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

Report prepared for Oceana

Juliano Palacios Abrantes, Camila Vargas, Daniel Viana, Maria I. Rivera, Renato Gozzer, Rocío López, Santiago de la Puente, Andrés M. Cisneros-Montemayor

December 21, 2018

Contents

Country-specific data, Chile

1. *SERNAPESCA* -SERNAPESCA - The Chilean National Service of Fisheries 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 additional databases upon request[Cˆ1]. We accessed their databases on landings from wild-caught and farmed fisheries, first transaction prices (ex-vessel price) 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 on artisanal and industrial vessels, including length and storing capacity. SERNAPESCA also provided the number of employees of each gender per processing facility.

2. *Aduanas Chile (Chilean Customes).* is the main entity in charge of keeping records of imported and exported goods in the country. We accessed their exports and imports data by product and region via their website. Each product in the original exports and imports datasets is identified through an ID number that matches the name of the product in a code known as the Arancel Aduanero. Most products provided details on the species or groups of species involved.

3. *IFOP* - The Fisheries Development Institute is a private entity that advises 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. *CCB* - The Chilean Central Bank (*Banco Central de Chile*) is the entity in charge of establishing the Chilean currency. To fulfill its function it monitors the main economic indicators per economic sector. We accessed their data on sectorial GDP (including fisheries) for each region.

5. We reviewed several reports from other national agencies like the Undersecretary of Fisheries (SUBPESCA), NGOs and scientific publications to complement our analysis.

Results Chile

Fisheries Context

To evaluate the volume contribution of specific fisheries over the last five years, we used records of landings and aquaculture harvests from SERNAPESCA (2013-2017). We identified the most exported fish products in terms of volume using trade records from Aduanas Chile. To identify the participation of different species in exported products 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.

Wild Caught Fish

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 tonnes of marine species while the industrial sector lands around 0.9 $\pm$ 0.16 million tonnes per year. Is worth noting that large part of the artisanal landings are 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 19). 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 human consumption (HC). The Chilean jack mackerel (*Trachurus murphyi*) is also an important fishery in terms of volume for the industrial sector, which is also mostly used in the production of fish meal and oil and to a lesser extent for direct HC.

Over the last years the catch composition of the artisanal sector has presented no major changes except for 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 species is also stable over the last years. Yet, the landings of Peruvian anchoveta (*Engraulis ringens*) started decreasing in 2014 relative to previous years, this incresed the relevance of other species like the Chilean jack mackerel (*Trachurus murphyi*). Other important species for the artisanal sector are the Mote sculpin (*Normanichthys crockeri*) and the Chilean sea urchin (*Loxechinus albus*) (Table 1).

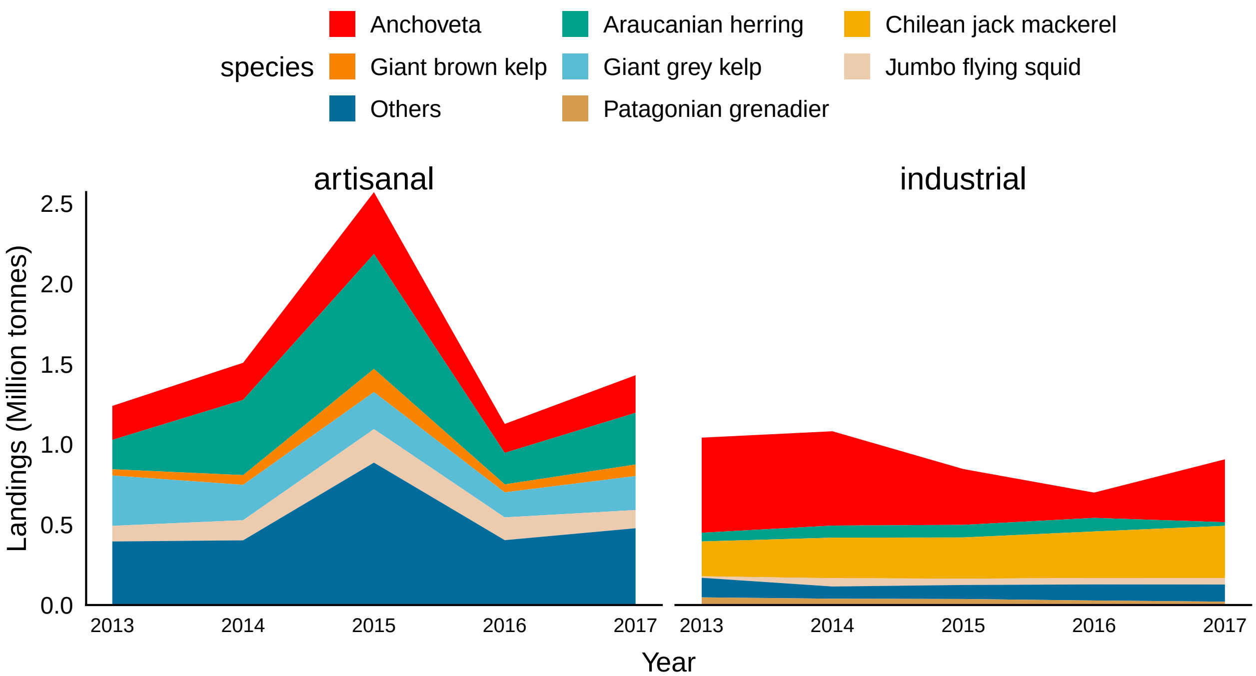

Figure 1: Top 5 species landed in Chile by the artisanal (left pannel) and industrial sector (right pannel) between 2013 and 2017. Data source: Landing records from SERNAPESCA, 2018.

These resuts are in line with those observed using international databases. SAU and FAO databases also identify Peruvian anchoveta (*Engraulis ringens*), the Araucarian herring (*Strangomera bentincki*) and the Chilean jack mackerel (*Trachurus murphyi*) as the main species.

Regional Diferences in volumes of wild-caught fisheries

Landings varies widely along the coast of Chile for both artisanal and industrial sectors. Figure 20 shows 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 region is by far the region with most landings from both sectors. However, the industrial sector also concentrates landings in the north of the country, while artisanals are spread throughout the country. The most landed species in 2017 also vary by region but have changed little over the last five years (Appendix Results Chile 1 and 2).

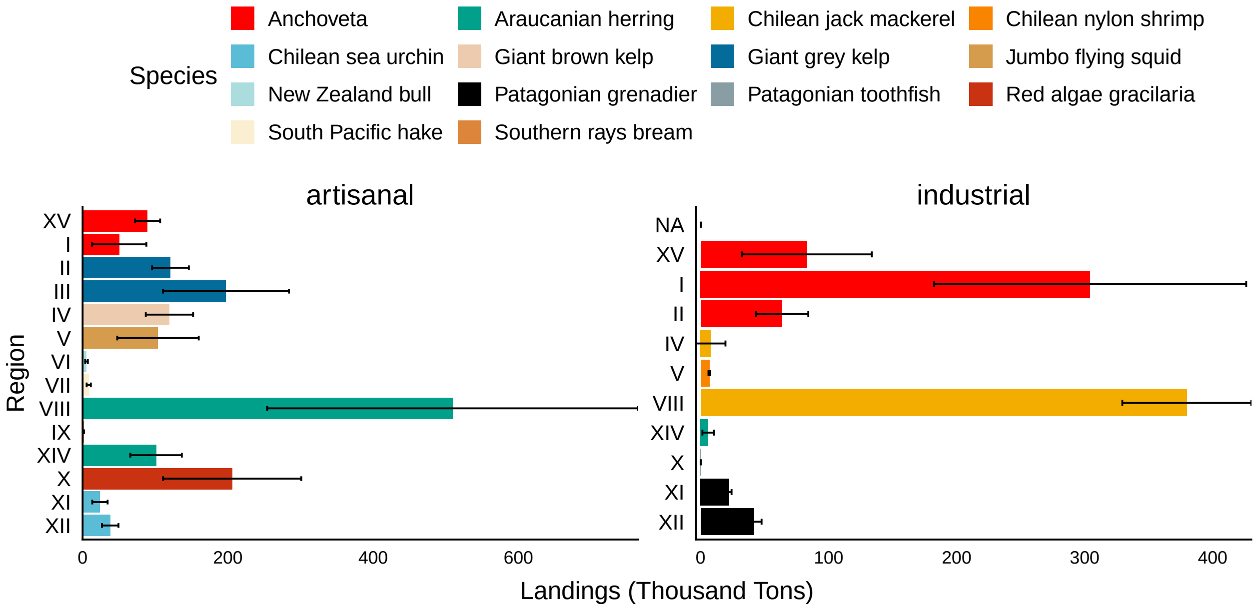

Figure 2: Mean annual total landings per region for the artisanal (left pannel) and industrial sector (right pannel) between 2013 and 2017. The color represents the most landed species in 2017 and regions are ordered vrom north to south. Error bars represent one standard deviation. Note that scales are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

Aquaculture production

Main farmed fisheries in terms of volume

The main species harvested from aquaculture centers in the last 5 years have been the Atlantic salmon (*Salmo salar*), the Chilean mussels (*Mytilus chilensis*), the Coho salmon (*Oncorhynchus kisutch*), and the Red algae gracilaria (*Gracilaria spp.*) in descending order (Figure 21). These species correspond to most of the harvest. Overall, the composition of the most farmed species and its volumes have been stable over the last 5 years. However, the Rainbow trout (*Oncorhynchus mykiss*) seems to be becoming less important over recent years.

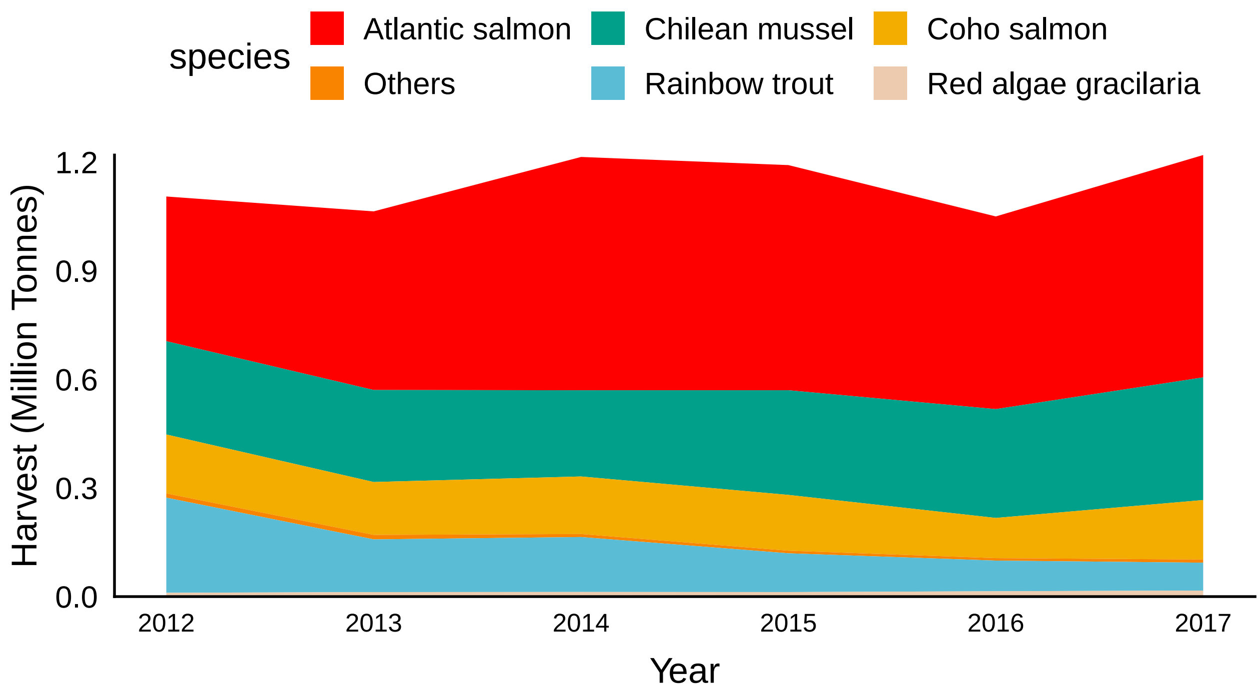

Figure 3: Top 5 species farmed in Chile between 2013 and 2017. Data source: Harvest records from SERNAPESCA, 2018.

Regional diferences in farmed fisheries

Aquaculture production is highly concentrated in the South of the country, between regions X and XII (Figure 22). Nevertheless, from the I to the IV region the most farmed resources are algaes and scallops (*Argopecten purpuratus*) (Appendix Results Chile 3). 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*).

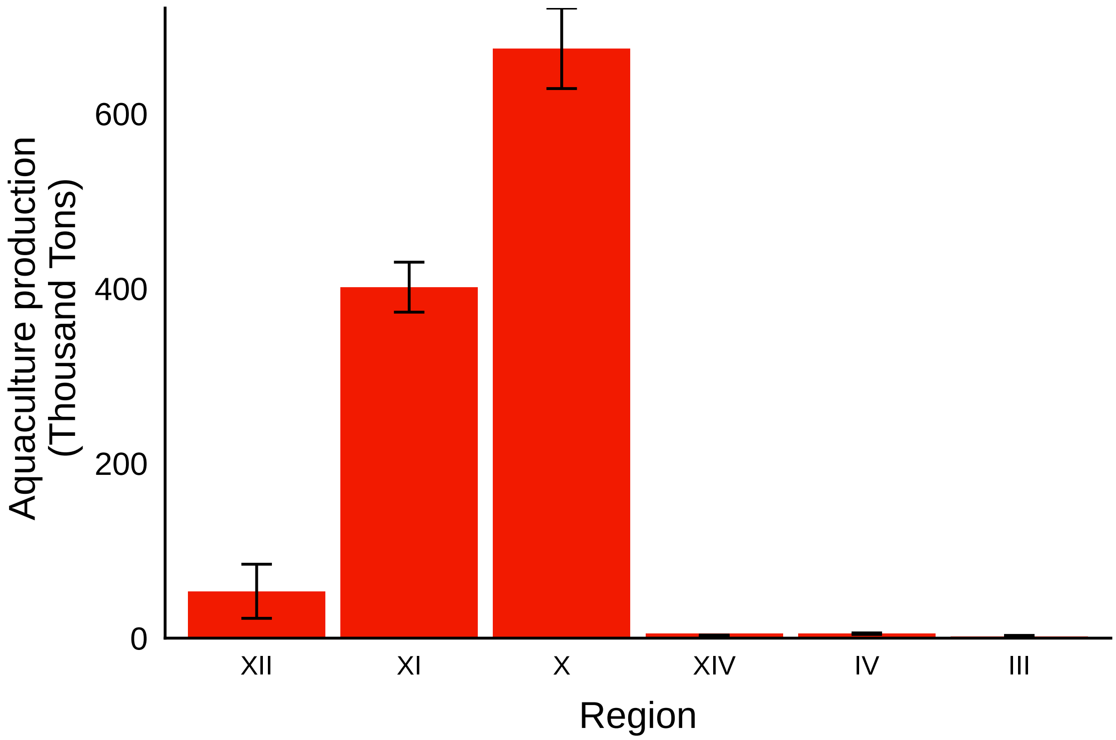

Figure 4: Mean annual harvest per region from aquaculture centers between 2012 and 2017. Error bars represent one standard deviation. Only showing regions with production. Database SERNAPESCA

Fish Trade

Around 72% of the landings from fisheries and aquaculture are exported outside the country [@ifop_monitoreo_2015]. In Chile, exported volumes of marine products are larger than imported volumes. The main group of species being exported is salmon, which is exclussively produced in aquaculture, followed by far by jack mackerel (Figure X). Tunas lead the import activities followed, by jack mackerels (Figure X). If we consider net trade, by substracting Chilean exported volumes of similar species, tuna is still the main group of imported species with a net trade of ~ 25,000 ± 4,200 tonnes per year Table X). When considering net trade, the second most imported group is no longer jack mackerels but shrimp. These results are in line with those done using international databases, which estimate tunas net trade to be ~ 22,000 tonnes per year and also identify jack mackerel and shrimp as groups with high net trade in Chile.

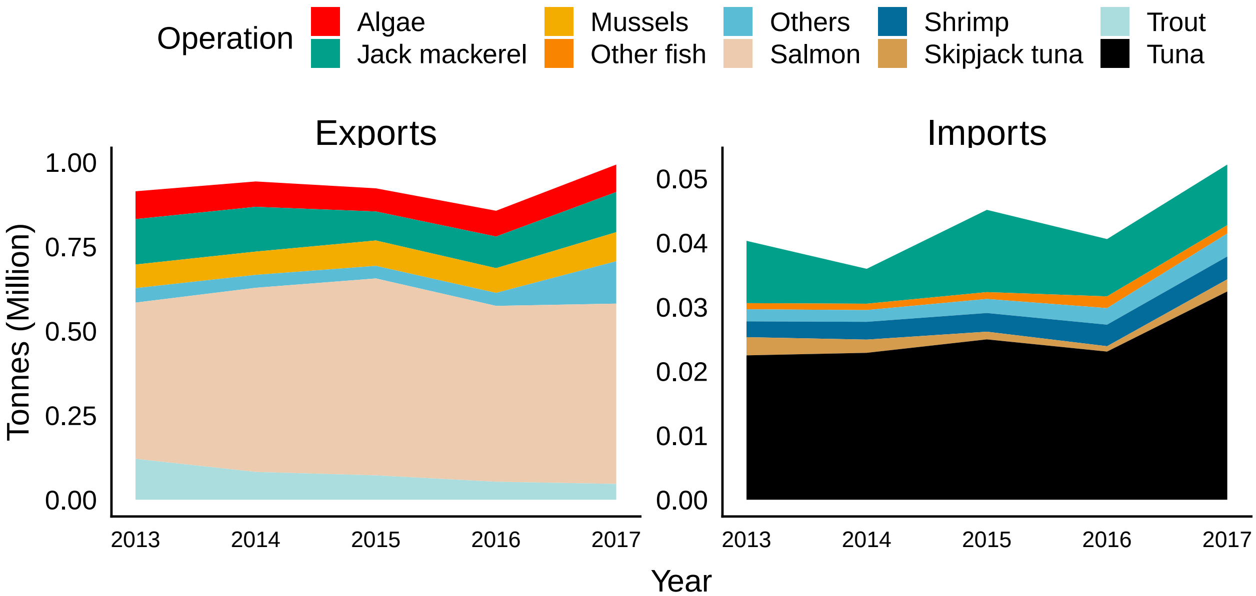

Figure 5: Main species exported and imported in Chile between 2013 and 2017. Thousand Tonnes

National Seafood Supply

Species contribution to Human and Non-human consumption

As a first approach to analyzed main fisheries that countribute to human conssumption in Chile, we looked into landings and aquaculture harvest that goes to processing facilities as raw material for products for human consumpotion (HC) and for non-human consumption (NHC). Our results show that the main species that enter supply chains for human consumption are the Atlantic Slamon (*Salmo salar*) and the Chilean Mussel (*Mytilus chilensis*), two of the main aquaculture products from Chile (Figure sp_HC_with_Aq). On the other hand species that are used for non-human consumption products are Peruvian Anchoveta (*Engraulis ringens*) Araucarian Herring (*Strangomera bentincki*), the two main wild-caught fisheries of the country (Figure HC_with_Aq). A third importatn specie for NHC is the Giant gray kelp (*Lessonia nigrescens*) and the Chilean Jack Mackerel (*Trachurus murphyi*) which contributs similarly to both HC and NHC products. The relative proportion of contribution of each specie to human consumption and non human consumption is relativly stable through time.

We then looked into only wild-caught species only and identified that the species that have historically contributed more to human consumption products are: Chilean Jack Mackerel (*Trachurus murphyi*), Jumbo flying squid (*Dosidicus gigas*), and in a minor contribution Sea Urchins (*Loxechinus albus*) (HC_no_Aq). These results (Figure HC_with_Aq NHC and HC_no_Aq) also shows that the amount of wild caught fiheries that go to non-human consumption is generally more than the double than what that goes to human consumption. It is necessary to remark that we identified that data per sector for 2015, prodived by SERNAPESCA and used for this analysis is not accurate. However we stil can see the trendes comparing data for years 2013, 2014, 2016 and 2017.

In Chile, almost all industrial landings and aquaculture harvest go to processing facilities while only some of the artisanal landing is processed. We assume that the the artisanals' catch that is not sent to processing facilities is sold as non-processed products for human consumption. These approach allowed us to analyze main species sold by artisanal fisher assuming it is all for human consumption. Results show that species vary across years, but the Southern rays bream (*Brama australis*) is the only specie that is common for every year of data (Figure line *791*). Indicating that historically has been an importat specie for direct human consumption. This aligns with results obtained in a survey implemented along Chile where 51% answered that Southern rays bream was their first preference (@fundacion_chile_chile_2016). Within 2013, 2014 and 2016, we can see the presence of anchoveta (*Engraulis ringens*), while in 2017 there is high increase in Jumbo flying squid (*Dosidicus gigas*).

Main fisheries for food supply

To identify the main fisheries for human food supply in Chile we combined datasets from landings, aquaculture, raw material that goes into facilities for non-human consumption, imports and exports. Assuming that all local landings and harvest that is not processed as non-human consumption products nor exported is comsumed locally. Eventhough landings and aquaculture databases are detailed at a species level, we agragated the data in larger groups (See Suplementary Material) to be able to combine them with the Chilean Customs datasets. Our results show, that the main fishery for local consumption across the years has been squid. Within this group we considered: Patagonian squid (*Loligo gahi*), Jumbo flying squid (*Dosidicus gigas*), Argentine shortfin squid (*Illex argentinus*) and Japanese flying squid (*Todarodes Pacificus*). These species predominate local consumption from 2013 to 2017. Our data shows that in 2017 there was a significant increase in the exports of this group of species, explaining their relative less contribution to domestic consumption, drastically reducing the total amount of seafood consumed locally that year. Other fisheries important for domestic human consumption in Chile are Hakes (Southern hake *Merluccius australis*, South Pacific hake *Merluccius gayi gayi*, Patagonian grenadier *Macruronus magellanicus*, Southern blue whiting *Micromesistius australis*) and Southern rays bream (*Brama australis*) (Figure line *939*). It is important to mention that the Southern rays bream is classified on its own group, therefore its relative contribution to domestic consumption is higher compared to other aggregated groups. Another caviet to make here is that squids have a the highest yield of all species, therfore their contribution to domestic consumption per landed tonnes is higher, partly explining its high predominance in our results. These resutls differ from the outcomes obtained with the international databases, where the model concludes that the main fish group for human consumption in Chile is salmon. This difference can be explained due to the method we used to calculate exports in our regional analysis. In our regional analysis we identified that out of all of the sea-products produced in Chile, salmon is the one that mostly contributes to human consumption (Figure HC_with_Aq). But, all the salmon produced in Chile is exported, therefore non is consumed locally. Through our model we probably undersested salmon production or overestimated salmon exports, beacause, eventhough salmon is not the most consumed species in Chile, we know that some salmon stays in Chile and sold in the supermarket.

Our models show the chilean population also consumes high volumens of Tuna, a group of specie that is mainly imported in a canned format. This result aliged with the chilean population preferences, based on a study along the country, where 84% of the respondee aswered that their normal format for eating fish within a month was canned fish, follwed by freshed fish (80%) and frozen fish (37%) [@fundacion_chile_chile_2016]. The ten most importat fisheries according to our model are provided in the Appendix (Appendix Chile Results 4).

Total and per capita food consumption in the country

Our models is highly sensitive to species yield, therefore in many cases results of our calculations return a negative number implaying that exports are higher than the product of the yield times the local production (landings and aquaculture) minus all tons that go for non-human consumption products. Assuming that all negative numbers do not contribut to domestic consumption because they are mainly exported or used for non human consumption (eg:algae) and none is imported, we calculated a per capita consumption per year. We summed all the human consumption per year (Table XX, chunk below) and devided by the chilean population of 17,574,033 [@instituto_nacional_de_estadisticas_-_chile_sintesis_2018]. We calculated an average of 11.5 kg of seafood compsumption a year, which is similar to what has been estimated by the FAO (2016) for Chile of 10-13kg of fish a year.

```
##Per capita consumption table

kable(per_capita_total_Lan, col.names = c('Year', 'Total Human Consumption (tonnes)', 'Per-capita consu
```

```r
kable_styling(latex_options = 'hold_position') #%>%
  #column_spec(4, width = "6cm")
```

Regional differences in per capita and total consumption

We where not able to do a regional analysis for domestic consuption. Even though most of the data is provided at a regional level. We realized that is was not possible to assume that what was landed in a region was processed and then exported in that same area. Nor that the imports per area accounted for the actual imported food consumed in the regions because there is internal transport within regions. On this regards, there is a study done in 2016, along the Chilean coast where people were asked how much fish they eat in a week. Regionla results say that 62% of the population from the north declares to eat fish once a week. In the north centre region that numbers decreases to 54% and it reaches its lowest point in the Metropolitan Region (42%). In the center south, 48% each fish at least once a week while in the southern most area 45% (@fundacion_chile_chile_2016)

National Economic Participation

Fisheries, as an economic sector in Chile, includes activities of extraction and farming of marine and freshwater products. This sector contributes to around 0.4% of the national GDP although it has highly variable production [@central_cuentas_2017]. An estimate for 2014 indicates that 90% of sales for the sector came from farmed products [@sence_reporte_2015]. Reflecting the importance of aquaculture in economic terms relative to wild fisheries. Yet, the extractive sector has a higher number of firms, 58% of the total [@sence_reporte_2015], and contributes to various sectors throughout the economy. Fishing manufacturing is closely relates to fisheries. Based on the latest input-output matrix for the country's economy (Banco Central de Chile, 2013), for every US$ 100 spent in the fisheries sector, a further US$ 52.2 dollars are generated in the manufacturing sector. Other sectors impacted by fisheries are the financing sector (US$ 24.8 generated for every US$100) and transportation and communication (US$13.4 generated for every US$100).

Wild-caught Fish Economic Participation

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 region XI to 0% in the Metropolitan (RM) and IX regions (Figure 23).

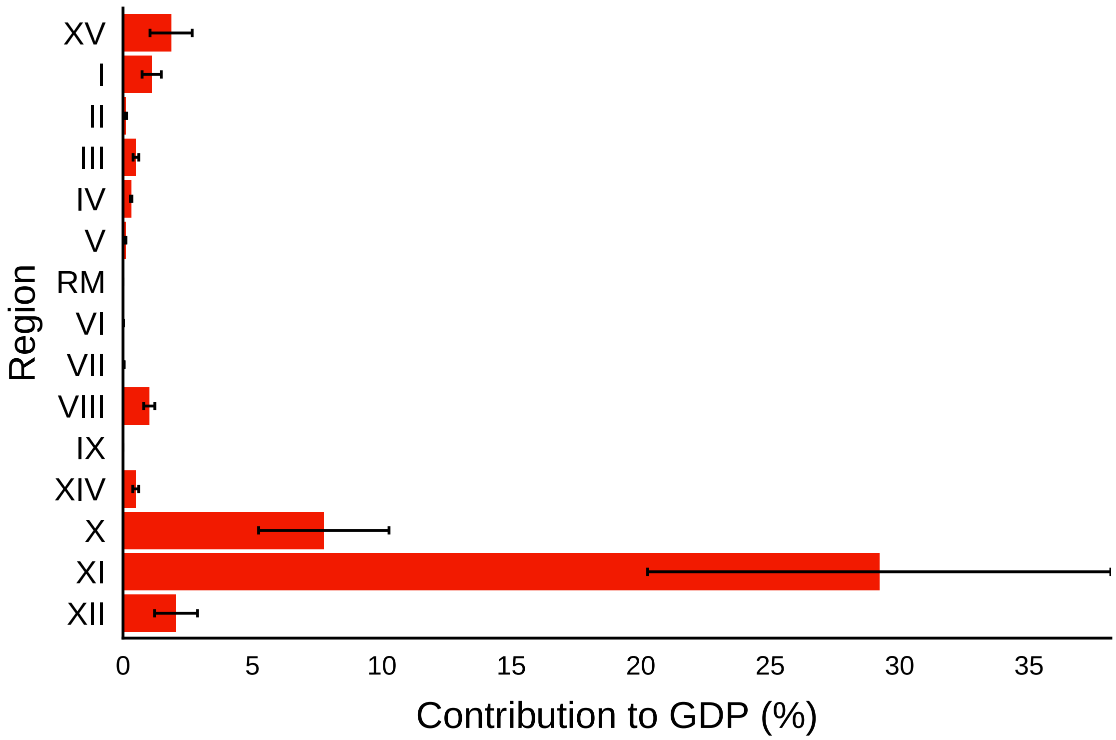

Figure 6: Percent of the regional GDP contirbuted by the fisheries sector averaging data between 2013 and 2016. Data source: Banco Central de Chile.

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 23). Nonetheless, 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*).

Some of these species are among the most expensive (Appendix Chile Results 5). 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 five in term of revenues. We should note 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 least 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 on their ex-vessel prices.

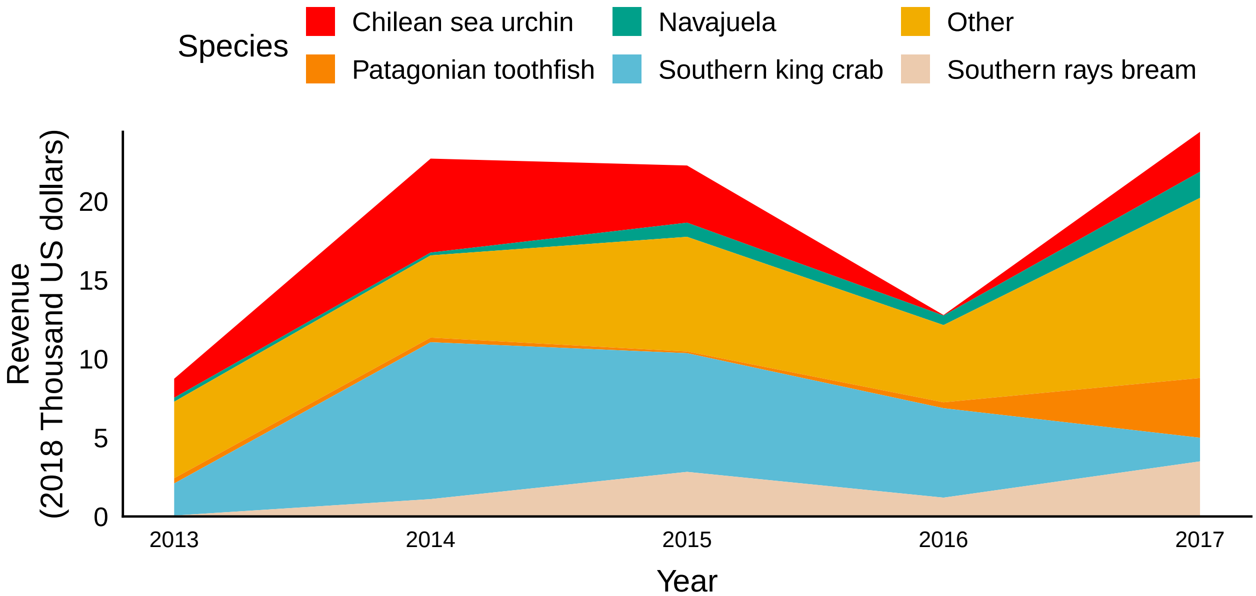

Figure 7: Species that generated the most revenue for the artisanal sector over the past five years based on records on landings and ex-vessel prices. Source: records from SERNAPESCA, 2018.

Trade Economic Participation

Seafood products are one of the most important exports of the country. IFOP valued the exportation of fisheries-related products in US$6.28 billion dollars in 2017 (@ifop_boletines_2017). This corresponded to ~ 9 % of the total value of national exports. By far, the most important group of species in terms of exports value are salmons, particularly the Atlantic salmon (*Salmo salar*) (Figure X). The net value of salmons is, on average, US/$ ~3.4 billion (Table X). They are almost exclussivelly produced by aquaculture. Mussels, specifically the Chilean Ribbed Mussel (*Aulacomya ater*) 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, contributing with ~ US$167 million. In general, the value composition of exports is stable. Yet, salmon seems to be driving and increase in exports value since 2015.

The most valuable sea products in terms of exports are frozen and fresh followed by fish meal and dried algae [@ifop_boletines_2017]. In 2016, fish fillets were the fourth most exported product by Chile. This commodity generates around US$2 billion per year and is mainly composed of farmed salmons [@datachile_fish_2016].

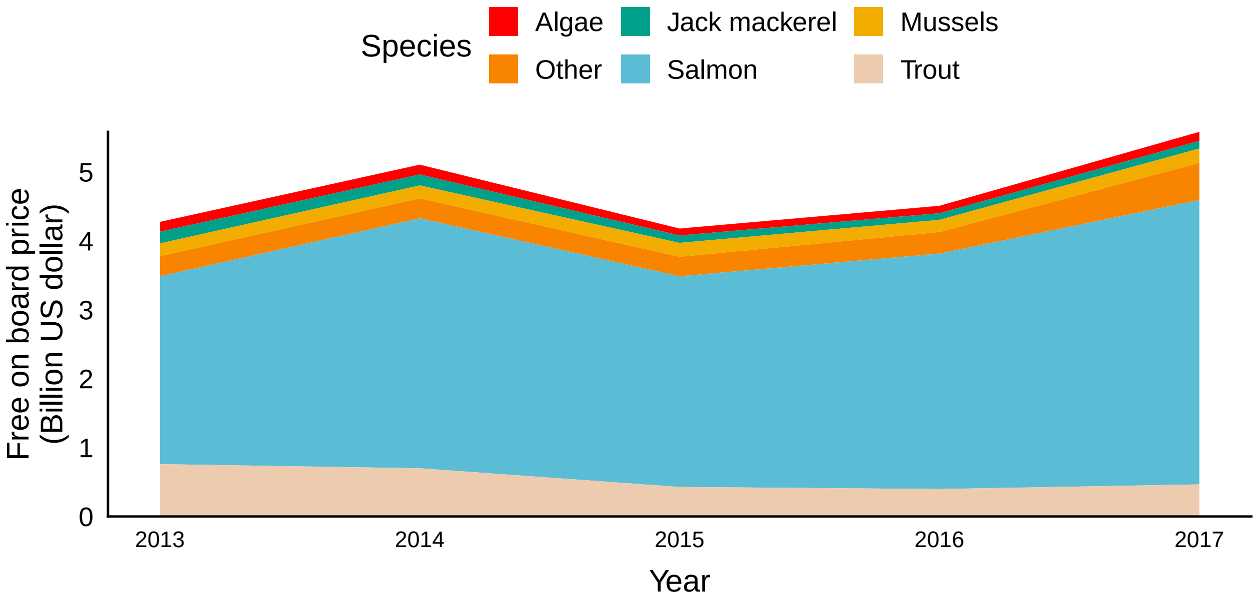

Figure 8: Main exported species in terms of econmic value. Dataset Aduanas Chile

Fish and Aquaculture Employment

Fisheries and aquaculture are considered to the second activity that provide less direct employment in the country, after agriculture [@sense_reporte_2015]. Yet, the number of people employed in the sector has been on the rise since 2010 [@sence_reporte_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 X). It does not include other indirect jobs generated by the extractive activities and its commercialization (for example, in the sectors impacts by fisheries noted above). 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 (2018)
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 have an average monthly income of US$579, the lowest mean income in the country after the one generated by the agricultural sector [@sence_reporte_2015]. This value ranges from US$258 per month for people working independently and part-time to US$1,160 per month for full-time employee (Appendix Chile Results 6).

On average, people employed in the fisheries and aquaculture sector are younger and less educated relative to the national average and are mostly men (Appendix Chile Results 7). However, there is high variation within subsectors, for example, artisanal fishers tend to be older [@tam_gone_2018]. Based on estimates from the national survey of employment (NENE, 2015) only 57.7% of the people employed in the sector are formally employed by an employer, the rest work independently, which usually means they do not have pension [@sense_reporte_2015].

Employment in the Artisanal Sector

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 [@subpesca_panorama_2018]. Based on the current RPA, there are around 89,000 artisanal fishers along with 12,700 vessels in Chile. Figure X, 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 (mostly meaning shoreline algae collection). All regions present similar composition of fishing activities (Figure X). 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.

Employment in the Industrial Sector

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_mujeres_2017]; a further 3,500 jobs are generated through vessels operations [@subpesca_pesca_2018]. Based on information on the distribution of vessels (Figure X), most industrial extractive activities occur in region VIII, as also reflected by landings estimates discussed above. Still, vessels are registered along the entire coast. Some of the firms that own industrial vessels also own processing facilities whose employees are included in estimates as part of the processing stage.

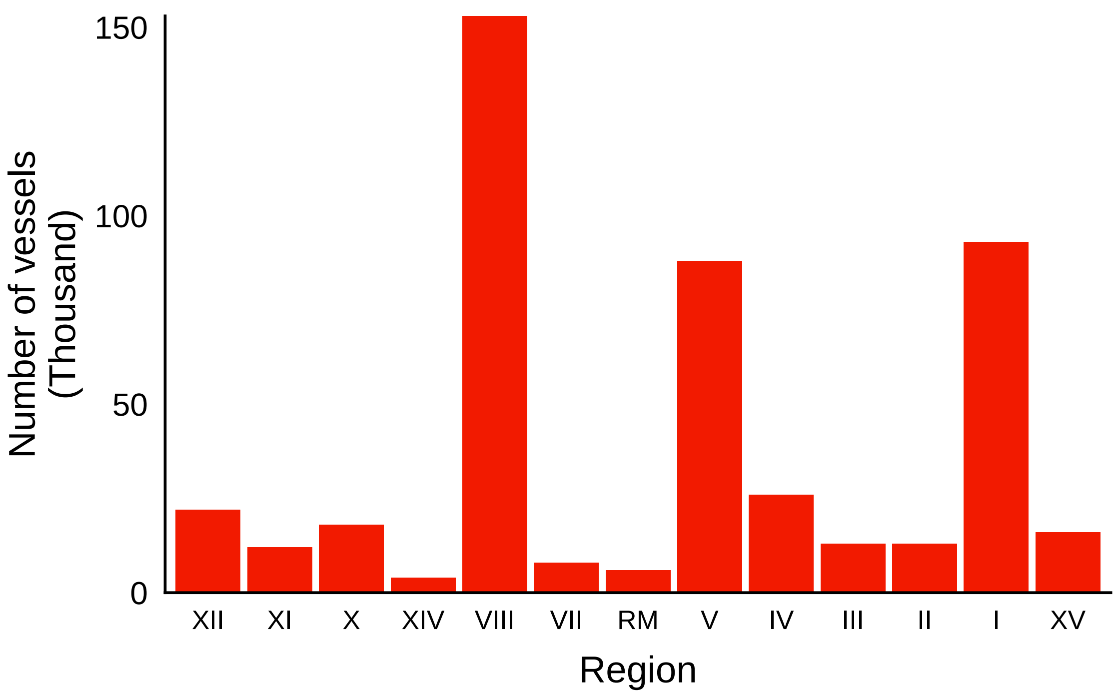

Figure 9: Number of industrial vessels per region. Dataset SERNAPESCA.

Employment in the Industry

A rigorous study by IFOP estimated a total of ~50,000 job positions in the manufacturing of marine products in processing facilities in 2014 [@ifop_monitoring_2015]. However, a more recent report from SERNAPESCA reports a total of 65,451 jobs [@maturana_mujeres_2017]. Figure X displays the geographic distribution of people employed in the manufacturing sector by gender and type of product for 2015. Employment in the processing facilities is mainly in products for human consumption (HC), with ~ 40,000 job positions. Products for animal consumption (AC) generated around 5,000 positions, while algae products, mainly destined for industrial uses, employed less than 3,000 people. Most people employed by the manufacturing sector are located in the southern part of the country and the majority are men.

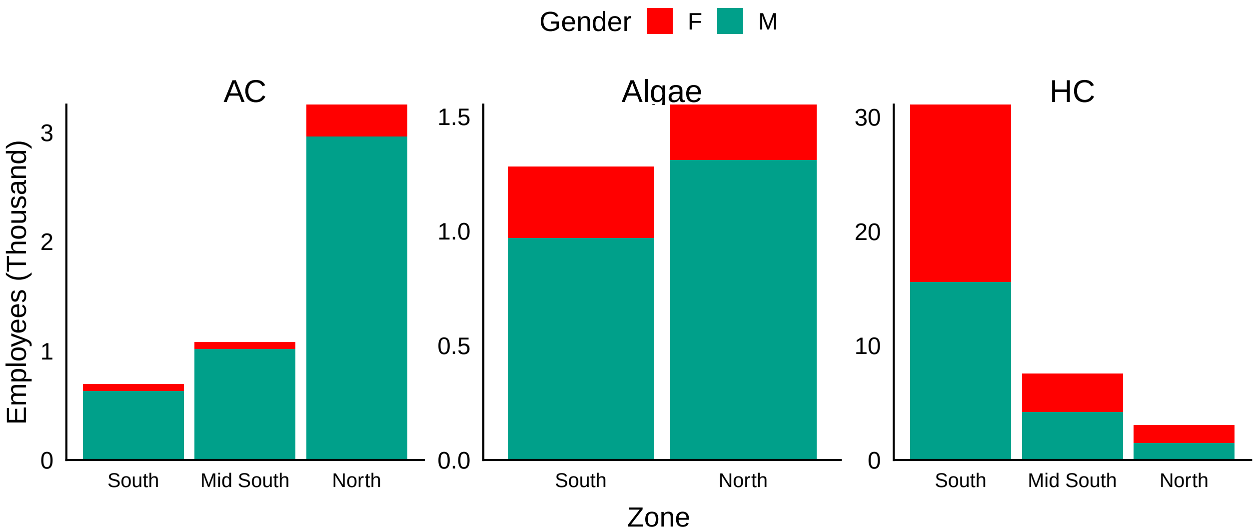

Figure 10: Number of employees in the fisheries manufacturing sector in each region by gender in 2015. AC refers to products for animal consumption and HC products for human consumption. Source: Report by IFOP based on facilities survey (IFOP, 2015)

Employment in the Aquaculture Sector

There are 17,631 people employed among the 3,683 aquaculture centers currently registered in Chile [@maturana_mujeres_2017], including ~4,500 women. Figure X 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 mollusks and algae. Region X hosts more than half of the aquaculture centers in the country.

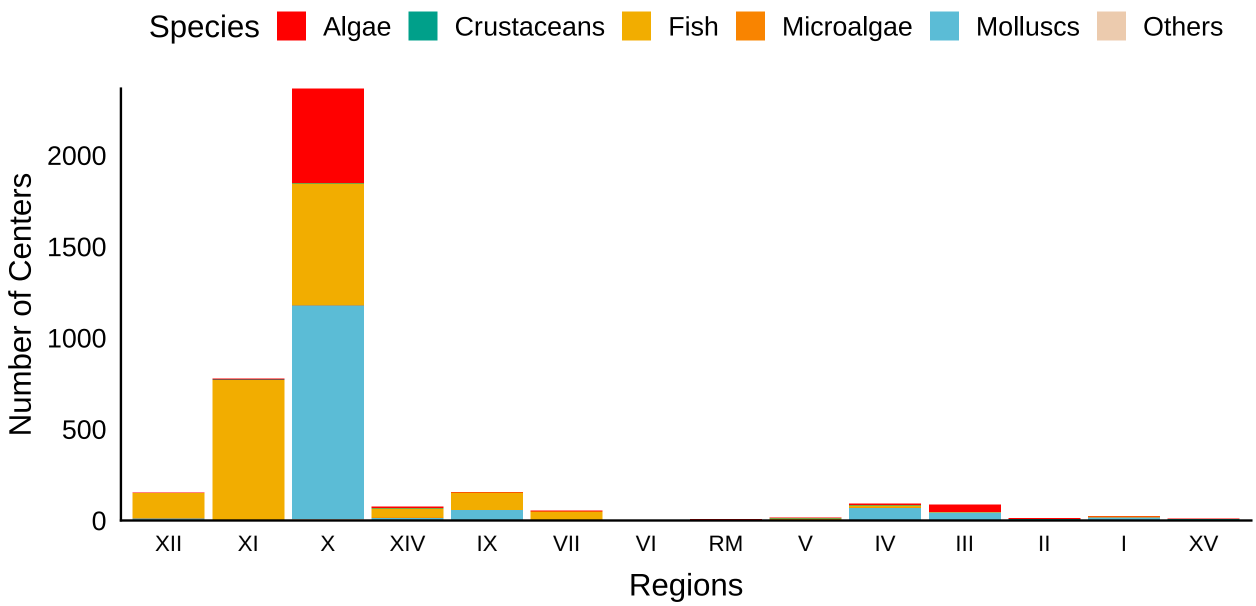

Figure 11: Number of aquaculture centers in each region by type of species in 2017. Source: Report Subsector Acuicultura 2017 by SERNAPESCA (SERNAPESCA website, 2017)

Critical Analysis

Data Uncertainty and Gaps

- Most of our analysis relied on publically available data collected by governmental institutions. Although national efforts towards transparency and better data collection have increased over the years, there are still sources of uncertainty and error. Clear evidence of the presence of error in our analysis are the negative estimates of domestic consumption we got for some species after substracting exports to all what was produced in the country. Negative estimates are not logic since a country cannot export more than what it has produced. We think that these estimates can be mainly explain by the presence of Illegal unreported and unregulated fishing (IUU), non-perfect matching between databases, and lack of information on species-specific yields and ingredients composition of marine products.
- Particularly concerning is landing data since it is mainly generated via landings declarations. Fishers should announce their intention to land catch to the authority in charge, who must weight and certify the catch. Commercialization centers should not sell any kind of catch that is not certified. Thus, fishers have an incentive to report their landings. In addition, those fishers that do not declare their landings risk their permits and penalty fees. Still, these rules are poorly enforced generating incentives to underreport. IUU fishing occurs in Chile. In 2017, the five most seized species due to non-compliance with fishing regulations were the Araucanian herring (*Strangomera bentincki*), the Peruvian anchoveta (*Engraulis ringens*), the Giant grey kelp (*Lessonia nigrescens*), the Jumbo Flying Squid (*Dosidicus gigas*), and the South pacific hake (*Merluccius gayi*). All of them are among the most landed species in the country. There has been recent efforts to generate estimates for IUU for some Chilean fisheries like Loco (*Concholepas concholepas*) (@oyanedel_illegal_2018) and the South pacific hake (@wwfchile_estimacion_2017). However, we did not include them in our analysis because they are not available for all species and including them only for the species that have been studied could have bias our results in a systematic way. IUU is not recorded in the landings database but products coming from IUU that are exported are likely to be recorded in the exports database. This could be making us to underestimate domestic consumption.
- 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. We designated the groups and did all the corresponfing matching, however this step is prone to human error, theredfore add uncerteinty to our analysis.
- We found lack of consistency in two datasets provided from SERNPESCA for the year 2015. Data segregated by sector, month and region did not match aggregated data published in a differen document. This confirms that even though official data is our most reliable source, it also provides uncerteinty.
- It is possible that we have overestimated exports volumes for some species since some products combine the species of interest with other ingredients. We could not account for this since we did not have data on the products composition on different ingredients. However, for the most exported products this is not a major issue since fish fillets and fresh products are usually almost 100% made by fish meat or shellfish. Similarly, we lacked data on species-specific yields to estimate how many Kg of a species translates into different marine products. We found our analysis to be particularly sensitive to the values of species-specific yields, highlighting the importance of improving this aspect of the model.
- 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. Even though we were able to estimate the total impact of the fisheries industry (supply chain) in the country's GDP using the SAU data and the multiplier developed by Dyck and Sumaila [@Dyck], there is no detailed information from the national sources for the industrial sector as there is for the artisanla sector in Chile. Thus, identifying what were the most valuable species for the industrial sector was not possible. One possibe future exploration could be to derive ex-vessel prices from trade data [@melnychuk_reconstruction_2017]. The fisheries sector for which we found most available information was the artisanal sector. We were able to get a count of the direct employment

generated by this sector through to the National Record of Artisanal Fishers (RPA). Eventhough the RPA is an official registration for fishers, we know enforcement is weak specially in remote areas of the country therefore there is room for illigal activity which could lead to underestimation of the the amount of people working in this area. 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.

Fisheries context

Key messages:

- The most important fisheries in Chile in terms of landings are Anchovy (*Engraulis ringens*), the Araucanian herring (*Strangomera bentincki*), which are fished by both the artisanal and industrial sectors, and the Chilean jack mackerel (*Trachurus murphyi*), fished mostly by artisanals.

Seafood Consumption

Key messages:

- Most importants species in terms of food consumption in Chile are Jumbo Squid (*Dosidicus gigas*) and Southern rays bream (*Brama australis*) followed by hakes and mackerel.
- Trends in food consumption show that in general the species that contrubut to domestic food consumption has been constant through time exept for Hake, that has been slowly decreasing.
- Tuna is one of the main groups of species consumed in the country but is mainly imported.
- Most of wild-caught fish is processed for non-human consumption products.
- Despite its massive production, aquaculutre is not a major source of food supply for the Chilean population. Most of its production is exported or are too expenssive to be accessed by lower income groups which is the population of interest in the contxt of food security.

Chile is considered one of the main countries in fishery production worldwide [@fao_estado_2016], however studies suggest the Chilean population does not consume as many marine products [@gonzales_solo_2018]. We found that on average between 2013 to 2017 the chilean population eats ~11kg of seafood a year. This is lower than the 20 kg a year recommended by Food and Agriculture organization (2016). According to the National Health Survey [@ministerio_de_salud_gobierno_de_chile_encuesta_2018], only 9.2% of the Chilean population eats fish at least two times a week as recommended. This value has decreased since the early 2000s where this percentage was 10.7% [@ministerio_de_salud_gobierno_de_chile_encuesta_2018]. World Data [@ritchie_our_nodate] also shows a decrease in the amount of per capita seafood consumed per year by the Chilean population from ~16kg consumed in 2004 to 12.5kg in 2013.

Looking into what type of seafood the Chilean population consumes, a study done in 2012 shows that 60% of the seafood consume are pelagic fishes, 12% are mollusk and 2% are crustaceans [@villena_marcelo_diagnostico_2012]. With our model we also identifyed that Chileans moslty rely on pelagic fisheries as their primary source for seafood and squids. The most important groups of species for domestic food consumption are squids, tuna, hake, and the Southern ray beam. However, it is likely that we have overestimated squid consumption. It is worth noting that Tuna is mostly imported into the country while most of the species that are use in Chile for Human Consumption products like salmon, trouts and mussels are exported. This reflects the importance of market forces on world-wide seafood distirbution and supply. Salmon and trouts get better prices a broad and are too expensive for Chileans in general.

Seafood consumption in Chile has been shown to be correlated with income, as in other parts of the world. However, the data is spotty and is probably missing some of the consumption that occurs in coastal communities. According to a study done in 2016 by Fundación Chile and Adimark [@fundacion_chile_chile_2016], the frequency of seafood consumption varies along socio-economic groups in Chile, 55% of the high-income group consumes seafood at least once a week compared to the 38% of the lower-income group. It has also been identified [@ministerio_de_salud_gobierno_de_chile_encuesta_2018] that people with less years of schooling tend to eat less fish (only 6.3 percent eats seafood twice a week) than people that have completed high school education, where 11.2% eats as frequently.

Within the Chilean population there is a strong belief that seafood is expensive. However, there is wide range of fish prices. There are expensive products such as salmon and affordable alternatives such as Chilean Jack Mackerel (*Trachurus murphyi*), Jumbo Flying Squid (*Dosidicus gigas*) and Southern Rays Bream (*Brama australis*) [@ministerio_de_salud_gobierno_de_chile_encuesta_2018].

Economic participation

Key messages: - Aquculture, specifically salmon is the species that contributes more to the local economy. - -

Aquaculuture is the most important activity in the fisheries sector in terms of economic value. Their profits come mainly from the exportation of salmon products. This places salmons as the group of marine species that contribute the most to the country's economy. The Chilean jack mackerel (*Trachurus murphyi*) and the Jumbo squid (*Dosidicus gigas*) are the wild-caught species that have contributed the most in exports over the past years. The latter is use for DHC and is targeted by both the artisanal an industrial sector. Yet, current discussion on closing access to the industrials to this fishery could bring consequences for both income and food supply.

Among wild-caught fisheries the ones that seems to generate more revenues for the artisanal sector are the Southern king crab (*Lithodes santolla*) and the Chilean sea urchin (*Loxechinus albus*). While the first fishery occurs only in the South of the country, the latter is ditributed along the coast of Chile.

Although the direct employment in aquaculture centers is low relative to the number of artisanal fishers, it is very likely that an important share of the job positions in the manufacturing sector are being supported by aquaculture. Especially in the South where most job positions for manufacturing of human consumption products are concetrated. The role of Algaes in terms of employment for the artisanal sector is also worth notice. The revenues of most these species are not particularly high, however the lower costs of extraction relative to other types of fishing make algae collection an attractive form of livelihood for coastal communities.

Oceana Next Steps

We learned that there is poor undertanding on Chile regarding the main marine species in terms of food security and economic participation. Although people have tried to answered these kind of questions before, there is not a constant track of what species are being eaten and how much do chilean people eat. We think that an approach like the one presented here could be easily automatized to keep track of the trends on domestic seafood consumption. Nonetheless, it would requiere some improvements to get more reliable estimates by full-filling some of the datagaps.

A mayor challenge we faced was to combine all datasets without losing species resolution. We think there is potential to imporve the methods we used for scraping data from the imports and exports databases as for example, the Chilean customs recently uploaded the export information for 2018 as an excel file combining type of products, aduana code, exported tones and values. When we ask for this sort of document back in October, the Chilean customes told us they were working on it so hopefully they will publish historic data in that fomat. This could increase the species resolution, reduce human error and facilitate automatization. Other two things that would improve the estimates we obtained here are species-specific IUU estimates and yields per type of product for Chilean species. IUU estimates are becoming more popular and different methods have been developed for estimate it from elliciation tasks to more model driven approaches. This kinds of estimate could be also of interested to management authorities. Thus, Oceana could cooperate with them to ellaborate them.

Chile is increasingly pushing for an increase in seafood consumption. Currently, there are programs that promote seafood consumption like *Del Mar a mia Mesa* (From the sea to my table). We think Oceana could contribute adding to the discussion the whole picture of the state of the fisheries and the economic implication for the country of transitioning to a more fish based diet. For this an integrated analysis about the state of the fishery and its economic importance for the country needs to be done. More than just promoting the increase in domestic seafood consumption we think it is necesary to know why is it important and who will benefit and loose. These are key elements for the success of any project of this type. Furthermore it in order to assure food securuty it is necesary to promote eating fish from well managed fisheries.

In our analysis we did not explore the role of the commercialization chain on food supply and distribution. Investing in better understanding from where can people access seafood and at what prices is crucial to improve food security. Thus, there is a need to better characterize the distirbution of seafood in Chile and explore the possibility of improving seafood access by better managing the supply chain.

Finally, it would be interesting to study the preferences an attitudes of Chileans towards products that have not been historically consumed but that are becoming important in terms of landings like algae and squid. Understanding the potential for this species to succed as food products within the country may be important to improve access to marine food at lower prices.

Conclusions

The main takeaway of our analysis regarding the contribution of domestic fisheries for human consumption is that most of the wild-caught fish currently does not go to human consumption, but to produce no human consumption products like fish meal and oil or algae products. On the other hand, most of the aquiculture produced in the country is for human consumption but it is exported elsewhere. Only *XX%* of the local production stays in the country for human consumption. Additionally, one of the most relevant species for human consumption in Chile is tuna, which mainly in imported and canned.

In economic terms, aquaculture is more important than wild-caught fisheries producing ~ 90% of the sales of the economic sector. Nontheless, wild fisheries is more important in terms of employment if we consider both the artisanal and industrial sector.

Chile

References

PRODUCE. (2010). Manual de administración de las infraestructuras pesqueras artesanales. Ministerio de la Producción, Viceministerio de Pesquería, Dirección General de Pesca Artesanal. Lima, Perú. 121p.

Supplemental Material List

Chile

Methods

Fisheries Context

National Seafood Supply

On order to develop the model describe in the general methods, we had to match all products impoted and exported with the species landed or harvested. We used as references products that containd multiple species within tha Aduana's databases. All species classified under a same **Aduna code** where groups in a same group. Whenever possible we mantaind single species. This allowed us to aggregate products per groups of 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 a common group among the import and export data (See appendix for group details).

We found inconsistencies between two databases of landings published by SERNAPESCA in their website. They differed in the level at which data was aggregated. One data base was clasified per sector (artisanal, industria, fabric vessels) and the other was the summary for lanfings and aquaculture for each year per region. When we aggregated the most detailed database to the same level as the anual summary database we observed differences in landing volumes for the year 2015. We considered this to be part of the measurement error involved in any process of data collection or data entry. We used the summary annual data for our domestic human consumption model because it alinged more with amounts reported all other years.

We calculated yield by estimating an average between the range of losses from discards and processing provided by Christensen et al. (2014) for Peruvian species. For species that did not have a matching yield we used the yield of the most similar species. Yields within a group os species where averaged for the final calculations of the model. See table XX for details on yeilds per sepcies used in our analysis.

```r
sp_yield <- read.csv(here('clean_databases/sp_index.csv')) %>%
  select(chl_name, sc_name, yield)


knitr::kable(sp_convertion, col.names = c('Name SERNAPESCA', 'Scientific Name', 'Yield'), format.args =
```

=

Economic Participation

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).

Results

Table 2: Index of all species considered in this analysis and their corresponding group

Name SERNAPESCA	Scientific Name	Group
AGUJILLA	Scomberesox saurus scombroides	King gar
ALBACORA O PEZ ESPADA	Xiphias gladius	Swordfish
ALBACORA	Xiphias gladius	Swordfish
ALFONSINO	Beryx splendens	Splendid alfonsino
ALMEJA	Venus antiqua	Clams
ANCHOVETA	Engraulis ringens	Peruvian anchoveta
ANCHOVETA BLANCA	Anchoa nasus	Anchovy
ANGUILA	Ophichthus spp.	Eel
APANADO	Hemilutjanus macrophthalmos	Grape-eye seabass
ATUN ALETA AMARILLA	Thunnus albacares	Tuna
ATUN ALETA LARGA	Thunnus alalunga	Tuna
ATUN CHAUCHERA	Gatrochisma melampus	Tuna
ATUN OJOS GRANDES	Thunnus obesus	Tuna
AYANQUE	Cynoscion analis	Peruvian weakfish
AZULEJO	Prionace glauca	Shark
BACALADILLO O MOTE	Normanichthys crockeri	Mote sculpin
BACALADILLO	Normanichthys crockeri	Mote sculpin
BACALAO DE PROFUNDIDAD	Dissostichus eleginoides	Patagonian toothfish
BAGRE AGUA DULCE	Ictalurus punctatus	Channel catfish
BESUGO	Epigonus crassicaudus	Sea bream
BLANQUILLO	Prolatilus jugularis	Pacific sandperch
BONITO	Sarda chiliensis	Skipjack tuna
BRECA O BILAGAY	Cheilodactylus variegatus	Peruvian morwong
BILAGAY	Cheilodactylus variegatus	Peruvian morwong
BRECA	Cheilodactylus variegatus	Peruvian morwong
VILAGAY	Cheilodactylus variegatus	Peruvian morwong
BRECA O VILAGAY	Cheilodactylus variegatus	Peruvian morwong
BROTULA	Salilota australis	Tadpole codling
CABALLA	Scomber japonicus	Mackerel
CABINZA	Isacia conceptionis	Cabinza grunt
CABRILLA	Paralabrax humeralis	Peruvian rock seabass
CABRILLA COMUN	Paralabrax humeralis	Peruvian rock seabass
CALAMAR	Loligo gahi	Squid
CAMARON DE ROCA	Rhynchocinetes typus	Shrimp
CAMARON NAILON	Heterocarpus reedi	Shrimp
CANGREJO DORADO DE J. FERNANDEZ	Chaceon chilensis	Crabs
CANGREJO D. DE J. FERNANDEZ	Chaceon chilensis	Crabs
CANGREJO DORADO DE JF	Chaceon chilensis	Crabs
CANQUE	Stellifer minor	Minor stardrum
CARACOL LOCATE	Thais chocolata	Snails
CARACOL PALO PALO	Argobuccinum spp.	Snails
CARACOL PICUYO	Odontocymbiola magellanica	Snails
CARACOL PIQUILHUE	Adelomelon ancilla	Snails
CARACOL RUBIO	Xantochorus cassidiformis	Snails
CARACOL TEGULA	Tegula atra	Snails
CARACOL TRUMULCO	Chorus giganteus	Snails
CENTOLLA	Lithodes santolla	King crab
CENTOLLON	Paralomis granulosa	King crab
CENTOLLON DEL NORTE	Paralomis spp.	King crab
CHANCHARRO	Helicolenus lengerichi	Rockfish helicolenus
CHASCA	Gelidium rex	Algae
CHASCON O HUIRO NEGRO	Lessonia nigrescens	Algae

Table 3: Species and their correspondding yield based on Christensen et al. (2014)

Name SERNAPESCA	Scientific Name	Yield
AGUJILLA	Scomberesox saurus scombroides	King gar
ALBACORA O PEZ ESPADA	Xiphias gladius	Swordfish
ALBACORA	Xiphias gladius	Swordfish
ALFONSINO	Beryx splendens	Splendid alfonsino
ALMEJA	Venus antiqua	Clams
ANCHOVETA	Engraulis ringens	Peruvian anchoveta
ANCHOVETA BLANCA	Anchoa nasus	Anchovy
ANGUILA	Ophichthus spp.	Eel
APANADO	Hemilutjanus macrophthalmos	Grape-eye seabass
ATUN ALETA AMARILLA	Thunnus albacares	Tuna
ATUN ALETA LARGA	Thunnus alalunga	Tuna
ATUN CHAUCHERA	Gatrochisma melampus	Tuna
ATUN OJOS GRANDES	Thunnus obesus	Tuna
AYANQUE	Cynoscion analis	Peruvian weakfish
AZULEJO	Prionace glauca	Shark
BACALADILLO O MOTE	Normanichthys crockeri	Mote sculpin
BACALADILLO	Normanichthys crockeri	Mote sculpin
BACALAO DE PROFUNDIDAD	Dissostichus eleginoides	Patagonian toothfish
BAGRE AGUA DULCE	Ictalurus punctatus	Channel catfish
BESUGO	Epigonus crassicaudus	Sea bream
BLANQUILLO	Prolatilus jugularis	Pacific sandperch
BONITO	Sarda chiliensis	Skipjack tuna
BRECA O BILAGAY	Cheilodactylus variegatus	Peruvian morwong
BILAGAY	Cheilodactylus variegatus	Peruvian morwong
BRECA	Cheilodactylus variegatus	Peruvian morwong
VILAGAY	Cheilodactylus variegatus	Peruvian morwong
BRECA O VILAGAY	Cheilodactylus variegatus	Peruvian morwong
BROTULA	Salilota australis	Tadpole codling
CABALLA	Scomber japonicus	Mackerel
CABINZA	Isacia conceptionis	Cabinza grunt
CABRILLA	Paralabrax humeralis	Peruvian rock seabass
CABRILLA COMUN	Paralabrax humeralis	Peruvian rock seabass
CALAMAR	Loligo gahi	Squid
CAMARON DE ROCA	Rhynchocinetes typus	Shrimp
CAMARON NAILON	Heterocarpus reedi	Shrimp
CANGREJO DORADO DE J. FERNANDEZ	Chaceon chilensis	Crabs
CANGREJO D. DE J. FERNANDEZ	Chaceon chilensis	Crabs
CANGREJO DORADO DE JF	Chaceon chilensis	Crabs
CANQUE	Stellifer minor	Minor stardrum
CARACOL LOCATE	Thais chocolata	Snails
CARACOL PALO PALO	Argobuccinum spp.	Snails
CARACOL PICUYO	Odontocymbiola magellanica	Snails
CARACOL PIQUILHUE	Adelomelon ancilla	Snails
CARACOL RUBIO	Xantochorus cassidiformis	Snails
CARACOL TEGULA	Tegula atra	Snails
CARACOL TRUMULCO	Chorus giganteus	Snails
CENTOLLA	Lithodes santolla	King crab
CENTOLLON	Paralomis granulosa	King crab
CENTOLLON DEL NORTE	Paralomis spp.	King crab
CHANCHARRO	Helicolenus lengerichi	Rockfish helicolenus
CHASCA	Gelidium rex	Algae
CHASCON O HUIRO NEGRO	Lessonia nigrescens	Algae

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
NA	NA	NA	NA	Patagonian toothfish	Patagonian too
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

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	1,160.8	352.0	885.6	381.7	674
Part time	707.3	258.1	465.1	288.9	302

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