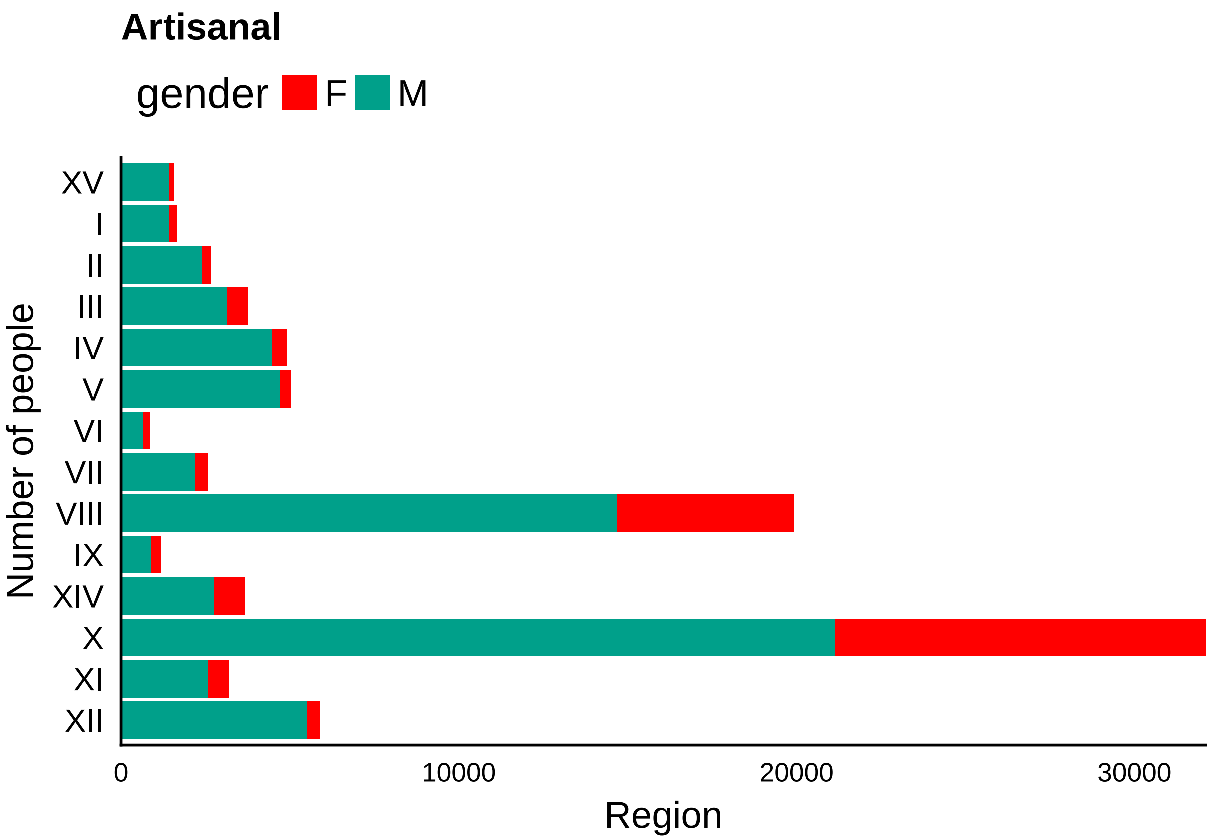


Figure 8: Number of artisanal fishers in each region by gender. Source: National record of artisanal fishers (SERNAPESCA, 2018)

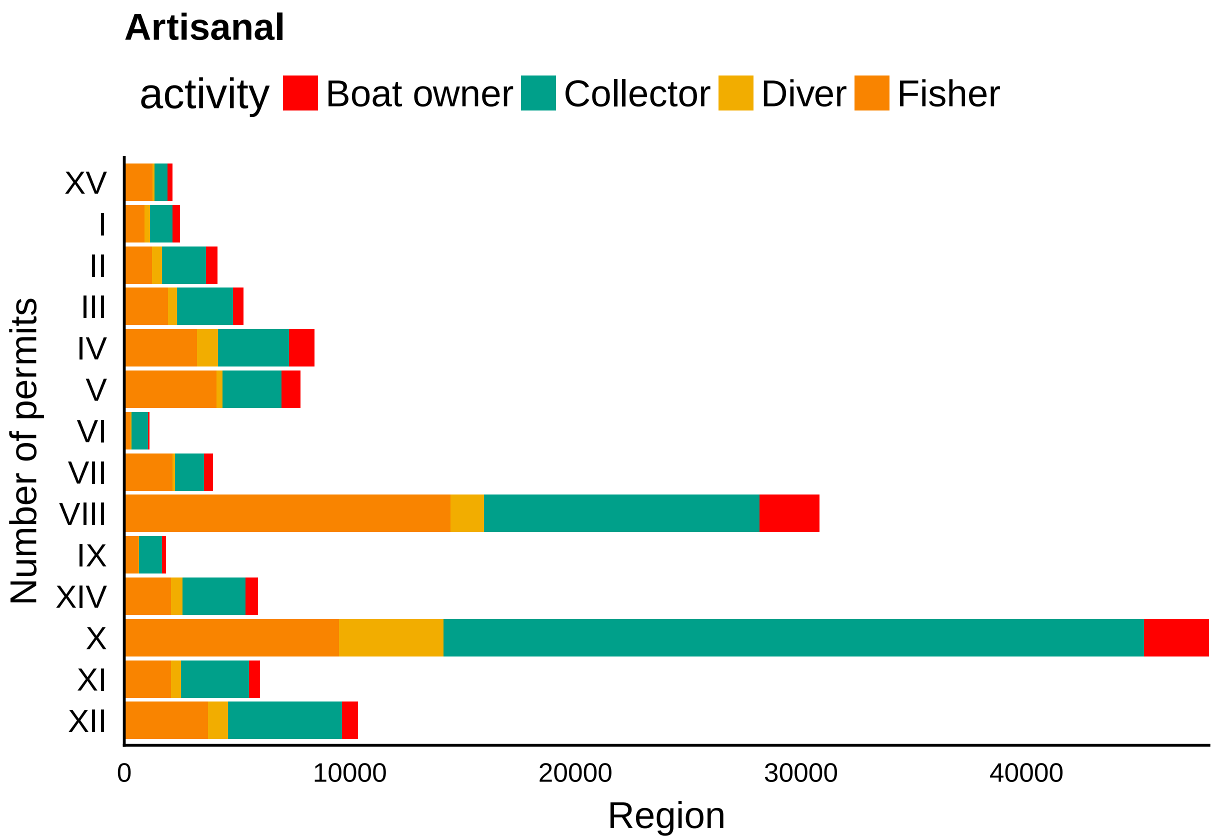


Figure 9: Number of permits issued in each region for different activities. One person can be registered in multiple activities. Source: National record of artisanal fishers (SERNAPESCA, 2018)

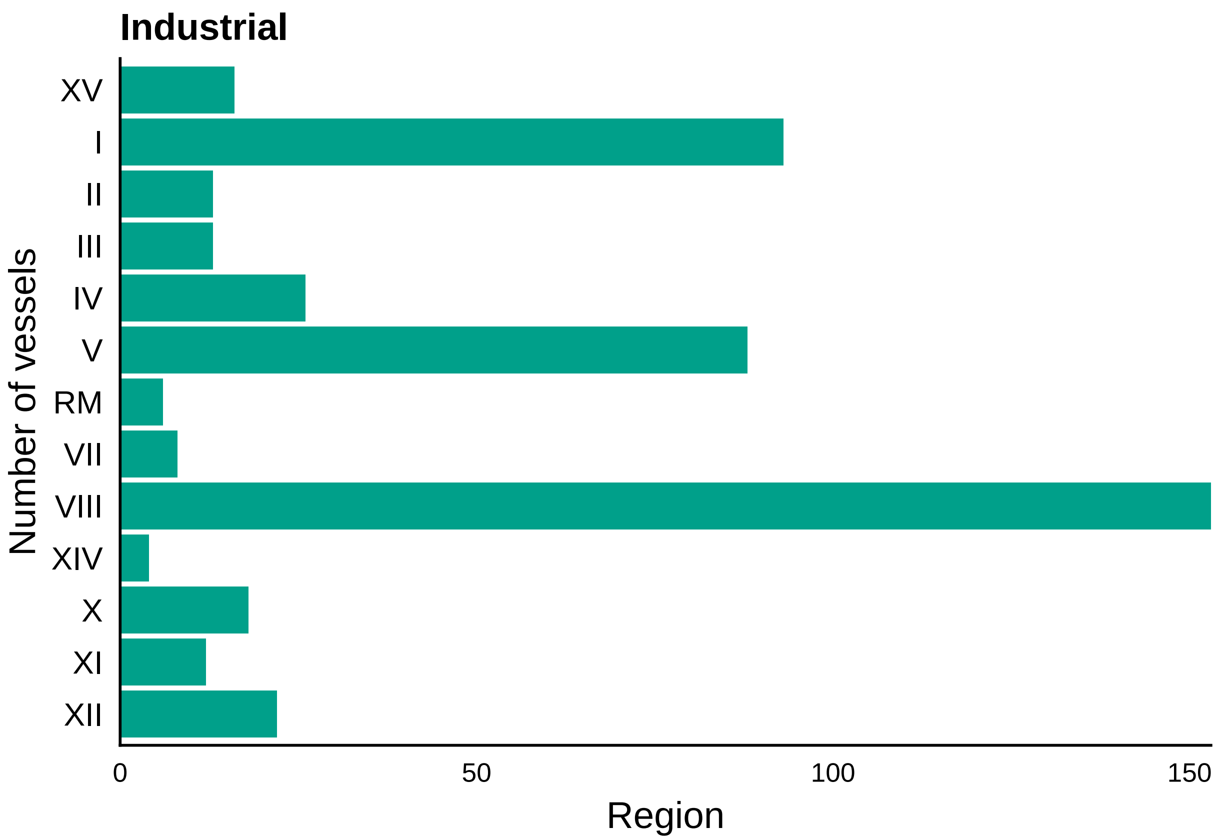


Figure 10: Number of industrial vessels per region. Source: National record of industrial fisheries (SERNAPESCA, 2018)

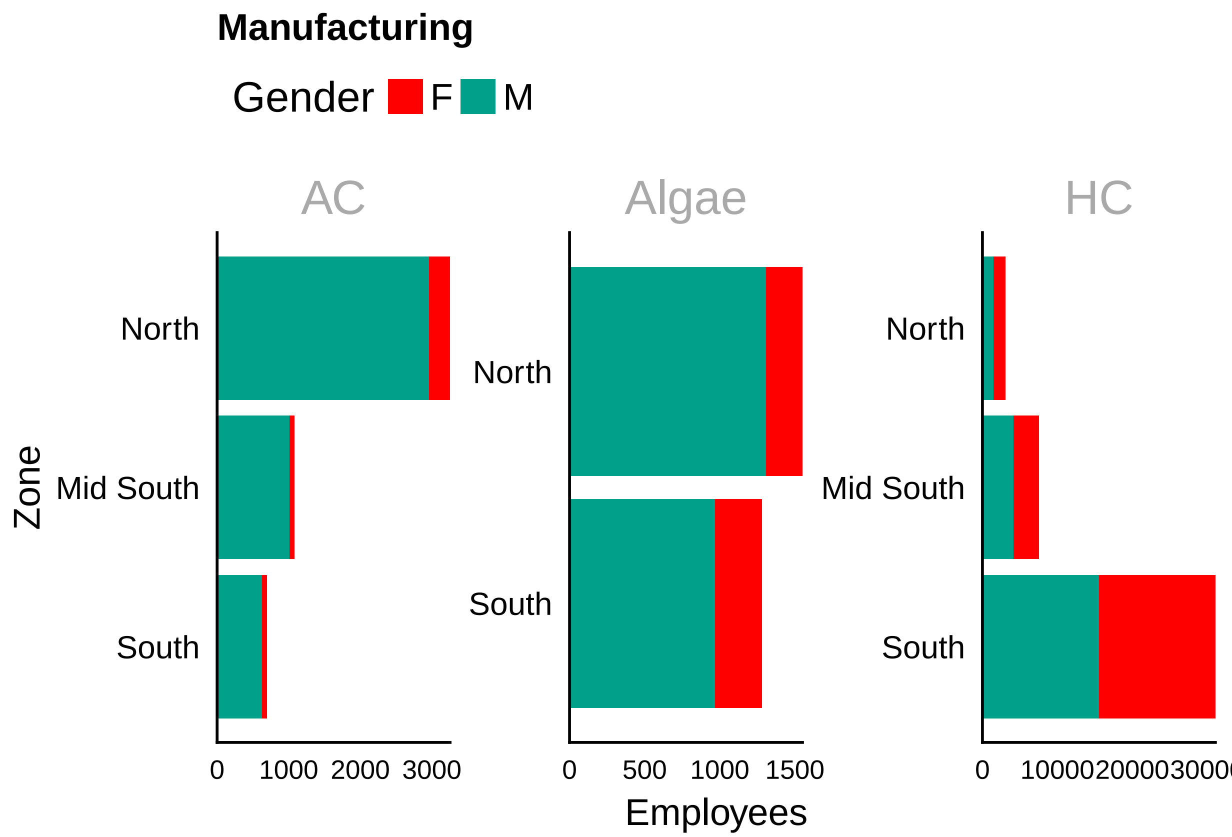


Figure 11: Number of employees in the fisheries manufacturing sector in each region by gender in 2015. AC refers to products for animal consumption and HC products for human consumption. Source: Report by IFOP based on facilities survey (IFOP, 2015)

Most people employed by the manufacturing sector are located in the southern part of the country and the majority are men.

There are 17,631 people employed among the 3,683 aquaculture centers currently registered in Chile (Maturana et al. (2017)). From these, ~4,500 are women. *Figure 10* shows the distribution of aquaculture centers per region and type of farmed species. The main type of product being farmed is fish, mostly salmon, followed by molluscs and algae. The X region hosts more than half of the aquaculture centers in the country.

** Species-specific estimates of economic contribution **

Critical Analysis

Data uncertainty

Most of our analisis relied on publically available data collected by govermental institutions. Although data collection has improved over the years and there have been important national efforts towards transparency, there are still reasons to think that data may be biased. Particularly concerning is landing data since it is mainly generated via landings declarations. This requiere fishers to announce their intention to land their catch to the authority in charge in their macrozone who must weight and certify the catch. Without the certification of their catch fishers cannot sell it in legal establishments and they risk their permits and

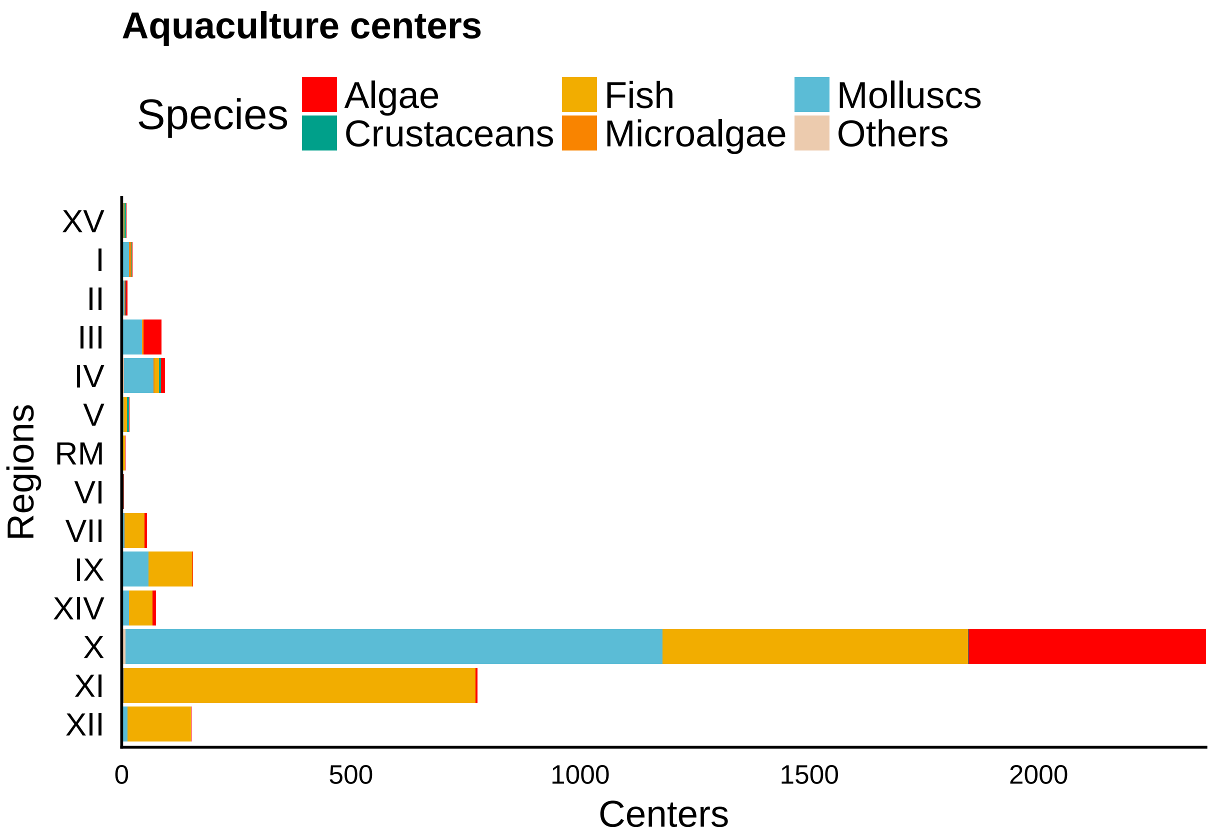


Figure 12: Number of aquaculture centers in each region by type of species in 2017. Source: Report Subsector Acuicultura 2017 by SERNAPESCA (SERNAPESCA website, 2017)

penalty fees. Still, the incomplete enforcement may generate incentives to undereport. Illegal unreported and unregulated (IUU) fishing has been evidenced in Chile, even in systems where fishers are expected to have high incentives against it like Territorial users' rights for fishing (Oyanedel et al. (2018)).

The lack of consistency in data collection between and within agencies brings another source of uncertaity for an analysis like ours. A major challenge was to match trade and landings data. SERNAPESCA collects data under the common names while Aduanas Chile record exported and imported products under the international Harmonized System nomenclature. To overcome this issue we use the information provided by Aduanas Chile on the species contained in some types of products. This allowed us to aggregate products per species and match volumes and values to landing record by SERNAPESCA. In addition, SERNAPESCA applies several variations of a species common name between databases. This difficults the calculation of aggregated estimates. We solve this by generating a dataset that categorize all the names currently used by SERNAPESCA under their respective scientific name to be able to aggregate data on a particular species. Although we did it as carefully as we could and we double checked the code several times, this kind of steps are always prone to human error bringing more uncertainty to the analisis. As for 2013, SERNAPESCA is using an online plataform that facilitates the reporting of catches to fishers and improves data automatization. Yet, there are still an important number of landings that are reported and recorded on paper. We expect that this new technology will bring more consistency in data collection facilitating this types of analsis in the future.

A major information gap we identified is the lack of publically available data on ex-vessel prices and employment for the industrial sector. To our knowledge neither SERNAPESCA, IFOP nor SUBPESCA collect data on this regard. Thus, identifying what were the most valuable species for the industrial sector was not possible. An approach we were unable to apply due to time constraints is to derive ex-vessel prices from trade data (Melnychuk et al. (2017)). Contrary to what we expected, the fisheries sector for which we found most available information was the artisanal sector. We were able to get a reliable count of the direct employment generated by the artisanal sector thanks to the National Record od Artisanal Fishers (RPA). We are confident of this estimate since the number of unregistered artisanal fishers is low in Chile.The main reason for this is that being registered gives fishers access to potential benefits like subsidies or territorial users' rights for fishing. We were also able to estimate species-specific revenues by using landings and prices of first transactions. Finally, information on employees in processing facilities was also available. However, some values were unrealistic since they were larger than the entire population of the country. Thus, we prefered relied on a survey study performed by IFOP to fullfill this estimate.

We also lacked data on the transportation of landings and products between Chilean regions and final destination. This prevented us from applying our model of food supply at the regional level. The problem is that the catch landed in one region could be processed in a different one and then the final product sold in a third region. Running the regional analysis without accounting for this issue would have led to incorrect estimates of food consumption.

Estimating National Seafood Supply

- Most importants species and products in terms of food consumption.
- Trends in food consumption.
- Lack of understanding on what species are the most important for domestic consumption. Only one serious attempt (Villena (2012)).
- Despite its massive production, aquaculutre is not a major source of food supply for the Chilean population. Most of its production is exported and the species being farmed either go to non-human consumption (algae) or are too expenssive to be accessed by lower income groups which is the population of interest in the contxt of food security.

Estimating National Economic Participation

Aquaculuture is the most important activity in the fisheries sector in terms of economic value, this positions salmon as the marine species that contribute the most to the country's economy. This species is also important in terms of employment. The direct employment in aquaculture centers is low relative to the number of artisanal fishers. Yet, it is very likely that an important share of the job positions in the manufacturing sector are being generated by aquaculture. Especially in the south where most job positions for manufacturing of HC products are concetrated.

Our analysis shows that Algaes are an important suorce of employment in the artisanal sector. Despite the revenues of these species are not particularly high, the lower costs of extraction relative to other types of fishing make algae collection an attractive form of livelihood for coastal communities. Algaes are mostly exported and not

Appendix

Table 2: Top 10 landed species per year in the artisanal sector. Source: Landing records from SERNAPESCA, 2018

Ranking	2013	2014	2015	2016	2017
1	Giant grey kelp	Araucanian herring	Araucanian herring	Araucanian herring	Araucanian herr
2	Anchoveta	Anchoveta	Anchoveta	Anchoveta	Anchoveta
3	Araucanian herring	Giant grey kelp	Giant grey kelp	Giant grey kelp	Giant grey kelp
4	Jumbo flying squid	Jumbo flying squid	Jumbo flying squid	Jumbo flying squid	Jumbo flying sq
5	Red algae gracilaria	Giant brown kelp	Giant brown kelp	Giant brown kelp	Giant brown kel
6	Red luga	Mote sculpin	Red algae gracilaria	Chilean jack mackerel	Mote sculpin
7	Mote sculpin	Black algae luga	Black algae luga	Giant kelp	Red algae gracil
8	Giant brown kelp	Southern rays bream	Chilean jack mackerel	Black algae luga	Chilean sea urch
9	Black algae luga	Chilean sea urchin	Falkland sprat	Chilean sea urchin	Pacific menhade
10	Giant kelp	Red algae gracilaria	Chilean sea urchin	Red algae gracilaria	Giant kelp

Table 3: Top 10 landed species per year in the industrial sector. Source: Landing records from SERNAPESCA, 2018

Ranking	2013	2014	2015	2016	2017
1	Anchoveta	Anchoveta	Anchoveta	Chilean jack mackerel	Anchoveta
2	Chilean jack mackerel	Chilean jack mackerel	Chilean jack mackerel	Anchoveta	Chilean jack
3	Araucanian herring	Araucanian herring	Araucanian herring	Araucanian herring	Chub macke
4	Patagonian grenadier	Jumbo flying squid	Jumbo flying squid	Jumbo flying squid	Jumbo flyin
5	South Pacific hake	Patagonian grenadier	Patagonian grenadier	Chub mackerel	Araucanian
6	Chub mackerel	Chub mackerel	Chub mackerel	Patagonian grenadier	Patagonian
7	Mote sculpin	South Pacific hake	South Pacific hake	South Pacific hake	South Pacif
8	Southern blue whiting	Southern blue whiting	Southern hake	Southern hake	Southern ha
9	Southern hake	Red squat lobster	Southern blue whiting	Southern blue whiting	Southern bl
10	Jumbo flying squid	Southern hake	Red squat lobster	Silver warehou	Red squat l

Table 4: Most landed species per and year region in the artisanal sector. Source: Landing records from SERNAPESCA, 2018

Region	Most landed in 2013	Most landed in 2014	Most landed in 2015	Most landed in 2016	Most landed in 201
I	Anchoveta	Giant grey kelp	Anchoveta	Anchoveta	Anchoveta
II	Giant grey kelp	Giant grey kelp	Anchoveta	Giant grey kelp	Giant grey kelp
III	Giant grey kelp	Giant grey kelp	Giant grey kelp	Giant grey kelp	Giant grey kelp
IV	Giant grey kelp	Jumbo flying squid	Giant brown kelp	Jumbo flying squid	Giant brown kelp
IX	Southern rays bream	Southern rays bream	Snoek	Southern rays bream	Southern rays brea
V	Jumbo flying squid	Jumbo flying squid	Jumbo flying squid	Jumbo flying squid	Jumbo flying squid
VI	New Zealand bull	New Zealand bull	New Zealand bull	New Zealand bull	New Zealand bull
VII	South Pacific hake	South Pacific hake	South Pacific hake	South Pacific hake	South Pacific hake
VIII	Araucanian herring	Araucanian herring	Araucanian herring	Araucanian herring	Araucanian herring
X	Red algae gracilaria	Black algae luga	Red algae gracilaria	Black algae luga	Red algae gracilaria
XI	Chilean sea urchin	Chilean sea urchin	Chilean sea urchin	Chilean sea urchin	Chilean sea urchin
XII	Red luga	Red luga	Chilean sea urchin	Chilean sea urchin	Chilean sea urchin
XIV	Araucanian herring	Araucanian herring	Araucanian herring	Araucanian herring	Araucanian herring
XV	Anchoveta	Anchoveta	Anchoveta	Anchoveta	Anchoveta

Table 5: Most landed species per region and year in the industrial sector. Source: Landing records from SERNAPESCA, 2018

Region	Most landed in 2013	Most landed in 2014	Most landed in 2015	Most landed in 2016	Most landed in
I	Anchoveta	Anchoveta	Anchoveta	Anchoveta	Anchoveta
II	Anchoveta	Anchoveta	Anchoveta	Anchoveta	Anchoveta
IV	Chilean jack mackerel	Chilean jack mackerel	Blue squat lobster	Blue squat lobster	Chilean jack m
V	South Pacific hake	Chilean nylon shrimp	Chilean nylon shrimp	Chilean nylon shrimp	Chilean nylon
VIII	Chilean jack mackerel	Chilean jack mackerel	Chilean jack mackerel	Chilean jack mackerel	Chilean jack m
X	Southern king crab	Southern king crab	Southern king crab	Patagonian toothfish	Patagonian too
XI	Patagonian grenadier	Patagonian grenadier	Patagonian grenadier	Patagonian grenadier	Patagonian gre
XII	Patagonian grenadier	Patagonian grenadier	Patagonian grenadier	Patagonian grenadier	Patagonian gre
XIV	Araucanian herring	Araucanian herring	Araucanian herring	Araucanian herring	Araucanian he
XV	Anchoveta	Anchoveta	Anchoveta	Anchoveta	Anchoveta

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Table 6: Most harvested species per region and year. When no data is available means there were no aquaculure that year in that region. Source: Harvest records from SERNAPESCA, 2018

Region	2012	2013	2014	2015	2016
I	Haematococcus	Haematococcus	Haematococcus	NA	Haematoco
II	Red algae gracilaria	Red algae gracilaria	Red algae gracilaria	Peruvian calico scallop	Peruvian ca
III	Peruvian calico scallop	Peruvian calico scallop	Red algae gracilaria	Red algae gracilaria	Red algae g
IV	Peruvian calico scallop	Peruvian calico scallop	Peruvian calico scallop	Peruvian calico scallop	Peruvian ca
IX	Atlantic salmon	Rainbow trout	Atlantic salmon	Rainbow trout	Chorus Mu
V	Turbot	Red Abalone	Red Abalone	Red Abalone	Red Abalo
VII	Atlantic salmon	NA	NA	NA	NA
VIII	Rainbow trout	Atlantic salmon	Red algae gracilaria	Red algae gracilaria	Red algae g
X	Chilean mussel	Chilean mussel	Atlantic salmon	Chilean mussel	Chilean mu
XI	Atlantic salmon	Atlantic salmon	Atlantic salmon	Atlantic salmon	Atlantic sa
XII	Atlantic salmon	Atlantic salmon	Atlantic salmon	Atlantic salmon	Atlantic sa
XIV	Rainbow trout	Rainbow trout	Rainbow trout	Rainbow trout	Rainbow tr

Table 7: Most expensive species in Chile based on their mean ex-vessel price between 2013 and 2017. Source: Data on ex-vessel prices for artisanal sector, SERNAPESCA, 2018.

Species	Mean price (US$/Kg)	SD Price
Patagonian toothfish	21.00	5.74
Common galaxias	18.82	0.25
Sea Chab	11.91	3.96
Chilean abalone	9.22	5.72
Large-tooth flounders	8.44	1.97
Small-eye flounder	7.98	2.62
Red cusk-eel	7.18	1.65
Southern king crab	7.13	2.70
Southern blue whiting	6.75	1.49
Chalapo clinid	6.59	2.47

Table 8: Monthly incomes of fisheries sector in 2018 US dollars. Source: Elaborated based on data from New national employment survey (NENE) in 2015 and published in SENSE, 2015

Type	Employer	Independent	Dependent with contract	Dependent without contract	Mean income
Full time	1,160.85	351.96	885.62	381.72	674
Part time	707.28	258.11	465.15	288.95	302

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Table 9: Average demographic characteristics of people employed in the fisheries and aquaculture sector in Chile. Source: Elaborated based on data from New supplementary income survey (NESI) in 2015 and published in SENSE, 2015

Characteristic	Fisheries_and_Aquaculture	National
Average age	42.1	43.2
Years of formal education	9.5	11.9
Percentage of women	8.2	40

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