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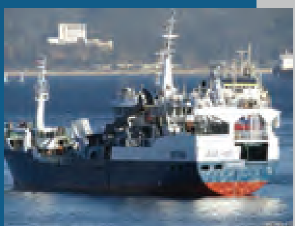

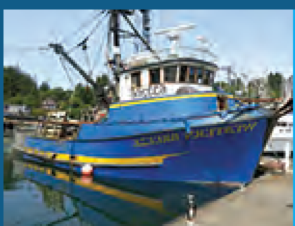
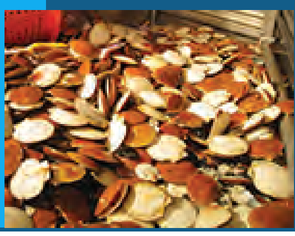

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Techno-economic performance review of selected fishing fleets in North and South America

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Preparation of this document

This publication on the techno-economic performance of selected marine fishing fleets in North and South America was prepared in 2019–20 by Andrew Kitts of the National Marine Fisheries Service (NMFS) under the National Oceanic and Atmospheric Administration (NOAA), Raymon van Anrooy of the FAO Fisheries and Aquaculture Department, Sjef van Eijs, Jesica Pino Shibata, René Pallalever Pérez, Alex Augusto Gonçalves (fisheries consultants), and Greg Ardini, Christopher Liese, Minling Pan, and Erin Steiner of NOAA.

This publication includes four national review studies of the main marine capture fisheries fleets of the following North and South American countries: United States of America, Brazil, Chile and Peru. The document on selected US fishery fleets is largely based on the information collected by the US NMFS within its economic data collection programme and through various fleet surveys. The reports on Brazil, Chile and Peru are based on fishing vessel surveys conducted by FAO fisheries consultants in 2019. The information presented for the US fleets uses data of 2012–17, depending on the fleet surveys carried out. The fishing vessel information of the other countries included in this report represents costs and earnings of these vessels during 2018.

The preparation of this regional review was a challenge. Most South American fishing vessels operators were very reluctant to provide precise financial data as they consider that this could jeopardize their competitive position and be used by authorities for taxation purposes. Nevertheless, the fisheries consultants, with support from national fisheries authorities, have managed to collect valuable information from the more collaborative fishing vessel operators, which permitted a techno-economic performance analysis of some of the main fishing fleets of South America.

The methodology for conducting the national review studies was discussed and agreed at the FAO/Bay of Bengal Programme – Intergovernmental Organization (BOBP-IGO) Expert Meeting on methodologies for conducting fishing fleet techno-economic performance reviews, which was held in Chennai, India, on 18–20 September 2018 (FAO, 2019). Following the preparation of the draft national review studies in 2019, an Expert Meeting to validate the outcomes and finalize the techno-economic performance review of the main global fishing fleets was held at FAO headquarters in Rome, Italy, on 8–10 October 2019. This latter Expert Meeting considered it important to publish not just a global review, but to complete the national review reports and also produce regional reviews for Europe, North and South America, Africa and Asia. This publication on the techno-economic performance of selected fishing fleets in North and South America, will thus be accompanied by similar regional reviews for the other regions. The preparation of the national fleet reports was coordinated by Yugraj Yadava and Rajdeep Mukherjee of the BOBP-IGO, and further facilitated by Graciela Pereira of INFOPESCA.

This publication was formatted by Estefanía Burgos and editorial and design assistance was provided by Magda Morales, Marianne Guyonnet and Chorouk Benkabbour of the FAO Fisheries and Aquaculture Department.

Abstract

This techno-economic performance review of selected fishing fleets in North and South America was carried out as part of the 2020 FAO Review of the techno-economic performance of the main global fishing fleets and presents the findings for four selected countries. The country studies are based on fishing fleet data from surveys conducted in the period 2012–17 in the United States of America by the National Marine Fisheries Service, and fishing vessel surveys carried out in Brazil, Chile and Peru during 2018 by national fisheries experts. The review includes financial and economic information of 21 fishing fleet segments, including shrimp and groundfish trawlers, demersal trawlers, longliners, purse seiners, dredgers as well as hook and line fishing vessels.

Analysis of the costs and earnings data of these important fishing fleet segments in North and South America, showed that 81 percent of the fleet segments had a positive net cash flow. The net profit margins of 38 percent of the 21 fishing fleet segments were >10 percent. Two-thirds (67 percent) of the fleet segments presented positive results in terms of their capital productivity, as the return on fixed tangible assets (ROFTA) was positive. Twenty-four percent of the fleet segments showed return on investment (ROI) figures of twenty percent or more. A majority of the Chilean and Peruvian fleet segments had ROIs of ten percent or higher in 2018.

The financial and economic performance of the fishing fleet segments is not only affected by the seafood prices, but also by the fisheries management regime in place, fish species targeted, fish stock status and fishing methods and technologies applied. The vessel age structure shows an increasing trend for most of the fishing fleet segments in this review, which is another issue that assisted in increasing profitability of vessels in these fleet segments, as replacement and depreciations costs are low or non-existent.

Contents

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The authors would like to acknowledge the important contribution by Yugraj Singh Yadava and Rajdeep Mukherjee of the Bay of Bengal Programme – Intergovernmental Organization (BOBP-IGO) for their assistance in coordinating the global review work and for generously hosting an Expert Meeting in Chennai.

The authors would also like to express appreciation for the valuable contributions by the participants of the Expert Meeting on methodologies for conducting fishing fleet techno-economic performance reviews, held in Chennai, India, on 18–20 September 2018, and by the participants of the Expert Meeting to validate the outcomes and finalize the techno-economic performance review of the main global fishing fleets, held in Rome, Italy, on 8–10 October 2019, in terms of supporting the development of a methodology for conducting technoeconomic performance reviews of fishing fleets and reviewing the draft national reports.

Acronyms and abbreviations

AIS	automatic identification system
DAS	days-at-sea
EEZ	exclusive economic zone
FMP	fishery management plan
FTE	fulltime-equivalent (employment figures)
GOM	Gulf of Mexico
GDP	gross domestic product
GPS	global positioning system
GT	gross tonnage
GVA	gross value added
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Sea
IFO	intermediate fuel oil
IFQ	individual fishing quota
ITQ	individual transferable quotas
kW	kilowatt
LOA	length overall
MAP	multi-annual plan
MHI	main Hawaiian Islands
MSY	maximum sustainable yield
NAFO	Northwest Atlantic Fisheries Organization
NMFS	National Marine Fisheries Service (NOAA)
NOAA	National Oceanic and Atmospheric Administration (U.S. Department of Commerce)
nm	nautical mile
ROI	return on investment
ROFTA	return on fixed tangible assets
RFMO	Regional Fishery Management Organization
SPRFMO	South Pacific Regional Fisheries Management Organisation
TAC	total allowable catch
USD	United States Dollar


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1. Introduction and background

In many countries the marine capture fisheries sector plays an important role in terms of generating employment, income and foreign exchange earnings. The sector also significantly contributes to meeting the nutritional requirements of the increasing global population.

The United Nations 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs) recognizes that the fisheries sector offers many opportunities to reduce hunger, improve nutrition, alleviate poverty, generate economic growth and to ensure better use of natural resources. In order to achieve SDG 14 (Conserve and sustainably use the oceans, seas and marine resources for sustainable development), it is imperative that fishing operations should become environmentally sustainable, socially acceptable and economically viable.

Great efforts are made world-wide towards achieving sustainable fisheries in terms of its interaction with the marine environment. A large number of academic research, conservation and fisheries management projects are focused on the environmental sustainability of the fisheries sector. This results in a plethora of information being available on environmental aspects of fisheries, while the economic and social aspects of fisheries often receive much less attention.

It is important that FAO Member States and their fisheries management and decision makers are aware of the economic aspects of fishing operations, monitor the financial and economic feasibility of the fishing fleets, and compare differences between fleets and, over time, within fishing fleets. Information on the technological and economic performance of the fishing fleets will facilitate fisheries governance processes. Such information is also instrumental for fisheries sector stakeholders, both public and private, to aid in investment decisions about fishing fleets, fisheries related infrastructure and logistics.

Technical and economic information on the fishing fleets is important for FAO Members in their implementation of the Code of Conduct for Responsible Fisheries,[1] and particularly its articles 7 and 8 on Fisheries Management and Fishing Operations, respectively. The information on techno-economic performance of the world's fishing fleets will further assist FAO Members in the implementation of the International Plan of Action for the Management of Fishing Capacity (IPOA-Capacity).[2] For fisheries managers and stakeholders it is essential to not only understand the status of the fisheries resources and the trends in seafood production, but also to know about the techno-economic performance of the fishing fleets. This will facilitate the development and implementation of national and regional action plans for the management of fishing capacity, in line with the IPOA-Capacity.

Therefore, FAO and particularly its Fishing Operations and Technology Branch (FIAO), regularly conduct global studies to analyse the cost structure and economic and financial performance of fishing fleets. These studies form part of the regular monitoring of the economic and financial viability of marine capture fisheries, conducted by FAO in close cooperation with national fisheries research institutions, fisheries administrations and experts in selected countries in Asia, Africa, the Americas, the Caribbean and Europe.

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1 More information about the FAO Code of Conduct for Responsible Fisheries (1995) can be found at: www.fao.org/fishery/code/en

2 More information on the IPOA-IUU can be found at: www.fao.org/fishery/ipoa-capacity/en

The findings of previous studies carried out in 1995 to 1997, 1999 to 2000 and 2003 to 2005 were reported in FAO Fisheries Technical Papers 377 (FAO, 1999), 421 (FAO, 2001) and 482 (Tietze, *et al.*, 2005), respectively. The findings of these studies demonstrated that despite fully and sometimes overexploited fisheries resources, marine capture fisheries were an economically and financially viable undertaking in the 1990s and the first years of this millennium, although definitely not achieving the possible optimum returns. The studies showed that marine fishing fleets generally generated enough revenue to cover the cost of depreciation as well as the opportunity cost of capital and generated funds for reinvestment in addition to employment, income and foreign exchange earnings.

The last FAO global fishing fleet techno-economic performance review study was done in 2002–03 and published in 2005. Since then, FAO has not conducted any major comparative study on fishing fleet performance. However, many developed countries, including Japan, Norway, the United States of America and the European Union have continued to carry out measurements on fleet performance in order to monitor the economic and financial feasibility of their fishing sector. In view of the range of methods being applied by countries for doing techno-economic performance evaluations of their fishing fleets, FAO, in close collaboration with BOBP-IGO, held an Expert Meeting on methodologies for conducting fishing fleet techno-economic performance reviews, in Chennai, India, on 18–20 September 2018. At the meeting the advantages and disadvantages of various methodologies applied for reviewing the economic and technical performance of fishing fleets were discussed and a general sampling/survey methodology for conducting techno-economic performance reviews, which can be applied also in developing countries, was developed and adopted.

In 2018–19 FAO collaborated with many fisheries economists world-wide to carry out national level techno-economic performance reviews of the main fishing fleets, applying the agreed methodology. These national reviews were validated in October 2019 and published in regional review reports. This report on the techno-economic performance of selected fishing fleets in North and South America, is accompanied by similar regional reviews for Europe (Carvalho *et al.,* 2020), Africa and Asia. The 2020 FAO Review of the techno-economic performance of the main global fishing fleets (FAO Fisheries and Aquaculture Technical Paper No. 654) compiles the findings of the national and regional reviews and includes a comparison with the findings of previous global reviews on this subject.

The North and South American countries that were included in the previous global fleet review studies were: Antigua and Barbuda, Argentina, Barbados, Peru, and Trinidad & Tobago. In this review Peru is included again, as well as Brazil, Chile and the United States of America. These four countries account together for about 14 percent of the global capture fisheries production in 2018. The number of fleets or fleet segments operating in South and North America, covered in the last (2003) global review for which profitability could be calculated was 15, while for the current review it was possible to do so for 21 fleets. Small-scale Caribbean fleets are not covered in this review as the Caribbean Regional Fisheries Mechanism (CRFM) and FAO conducted a study on the cost of fishing in Caribbean states in 2016.

2. Fishing fleet characteristics of the selected North and South American fishing fleets

The fleets covered in this regional review are the three to seven most important fleet segments of selected North and South American countries in terms of volume and value of seafood landed. The vessel types covered are: shrimp and groundfish trawlers (5 fleets), demersal trawlers (4 fleets), longliners (5 fleets) purse seiners (4 fleets), dredgers (2 fleets) and one hook and line/handliner fishing fleet.

FAO estimates that the number of fishing vessels in the Americas increased by approximately 90 000 vessels between 2000 and 2017, from around 380 000 vessels to some 470 000 vessels. While in South America the number of vessels and capacity increased during this period, it decreased in North America. For instance, the number of registered fishing vessels in Peru increased from 4 400 in 2007 to 14 064 in 2019, a 320 percent increase. However, gaps in reporting on active fishing vessels do not allow the drawing of clear conclusions, in particular on fishing vessel capacity trends in South America. Compared to the 2003 FAO review, the number of Peruvian purse seiners increased, as well as the length of the vessels, the vessel capacity in gross tonnage (GT) and engine kilowatt (kW). For example, the overall length (LOA) of Peruvian purse seiners increased from an average 38 meters to above 50 meters, while their engine power increased with about 100 kW per vessel.

The age structure of the main fishing fleets in North and South America showed an increasing trend for most fleet segments. This means that most fleet segments are ageing and that few fishing vessels have been constructed recently and entered these fleets. Vessels are kept operational longer by installing new more fuel-efficient engines, modernizing their fishing gear systems and putting into effect adequate maintenance and repair regimes. For example, in the United States of America the average age of vessels in five of the seven fleets surveyed was above 30 years. The average age of groundfish trawlers was even above 40 years and longliners in Hawaii and Gulf of Mexico shrimp trawlers also presented average ages of 31 and 30 years, respectively, in 2018. Two-thirds of the scallop dredgers were over 20 years of age as well. In Brazil, the longline vessels were nearly all above 20 years of age and, due to poor maintenance, a renewal or modernization of this fleet is needed. The shrimp, demersal and bottom trawler vessels in the south region were between 15 and 30 years of age. Overall, the fishing vessels in Brazil were on average more than 20 years in use, and the number of new vessels entering the fleets in recent years was low. In Chile the active purse seiners were on average between 20 and 24 years in 2018 and longline vessels had an age of around 18 years. In contrast the trawlers in Chile were on average 41 years old, but they appeared well maintained and with modern equipment onboard. Ninety percent of the purse seine vessels in Peru, fishing for anchovy and/or chub mackerel, were above 15 years of age, and the remaining 10 percent were older than 20 years in 2018. The jumbo squid handliner vessels were relatively young, with 95 percent in the age category of 5 to 10 years in 2018. Overall, it can be concluded that the vessel hull age is increasing in North and South America, but that many have been upgraded by their owners with new equipment, and modern technologies for fish finding, navigation and communication. Sometimes the vessels have been converted by their owners from one fishing method into another (e.g. trawling to longline fishing) to adjust to changes in resources, fisheries regulations or market demand, and to maintain or increase vessel profitability.

The volume of seafood landed (in live weight) per fleet segment differs largely with the target species. In general, the semi-industrial longline vessels (mainly tuna and tuna-like species) land tens of tonnes per year, while dredgers land hundreds of tonnes of seafood annually. The industrial trawlers surveyed land annually a few hundred to one thousand tonnes of groundfish or demersal fish. The industrial purse seiners in Chile and Peru generally land more than ten thousand tonnes of fish (mainly anchovies and mackerel species) per vessel annually. Detailed information on target species and landings per fleet segment can be found in the national reports.

3. Costs and earnings structures of North and South American fishing fleets

In this chapter the costs and earnings structures of the selected fleet segments are compared, first by country, followed by a regional comparison. As much as possible similar cost categories are applied:

Labour costs = personnel costs = labour share and wages (including social security contributions, life/accident and health insurance), food, other provisions and crew travel related costs. Unpaid labour was excluded, as insufficient information was available on this item.

Running costs = energy costs (including fuel, lubricants/oil/filters) and other variable costs (including harbour dues and levies, ice, bait, salt, fish selling costs, packaging materials and other related operational costs).

Vessel costs = gear replacements, gear repair & maintenance, vessel repair and maintenance, other non-variable costs (including hull, equipment and employer's insurance, accountancy, audit and legal fees, general expenses, subscriptions), fishing licenses, permits and quota (only annual costs) and the purchase of fishing rights (quotas).

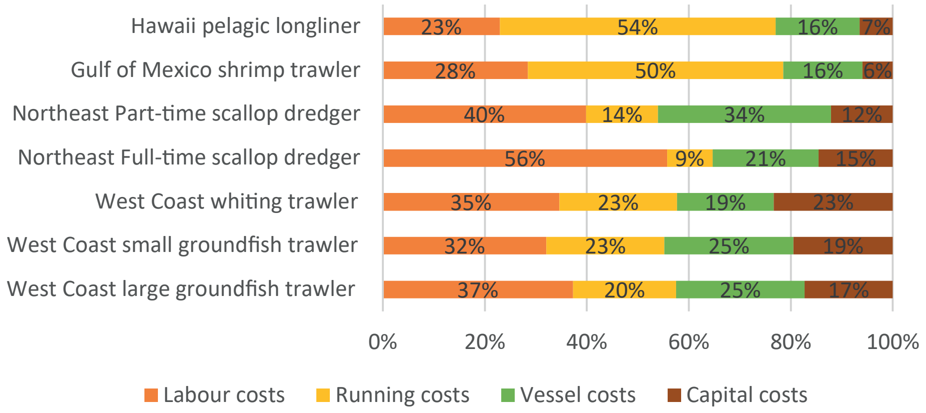
Capital costs = depreciation (of the hull, engines, equipment, and gears that last more than 3 years), interest and amortization of intangible assets (fishing permits, licences, etc.). The information available on the Chilean longline and artisanal purse seine vessels lacked data on depreciation, while most of the Chilean and Peruvian vessels did not provide information on interest payments on loans. Amortization data were lacking for most of the fleets, but were included when available.

The cost components shares in relation to the total costs of the fleets per country are described below:

UNITED STATES OF AMERICA

Labour costs were the largest component of total costs in the Northeast scallop dredger fleet segments included in this analysis, accounting for 56 percent and 40 percent of the total costs in 2012. In contrast, the labour costs were relatively low for the Hawaiian pelagic longline vessels in the same year, accounting for just 23 percent of total costs. The running costs for vessels in this fleet segment amounted to 54 percent of the total costs, and this was largely due to high fuel and fish selling costs (73 percent of the running costs). For the Gulf of Mexico shrimp trawlers, the running costs added up to 50 percent of total costs in 2017, and within the running cost component 83 percent was spent on fuel. The West Coast trawlers of the three fleet segments included in the 2017 survey experienced a largely similar cost item distribution, with labour costs accounting for approximately one-third of total costs.

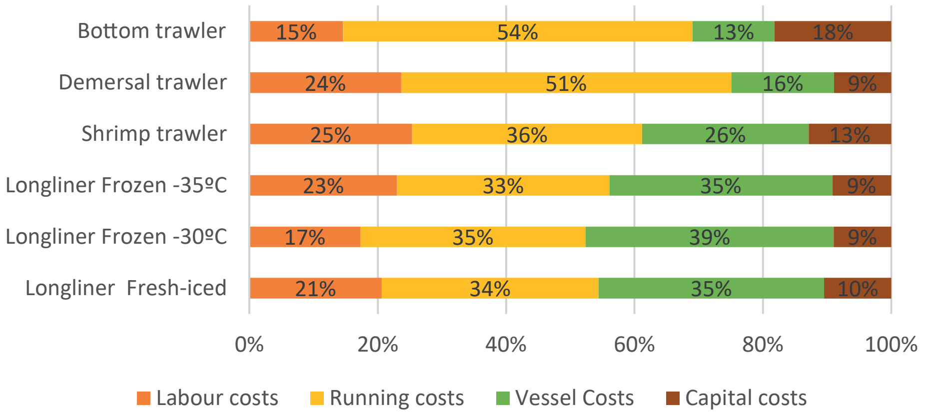
FIGURE 1
Cost items as percentage of the total gross costs in selected United States of America fishing fleet segments



BRAZIL

The labour costs component was relatively small in the Brazilian fleet segments included in the survey, ranging between 15 and 25 percent of the total vessel costs in 2018. In 2018 the bottom and demersal trawlers spent most on running costs and within this component their expenditures on fuel added up to respectively 89 percent and 83 percent. The vessel owner cost component was 35 percent or higher for the longline fleet segments in Brazil and major costs within this component were made for vessel repair and maintenance.

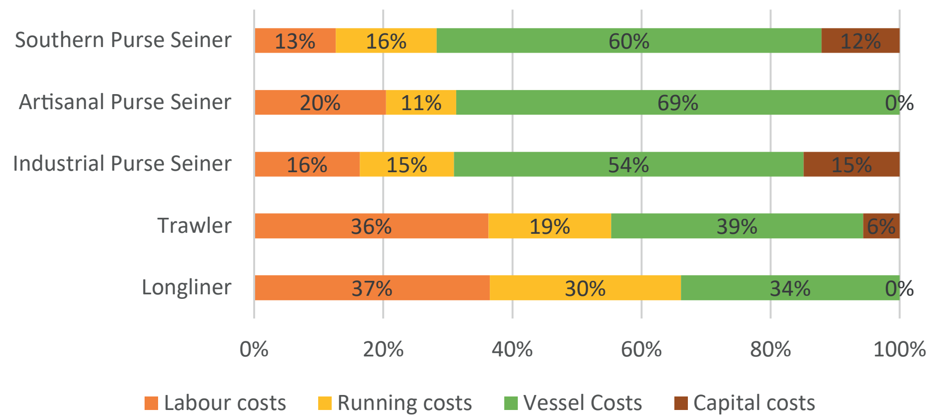
FIGURE 2
Cost items as percentage of the total gross costs in selected Brazilian fishing fleet segments



CHILE

Vessel costs were the largest cost component within the total cost for four of the five fleet segments included in the survey in 2018. Particularly for purse seiners the vessel costs share was high (between 54 percent and 69 percent), because of significant fishing rights and quota purchase expenses. Labour costs for the hake trawlers and longliners was on average more than one-third of the total costs.

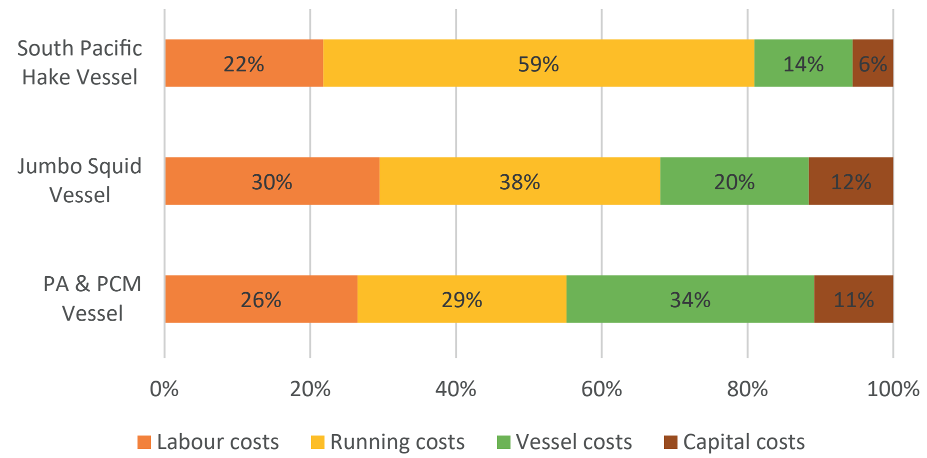
FIGURE 3
Cost items as percentage of the total costs in selected Chilean fishing fleet segments



PERU

For the Peruvian Pacific hake trawlers, the running costs were the largest cost component in 2018, accounting for nearly 60 percent of the total costs. Within the running costs component most expenses (43 percent) were made on fuel. The running costs were also the largest cost component for the jumbo squid hand-line fishing vessels, with fuel and ice amounting to respectively 35 percent and 28 percent of the running costs of these vessels. The labour costs for the eight-person crew on the jumbo squid vessels added up to around 30 percent of their total costs. The vessel costs are the largest cost component for Peruvian anchovy and chub mackerel vessels (PA & PCM) with 34 percent of the total costs. Within this component the vessel repair and maintenance expenses account for 39 percent of the vessel owner costs.

FIGURE 4
Cost items as percentage of the total costs in selected Peruvian fishing fleet segments



Given the large differences between fishing fleet segments and within fishing fleet segments between countries it is not possible to draw region wide conclusions regarding cost component shares for specific vessel sizes or fishing methods.

Compared to the 2003 FAO fishing fleet economic performance review it can be concluded that the cost component distribution of the Peruvian large industrial purse seine vessels experienced little change. The total annual costs of the large industrial purse seiners increased by USD 890 000 compared to 2003, which is mainly comprised of costs increases of 50–60 percent in labour and running costs and a 100 percent increase in vessel (owner) costs. However, capital costs seem to have diminished by about 20 percent in dollar terms, which may be caused by the fact that the vessels are now generally older and that the depreciation costs and interest payments are relatively lower. The cost component distribution for hake trawlers did not change much either. In 2003 some 62 percent of the operational costs were running costs. Nevertheless, the total annual operational costs for vessels in this segment was in 2018 around 40 percent lower than in 2003. This was mainly due to the much lower capital costs, which reduced with almost 90 percent compared to 2003. The latter may be due to the fact that the hake vessels surveyed in 2018 were on average 9 years old and may have been largely paid for, thus owners have less debt and interest payments to make. In addition, the vessel depreciation was considered larger in the first years after construction than after nine years of operation. The only cost component that increased for the hake vessels were the labour costs, which went up from USD 38 000 to USD 86 000, an increase of around 130 percent in 15 years.

The revenue of most fishing fleet segments included in this review consisted solely of income earned from the sale of seafood landed. Table 1 presents the average annual revenue in the year of the survey, from landed seafood only, in thousands of USD per vessel for the various fishing fleet segments.

TABLE 1
Average ex-vessel landing value in thousands of USD per vessel from seafood landings per fleet segment

		Fleet segments covered in this report per country	Number of vessels in segment	Average ex-vessel landing value (thousand USD)
United States of America	1	West Coast large non-whiting groundfish trawl vessel	34	903
	2	West Coast small non-whiting groundfish trawl vessel	20	377
	3	West Coast whiting trawl vessel	32	1 437
	4	Northeast scallop dredger – full-time	313	1 423
	5	Northeast scallop dredger – part-time	35	736
	6	Gulf of Mexico shrimp trawl vessel	1 043	373
	7	Hawaii pelagic longline vessels	142	203
Brazil	8	Northeast region tuna long line vessel -ice fresh	168	415
	9	Northeast region tuna long line vessel -frozen -30 degrees		425
	10	Northeast region tuna long line vessel -frozen -35 degrees		637
	11	South region shrimp trawler	1 824	208
	12	South region demersal trawler		694
	13	South region bottom trawler		463
Chile	14	Longline vessel	8	6 544
	15	Trawler	44	4 580
	16	Industrial purse seiner	88	10 050
	17	Southern purse seiner		9 234
	18	Artisanal purse seiner	N/I	182
Peru	19	Jumbo squid hook & line fishing vessel	698	209
	20	Anchovy/chub mackerel purse seiner	126	3 330
	21	South Pacific hake trawler	33	282

In terms of value of seafood landed, and comparing the North and South American fleets covered in this survey, it is clear that vessels in the Chilean industrial purse seine fleet landed the highest value of seafood per vessel in 2018 with USD 10 million. Industrial trawlers in Chile landed around USD 4.5 million in 2018 and the total ex-vessel value of landings by Peruvian anchovy purse seiners averaged around USD 3.3 million in the same year. In comparison, the substantially smaller semi-industrial shrimp trawlers in Brazil and hook and line fishing vessels for jumbo squid in Peru presented ex-vessel values of just over USD 200 000 in 2018. Brazilian longline vessels and bottom trawlers reported ex-vessel values of over USD 400 000 in 2018. The large variation among the fleets covered in this report, in terms of vessel size, fishing methods used, species targeted and their stock status, makes a comparison between trawlers or purse seiners of limited value.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WESTERN BREEZE
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4. Financial and economic performance of selected fishing fleets in North and South America

Analysis of the costs and earnings data of 21 of the main fishing fleet segments in the Americas showed that 81 percent of the types of vessels had a positive gross cash flow, meaning that revenues from landings were larger than the total gross costs. Three Brazilian fleet segments (longline freezer vessels and shrimp trawlers) and the Peruvian hake trawlers experienced negative cash flows in 2018. In the other fleet segments covered in this review, there may have been individual fishing vessels with negative cash flows, but on average vessels in these fleet segments were profitable. For some fleet segments a large variation in cash flow figures could be observed between vessels that had operated throughout the year and those that missed some part of the fishing season. For example, a Chilean longliner and a southern purse seine vessel were not operating for some time in 2018, which affected their level of earnings.

To assess the economic and financial performance of the fishing vessels in the 21 fleet segments seven indicators were used:

	Indicators
1	Net cash flow = revenue from landings – total gross costs
2	Net profit before taxes = gross profit – interest
3	Net profit margin (NPM) = net profit before taxes/revenue from landings
4	Return on fixed tangible assets (ROFTA) = net profit before taxes/value of tangible assets
5	Return on investment (ROI) = net profit before taxes/value of tangible and intangible assets
6	Gross value added (GVA) = net cash flow + labour costs
7	GVA to revenue = GVA/revenue from landings

The net cash flow (NCF) can be regarded as an award for entrepreneurship. A net profit margin higher than 20 percent is often considered good, while 10 percent is regarded as average in many industries.[3] The net profit margin is a measure of profitability after all costs have been accounted for and reflects the percentage of revenue that a vessel owner retains as profit. In this analysis it is used to measure the relative performance of a fishing vessel segment compared to other vessel segments or other activities in the economy as it provides an indication of the vessel segment's operating efficiency as it captures the amount of surplus generated per unit of production.[4]

The return on fixed tangible assets (ROFTA) indicator provides a useful measure for the return on capital. The return on investment (ROI) is the most commonly used indicator for financial performance. For the ROI any percentage higher than 10 percent is generally considered good, however in some other sectors only ROI percentages of 12 percent to 15 percent and higher are considered good.

3 https://corporatefinanceinstitute.com/resources/knowledge/accounting/profit-margin/
4 https://stecf.jrc.ec.europa.eu/documents/43805/1489224/2016_AER_6_METHODOLOGY.pdf

There exists a large variation in depreciation rates applied by the fishing vessels surveyed, which is due to a large extent by the fact that parts of the tangible assets are of a different age (e.g. engines, navigation and on-deck equipment). Detailed information on amortization of loans, interest payment and the value of intangible assets was not available for most of the vessels. The ROI was calculated (for the overview in Table 2) over the initial investment and not over the sum of the prevailing value of the tangible plus intangible assets. The consequence is that both ROFTA and ROI are different in this section of the paper compared to the country papers, even when no information was available on intangible assets.

The gross value added (GVA) figure is perhaps of less importance to individual vessel owners, but is an important figure for fisheries policy and decision makers. It shows what the fishing vessel operations contribute to the economy, and is useful for making future fisheries sector investment and expenditure decisions. The GVA to revenue figure is expressed as percentage and provides for the share of revenue that contributes to the economy through the production factors (in this case mainly labour).

TABLE 2
Financial and economic performance of the various types of vessels covered in this review.[5]

	Indicators	Net cash flow	Net profit margin	Return on fixed tangible assets (ROFTA)	Return on investment (ROI)	Gross value added (GVA)	GVA to revenue
		Thousands of USD	%	%	%	Thousands of USD	%
United States of America	West Coast large non-whiting groundfish trawl vessel	175	3%	1%	1%	503	56%
	West Coast small non-whiting groundfish trawl vessel	26	-16%	-4%	-4%	166	44%
	West Coast whiting trawl vessel	364	3%	1%	1%	849	59%
	Northeast scallop dredger – full-time	314	9%	31%	3%	1 037	73%
	Northeast scallop dredger – part-time	82	-1%	-2%	0%	379	51%
	Gulf of Mexico shrimp trawl vessel	62	11%	16%	16%	156	42%
	Hawaii pelagic longline vessel	100	7%	9%	9%	259	35%
Brazil	Northeast region tuna long line vessel -ice fresh	153	33%	131%	46%	213	51%
	Northeast region tuna long line vessel -frozen -30 degrees	-89	-26%	-78%	-27%	9	2%
	northeast region tuna long line vessel -frozen -35 degrees	-83	-18%	-54%	-19%	99	16%
	South region shrimp trawler	-37	-28%	-42%	-8%	34	17%
	South region demersal trawler	100	11%	56%	11%	254	37%
	South region bottom trawler	99	9%	78%	12%	164	35%
Chile	Longline vessel	1 062	16%	59%	21%	3 063	47%
	Trawler	260	0%	0%	0%	1 923	42%
	Industrial purse seiner	5 144	43%	134%	30%	6 086	61%
	Artisanal purse seiner	102	56%	45%	52%	118	65%
	Southern purse seiner	1 769	8%	9%	3%	2 844	31%
Peru	Anchovy/chub mackerel purse seiner	909	18%	13%	12%	1 629	49%
	Jumbo squid hook & line fishing vessel	116	49%	72%	92%	147	70%
	South Pacific hake trawler	-91	-40%	-52%	-26%	-5	-2%

5 The ROI in Table 2 was calculated based on initial investment costs for South America fleets and the Hawaii longline fleet, and was based on mean market value for the remaining North America fleets.

Seventeen (81 percent) of the 21 fleet segments included in the review study had positive cash flows. The average net profit margin of the fishing fleet segments covered in this review showed large variations ranging from 40 percent negative (Peruvian hake trawlers) to 56 percent positive (Chilean artisanal purse seiners). Only 38 percent of the fleet segments included in this analysis showed net profit margins of more than 10 percent.

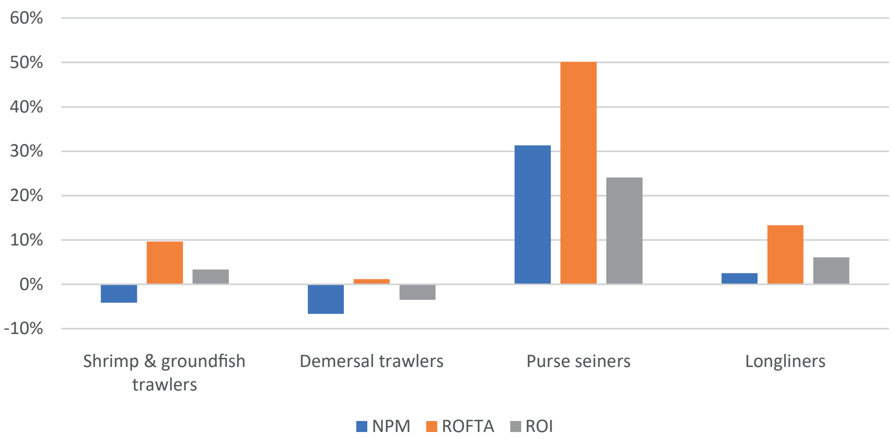
Two-thirds (67 percent) of the fleet segments covered in the review reported positive results in terms of their capital productivity, as the ROFTA was positive. Fifty-two percent of the fishing fleet segments showed ROFTAs of 10 percent and higher.

Five fleet segments showed negative return on investment (ROI) percentages. In particular three Brazilian fleets appear to show negative ROIs, as well as the Peruvian hake trawlers and the United States West Coast small non-whiting groundfish trawlers. In addition, some 29 percent of the vessel segments covered in this review demonstrated rather low but still positive ROIs of less than 10 percent. On the other hand, 24 percent of the fleet segments showed ROIs of twenty percent or more, indicating very good financial and economic results of these fleets. A majority of the Chilean and Peruvian fleet segments had good ROIs of ten percent or higher in 2018.

The average GVA to revenue indicator of all 21 fleet segments analysed was 41 percent, which shows that the gross value added by the fishing fleet segments was significant. The GVA to revenue indicator ranged from a negative of two percent for the Peruvian hake trawlers to a high of 73 percent for the United States Northeast scallop dredger (full-time).

Figure 5 shows some of the financial performance indicator averages per common fishing vessel type in the North and South American region. The averages were calculated based on fleet segments of similar vessel types of the four countries covered in this study. On average, the highest performance figures were realized by the purse seiners, while the demersal trawlers reported negative average figures for two of the three indicators.

FIGURE 5
Financial performance averages by common fishing fleet segments



Comparing the 2018 financial and economic performance results of some of the Peruvian fishing fleet segments with the findings of the 2002–03 review study, it is clear that the net cash flow generated by the anchovy/chub mackerel purse seiners has increased tremendously from some USD 362 000 to USD 909 000. The ROI of these vessels was slightly lower in 2018 than in 2003, with 12 percent against 16 percent in 2003, but it was still nicely above ten percent. In comparison, the hake trawlers, which presented in 2003 already a very small ROI of one percent and a net cash flow of USD 8 700 saw a further deterioration of performance since and consequently negative figures in 2018.

Overall, the performance of the main fishing fleets covered in this regional review showed mixed results. Many fleet segments presented negative to slightly positive financial figures. The number of vessels fishing for some of the fisheries resources (e.g. hake) may be too high for individual vessel owners to maintain profitable fishing operations. The increase in fishing fleet capacity in Brazil and Peru over the last two decades appears to have negative consequences for the financial and economic performance of some of the main fishing fleets in these countries. Some of the fleet segments could improve their performance by a more adequate matching of fishing fleet capacity with the fisheries resources status, supported by adaptive fisheries management.

REFERENCES

Carvalho, N., Van Anrooy, R., Vassdal, T. and Dağtekin, M. 2020. *Techno-economic performance review of selected fishing fleets in Europe.* FAO Fisheries and Aquaculture Technical Paper No. 653/1. Rome, FAO. www.fao.org/documents/card/en/c/ca9188en

FAO. 1999. *Economic viability of marine capture fisheries.* Lery, J-M., Pado, J., & Tietze, U. FAO Fisheries Technical Paper No. 377. Rome.

FAO. 2001. *Techno-economic performance of marine capture fisheries.* Tietze, U., Prado, J., Lery, J-M., & Lasch, R. FAO Fisheries Technical Paper No. 421. Rome. www.fao.org/docrep/004/Y2786E/Y2786E00.htm

FAO. 2019. *Report of the Expert Meeting on Methodologies for Conducting Fishing Fleet Techno-Economic Performance Reviews, Chennai, India, 18-20 September 2018.* FAO Fisheries and Aquaculture Report No. 1243. FAO. 2019. www.fao.org/3/ca4427en/ca4427en.pdf

Tietze, U., Thiele, W., Lasch, R., Thomsen, B., & Rihan, D. 2005. *Economic performance and fishing efficiency of marine capture fisheries.* FAO Fisheries Technical Paper No. 482. Rome, FAO. www.fao.org/docrep/008/y6982e/y6982e00.htm

National reports

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Report of the United States of America

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National report for the United States of America

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1. OBJECTIVES AND CONTEXT

The economic performance of fishing fleets in the United States of America (US) has not been analysed in previous Food and Agriculture Organization (FAO) reports. In this report, seven fishing fleets from the US are profiled. These seven fleets are economically important to the US fishing industry and are geographically diverse. There are certainly other economically important fishing fleets and regions that are not included in this report, which is mostly due to data limitations. An overview of the entire United States commercial fishing industry can be found in the Fisheries Economics of the United States Annual Report. While the seven fleets described here are not a complete accounting of the financial and technological characteristics of the United States fishing industry, they do serve as useful examples of some important fleets from the United States. The seven fleets are:

1. West Coast groundfish trawl catch share program – large non-whiting groundfish trawl vessels
2. West Coast groundfish trawl catch share program – small non-whiting groundfish trawl vessels
3. West Coast groundfish trawl catch share program – whiting trawl vessels
4. Northeast limited access scallop dredge – full-time
5. Northeast limited access scallop dredge – part-time
6. Gulf of Mexico shrimp trawl vessels
7. Hawaii pelagic longline vessels

The United States produced approximately 5.4 percent of the global capture fisheries production in 2016, and is therefore included in the global fishing fleet performance assessment of FAO.

2. CHARACTERISTICS OF FISHING FLEETS OPERATING IN THE UNITED STATES OF AMERICA

Information about fishing fleet characteristics are based on the most recent data available at the time of writing. That is, 2018 for the Hawaii pelagic longline and Gulf of Mexico shrimp trawl fleets, 2017 for the West Coast groundfish catch share program fleets, and fishing year 2016 (ended Feb 2017) for the Northeast limited access scallop dredge fleets.

[1] NOAA, National Marine Fisheries Service, Office of Science and Technology.
[2] NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center.
[3] NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center.
[4] NOAA, National Marine Fisheries Service, Pacific Islands Fisheries Science Center.
[5] NOAA, National Marine Fisheries Service, Northwest Fisheries Science Center.

West Coast groundfish trawl catch share program (WCCSP)

In 2011, the West Coast Limited Entry Trawl Fishery transitioned to a catch share program. The catch share program includes an individual fishing quota (IFQ) program for vessels that deliver groundfish to shore-based processors and an association of vessels (called a cooperative) that deliver while at sea to floating processors. A catcher-processor fleet also operates as part of the catch share program, but is not part of this report. Fishing occurs in the eastern Pacific Ocean, off the coast of Oregon, Washington, and California. Under the IFQ program, annual allocations of target and bycatch species are assigned to quota share permits that must be transferred to vessels in the form of "quota pounds." Once converted to quota pounds, they can be transferred between vessels. Under the at-sea cooperative program, target and bycatch species are allocated to permits annually and each permit owner must obligate their quota to a mothership vessel before fishing.

Program participants are divided into three fleets, whiting vessels, small groundfish vessels, and large groundfish vessels. All vessels that deliver Pacific whiting (at-sea or shore-side) are classified as whiting vessels, vessels that deliver non-whiting groundfish are split into small and large trawlers, based on their annual ex-vessel revenue. Some vessels fish for both Pacific whiting and non-whiting groundfish, for the purposes of this analysis, these participants are classified as whiting vessels. Vessels in the catch share program also participate in non-federally managed fisheries including crab, salmon, and shrimp and some vessels also fish in the Gulf of Alaska. For this report, we include the other fisheries in the Eastern Pacific Ocean, but exclude Gulf of Alaska activities. All data provided are from fishing in 2017.

The following fisheries legislation and regulations are some of the most notable and govern the operations and developments of these fishing fleets:

1. Magnuson-Stevens Fishery Conservation and Management Act
2. Title 50: Wildlife and Fisheries; part 660 – fisheries off west coast states; Subpart D – West Coast Groundfish – Limited Entry Trawl Fisheries
3. Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery

For more information about the history of the program and the associated regulations, see Warlick et al. (2018).

The West Coast groundfish trawl catch share program is part of the Pacific Coast Groundfish Fishery Management Plan (FMP) that also includes several other federally managed fisheries. The FMP includes close to 100 species with various life histories and, in addition to the catch share program, management tools include time and area closures.

Recently, the Pacific Fishery Management Council took action to amend the FMP to change the configuration of areas closed to bottom-impact gear and to allow vessels to carry multiple trawl gears on-board (pelagic and demersal nets). Other regulations currently in development include provisions to remove certain restrictions to net configurations, allow year-round fishing with pelagic trawl nets, and allow all vessels in the program to opt into an electronic-monitoring program in-lieu of observer coverage for compliance monitoring.

Northeast limited access scallop dredge fishery

The sea scallop fishery is one of the most economically important fisheries in the Northeast period Management of the fishery is complex, but the vast majority of catch is from the "limited access" fleet.[6] This fleet is allocated days-at-sea (DAS) during

[6] ~95 percent of sea scallops were harvested by the "Limited Access" fleet in recent fishing years. Virtually all of the remaining scallop landings were from vessels operating under Individual Fishing Quotas (IFQs).

which vessels are allowed to fish for scallops in a fishing year. The fleet characteristics portion of this profile covers information from the 2016 scallop fishing year, which ran from March 2016 to February 2017.

The limited access fleet is subdivided between "full-time" and "part-time" vessels, with full-time vessels being allocated more DAS in a fishing year. Allocations in the 2016 fishing year were 34.55 DAS for each full-time vessel and 13.82 DAS for each part-time vessel.[7] As a result, the full-time fleet was more reliant on sea scallops for fishing revenue. The full-time fleet had 313 active vessels in the 2016 fishing year, while the part-time fleet had 35 active vessels.[8] Both fleets operate on an industrial scale and fish in the Northwest Atlantic (FAO major fishing area 21). The main fishing harbors where seafood is landed are located primarily in Massachusetts, New Jersey, and Virginia (Table 1). The main species targeted by each fleet are listed in Table 2. These target species were identified using data collected by at-sea observers. Fishing vessel operators were asked what species they will be targeting on a trip. At-sea observers were present on ~ 10 percent of limited access scallop fishing trips during the 2016 fishing year.

The Atlantic Sea Scallop Fishery Management Plan (FMP) was implemented by the New England Fishery Management Council in 1982. The plan was established to achieve, among other things, a restoration of the adult scallop stock, and a reduction in year-to-year fluctuations in stock abundance. Since then, this FMP has been amended a number of times. The following amendments to the FMP are some of the more notable in terms of governing the operations and developments of the limited access scallop fishing fleet:

1. Amendment 4 to the Sea Scallop FMP (NEFMC 1994):[9] implemented limited access in the fishery in 1994. Qualifying vessels for limited access were divided between full and part-time based on their level of effort during the qualification period. Since Amendment 4, the number of vessels active in the fishery has had limited variability. Year-to-year fluctuations in effort are mainly a function of changes in days-at-sea allocations and "access area" trips allowed (see 2).
2. Amendment 10 to the Sea Scallop FMP (NEFMC 2004):[10] implemented rotational "access area" management in 2004. This action had a significant impact on how the scallop fishery operates. Rather than only being allocated days-at-sea that could be fished anywhere, the fleet now was allocated trips to access areas. These access areas are closed to fishing for a period of time to allow scallops to grow. Once scallops reach large sizes, the scallop fleet is allocated a certain number of trips in a fishing year to harvest in the access areas.

There are no imminent regulatory changes that would significantly alter the makeup of the limited access scallop fleet. All full-time vessels receive the same number of DAS and access area trips in a given fishing year. Likewise, all part-time vessels receive the same allocations as each other in a given fishing year (though smaller allocations than the full-time fleet). Given the high price of sea scallops, and a healthy scallop stock, utilization rates of DAS and access area trips among full-time and part-time vessels is high. Likewise, the vast majority of vessels with limited access scallop permits participate in the fishery in a given year.

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7 In addition to DAS allocations, the full-time and part-time limited access scallop fleet are allocated quota to "access areas" in which DAS management does not apply. Access area allocations were 51 000 lbs. for full-time vessels and 20 400 lbs. for part-time vessels in the 2016 fishing year.

8 An active vessel is defined as having any amount of commercial landings of any species.

9 NEFMC (New England Fishery Management Council). 1994. "Amendment 4 to the Atlantic Sea Scallop Fishery Management Plan." Newburyport, MA

10 NEFMC (New England Fishery Management Council). 2004. "Amendment 10 to the Atlantic Sea Scallop Fishery Management Plan." Newburyport, MA

Gulf of Mexico Shrimp Trawl Vessels

The commercial shrimp fishery in the Gulf of Mexico (GOM) is one of the most economically important fisheries in the southeast region, targeting three major species of shrimp (brown shrimp, white shrimp, and pink shrimp). Broadly, the Gulf's shrimp fleet consists of an inshore segment, which is very diverse and only active in state waters (of Florida, Alabama, Mississippi, Louisiana, Texas), and an offshore segment, which is largely active in United States federal waters and almost always uses otter trawl gear. We delineate the two segments through ownership of the federal shrimp permit. The fleet characteristics portion of this profile covers information from 2018.

The commercial shrimp fleet that operates in federal waters of the Gulf is managed under the Gulf of Mexico Shrimp Fishery Management Plan, and a limited-access permit is required to harvest shrimp in federal/U.S. EEZ waters. The federally-permitted Gulf of Mexico shrimp fleet consists predominantly of larger otter-trawl vessels that specialize on shrimp harvesting. Vessels go on multi-week trips, freezing product as it is harvested. Most vessels operate exclusively in the Gulf of Mexico shrimp fishery.

As the shrimp resources are mostly an annual crop, the fishery management focuses largely on bycatch reduction of sea turtles and larger finfish, which requires the use of turtle excluder devices and bycatch reduction devices. Each state has further regulation. For example, Texas uses time-area closures which are intended to maximize economic benefits by allowing shrimp to grow to larger sizes and obtain higher market prices on a per pound basis. Due to a drop in real shrimp prices (due to growing imports of farmed shrimp), the Gulf of Mexico shrimp fishery has substantially consolidated since 2000. Frequent major hurricanes and, in 2010, the BP Deep Water Horizon oil spill and related responses have further materially affected the fishery in recent years.

There are no major regulatory changes anticipated for the Gulf of Mexico shrimp trawl fleet.

Hawaii pelagic longline vessels

A large majority of the United States pelagic longline fishery in North Pacific is based in Hawaii. The Hawaii pelagic longline fleet operates under a limited entry program established in 1993, which allowed a total of 164 permits in the fishery. The Hawaii pelagic longline is the largest fishery under management by the Western Pacific Fishery Management Council. The number of active vessels/permits was 142 in 2018. The fleet harvests multiple pelagic species. Vessels perform two types of fishing: setting the gear in shallower water to target swordfish or setting the gear in deeper water to target bigeye tuna (Table 2). Prior to the year 2000, swordfish was the top species landed by the Hawaii pelagic longline fleet. Since swordfish fishing was constrained by regulations for sea turtle conservation, many Hawaii pelagic longline fishers switched to targeting bigeye tuna. Bigeye tuna became the primary species since 2000, and bigeye landings accounted for 64 percent of the total revenue and 49 percent of the total commercial landings in 2018. This was followed by yellowfin tuna and swordfish comprising 18 percent and 7 percent of the total revenue, respectively. The fleet characteristics portion of this profile covers information from 2018.

The Hawaii pelagic longline fleet is subject to a suite of rules and regulations. The discussion here focuses on three since they impose substantial constraints to the fishery: 1) annual limits on interactions with sea turtles, 2) annual catch limits of bigeye tuna, and 3) area closures.

The annual interaction limits of sea turtles only applies to the shallow-set gear (fishing for swordfish). The Hawaii shallow-set longline fishery was regulated by sea turtle interaction caps of 26 leatherback turtles and 34 loggerhead turtles (in 2018). If either limit is determined to have been reached, the Hawaii based shallow-set longline fishery is immediately closed. When closed, Hawaii longline vessels are prohibited from shallow-set fishing north of the equator for the remainder of the calendar year. The shallow-set fishery is subject to 100 percent observer coverage, and all sea turtle interactions are recorded and reported to NMFS. Interaction limits and monitoring are updated regularly.[11] Recent levels of catch and effort from the swordfish fishery is significantly lower than historical levels, since the implementation of regulations on annual interaction limits for sea turtles. The annual interaction limits were adjusted four times during the 2004–2018 period, with an average limit of 21 interactions for leatherback and 27 for loggerhead. The actual interactions were lower than the caps, with an average of seven leatherback interactions and 12 loggerhead interactions per year. Currently, the Council is proposing a new set of management rules for sea turtle conservation consistent with the reasonable and prudent measures and terms and conditions contained in a 2019 biological opinion (2019 BiOp) NMFS prepared for the fishery. The 2019 BiOp includes a new population vulnerability assessment (PVA) indicating that the North Pacific loggerhead population exhibit a long-term increasing trend at a mean estimated population growth rate of 2.4 percent, and the western Pacific leatherback turtle population exhibit a long-term declining trend at a mean estimated population growth rate of -5.3 percent.

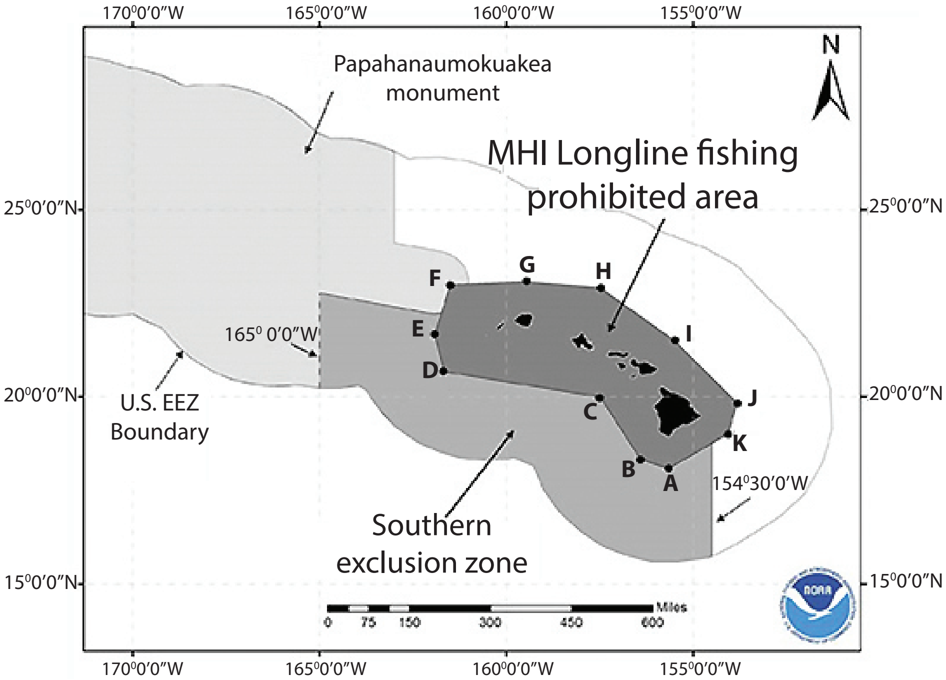
The main target species of the Hawaii pelagic longline fleet is bigeye tuna which is regulated by fleet-wide annual catch limits assigned by Regional Fishery Management Organizations (RFMOs). The Hawaii pelagic longline fleet has two separate bigeye catch limits, one in the western and central Pacific Ocean (WCPO) area and the other in the Eastern Pacific Ocean (EPO) area. In 2018, the bigeye tuna catch limit in WCPO for the United States longline fishery was 3 554 metric tonnes and the bigeye tuna catch limit in EPO was 750 tonnes for all United States vessels greater than 24 m (vessels equal to or under 24 m are not subjected to any catch limit). Area limits are updated regularly and posted to www.fisheries.noaa.gov/pacific-islands/commercial-fishing/pacific-islands-annual-catch-limits. When either of the catch limits are met, the associated area (WCPO or EPO) is closed to deep-set fishing (for tuna).

The fishing grounds of the Hawaii pelagic longline fleet has been mostly limited to the high sea areas outside of the Hawaii EEZ. The majority of Hawaii EEZ waters surrounding the Hawaiian Archipelago, including the inhabited main Hawaiian Islands (MHI) and the uninhabited Northwestern Hawaiian Islands (NWHI), used to be accessible to the Hawaii pelagic longline fleet. However, since 15 June 2006, the North-western Hawaiian Islands Marine National Monument (Papahānaumokuākea) was established and later expanded out to 200 nautical miles within federal waters in 2010. All commercial fishing was eliminated inside the Monument since 2010. The monument is the largest contiguous fully protected conservation area in the United States and one of the largest marine conservation areas in the world. The Southern Exclusion Zone (SEZ), a management area in the MHI was created for the conversation of false killer whale. The SEZ closes to deep-set longline fishing if, in a given year, the fishery has two observed false killer whale interactions in United States waters around Hawaii (i.e., Hawaii EEZ) that NOAA Fisheries scientists determine as deaths or have resulted in "serious injuries." In 2018, the SEZ was closed to the deep-set fishing (for tuna) trips from 24 July 2018 to 31 December 2018.[12] The map below shows the areas of the Monument of the NWHI and the SEZ in MHI.

11 Updates are posted on www.fisheries.noaa.gov/pacific-islands/bycatch/sea-turtle-interactions-hawaii-shallow-set-longline-fishery

12 On February 22, 2019, NMFS closed the SEZ following one observed mortality and one observed serious injuries to false killer whales in the deep-set fishery in January 2019. The area will remain closed until certain pre-set criteria have been met; (1) after consideration of the Team's recommendations and evaluation of all relevant circumstances, it is determined that reopening of the SEZ is warranted; (2) in the 2-year period following SEZ closure, there are zero observed false killer whale M&SI in the EEZ; (3) in the 2-year period following the SEZ closure, the fishery reduces its total M&SI rate by an amount equal to or greater than the rate required to reduce M&SI within the EEZ to below the pelagic stock's potential biological removal; or (4) the average estimated level of false killer whale M&SI in within the EEZ for the 5 most recent years is below the pelagic stock's potential biological removal.

FIGURE 1
Map of the Hawaii Pelagic Longline Exclusion Areas



Data source: www.fisheries.noaa.gov/pacific-islands/marine-mammal-protection/frequently-asked-questions-about-2019-southern-exclusion

Beside the possible changes in the sea turtle caps currently under discussion by the fishery management council, there are no major regulatory changes anticipated for the Hawaii pelagic longline fleet in the next couple of years.

TABLE 1
Overview of main fishing fleets

Fishing fleet listed by gear name	Number of vessels	Scale	FAO fishing area	Main fishing ports (ranked by value)	Season
WCCSP – Large groundfish trawler	34	Industrial	(North-eastern part of the Pacific Ocean – area 67) and the Eastern Central part of the Pacific ocean (Area 77)	Astoria, Newport, Coos Bay, Eureka, South and central WA coast, Brookings, Puget Sound	Year-round
WCCSP – Small groundfish trawler	20	Industrial	67/77	Coos Bay, San Francisco, Astoria, Morro Bay, Newport, Fort Bragg, Brookings	Year-round
WCCSP – Whiting trawler	32	Industrial	67/77	Astoria, Newport, Seattle	April/May-end of year
Northeast limited access scallop dredge (full-time)	313	Industrial	Northwest Atlantic (Area 21)	New Bedford, MA, Cape May, NJ, Newport News, VA, Fairhaven, MA, Seaford, VA	Year-round
Northeast limited access scallop dredge (part-time)	35	Industrial	Northwest Atlantic (Area 21)	Cape May, NJ, Point Pleasant, NJ, New Bedford, MA, Hampton, VA, Barnegat Light, NJ	Year-round
Gulf of Mexico shrimp trawl vessels	1 043	Industrial	Gulf of Mexico (in Area 31 – Western Central Atlantic)	Bayou La Batre, AL Port Arthur, TX Palacios, TX Port Isabel, TX Abbeville, LA Brownsville, TX	Year-round
Hawaii pelagic longline vessels	142	Industrial	67/77	Honolulu, HI	Year-round

TABLE 2
Main species targeted by fishing fleet (ranked from 1 to 5)

Fleets/species targeted	1	2	3	4	5
WCCSP – Large groundfish trawler	Sablefish, *Anoplopoma fimbria*	Crab, *Metacarcinus magister*	Dover sole, *Microstomus pacificus*	Petrale sole, *Eopsetta jordani*	Shrimp, *Pandalus jordani*
WCCSP – Small groundfish trawler	Crab, *Metacarcinus magister*	Sablefish, *Anoplopoma fimbria*	Shrimp, *Pandalus jordani*	Petrale sole, *Eopsetta jordani*	Dover sole, *Microstomus pacificus*
WCCSP – Whiting trawler	Pacific whiting, *Merluccius productus*	Crab, *Metacarcinus magister*	Widow rockfish, *Sebastes entomelas*	Yellowtail rockfish, *Sebastes flavidus*	
Northeast limited access scallop dredge (full-time)	Sea Scallops *Placopecten magellanicus*	Summer Flounder *Paralichthys dentatus*	Loligo Squid *Dorytheuthis (amerigo) pealeii*		
Northeast limited access scallop dredge (part-time)	Sea Scallops *Placopecten magellanicus*	Summer Flounder *Paralichthys dentatus*	Loligo Squid *Dorytheuthis (amerigo) pealeii*		
Gulf of Mexico shrimp trawl vessels	Brown shrimp *Farfantepenaeus aztecus*	White shrimp *Litopenaeus setiferus*	Pink shrimp *Farfantepenaeus duorarum*	Royal red shrimp *Pleoticus robustus*	
Hawaii pelagic longline vessels	Bigeye tuna, *Thunnus obesus*	Swordfish, *Xiphias gladius*			

The main species commonly caught by each fleet (in terms of commercial value generation) are listed in Table 3.

West Coast groundfish trawl catch share program

Outside of participation in the catch share program, large West Coast groundfish trawlers also participate in the Dungeness crab and pink shrimp fisheries and fish in Alaska. The small groundfish trawlers also fish for crab and shrimp, but do not fish in Alaska. Many of the vessels in the whiting vessel fleet also fish for walleye pollock *Gadus chalcogrammus* in the Bering Sea and Gulf of Alaska, but this portion of their activities is not included in this report. Prior to the introduction of the catch share program, vessel-specific regulatory limits based on landings instead of catch resulted in the discard of nearly 30 percent of all catch. Discards decreased dramatically with the introduction of a catch share program in 2011, dropping by as much as 97 percent for some species and now consist of mostly unmarketable and low value fish (Somers *et al.*, 2019). The citation is already in the literature list. The crab fishery has mandatory live discard of all females and sub-legal size males.

Northeast limited access scallop dredge fishery

In terms of commercial value generation, sea scallops comprise the vast majority of revenue (97 percent) for the full-time limited access fleet. For the part-time fleet, revenue is more diversified, with sea scallops comprising 68 percent of total revenue. Revenue dependence on sea scallops between the two fleets is driven largely by differences in input regulations. The main species discarded at sea by fleet are presented in Table 4. The main reasons for discarding these species are catch of under-sized fish/shellfish or unmarketable fish/shellfish.

Gulf of Mexico shrimp trawl vessels

The federally permitted Gulf of Mexico shrimp fleet consists predominantly of larger otter-trawl vessels that specialize on shrimp harvesting. Overall, brown and white shrimp are the predominant species caught, with pink shrimp a distant third. However, there are strong regional differences, e.g., south Florida specializing on pink shrimp and a niche product caught in deeper waters off the coast of Alabama is royal red shrimp. Bycatch in bottom trawling fishery is significant in quantity, consisting of small and juvenile finfish of many species, shrimp, and other invertebrates.

Hawaii pelagic longline vessels

The Hawaii pelagic longline fleet typically discards sharks and lancetfish, because they are not commonly used for human consumption and thus little economic value can be generated from these species.

TABLE 3
Main species commonly caught by fleet (ranked from 1 to 5 in value)

Fleets/species commonly caught	1	2	3	4	5
WCCSP – Large groundfish trawler	Dover sole, *Microstomus pacificus*	Shrimp, *Pandalus jordani*	Sablefish, *Anoplopoma fimbria*	Petrale sole, *Eopsetta jordani*	Crab, *Metacarcinus magister*
WCCSP – Small groundfish trawler	Shrimp, *Pandalus jordani*	Dover sole, *Microstomus pacificus*	Sablefish, *Anoplopoma fimbria*	Crab, *Metacarcinus magister*	Petrale sole, *Eopsetta jordani*
WCCSP – Whiting trawler	Pacific whiting, *Merluccius productus*				
Northeast limited access scallop dredge (full-time)	Sea Scallops *Placopecten magellanicus*	Loligo Squid *Doryteuthis (amerigo) pealeii*	Summer Flounder *Paralichthys dentatus*	Black Sea Bass *Centropristis striata*	Monkfish *Lophius americanus*
Northeast limited access scallop dredge (part-time)	Sea Scallops *Placopecten magellanicus*	Summer Flounder *Paralichthys dentatus*	Menhaden *Brevoortia tyrannus*	Loligo Squid *Doryteuthis (amerigo) pealeii*	Brown Shrimp *Farfantepenaeus aztecus*
Gulf of Mexico shrimp trawl vessels	Brown shrimp *Farfantepenaeus aztecus*	White shrimp *Litopenaeus setiferus*	Pink shrimp *Farfantepenaeus duorarum*	Royal red shrimp *Pleoticus robustus*	
Hawaii pelagic longline vessels	Bigeye tuna *Thunnus obesus*	Yellowfin tuna *Thunnus albacares*	Swordfish *Xiphias gladius*	Opah *Lampris guttatus*	Pomfrets *Taractichthys steindachneri*

TABLE 4
Main species discarded at sea by fleet (ranked from 1 to 5 by weight)

Fleets/species discarded at sea	1	2	3	4	5
WCCSP – Large groundfish trawler	Arrowtooth flounder, *Atheresthes stomias*	Crab, *Metacarcinus magister*	Pacific whiting, *Merluccius productus*	Rex sole, *Glyptocephalus zachirus*	Spiny dogfish shark, *Squalus acanthias*
WCCSP – Small groundfish trawler	Arrowtooth flounder, *Atheresthes stomias*	Big skate, *Raja binoculata*	Crab, *Metacarcinus magister*	Longnose skate, *Raja rhina*	Pacific whiting, *Merluccius productus*
WCCSP – Whiting trawler[14]	Arrowtooth flounder, *Atheresthes stomias*	Pacific halibut, *Hippoglossus stenolepis*	Pacific whiting, *Merluccius productus*	Spiny dogfish shark, *Squalus acanthias*	Spotted ratfish, *Hydrolagus colliei*
Northeast limited access scallop dredge (full-time)	Sea Scallops *Placopecten magellanicus*	Little Skate *Leucoraja erinacea*	Monkfish *Lophius americanus*	Spiny Dogfish *Squalus acanthias*	Winter Skate *Leucoraja ocellata*
Northeast limited access scallop dredge (part-time)	Little Skate *Leucoraja erinacea*	Spiny Dogfish *Squalus acanthias*	Sea Scallops *Placopecten magellanicus*	Black Sea Bass *Centropristis striata*	Scup *Stenotomus chrysops*
Gulf of Mexico shrimp trawl vessels	Atlantic croaker *Micropogonias undulatus*	Sea trout *Cynoscion nebulosus*	Longspine porgy *Stenotomus caprinus*	Portunid crabs	Mantis shrimp
Hawaii pelagic longline vessels (sharks ordered by number of fish)	Lancetfish, *Alepisaurus ferox*	Blue shark *Prionace glauca*	Mako shark *Isurus oxyrinchus*	Thresher shark *Alopias*	Oceanic whitetip shark *Carcharhinus longimanus*

Table 5 provides an overview of the age structure of the vessels in the main fishing fleets.

[14] Excludes species caught off the coast of Alaska.

West Coast groundfish trawl catch share program

The average age of the fleet is 40 years and only four vessels are less than 20 years old, all of which are in the non-whiting groundfish fleets.

Northeast limited access scallop dredge fishery

For both the full-time and part-time scallop fleets, the majority of vessels are over 20 years old. The lifetime of scallop vessels is extended in part by the limited number of days allocated to fish in a year. All of the vessels built in the last 10 years are active in the full-time fleet.

Gulf of Mexico shrimp trawl vessels

The average age of the fleet is 30 years and very few vessels have been replaced since the beginning of the millennium. The year 2000 was the last highly profitable year in the fishery.

Hawaii pelagic longline vessels

In 2018, the average vessel age of the Hawaii pelagic longline fleet was 31 years, while the youngest and oldest vessel were 5 and 51 years, respectively.

TABLE 5
Average age of fishing vessels by fleet in years (in percentages)

Fleets/average age of vessels in percentages of total fleet size	0–5 years	5–10 years	10–15 years	15–20 years	more than 20 years	Unknown
WCCSP – Large groundfish trawler	2%	2%	4%	0%	92%	0%
WCCSP – Small groundfish trawler	0%	0%	2%	2%	86%	10%
WCCSP – Whiting trawler	0%	0%	0%	0%	100%	0%
Northeast limited access scallop dredge (full-time)	4%	4%	12%	9%	71%	0%
Northeast limited access scallop dredge (part-time)	0%	0%	14%	20%	66%	0%
Gulf of Mexico shrimp trawl vessels	1%	1%	1%	23%	74%	0%
Hawaii pelagic longline vessels	1%	0%	2%	8%	89%	0%

Employment in US commercial fishing

Accurate information about the number of people employed as fishing crew and captains is not available for US fishing fleets. However, estimates of employment generated by the commercial harvest sector are available from annual NOAA/NMFS publications. Information about employment specific to all profiled fleets is not available. Table 6 is a compilation of the employment estimates provided in the Fisheries Economics of the United States Report for 2016. The estimated number of jobs includes those in the commercial harvest sector only. The figures do not include subsistence fishers, recreational anglers, or jobs in the recreational for-hire sector. The number of jobs does include both full-time and part-time jobs. It is possible that one person could hold more than one part-time job so these figures do not represent the number of people employed. Further, the number of jobs presented in Table 6 includes not only crew and captains working on fishing boats, but also jobs generated by the harvest sector in other sectors of the economy. It is likely that the crew/captain jobs are a small portion of the overall jobs. Estimates of the number of crew/captain jobs alone are not available.

The total number of jobs generated by the commercial harvest sector for the nation as a whole in 2016 was about 167 000.[15] Over a five-year time frame from 2012–16, the total number of jobs ranged from a low of 164 000 in 2015 to a high of 198 000 in

[15] This number was estimated by a model at the national level. It is not the sum of individual state estimates, which would be an underestimate since cross-state interactions would be lost.

2013. The jobs estimate can fluctuate due to a number of factors, including changes in revenues received by commercial harvesters. The change in actual jobs from year to year, particularly the portion that are crew/captain jobs, is not known.

TABLE 6
Number of jobs (full or part-time), by State, generated by the commercial harvest sector in 2016

State	Number of jobs	State	Number of jobs
AK	33 414	MD	3 115
ME	18 927	NJ	2 935
LA	14 635	NC	2 500
MA	11 490	RI	2 316
West FL	7 158	AL	1 977
East FL	7 158	NY	1 591
WA	6 195	NH	890
VA	4 867	MS	841
OR	4 795	GA	472
TX	4 446	SC	441
CA	4 093	CT	403
HI	3 691	DE	190

3. TECHNO-ECONOMIC AND OPERATIONAL CHARACTERISTICS OF INDIVIDUAL FISHING UNITS

West Coast groundfish trawl catch share program

The large groundfish trawler fleet has an average length (LOA) of 19.7 m and a gross tonnage of 105.6 tonnes (see Table 7). The power of the main engines ranges between 268 kW and 564 kW. The average crew size is 2.9. The main fishing gears carried include: demersal trawl, pot, and shrimp trawl. In 2017, the number of days at sea per vessel ranged from 43 to 176 days. The average number of fishing trips in 2017 was 31, ranging from 13 to 53.

The small groundfish trawler fleet can be characterized by an average length (LOA) of 17.6 m and a gross tonnage of 74.5 tonnes. The power of the main engines ranges between 212 kW and 640 kW. The average crew size is 2.5. The main fishing gears carried include: pot, demersal trawl, shrimp trawl, and longline gear. The number of days at sea per vessel ranged in 2017 from 35 to 98 days. The average number of fishing trips in 2017 was 27, ranging from 14 to 44.

The vessels in the Whiting trawler fleet are much larger, with an average LOA of 26.5 m and a gross tonnage of 176.9 tonnes (see Table 7). The power of the main engines ranges between 420 kW and 1 889 kW. The average crew size is 3.2. The main fishing gear carried is midwater trawl gear. The number of days at sea per vessel ranged in 2017 from 43 days to 271 days. The average number of fishing trips in 2017 was 65, ranging from 24 to 104.

TABLE 7

Basic information about surveyed vessels (mean and median values)

Large groundfish trawler (2017)		**Mean**	**Median**
Length overall (meters)		19.7	20.3
Gross tonnage		105.6	107.5
Net tonnage		70.4	69
Total power of main engines (kW)		398	382
Crew size (persons)		2.9	3.0
Ownership	Company		
Days fishing at sea		101	94
Number of fishing trips		31	30
Fishing season (months)	12		

Small groundfish trawler (2017)		**Mean**	**Median**
Length overall (meters)		17.6	16.8
Gross tonnage		74.5	72.5
Net tonnage		52.5	50.5
Total power of main engines (kW)		364	345
Crew size (persons)		2.5	2.1
Ownership	Company		
Days fishing at sea		69	69
Number of fishing trips		27	25
Fishing season (months)	12		

Whiting trawler (2017)		**Mean**	**Median**
Length overall (meters)		26.5	25.8
Gross tonnage		176.9	188.5
Net tonnage		100.3	114
Total power of main engines (kW)		956.3	924.7
Crew size (persons)		3.2	3.0
Ownership	Company		
Days fishing at sea		174	182
Number of fishing trips		65	66
Fishing season (months)	7.5		

The main fishing gears employed while fishing for groundfish and whiting are demersal trawl, midwater trawl, and pots. Pots are also used for fishing in the crab fishery.

TABLE 8

Fishing methods employed (percentage of trips in 2017)

Fishing gears	**Large groundfish trawler**	**Small groundfish trawler**	**Whiting trawler**
Demersal trawl	61.1%	55.9%	7.1%
Midwater trawl	4.0%	0.0%	89.2%
Pot	17.4%	24.6%	3.7%
Shrimp Trawl	17.5%	18.0%	0.0%
Other	0.0%	1.5%	0.0%

TABLE 9

Labour employed in the West Coast groundfish trawl catch share program

Fleet	**Total number of crew and captain positions**
Large groundfish trawler	106
Small groundfish trawler	61
Whiting trawler	111

It was not possible to differentiate between full-time and part-time employment using the data available. However, based on information from social surveys conducted in 2012 and 2016, the majority of crew reported to have no other income sources outside of fishing.

TABLE 10
Age range of male[16] fishers, percent (number of observations)

Fleet	Under 30	30–49	50 +
Large groundfish trawler	11.1% (1)	11.1% (1)	77.8% (7)
Small groundfish trawler	16.7% (2)	58.3% (7)	25% (3)
Whiting trawler	11.8% (2)	35.3% (6)	52.9% (9)

Northeast limited access scallop dredge

The full-time limited access scallop fleet consisted of vessels with an average length (LOA) of 24 m (80 feet) and a gross tonnage of 148 tonnes (see Table 11). The power of the main engines averaged 589 kW (790 horsepower). The main fishing gear utilized were scallop dredges, with trawl gear occasionally used. The average crew size was seven during the 2016 fishing year. The average number of days at sea per vessel was 79 days and vessels did an average of 12 fishing trips during the year.

The part-time limited access scallop fleet consisted of vessels with an average length (LOA) of 20 m (67 feet) and a gross tonnage of 90 tonnes (see Table 11). The power of the main engines averaged 342 kW (459 horsepower). The main fishing gear utilized were scallop dredges and bottom trawls. The average crew size was five during the 2016 fishing year. The average number of days at sea per vessel was 91 days, and vessels did an average of 33 fishing trips during the year.

TABLE 11
Basic information of each fishing vessel surveyed (mean and median values)

Northeast limited access scallop dredge (2016)	Full-time (313 vessels)	Part-time (35 vessels)
Length overall (LOA)	Mean: 24 m Median: 25 m	Mean: 20 m Median: 22 m
Gross tonnage (GT)	Mean: 148 GT Median: 154 GT	Mean: 90 GT Median: 97 GT
Total power of main engines in kilowatts (kW)	Mean: 589 kW Median: 558 kW	Mean: 342 kW Median: 321 kW
fishing gear (see Table 8)	Primarily dredge, some trawl	Primarily dredge and bottom trawl
Crew size (persons)	Mean: 7 Median: 7	Mean: 5 Median: 5
Total days fishing at sea	Total: 24 661 Per vessel: 79	Total: 3 198 Per vessel: 91
Number of fishing trips	Total: 3 768 Per vessel: 12	Total: 1 160 Per vessel: 33
Fishing season (months)	Year-round, highest effort in May – August	Year round, highest effort in May – August

The main fishing methods that were employed are presented in Table 12. For the full-time fleet, dredge gear was used on 87 percent of fishing trips, while bottom trawl gear was used on 12 percent of trips. On one percent of trips, the vessel captain indicated another type of gear. For the part-time fleet, dredge gear was used on 57 percent of fishing trips, while bottom trawl gear was used on 35 percent of trips. On 8 percent of trips, the vessel captain indicated to have used another type of gear.

[16] Although there are a small number of women who fish on these vessels, age information is not available.

TABLE 12
Fishing methods employed (percentage of trips in 2016) by the Northeast limited access scallop dredge fleet divided by full-time and part-time fleet segments

Full-time fleet fishing gears	Percentage of trips used	Fishing gears	Percentage of trips used
Pots or creels	0	Pelagic trawl	0
Drift/fixed nets	0	Purse seine	0
Hooks and lines	0	Seine nets	0
Dredge	87	Beam trawl	0
Demersal trawl	12	Other	1
Mid water trawl	0		
Part-time fleet fishing gears	**Percentage of trips used**	**Fishing gears**	**Percentage of trips used**
Pots or creels	0	Pelagic trawl	0
Drift/fixed nets	0	Purse seine	0
Hooks and lines	0	Seine nets	0
Dredge	57	Beam trawl	0
Demersal trawl	35	Other	8
Mid water trawl	0		

In the Northeast region of the United States, surveys of commercial fishing crew were conducted in 2012 and in 2018–19. During the 2012 crew survey, there were 100 unique crew members interviewed who identified sea scallop as their primary fishery. Of those interviewed, the largest number of crew fell into the 40–49 age group. Based on preliminary results of the 2018–19 crew survey, there were 65 crew members, which identified sea scallop as their primary fishery. Of those interviewed, the largest number of crew fell into the 50–59 age group.

TABLE 13
Age distribution of crew employed in fishing from crew surveys in 2012 and 2018

Age distribution of fishers	Under 20	20–29	30–39	40–49	50–59	Over 60	No response	Total
2012 crew survey	1	20	23	34	18	3	1	100
2018 crew survey	0	12	14	14	17	8	0	65

Gulf of Mexico shrimp trawl vessels

The Gulf of Mexico shrimp fleet can be characterised by an average length (LOA) of 21 m and a gross tonnage of 103 tonnes (see Table 14). The power of the main engines averages 408 kW. On board storage freezer capacity is on average 23 m^3 of frozen shrimp; with a median volume of 16 m^3.

The main fishing gear used is an otter trawl, and no other gears were used. Turtle excluder devices and bycatch reduction devices must usually be used. After a trawl, the catch is sorted and the shrimp product is frozen, sometimes after being headed. The average crew size is 3.2.

The number of days at sea per vessel in 2014 averaged 171 days, with a median of 180 days. The average number of fishing trips in 2014 was 21, with a median of 8 trips.

TABLE 14
Basic information about surveyed vessels (mean and median values)

Gulf of Mexico shrimp trawl vessels (2014)		Mean	Median
Length overall (LOA)	meters	20.7	21.3
Gross tonnage (GT)		103	111
Total power of main engines in kilowatts (kW)		408	336
On-board storage facilities (m^3)		23	16
Crew size (persons)		3.2	3
Ownership (state, shared, chartered, company)	company		
Total days fishing at sea		171	180
Number of fishing trips		21	8
Fishing season (months)	12		

Hawaii pelagic longline fishery

The Hawaii pelagic longline is a year-round limited entry fishery with a maximum of 164 permits. No new permits have been issued since 1993. In 2012, there were 129 active vessels (gradually increasing to 142 in 2018). A cost-earnings survey was conducted in 2013 to collect 2012 operation data. Over 90 percent of the fishers/vessels participated the survey. Most of the information was collected through the survey.

Table 15 shows the basic information about surveyed vessels. The number of days at sea per vessel in 2012 ranged from 11 to 329 days with an average of 249 days. The average fishing days at sea (not counting the travel and searching time) was 150 days within an average of 12 fishing trips per year. The average vessel length was 23 m and 111 GT (see Table 15). The power of the main engine ranged between 130 kW and 540 kW and averaged 329 kW. On board storage of tuna fish with ice (for fresh chilled tuna) ranged from 4.5 m^3 to 54 m^3 and averaged 19 m^3. The mean and median for the physical and operational characteristics listed in Table 15 have similar results, showing the approximate normal distribution among the surveyed vessels.

TABLE 15
Basic information about surveyed vessels (mean and median values)

Hawaii pelagic longline (2012)	Mean	Median
Length overall (LOA)	23 m (75 ft)	23 m (75 ft)
Gross tonnage (GT)	111	113
Total power of main engines in kilowatts (kW)	329 (442 hp)	317 (425 hp)
On-board storage facilities (m^3)	19	16
fishing gear	longline	longline
Crew size (persons) – per vessel, including captain	6	6
Ownership (state, shared, chartered, company)	company	company
Days fishing at sea	150	150
Days at sea (including travel days)	249	265
Number of fishing trips	12	12
Fishing season (months)	12	12

The fishing gear carried was "longline" and the longline gear was set in different depths depending on the target species (Table 16). Deep-set longline gear (targeting bigeye tuna) typically consists of a continuous mainline set below the surface (approximately 400 m) and shallow-set longline gear (targeting swordfish) typically consists of a continuous mainline set near the surface at depths of 30–90 m.

Shallow-set fishing for swordfish was the main component of the Hawaii pelagic longline fleet in the early 1990s. However, the swordfish fishing was closed for 4 years from 2000 to 2004 and a series of regulations followed, with the reopening of the fishery in 2005. The main reason for the closure and subsequent regulations was the interaction of shallow-set swordfish longline fishing with sea turtles. The regulations to conserve sea turtles, especially the annual hard caps on sea turtle interactions of loggerhead and leatherback turtles, imposed significant constraints on the shallow-set longline fishing. Deep-set longline fishing for bigeye tuna became the dominate fishery of the fleet since 2001. In 2012, 94 **percent** of the fishing trips were targeting tuna.

TABLE 16
Fishing methods employed in the Hawaiian pelagic longline fishery

Fishing gears	Percent of time used in 2012 (of total trips)
Deep-set tuna longline	94%
Shallow-set swordfish longline	6%

The average crew size (including captain) was six. The majority of the crew employed in the fishery were full-time employees. Vessel owners who had hired captains to handle fishing operations may have spent time managing the land-bases aspects of their business. However, detailed information about the amount of time noncaptain owners spent on their fishing business was not available. The age data of the operators (captains) were collected through in-person interviews and no information was available on other crew members. Table 17 shows the information on the age of captains employed in fishing based on the survey. The majority of the captains were 50 years of age or older, and only 21 **percent** of the captains were under the age of 50.

TABLE 17
Labour Employed in in the Hawaiian Pelagic Longline Fishery (2012)

Fishers	Total crew members (including captains)	Age and distribution (Captains only)	Under 20	20–29	30–39	40–49	50–59	60 and over
Total number of crew and captain positions	674	142	0%	4%	8%	10%	41%	38%

4. FINANCIAL AND ECONOMIC CHARACTERISTICS OF INDIVIDUAL FISHING UNITS

West Coast groundfish trawl catch share program

Capital investments

In 2017, the median replacement value for whiting trawlers was over two times the replacement value of large groundfish trawlers (USD 2.5 million) and four times that of small groundfish trawlers (USD 1.3 million).

TABLE 18
Vessel investment costs and values as of 2017

Fleet	Vessel market value (mean USD)	Vessel replacement value (mean USD)
Large groundfish trawler	1 226 042	2 653 750
Small groundfish trawler	534 714	1 387 500
Whiting trawler	3 283 647	6 040 000
Fleet	**Vessel market value (median USD)**	**Vessel replacement value (median USD)**
Large groundfish trawler	805 000	2 550 000
Small groundfish trawler	500 000	1 322 500
Whiting trawler	3 256 300	5 285 000

Landings

In general, the top sources of revenue for groundfish trawlers that participate in the catch share fishery are groundfish, crab, and shrimp. The relative importance within a year is determined by the biomass of crab and shrimp, which are both characterized by high inter-annual variability driven by environmental conditions. For activities off the coast of the states of Washington (WA) and Oregon (OR), Pacific whiting is always the most important revenue source for whiting vessels. However, the importance relative to income from fishing off the coast of Alaska depends on the total allowable catches (TAC) for Pacific whiting and for walleye pollock in any given year.

In 2017, the main source of ex-vessel revenue by vessels in the large groundfish trawler fleet was groundfish (USD 20.3 million), caught with demersal trawl gear and crab (USD 6.2 million), caught with pots. The main place of landing for both groundfish and crab were ports in Oregon. The top two species for small groundfish trawlers were also groundfish (USD 4.4 million) and crab (USD 1.7 million). The primary port for small groundfish trawler landings was also in Oregon, but the primary port for crab landings was San Francisco, California (CA) in 2017. Whiting trawlers earned almost all ex-vessel revenue from Pacific whiting (USD 35 million) caught off the coasts of the states of Washington and Oregon. These vessels deliver at-sea to motherships as well as to ports in Washington and Oregon. These vessels also earn revenue fishing in Alaska, however that information is excluded from Table 19 due to data unavailability. The other top species group for whiting trawlers was groundfish, primarily widow and yellowtail rockfish, a reemerging fishery following the widow rockfish stock being declared rebuilt in 2012.

TABLE 19
Landing and value of fish per vessel (2017)

Large groundfish trawler

Species	Quantity (mean tonnes)	Ex-vessel value (mean USD)	Main place of landings	Gear
Groundfish	404	599 879	Astoria, OR	Demersal trawl
Crab	37	246 161	Coos Bay, OR	Pot
Shrimp	196	221 320	Newport, OR	Shrimp Trawl
Sharks, skates and rays	22	17 842	Astoria, OR	Demersal trawl

Small groundfish trawler

Species	Quantity (mean tonnes)	Ex-vessel value (mean USD)	Main place of landings	Gear
Groundfish	135	232 824	Coos Bay, OR	Demersal trawl
Crab	19	145 184	San Francisco, CA	Pot
Shrimp	110	126 196	Coos Bay, OR	Shrimp Trawl
Sharks, skates and rays	8	5 966	Astoria, OR	Demersal trawl

Whiting trawler

Species	Quantity (mean tonnes)	Ex-vessel value (mean USD)	Main place of landings	Gear
Pacific whiting	6 589	1 101 185	Seattle, WA	Midwater trawl
Groundfish	337	234 655	Astoria, OR	Midwater trawl
Crab	35	224 974	Newport, OR	Pot
Sharks, skates and rays	19	20 335	Astoria, OR	Demersal trawl
Shrimp	9	7 258	South and central WA coast	Shrimp trawl

Operating and owner costs

Labour costs were the highest cost category for all three fleets in 2017. The largest mean running costs for a large groundfish trawler were for fuel and lubrication (USD 57 688), followed by taxes (USD 49 189), and association dues, observer fees, vessel lease (USD 33 618). The largest mean vessel costs in the large groundfish trawler were for vessel repairs and maintenance (USD 77 518), followed by purchase of fishing rights (USD 73 777), and insurance premium payments (USD 40 191). The largest mean running costs for a small groundfish trawler were for fuel and lubrication (USD 30 757), followed by association dues, observer fees, vessel lease (USD 26 568), and taxes (USD 17 488). The largest mean vessel costs in the small groundfish trawler were for vessel repairs and maintenance (USD 36 510), followed by purchase of fishing rights (USD 35 097), and insurance premium payments (USD 25 158). The largest mean running costs for a whiting trawler were for fuel and lubrication (USD 142 997), followed by taxes (USD 99 053), and association dues, observer fees, vessel lease (USD 39 483). The largest mean vessel costs in the whiting trawler were for vessel repairs and maintenance (USD 82 899), followed by purchase of fishing rights (USD 82 029), and insurance premium payments (USD 55 560).

TABLE 20
Annual costs and earnings per fishing vessel in USD (2017)

Category	Item	Large groundfish trawler	Small groundfish trawler	Whiting trawler
Revenue	Revenue from landings	902 931	377 471	1 437 342
Labour costs	Captain	136 175	53 794	201 884
	Crew	187 058	81 829	273 158
	Food	4 956	4 232	9 406
Running costs	Association dues, observer fees, vessel lease	33 618	26 568	39 483
	Bait	9 880	4 521	5 200
	Fuel and lubrication	57 668	30 757	142 997
	Ice	11 731	6 598	10 358
	Moorage	5 290	5 482	8 976
	Other operating costs	9 362	9 236	16 146
	Taxes	49 189	17 488	99 053
	Travel	976	296	908
Vessel costs	Fishing gear	26 282	10 680	41 946
	Insurance premium payments	40 191	25 158	55 560
	License fees	4 122	2 804	2 903
	Purchase of fishing rights	73 777	35 097	82 029
	Vessel repairs and maintenance	77 518	36 510	82 899
Capital costs	Depreciation	46 059	29 477	85 203

Revenues

Nearly all revenue for the West Coast groundfish trawl catch share program fleets came in 2017 from the sale of the fish. Other income-generating activities included the sale of annual fishing rights, chartering, research, and tendering. The average revenue per vessel in the whiting trawler fleet was substantially larger than either of the groundfish trawler fleets.

Economic and financial performance of fishing vessels

Whiting trawlers had much higher net cash flow than either of the groundfish fleets (two times that of the large groundfish fleet and eleven times that of the small groundfish trawler fleet). In contrast, the average gross value added per vessel for the three fleets was only five times higher for the whiting trawlers than for the small groundfish trawlers. This was a result of the small groundfish trawlers paying a larger share of ex-vessel revenue to labour than whiting vessels do.

Return on investment was highest for the large groundfish trawler fleet and smallest for the small groundfish trawler fleet. Once interest was accounted for in the calculation of net profit before taxes, the small groundfish trawler fleet lost money in 2017. The whiting trawler fleet was the most fuel efficient per tonne of catch.

TABLE 21
Financial and economic indicators in USD and percentages (2017)

Indicator	Large groundfish trawler	Small groundfish trawler	Whiting trawler	Code	Calculation
Revenue from landings[17]	902 931	377 471	1 437 342	A	
Labour costs	328 189	139 855	484 447	B	
Running costs	177 713	100 946	323 121	C	
Vessel costs	221 890	110 250	265 336	D	
Total gross cost	727 792	351 051	1 072 904	E	B + C + D
Net cash flow	175 139	26 420	364 439	F	A - E
Depreciation	46 059	29 477	85 203	G	From survey

[17] Shaded rows use values from table 20.

Indicator	Large groundfish trawler	Small groundfish trawler	Whiting trawler	Code	Calculation
Amortization	0	0	0	H	No information was available on separate values for intangible assets (fishing permits, quota, etc). These values are subsumed in the vessel value.
Gross profit	129 080	-3 057	279 236	I	F – G - H
Interest	106 150	55 500	241 600	J	Rate = 4%. Based on: 10 year Treasury rate has been about 2% since 2011 (see www.macrotrends.net/2016/10-year-treasury-bond-rate-yield-chart). Added is 2% for NMFS Fisheries Finance Program. This applies to vessel and permits value.
Net profit before taxes	22 930	-58 557	37 636	K	I - J
Net profit margin	2.5%	-15.5%	2.6%	L	K/A
Value of tangible assets	2 653 750	1 387 500	6 040 000	M	
Return on fixed tangible assets	Unknown because tangible and intangible values are combined	Unknown because tangible and intangible values are combined	Unknown because tangible and intangible values are combined	N	K/M
Value of intangible assets	0	0	0	O	No information was available on separate values for intangible assets (fishing permits, quota, etc). These values are subsumed in the vessel value.
Return on investment	0.9%	-4.2%	0.6%	P	K/(M+O)
Gross value added	503 328	166 275	848 886	Q	F + B
Gross value added to revenue	55.7%	44.0%	59.1%	R	Q/A
Fish stock status	Not overfishing not overfished two rebuilding plans.	Not overfishing not overfished two rebuilding plans.	Not overfishing not overfished two rebuilding plans.	S	
Fuel efficiency	23.5	30.2	6.3	T	Gallons per thousand landed pounds

Northeast limited access scallop dredge

Capital investments

The age and market values provided in Table 22 are from cost surveys conducted in 2011 and 2012. Among survey respondents, the full-time fleet consisted on average of older vessels. However, when comparing the two fleets as a whole, vessel age was fairly similar. Asset market value was attained by asking vessel owners the value of their vessel, including all equipment, fishing gear, permits, and fishing history. The average asset market value for the full-time fleet was over twice the value as that for the part-time fleet.

TABLE 22
Vessel investment costs and values in 2011/2012 for vessels in the Northeast limited access scallop dredge fleet (in 2016 dollars)

2011/2012	Age (years)	Market value USD
Vessels, gear, equipment, and fishing permits – full-time fleet	Mean: 26 Median: 27	Mean: 4 438 886 Median: 4 853 049
Vessels, gear, equipment, and fishing permits – part-time fleet	Mean: 19 Median: 16	Mean: 1 977 168 Median: 1 617 683

Landings

The average annual gross revenue of full-time vessels in the Northeast limited access scallop dredge fleet during the scallop fishing season of March 2016 to February 2017 was USD 1 422 692, with sea scallops accounting for 97 percent of gross revenue. Sea scallops accounted for 81 percent of landed volume for the full-time fleet. Among the 313 full-time vessels, 257 vessels (82 percent) received 99–100 percent of their revenue from sea scallops. For part-time vessels, the average revenue realized was USD 736 433, with sea scallops accounting for 68 percent of gross revenue. Sea scallops accounted for 8 percent of landed volume by the part-time fleet. Among the 35 part-time vessels, 13 vessels (37 percent) received 99–100 percent of their revenue from sea scallops. The high price for sea scallops explained the difference in the value/volume ratios for the full-time fleet compared to the part-time fleet. The part-time fleet, as a whole, also landed relatively large volumes of menhaden, a species which has yielded a very low ex-vessel value.

TABLE 23
Landing and value of fish per vessel in the Northeast limited access scallop dredge fleet (2016–2017 season)

Full-time

Species	Quantity (tonnes)	Ex-vessel value (USD)	Main place of landing	Gear used
Sea Scallops *Placopecten magellanicus*	52.4	1 374 282	New Bedford, Massachusetts (MA)	Dredge
Loligo Squid *Doryteuthis Amerigo pealeii*	4.7	12 480	Cape May, New Jersey (NJ)	Demersal trawl
Summer Flounder *Paralichthys dentatus*	1.6	11 744	Hampton, Virginia (VA)	Demersal trawl
Other	6.2	24 186	New Bedford, MA	Dredge and trawl
Total	64.8	1 422 692	New Bedford, MA	Dredge and trawl

Part-time

Species	Quantity (tonnes)	Ex-vessel value (USD)	Main place of landing	Gear used
Sea Scallops *Placopecten magellanicus*	19.7	499 306	Cape May, NJ	Dredge
Summer Flounder *Paralichthys dentatus*	6.3	49 186	Hampton, VA	Demersal trawl
Menhaden *Brevoortia tyrannus*	175.2	39 433	Cape May, NJ	Trawl/gillnet/purse seine
Other	37.1	148 507	Beaufort, North Carolina (NC)	Mainly dredge and trawl
Total	238.3	736 433	Cape May, NJ	Mainly dredge and trawl

Operating and owner costs

Cost information was collected via two different methods for the Northeast limited access scallop dredge fleet. Running costs were collected by at-sea observers. Some 10 percent of trips by the limited access scallop fleet were observed, and a modelling approach was therefore used to fill in gaps in cost data. Running costs were predicted for each of the 4 928 commercial fishing trips by the limited access scallop fleet in the 2016 fishing year. Estimated running costs for full-time and part-time vessels averaged around USD 100 000 for the 2016 fishing year. Median values were slightly lower for both fleets. Average running costs as a percentage of average gross revenue were 8.1 percent for full-time vessels and 14.2 percent for part-time vessels.

For labour, vessel and capital costs, a survey of fishing vessel owners was conducted (see Annex A). The values presented in Table 24 for labour, vessel and capital costs represent mean and median values for scallop vessels surveyed in 2011 and 2012. This is an important distinction since revenue and running costs are from the 2016 fishing year. Since there are limited observations from the surveys, especially for the part-time fleet, mean and median values can vary quite substantially. Labour expenses were by far the largest cost to vessels owners, with a mean annual value over USD 700 000 and a median annual value over USD 800 000 for full-time vessels. For part-time vessels, these values were around USD 300 000. Vessel repairs/maintenance, vessel insurance, and loans were other substantial expenses to vessel owners. The higher insurance premiums for the full-time fleet may have been a product of the fleet being comprised on average of larger vessels than the part-time fleet.

TABLE 24
Annual costs and earning per fishing vessel of the Northeast limited access scallop dredge fleet in USD (revenue data from 2016, cost data from 2011–2012)

Category	Item	Full-time	Part-time
Revenue	Revenue from landings	Mean scallop rev: 1 374 282 Median scallop rev: 1 390 187 Mean total rev: 1 422 692 Median total rev: 1 433 099	Mean scallop rev: 499 306 Median scallop rev: 446 987 Mean total rev: 736 433 Median total rev: 658 661
Labour costs[18]	Labour share and wages	Mean: 723 601 Median: 816 404	Mean: 296 947 Median: 312 856
Running costs	Fuel, oil, ice, bait, water, food, materials	Mean: 115 518 Median: 108 764	Mean: 104 926 Median: 100 176
Vessel costs	Vessel insurance	Mean: 76 398 Median: 67 641	Mean: 38 109 Median: 42 461
	Gear replacements, repairs and maintenance	Mean: 29 818 Median: 22 712	Mean: 29 904 Median: 12 620
	Vessel repairs and maintenance (includes upgrade/improvement).	Mean: 128 240 Median: 92 265	Mean: 158 072 Median: 51 662
	Other fixed costs (accountancy, audit and legal fees, general expenses, subscriptions, etc.) Mooring and permit fees	Mean: 8 128 Median: 3 817	Mean: 5 352 Median: 4 996
	Other business costs	Mean: 27 401 Median: 17 796	Mean: 21 423 Median: 23 796
Capital costs	Depreciation[19]	Mean: 11 102 Median: 7 844	Mean: 11 260 Median: 7 398
	Interest on loans	Mean: 51 548 Median: 33 347	Mean: 36 498 Median: 2 157
Other costs	Principal on loans	Mean: 98 699 Median: 97 668	Mean: 53 541 Median: 37 746

18 Food is not included in labour costs since it cannot be estimated separately from running costs.
19 Depreciation was calculated as 4 percent of the value of the vessel for vessels <25 years age and 2 percent of vessel value for vessels >=25 years of age.

Revenues

The limited access scallop fleet received all of its fishing revenue from commercial sales of shellfish/fish, as leasing of days-at-sea was not permitted. For full-time vessels, average revenue was USD 1 422 692, with sea scallops accounting for 97 percent of gross revenue. For part-time vessels, average revenue was USD 736 433, with sea scallops accounting for 68 percent of gross revenue.

Economic and financial performance of fishing vessels

Table 25 contains financial and economic indicators based on the average values presented in Table 24. In general, they reflect the overall condition of the fishing fleet during the 2016 fishing year. Individual vessels that make up the fleet may have indicator values well above or below the fleet level values as reflected in Table 25.

The net cash flow was substantial higher for full-time vessels, on average, than for part-time vessels. Similarly, after subtracting depreciation, gross profit was substantial higher for full-time vessels, on average. The average value of total assets, as shown in Table 22, within the full-time fleet is more than twice that of the part-time fleet. This is almost entirely due to differences in scallop permit value. As shown in Table 25, the value of the fishing vessels (tangible assets) between the two fleets was similar. Therefore, the depreciation expenses for each fleet are also similar. In the calculation of gross profit, both depreciation and amortization are deducted from the net cash flow. However, for these two scallop fleets, the fishing permits do not have expiration dates and so the amortization expense applied here is zero. If there were an end date for the useful life of the permit, the intangible asset value would have been amortized over the lifetime of the permit. This would have resulted in much lower gross profits for both fleets. The estimated interest expense is based on the full asset values resulting in reduced net profit before taxes (a loss of USD 8 647 for the part-time fleet, on average).

TABLE 25

Financial and economic indicators of the Northeast limited access scallop dredge fleet in USD and percentages (2016)

Indicator	Full-time	Part-time	Code	Calculation
Revenue from landings[20]	1 422 692	736 433	A	
Labour costs	723 601	296 947	B	
Running costs	115 518	104 926	C	
Vessel costs	269 985	252 860	D	
Total gross cost	1 109 104	654 733	E	B + C + D
Net cash flow	313 588	81 700	F	A – E
Depreciation	11 102	11 260	G	Depreciation was calculated as *4%* of the value of the vessel for vessels *<25 years* age *and 2%* of vessel value for vessels >=25 years of age.
Amortization	0	0	H	Limited access scallop permits do not have an expiration date so amortization is assumed to be zero.
Gross profit	302 486	70 440	I	F – G – H
Estimated interest	177 555	79 087	J	Rate = 4%. Based on: 10 year Treasury rate has been about 2% since 2011 (see www.macrotrends.net/2016/10-year-treasury-bond-rate-yield-chart). Add 2% for NMFS Fisheries Finance Program. Applied to vessel and permit values combined.
Net profit before taxes	124 931	-8 647	K	I – J
Net profit margin	8.8%	-1.2%	L	K/A
Value of tangible assets	397 923	371 922	M	
Return on fixed tangible assets	31.4%	-2.3%	N	K/M

[20] Shaded rows use values from Table 24.

Indicator	Full-time	Part-time	Code	Calculation
Value of intangible assets	4 040 963	1 605 246	O	
Return on investment	2.8%	-0.4%	P	K/(M+O)
Gross value added	1 037 189	378 647	Q	F + B
Gross value added to revenue	72.9%	51.4%	R	Q/A
Fish stock status	Not overfished. Not overfishing.	Not overfished. Not overfishing.	S	
Fuel efficiency	0.29	0.17	T	Gallons per pound (meat weight)

Gulf of Mexico shrimp trawl vessels

Capital investments

In the Gulf of Mexico shrimp trawl fleet the average age of the hulls was 26 years in 2014. The estimated market value of the average vessel and associated equipment, including fishing gear, of this fleet averaged USD 272 193. Less than half the vessels had hull insurance so, on average, only USD 117 043 of the fleet's investment was insured. For the vessels that were insured (about 40 percent of the fleet), the average insured value was USD 269 042.

Landings

In the Gulf of Mexico, shrimp are landed both with their heads-on (whole weight) and, somewhat more frequently, heads-off ("tails"). Customarily, the landings are measured in terms of heads-off weight. On average, a vessel in this fleet landed 33.5 tonnes of frozen product with an ex-vessel value of USD 365 678 in 2017.

Operating and owner costs

Among operating costs, the fuel costs are generally highest and accounted for 41 percent of the cost of operations in 2017. Other important variable costs were labour (28 percent) and other supplies (9 percent).

In 2017, the vessel costs were 12 percent of the cost of operations and capital costs are 3 percent. In this fishery, approximately 51 percent of vessels were operated by the vessel owners. The opportunity cost of an owner's time as captain was not included in the labour share and wages in Table 26 but is listed under "Other costs" for reference.

TABLE 26

Average annual costs and earning of the Gulf of Mexico shrimp trawl fleet per vessel in USD (2017)

Category	Item	USD
Revenue	Total fishing revenue	365 678 (shrimp) 7 812 (other)
	Subsidies and grants	532
	Other vessel income (from tourism, charters, etc.)	2 572
Labour costs[21]	Labour share and wages, crew travel	94 083
Running costs	Fuel	136 014
	Other supplies (oil, harbor dues, ice, bait, salt, food, fish selling costs, materials)	29 594
Vessel costs	Insurance fees (vessel, employers, equipment)	7 011
	Vessel and gear repair and maintenance	31 421
	Other fixed costs	12 999
Capital costs	Depreciation	8 832
	Interest on Loans	1 883
Other costs	Investments (in vessel, beyond repair and maintenance)	4 503
	Principal payments (on vessel loans)	4 285
	Opportunity cost of owner's time as captain	13 360

[21] Food is not included in labour costs since it cannot be estimated separately from running costs

Revenues

The main revenue of the Gulf of Mexico shrimp trawl fleet comes from the sale of the shrimp landings, which is approximately 97 percent of all revenue. Minor other revenue of the fleet consists of non-shrimp seafood (2 percent) landed and minimal payments from the government or non-fishing activities.

Economic and financial performance of fishing vessels

Table 27 contains financial and economic indicators based on the average values contained in Table 26. In general, they reflect the overall condition of the fishing fleet. Individual vessels that make up the fleet may have indicator values well above or below the average fleet level values as reflected in Table 27. Average net cash flow for this fleet was USD 62 368. Gross profit, which is net cash flow after deducting depreciation and amortization, was USD 53 536 per vessel. Average gross value added per vessel was USD 156 451. At nearly 16 percent each in 2017, the return on fixed tangible assets and return on investment in the Gulf of Mexico shrimp fleet was a respectable return, the highest in years. In 2014, high shrimp prices coincided with good abundance and hence high catches. On average, 2006–2014, the fishery's return is only close to breaking even, with a clear trend from negative returns to positive ones, especially after 2010. Since there is a large portion of this fleet for which the vessel owner is also the captain, the profit and value added figures are higher than they would be if an opportunity cost value was estimated for their time spent at sea operating the fishing vessel.

TABLE 27

Financial and economic indicators of an average full-time fishing vessel in the Gulf of Mexico shrimp trawl fleet in 2017 in USD[22]

Indicator	Shrimp trawler	Code	Calculation
Revenue from landings	373 490	A	
Labour costs	94 083	B	
Running costs	165 608	C	
Vessel costs	51 431	D	
Total gross cost	311 122	E	B + C + D
Net cash flow	62 368	F	A – E
Depreciation	8 832	G	From survey
Amortization	0	H	No information on values for intangible assets (fishing permits, quota, etc.). Assumed to be small relative to vessel value.
Gross profit	53 536	I	F – G – H
Estimated interest	10 889	J	Rate = 4%. Based on: 10 year Treasury rate has been about 2% since 2011 (see www.macrotrends.net/2016/10-year-treasury-bond-rate-yield-chart). Add 2% for NMFS Fisheries Finance Program. Applied to vessel value.
Net profit before taxes	42 647	K	I – J
Net profit margin	11.4%	L	K/A
Value of tangible assets	272 193	M	
Return on fixed tangible assets	15.7%	N	K/M
Value of intangible assets	0	O	
Return on investment	15.7%	P	K/(M+O)
Gross value added	156 451	Q	F + B
Gross value added to revenue	41.9%	R	Q/A
Fish stock status	Not overfished. Not overfishing.	S	
Fuel efficiency	0.625	T	Gallons per pound (heads off)

22 Shaded rows use values from Table 26.

Hawaii pelagic longline fishery

Capital investments

The original investment for an average fishing vessel in the Hawaiian pelagic longline fleet was USD 406 000 per vessel (in 2012), which included vessel purchase price and start-up investment. The average age of the vessels in that year was 27 years. The appraised value of the vessels (including associated equipment) averaged USD 606 000. As required by the state of Hawaii, all vessels moored in state facilities, including harbours and off-shore moorings, are required to carry insurance (with a minimum of USD 300 000 in liability insurance). The average insurance cost per vessel was USD 27 200 in 2012.

Landings

Bigeye and yellowfin tunas were landed, gilled, and gutted while other species were landed in different forms. On average, a Hawaiian pelagic longline vessel landed about 92 tonnes (whole weight), valued at USD 745 800, mostly in the port of Honolulu Hawaii. A small percentage of vessels landed their catches in California ports. Table 28 shows volumes and values of the main species landed.

TABLE 28
Average volume and value of fish landed per Hawaiian pelagic longline vessel in 2012

Species	Quantity (tonnes)	Ex-vessel value (USD)	Main place of landing	Gear used
Bigeye tuna *Thunnus obesus*	45	100 200	Honolulu, HI	Longline
Swordfish *Xiphias gladius*	11	24 300	Honolulu, HI	Longline
Yellowfin tuna *Thunnus albacares*	7	15 100	Honolulu, HI	Longline
Moonfish *Coryphaena hippurus*	6	12 300	Honolulu, HI	Longline
Albacore *hunnus alalunga*	5	11 300	Honolulu, HI	Longline
Dolphinfish *Coryphaena hippurus*	3	7 400	Honolulu, HI	Longline
Other pelagic fish	14	32 000	Honolulu, HI	Longline

Operating and owner costs

Based on the 2012 survey, the total gross costs per vessel in the Hawaiian pelagic longline fleet were USD 645 500 which included labour costs of USD 158 400, running costs of USD 373 300, and vessel costs of USD 113 800. Labour share and wages were made as direct payments to captain and crew. Hired captains were paid a share of either the gross or net revenue. In this fishery, approximately 39 percent of vessels were operated by the vessel owners. The opportunity cost of an owner's time as captain was not included in the labour share and wages in Table 29, but is listed among "other costs" for reference.

The itemized costs are shown in Table 29. Among the total gross costs, the leading operating cost was fuel (31.2 percent), followed by labour costs (24.5 percent), fish selling costs (12.1 percent), and bait cost (9.8 percent).

TABLE 29

Mean annual costs and earning per fishing vessel in the Hawaiian pelagic longline fleet in USD (2012)

Category	Item	USD
Revenue		745 800
Labour costs	Labour share and wages (captain and crew)	134 400
	Food, stores and other provisions	24 000
Running costs	Fuel	201 200
	Lubricants/oil/filters	6 300
	Harbour dues and levies (mooring fee)	5 600
	Ice	10 700
	Bait	63 500
	Fish selling costs (auction commission, etc.)	78 000
	Other operating costs (nightsticks and communications)	8 000
Vessel costs	Insurance fees (vessel, employers, equipment)	27 200
	Gear replacements, repairs and maintenance[23]	26 000
	Vessel repairs and maintenance	57 100
	Other fixed costs (accountancy and others)	3 500
Capital costs	Depreciation (vessel, engine, equipment, and gears that last more than 3 years)[24]	20 800
	Loan payments (Principal and interest on vessel loans)	5 100
Other costs	Opportunity cost of labour of owner/operator	38 700

Revenues

The sale from fish landings was the sole revenue of the Hawaii pelagic fishing vessels, which was approximately USD 745 800 per vessel in 2012.

Economic and financial performance of fishing vessels

Table 30 contains financial and economic indicators based on the average values contained in Table 29. These figures reflect the average economic performance of the Hawaii pelagic longline fleet. The economic performance varied however widely among vessels in this fleet. Thus, individual vessels might have indicator values well above or below the fleet-level values as reflected in Table 30. Average net cash flow for this fleet was USD 100 300. Gross profit, which is net cash flow less depreciation and amortization was USD 79 500 per vessel. Average gross value added per vessel was USD 258 700. Since there is a large portion of this fleet for which the vessel owner is also the captain, the profit and value added figures were higher than they would be if an opportunity cost value was estimated for their time spent at sea operating the fishing vessel.

TABLE 30

Financial and economic indicators of an average vessel in the Hawaiian pelagic longline fleet in USD and percentages (in 2012)

Indicator	Indicator Value	Code	Calculation
Revenue from landings[25]	745 800	A	
Labour costs	158 400	B	
Running costs	373 300	C	
Vessel costs	113 800	D	
Total gross cost	645 500	E	B + C + D
Net cash flow	100 300	F	A – E

[23] Purchase costs of gears that have a life of 3 years or more are reported in the investment items.

[24] The annual depreciation of investment (investment vessel purchase price and the startup cost) was estimated by assuming 4 percent of replacement cost during 25 years and after that period of 2 percent annually.

[25] Shaded rows use values from Table 29.

Indicator	Indicator Value	Code	Calculation
Depreciation	20 800	G	Depreciation was calculated as *4%* of the value of the vessel for vessels *<25 years* age *and 2%* of vessel value for vessels >=25 years of age.
Amortization	0	H	No information on separate values for intangible assets (fishing permits, quota, etc). These values are subsumed in the vessel value.
Gross profit	79 500	I	F – G – H
Estimated interest	24 244	J	Rate = 4%. Based on: 10 year Treasury rate has been about 2% since 2011 (see www.macrotrends.net/2016/10-year-treasury-bond-rate-yield-chart). Add 2% for NMFS Fisheries Finance Program. Apply to vessel and permits value.
Net profit before taxes	55 256	K	I – J
Net profit margin	7.4%	L	K/A
Value of tangible assets	606 100	M	
Return on fixed tangible assets	Unknown because tangible and intangible values are combined	N	K/M
Value of intangible assets		O	No information on separate values for intangible assets (fishing permits, quota, etc). These values are subsumed in the vessel value.
Return on investment	9.1%	P	K/(M+O)
Gross value added	258 700	Q	F + B
Gross value added to revenue	34.7%	R	Q/A
Fish stock status	Not overfished. Not overfishing.	S	
Fuel efficiency	0.25	T	Gallons per pound (whole weight)

5. FINANCIAL SERVICES AVAILABLE TO THE FISHERIES SECTOR INCLUDING INSTITUTIONAL CREDIT PROGRAMMES

There are number of different ways in which US fishers can obtain financing for their fishing businesses. They can use traditional financial institutions for business loans, there are agriculture-oriented financial cooperatives that have programs for fishers, and there are fishers's associations and fishing community initiatives that have set up funds. In terms of government support, the National Marine Fisheries Service has the Fisheries Finance Program. The Small Business Administration also has programs to help fishers obtain private loans. Each of these avenues for obtaining credit are briefly described below. There may be other means for obtaining credit for fishers; therefore, what is provided here should not be considered a complete summary.

Private financial institutions

Most, if not all, private banks have business loans or lines of credit. There can be a wide variety of terms (interest rate, loan duration, collateral required, etc.) associated with these loans. In major fishing ports, there are banks that have loan programs specific to commercial fishing businesses, since they have gained experience in this industry due to local relationships they have developed.

For example, Peoples Bank in Seattle Washington State announced in 2017 its commitment to new vessel construction lending.

The First Bank in Ketchican, Alaska State (AK) advertises on its website that it is familiar with the characteristics of fishing businesses in AK and can handle the seasonal nature of fishing in how it structures a loan.[26]

Farm credit cooperatives

There are two Farm Credit cooperatives – Farm Credit East and Farm Credit West. A financial cooperative is owned by its members who both borrow money and receive dividends from lending activity.

Farm Credit East provides short-term operating lines of credit for one year and lines of credit for gear for three years. Vessel purchase, construction, or overhaul loans are available for five to ten years. They are able to set up seasonal payment schedules for inshore/part-time fishing businesses. They require particular types of collateral due to the variable nature of economic conditions in fisheries which can result in unpredictable changes in assets.

Farm Credit West provides loans for vessels, fishing quota and permit purchases, equipment, and refrigeration. They also provide variable or fixed rate terms, programs for young fishers, and seasonal payments.[27]

Fishermen's associations/Fishing communities

In some fishing ports and fishing communities, associations and/or communities have developed financing programs for local fishers. Two examples are provided to give a sense of what these types of programs do.

The Northern California Community Loan Fund offers loans of USD 50 000 to USD 3 million for vessels, quota and permits, and equipment. The term is for up to ten years at interest rates of 5–7 percent for most borrowers.

Another example is provided by the Community Development Partnership, which has micro-loans of up to USD 40 000, a groundfish revolving loan fund, and loans for shellfish fishers of Cape Cod (MA), the islands of Martha's Vineyard and Nantucket. The groundfish revolving loan fund is in cooperation with the National Marine Fisheries Service and the Commonwealth of Massachusetts.[28]

National marine fisheries service fisheries finance program

The NMFS Fisheries Finance Program is providing credit for fishing vessels, fisheries and aquaculture facilities, harvesting rights in federally managed limited access systems, and fishing quota in the Northwest halibut/sablefish and Alaskan crab fisheries. There is a proposal to expand this to additional limited access fisheries. The length of loans can range from five to 25 years. Interest rates are two percent over the United States Department of Treasury's applied rates.[29]

Small business administration

The Small Business Administration (SBA) does not provide loans directly to commercial fishers, but will work with private lenders to reduce loan risks by guaranteeing the loans. In order to do that it sets specific guidelines for the loans. Businesses must be considered small according to SBA size standards. They must also have exhausted other financing options.[30]

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[26] For more information please see: www.peoplesbank-wa.com/about-us/news/peoples-bank-expands-commercial-maritime-lending-f/ or www.firstbankak.com/business/loans/commercial-fishing-loans.html

[27] For more information see: www.farmcrediteast.com/knowledge-exchange/blog/todays-harvest/financing-the-lobster-industry and www.northwestfcs.com/en/Services/fisheries-financing

[28] For more information see: www.ncclf.org/cafisheriesfund/ and www.capecdp.org/local-business/fishing

[29] For more information see: www.fisheries.noaa.gov/national/funding-and-financial-services/fisheries-finance-program

[30] For more information see: www.sba.gov/funding-programs/loans

6. SUBSIDIES AND SUPPORT TO THE SECTOR

There are a number of subsidies that benefit US fishers. The following describes the programs and activities that may or may not apply to the profiled US fleets in this report.

Information is not available at the vessel or fleet level to determine precisely the level of participation and/or the degree of benefit derived from the subsidy. Most United States subsidies are indirect in that fishers do not receive a direct cash payment. Rather, fishers benefit from overall initiatives to enhance the productivity of the fishing industry (e.g., fisheries research and seafood marketing programs) or benefit from being exempt from taxes on certain inputs.

Some subsidies are however direct, such as disaster assistance grants and vessel buybacks. Sharp and Sumaila (2009) provide a comprehensive overview of the subsidies available to United States fishers with estimates of the monetary value (estimated dollars spent by the program and/or amount of exempted taxes). The subsidies described in this paper are summarized in Table 31. Table 3 from Sharp and Sumaila (2009) is copied here to show the relative magnitude of United States subsidies for 1996 through 2004. According to their estimates for 1996 – 2004 (summed over all years), the most significant subsidies overall were the fuel tax exemptions and sales tax exemptions. Disaster aid was important to Alaska and fishing access payments were important to the Western Pacific region. The two most subsidized regions were Alaska and the Western Pacific region.

TABLE 31
Summary of United States fishing subsidies based on Sharp and Sumaila (2009)

Type of subsidy	Description
Fuel subsidies	Exemptions from federal and state fuel taxes
Fisheries research	Research that enhances the productivity of commercial fishing
Sales tax subsidy	Exemptions from taxes on inputs
Disaster aid	Payments to fishers, fishing communities, or fishing-related businesses impacted by a natural disaster.
Fishing access payments	Government payments to other countries for allowing access by United States fishing businesses.
Surplus removal	Government purchase of surplus fish in order to enhance fish prices.
Capital Construction Fund	Tax deferred program for construction or reconstruction of fishing vessels.
Seafood marketing programs	Government program to promote United States seafood domestically and internationally.
Fishing vessel and permit buybacks	Publicly or privately financed purchase of fishing vessels and/or permits in order to reduce fishing pressure.
Fisheries Finance Program	Government low interest and extended term loans for vessel (re) construction.
Fishermen’s Contingency Fund	Government payments to fishers for losses caused by oil and gas operations. Funded by a tax on oil and gas companies

TABLE 32
Distribution of United States fisheries subsidies (millions of 2007 USD), by program and region, for 1996–2004

Subsidy program	Western Pacific	Alaska	Northern Atlantic	Southern Atlantic	Pacific Northwest	California	Gulf Coast
State fuel subsidies	230.1	100.0	121.4	100.1	104.8	83.4	4.0
State sales tax exemptions	104.3	0	108.9	58.0	19.7	47.6	0
Disaster aid	9.1	161.9	22.9	27.6	3.9	2.1	29.7
Fishing access payments	158.7	0	0	0	0	0	0
Surplus fish purchases	0	50.6	1.4	6.6	5.0	8.4	44.5
Capital Construction Fund	5.6	34.2	13.3	1.5	5.6	3.6	1.1
Seafood marketing	0	51.3	0.3	2.2	1.6	0.1	0.1
Vessel and permit buybacks	0	21.8	14.4	0	19.3	0	0
Fisheries Finance Program	0.6	0.3	0.8	0	0	,0.1	0.1
Fishermen's Contingency Fund	0	0	0	0	0	0.1	1.2
Total	508.3	420.0	283.4	196.0	159.9	145.2	80.6

Since 2004, most all of the subsidy programs described in Sharp and Sumaila (2009) have continued, in varying degrees, to the present.

In some fisheries, funds have been made available to pay for the cost of monitoring catch in catch share fisheries. This could be considered an additional type of subsidy.[31]

There is an additional type of subsidy available to West Coast fishers operating in and around Santa Barbara County, California, and who meet specific requirements. These fishers can apply to receive up to USD 150 000 or 80 percent, whichever is less, of the cost to upgrade diesel-powered engines to modern engines that emit less pollution.[32]

The Sharp and Sumaila (2009) study noted that a large majority of the fishing access payments were for tuna purse seine vessels to operate in the waters of several South Pacific island states. The Hawaii pelagic longline fleet did not benefit from this type of subsidy.

The scallop fishery benefits greatly from a number of fisheries independent surveys conducted in the region. These surveys are a major component in producing reliable stock biomass estimates. These estimates are used for regulating the fishery. Through improved management, catch per unit effort in the fishery has increased substantially since the 1990s. A list of the major scallop surveys is given below, and a description of these surveys can be found in NEFSC (2018).

Northeast Fisheries Science Center Dredge Survey (since 1975)
Virginia Institute of Marine Science Dredge Survey (since 2005)
School of Marine Sciences and Technology, University of Massachusetts, Dartmouth Drop Camera Survey (since 2003)
Northeast Fisheries Science Center Habcam survey (since 2005)

[31] For more information about this type of subsidy, see this example from the West Coast (on page ES-12): www.pcouncil.org/wp-content/uploads/2018/12/Trawl_CSR_2017_MainDoc_Final.pdf
[32] For more information see: www.ourair.org/grants-for-marine-vessels/

7. TECHNOLOGICAL INNOVATIONS IN GEARS, EQUIPMENT AND VESSELS THAT IMPACT FISHING VESSEL ECONOMIC PERFORMANCE

Technological innovations by fleet:

West Coast groundfish catch share program

Table 33 provides technological innovations introduced in the West Coast groundfish catch share program.[33]

TABLE 33
Technological innovations that have had an impact on the fishing fleet economic performance since 2000

Specific innovations	How these affected economic performance of the fleet
Computer-controlled diesel engines[1,3]	Decreased fuel costs (and emissions)
Hull design, bulbous bow[1]	Hull design reduced resistance
Bycatch reduction devices: escape panels, size selective grates, net cameras[2,3]	Reduced catch of low-value species as well as species that are at risk of being overfished, increasing the spatial areas where vessels can fish and decreasing the risk of closures.
Net redesign[1,3]	Limited the trawl gear touching the seafloor, reduced bottom contact by significant amounts, benthic invertebrates, habitat structures (corals and sponges), and as an advantage to the fishers resulted in less chance to damage fishing gear on the seafloor.
Software i.e. Olex - integrated with sonar to provide three dimensional view of water column and fish school location[1,2,3]	Automatic target tracking allowed for the captain to track course, depth, and speed of the school of fish eliminating guess work of captains; trawls could be shorter, more efficient, burn less fuel pulling net.
Headrope multibeam net opening imagers - example; Simrad FM90[2,3]	Allowed the captain to fine-tune his target species, increased efficiency and avoided unwanted bycatch.
Double hulled vessels after sponsons; voids under the fish hold; increased use of refrigerated seawater tanks and recirculated tanks[1,2,3,4]	Fish are kept cooler or alive longer, which increased the value of the catch at the dock and decreased fuel use, because less energy is required to keep catch cool. This innovation also increased fishing efficiency, because vessels can stay out at sea longer without sacrificing product quality
New designs for Personal Flotation Devices (PFDs), and Emergency Position Indicating Radio Beacon (EPIRB)s and culture change of safety [2,5]	New designs allowed crew to use safety devices without sacrificing performance on deck.
Engine room fire suppression systems, satellite communications, radar and watch alarms, vessel cameras[1,5]	These systems allowed vessels to detect vessel safety/equipment issues and call in support in a more timely fashion, potential reducing the magnitude of the harm and/or time lost from fishing.

Category

[1]Cost reductions and energy savings
[2]Increasing fishing efficiency
[3]Reducing the environmental/ecological impact
[4]Improving fish handling, product quality and food safety
[5]Improving safety at sea and working conditions of fishers

Northeast limited access scallop dredge fishery

A number of technological innovations have contributed to the economic performance of the limited access scallop fishery. Dredge rings have been modified over time to decrease bycatch of undersized scallops and flatfish, while maximizing retention of legal-sized scallops. A turtle deflector modification has been added to dredges to decrease bycatch of sea turtles, allowing scallop fishing to still occur in areas of high turtle abundance. Air-conditioned shucking houses are on board many vessels now, increasing crew efficiency and product quality in the summer months. More efficient lighting has decreased energy costs on board of the vessels. Finally, while not necessarily a fleet innovation, the use of rotational management has helped costs associated with searching for large aggregations of scallops.

[33] Information provided by Mr Victor Simon of NOAA's Northwest Fisheries Science Center.

Gulf of Mexico shrimp trawl vessels

Due to a drop in real shrimp prices (due to imports of farmed shrimp), the Gulf of Mexico shrimp fishery has substantially consolidated since 2000. Presumably, less efficient vessels left the industry. To save on fuel, some vessels employed newer net material as well as lighter (trawl) doors that lower the resistance to being dragged. Others vessel owners have focused on raising the dockside price by improving the product quality through innovations in handling, processing (heading) and freezing.

Hawaii pelagic longline vessels

Gear modification to reduce sea turtle bycatch began in 2004. In that year, the Hawaii pelagic longline fishery adapted fishing gear as required by regulation, switching from using a J-shaped hook with squid bait to a wider circle-shaped hook with fish bait for swordfish fishing. The adoption of circle-shaped hook technology showed significant and large reductions in sea turtle (a protected species) bycatch without compromising target species catches. Particularly, bycatch rates of leatherback and loggerhead turtles significantly declined by 83 percent and 90 percent, respectively, for swordfish fishing of the Hawaii pelagic longline. Prior to the adoption of the circle-shaped hook with fish bait, the Hawaii pelagic longline was closed for swordfish fishing from 2000 to 2004 by regulation, due to the high interaction rates with leatherback and loggerhead turtles in the fishery. The adoption of this technological innovation has likely saved the Hawaii swordfish fishery from a continuous closure.

8. SUMMARY DESCRIPTION OF NATIONAL PLANS AND POLICIES FOR ADJUSTMENT OF FLEET CAPACITIES

There are three overarching ways in which the United States National Marine Fisheries Service influences fleet capacity. The first is the direct removal of fishing capacity through the Fishing Capacity Reduction Program. Section 312(b) of the Magnuson-Stevens Fishery Conservation and Management Act authorizes the buy-back of fishing vessels and/or permits in order to control capacity. The second is an indirect approach whereby the National Marine Fisheries Service encourages and supports the design and implementation of catch share fisheries management. Catch shares are allocations of quantities of fish/shellfish to individual fishers or fishing groups. Through the economic incentives that catch shares provide for fishers, fishing capacity becomes aligned with the resource. The third approach is through limiting the number of fishing permits in a fishery, referred to as limited entry. Often, all three approaches are used in combination.

Since its implementation in 1996, there have been 5 fisheries which have utilized the Fishing Capacity Reduction Program.[34] In general, the mechanism for implementing capacity reduction is that a regional fishery management council proposes that a loan from the federal government be used to purchase and permanently remove fishing vessels and/or permits from a fishery. A majority of the fishers must approve the action through a referendum. Selection of vessels/permits, and the prices paid, are done through a bidding process. Fishers that remain in the fishery then pay back the loan through a fee placed on landings.[35]

There are currently 16 catch share programs in the United States. Similar to the Fishing Capacity Reduction Program, the National Marine Fisheries Service works with regional fishery management councils to design and implement the catch share

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[34] Through other provisions, there have been fishing vessel/permit buybacks through grants for which no repayment was required.

[35] For more information see: www.fisheries.noaa.gov/national/funding-and-financial-services/fishing-capacity-reduction-programs

programs. The 16 catch share programs operate in somewhat different ways, but all have as one of the underlying objectives the goal of reducing/minimizing fishing capacity.[36]

There are very few federally managed fisheries that do not have limited entry as a major feature of the rules governing the fishery. Often, there are limited entry permits issued to a component of the fleet, with relatively more liberal restrictions on fishing activity. Then there may be open access permits issued in the same fishery, which have highly limiting restrictions on fishing activity. While these open-access permits may be obtained by anyone, they are designed to accommodate a small amount of catch by vessels primarily operating in other fisheries and are structured to discourage rapid expansion of effort and/or capacity.

REFERENCES

FAO. 2018. *FAO yearbook. Fishery and Aquaculture Statistics 2016.* 104 pp.

Gillman, E. *et al.* 2007. *Reducing sea turtle interactions in the Hawaii-based longline swordfish fishery.* Biological Conservation, 139:1–2.

Kalberg, K.O. & M. Pan. 2015. *2012 Economic Cost Earnings of Pelagic Longline Fishing in Hawaii.* U.S. NOAA tech. Memo., NOAA-TM-NMFS-PIFSC-56, 60p. Doi: 10.7289/V5/TM-PIFSC-56.

National Marine Fisheries Service. 2018. *Fisheries Economics of the United States, 2016.* United States. Dept. of Commerce, NOAA Tech. Memo. NMFS-F/SPO-187, 243 p. www.fisheries.noaa.gov/content/fisheries-economics-united-states-2016

Northeast Fisheries Science Center (NEFSC). 2018. *65th Northeast Regional Stock Assessment Workshop (65th SAW) Assessment Report.* U.S. Dept Commer, Northeast Fish Sci Cent Ref Doc. 18-11; 659 p. Available from: www.nefsc.noaa.gov/publications

Sharp, R. & Sumaila, U. R. 2009. *Quantification of U.S. Marine Fisheries Subsidies. North American Journal of Fisheries Management 29:18–32, 2009.* www.enfestocean.org/en/news-and-publications/published-paper/quantification-of-us-marine-fisheries-subsidies

Somers, K. A., Pfeiffer, L., Miller S. & Morrison W. 2019. *Using Incentives to Reduce Bycatch and Discarding: Results under the West Coast Catch Share Program.* Coastal Management, January 15, 2019, 1–17. https://doi.org/10.1080/08920753.2018.1522492.

Warlick, A., Steiner, E. & Guldin M. 2018. *History of the West Coast Groundfish Trawl Fishery: Tracking Socioeconomic Characteristics across Different Management Policies in a Multispecies Fishery*. Marine Policy 93 (July): 9–21. https://doi:10.1016/j.marpol.2018.03.014.

[36] For more information see: https://www.fisheries.noaa.gov/national/laws-and-policies/catch-shares

Report of Brazil

National report of Brazil

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EXECUTIVE SUMMARY

The present report intended to provide a techno-economic evaluation of the five economically most important semi-industrial and industrial fishing fleets of Brazil in terms of quantity and value of total catch, their operational costs and of the generation of employment and income by these fleets. Unfortunately, fishers' syndicates from the four official coastal regions showed considerable reluctance to collaborate and provide data. Therefore, the objective of the survey could only partially be achieved.

Total annual landings by the marine capture sector in Brazil were around half a million tonnes in recent years. Of the four coastal regions, the Northeastern Region contributed in 2018 the largest share to the national marine capture fisheries production, followed by the South Region. Coastal marine resources are under pressure, which has resulted in a push into waters that form part of the outer areas of the EEZ and beyond. This has also had an impact on the species composition of the landings, with tuna and tuna like species showing a considerable growth over the years. In early 2018, a total of 23 901 vessels were active in marine capture fisheries. Brazil has considerable potential in aquaculture and inland fisheries, with a consequent shift in government attention and support.

In each of the four coastal regions several fishing fleets operate that commercially target the seafood resources available. The fishing methods and gears used are largely determined by the fish stocks, prevailing climate and sea currents. In the North Region, shrimp is the main targeted species, taking due advantage of the nutrients from the Amazon basin being deposited on the extended shallow continental shelf. Lobster is the main species in the Northeast region. Recently the Northeast Region ports have become the bases for a large part of the tuna longline fleet. The fishing fleets in the Southeast Region commonly target Brazilian sardine. The region also has important shrimp and demersal fish resources. Bottom trawling is the major fishing operation. The South Region has the largest number of vessels, including substantial gillnet and trawler operations.

The vast majority of the fleets' vessels are of advanced age, except for the leased and foreign tuna longline fleets, and are in dire need of an overhaul, technological renovation, and/or replacement. The latter is a slow process for the limited availability of suitable credit facilities. There is some replacement of vessels and new vessels entering the fleets that produce high value fresh and frozen tuna.

The calculation of several economic indicators applied in this report was constrained by the fact that information was either not available or was suspicious. Depreciation percentages and amounts provided by vessel operators surveyed did not concur with the age of the assets subject of depreciation. For the analysis, a depreciation percentage was applied over the initial investments, disregarding the age of the assets. It can be assumed that intangible assets do exist, but are not put in value terms and as such not included in the economic analysis. Therefore, the return on investment (ROI) was calculated over the initial investment and not over the sum of the current value of the tangible plus intangible assets, as this would have resulted in the same outcome for return on fixed tangible assets (ROFTA) and ROI.

The absence of comprehensive data on how these fishery activities are financed has as consequence that no reliable information is available on amortization and interest paid or due. Amortizations have a direct impact on gross profit, while the absence of interest payments increases net profits substantially in the format applied for the FAO global review study on the techno-economic performance of the main fishing fleets. Interest payments in countries like Brazil may present an additional challenge for the vessel owners, particularly when loans are in local currency. However, none of the vessel owners mentioned to use credit and therefore interest payment estimations were not used further in the calculations.

Data collection for the purpose of this techno-economic performance analysis of the various fleets was a challenge. Therefore, only a small number of fleets could be analyzed, more particularly the South Region fleets and some longline fleets. It was possible to collect technical data of the respective vessels, as well as data on the investment costs, operational expenditures and revenue from landings. However, data availability on the financing of these industrial fishing operations, on government support, if any, and on loan availability and terms (interests, amortization, among others), was very limited.

The data gaps mentioned above led to the following conclusions: For the five fleets active in the North Region not any financial data were provided. The technical data for these fleets did not allow financial analysis. Technical information on the fleets in the North Region is provided in Annex 1.

The two most important fishery activities in the Northeast Region target lobster and tuna. The information on the lobster fishery was very diverse, mainly because of the wide variety in methods and participants. The tuna longline fishery provided more technical and financial information which is summarized in Annex 2. With certain adjustments and creativity, a preliminary performance analysis could be performed.

TABLE 1
Northeast Region: Financial and economic indicators of tuna longline fleets, 2018

Indicators	Longline ice-fresh	Longline frozen -30ºC	Longline frozen -35ºC
	USD		
Estimated initial vessel investment	300 000	400 000	600 000
Revenue from landings	415 105	425 200	636 507
Labour costs	60 400	97 670	182 400
Running costs	99 000	198 060	262 200
Vessel costs	103 000	218 500	275 000
Total gross costs	262 400	514 230	719 600
Net cash flow	152 705	-89 030	-83 093
Depreciation	15 000	20 000	30 000
Amortization	0	0	0
Gross profit	137 705	-109 030	-113 093
Interest (5.95%)*	15 613	30 597	42 816
Net profit before taxes	137 705	-109 030	-113 093
Net profit margin	33%	-26%	-18%
Value of tangible assets**	105 000	140 000	210 000
Return on fixed tangible assets (ROFTA)	131%	-78%	-54%
Value of intangible assets	0	0	0
Return on investment (ROI)	46%	-17%	-19%
Gross value added (GVA)	213 105	8 640	99 307
GVA to revenue	51%	2%	16%

* Brazil Bank lending rate: Weighted average annual rate of interest charged on loans by commercial banks to private individuals and companies. September 2019: 5.95%. The interest listed in the table would be the amount if the government rate was applied over total gross costs. It is included in the table for illustrative purposes only.
** Value taken as 25% of the original investment costs in hull and main engine.

There are a few issues with the financial data that were provided. Annex 2 provides a comparative scheme of the data and it is obvious that some of the data are very suspect. The significant difference in operational costs between similar vessels and inconsistent sale price indicators indicate that conclusions, if any, should be used with major caution. From the economic indicators listed in the above table an obvious conclusion should be that the frozen tuna longliners will soon change practices towards landing fresh produce. The return on investment (ROI) for fresh tuna longlining is very good, and the profit margin is high. The figures for frozen tuna longliners contradict the reports from the field of private investments being made in this type of vessels in 2018.

For the five fleets active in the Southeast Region only technical data, with important omissions, were obtained, which are presented in Annex 3. The fishing fleets from the South Region provided data which allowed for a cautious economic analysis. Despite the limited number of vessels surveyed per category, there exist enough uniformity between the vessels. In considering the final figures, due attention should be paid to the low revenues reported by the shrimp trawling fleet, the suspicious similarity between the trawler vessels involved in different activities and the absence of tangible assets book values. In addition, some of the operational costs reported did not fully match the fishing methods and operations.

TABLE 2
South Region: Financial and economic indicators of fishing fleets, 2018

Indicators	Shrimp trawler	Demersal trawler	Bottom trawl
	USD		
Estimated vessel cost price	723 200	685 900	326 400
Revenue from landings	208 000	694 085	462 725
Labour costs	71 200	154 242	64 780
Running costs	100 634	335 935	242 160
Vessel costs	72 925	104 275	56 778
Total gross cost	244 759	594 452	363 718
Net cash flow	-36 759	99 633	99 007
Depreciation*	21 600	21 600	15 424
Amortization	-	1 235	43 700
Gross profit	-58 359	76 798	39 883
Interest (5.95%)**	14 563	35 370	21 641
Net profit before taxes	-58 359	76 798	39 883
Net profit margin	-28%	11%	9%
Value of tangible assets***	138 375	138 188	51 400
Return on fixed tangible assets (ROFTA)	-42%	56%	78%
Value of intangible assets****	0	0	0
Return on investment	-8%	11%	12%
Gross value added (GVA)	34 441	253 875	163 787
GVA to revenue	17%	37%	35%

* Value for Shrimp trawler taken from demersal trawler as technical characteristics are very similar.
** Brazil Bank lending rate: Weighted average annual rate of interest charged on loans by commercial banks to private individuals and companies. September 2019: 5.95 percent. The interest listed in the table would be the amount if the government rate was applied over total gross costs. It is included in the table for illustrative purposes only.
*** Value taken as 25 percent of the original investment costs in hull and main engine.
**** Fishing right payments were reported, but no period of validity or full amount was provided.

The economic indicators that are the result of the financial data provided, show a rather negative picture for the South Region fishing fleets, except for the demersal pair trawling vessels and the bottom trawlers, although the return on investment and the Net Profit Margin of the latter can be considered reasonable, at best.

Based on the results of this analysis it may be concluded that vessel owners will not be keen to re-invest in fisheries as even the average Government Bond yield of 5.43 percent cannot be attained for most fleets.

1. INTRODUCTION

In Brazil, syndicates that represent their fishing industry members negotiate with the government on the formulation and implementation of the fishery policies in the various regions. These policies include agreements on resource allocations and issues that impact on operational costs in the fishery, such as the eligibility for subsidies and tax exceptions.

The syndicates that were interested in participating in the review study, represent the four official coastal regions: SINPESCA representing the North Region; SINDIPESCA CE/PI and SINDIPESCA RN the Northeast Region; SIPESP and SAPESP the Southeast Region and SINDIPI the South Region. More syndicates are active in these regions, but most showed little inclination to collaborate with the author of this report within the framework of this techno-economic survey. Despite support from the Brazilian Government to the survey and its objectives, the limited collaboration by the syndicates resulted in major gaps in the required data for the pertinent economic and financial analysis.

The Brazilian coastline extends for some 8 500 km forming the basis for an Exclusive Economic Zone (EEZ) of approximately 3.5 million km^2, the 15th largest EEZ area in the world. Taking advantage of this situation, the Brazilian industrial marine fishing sector is assuming its due place as an important source of protein rich food and revenue for the country in general and coastal areas. The marine capture fisheries sector supplies basic raw materials to many national food processing industries. Although not a subject in this evaluation, it is important to take into consideration that Brazil also counts with some 5.5 million hectares of artificial freshwater reservoirs and vast natural inland river basins. In addition, marine and inland water aquaculture are rapidly increasing in importance as a reliable source of aquatic produce.

The main landing ports of marine seafood are located in the following cities (state): Belém (Pará), Camocim (Ceará), Natal (Rio Grande do Norte), Vitória (Espírito Santo), Rio de Janeiro and Niterói (Rio de Janeiro), Santos and Guarujá (São Paulo), Itajaí and Navegantes (Santa Catarina) and Rio Grande (Rio Grande do Sul).

The most recent reliable official fishery statistics date from 2011. Total national landings from capture fisheries reported were around 690 000 tonnes in 2011. Marine capture fisheries accounted for about 70 percent (or 553 670 tonnes) of this total, an increase of about 1 percent over the 2010 total (548 133 tonnes).

TABLE 3
Brazil: Seafood production by marine capture fisheries, by region, 2010–11 (in tonnes)

Region	2011	%	2010	% Change
North Region	94 265	17	89 552	+ 5
Northeast Region	186 012	34	195 313	- 5
Southeast Region	114 877	21	83 860	+ 27
South Region	158 516	28	179 408	- 12
Total	**553 670**	**100**	**548 133**	**+ 1**

Over time, the main species captured by the industrial fishing fleets have changed little and still mainly consist of pink shrimp, lobster, snapper and tunas (from the North and Northeast Regions), tunas, skipjack, sardines, croaker, mullet, shrimp and octopus (from the Southeast and South Regions). The FAO estimated marine capture production of Brazil over the period up till 2016 is presented in Table 4.

TABLE 4

Brazil: Total capture fisheries production, 2000–2016 (in tonnes)[1]

Year	tonnes	Year	tonnes	Year	tonnes
2000	666 846	**2011**	765 393	**2014**	767 026
2005	750 261	**2012**	820 112	**2015**	700 000
2010	785 369	**2013**	765 286	**2016**	705 000

The main marine species produced by Brazil's capture fishery fleets in 2011–2013 were: Brazilian sardinella (*Sardinella brasiliensis*), whitemouth croaker (*Micropogonias furnieri*), Skipjack tuna (*Katsuwonus pelamis*), striped weakfish (*Cynoscion acoupa*), flathead grey mullet (*Mugil brasiliensis*) and Atlantic seabob prawn (*Xiphopenaeus kroyeri*). More recently, the marine fishery sector has ventured into high seas fishing to offset overexploited and depleted coastal resources, landing annually around 40 000 tonnes of high value tunas and related fishes (swordfish and sharks). All fishing takes place in FAO Area 41 (Southwest Atlantic).

2. TECHNO-ECONOMIC AND OPERATIONAL CHARACTERISTICS OF FISHING FLEETS OPERATING IN BRAZIL

2.1 Characteristics of the fishing fleet

The fleet of active fishing craft, according to the National Fisheries and Aquaculture Collective (CONEPE), consists of some 24 000 vessels in total, with bottom gillnetter and bottom trawlers making up the lion's share of the total. Other sources, among them FAO, provide an estimate well above this total, which indicates that the number of active vessels within the respective fleets is dynamic. It is also argued that available data on fishing effort (gears, boats, active fishers) and landings are highly inconsistent.

TABLE 5

Brazil: Active fishing vessels, by gear type. April 2018[2]

Fishing methods	Fishing gear	North	Northeast	Southeast	South	Total
Hook & line	horizontal surface longline	11	168	577	71	**827**
	horizontal bottom longline	339	162	150	17	**668**
	vertical longline	81	28	15	0	**124**
	line / stick with live bait	0	0	16	31	**47**
	surface hand line	0	0	45	0	**45**
Gillnet	surface oceanic gillnet	179	74	631	547	**1 431**
	bottom oceanic gillnet	0	0	0	4	**4**
	surface coastal gillnet	6	798	71	983	**1 858**
	bottom coastal gillnet	1 442	500	454	3 680	**6 076**
	diversified coastal gillnet	0	1	0	64	**65**
Trawl	bottom trawling	164	1 334	1 816	1 824	**5 138**
	bottom coastal trawling	0	0	16	45	**61**
	bottom oceanic trawling	0	0	1	5	**6**
Purse seine	purse seine	0	1	411	357	**769**
Traps & pots	lobster traps	27	2 845	95	0	**2 967**
	red mullet traps	0	123	0	0	**123**
	pink snapper traps	0	0	12	1	**13**
	crab traps	0	1	0	1	**2**
	octopus pots	0	5	24	8	**37**
Diversified	fishing tackle net and diving	0	20	47	1	**68**
	diversified fishing coastal	11	315	2 032	223	**2 581**
	gillnet (drift)	0	0	0	991	**991**
Total		**2 260**	**6 420**	**6 368**	**8 853**	**23 901**

[1] FAO Statistical Yearbook (2018).

[2] National Fisheries and Aquaculture Collective (CONEPE), General Registry of Fishing Activity System (SisRGP).

In the category of Traps and Pots, the lobster fishing fleet is by far the most important and employs a variety of boats, methods and gears. Most of the vessels participating in the lobster fishery are <8 meters in length and mostly made of wood and a few of glass fiber reinforced plastic (GRP). Lobster fishing is practiced up to 100 meters depth and the activity generally takes place in an area within 20 miles from shore.

The tuna longline fleet is characterized by a considerable variety of target species, fishing methods, preservation techniques and intended markets. The landings of high-quality tuna and tuna-like species continued to expand in recent years. However, most landed tuna consists of skipjack, generally of lower monetary value, caught by the national pole and line fleet and a few purse seiners within the Brazilian EEZ. Foreign interests in the tuna fishery is high, particularly in fresh tuna for the lucrative sashimi markets.

TABLE 6
Brazil: Characteristics of the tuna and tuna like capture fleets (2018)

Fleets	National surface longliners	Leased surface longliners	Longliners	Freezer longliners	Super freezer longliners	Pole and line vessels
Vessel number	46	34	55	23	20	45
Hull length (m)	16–30	24–28	16–30	28–35	42–52	18–35
Gross tonnage (GT)	40–200	40–200	-	150–450	550–750	190–330
Power main engine (kW)	75–317	112–150	70–150	270–388	746–1193	157–970
Hull type	Wood, Aluminum	Steel, GRP, Aluminum	Wood, Aluminum	Steel	Steel	Wood, Steel
Average age of vessels (years)	>20	>20	>20	>20	>30	>30
Conservation method	Ice	Ice	Ice	Frozen -25°C	Super frozen -55°C	Ice
Main target species	Big-eye, Swordfish	Big-eye, Swordfish	Skipjack, Big-eye, Swordfish	Albacore, Mackerel, Shark	Tuna, Tuna-like	Skipjack

The national surface longline fleets consisted in 2018 partly of vessels previously used in other fisheries, but modified with technologies for tuna longline fisheries. These vessels have limited autonomy, which restricts their operations and economic performance. Due to age and generally poor maintenance, renewal or comprehensive overhaul and modernization of this fleet is very much due. While the high-quality swordfish and big-eye tuna captured is exported fresh to outlets in the United States of America, the remainder of the catch is sold fresh on the national market and to the national canning industry.

In addition, there is a surface longline tuna fleet made up of leased vessels. As with the national longline fleet, it concerns vessels of >20 years of construction, but these vessels have been subject to high quality maintenance and timely technological updates. Landings consist largely of tuna and tuna-like fish, particularly big-eye tuna (*Thunnus obesus*) and swordfish (*Xiphias gladius*), which are exported fresh to the United States of America.

The freezer longline vessels target tunas and the tuna like species. These include albacore (*Thunnus alalunga*), big-eye, swordfish, mackerel and sharks. The fish is processed on board and exported frozen to various international markets. There is also the longline fleet that is being referred to as the super freezer longliners. The vessels that make up this fleet, mainly of Asian origin (Taiwan PC, Japan, South Korea), have an extended autonomy and target high value tuna and tuna like species, which are processed on board, super-frozen (-55°C), and primarily exported to Asian markets.

The tuna pole and line fleet that targets skipjack (*Katsuwonus pelamis*) is 100 percent national owned. It produces fresh, high quality produce, mainly destined for the national canning industry. The fleet of bait boats that support this pole and line fleet consists of about 45 vessels, is divided over different ports, but primarily concentrated in the Southeast and South Regions.

The majority of all fishing vessels in Brazil is of an advanced age and will require replacement soon. The Brazilian fleet engaged in deep-sea fishing is old, poorly maintained, technically outdated, unproductive and with limited autonomy. These vessels are almost always adapted coastal fishing vessels that moved their operations further off-shore.

Marine capture fisheries are an important source of employment and revenue, in addition to a much-appreciated source of nutrient rich food. Crews on the fishing vessels are nearly all men and the age distribution shows that most are in the range of 20 to 49 years of age.

2.2 Financial services and assistance available to the fishery capture sector

In Brazil, two official credit institutions are dedicated to the fishery industry. FINAME finances, through accredited financial institutions, the production and acquisition of new machinery and equipment by and from national manufactures. PROFROTA finances the acquisition, construction, conversion, modernization, replacement, repair and equipping of fishing vessels. In the past, these institutions were instrumental for fleet modernization, but more recently their lending activities have experienced a substantial decline as they do not accept vessels as collateral. Private financial institutions provide credit to well established fishing companies. Small-scale fishing enterprises find it harder to obtain credit, because of the prevailing poor image of the fishery sector. Now (2018–19), it is observed that some vessel owners are investing, commonly with their own financial resources, in the adaptation and construction of vessels, especially longliners, for the capture of tunas.

No major government subsidy, exemption or incentive schemes are currently in place to assist the fishing industry in enhancing its economic performance.

2.3 North Region

2.3.1 North Region: Bottom trawl and vertical longline fishing vessels

The marine fishing sector in the North Region of Brazil sustains a significant part of the national production, largely due to the nutrients coming from the Amazon basin. This region's main fishing fleet consists of industrial bottom trawl vessels, aimed at capturing pink shrimp (*Farfantepenaeus subtilis*), with an associated economically important shrimp processing sector. Snapper is another important species landed, primarily caught by vertical longline vessels. The category Diverse Fishing refers generally to a range of unspecified trawl operations. Discards are few as most species caught find a ready market. Details on the technical characteristics of the North Region's fleets can be found in Annex 1.

No information is available on policies and plans for the development of these fleets and related fishing operations in terms of fishing effort management, fleet capacity control, vessel renewal, vessel scrapping, new fishing areas and/or target species.

TABLE 7
North Region: Overview of fishing fleets

Fishing fleet by gear type	Number of vessels	Scale	Target species	Main fishing ports
Bottom trawl	101	Industrial	Pink shrimp	Belém
Vertical longline	150	Industrial	Snapper	Bragança, Augusto Correa, Vigia, Belém
Pair trawl	48	Industrial	Various	Belém
Traps	30	Industrial	Snapper	Bragança, Augusto Correa
Diverse fishing	150	Industrial	Various	Belém

TABLE 8
North Region: Main species commonly landed by fleets (by rank of importance)

Fleets	1	2	3	4	5
Bottom trawl	Pink shrimp (*Farfantepenaeus paulensis*)	Seabob shrimp (*Xiphopenaeus kroyeri*)	White shrimp (*Litopenaeus* spp)	Hake (*Merluccius* spp)	White hake (*Urophycis* spp)
Vertical longline	Snapper (*Lutjanus alexandrei*)	Lane snapper (*Lutjanus synagris*)	Amberjack (*Seriola* spp)	Piranga snapper, *Rhomboplites aurorubens* (Cuvier, 1829)	Grouper (*Epinephelus marginatus*)
Pair trawl	Goliath catfish (*Brachyplatystoma rousseauxii*)	Pink catfish	Dolphinfish (*Coryphaena hippurus*)	White hake	Yellow catfish
Traps	Snapper	Grouper	Lane snapper	Piraña	Red fish (*Sciaenops ocellatus*)
Diverse fishing	Catfish	White catfish	Hake	Yellow hake	Croaker (*Sciaenidae* spp)

2.4 Northeast Region

2.4.1 Northeast Region: Techno-economic and operational characteristics of the fishing fleets

Despite the vast coastal extension, the volume of seafood produced is lower than in the North region, because of the hot waters of the Brazilian and South Equator currents, associated with the small width of the continental shelf. The major semi-industrial and industrial fishing fleets that operate in the Northeast Region can be identified by the species targeted. The primary species targeted consist of lobster, tuna, snapper, shrimp and miscellaneous fin fish.

The red spiny lobster (*Panulirus argus*) and the green spiny lobster (*Panulirus laevicauda*) fishery is economically the most important in the Northeast Region. The lobster fishery is characterized by a large variety of methods, techniques, gears, boats and fishers. The gear most commonly used is the rectangular single-entrance trap. Available data on the fishing effort (gears, boats, fishers and landings, among others) are highly inconsistent and fragmented. No economic and financial data on investment and operational aspects of this important fishery were provided by the region's industry representatives. The lobster fishery is important to the region, because of the economic value its represents, its export potential and its impact on the local economies.

Many of the vessels that belong to the various longline fleets use ports in the Northeast Region as their base. The part of the surface longline fleet that is under domestic ownership consists partly of adapted vessels from other fisheries. Despite being outfitted with technology already used successfully by the leased foreign longline fleet, the adapted vessels continue to show operational limitations and restricted autonomy. Production consists primarily of fresh tuna and tuna-like fish for the domestic market and canning industry. Swordfish and big-eye tuna are exported fresh to the United States of America.

Vessels in the leased surface longline fleet are generally over 20 years of age, but receive high quality maintenance and are fitted with up-to-date technology. Landings consist of tunas and tuna-like fishes (big-eye tuna and swordfish), which are mostly exported fresh to major world markets.

The freezer long line fleet targets tunas and tuna-like fishes (big-eye and albacore tuna, swordfish, mackerel, sharks). The fish is processed on board and exported frozen. This fleet, consisting of some 23 in 2018, has characteristics very similar to the fresh longline fleet. The age of the vessels is well over 20 years for most of the vessels in this fleet.

Almost all the foreign super freezer longline vessels are of Asian origin. These vessels enjoy an extended autonomy and target tuna and the tuna-like species, which they process and super freeze (-55 °C) on board, for subsequent export to Asian markets. There were about 20 of these vessels in operation in 2018. They are based in the Northeast Region and are substantially larger than the fresh longliners, in size, engine capacity as well as autonomy. Detailed information on the technical characteristics and economic performance of these tuna and tuna-like fish longline fleets can be found in Annex 2.

2.5 Southeast Region

2.5.1 Southeast Region: Techno-economic and operational characteristics of the fishing fleets

There is a significant primary productivity caused by seasonal upwellings, particularly in the coastal area in front of the cities of Santos and Rio de Janeiro. This is of prominent importance for the small pelagics and demersal finfish resources. The region's fishing fleets consisted in 2018 of a Brazilian sardinella purse seine fleet (5 vessels); pink shrimp trawling fleet (7 vessels); demersal finfish pairtrawling fleet (10 vessels); octopus fishing fleet (6 vessels) and a Seabob shrimp trawling fleet (5 vessels). In addition, there was some fishing activity taking place using gillnets (pelagics), surface horizontal longline (tuna) and pole/bait (skipjack). The artisanal fishery accounts for about half of the landings in this region. The various fleets reported bycatch, but no fish is discarded. All fish caught is landed, has financial value and market demand.

TABLE 9
Southeast Region: Main species landed by the various fishing fleets[3]

Fleets Species targeted	1	2	3	4
Pelagic purse seine fishing fleet	Brazilian sardinella (*Sardinella brasiliensis*)	Bluefish (*Pomatomus saltatrix*)	Horse mackerel (*Scomberomorus brasiliensis*)	Herring
Shrimp trawler fishing fleet	Pink shrimp	Red shrimp	Argentine stiletto shrimp (*Artemesia longinaris*)	Brazilian flounder (*Paralichthys orbignyanus*)
Demersal fish pair-trawler fishing fleet	Argentine croaker (*Umbrina canosai*)	Striped weakfish (*Cynoscion guatucupa*)	King weakfish (*Macrodon ancylodon*)	Pink cusk-eel (*Genypterus blacodes*)
Octopus fishing fleet	Octopus (*Octopus* spp)	-	-	-
Seabob shrimp fishing fleet	Seabob shrimp	Argentine stiletto shrimp	Red shrimp	Croaker (*Sciaenidae* spp)

The available technical information on the fishing vessels used in this region is very limited and insufficient to conduct a performance analysis. All vessels in these fleets are reportedly older than 20 years. The collected technological data of the fishing vessels with base in the Southeast Region can be found in Annex 3. Information on the investments made, operational costs and revenues obtained from the fishing operations was not available for vessels from this region.

2.6 South Region

2.6.1 South Region: Techno-economic and operational characteristics of the fishing fleets

The marine fishing industry is important for the South Region as a major source of employment. The region's fishery industry is also an important source of food for the coastal and regional population. Although all produce that is landed is used as food for human consumption, some species are regularly discarded at sea for lack of holding space and/or low market value. These species are the guitarfish (*Rhinobatos horkeli*), angel sharks (*Squatinidae* spp) and the grey mullet (*Mugil brasiliensis*).

The fishing industry in the South Region consists primarily of industrial and semi-industrial purse seiners and trawlers. The purse seine fishing fleet is recognized to be one of the best equipped fishing fleets in the country in terms of fishing gears and

[3] Ranked from 1 to 4, with 1 being considered the most important.

preservation methods. The trawler fleet operates in an area that extends between 30 and 50 miles from shore, while the purse seine fleet's operation radius can be up to 150 miles from shore. In 2018, there were just over 100 purse seiners active and about 145 trawlers, of which the vast majority targets shrimp resources. There is also a small fleet of pole and line (skipjack) vessels, in addition to a couple of gillnet and pair trawling vessels. The fleets operate in FAO Area 41. Vessel crew members on these fleets generally are between 20 and 49 years.

TABLE 10
South Region: Main species landed by the various fishing fleets

Fleets	1	2	3	4	5
Shrimp trawling	Pink shrimp (*Farfantepenaeus paulensis*)	Red spotted shrimp (*Litopenaeus brasiliensis*)	Shrimp Pitú (*Macrobrachium carcinus*)	Brazilian codling (*Urophycis brasiliensis*)	Squid (*Loliginidae* spp)
Demersal trawling	Hake (*Merluccius* spp)	Whitemouth croaker (*Micropogonias furnieri*)	Sand drum (*Umbrina coroides*)	King croaker (*Sciaenidae* spp)	Brazilian codling
Bottom trawling	Hake	Brazilian flounder	Sea robin (*Triglidae* spp)	Brazilian codling	Slipper lobster (*Scyllaridae* spp)
Purse seining	Brazilian sardinella	Atlantic threat herring (*Opisthenoma oglinum*)	Blue runner (*Caranx crysos*)	Flathead grey mullet (*Mugil brasiliensis*)	Atlantic bumper (*Chloroscombrus crysurus*)

TABLE 11
South Region: Average age of fishing vessels in respective fishing fleets (in percentages)

Fleets	<5 years	5–10 years	15–20 years	>20 years
Shrimp trawling	10	30	50	10
Demersal trawling	-	-	-	100
Bottom trawling	-	40	40	20
Purse seine	-	-	100	-

Information on the common technical characteristics of the main fishing fleets active in the South Region can be found in Annex 4.

TABLE 12
South Region: Average volume of annual landings and value per kilo of product landed in 2018, per vessel type in USD

Fleet/species	Quantity (tonnes)	Ex-vessel value (in USD)[4]	Fleet/species	Quantity (tonnes)	Ex-vessel value (USD)
Trawling (shrimp)	180	4.00/kg	Purse seine (palometa – *Chloroscombrus chrysurus*)	300	0.25/kg
Trawling (finfish various species)	2 400	0.85/kg	Purse seine (chub mackerel – *Scomber Japonicus*)	300	0.30/kg
Trawling (finfish high value species)	2 000	1.30/kg	Purse seine (bluefish)	200	1.30/kg
Purse seine (sardine)	400	0.50/kg	Purse seine (mullet)	200	1.30/kg

Annex 5 contains data on investment costs, current values and depreciation rates of the South Region fleets. Information on annual earnings and operating costs of fishing vessels belonging to the shrimp trawling, demersal trawling, bottom trawling and purse seine fleets from the South Region, can be found in Annex 6.

REFERENCES

FAO. 2010. *Fishery and Aquaculture Profiles. Brazil.* Country Profiles Fact Sheets. In: FAO Fisheries and Aquaculture Department, Rome. Updated 1 June 2010. www.fao.org/fishery/

[4] USD 1 = BRL 3.89 (or BRL 1 = USD 0.26) – exchange rate of 16 April 2019.

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Report of Chile

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National report of Chile

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SUMMARY

Chile is a country richly endowed with elements for a successful fisheries sector. Capture fisheries started in all earnest in the 1950s. Fish landings reached a peak in 1994 with 6.8 million tonnes, but have since declined steadily as a result of earlier overexploitation of the (pelagic) resources as well as management measures. The composition of the exports reflects this trend, with a dominance of high value finfish species and fishmeal from pelagic species mainly for the extensive and successful national marine aquaculture operations. Still, pelagic species continue to dominate landings by the national capture fishery fleet.

The commitment of the government is to conceive and implement the official fishery policy and management systems to guide and enhance the development of the industrial, artisanal and aquaculture sub-sectors. Except for establishing, distributing and monitoring annual quotas, the direct involvement of the government is very limited.

TABLE 1
Chile: Basic average data on fishing fleets based on vessels included in the survey

Characteristics	Longline vessels	Trawler vessels	Industrial purse seiners	Artisanal purse seiners	Southern purse seiners
Overall length (LOA) (meters)	63.00	54.00	66.00	18.00	66.00
Gross tonnage (GT)	1 165	949	1 409	113	1 572
Total power of main engine (kW)	1 185	1 180	3 400	430	3 460
Capacity of on-board storage facilities (m^3)	922	920	1 600	75	1 640
Number of crew (persons)	49	49	17	10	19
Ownership	Private	Private	Private	Private	Private
Total days of fishing at sea per calendar year	300	300	112	60	118
Number of fishing trips per calendar year	2-3	2-3	35	60	30
Length of main fishing season (in months)	3-5	3-5	8	3-4	8
Average initial investment per vessel (thousands of USD)	4 980	2 451 (hull only)	13 999	320	25 174
Average age of vessels' hull (years)	18	41	24	24	20
Number of vessels in the survey/ Total units in fleet	3/8	3/8	11/88		

Although the fishing vessels are generally of an advanced age, they are reasonably well maintained and well equipped with harvesting and electronic equipment for the tasks at hand. Improvements have been made on most vessels in order to increase efficiency, meet environmental requirements and improve marketability of the produce landed.

Data required for a comprehensive financial and economic evaluation of the respective fishing fleets are scarce and fragmented. This is mainly due to the reluctance of the ship owners to provide costs and earnings information and the fact that official data collection is primarily focused on landings. Particularly data on investments and depreciation rates are lacking, partly because of the advanced age of these investments. Data availability on the financing of these industrial operations, particularly on loan terms (interests, amortization, among others), is also limited.

The random sampling of vessels of each fleet resulted in a representative sample. The variation between the vessels within the respective fleet is within range. The average scores obtained on the techno-economic performance can therefore be considered workable for the intended analysis.

TABLE 2
Chile: Financial indicators on operations of domestic industrial fishing vessels

Indicators	Longliner fleet	Trawler fleet	Industrial purse seiner fleet	Artisanal purse seiner fleet	Southern purse seiner fleet
	USD				
Initial investment costs	4 979 843	2 451 286	14 480 346	196 000	25 174 323
Revenue from landings	6 544 119	4 579 651	10 049 507	182 000	9 234 333
Labour costs	2 001 316	1 662 864	942 252	16 308	1 075 018
Running costs	1 622 567	869 341	840 641	8 688	1 324 932
Vessel costs	1 858 663	1 787 331	3 122 481	54 833	5 065 803
Total gross cost	5 482 546	4 319 536	4 905 374	79 829	7 465 753
Net cash flow	1 061 573	260 115	5 144 133	102 171	1 768 580
Depreciation	0	260 114	859 186	0	1 027 381
Amortization	0	0	0	0	0
Gross profit	1 061 573	1	4 284 947	102 171	741 199
Interest	0	0	0	0	0
Net profit before taxes	1 061 573	1	4 284 947	102 171	741 199
Net profit margin	16%	0%	43%	56%	8%
Value of tangible assets	1 813 097	803 764	3 196 828	228 165	8 698 401
Value of intangible assets	0	0	0	0	0
Return on fixed tangible assets (ROFTA)	59%	0%	134%	45%	9%
Return on investment (ROI)	21%	0%	30%	52%	3%
Gross value added (GVA)	3 062 889	1 922 979	6 086 385	118 479	2 843 598
GVA to revenue	47%	42%	61%	65%	31%

The economic indicators of the Chilean fishing fleets, with the noticeable exception of the trawler fleet vessels, were rather encouraging in 2018–19. An explanation of the poor performance of the trawler fleet lies most probably in the fact that the ex-vessel price for its landings is not determined by market forces, but rather by the processing plant where they land their products, and which often owns the vessel. An estimate of the production costs was therefore taken as the sale price in the financial calculations.

Vessel costs, and more particularly the costs made for fishing licenses and rights, affected the economic performance of the Southern Purse Seine Fleet. At the same time, the total amount of tangible assets was remarkable and substantially superior compared to the other fleets included in the analysis.

The depreciation amounts provided by most vessels were very suspect in view of the age of the vessels and the fact that part of the tangible assets may be of a younger age (engines, on-deck equipment, among others). Amortization of loans, interest payment information and other financial instruments put at the disposal of the respective vessels, ranging from short to long term commitments, were not provided by any of the vessels. However, it is not very sensible economically if these vessels and operations would be fully financed by internal liquid financial assets. In general, no information was provided on taxes levied and/or paid. Intangible assets were not valued although these could be considered assets, particularly in the fresh fish trade.

As a result of these latter points, the return on investment (ROI) was calculated over the initial investment and not over the sum of the current value of the tangible plus intangible assets. The consequence is that return on fixed tangible assets (ROFTA) and ROI are different in this report, despite the fact that intangible assets were not valued.

The gross value added of the vessels in the different fleets analysed was substantial. The return on investment (ROI) of vessels of various fleets was good to excellent. The ROI of three of the five fleets included in the analysis was well above the opportunity cost of capital, if the average 10-year yield on government bonds (2.97 percent) is taken as a guideline. The Chile 10 Years Government Bond reached a maximum yield of 4.95 percent (15 October 2018). One can, therefore, conclude that an investment in the fishery fleets included in the survey is attractive from a financial point of view.

Based on the results of this analysis it may be concluded that vessel owners will likely be keen to continue to invest in fisheries in Chile. This would be particularly encouraging as the fishery resource management model as pursued by the Chilean authorities seems to guarantee continued profitability.

1. INTRODUCTION

Chile is often defined by the geopolitical concept of a tricontinental country, consisting of Continental Chile (mainland on the South America continent), Insular Chile (Easter Island in Oceania/Polynesia), and the Chilean Antarctic Territory (Chilean territory on Antarctica).

Continental Chile extends between parallels 17°29'57''S and 56°32'12''S, with a coastline of some 6 435 km, a land mass of 756 100 km^2 and an Exclusive Economic Zone of 3 681 989 km^2. Due to the Humboldt Current, the Chilean Sea is considered among the most productive marine ecosystems in the world.

During past decades, Chile has been one of Latin America's fastest-growing economies based on a solid macro-economic framework. The economy is highly dependent on international trade, with exports accounting for more than one-third of GDP. Foreign trade is widely liberalized with uniform, low tariffs and few non-tariff barriers in place.

The country´s total population stood at about 17.9 million persons in 2016 and the GDP growth was calculated at 1.3 percent, while inflation was 4.35 percent. In 2016 official sources reported an overall unemployment of 6.5 percent, while at the same time mentioning that informal jobs constituted 20 to 25 percent of all jobs. Overall, governmental policy is focused on general assurance and maintenance of the rules of the game.[1]

Chile did not participate in previous FAO global studies on the techno-economic performance of the main fishing fleets (1995/1997, 1999/2000 and 2002/2003). The objective of the present evaluation of the techno-economic performance of the Chilean fleets is to compare the financial and economic performance of the respective fishing fleets in Chile with those in other major fishing nations. In 2016, the Chilean marine fishery sector produced 1.8 million tonnes or nearly two percent of the global capture fisheries production and was therefore included in this FAO techno-economic performance evaluation of the global fishing fleets.

The present study on the economic performance of the main Chilean fishing fleets, which covers the period 2018–19, shows that marine capture fishing is a financially viable economic activity. It generates enough income to cover depreciation costs, opportunity cost associated with capital, as well as financial resources for reinvestment.

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1 The World Bank Group, Chile Overview, accessible at: www.worldbank.org/en/country/chile

In addition, it constitutes a very importance source of employment and foreign currency.

2. OBJECTIVES AND CONTEXT

Chile, one of the major players in the world fishing scene, has experienced over the past few decennia issues of over-investment, sharply fluctuating catch levels, disputes among stakeholders, fleet downsizing and an impressive and challenging development in aquaculture, among others. Official policy and management systems have evolved to guide and enhance the development of the industrial and artisanal fisheries and aquaculture sub-sectors. The commitment of the government is to facilitate the performance of the seafood industry by implementing a comprehensive and balanced fishery sector development policy based on legislation that is conceived, drafted and approved with cross sectoral participation and consensus.

The principal legislation on fisheries is contained in the General Law of Fishing and Aquaculture (Law No. 18,892 of 1989 and its amendments), supplemented by decrees and regulations. These are in line with common and acceptable international standard norms and procedures. In February 2013 access to specific portions of national marine resources were assigned for a period of 20 years, to industrial and artisanal fishing. This has turned out to be quite a controversial amendment to the General Law. It was looked at with suspicion by certain groups of fishers, as the amendment seemed to favour the industrial sector in the distribution of the annual quotas. New amendments were under development at the time of this study.

From the late 1980s onwards, most pelagic and demersal fish resources in Chile's EEZ have been fully exploited. Vessel access to the various resources is limited and regulated. Since 2001 maximum catch limits have been in effect and annual catch quotas have been assigned to the participants in the fisheries. Marine capture fishing in Chile has an industrial and artisanal component, each being assigned a share of the available catch quotas. The 1991 General Law also allows for the establishment of coastal fishing management areas, reserved for and operated by legally constituted artisanal fishers' organizations, mainly for the sustainable exploitation of benthonic resources.

A major share of the overall current landings by the semi-industrial and industrial marine fishing fleets consisted in recent years of pelagic species, representing about 75 percent of the total landings. These pelagics mainly included jack mackerel (*Trachurus murphyi*), anchovy (*Engraulis ringens*), mackerel (*Scomber japonicus*) and common sardine (*Sardinops sagax*). Demersal finfish species made up the lion's share of the remaining 25 percent. These demersal species included, among others, Southern hake (*Merluccius australis*), kingclip species (*Genypterus* spp), Patagonian toothfish (*Dissostichus eleginoides*) and Chilean hake (*Merluccius gayi*). Economically important additional fishery activities targeted jumbo squid (*Dosidicas gigas*) and various shrimp species.

The composition of exports of marine fisheries and aquaculture products has also substantially changed over the years in accordance with the resources' status. Chile was a major exporter of fishmeal and canned seafood products, based on record landings of pelagic species. However, exports of fresh and frozen finfish have been dominating more recently, consisting largely of aquaculture produce and high value wild finfish caught by the industrial fleet. Aquaculture operations, particularly of salmon, have become one of the most dynamic and profitable productive activities in Chile. Next to Atlantic salmon and related species, culture operations of molluscs, bivalves and seaweeds showed increased production trends.

The 2019 analysis of economic performance of some major fishing fleets in Chile encompasses information compiled during the years 2016, 2017, 2018 and 2019. The main fleets covered in this report represent the following fishing activities: purse seining, trawling, longlining and advanced artisanal fishing.

TABLE 3
Chile: Total capture fisheries production, 2000-2016 (in tonnes)

Year	tonnes	Year	tonnes	Year	tonnes
2000	4 547 594	**2011**	3 466 959	**2014**	2 592 790
2005	4 738 165	**2012**	3 008 915	**2015**	2 131 953
2010	3 048 316	**2013**	2 288 885	**2016**	1 829 238

Source: FAO Statistical Yearbook 2018.

3. CHARACTERISTICS OF THE FISHING FLEETS OPERATING IN CHILE

For 2017, total landings by the industrial fleet reached 855 203 tonnes, of which some 3 500 tonnes corresponded to fishing operations in international waters (SPRFMO Area). Approximately 92 percent of these landings by industrial fishing vessels in international waters consisted of Chilean jack mackerel (*Trachurus murphyi*). To the total industrial fleet landings should be added the landings by the fleet of factory vessels, totaling 48 000 tonnes, of which 38 percent (18 240 tonnes), originated from operations in international waters.

As in previous years, the landings in 2017 consisted largely of pelagic species caught by the industrial purse seine fleet, representing 90 percent of the total tonnage captured. The main species landed by this sub-sector were anchovies and jack mackerel, accounting together for 82 percent of the total industrial landings. The overall 2017 catches by industrial vessels operating in international waters registered a 50 percent decrease compared to 2016.

A total of 143 industrial fishing vessels reported operations during 2017, which represents an increase of five percent over 2016. In terms of fishing vessel type, the purse seine fishing fleet is the largest with 88 vessels operating. The remainder of the industrial fleet is made up of 44 trawlers, 8 longline vessels and 3 vessels operating traps. The fleet operates primarily in FAO fishing area 87 (Southeast Pacific).

TABLE 4
Chile: Summary of the main fishing fleets operations

Fishing fleets according to type		Total vessels	Vessels in survey	Radius of operation	FAO area	Main ports for these fleets
1	Longline fleet	8	3	0–2 500 Km	87	Porvenir, Punta Arenas
2	Trawler fleet	44	3	0–2 500 Km	87	Puerto San Vicente
3	Purse seine fleet	88	3	0–2 500 Km	87	Puerto San Vicente, Lota
4	Artisanal fleet	no data provided	3	0–10 Km	87	Puerto San Vicente, Lebu, Lota
5	Southern purse seine fleet	(Included in 88)	3	0–2 500 Km	87	Puerto San Vicente
6	Trap vessel fleet	3	0	0–5 Km	87	-

The main Chilean fishing ports are Porvenir, Punta Arenas, Puerto San Vicente, Talcahuano, Puerto Lirquen, Tome, Lebu, Lota, and Coronel. The most important fishing fleets in Chile consist of a longline fleet, a trawler fleet, purse seine fleets and the artisanal[2] fleet.

The purse seine fleets target primarily anchovies and mackerels. The artisanal fleet, in addition to the pelagic species, also dedicates effort to other accessible commercial species, depending on seasonal availability, with main species being octopus (*Octopus vulgaris*) and giant squid. The trawler fleet focusses mainly on the hake species and

[2] In Chile, the artisanal fishery is defined as a capture fishing activity carried out by natural or legal persons composed of fishers who operate in a personal, direct and habitual way, using vessels of up to 18 meters in length (LOA) and 50 tonnes Gross Tonnage (GT).

giant squid, while the longline fleet targets primarily high value fish, such as Patagonian toothfish, swordfish (*Xiphias gladius*), as well as various kingclip and tuna species (*Thunnus* spp).

TABLE 5
Chile: Main target species of the fishing fleets included in the survey*

Fishing Fleets		1	2	3	4	5
1	Longline fleet	**Patagonian toothfish** *Dissostichus eleginoides*	**Golden kingclip** *Genypterus blacodes*	**Red kingclip** *Genypterus chilensis*	**Swordfish** (*Xiphias gladius*)	**Oceanic Whitetip shark** *Carcharhinus* spp
2	Trawler fleet	**Chilean hake** *Merluccius gayi*	**Hoki** *Macruronus Magellanicus*	**Jumbo squid** *Dosidicas gigas*	**Antarctic whiting** *Merluccius australis*	-
3	Industrial purse seine fleet	**Jack mackerel** *Trachurus murphyi*	**Mackerel** *Scomber japonicus*	**Sardine** *Sardinops sagax*	**Anchovy** *Engraulis ringens*	**Mote sculpin** *Normanichthys crockeri*
4	Artisanal purse seine fleet	**Sardine** *Sardinops sagax*	**Anchovy** *Engraulis ringens*	**Jack mackerel** *Trachurus murphyi*	**Octopus** *vulgaris*	-
5	Southern purse seine fleet	**Jack mackerel** *Trachurus murphyi*	**Mackerel** *Scomber japonicus*	**Pilchard** *Sadinops sagax*	**Bonito** *Sarda chilensis*	**Sardine** *Clupea benticki*

* Ranked from 1 to 5, with 1 being considered the most important.

Vessels belonging to the various fleets, generally target the species they have annual catch quotas for. By-catch is an issue, but very few regulations are in place that oblige the use of fishing gear and harvesting techniques aimed at reducing by-catch. Bycatch is not considered an important constraint to the various fisheries. The introduction of the catch quotas also resulted in an important reduction in discards. Discards are allowed, though discouraged, and mainly the result of storage space considerations, size limitations and marketability. The main discarded species by the various fleets are shown in Table 6.

At the national level, the fishing industry plays a crucial role as a source of protein rich food, as well as within the overall food security context. In addition, it is an important source of employment. Although the overall employment in fisheries is substantial, information from the vessels that participated in the present survey indicates that the work force consists largely of part-time employees, while the number of full-time paid employees is limited. There are very few female fishers.

As a rule, the government does not provide subsidies, tax or import tax exemptions and/or incentives to enhance the economic performance of the fishery industry. There appears to be scope for flexibility in the fuel pricing mechanism to allow for some subsidy. Small and Medium Size Enterprises (SMEs) receive a beneficial treatment through the tax system.

TABLE 6
Chile: Main species discarded at sea by the fleets included in the survey*

Fleets/species discarded in the sea		1	2	3	4	5
1	Longline fleet	**Dogfish** *Mustelus spp*	**Croaker** *Cilus montti*	**Swordfish** *Xiphias gladiius*	**Silver fish** *Seriolella caerulea*	**Elephant fish** *Callorhynchus*
2	Trawl fleet	**Octopus** *Octopus vulgaris*	**Dogfish** *Mustelus mento*	**Skate** *Raja* spp	-	-
3	Industrial purse seine fleet	**Silver fish** *Seriolella caerulea*	**HokiTotal le** *Macruronus Magellanicus*	-	-	-
4	Artisanal purse seine fleet	**Dogfish** *Mustelus mento*	**Jack mackerel** *Trachurus murphyi*	**Octopus** *Octopus vulgaris*	**Anchovy** *Engraulis ringens*	**Hoki** *Macruronus Magellanicus*
5	Southern purse seine fleet	**Snoek** *Thyrsites* spp	**Octopus** *Octopus vulgaris*	-	-	-

* Ranked from 1 to 5, with 1 being considered the most important.

Fishing vessel owners that actively participate in the respective fisheries do have access to credit from national and international financial institutions. The loans are mainly used for the financing of vessels, engines, equipment, fishing gears, as well as operational costs. No detailed information is available on the maximum loan amounts, repayment periods, nor on collateral requirements. Interest rates are negotiable, can be fixed or variable and are subject to the prevailing financial and sectoral situation and outlook.

The government has no specific plans to adjust the capacity and operations of the various fishing fleets. As most fisheries are subject to the annual catch limit system, each company is granted a quota and defines on an annual basis how many vessels it operates to use the quota assigned. There is no national initiative to assist in the renewal of the various fishing fleets in operation.

4. TECHNICAL-ECONOMIC AND OPERATIONAL CHARACTERISTICS OF INDIVIDUAL FLEET VESSELS

4.1 The longline vessel fleet

Vessels belonging to the longline fleet are characterized by an average length (LOA) of 63.5 meters. The power of the main engine oscillates between 1 176 and 1 201 kW. The storage space on board for species landed and kept, is between 1 100 m^3 and 1 197 m^3, while the capacity of the on board freezers is generally around 200 tonnes. The average crew size is about 50 persons. The sole fishing gear employed is the horizontal longline. The total number of fishing days at sea per vessel is 300 days (2018). Most of the vessels have an age of over 20 years, but are generally in good shape and well equipped for the job at hand. Three vessels participated in the survey.

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TABLE 7

Chile: Basic information of longline vessels participating in the survey

	Vessel one	Vessel two	Vessel three
Overall length (LOA) (in meters)	62.60	63.15	63.15
Gross tonnage (GT)	1 197	1 197	1 100
Total power of main engine (in kW)	1 176	1 176	1 201
Capacity of on-board storage facilities (in m^3)	926	926	916
Main fishing equipment	Longline	Longline	Longline
Number of crew (persons)	50	49	47
Ownership	Private	Private	Private
Total days of fishing at sea per calendar year	300	300	300
Number of fishing trips per calendar year	2 to 3	2 to 3	2 to 3
Length of main fishing season (in months)	3 to 5	3 to 5	3 to 5

The average annual landings of fish by the three longline vessels participating in the survey were 213 tonnes. These were sold mainly to China and the United States of America (New York), with a minor share being landed and processed at the local southern port of Porvenir. The average sales price per tonne was reportedly USD 30 708. The main fishing gear used consisted of horizontal longline systems.

4.1.1 Financial and economic characteristics of the individual longline fishing vessels participating in the survey

The original investment in the long-line vessels included in the study took place in 2001–02, which means that the vessels have been in operation for 17 to 18 years. The level of investment varied between USD 4.5 and 5.7 million USD. The book value in 2018 of the original investment was USD 1.8 million on average, while the insured value of each of the vessels was over USD 3 million. The investment in the engine and propulsion systems of the vessels was higher than in the hull. Details are provided in Table 8.

TABLE 8
Chile: Longline vessel and other equipment investment costs, current value and depreciation, 2018

	Average year of investment	Average original investment	Depreciation rate	Average book value	Insured value
	Year	USD	%	USD	USD
Vessel (hull)	2001–02	1 145 877	74	443 613	1 125 000
Main engine	2001–02	1 991 937		549 686	1 500 000
Equipment on deck	2001–03	248 992		178 431	187 500
Equipment below deck	2002–03	348 589		199 646	262 500
Fishing gears with a lifespan of >3 years	2002–03	497 984		231 468	375 000
Electronic devices	2002–2015	746 463		210 253	300 000
Total Value Vessel		**4 979 843**		**1 813 097**	

The sole source of income of the longline fleet was the revenue of fish landings. Table 9 shows that these revenues varied between the vessels in this fleet, and were between USD 3.9 million and USD 8.5 million in 2018. The total (operational) costs in 2018 ranged between USD 4.4 million and USD 7.5 million USD in the same year. The operating costs were higher than the vessel owner costs with respectively 58 percent and 42 percent of the total annual operational costs. On average one-third of the operating costs was spent on labour (wages and catch shares). Not any significant expenses were made on quota or fishing permits, and therefore these were not included in the calculations. Fixed costs and taxes on profits applied in Table 6 were estimated by the authors.

TABLE 9
Chile: Annual earnings and costs for the longline vessels included in the survey, 2018 (in USD)

	Vessel one	Vessel two	Vessel three	Average
Category	USD	USD	USD	USD
Earnings/revenue				
Gross value of landings	8 536 069	7 207 922	3 888 366	6 544 119
Total earnings	**8 536 069**	**7 207 922**	**3 888 366**	**6 544 119**
Operating costs				
Fuel	676 975	571 643	308 376	518 998
Lubricants/oil/filters	24 066	20 321	10 963	18 450
Harbour dues and levies	178 009	150 312	81 086	136 469
Bait	486 549	410 845	221 633	373 009
Food, stores and other provisions	855 109	722 060	389 520	655 563
Materials	102 595	86 632	46 735	78 654
Crew travel	97 146	82 030	44 252	74 476

	Vessel one	Vessel two	Vessel three	Average
Category	**USD**	**USD**	**USD**	**USD**
Other operating costs	648 264	547 399	295 298	496 987
Labour share and wages	1 658 238	1 400 229	755 364	1 271 277
Total operating costs	**4 726 951**	**3 991 471**	**2 153 227**	**3 623 883**
Permits & license fees	981 147	981 147	981 147	981 147
Vessel repairs & maintenance	1 052 245	888 523	479 320	806 696
Other fixed costs	70 820	70 820	70 820	70 820
Taxes on profits	685 524	685 524	685 524	685 524
Total vessel owner costs	**2 789 736**	**2 626 014**	**2 216 811**	**2 544 187**
Total annual costs	**7 516 687**	**6 617 485**	**4 370 038**	**6 168 070**

4.1.2 Technological innovations in gears, equipment and vessels that have impacted the economic performance of longline vessels

The main technological innovations from the year 2000 onward that have had an impact on the economic performance of the Chilean longline fishing fleet are presented in Table 10. The Table also specifies how these changes have contributed to the overall economic performance of the fleet.

TABLE 10
Chile: Impact of technological innovations on the economic performance of the longline fleet, since 2000

Category	Specific innovations	Effects on the economic performance of the fleet
Cost reductions and energy savings.	IFO 180 Intermediate fuel oil. Bunker fuel. Incorporation of Hydroconic design hulls.	Reduced fuel consumption costs.
Increasing fishing efficiency.	Incorporation of sonar and other electronic equipment aimed at localizing fish and optimum fishing areas.	More efficient fishing. Extended autonomy.
Reducing the environmental/ ecological impact.	Incorporation of on-board waste water plants. Lower fuel consumption. Reduced by-catch and discards.	Decrease in pollution levels. Reduction of the ecological foot print.
Improving fish handling, product quality and food safety.	Incorporation of refrigerated sea water (RSW) plants. Improved design and construction materials of fish storage holds. Automated quality assurance monitoring systems.	Improved quality and higher economic value of final product landed.
Improving safety at sea and working conditions for fishers.	Introduction of safety protocols and effective monitoring systems.	Improvement in safety standards. Fewer accidents; improved productivity; reduced labour absence.

4.2 Trawler vessel fishing fleet

The trawler vessels are characterized by an average length (LOA) of some 54 meters and an average gross tonnage of around 950 tonnes. The capacity of the main engines varies between 1 176 kW and 1 201 kW. The fish storage capacity on board is generally between 1 100 m^3 and 1 197 m^3, while the capacity of the freezer is mostly around 200 tonnes. The average crew size is 50 persons. The number of fishing days at sea per vessel averages 300 days (2018). The sole type of fishing gear used are otter trawl nets. Vessels belonging to the trawler fleet are generally of an advanced age of 40 years and over, but they are in relatively good shape and well equipped. Some important changes have been introduced in the fish preservation systems to improve autonomy and quality.

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TABLE 11
Chile: Basic information of trawler vessels included in the survey, 2018

	Trawler 1	Trawler 2	Trawler 3
Overall length (LOA) (m)	53	55	54
Gross tonnage (GT)	866	1 037	945
Total power of main engines (kilowatts/kW)	1 176	1 176	1 201
Capacity of on-board fish storage facilities (m^3)	926	926	916
Fishing equipment	Trawl nets (otter trawl)	Trawl nets (otter trawl)	Trawl nets (otter trawl)
Number of crew (persons)	50	49	47
Ownership	Private	Private	Private
Total days of fishing at sea per calendar year	300	300	300
Number of fishing trips per calendar year	2 to 3	2 to 3	2 to 3
Length of main fishing season (months)	3 to 5	3 to 5	3 to 5

The main port of landing of the trawler vessels is Talcahuano in Chile.

TABLE 12
Chile: Landings of fish by trawler vessels included in the survey, 2018

	Trawler 1	
Species	**Quantity in tonnes**	**Ex-vessel value USD/tonne***
Chilean hake - *Merluccius gayi*	4 588	577
Hoki - *Macruronus Magallanicus*	3 246	577
Antarctic Whiting - *Merluccius australis*	34	577
Jumbo squid - *Dosidicas gigas*	407	577
Other species	16	577
Total	**8 292**	**577**
	Trawler 2	
Chilean hake - *Merluccius gayi*	2 850	454
Hoki - *Macruronus Magallanicus*	2 118	454
Antarctic Whiting - *Merluccius australis*	25	454
Jumbo squid - *Dosidicas gigas*	5 432	454
Other species	6	454
Total	**10 430**	**454**
	Trawler 3	
Chilean hake - *Merluccius gayi*	2 992	447
Hoki - *Macruronus Magallanicus*	680	447
Antarctic Whiting - *Merluccius australis*	11	447
Jumbo squid - *Dosidicas gigas*	5 768	447
Other species	7	447
Total	**9 458**	**447**

* Vessels do not sell fish but deliver to processing plant they belong to. Reported value is the average production cost per tonne, 2018.

4.2.1 Financial and economic characteristics of individual trawler vessels

The industrial trawler vessels included in the survey were constructed between 1977 and 1980. The original investment in the hull, equipment and gears ranged from USD 1.5 million to USD 3.9 million. Trawler 1 counted with an original investment of USD 1.95 million and had in 2018 a book value of USD 706 000. The investment in 1980 in Trawler 2 was USD 1.5 million and the 2018 book value was nearly USD 1.2 million. Trawler 3 received the highest investment, when built in 1977, with USD 3.9 million and the book value of the vessel was USD 513 000 in 2018. All three vessels were insured in 2018 for USD 2 million. Detailed information on investments in recent years on engines, equipment or gears were not available.

The annual earnings and operating costs of the trawler vessels in 2018 were largely similar. Revenues from the landing of fish ranged between USD 4.2 million and USD 4.8 million, with an average of USD 4.6 million.

The operating costs in 2018 were around USD 2.5 million of which 63 percent was spent on labour catch shares and wages and 21 percent was spent on fuel. The vessel owner costs ranged between USD 1.8 million and USD 2.3 million in 2018. The largest cost category among vessel owner costs were the license fees and quota costs, which accounted for 40 percent. Vessel repairs and maintenance was another major cost item for the vessel owner and added up to 33 percent of the vessel owner costs in 2018.

TABLE 13
Chile: Annual costs and earnings per trawler vessel included in the survey, 2018

	Trawler 1	Trawler 2	Trawler 3	Average 3 vesssels
Category	**USD**	**USD**	**USD**	**USD**
Earnings/revenue				
Gross value of landings	4 783 119	4 732 762	4 223 072	4 579 651
Total earnings/revenue	**4 783 119**	**4 732 762**	**4 223 072**	**4 579 651**
Operating costs				
Fuel	581 676	494 656	474 852	517 062
Lubricants/oil/filters	15 922	36 989	25 328	26 080
Harbour dues and levies	25 050	31 510	28 572	28 377
Ice	14 506	0	7 970	7 492
Food, stores and other provisions	69 640	83 881	82 279	78 600
Crew travel	1 401	1 762	1 598	1 587
Other operating costs	231 591	290 850	348 551	290 331
Labour share and wages (including social security contributions, life/accident and health insurance)	1 559 813	1 700 895	1 487 324	1 582 677
Total operating costs	**2 499 599**	**2 640 544**	**2 456 473**	**2 532 206**
Vessel owner costs				
Fishing license fees, permits and quota	1 104 041	818 858	538 161	820 353
Insurance fees (vessel, employees, equipment)	33 195	13 454	34 120	26 923
Gear replacements, repairs and maintenance (lifespan <3 years)	149 565	160 498	155 301	155 121
Vessel repairs & maintenance	659 149	738 171	661 657	686 326
Other fixed costs (accountancy, audit, legal fees, general expenses, etc.)	87 042	109 492	99 291	98 608
Depreciation (vessel, engine, gears and equipment that last > 3 years)	250 528	251 745	278 069	260 114
Total vessel owner costs	**2 283 520**	**2 092 217**	**1 766 599**	**2 047 445**
Total annual costs	**4 783 119**	**4 732 762**	**4 223 072**	**4 579 651**

4.2.2 Technological innovations in gear and equipment on trawler vessels that impacted the vessels' economic performance

TABLE 14
Chile: Technological innovations that have had an impact on the economic performance of the trawler fleet, since 2000

Category	Specific innovations	Effects on the economic performance of the fleet
Cost reductions and energy savings.	IFO 180 Intermediate fuel oil; Bunker fuel. Incorporation of Hydroconic design hulls.	Reduced fuel consumption costs.
Increasing fishing efficiency.	Incorporation of sonar and other electronic equipment aimed at localizing fish and optimum fishing areas.	More efficient fishing. Extended autonomy.
Reducing the environmental/ecological impact.	Incorporation of on-board waste water plants. Lower fuel consumption. Reduced by-catch and discards.	Decrease in pollution levels. Reduction ecological foot print.
Improving fish handling, product quality and food safety.	Incorporation of refrigerated sea water (RSW) plants. Automated quality assurance monitoring systems. Improved design and construction materials of fish storage holds.	Improved quality and higher economic value of final product landed.
Improving safety at sea and working conditions for fishers.	Introduction of safety protocols and effective monitoring systems.	Improvement in safety standards. Fewer accidents; improved productivity; reduced labour absence.

4.3 The Industrial Purse Seine Vessel Fleet

Vessels of the industrial purse seine fleet can be characterized by an average length (LOA) of 66 meters. The capacity of the main engines oscillates between 2 000 and 3 600 HP. The fish storage capacity on board is generally between 1 500 m^3 and 2 000 m^3. The average crew size is 17 persons. Most of the vessels of this fleet are over the age of 20 years. Modern harvesting equipment has been installed to increase efficiency, on board fish preservation has been improved as well as the design of the fish holds.

Pam Don Alfonso

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TABLE 15
Chile: Basic information of industrial purse seine vessels included in the survey

	Industrial purse seiner 1	Industrial purse seiner 2	Industrial purse seiner 3	Industrial purse seiner 4	Industrial purse seiner 5
Overall length (LOA)	74.5	66	64	60.5	64.7
Gross tonnage (GT)	1 900	1 448	1 196	1 189	1 312
Total power of the main engines (kilowatts/kW)	4 160	not available (N.A)	N.A.	N.A.	2 640
Capacity of on-board storage facilities (m^3)	2 000	1 600	N.A.	1 300	1 500
Fishing gear and equipment (Operated with modern equipment: Triplex, Rapp hydema, etc.)	Purse seine	Purse seine	Purse seine	Purse seine	Purse seine
Number of crew (persons)	17	17	17	17	15
Ownership	Private	Private	Private	Private	Private
Total days of fishing at sea per calendar year	125	94	107	122	111
Number of fishing trips per calendar year	41	27	29	37	39
Length of fishing season (months)	8	8	8	8	8

4.3.1 Financial and economic characteristics of the respective industrial purse seine vessels participating in the survey

Many of the vessels in the industrial purse seine fleet in Chile were built in the second half of the 1990s. The 5 vessels in this fleet segment that were included in the survey were built in this period as well. As shown in Table 15 the variation in size of the 5 surveyed purse seine vessels is some 20 percent in LOA (between 60 m and 75 m) and around 60 percent in gross tonnage. Consequently, the initial investments also differed largely. The initial investment in the hull was for the largest vessel in this segment around USD 6.7 million and on the smallest vessel USD 2.8 million. Similarly, the original investments in engine systems of these five vessels ranged between a high of USD 8.7 million and low of USD 3.8 million.

Table 16 presents the average investments made, as well as book and insured values in 2018. The depreciation of the hull and main engine and propulsion systems since 1995–98 was around 72 percent.

TABLE 16
Chile: Industrial purse seine vessel and equipment investment costs and values in 2018

	Age	Cost of original investment	Book value	Insured value
	Years	USD	USD	USD
Vessel (hull)	1995–1998	4 344 104	1 222 964	3 960 000
Main engine	1995–1998	5 792 139	1 630 618	5 280 000
Equipment on deck (e.g. cranes, beams)	1995–1998	724 017	203 827	660 000
Equipment below deck (e.g. cold storage, ice making, freezers)	2000–2012	1 013 624	285 358	924 000
Fishing gears with lifespan of >3 years	Various years	1 448 035	407 655	1 320 000
Electronic devices (navigation, fish finding and communication)	2011–2017	1 158 428	326 124	1 056 000
Total vessel investments and vessel value		**14 480 346**	**4 076 545**	

The main ports from which the purse seine fleet operates are San Vicente and Talcahuano in Chile. The landings of fish by the surveyed vessels in 2018 ranged between 13 000 and 22 000 tonnes (see Table 17). The average ex-vessel value per tonne landed was generally around USD 600/tonne.

TABLE 17
Landings of fish by industrial purse seiner participating in the survey, 2018

Vessel 1		
Species	**Quantity tonnes**	**Ex-vessel value USD/tonne**
1- Jack mackerel	18 596	600
2- Mackerel	1 415	600
Other species		
Total	**20 011**	**600**
Vessel 2		
1- Jack mackerel	12 286	600
2- Mackerel	906	600
Other species		
Total	**13 192**	**600**
Vessel 3		
1- Jack mackerel	20 691	600
2- Mackerel	1 296	600
Other species		
Total	**21 987**	**600**
Vessel 4		
1- Jack mackerel	9 291	600
2- Mackerel	657	600
3- Sardine	2 728	227
4- Anchovy	354	227
5-Mote sculpin	32	227
Other species		
Total	**13 062**	**511**
Vessel 5		
1- Jack mackerel	15 722	600
2- Mackerel	1 709	600
Other species		
Total	**17 431**	**600**

The annual earnings and operating costs of the industrial purse seiners in 2018 were largely following the sizes of the vessels, with larger vessels having higher operational costs and higher earnings. Revenues from the landing of fish ranged between USD 6.7 million and USD 12.0 million, with an average of USD 10.0 million. Apart from fish sales the vessels had no other major source of revenues.

The total annual costs for vessels in this segment in 2018 ranged between USD 4.8 million and USD 7.2 million. On average 31 percent was spent on operational costs and 69 percent on vessel owner costs. Within the operational costs category 51 percent was spent on labour and 39 percent on fuel. The largest cost category among vessel owner costs were the license fees and quota costs were each over 25 percent. Variations were high between vessels in expenditures on maintenance and repair in 2018 and depreciation.

TABLE 18

Chile: Annual earnings and costs of industrial purse seiners included in the survey, 2018

	Vessel 1	Vessel 2	Vessel 3	Vessel 4	Vessel 5	Average 5 vessels
Category	**USD**	**USD**	**USD**	**USD**	**USD**	**USD**
Earnings/revenue						
Income from sale of fish	12 006 413	7 914 998	13 191 985	6 675 414	10 458 727	10 049 507
Total earnings	**12 006 413**	**7 914 998**	**13 191 985**	**6 675 414**	**10 458 727**	**10 049 507**
Operating Costs						
Fuel	1 140 526	552 626	605 962	568 994	642 813	702 184
Lubricants/oil/filters	24 374	17 818	46 750	22 289	20 782	26 403
Harbour dues and levies	5 378	5 186	7 995	5 293	5 081	5 787
Food, stores and other provisions	34 835	25 420	28 280	27 709	32 889	29 827
Other operating costs	123 215	97 112	129 137	75 602	106 270	106 267
Labour share and wages	1 002 265	778 259	961 205	919 723	900 673	912 425
Total operating costs	**2 330 593**	**1 476 421**	**1 779 329**	**1 619 610**	**1 708 508**	**1 782 892**
Vessel owner costs						
Fishing license fees, permits, quota	1 251 752	990 630	1 459 484	966 766	802 257	1 094 178
Insurance fees (vessel, employees, equipment)	59 743	44 452	27 532	41 574	30 214	40 703
Purchase of fishing rights (quotas)	1 343 787	865 481	1 242 639	816 796	1 053 494	1 064 439
Gear replacements, repairs and maintenance (lifespan <3 years)	194 739	229 776	180 384	0	292 979	179 576
Vessel repairs & maintenance	435 210	1 538 184	449 461	546 626	576 017	709 100
Other fixed costs (accountancy, audit, legal fees, expenses, etc.)	54 880	25 100	33 469	28 323	30 656	34 486
Depreciation (vessel, engine, equipment, gears that last >3 years)	1 491 895	694 312	641 957	777 154	690 613	859 186
Total vessel owner costs	**4 832 006**	**4 387 935**	**4 034 926**	**3 177 239**	**3 476 230**	**3 981 667**
Total annual costs	**7 162 599**	**5 864 356**	**5 814 255**	**4 796 849**	**5 184 738**	**5 764 559**

4.3.2 Technological innovations in gears, equipment and vessels that impacted the economic performance of the industrial purse seine fleet

The main technological innovations that have had an impact on the economic performance of the purse seine fleet since the year 2000 are presented in Table 19.

TABLE 19

Chile: Technological innovations that have had an impact on the economic performance of the industrial purse seine fleet, since 2000

Category	Specific innovations	Impacts on economic performance of the fleet
Cost reductions and energy savings.	IFO 180 Intermediate fuel oil; Bunker fuel. Incorporation of hulls with Hydroconic design.	Reduced fuel consumption costs.
Increasing fishing efficiency.	Incorporation of sonar and other electronic equipment, aimed at localizing fish and optimum fishing areas. Improved hauling equipment.	More efficient fishing. Extended autonomy.
Reducing the environmental/ ecological impact.	Incorporation of on-board waste water plants. Lower fuel consumption. Reduced by-catch and discards.	Decrease in pollution levels. Reduction ecological foot print.
Improving fish handling, product quality and food safety.	Extensive use of modern net operating equipment. Incorporation of Refrigerated sea water (RSW) plants. Automated quality assurance monitoring systems. Improved design and construction materials of fish storage holds.	Improved quality and higher economic value of final product landed.
Improving safety at sea and working conditions for fishers.	Introduction of safety protocols and effective monitoring systems.	Improvement in safety standards. Fewer accidents; improved productivity; reduced labour absence.

4.4 Artisanal purse seine fishing fleet

Vessels belonging to the artisanal purse seine fishing fleet can be characterized by an average length (LOA) of 17.6 meters. The power of the main engines is generally around 500 kW. The on-board fish storage capacity is generally around 30 m^3. The average size of the crew is 10 persons. The total number of fishing days at sea per vessel was around 300 days in 2018. All vessels of this fleet are equipped with purse seine nets, although some mid water trawling is also done.

Artisanal purse seiners

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TABLE 20
Chile: Basic information of artisanal purse seiners included in the survey

	Artisanal purse seiner I	Artisanal purse seiner 2	Artisanal purse seiner 3
Length overall (LOA) (meters)	17.60	17.95	17.95
Gross tonnage (GT)	112	120	107
Total power of main engines (kW)	340	325	317
On-board storage facilities (m^3)	>35	80	70
Fishing gear	Purse seine	Purse seine	Purse seine
Crew size (persons)	10	10	10
Ownership	Private	Private	Private
Total days fishing at sea per calendar year	60	60	60
Number of fishing trips per calendar year	60	60	60
Length of main fishing season (months)	3 to 4	3 to 4	3 to 4

4.4.1 Financial and economic characteristics of the individual artisanal purse seine vessels

Three artisanal purse seine vessels surveyed included two with an original investment of around USD 110 000 and one vessel with a much higher investment in the hull, of USD 369 000. All other investment items, such as engines and deck equipment were similar for the 3 vessels. The engines and other equipment were replaced in 2012–13 and were 6 years of age in 2018. The insured values were higher for all vessels than the book values. See Table 21 for details.

TABLE 21
Chile: Investment costs, book and insured values of artisanal purse seine vessels included in the survey, 2018

	Age	Original investment	Book value	Insured value
	Year	USD	USD	USD
Vessel (hull)	21–28	111 000 to 369 000	145 000	227 980
Main engines				
Main engine	6	50 000	38 300	57 081
Secondary engine	6	8 500	4 522	9 704
Propulsion system	6	30 000	15 960	34 249
Equipment on deck				
Cranes	6	2 500	1 912	2 854
Winches	6	15 000	11 490	17 124
Equipment below deck				
Fishing gears with a lifespan of >3 years				
Electronic devices				
Sonar	6	11 000	5 852	12 558
Radar	6	5 300	2 822	6 051
GPS	6	500	266	571
Radios and other communication equipment	6	3 500	1 862	3 996
Total Investment		**325 998**	**228 165**	

The revenues and costs of vessels in the artisanal purse seine fleet in 2018 varied significantly. The total operational costs ranged between USD 60 000 and USD 104 000. The earnings by vessels in this fleet were solely coming from the sale of fish. The vessel with the highest earnings made USD 210 000 in 2018. The few vessels surveyed and the large differences between them in earnings result in a high level of uncertainty of the actual costs and revenues. Moreover, the non-availability of labour (wage and catch share) costs information, which is commonly substantial in small-scale fishing vessels causes that the operational costs in Table 22 are not complete. In addition, the vessel owner costs reported contains mostly estimations made by the owners and was not based on available data.

TABLE 22
Chile: Annual costs and earnings per artisanal purse seiner vessel participating in the survey, 2018

	Artisanal purse seiner 1	Artisanal purse seiner 2	Artisanal purse seiner 3	Average 3 vessels
Category	**USD**	**USD**	**USD**	**USD**
Earnings/Revenue (at USD 140 per tonne)	1 500 tonnes	1 300 tonnes	1 100 tonnes	1 300 tonnes
Total fishing revenue (gross value of landings)	210 000	182 000	154 000	182 000
Total earnings	**210 000**	**182 000**	**154 000**	**182 000**
Operating costs				
Fuel	6 154	5 000	4 000	5 051
Lubricants/oil/filters	3 348	2 615	2 000	2 654
Harbour dues and levies	738		500	413
Ice	360	200	100	220
Bait	300	200	100	200
Salt	200	150	100	150
Food, stores and other provisions	1 723	1 200	1 000	1 308
Crew travel	20 000	15 000	10 000	15 000

	Artisanal purse seiner 1	Artisanal purse seiner 2	Artisanal purse seiner 3	Average 3 vessels
Category	**USD**	**USD**	**USD**	**USD**
Labour share and wages (including social security contributions, life/accident and health insurance)	N A	N A	N A	-
Total operating costs	**32 823**	**24 965**	**17 800**	**25 196**
Vessel owner costs				
Fishing license fees, permits and quota	12 000	9 000	8 000	9 667
Insurance fees (vessel, employers, equipment) (est. 5%)	15 000	12 000	10 000	12 333
Gear replacements, repairs and maintenance, with lifespan of <3 years	12 000	9 000	8 000	9 667
Vessel repairs & maintenance (est. 3%)	2 000	1 500	1 000	1 500
Other fixed costs (accountancy, audit and legal fees, general expenses, subscriptions, etc.)	30 000	20 000	15 000	21 667
Total vessel owner costs	**71 000**	**51 500**	**42 000**	**54 833**
Total annual costs	**103 823**	**76 465**	**59 800**	**80 029**

4.4.2 Technological Innovations in gears equipment and vessels that impact the economic performance of the artisanal purse seine fleet

Most of the vessels in this fleet are of relatively young age (10 to 15 years), but their autonomy and the quality of their catch are hampered by the way they are designed and equipped. The main technological innovations that have had an impact on the economic performance of the artisanal purse seine fleet, since 2000, are presented in Table 23. The Table also specifies how these changes have impacted the performance of the fleet.

TABLE 23
Chile: Technological innovations that have had an impact on the economic performance of the artisanal purse seine fishing fleet, since 2000

Category	Specific innovations	Effects on economic performance of the fleet
Cost reductions and energy savings.	Use of intermediate fuel oils.	Reduced fuel consumption costs.
Increasing fishing efficiency.	Incorporation of electronic equipment to facilitate the localization of fish schools.	More efficient fishing.
Reducing the environmental/ ecological impact.	Lower fuel consumption. More modern vessels.	Decrease in pollution levels. Lower emissions of sulphur. Reduction ecological foot print.
Improving fish handling, product quality and food safety.	Incorporation of refrigerated water circulation systems. Quality assurance and traceability monitoring systems in place.	Improved quality and higher economic value of final product landed.
Improving safety at sea and working conditions for fishers.	Introduction of safety protocols and effective monitoring systems.	Improvement in safety standards. Fewer accidents; improved productivity; reduced labour absence.

4.5 The Southern purse seine fishing fleet

The vessels of the southern purse seine fishing fleet can be characterized by an average length (LOA) of 66 meters. The capacity of the main engines oscillates between 3 000 kW and 4 100 kW. The on board fish storage capacity is generally between 1 500 m^3 and 2 000 m^3. The average crew size is 17 people. Landings consist primarily of jack mackerel and common mackerel. Average annual landings are around 25 000 tonnes. As with the industrial purse seine fleet, these vessels are mostly over 20 years of age, but rather well maintained and equipped to perform their tasks.

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TABLE 24
Chile: Basic information of Southern purse seine vessels included in survey

	Southern purse seiner 1	Southern purse seiner 2	Southern purse seiner 3
Total length (LOA) (meters)	75	60	64
Gross tonnage (GT)	2 005	1 397	1 315
Total power of main engines (Kilowatts/kW)	4 100	3 280	3 000
Capacity on-board storage facilities (m^3)	1 925	1 600	1 400
Fishing equipment	Purse seine	Purse seine/trawl	Purse seine
Size of the crew (persons)	16	21	N.A.
Property	Private	Private	Private
Total days of fishing at sea per calendar year	107	128	120
Number of fishing trips per calendar year	29	32	30
Length main fishing season (months)	8	8	8

4.5.1 Financial and economic characteristics of the individual southern purse seiners

The southern purse seiners included in this study were all constructed in the period 1997 to 1999, with an average age of 21 years at the time of the study in 2018. The main engines were often replaced and were 13 years in use, while the auxiliary engines were of the same age as the vessel hulls. The original investments in the vessel hulls ranged between USD 12.5 million and USD 14.1 million. The average original investment in the engine and propulsion systems added up to USD 4.9 million. The total original investments in the vessels was between USD 24.1 million and USD 26.2 million. The vessels and their main equipment were insured in 2018 for USD 14 million to USD 18 million. The book values of the hulls ranged between USD 4.4 million and USD 6.1 million in the same year. The average book value of the vessels and their equipment in 2018 was USD 8.7 million. Details are presented in Table 25.

TABLE 25
Chile: Southern purse seine vessel and other equipment investment costs and current values, 2018

		Vessel 1		Vessel 2		Vessel 3		Average of 3 vessels	
	Average age	Cost of original investment	Book value	Cost of original investment	Book value	Cost of original investment	Book value	Cost of original investment	Book value
	Year	USD	USD	USD	USD	USD	USD	USD	USD
Vessel (hull)	21	14 114 226	6 139 855	13 563 517	4 373 158	12 531 754	4 611 718	13 403 166	5 041 577
Main engines									
Main engine	13	2 055 674	1 138 397	2 217 733	633 903	2 883 830	1 295 926	2 385 746	1 022 742
Aux. engine 1	21	164 693	64 887	343 818	105 186	517 478	82 957	341 997	84 344
Aux. engine 2	21	122 541	51 742	227 733	69 164	563 274	73 751	304 516	64 886
Aux. engine 3	21	15 729	8 973	40 846	29 749	354 496	24 427	137 024	21 049
Aux. engine 4						204 432	61 178	68 144	20 393
Shaft generator	21	149 282	79 018	248 190	152 535	112 067	13 127	169 847	81 560
Propulsion system		1 270 206	566 110	1 409 717	428 307	1 587 586	435 192	1 422 503	476 536
Equipment on deck									
Cranes	21	272 922	116 747	667 184	248 290	791 617	333 252	577 241	232 763
Winches	21	1 859 639	827 472	1 888 379	564 213	687 146	220 719	1 478 388	537 468
Fish handling equipment	21	329 151	160 970	103 922	32 601	486 868	189 427	306 647	127 666
Equipment below deck									
RSW & fish discharge system	21	2 099 365	772 988	458 925	200 578	1 136 138	159 582	1 231 476	377 716
Fishing gears with a lifespan of >3 years									
Purse seine	1 to 9	1 503 280	225 021	1 863 844	447 022	1 673 192	243 625	1 680 105	305 223
Trawl system	10	146 550	6 824	-	-	-	-	48 850	2 275
Electronic devices									
Echo sounder		160 514	22 651.62	120 680	10 119	16 845	0	99 346	10 924
Sonar	1 to 21	1 415 714	316 925	645 452	67 000	718 357	150 542	926 508	178 156
Radar		107 255	40 425	41 204	4 421	103 912	34 740	84 124	26 529
Vessel Monitoring System (VMS) & Navigational Aids		135 078	22 032	80 100	8 959	653 794	37 325	289 657	22 772
GPS		29 070.8	24 045.9	12 464	1 190	26 092	2 830	22 542	9 355
Radios and other communication equipment		65 472.0	7 277	44 901	5 059	48 553	181	52 975	4 172
Other		158 875	60 052	138 632	30 465	133 058	60 373	143 522	50 297
Total investments		**26 175 236**	**10 652 414**	**24 117 241**	**7 411 920**	**25 230 490**	**8 030 870**	**25 174 323**	**8 698 401**

The southern purse seine vessels only obtained revenues from fish landings in 2018 and did not have any other income source. The total revenues of the three vessels studies varied greatly between USD 6 million and USD 12 million. In terms of annual (operational) costs, the vessel owner costs were highest accounting for over 70 percent of the annual costs. The expenses on fishing licenses, permits and quota added up for each vessel to over USD 4 million in 2018. Within the operating costs category, the labour costs (wages and catch share) was the highest cost item amounting on average to 43 percent of these costs. Information on interest payments and taxes on profits was not available and therefore not included in Table 26. Two of the three vessels included in the survey had a positive net cash flow, with revenues higher than costs.

TABLE 26
Chile: Annual earnings and cost of southern purse seine vessels included in the survey, 2018 (in USD)

	Southern purse seine vessel 1	Southern purse seine vessel 2	Southern purse seine vessel 3	Average 3 vessels
Category	**USD**	**USD**	**USD**	**USD**
Earnings/revenue				
Total fishing revenue (gross value of landings)	11 932 000	9 775 000	5 996 000	9 234 333
Total earnings	**11 932 000**	**9 775 000**	**5 996 000**	**9 234 333**
Operating costs	1 421 442	1 120 971	650 020	1 064 144
Fuel	46 683	56 207	29 530	44 140
Harbour dues and levies	138 710	111 437	68 055	106 067
Food, stores and other provisions	37 246	39 814	34 766	37 275
Other operating costs	112 801	137 366	81 576	110 581
Labour share and wages (including social security contributions, life/accident and health insurance)	1 211 529	1 035 447	866 251	1 037 742
Total operating costs	**2 968 410**	**2 501 242**	**1 730 198**	**2 399 950**
Vessel owner costs				
Fishing license fees, permits and quota	3 428 608	3 386 148	3 022 903	3 279 219
Insurance fees (vessel, employers, equipment)	116 645	103 883	72 488	97 672
Purchase of fishing rights (quotas)	967 043	951 576	845 927	921 515
Gear replacements, repairs and maintenance with lifespan of <3 years	81 982	125 516	110 616	106 038
Vessel repairs & maintenance	321 655	274 186	240 093	278 645
Other fixed costs (accountancy, audit, legal fees, general expenses, etc.)	494 306	405 255	248 579	382 713
Depreciation (vessel, engine, equipment, and gears that last >3 years)	1 296 388	921 946	863 809	1 027 381
Total vessel owner costs	**6 706 627**	**6 168 510**	**5 404 415**	**6 093 184**
Total annual costs	**9 675 037**	**8 669 752**	**7 134 613**	**8 493 134**

4.5.2 Technological innovations in gears equipment and vessels that impact the economic performance of the southern purse seine fleet

TABLE 27
Chile: Technological innovations that have had an impact on the economic performance of the southern purse seine fishing fleet, since 2000

Category	Specific innovations	Effects on the economic performance of the fleet
Cost reductions and energy savings.	IFO 180 Intermediate fuel oil; Bunker fuel. Incorporation of hydroconic design hulls.	Reduced fuel consumption costs.
Increasing fishing efficiency.	Incorporation of sonar and other electronic equipment aimed at localizing fish and optimum fishing areas.	More efficient fishing. Extended autonomy.
Reducing the environmental/ ecological impact.	Incorporation of on-board waste water plants. Lower fuel consumption. Reduced by-catch and discards.	Decrease in pollution levels. Reduction ecological foot print.
Improving fish handling, product quality and food safety.	Incorporation of RSW plants. Automated quality assurance monitoring systems. Improved design and construction materials of fish storage holds.	Improved quality and higher economic value of final product landed.
Improving safety at sea and working conditions for fishers.	Introduction of safety protocols and effective monitoring systems.	Improvement in safety standards. Fewer accidents; improved productivity; reduced labour absence.


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National report of Peru

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EXECUTIVE SUMMARY

Peru is a country in South America with a land area of about 1.3 million km^2 and a Pacific Ocean coastline of 2 414 kilometres. The Peruvian exclusive economic zone (EEZ) covers a geographical area of 626 540 km^2. For 2019 its population is estimated at around 32.7 million (2019). The nation enjoys an annual GDP growth of 3.6 percent (2013–2017 average), with an estimated unemployment rate of 6 percent.

Peru is endowed with an extremely productive marine environment as a result of an upwelling ecosystem that is conducive to abundant and diverse aquatic living resources. This has made marine fisheries, after mining, a major contributor to the Peruvian economy. Although landings have decreased substantially since the beginning of this century due to biological factors and catch quotas for major species, the more diversified capture effort has remained an important source of foreign revenue and direct- and indirect employment.

The government has put in place fisheries legislation and regulations to govern the fishery sector. As part of this, individual rights to fishery resources per vessel were assigned in order to rationalize the fishing effort and make it more efficient, in addition, it is meant to mitigate the impact of the fishery activities on the marine ecosystem.

Peru was included in this techno-economic analysis, because its annual marine fisheries production reached approximately 5 percent of global capture fisheries. Of the various fleets targeting commercial species, three fleets were selected for their importance and future potential.

The estimated number of active commercial fishing vessels increased by 320 percent between 2007 and 2019, to reach 14 064 units. The most important commercial species captured are Peruvian anchovy, Pacific chub mackerel, Peruvian jack mackerel, jumbo squid, Eastern Pacific bonito and South Pacific hake.

The limited number of vessels of these three major fleets included in the survey obliges to view the results with a fair degree of caution. The Pacific anchovy and jumbo squid vessels included in the survey represented the mean gross tonnage of the respective fleet segments. In the case of the Pacific hake fleet, the survey sample was three vessels of a 33 vessel fleet segment, but the revenue and operational expense data of one of these vessels had to be deleted as it only fished during part of the season. Data availability on the financing of these industrial operations, particularly on the source of funds and terms was too limited to understand its effects on the profitability of the operations. The earnings information obtained on the other two Pacific hake fleet vessels was incomplete, which resulted in negative performance indicators.

The calculation of some economic indicators was amended in view of the fact that information on a few issues was not available or was suspicious. Intangible assets (e.g. goodwill, market recognition, fish licenses and quotas, fishing grounds knowledge) exist but are rarely assigned a value and weight in the economic analysis of the fleet segments. Therefore, the return on investment (ROI) was calculated over the initial investment and not over the sum of the current value of the tangible plus intangible assets, as this would have made for the same outcome for return on fixed tangible assets (ROFTA) and ROI.

The absence of comprehensive data on how the fishery activities are financed in Peru carries as a consequence that no reliable information was available on amortization and interest paid or due. Amortizations have a direct impact on gross profit, while the absence of interest payments increases net profits substantially in the format applied. Interest payments in countries like Peru may present an additional challenge, particularly when these are in local currency. Depreciation is another issue of concern. In general, depreciation percentages and amounts provided do not concur with the age of the assets subject of depreciation. For the analysis, the depreciation is calculated over the initial investments applying the apparent prevailing percentages as provided by the vessel owners, disregarding the age of the assets.

TABLE 1
Peru: Average economic and financial indicators of selected domestic industrial fishing vessels, 2018

Indicators	PA & PCM* vessel	Jumbo squid vessel	South Pacific hake vessel
		USD	
Initial investment costs	5 273 667	112 966	432 072
Revenue from landings	3 330 519	209 165	281 852
Labour costs	719 469	31 204	86 065
Running costs	778 953	40 686	233 730
Vessel costs	922 622	21 559	53 386
Total gross costs	2 421 044	93 449	373 181
Net cash flow (NCF)	909 475	115 716	-91 330
Depreciation	170 235	12 262	22 075
Amortization	0	0	0
Gross profit	739 240	103 454	-113 405
Interest	125 000	-	0
Net profit before taxes	614 240	103454	-113 405
Net profit margin	18%	49%	-40%
Value of tangible assets	4 651 000	144 135	218 590
Value of intangible assets	-	-	-
Return on fixed tangible assets (ROFTA)	13%	72%	-52%
Return on investment (ROI)	12%	92%	-26%
Gross value added (GVA)	1 628 944	146 920	-5 264
Gross value added to revenue	49%	70%	-2%

* PA = Peruvian anchovies PCM = Pacific chub mackerel

The overall performance of two of the three fishing fleets included in the survey, namely Peruvian anchovies/Pacific chub mackerel and jumbo squid in 2018 was very encouraging according to the results of the economic indicators. The net profit margins were well above the 7–8 percent benchmark, which indicates that the profitability of the fleets is good. The return on investment (ROI) for the jumbo squid fleet may be considered unrealistically high, but it should be taken into consideration that no interest costs were provided and that about a quarter of the revenue consisted of by-catch species. Nevertheless, the ROIs of the Peruvian anchovies, Pacific chub mackerel and jumbo squid vessels were also above 10 percent and thus good.

Return on fixed tangible assets (ROFTA) was particularly high for the jumbo squid fleet, which is due to the fact that, with the exception of navigational and communication equipment, the value of the assets had increased on average by 30 percent over their initial cost. No reason was provided for this increase and it was noted that this issue was not repeated in the other fleets studied in this analysis. The incomplete information on the revenue of landings by the South Pacific hake vessels surveyed made that the indicators presented in table 1 are of limited value and cannot be used to estimate true profitability of this fleet.

On the basis of the results of this analysis it may be concluded that vessel owners of Peruvian anchovies, Pacific chub mackerel and jumbo squid vessels obtained in 2018 high returns on investment and thus have incentives to re-invest in fisheries. This would be particularly encouraging as the fishery resource management model, as pursued by the Peruvian authorities, would seem to guarantee continued profitability. The management model, with individual rights to resources per fishing vessels and quotas based on scientific data, appears to provide good economic results to the fleets.

INTRODUCTION

Peru is located in the southern hemisphere between 0°01'48"S latitude and 8°21'03"S. The Peruvian exclusive economic zone covers a geographical area of 626 540 km^2. The anticyclonic movement of the eastern part of the Southern Pacific Ocean off the coast of Peru with its characteristic slow-moving surface currents, creates a complex system of water flows and masses with seasonal variations associated with the south-eastern trade winds. These conditions produce an upwelling ecosystem that is conducive to abundant and diverse aquatic living resources. Chirichigno[1] reports a variety of 737 aquatic marine species.

The fisheries sector is a key component of Peru's economy, after mining, mainly as a significant source of foreign currency. Particularly important is the marine fisheries sector. Catches consist primarily of jumbo flying squid (*Dosidicus gigas*), Peruvian anchovy (*Engraulis ringens*), Pacific chub mackerel (*Scomber japonicus*), Peruvian jack mackerel (*Trachurus murphyi*) and South Pacific hake (*Merluccius gayi*).

In 2018/2019 a total of 14 064 fishing vessels were formally registered in the country, including artisanal, semi-industrial and industrial vessels, which capture mostly jumbo flying squid, Peruvian anchovy, Pacific chub mackerel, Peruvian jack mackerel and South Pacific hake.

1. OBJECTIVES AND CONTEXT

The economic performance of the fishing fleets in Peru has previously been analysed. Peru has participated in the FAO global studies on techno-economic performance of the main fishing fleets in 1995–97, 1999–2000 and 2002–03. The main fleets covered in the previous analysis included the fishing fleets that target the following specific species: Peruvian anchovy, jumbo squid, Pacific chub mackerel and South Pacific hake.

The 2018–19 fleet assessment is part of a global assessment by FAO and aims to compare the financial and economic performance between fleets over time on a national and global level. The following three Peruvian fishing fleets are part of the present assessment of the technoeconomic performance: the Peruvian anchovy fleet, the jumbo squid fleet and the South Pacific hake fleet. This report provides operational and economic information of these most important Peruvian fishing fleets for the period 2016 to 2018.

In 2016, Peru produced approximately 5 percent of the global capture fisheries production and was therefore included in the global fishing fleet performance assessment of FAO.

[1] Chirichigno, Nuevas Adicionales a la Ictiofauna Marina del Perú, Norma Chirichigno, 1978 (http://biblioimarpe.imarpe.gob.pe/bitstream/123456789/274/1/INF%2046.pdf)

TABLE 2
Peru: Total capture fisheries production, 2000–2016 (in '000 tonnes)[2]

Year	tonnes	Year	tonnes	Year	tonnes
2000	10 659	2011	8 255	2014	3 599
2005	9 394	2012	4 853	2015	4 839
2010	4 306	2013	5 876	2016	3 812

2. CHARACTERISTICS OF THE FISHING FLEETS OPERATING IN PERU

The marine capture fisheries production in Peru decreased from 7 020 925 tonnes in 2006–07 to 3 811 802 tonnes in 2016–17. At the same time, the estimated number of active commercial fishing vessels went up from 4 400 in 2007 to 14 064 in 2019, a 320 percent increase. The economically most important semi-industrial and industrial fishing fleets in terms of volume of seafood landed are the following: the Peruvian anchovy fleet, the jumbo squid fleet, the Peruvian jack mackerel and Pacific chub mackerel fleet, the Eastern Pacific bonito (*Sarda chiliensis chiliensis*) fleet and the South Pacific hake fleet.

The Peruvian anchovy fishing fleet is the largest in terms of number of fishing craft, followed by the jumbo squid fishing fleets. These fleets are made up of industrial, semi-industrial, artisanal and small-scale[3] units and operate primarily in the Peruvian EEZ waters and some also venture occasionally into the South Pacific Regional Fishery management organization (SPRFMO) area. The activities of all fleets take place primarily in FAO Area 87 (Southeast Pacific). The main fishing harbours where the seafood is landed are Callao, Chimbote, Paita, Chicama, Pucusana, Pisco and Ilo.

TABLE 3
Overview of the most important fishing fleets, 2018

Fishing fleets	Number of vessels[4]	Scale[5]	FAO Area	Main landing ports
Jumbo squid fishing fleet	698	Small-scale	87	Paita, Pucusana, Chimbote and Ilo
Peruvian anchovy fishing fleet	993 229 MC[6]	Industrial Semi-industrial	87	Chimbote, Paita, Pisco and Chicama
Pacific chub mackerel and Peruvian jack mackerel fishing fleet	126	Industrial	87	Callao and Pisco
South Pacific hake fishing fleet	33	Semi-industrial	87	Paita
Tuna – Longline*	21	Semi-industrial	87	-
Tuna – purse seine*	51	Industrial	87	-

* in total 54 Peruvian tuna fishing vessels were registered with the Inter-American Tropical Tuna Commission (IATTC) in 2018.

2 Source: FAO Statistical Yearbook.
3 Artisanal fisheries is locally defined as fisheries carried out by natural or legal persons that have no vessel or a vessel with a hold capacity of up to 32.6 m^3 and a length of up to 15 metres, and where most of the work is done manually. Small-scale fisheries is performed with the same type of vessels, but using modern fishing gear and methods.
4 Source: Ministry of Production.
5 Three scales are generally distinguished: Industrial; semi-industrial or minor climbing (MC); artisanal or small-scale.
6 MC stands for minor climbing. Vessels of 10 to 32 gross tonnage (GT), with fishing permits for Peruvian anchovy.

TABLE 4
Main species commonly caught by fleets, according to importance[7]

Fishing fleets	1	2	3	4
Jumbo squid fishing fleet	Jumbo squid	Mahi mahi (*Coryphaena hippurus*)	Pacific chub mackerel	Peruvian jack mackerel
Peruvian anchovy fishing fleet	Peruvian anchovy	Pacific chub mackerel	Peruvian jack mackerel	Mahi mahi
Pacific chub mackerel and Peruvian jack mackerel fleet	Peruvian jack mackerel	Pacific chub mackerel	Eastern Pacific bonito	South Pacific hake
South Pacific hake fishing fleet	South Pacific hake	Flying fishes (*Cheilopogon* spp)	-	-

The main species discarded at sea by the various fleets are presented in Table 5. In most fisheries, vessels are not allowed to land certain species for which they have no permit. In the case of the Peruvian anchovy vessels, these are allowed to bring in all by-catch species. The Pacific chub mackerel and Peruvian jack mackerel fleet, which consisted in 2018 of 126 vessels, included many vessels with a license to capture also other small pelagics. Some 10 percent of the licenses held by this fleet gave permission to catch and land also species like tuna and hake.

TABLE 5
Species discarded at sea by respective fishing fleets

Fishing fleets	Species			
	1	2	3	4
Jumbo squid fishing fleet	Small pelagics	South Pacific hake	Eels (*Halosauridae* spp)	-
Peruvian anchovy fishing	Eels	-	-	-
Pacific chub mackerel/ Peruvian jack mackerel fishing fleet	-	-	-	-
South Pacific hake fishing fleet	Eels	Tonguefishes (*Symphurus* spp)	-	-

The following fisheries legislation and regulations were governing, to a major extent, the development and operations of these four fishing fleets in 2018:

1. General Fisheries Law. (Law 25977-1992)[8]
2. Regulation of the general fishing law. (Supreme Decree N° 012-2001-PE)[9]
3. Law on maximum catch limits per vessel. (Legislative Decree 1084-2008)[10]
4. Resource Regulation of the Hake Resource. (Supreme Decree N° 016-2003)
5. Regulation of Fishing Management of Peruvian jack mackerel and Pacific chub mackerel, (Supreme Decree N° 011-2007)[11]
6. Regulation of the jumbo flying squid fishery. (Supreme Decree N° 014-2011)[12]
7. Supreme decree that establishes measures to strengthen the control and monitoring of the extractive activity for the conservation and sustainable use of the anchoveta resource. (Supreme Decree N° 024-2016)[13]

7 Ranked from 1 to 5, with 1 being considered the most important.
8 www.peru.gob.pe/docs/PLANES/14303/PLAN_14303_2015_LEY_25977_LEY_GENERAL_DE_PESCA.PDF
9 www.produce.gob.pe/landing/pescayconsumoresponsable/ley-general-de-pesca.pdf
10 www2.congreso.gob.pe/sicr/cendocbib/con4_uibd.nsf/E8DBF74350FDFD0905257B4400587313/$FILE/2_ DECRETO_LEGISLATIVO_1084.pdf
11 https://snp.org.pe/docs/8%20ROP%20JUREL%20Y%20CABALLA.pdf
12 www2.produce.gob.pe/dispositivos/publicaciones/2011/octubre/ds014-2011-produce.pdf
13 www2.produce.gob.pe/dispositivos/publicaciones/ds024-2016-produce.pdf

The Legislative Decree 1084 establishes the "Law on Maximum Catch Levels per Vessel", a regulatory instrument assigning individual rights to fishery resources, which intends to rationalize fishing effort, increase fishing efficiency, allow longer fishing seasons and reduce environmental impact.

With regard to the future development of the fishery capture industry, the government did not have any major new policies or plans to limit or reduce the capacity of the various fleets in 2018. Fisheries management continues to be conducted through laws and regulations that set out the principles, rules and measures applied to the exploitation and protection of aquatic living resources. Adjustments to legislation made are mainly the result of extensive scientific research. Fisheries management regulations are applied to all major fisheries, including also hake, jack mackerel, chub mackerel and giant squid.

Table 6 provides an overview of the age structure of the vessels in the main fishing fleets. Vessels in the jumbo squid fleet were relatively new with many in the category of 5 to 10 years in 2018. In contrast, the vessels in the South Pacific hake fleet were generally older.

TABLE 6
Average age of fishing vessels by fleet, by age group (percentages), 2018

Fishing fleets	< 5 years	5–10 years	15–20 years	> 20 years
Peruvian anchovy fishing fleet			90%	10%
Jumbo squid fishing fleet		95%	5%	
South Pacific hake fishing fleet				100%
Pacific chub mackerel fishing fleet			90%	10%

At the national level, the fishing industry plays a crucial role as it provides protein rich food and is important within the overall food security context. In addition, the sector is an important source of employment. Although the overall employment number is substantial, information from the vessels that participated in the 2018–19 survey indicates that the work force consists largely of part-time employees. The number of full-time paid crew is limited. There are very few, if none, female fishers. The economically active population in the capture fisheries is estimated to be around 250 000 persons. The age structure of the fishers indicates that they are mostly in the range of 30 to 49 years of age. However, in most cases information on the age of the crew members who work on the vessels is not available due to the high turnover of personnel and the informality of labour arrangements in the sector.

3. TECHNO-ECONOMIC AND OPERATIONAL CHARACTERISTICS OF INDIVIDUAL UNITS IN THE RESPECTIVE FISHING FLEETS

3.1 Peruvian anchovy fishing fleet

Marina

© Austral

3.1.1 Basic information

Of the total of 1 498 vessels that form part of this purse seine fleet, about 800 or 53 percent have a gross tonnage of over 110 tonnes. The vessels included in this survey are within this category (Table 6). The length overall (LOA) is around 50 meters, the power of the main engine ranges from 700 to 1 000 kW, while the on-board fish storage capacity varies from 100 to 500 m^3. Purse seine nets are the main (and often the only) fishing gear operated. The setting, hauling and storage of the purse seine nets is facilitated by modern power block winches. In the period 2016–18 the number of days at sea per vessel ranged from 53 to 60 days and the average crew size consisted of 19 persons for vessels in this fleet segment.

TABLE 7
Basic information per purse seine vessel of the Peruvian anchovy fishing fleet; survey data, 2018

	Vessel 1	Vessel 2	Vessel 3
Overall length (LOA) (meters)	54.30	50.60	50.52
Gross tonnage (GT)	497	470	457
Total power of the main engine (kW)	970	970	970
Capacity of on-board fish storage facilities (m^3)	437.5	431	431.23
Fishing gear and equipment	Purse seine (+ hydraulic winches)	Purse seine (+ hydraulic winches)	Purse seine (+hydraulic winches)
Number of crew (persons)	19	19	19
Ownership	Private	Private	Private
Total days of fishing at sea per calendar year	56	53	53
Number of fishing trips per calendar year	-	-	-
Fishing season (months per calendar year)	-	-	-

3.1.2 Financial and economic characteristics of the Peruvian anchovy purse seine vessels participating in the survey

3.1.2.1 Capital investments

The average initial investment costs in hull, engines, propulsion equipment, gears and electronic devices for this type of pelagic purse seine fishing vessel are estimated at around USD 5.3 million. Depreciation on the initial investment is just over 3 percent per annum, which implies an anticipated lifespan of 30 years. This may be reasonable for the hull, but is rather long for a main engine and on-board equipment.

TABLE 8
Investment costs, depreciation and current value of Peruvian anchovy fleet vessels; survey data, 2018

Vessel	Age of hull years	Original investment USD	Annual depreciation %	Book value USD	Insured value USD
Vessel 1	15-20	5 544 000	3.125	4 951 000	8 000 000
Vessel 2	15-20	5 406 000	3.226	4 825 000	8 000 000
Vessel 3	15-20	4 871 000	3.333	4 177 000	8 000 000
Average 3 vessels	15-20	5 273 667	3.228	4 651 000	8 000 000

3.1.2.2 Operating and vessel owner's costs for Peruvian anchovy fishing vessels participating in the survey

The vessels in this segment target two species (Peruvian anchovy and Peruvian jack mackerel) and they do so in different seasons. In table 9 the earnings and costs of the vessel operations are listed. No item specific cost indications were provided for bait, ice, salt, crew travel, harbour dues, fish selling and packaging materials.

The operating costs and vessel owner costs were in balance, with the first amounting to 45 percent of total annual operational costs and the latter some 55 percent. The labour share of the catch and contract wages (including social security contributions, life/accident, health insurance and food provisions) was the highest cost item, adding up to about 46 percent of the total operating costs.

The most important owner costs categories were vessel repairs and management costs. Depreciation on capital goods that last more than 3 years (hull, engine, equipment and fishing gears) was calculated over total initial investment costs on the basis of a 30 year life span. No cost information was provided for fishing licenses and quotas, or for tax payments on profits made.

The total operating expenses to capture the Peruvian jack mackerel share of the catch amount to 11 percent of the total vessel operating costs. The share of the expenses for fuel (32 percent) to capture the Peruvian jack mackerel could indicate that is a time consuming operation, although this is not substantiated by other related operational and owner's costs.

TABLE 9
Average earnings and costs of an average Peruvian anchovy fishing vessel; survey data, 2018

	Peruvian anchovy catch	Chilean Jack mackerel catch	Total vessel operation
Category	**USD**	**USD**	**USD**
Earnings/revenue			
Gross value of landings	2 967 826	362 693	3 330 519
Total earnings	**2 967 826**	**362 693**	**3 330 519**
Operating costs			
Fuel	293 258	94 119	387 377
Lubricants/oil/filters	22 663	1 592	24 255
Food, stores and other provisions	25 707	4 790	30 497
Other operating costs	326 086	41 235	367 321
Labour share and wages	622 602	66 370	688 972
Total operating costs	**1 290 316**	**208 106**	**1 498 422**
Vessel owner costs			
Insurance fees (vessel, employers, equipment)	51 616	4 079	55 695
Vessel repairs & maintenance	331 641	25 595	357 236
Other fixed costs (accountancy, audit and legal fees, general expenses, subscriptions, etc.)	482 109	27 582	509 691
Depreciation (vessel, engine, equipment, gears with lifespan >3 years)	156 616	13 619	170 235
Interest	116 250	8 750	125 000
Total vessel owner costs	**1 138 232**	**118 484**	**1 217 857**
Total annual operational costs	**2 428 548**	**326 590**	**2 716 279**

3.1.2.3 Revenues for Peruvian anchovy fishing vessels participating in the survey

The sole revenue of the Peruvian anchovy fishing vessels participating in the survey came from the sale of captured fish. According to the data provided, the produce landed consisted of just three species. This fleet is also permitted to land all by-catch, but no data were provided. Peruvian jack mackerel contributed about 12 percent to the total revenue from landings. The difference in ex-vessel price would indicate a preference for pursuing Peruvian jack mackerel, but Peruvian anchovy and Pacific chub mackerel are obviously more readily available and the prime species of the fishing licenses of this fleet.

TABLE 10
Catch earnings of Peruvian anchovy fishing vessels; survey data, 2018

Vessel 1			
Species	**Quantity (tonnes)**	**Ex-vessel Value (USD/tonne)**	**Main landing places**
Peruvian anchovy and Pacific chub mackerel	11 555	246	Lat 11 to 13, Huacho a Chincha
Peruvian jack mackerel	753	280	
Other species	0	0	
Total yield	**12 308**	**3 053 370**	
Vessel 2			
Peruvian anchovy and Pacific chub mackerel	11 873	246	Lat 7 to 8 Pacasmayo a Salaverry
Peruvian jack mackerel	1 072	280	
Other species	0	0	
Total Yield	**12 945**	**3 220 918**	
Vessel 3			
Peruvian anchovy and Pacific chub mackerel	12 765	246	Lat 8 to 9 Salaverry a Chimbote
Peruvian jack mackerel	2 061	280	
Other species	0	0	
Total yield	**14 826**	**3 717 270**	

3.1.2.4 Financial assistance available to the Peruvian anchovy fishing fleet

Fishing vessel owners and fishers' cooperatives that participate in the Peruvian anchovy fishery have access to credit from international and national banking institutions.

The mid- and long-term loans obtained are mainly used for the financing of vessels, engines, equipment and fishing gears, and short-term loans are used to cover part of the operational costs. The maximum loan size is around USD 30 million. Loan periods of seven years are generally the norm and collateral requirements are generally 1.5 times the value of the loan amount. Interest rates can be fixed or variable and are subject to the prevailing financial situation and outlook for the overall national economy and/or the fishery sector.

The government does not provide subsidies, tax exemptions or financial incentives to enhance the economic performance of the Peruvian anchovy fishing operations.

3.1.2.5 Technological innovations that have impacted on the economic performance of the Peruvian anchovy fishing fleets

The technological innovations introduced before and after the year 2000 have had a positive impact on the techno-economic performance of the Peruvian anchovy fishing fleets. The most important of these changes are presented in Table 11.

TABLE 11
Technological innovations that have impacted on the techno-economic performance of the Peruvian anchovy fishing fleet since the year 2000

Category	Specific innovations	Effects on techno-economic performance of vessels
Cost reductions and energy savings.	Use of intermediate fuel oils (IFO 180, IFO 380).	Reduced fuel consumption costs.
Increasing fishing efficiency.	Increased use of sophisticated digital fish finding and operational equipment.	More efficient fishing operations.
Reducing the environmental/ ecological impact	Diesel engines are being replaced by electric engines for increased energy efficiency and to lower pollution levels. Use of intermediate oils with reduced sulphur emissions.	Reduction in ecological footprint.
Improving fish handling, product quality and food safety.	Incorporation of refrigerated seawater (RSW) systems. Improved water circulation systems. Installation of Triplex net handling equipment.	Improved quality of landed produce and consequent higher economic value due to improved price levels and reduced post-harvest losses.
Improving safety at sea and working conditions of fishers.	Improvements in freeboard and stability through the lengthening of the hull. A net pool was introduced to facilitate on-board net manipulation under better safety conditions. Improvements in the on-board accommodation/facilities for crew. Introduction of firefighting training modules and equipment.	Reduction in the number of accidents. Improved productivity.

3.2 Jumbo squid fishing vessel fleet

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3.2.1 Basic information

The jumbo squid fleet consisted in 2018 of 698 units, of which the vast majority has a gross tonnage of less than 10 tonnes and only four are of a gross tonnage of over 40 tonnes. These four vessels employ heavy gears (purse seine and trawl nets), in addition to the artisanal jumbo squid longline and the vertical hand line with its typical squid hooks/lures. The majority of the vessels of the jumbo squid fishing fleet are of a length (LOA) of up to 10 meters and the average gross tonnage of a vessel in this fleet is 6.9 tonnes. The power of the main engines for the majority of the vessels does not exceed 150 kW. The capacity of the on-board fish storage facilities is generally below 15 m^3.

The type of fishing gears used in the operation implicates that it is a labour intensive activity. The average crew size is eight fishers, who are in their majority between 30 and 39 years of age. The number of female jumbo squid fishers is extremely low. During 2018, the number of days at sea per vessel averaged 175 days, spread over some 25 fishing trips. The jumbo squid fleet is relatively young with an average hull age of 5 to 10 years, which in turn has an impact on the cost structure of the operation (depreciation and repairs).

TABLE 12
Basic information of jumbo squid fishing vessels participating in the survey

Technical Characteristics	Vessel 1	Vessel 2	Vessel 3
Overall length (LOA) (in meters)	9.60	9.70	9.60
Gross tonnage (GT)	6.91	6.87	6.91
Total power of the main engine (in kW)	-	150	150
Capacity of on-board fish storage facilities (in m^3)	8.79	10.0	8.79
Fishing gear and equipment	Hook & line; manual	Hook & line; manual	Hook & line; manual
Number of crew (persons)	8	8	8
Ownership	Private	Private	Private
Total days of fishing at sea per calendar year	175	182	175
Number of fishing trips per calendar year	25	26	25
Fishing season (in months per calendar year)	6	6	6

3.2.2 Financial and economic characteristics of the jumbo squid vessels participating in the survey

3.2.2.1 Capital investments in the jumbo squid fishing fleet

The initial investment in hull, engine and propulsion, equipment, gears and electronic devices for the three giant squid fishing vessels participating in this survey, ranged from USD 110 000 to USD 120 000. The current average value of investments made in a jumbo squid vessel and related equipment is estimated at about USD 113 000. The variation in investments in the three jumbo squid fishing vessels surveyed was rather small (see table 13).

The total initial investments in the vessel consist largely of the hull (36 percent), followed by the engine (31 percent) and the propulsion system (15 percent). The average age of the hulls and engines of the vessels participating in the survey was 5 years. The depreciation rate applied by the fishers on these vessel hulls, engines and propulsion system is 10 percent per year and 25 percent on navigational equipment. From the investment costs sheet it becomes apparent that these artisanal and/or small-scale vessels only count with the basic necessary equipment. Interesting feature is that the book value of the various items, with the exception of the electronic navigational and communication equipment, is above the original value.

TABLE 13
Investment costs, current value and depreciation of jumbo squid fishing vessels; survey data, 2018

Jumbo squid vessels	Vessel 1		Vessel 2		Vesel 3		Average	
	Cost of original investment	Book value	Cost of original investment	Book value	Cost of original investment	Book value	Cost of original investment	Book value
	USD	USD	USD	USD	USD	USD	USD	USD
Vessel (hull)	42 857	60 000	40 000	56 000	39 000	43 680	40 619	53 227
Main engine(s)								
engine 1	35 000	49 000	36 000	50 400	33 000	36 960	34 667	45 453
propulsion system	17 857	25 000	15 600	21 840	16 200	18 144	16 552	21 661

Jumbo squid vessels	Vessel 1		Vessel 2		Vesel 3		Average	
	Cost of original investment	Book value	Cost of original investment	Book value	Cost of original investment	Book value	Cost of original investment	Book value
	USD	USD	USD	USD	USD	USD	USD	USD
Equipment below deck								
freezers	14 285	20 000	15 300	21 280	14 500	16 240	14 695	19 173
Electronic devices								
Radios and other communication (VHF, Satelite phone)	7 000	5 250	5 500	3 850	6 800	4 760	6 433	4 620
Total investment & book values	116 999	159 250	112 400	153 370	109 500	119 784	112 966	144 135

3.2.2.2 Revenues

Data provided indicate that the revenue of the jumbo squid vessels participating in the survey comes from the sale of the jumbo squid landed, in addition to by-catch species, mostly dolphinfish. The by-catch species contributed in 2018 an average of 22.5 percent to the total value of the landings. The volume of jumbo squid landed in 2018 by the surveyed vessels ranged between 152 tonnes and 170 tonnes and the average ex-vessel sale price in the fishing season received by these vessels oscillated between USD 970 and USD 1 020 per tonne. The sale price fluctuated during the year. The main landing site/buyer was dock of HAYDUK SA for the squid. Apart from the squid and fish sales the vessel did not have other income sources.

3.2.2.3 Operating and owner costs

More than 70 percent of the total annual operating costs of jumbo squid vessels in 2018 was made on operating costs (see table 14). With the category of operating costs, the share of wages and crew participation are highest, adding up to about 36 percent, followed by fuel costs (20 percent) and ice (15 percent) for the preservation of the catch. The vessels did not have any costs for salt, bait or crew travels.

The highest owner related cost category consists of depreciation (32 percent), while vessel repair and maintenance costs (29 percent) were also substantial, as can be expected for this type of vessel. Fishing license fees and permit expenses form an important share of the overall vessel owner costs. The vessel owners did not report on insurance expenditures or interest paid on loans.

TABLE 14
Average earnings and costs of jumbo squid fishing vessels; survey data, 2018

Jumbo Squid Vessels	Vessel 1	Vessel 2	Vesssel 3	Average
Category	USD			
Earnings/revenue				
Total fishing revenue (gross value of landings)	216 461	192 763	218 271	209 165
Total earnings	**216 461**	**192 763**	**218 271**	**209 165**
Operating costs				
Fuel	13 939	14 868	14 200	14 336
Lubricants/oil/filters	593	620	570	594
Harbour dues and levies	1 982	1 869	1 990	1 947
Ice	10 975	10 975	10 975	10 975
Food, stores and other provisions	5 854	5 010	5 530	5 465
Fish selling costs	1 000	800	1 100	967
Materials (packaging, boxes)	5 800	5 300	5 000	5 367

Jumbo Squid Vessels	Vessel 1	Vessel 2	Vesssel 3	Average
Other operating costs	6 000	6 500	7 000	6 500
Labour share and wages	25 400	26 416	25 400	25 739
Total operating costs	**71 542**	**72 358**	**71 765**	**71 889**
Vessel owner costs				
Fishing license fees, permits and quota	5 000	5 000	5 000	5 000
Purchase of fishing rights (quotas)	195	174	197	189
Vessel repairs & maintenance	10 000	8 000	9 500	9 167
Other fixed costs (accountancy, audit and legal fees, general expenses, etc.)	4 000	4 000	4 000	4 000
Depreciation (vessel, engine, equipment, and gears that last more than 3 years)	11 265	10 290	8 405	9 987
Taxes on profits	3 246	2 891	3 472	3 203
Total vessel owner costs	**33 706**	**30 355**	**30 574**	**31 545**
Total annual operational costs	**105 248**	**102 713**	**102 339**	**103 434**

3.2.2.4 Financial assistance available to the jumbo squid fishing fleet

Individual fishing vessel owners and fishing cooperatives operating jumbo squid vessels have access to credit from financial institutions at national level. Credit is generally requested for financing the purchase of hulls, engines, equipment, fishing gears, as well as to cover operational costs. The maximum loan size is generally around USD 500 000 and the repayments are commonly scheduled over a period not exceeding 10 years, which is in line with the life-cycle of these vessels and depreciation rates applied. Common interest rates charged by the credit providers were between 15 percent and 16 percent in 2018. However, interest rates vary according to the overall and sector related economic situation and outlook, as well as the history of the relationship between the bank and client.

3.2.2.5 Technological innovations that have impacted the techno-economic performance of the jumbo squid fishing fleet

The main technological innovations that have had an impact on the jumbo squid fishing fleet techno-economic performance since the year 2000 are presented in the Table 15.

TABLE 15
Technological innovations that have impacted on the techno-economic performance of the jumbo squid fishing fleet

Category	Specific innovations	Effects on techno-economic performance of vessels
Cost reductions and energy savings.	Use of intermediate fuel oils (IFO 180, IFO 380).	Reduced fuel consumption costs.
Increasing fishing efficiency.	Increasing use of sonar and GPS digital equipment.	More efficient fishing operations.
Reducing the environmental/ ecological impact	Use of intermediate oils with reduced sulphur emissions.	Reduction in ecological footprint.
Improving fish handling, product quality and food safety.	Improved handling, storage and preservation of captured fish.	Improved quality of landed produce and consequent higher economic value due to improved price levels and reduced post-harvest losses.
Improving safety at sea and working conditions of fishers.	Improvements in safety protocols. Introduction of firefighting modules.	Reduction in the number of accidents. Improved productivity.

3.3 South Pacific hake fishing fleet

La Merlin

© Seafrost SAC

3.3.1 Basic information

The South Pacific hake trawl fishing fleet consisted in 2018 of 33 licenced vessels, which are owned by just 14 companies. There is only one vessel that falls in the category of small-scale vessels with a gross tonnage of less than 32.6 tonnes. The vast majority of the vessels have between 60 gross tonnage (GT) and 100 GT and two vessels have a GT in excess of 200 tonnes. All vessels employ trawl nets, but 8 of the vessels reported to have licences that include the use of longlines and two are allowed to also use purse seine nets.

The South Pacific hake trawlers generally have a length (LOA) of up to 18 meters and the mean gross tonnage of these 33 vessels is 96 tonnes. The power of the main engines is commonly in the range of 200 to 260 kW. The capacity of the on-board fish storage facilities varies between 48 m^3 and 110 m^3.

In 2018, the number of days at sea per vessel ranged from 85 days to 115 days, spread out over an average of 100 trips, which indicate that these are day boats. The vessels carry ice on their day trips to preserve the catch.

TABLE 16
Basic information of the South Pacific hake fishing vessels participating in the survey

	Vessel 1	Vessel 2	Vessel 3	Average
Length overall (LOA) (meters)	19.9	17.0	17.6	18.2
Gross tonnage (GT)	68.84	52.59	40.83	54.09
Total power of the main engine (kW)	268	172	160	200
On-board storage facilities (m^3)	102	53	49	68
Fishing gear	Demersal trawl	Demersal trawl	Demersal trawl	Demersal trawl
Crew size (persons)	10	8	7	8.3
Ownership	Private	Private	Private	Private
Total days fishing at sea per calendar year	115	85	-	100
Number of fishing trips per calendar year	115	85	-	-
Fishing season (months per year)	11 (Nov–Sept)	11 (Nov–Sept)	11 (Nov–Sept)	11

The average crew size is eight fishers. As far as age categories of the crew members are concerned, 10 percent are in the 30-39 years of age range, while the bulk (50 percent) is comprised by crew in the 40-49 years range. The 50 to 59 age group makes up 30 percent of the crew numbers, which is surprising in view of the hard labour that South Pacific hake fishing represents. About 10 percent of the crew are of the age category of 60 years and over, which means that vessels in this fleet have very few young crew members.

The economic and financial analysis of the South Pacific hake fleet is largely based on the averages of two vessels only, as the third vessel did not fish during most of the 2018. The investment costs of the third vessel were considered relevant for this survey. The two vessels included represent one medium size and one slightly larger size vessel.

3.3.2 Financial and economic characteristics of the South Pacific hake fishing vessels participating in the survey

3.3.2.1 Capital investments in the South Pacific hake fishing fleet

In 2018 the three South Pacific hake trawlers surveyed were nine years old. Hull, engines, main deck equipment and electronics were of the same age. The vessels were expected to be in service for over 20 years and the depreciation rate applied on hulls and engines is 5 percent annually.

The average initial investment in hull, engine and propulsion, equipment, fishing gears and electronic devices for the demersal trawl vessels which are part of the South Pacific hake fleet was around USD 432 000 in 2008-09. In terms of original investment, the main investments are generally made in the hull (58 percent), followed by investment in the engines (18 percent) and deck equipment (17 percent).

TABLE 17

Investment costs, current value and depreciation of hake trawl fishing vessels; survey data, 2018

South Pacific hake fishing vessels	Vessel 1		Vessel 2		Vessel 3		Average	
	Cost original investment	Book value	Cost original investment	Book value	Cost original investment	Book value	Cost original investment	Book value
	USD	USD	USD	USD	USD	USD	USD	USD
Vessel (hull)	230 182	124 463	297 006	139 017	230 182	124 463	252 457	129 314
Main engine	77 860	51 306	76 470	46 261	77 860	51 306	77 397	49 624
propulsion system		39 331					-	-
Equipment on deck	**72 363**		**75 504**	**39 852**	**72 363**	**39 331**	**73 410**	**26 394**
Electronic devices	20 328	11 180	13 324	7 033	20 328	11 180	17 993	9 798
Other	12 360	3 466	7 724	3 447	12 360	3 466	10 815	3 460
Total Investment & book value	**413 093**	**229 746**	**470 029**	**235 610**	**413 093**	**229 746**	**432 072**	**218 590**

3.3.2.2 Revenues

The reported revenue of the South Pacific hake trawlers participating in this survey came in 2018 solely from the sale of the fish landed. The fish was landed in Paita. The two vessels from which information was collected landed respectively 1 522 tonnes and 789 tonnes of hake in 2018. The hake sales provided an income of respectively of USD 395 000 and USD 169 000. The vessel operators did not provide information on the sale of bycatch species, which may represent a major source of income. Some of the bycatch species are of much higher value than the approximately USD 250/tonne received ex-vessel for hake. It should be noted further that the vessels reported to have fished for hake only 115 and 85 days respectively. This means that the vessels may either have been fishing for other species during part of the year in 2018, or that the crew had other sources of employment and income.

3.3.2.3 Operating and owner costs

Among the operating costs of the South Pacific hake trawlers in 2018, the fuel costs and labour costs were highest, amounting to respectively 31 percent and 25 percent of the total operating costs. Other important operating costs were harbour dues and levies, packing materials and ice. The vessels did not report any costs for bait, salt, selling of fish, interest, in-year investments or taxes on profits.

Major owner costs categories in 2018 were vessel repair and maintenance representing 27 percent of the owner costs, and insurance fees which represented 15 percent of the costs for owners. The depreciation rate applied was 5 percent on the vessel and major equipment and represents nearly 6 percent of the total annual operational costs of these vessels. Within the total annual operational costs 20 percent were vessel owner costs and the large majority of 80 percent were operating costs in 2018.

While costs were reported on an annual basis, the gap in information on revenues in 2018 causes negative results in the economic and financial performance calculations presented in Table 18.

TABLE 18
Average earnings and costs of hake trawl fishing vessels; survey data, 2018

South Pacific hake fishing vessels	Vessel 1	Vessel 2	Average
Category	**USD**		
Earnings/revenue			
Gross value of landings	394 592	169 111	281 852
Total earnings	**394 592**	**169 111**	**281 852**
Operating costs			
Fuel	138 307	59 274	98 790
Lubricants/oil/filters	5 319	2 279	3 799
Harbour dues and levies	62 927	26 969	44 948
Ice	54 955	23 552	39 254
Food, stores and other provisions	9 454	4 052	6 753
Materials (packaging, boxes)	65 714	28 163	46 939
Crew travel	1 211	519	865
Labour share and wages	109 827	47 069	78 448
Total operating costs	**447 713**	**191 877**	**319 795**
Vessel owner costs			
Fishing license fees, permits and quota	2 628	1 126	1 877
Insurance fees (vessel, employers, equipment)	16 349	7 007	11 678
Purchase of fishing rights/quotas	7 282	3 121	5 202
Vessel repairs & maintenance	28 290	12 124	20 207
Other fixed costs	20 191	8 653	14 422
Depreciation	20 650	23 500	22 075
Total vessel owner costs	**95 390**	**55 532**	**75 461**
Total annual operational costs	**543 103**	**247 409**	**395 256**

3.3.2.4 Financial assistance available to the South Pacific hake fishing fleet

Individual fishing vessel owners and fishing cooperatives operating South Pacific hake trawlers can receive credit from national financial institutions. Credit requested from the institutions is mainly used to finance the purchase of hulls, engines, equipment and fishing gears. Short-term loans to cover operational costs are also available. Interest rates charged by the credit providers depend on the overall and sector related economic situation and outlook, as well as on the credit history of the vessel owner.

3.3.2.5 Technological innovations that have impacted on the techno-economic performance of the South Pacific hake fishing fleet

TABLE 19
Technological innovations that have impacted on the techno-economic performance of the Pacific hake fishing fleet since 2000

Category	Specific innovations	Effects on techno-economic performance of vessels
Cost reductions and energy savings.	Use of intermediate fuel oils (IFO 180, IFO 380).	Reduced fuel consumption costs.
Increasing fishing efficiency.	Increasing use of more advanced sonar and GPS equipment.	More efficient fishing operations.
Reducing the environmental / ecological impact	Use of intermediate oils with reduced sulphur emissions.	Reduction in ecological footprint.
Improving fish handling, product quality and food safety.	Improved on board fish storage facilities.	Improved quality of landed produce and consequent higher economic value due to improved price levels and reduced post-harvest losses.
Improving safety at sea and working conditions of fishers.	Improvements in safety protocols. Introduction of improved firefighting capabilities.	Reduction in the number of accidents. Improved productivity.


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Annexes

Overview of fishing fleet information by major fleet segment, including basic technological data, costs, earnings and financial indicators

Annex A – United States of America

DESCRIPTION OF METHODOLOGY FOLLOWED BY THE STUDY

Description of data and information collection methods used by fishing fleet covered in this national report for the United States:

West Coast groundfish catch share program

All vessels with limited entry groundfish permits with trawl endorsements are surveyed annually by the Economic Data Collection Program. They report variable and fixed costs, non-fishing earnings, vessel characteristics, number of crew on-board, and fuel use. For this national report, additional vessel characteristics were pulled from the Coast Guard Vessel Registry system. Discard information was provided by the West Coast Groundfish Observer Program. To protect confidentiality, when ranges of values are presented the minimum is the average of the bottom three observations and the maximum is the average of the top three observations for each fleet. More information about the data collection programs can be found here: www.nwfsc.noaa.gov/edc.

Northeast limited access scallop dredge fishery

Cost information is collected via two different methods in the Northeast region of the United States. Running costs are collected by at-sea observers. Because only ~10 percent of trips by the limited access scallop fleet are observed, a modelling approach is used to fill in gaps in cost data. Independent variables in the model include vessel horse power, vessel age, vessel tonnage, hours absent at sea, and the price of diesel. Modelling methods utilized include Ordinary Least Squares (OLS), Weighted Ordinary Least Squares (WOLS), and Heckman Selection. The Heckman Modelling approach is used for the purpose of correcting for bias in the deployment of at-sea observers. For more information on the operating cost models, see Werner et al (2019). Running costs are predicted for all commercial fishing trips by the limited access scallop fleet in the 2016 fishing year. Information on discards is also collected by at-sea observers.

For labour, vessel, and capital costs, a survey of fishing vessel owners in the Northeast of the United States was conducted. The values presented in the tables for labour, vessel, and capital costs represent the average values for scallop vessels from surveys conducted in 2011 and 2012. A total of 59 scallop vessels responded to these surveys between the two years. Values from these surveys were converted to 2016 dollars, using the seasonally adjusted GDP implicit price deflator (https://fred.stlouisfed.org/series/GDPDEF), to match revenue and operating costs.

Depreciation values were calculated in a different manner than other vessel owner costs. The fishing vessel owner survey asks for owners to provide the market value of their vessel, fishing gear, and fishing permits combined. Since limited access scallop permits are of substantial value, assigning a depreciation value to these responses would not be appropriate. Instead, a distance function approach for steel hulled vessels in the Northeast region was utilized (Färe *et al.* 2017). This method calculated shadow values for vessel attributes such as length and horsepower. These shadow values were then applied to the dataset of limited access scallop vessels to arrive at vessel value. For each observation in the dataset, depreciation was calculated as 4 percent of vessel value for vessels <25 years of age and 2 percent of vessel value for vessels >=25 years of age.

Gulf of Mexico shrimp trawl vessels

An economic survey of federally-permitted vessel operations is conducted annually. Roughly 300 responses from active vessels are obtained per year. The survey only requests information about broad cost categories. Results from 2014 are presented in this national report.

Hawaii pelagic longline vessels

Multiple data sources were utilized to provide the economic performance profile of the Hawaii pelagic longline fishery in 2012. First, cost information was obtained from two sources: (1) in-person interviews and (2) the Continuous Economic Data Collection Program. Vessel owners and operators were interviewed from January through September 2013 to collect fixed-cost information and vessel physical and operational characteristics based on 2012 operations. The Continuous Economic Data Collection Program, established since 2006, collected trip-level cost information from observed longline fishing trips (approximately 20 percent of the total fishing trips). Second, sales revenues were obtained from the Hawaii Department of Aquatic Resources (HDAR) dealer database. Third, reported catch and trip related data were used from National Marine Fisheries Service (NMFS) federal logbooks.

References

Werner, S., DePiper G., Jin, D. & Kitts, A. 2020. *"Estimation of Commercial Fishing Trip Costs Using Sea Sampling Data".* Unpublished manuscript- in review.

Färe, R., Grosskopf, S. & Walden, J. 2017. *"Measuring capital value in a commercial fishery: A distance function approach."* Marine Policy 81: 109–15.

Annexes – Brazil

Annex – 1 North Region: Technical characteristics of vessels from the industrial fishing fleets participating in the survey

North Region: Average technical data of fishing fleets participating in the survey

Characteristics	Bottom trawl vessels	Vertical longline vessels	Pair trawl vessels	Trap & pot vessels
Length overall (LOA) (meters)	17–28	12–22	17–28	12–22
Gross tonnage (GT)	50–120	12–22	17–28	12–22
Total power of main engine (kW)	370	150	150	150
Volume of fish hold(s) (m^3)	30–50	20	30–50	20
Freezing capacity (tonnes)	N/A	20	N/A	20
Buffer capacity (tonnes)	N/I[1]	N/I	N/I	N/I
Machinery for processing the catch	N/I	N/I	N/I	N/I
Type of fishing gear	Bottom trawl	Vertical longline	Diverse fishing	Traps
Net drums (number)	1	-	1	-
Number of the crew	5	7	5	7
Ownership	Private	Private	Private	Private
Sharing systems	N/A	N/A	N/A	N/A
Fishing days at sea per annum	160	200	120	200
Number of fishing trips per annum	4	10	12	10
Fishing seasons (months)	N/I	N/I	N/I	N/I
Average age of vessels (years)	>20	>20	>20	>20

Annex – 2 Northeast Region: Technical and economic characteristics of longline fishing vessels participating in the survey

Vessel characteristics	Fresh - iced	Frozen -30°C	Frozen -35°C
Maximum age of the vessel	15 years	15 years	15 years
Length overall (LOA)	24–28 m	24–28 m	28–36 m
Gross tonnage	150 to 200 GT	150 to 200 GT	200 to 300 tons
Main engine	350 to 450 HP	350 to 450 HP	450 to 700 HP
Hull construction	Steel, aluminum, fibre	Steel	Steel
Autonomy of the sea	40 days	60 days	80 days
Storage capacity for fish	<40 tonnes at 0°C	<80 tonnes at -17°C	<100 tonnes at -17°C
Cooling capacity	5–10 tonnes; below -17°C	5–10 tonnes; below -30°C	10–15 tonnes; below -35°C
Ice production with seawater	Minimum of 2 tonnes/day	-	-
Estimated vessel cost price (fishing equipment not included).	USD 300 000	USD 400 000	USD 600 000
Number of fishing trips per calendar year	10	10	10
Average Annual Operational Costs (in USD)			
Diesel oil	72 000	144 000	216 000
Lubricants	5 150	10 300	15 400
Bait	10 300	20 600	30 800
Ice	6 400	12 860	257 000
Food	6 400	12 860	20 600

[1] N/I = no information available; N/A= not applicable

Vessel characteristics	Fresh - iced	Frozen -30°C	Frozen -35°C
Consumables (miscellaneous)	5 150	10 300	25 700
Specialized personnel	46 300	77 100	138 800
Administrative staff	7 700	7 710	23 000
Other costs (vessel and crew insurance, air and land freight, maintenance/repairs, taxes, packaging, dock/storage and sales commission)	103 000	218 500	275 000
Total annual operational costs	**USD 262 400**	**USD 514 230**	**USD 771 000**
Average annual operational revenues (in USD)[2]			
Big-eye tuna	326 500	129 563	194 345
Swordfish	60 462	246 790	370 180
Sailfish	6 500	10 283	15 424
Shark	6 500	15 424	25 710
Shark fin	8 098	19 280	23 136
Others	7 045	3 860	7 712
Total Annual Revenue	**USD 415 105**	**USD 425 200**	**USD 636 507**
Average annual operational income per year (in USD)			
Net cash flow	152 705	(89 030)	(83 093)
Depreciation (est.)	15 000	20 000	30 000
Gross profit	137 705	(109 030)	(113 093)

Annex – 3 Southeast Region: Technical characteristics of surveyed fleets

The table below includes the averages of 5 vessels of each of the 5 fleets surveyed in the southeast region.

	Sardinella vessels	Pink shrimp vessels	Demersal trawl finfish vessels	Octopus fishing vessels	Seabob shrimp vessels
Overall length (LOA) (in meters)	21.2	21.1	20.8	20.1	14.5
Material of the hull	Wood or steel	Mainly wood, with some steel vessels	Wood or steel	Wood or steel	Wood
Gross tonnage (GT)	N/I	N/I	N/I	N/I	N/I
Type of propeller (fixed propeller, controllable pitch propeller)	Fixed propeller	Fixed propeller	Fixed propeller	Fixed propeller	Fixed propeller
Total power of main engine (in kW)	212,6	215	225,8	194,2	135,4
The volume of fish hold(s) (in m^3)	N/I	N/I	N/I	N/I	N/I
Freezing capacity (in tonnes)	N/I	N/I	N/I	N/I	N/I
Buffer capacity (in tonnes)	N/A	N/A	N/A	N/A	N/A
Machinery for processing catch	N/A	N/A	N/A	N/A	N/A
Type of fishing gear employed	Purse seine	Bottom pair trawl	Bottom pair trawl	Pot fishing	Single or double bottom trawl
Net drums (number)	1	1	1	N/I	1
Fish pumps (capacity)	N/A	N/A	N/A	N/A	N/A
Number of crew	4 to 6	4 to 6	6 to 8	5	4 or 5
Ownership	Private	Private	Private	Private	Private
Sharing systems	N/A	N/A	N/A	N/A	N/A
Fishing days at sea per calendar year	240	N/I	N/I	N/I	N/I
Number of fishing trips per calendar year	15	N/I	N/I	N/I	N/I
Fishing seasons (in months)	8	N/I	N/I	N/I	N/I

2 Exchange rate applied: USD 1.00 = BRL 3.89

Annex – 4 South Region: Technological characteristics of surveyed fleets

This table includes the averages of 5 vessels of each of the 4 fishing fleets surveyed in the south region.

	Shrimp trawlers	Demersal trawlers	Bottom trawlers	Purse seiners
Length overall (LOA) (in meters)	22	25	21 to 25	27
Gross tonnage (GT)	93	100	90 to 120	140
Type of propeller (fixed propeller, controllable pitch propeller)	Kaplan/fixed	Kaplan/fixed	Kaplan	Fixed
Total power of main engine (in kW)	272	210 to 480	213 to 478	400
Volume of fish hold(s) (in m^3)	28	30-40	20 to 50	N/I
Freezing capacity (in tonnes)	27 to 30	30-40	20 to 50	N/I
Buffer capacity (in tonnes)	N/A	N/A	N/A	N/I
Machinery for processing of catch	N/A	N/A	N/A	N/I
Type of fishing gear	Trawl	Pair trawl	Double trawl	Purse seine
Net drums (number)	1	1	1	N/I
Fish pumps (capacity)	N/A	-	-	N/I
Number of crew	5	6 to 8	5 or 6	19
Ownership	Private	Private	Private	private
Sharing systems	N/A	N/A	N/A	N/A
Fishing days at sea per calendar year	180	300	240 to 300	210
Number of fishing trips per calendar year	40	15	15 to 50	5
Fishing seasons (in months)	9	9	9	N/I

Annex – 5 South Region: Average investment costs in various trawler fleets.

The table below presents the original average investments costs in USD for shrimp, demersal and bottom trawlers based on information from at least 3 vessels. The purse seiner investment information in the table was obtained from just one vessel.

	Shrimp trawler		Demersal trawler		Bottom trawler		Purse seiner	
	Age (years)	Original investment (USD)	Age (years)	Original investment (USD)	Age (years)	Original investment (USD)	Age (years)	Original investment (USD)
Vessel (hull)	15	515 000	15 to 30	514 250	15	515 000	15 to 20	154 200
Main engine(s): Engine and propulsion	15	38 500	15	38 500	15	38 500	15	51 400
Equipment on deck (e.g. fishing gear and related deck equipment), as well as lifesaving equipment	8 to 10	51 000	8 to 10	51 000	8 to 10	51 000	10	18 000
Electronic devices (navigation and communication equipment, fishing finders/fish detection, AIS/VMS)	8 to 10	77 000	8 to 10	38 500	8 to 10	77 000	10	102 800
The equipment below deck	1 or 2	3 200	1 or 2	5 150	1 or 2	3 200		N/A
Fishing gears (BRDs, FADs)	8	38 500	8	38 500	8	38 500		N/A
Total investment		**723 200**		**685 900**		**723 200**		**326 400**

Annex – 6 South Region: Annual Earnings and Costs per Individual Fishing Vessel (in USD)

The table presents the annual average operational costs and earnings of shrimp trawlers demersal trawlers and bottom trawlers in the South region in 2018.

		Shrimp trawler	Demersal trawler	Bottom trawler
		USD		
	Total revenue from sale of landings	**208 000**	**694 085**	**462 725**
Operating costs	Fuel	93 667	277 630	215 940
	Lubricants/oil/filters	2 200	6 170	4 627
	Ice	800	32 390	15 424
	Food, stores, and other provisions	8 067	20 050	9 255
	Fish selling costs	-	16 965	4 627
	Crew travel	-	33 934	15 425
	Other operating costs	3 967	2 780	1 542
	Labour share and wages (including social security contributions, life/accident, and health insurance)	63 133	100 258	40 100
Vessel owner costs	Fishing license fees, permits, and quota	-	1 235	620
	Insurance fees (vessel, employers, equipment)	17 400	1 235	629
	Gear replacements, repairs & maintenance	8 033	61 700	37 020
	Vessel repairs & maintenance	47 492	33 935	15 424
	Other fixed costs (accountancy, audit and legal fees, general expenses, subscriptions, etc.)	-	6 170	3 085
	Depreciation (vessel, engine, equipment, and gears that last more than 3 years)	21 600	21 600	15 424
	Taxes on profits	-	27 640	22 828
	Total operational costs in 2018	**244 759**	**594 452**	**363 718**

The vessels obtained revenues in 2018 solely from the sale of fish landings. Not any subsidies or grants were obtained according to the vessel owners. Not any operating costs were reported to have been made on payment of harbour dues, salt, bait, or packaging. In the category vessel costs, the vessel owners did not report expenses on purchase of fishing rights (quotas) or in-year investments in equipment. Reported taxes on profits and vessel and equipment depreciation were not included in the total operating costs above.

This techno-economic performance review of selected fishing fleets in North and South America presents the findings of four country level studies of fishing fleets in the United States of America, Brazil, Chile and Peru. The review includes financial and economic information of 21 fishing fleet segments, including shrimp and groundfish trawlers, demersal trawlers, longliners, purse seiners, dredgers as well as hook and line fishing vessels.

Analysis of the costs and earnings data of these important fishing fleet segments in North and South America, using survey data from 2012–17 for the US fleet segments and 2018 data for the South American countries' fleets showed that 81 percent of the fleet segments had a positive net cash flow. The net profit margins of 38 percent of the 21 fishing fleet segments were >10 percent. Two-thirds (67 percent) of the fleet segments presented positive results in terms of their capital productivity as the return on fixed tangible assets (ROFTA) was positive. Twenty four percent of the fleet segments showed return on investment (ROI) figures of twenty percent or more. A majority of the Chilean and Peruvian fleet segments had ROIs of ten percent or higher in 2018.

The financial and economic performance of the fishing fleet segments is not only affected by the seafood prices, but also by the fisheries management regime in place, fish species targeted, fish stock status and fishing methods and technologies applied. The age structure of the fishing vessels shows an increasing trend for most of the fishing fleet segments in this review, which adds to the apparent profitability of the vessels in these fleet segments as depreciation and interests on loans are minimized.

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