CHAPTER 2

An overview of the Chilean fisheries and aquaculture sector

Chile's territories are located in continental South America, on the Antarctic, in Oceania, and in the Pacific Ocean. Its continental coastline stretches 4 337 km (measured on a straight line), while its Exclusive Economic Zone (EEZ) totals almost 2.8 million km^2. In the Chilean wild capture fisheries, the most abundant species are the pelagic species of jack mackerel, sardine, anchovy and "caballa" mackerel. Salmon and trout farming dominate in aquaculture production. In 2005-2006 a total of 156 species were recorded as having been landed, comprising 75 fish species, 35 mollusk species, 25 crustacean species, 18 species of algae, and three other species).

Commercial fisheries started their development in the early 1960s when significant investments were made to install large fish meal processing lines in the northern part of the country. These were aimed at processing the large catches of anchovy and sardine available close by, caught through a large number of purse seiners built and bought specifically for these purposes. This was followed by the exploitation of hake, cold water shrimp and prawn in successive decades. The variability of pelagic fisheries along the Chilean coastline also influenced further development of fish meal production in central and southern areas, this time mainly based on jack mackerel, together with the production of canned products.[1]

The 1980s saw the start and rapid growth of the Chilean aquaculture industry, mainly based on salmon and trout (although it has begun expanding into other species in recent years). This growth has transformed Chilean fishing activities to the point that, in 2007, aquaculture accounts for 65% of total fish export values, based on only 17.9% of the volumes landed and 38% of the volumes exported. This growth has shifted the focus of policy, investment and development in fisheries, to the point that aquaculture is increasingly becoming the center of attention.

During this decade, environmental and biological fluctuations have also meant that a significant part of local pelagic catches (jack mackerel and "caballa"mackerel) are currently obtained beyond the EEZ, where Chile competes for these resources with several foreign fishing fleets. Chile is also actively involved in the catching of several demersal fish and other species in Southern and Antarctic waters, operating several factory vessels which are the property of local companies, owned by foreigners, but already well established in Chile.

The Chilean fishing industry (including aquaculture) has been modeled for decades on the concept that, having a small local population and ample fishery (and aquaculture) resources, it should have a strong export orientation. This has meant that local factories and production facilities have been designed to produce high quality fishery products, acceptable in the most demanding markets. They generally use very big processing lines, which because of their size and technology can be very efficient, taking advantage of economies of scale, both in investments and costs. This has been supported by the fact that national policies have favored market oriented and open economic policies and have reinforced the viability and long-term stability of export oriented Chilean fishing and aquaculture activities.

Following initial rapid growth, industrial fishing activities, the most voluminous of all on the Chilean scene, have leveled off during the last decade, following a severe collapse between 1994 and 1998. For the most part, they are export oriented. In contrast, artisanal fishers primarily supply the internal market with fish and shellfish that are generally available in small quantities and sold fresh. At the same time, some parts of the small-scale sector also supply several industrial processors on a regular basis, and are responsible for delivering fresh (and live) fish and shellfish to exporters that specialize in trading quality fish products. Artisanal landings have evolved considerably during the last decade, nearly doubling their volumes since 1996.

Small-scale aquaculture is mainly centered on the production of molluscs, algae and trout, and has not been as successful. Even so, this economic activity is currently regarded as an opportunity for further growth, particularly due to its potential to attract and convert artisanal fishers, some of whom are adversely affected by the growing resource scarcity and overexploitation in several coastal fisheries. Industrial scale aquaculture, in turn, has been extremely successful during the last two decades, growing at about 40% a year between 1986-87 and 1996-97, and thereafter (1996-97–2006-07) at 10% a year . However, there is concern that the original monoculture-producer model is quickly being exhausted, and the government's Salmon Round Table initiative is intended to reinvigorate the

industry, including exploring how to expand the range of species farmed in the future.

In terms of the status of the resource stocks, most natural resources fished today in Chile are either fully exploited or overexploited. As a result, no substantial growth is expected in the future for wild caught fishery products from traditional species. There is potential to develop fishing activities for non-conventional species, both in Southern or Antarctic waters (krill; cephalopods, etc.) and beyond the EEZ, where the Chilean fishing fleet has already gained experience.

Fisheries and aquaculture production

Total fisheries and aquaculture production reached a peak of 8 million tonnes in 1994, followed by a severe decline to 3.8 million tonnes in 1998. Annual production since then has stabilized to between 4.7 and 6 million tonnes, and has been characterized by a growth in aquaculture production (Table 2.1 and Figure 2.1). Aquaculture represented around 18% of total production in 2007.

Figure 2.1. Total fisheries and aquaculture production

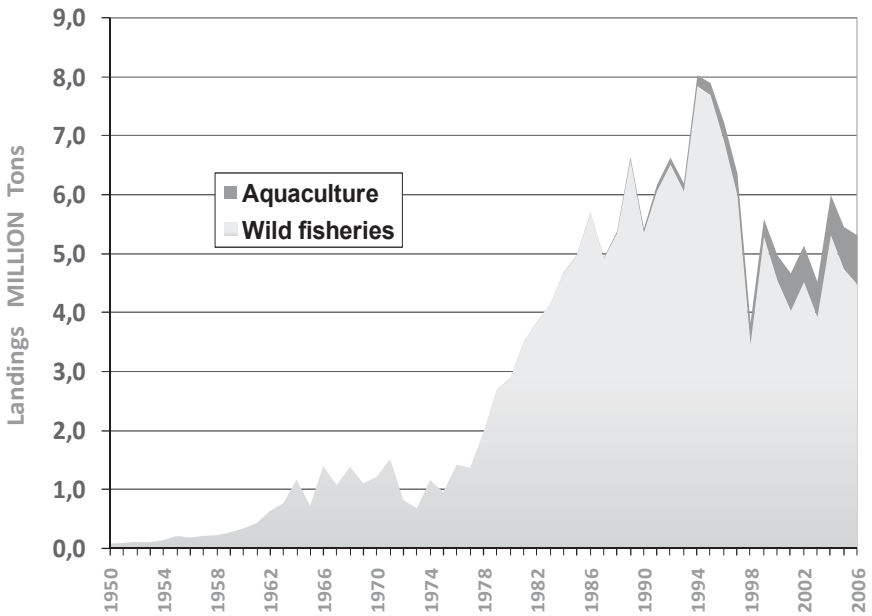


Table 2.1 Fisheries and aquaculture production, 1984-2007

Year	Total landings						Aquaculture				
	Fish	Mol-lusks	Crusta-ceans	Algae	other	total	Fish	Mol-lusks	Algae	other	total
1984	4 363	89	29	175	19	**4.674**	0	1	7	-	**9**
1985	4.660	89	21	182	34	**4.987**	1	1	5	-	**7**
1986	5.415	100	26	124	30	**5.696**	2	2	5	-	**10**
1987	4.647	108	31	117	29	**4.932**	3	2	9	-	**14**
1988	5.028	121	33	166	27	**5.375**	5	4	23	-	**32**
1989	6.291	110	24	178	29	**6.633**	12	4	36	-	**52**
1990	5.043	106	27	229	20	**5.424**	29	4	38	-	**71**
1991	5.830	122	29	160	26	**6.166**	42	5	58	-	**105**
1992	6.304	135	30	127	33	**6.628**	62	6	48	-	**116**
1993	5.864	110	26	156	35	**6.191**	77	9	49	-	**135**
1994	7.660	105	31	183	43	**8.021**	102	16	66	-	**184**
1995	7.411	91	31	299	58	**7.890**	141	16	49	-	**206**
1996	6.726	96	33	322	56	**7.233**	199	19	105	-	**323**
1997	5.905	93	37	282	49	**6.366**	248	24	103	-	**375**
1998	3.362	109	39	266	47	**3.824**	260	33	68	-	**361**
1999	5.118	110	39	261	58	**5.587**	231	44	31	0	**305**
2000	4.486	110	37	281	58	**4.972**	343	49	33	0	**425**
2001	4.151	138	26	300	48	**4.663**	505	61	66	-	**632**
2002	4.621	111	24	316	61	**5.133**	483	63	72	-	**617**
2003	3.971	145	19	349	44	**4.528**	489	79	40	0	**607**
2004	5.176	356	20	411	51	**6.014**	569	107	20	0	**696**
2005	4.531	460	23	425	39	**5.478**	614	109	15	-	**739**
2006	4.443	457	22	339	36	**5.298**	648	150	38	-	**836**
2007 P	4.232	397	22	360	36	**5.047**	664	216	23	-	**904**

Source : SERNAPESCA, *Anuarios Estadísticos*, Various volumes 2007P: Preliminary only

Table 2.1 Fisheries and aquaculture production, 1984-2007 (cont.)

	Wild Fisheries						% of Totals	
Year	Fish	Mollusks	Crusta-ceans	Algae	Other	TOTAL	Aqua-culture	Wild fisheries
1984	4 363	87	29	168	19	**4 665**	0.2	99.8
1985	4 659	88	21	177	34	**4 979**	0.2	99.8
1986	5 413	98	26	119	30	**5 686**	0.2	99.8
1987	4 644	106	31	108	29	**4 918**	0.3	99.7
1988	5 022	117	33	143	27	**5 342**	0.6	99.4
1989	6 279	107	24	142	29	**6 581**	0.8	99.2
1990	5 014	102	27	191	20	**5 354**	1.3	98.7
1991	5 787	117	29	102	26	**6 061**	1.7	98.3
1992	6 241	128	30	79	33	**6 512**	1.8	98.2
1993	5 786	101	26	107	35	**6 056**	2.2	97.8
1994	7 558	89	31	117	43	**7 837**	2.3	97.7
1995	7 270	75	31	250	58	**7 684**	2.6	91.5
1996	6 526	77	33	217	56	**6 910**	4.5	86.5
1997	5 656	69	37	179	49	**5 990**	5.9	88.0
1998	3 103	76	39	197	47	**3 463**	9.5	86.6
1999	4 887	67	39	230	58	**5 282**	5.5	88.4
2000	3 916	350	23	410	39	**4 738**	13.5	86.5
2001	3 795	307	22	301	36	**4 462**	15.8	84.2
2002	3 567	181	22	336	36	**4 143**	17.9	82.1
2003	3 482	67	19	309	44	**3 921**	13.4	86.6
2004	4 607	249	20	391	51	**5 317**	11.6	88.4
2005	3 916	350	23	410	39	**4 738**	13.5	86.5
2006	3 795	307	22	301	36	**4 462**	15.8	84.2
2007 P	3 567	181	22	336	36	**4 143**	17.9	82.1

Various volumes 2007P: Preliminary only

Source: SERNAPESCA, *Anuarios Estadísticos*,

About 84% of wild landings in 2005-2006 correspond to fish (Table 2.2). An extra 8% are algae, while 7% correspond to mollusks. 'Other species', even though meaning only 0.8% in volume terms, have a high unit value (sea urchin('erizo'), sea cucumber('pepino de mar'), while crustaceans (0.5%) are also limited in availability, but show as well high market prices (cold water shrimp; Chilean king crab ('centolla'); other crabs ('jaibas'), etc.).

Table 2.2. Wild capture fisheries production, 2005-06

Species		2005	2006	Average landing 2005-2006	% of Total 2005-2006	% Accumulated
Ranking	**TOTAL FISH**	**3 916.1**	**3795.3**	**3 855.7**	**100**	
1	JUREL	1 430.4	1.379.9	1 405.2	36.4	36.4
2	ANCHOVETA	1 548.8	995 2	1 272.0	33	69.4
3	SARDINA COMUN	289 5	440 1	364 8	9.5	78.9
4	CABALLA	280 8	368 8	324 8	8.4	87.3
5	BACALADILLO O MOTE	110 4	319 5	214 9	5.6	92.9
6	MERLUZA DE COLA	79.8	73.4	76.6	2	94.9
7	MERLUZA COMUN	47.4	48.0	47.7	1.2	96.1
8	MERLUZA DEL SUR	31.5	31.5	31.5	0.8	96.9
9	MERLUZA DE TRES ALETAS	25.4	29.1	27.3	0.7	97.6
10	SARDINA AUSTRAL	-	39.5	19.8	0.5	98.2
11	Other (65 species)	72.1	70.2	71.2	1.8	100
Ranking	**TOTAL MOLLUSCS**	**350 4**	**307 1**	**328 8**	**100**	
1	JIBIA	297,0	251.0	274,0	83.3	83.3
2	ALMEJA	14.1	13.9	14,0	4.3	87.6
3	TAQUILLA	7.0	5.3	6.1	1.9	89.5
4	JULIANA O TAWERA	2.9	6.3	4.6	1.4	90.9
5	NAVAJUELA	3.9	5.2	4.5	1.4	92.2
6	HUEPO O NAVAJA DE MAR	4.5	4.2	4.3	1.3	93.6
7	LOCO	3.3	3.9	3.6	1.1	94.7
8	CULENGUE	2.4	3.8	3.1	0.9	95.6
9	PULPO	2.6	2.8	2.7	0.8	96.4
10	CHOLGA	1.7	3.1	2.4	0.7	97.2
11	Other (25 species)	11.1	7.6	9.4	2.8	100
Ranking	**TOTAL CRUSTACEANS**	**22.9**	**22.3**	**22.6**	**100**	
1	JAIBA MARMOLA	4.6	5.1	4.8	21.4	21.4
2	CAMARON NAILON	3.9	4.5	4.2	18.5	39.9
3	CENTOLLON	5.7	2.3	4.0	17.7	57.6
4	CENTOLLA	3.2	4.1	3.7	16.2	73.9
5	LANGOSTINO AMARILLO	3.0	4.2	3.6	15.9	89.8
6	LANGOSTINO COLORADO	1.1	1.0	1.1	4.7	94.5
7	PICOROCO	0.3	0.2	0.2	1	95.5
8	GAMBA	0.3	0.2	0.2	1	96.5
9	JAIBA PELUDA O PACHONA	0.2	0.2	0.2	0.7	97.2
10	JAIBA	0.2	0.1	0.1	0.6	97.8
11	Other (15 species)	0.5	0.5	0.5	2.2	100

Table 2. Wild capture fisheries production, 2005-06 (*cont*)

Species		2005	2006	Average landing 2005-2006	% of Total 2005-2006	% Accumulated
Ranking	**TOTAL ALGAE**	**409.9**	**301.1**	**355.5**	**100**	
1	CHASCON	203.9	161.8	182.9	51.4	51.4
2	PELILLO	72.9	43.8	58.3	16.4	67.8
3	LUGA-ROJA	42.5	33.3	37.9	10.7	78.5
4	HUIRO PALO	46.9	27.6	37.2	10.5	89.0
5	LUGA NEGRA O CRESPA	24.9	17.1	21.0	5.9	94.9
6	HUIRO	8.8	9.3	9.1	2.5	97.5
7	LUGA CUCHARA O CORTA	4.9	3.7	4.3	1.2	98.7
8	COCHAYUYO	2.6	2.3	2.4	0.7	99.4
9	SPIRULINA	-	-	-	-	99.4
10	CHICOREA DE MAR	1.5	1.6	1.6	0.4	99.8
11	Other (8 species)	0.9	0.6	0.7	0.2	100.0
Ranking	**TOTAL OTHER SPECIES**	**38.9**	**36.1**	**37.5**	**100**	
1	ERIZO	37.6	34.8	36.2	96.5	96.5
2	PIURE	1.2	1.2	1.2	3.2	99.8
3	PEPINO DE MAR	0.2	0.0	0.1	0.2	100

Source: SERNAPESCA, *Anuarios Estadísticos* 2005 and 2006, and calculations/estimates of the study

Wild fish production is highly concentrated on a few pelagic species (87% on jack mackerel, anchovy, sardine and 'caballa' mackerel)[2], which supply well organized and efficient fish meal-oil and canned production, both in Northern and Central Chile. Smaller proportions of these pelagic catches are also transformed into frozen and other products.

In recent years the availability of wild mollusk has been highly dependent on jumbo squid landings ('jibia'), which arrived in unexpectedly high quantities to the Chilean coast, followed by two different clams, gastropods and mussels. Again, the top three species (among 35 available) represent about 90% of this category (2005-2006). In turn, crustaceans (25 species) are available in smaller quantities, led by various crabs ('jaibas'), cold water shrimp and the valuable Chilean king and snow crabs. The most important five species account for 90% of the total wild catches. Eighteen species of algae are also exploited, with the most important four accounting for 89% of whatever is landed throughout the country. High priced sea urchins and sea cucumbers account for most part of 'other' wild species in 2005 and 2006.

Chile's aquaculture industry is dominated by salmon and trout (primarily Atlantic salmon), although mollusk production (mussels and scallops) has been increasing rapidly in recent years (Table 2.3). From the early 1990s Chile also started to work on the farming of abalones and turbot, becoming the first nation to do so in Latin America and one of the few that

commercially farm marine species in-land in this part of the world. The aquaculture industry now produces over 16 different species.

Table 2.3. Aquaculture production, 1981-2007

Year	Salmon and trout	Other Fishes	Total Fish	Algae	Molluscs	Crustaceans	Other species	Total
1981	-	-	-	-	0.7	-	-	0.7
1985	1.1	-	1.1	4 9	1,5	0	-	7.5
1990	28.8	-	28 8	38 0	3,8	-	-	70 7
1991	42.5	-	42 5	57 7	5,1	-	-	105 3
1992	62.2	-	62 2	47 8	6,3	-	-	116 3
1993	77,4	-	77 5	48 6	9,0	-	-	135 1
1994	101 9	-	101 9	65 8	16,0	-	-	183 7
1995	141 4	-	141 4	49 2	15,7	-	-	206 3
1996	199 1	-	199 3	105 2	18,7	-	-	323 1
1997	248 0	-	248 2	102 8	24,1	-	-	375 1
1998	259 2	0.4	259 7	68 4	33,4	-	-	361 4
1999	230 2	0.3	230 5	31 3	43,7	-	0	305 5
2000	342 4	0.3	342 7	33 5	48,9	-	0	425 1
2001	504 4	0.3	504 7	65 5	61,4	-	-	631 6
2002	482 4	0.3	482 7	71 6	62,9	-	-	617 3
2003	488 2	0.4	488 7	40 0	78,6	-	0	607 2
2004	569 1	0.3	569 4	20 3	106 6	-	0	696 3
2005	614 1	0.3	614 4	15 5	109 4	-	-	739 4
2006	647 3	0.3	647 6	38 2	149 9	-	-	835 7
2007P	664 2	0.3	664 5	23 5	216 1	-	0	904

Source :SERNAPESCA, *Anuarios Estadísticos*, various volumes. Figures for 2007 are preliminary only.

In summary, the Chilean fisheries and aquaculture sector has grown substantially in recent years, and ranks among the major fishing and aquaculture nations in the world. As detailed in a subsequent chapter, the management regimes fisheries and aquaculture have evolved significantly, particularly with respect to the industrial fisheries. However, there is scope for further improvements in the management policies governing aquaculture and small-scale fisheries.

Processing

Fishery products, caught in the wild or farmed, are either processed, consumed fresh within the country or exported. The relatively small domestic market means that a high proportion of production is exported, and a significant portion of exports are processed to some degree. The number of processing facilities along the country has remained fairly stable between 2003-2007, with a slight increase in the number of facilities in both

Northern and Southern Chile (Table 2.4). Most of the processing facilities focus primarily on fresh and frozen products, while there are also a number of fish meal and canning processing lines.

Table 2.4. Number of fish processing plants by geographic area, 2003-07

Year	North	Center	South	Extreme South	Total
2003	115	50	222	54	441
2004	122	54	231	59	466
2005	138	54	240	56	488
2006	154	45	226	56	481
2007	147	49	240	48	484

Anuarios Estadísticos, various volumes. North: Regions I to IV, plus XV. Center: Regions Vth to VIIth, plus Metropolitan Region. South: Regions VIII to X plus Region XIV. Extreme South: Regions XI and XII

Source: SERNAPESCA

The production of fish meal and oil dominates the processing sector, absorbing 60% of all raw materials in 2006 and accounting for 51% of the end products (Table 2.5). This share has been declining in recent years as fresh and frozen products have become relatively more significant. In terms of end products, frozen products accounted for 27% of the volume produced in 2006, up from 22% in 2004, while the proportion for fresh products increased from 8% to 14% over the same period.

The growth in aquaculture production has been one of the driving forces behind the development of new and bigger industrial processing facilities, particularly in Regions X to XII in Southern Chile. Chile exports the majority of its salmon/trout production as value added products that are, in many cases portioned, packed and labeled and ready to be sold in supermarket chains in importing destinations. Chile is the major supplier of fresh and frozen salmon and trout fillets, steaks and portions for the US and Japanese markets. In recent years, the rapid growth in the farmed production of mussels has prompted the establishment of a number of highly mechanized and high-tech processing facilities in or near Puerto Montt and Chiloé Island (Xth Region), with the capacity to handle around 350 000-400 000 tonnes of raw mussels per year.

Table 2.5. Raw materials processed and end products, 2004-06

	Year	Fresh	Frozen	Canned	Salted dried, etc.	Algue-Algue products	Fish meal	Fish oil	other	Total
Raw materials										
Total thousand tonnes	2004	264.5	843.6	357.6	11	407.3	3 871.6	-	5.4	5 760.8
	2005	298.4	871.9	343.2	10.7	423.2	3 317	-	5.2	5 269.6
	2006	319.8	942.9	437.1	3.1	335.5	3 075	-	-	5 113.4
% of Totals	2004	4.6	14.6	6.2	0.2	7.1	67.2	-	0.1	100
	2005	5.7	16.5	6.5	0.2	8	62.9	-	0.1	100
	2006	6.3	18.4	8.5	0.1	6.6	60.1	-	-	100
End products										
Total thousand tonnes	2004	161.8	433.9	116.2	6.3	50.6	1 015.6	195.3	1.9	1 981.7
	2005	199	469.1	109.2	5.8	56.1	865.8	168.9	2.4	1 876.3
	2006	243.5	462.4	85.9	1.4	48.4	707.5	180.2	-	1 729.3
% of Totals	2004	8.2	21.9	5.9	0.3	2.6	51.2	9.9	0.1	100
	2005	10.6	25	5.8	0.3	3	46.1	9	0.1	100
	2006	14.1	26.7	5	0.1	2.8	40.9	10.4	-	100

Raw materials used for these calculations do not include re-processing nor fishery products caught by factory vessels in Chilean nor in international waters. Therefore, total raw material figures differ for those for landings presented elsewhere.
Source: SERNAPESCA, Anuarios Estadísticos, various volumes

Local fish meal plants are also among the biggest and most efficient in the world, permitting Chile to produce high quality, highly digestible fish meals, with substantial protein content. This allows Chilean producers to obtain good prices for these products in the international market. The same applies to fish oils which are extensively used in fish diets for aquaculture operations. Formerly the most important fishery exports of Chile, fishmeal and fish oil are currently mass-consumed by local salmon farmers, who demand around a million tonnes a year of balanced food for farmed fish diets. These balanced diets use a good proportion of fish meal and oil and are basically produced by five industrial facilities which are among the largest and most efficient in the world.

Between 1996 and 2006, local fish meal and fish oil production have diminished substantially, in response to severe declines in the most important pelagic fisheries, particularly that of jack mackerel. In that period, fish meal production declined from 1.4 million tonnes (1996), to 0.7 million tonnes (2006), while fish oil production reached 0.18 million tonnes in 2006, after an impressive 0.29 million tonnes in 1996.

In addition, Chile is a large producer of canned pelagic fish, particularly jack mackerel, which is consumed in Chile as well as exported. Beyond these main product lines, the country produces Chilean king crab ('centolla'), which is currently exploited in reasonable amounts in the Magellan (XIIth) Region, and exported either frozen or canned. In addition, the country produces a substantial amount of farmed scallops that are exported (primarily frozen) to the French market. Chile is also a major producer and exporter of algae, both wild and farmed, as well as different chemical derivatives, such as agar-agar and carrageenan.

International Trade

Chile's fisheries and aquaculture development has been strongly linked to foreign demand for fishery products. Limited local consumption means that the future of this industry is intrinsically linked to the international demand for fish products, in particular those produced by Chile.

In 2007, Chilean fishery exports amounted to 1.41 million tonnes and USD 3 827 million. This accounted for 5.7% of the value of all Chilean exports. These figures have varied rather widely during the last twenty years or so, as shown in Table 2.6, where all monetary values are expressed in 2006 USD to facilitate comparison. The primary export markets are Japan (USD 850 million), the United States (USD 741 million), China (USD 228 million), Spain (USD 167 million), and Germany (USD 154 million).

Over the last fifteen years (1992-2007), the volume of exports from wild capture fisheries has diminished at an average annual rate of 2.7%, and the value has also decreased at an average of 0.7% a year. In contrast, aquaculture-based export volumes have grown at an average annual rate of 16.7%, while the export value has increased by 12.4% a year[3]. As a result, aquaculture products accounted for 65.2% of total fishery exports in 2007, compared with 22.8% in 2002. Similarly, the share of aquaculture exports in the total value of exports has increased from 3.9% to 38.2% over the same period.

It is worth noting that the average annual unit values for aquaculture exports have decreased over the years, from USD 7.80 to USD 4.40 between 1990 and 2007, while those based on wild fish have shown a slightly increasing trend during the same period (Figure 2.2). While this trend is consistent with the global aquaculture sector[4], it has presented the Chilean aquaculture industry with significant challenges. Chilean fish farmers not only grew substantially in size during the last 25 years, but they did so while also improving their technology and productivity to the point that nowadays, notwithstanding some unresolved problems, Chilean salmon farms are probably among the most efficient in the world.[5]

Even though Chile is one of the most important manufacturers of fish meal in the world, over 80% of its fishery export values (and around 55% of its volumes) are comprised of products for direct human consumption (Table 2.6). Over 66% of export values of products intended for human consumption is accounted for by frozen products, and 24% by fresh products, particularly salmon sold in the US market. Average export prices for fishery products for direct human consumption practically quadruple those for fish meal, and are about 50% higher than those for algae.

Table 2.6. Chilean exports of fishery products, 1990-2007

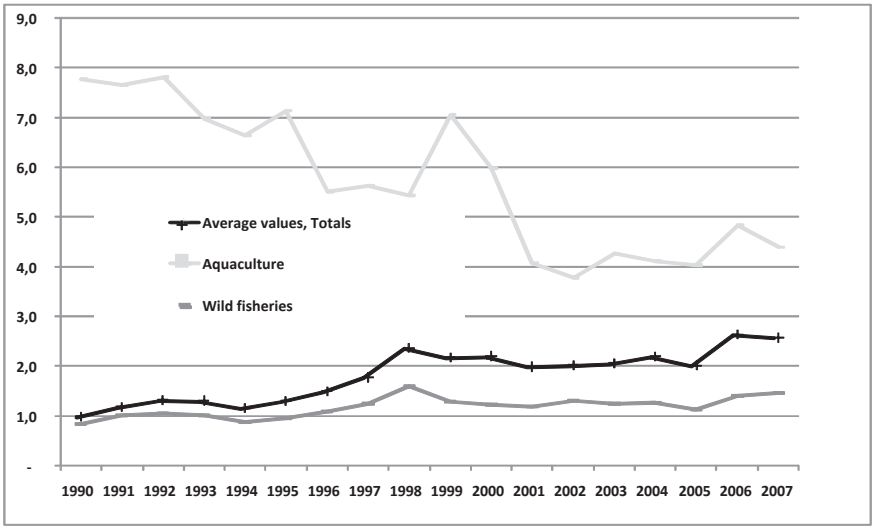
Year	Total fishery exports		Aquaculture		Wild fisheries		Avrg. values*Kilo, USD 2006			Aquaculture/ Totals(%)	
	Thousand tonnes	Million USD 2006	Thousand tonnes	Million USD 2006	Thousand tonnes	Million USD 2006	Total	Aqua culture	Wild fisheries	Volumes	Values
1990	1 299	1 298	28	219	1 271	1 080	1.0	7.8	0.8	2.2	16.8
1991	1 326	1 582	36	273	1 290	1 310	1.2	7.7	1.0	2.7	17.2
1992	1 370	1 819	53	414	1 317	1 405	1.3	7.8	1.1	3.9	22.8
1993	1 233	1 623	61	426	1 172	1 197	1.3	7.0	1.0	5.0	26.3
1994	1 602	1 869	78	522	1 524	1 347	1.2	6.7	0.9	4.9	27.9
1995	1 792	2 354	100	714	1 692	1 640	1.3	7.1	1.0	5.6	30.3
1996	1 521	2 286	140	771	1 381	1 515	1.5	5.5	1.1	9.2	33.7
1997	1 352	2 416	165	929	1 187	1 487	1.8	5.6	1.3	12.2	38.4
1998	932	2 217	189	1 030	743	1 187	2.4	5.4	1.6	20.3	46.5
1999	1 072	2 341	166	1 172	906	1 169	2.2	7.1	1.3	15.5	50.1
2000	1 053	2 326	218	1 303	835	1 023	2.2	6.0	1.2	20.7	56.0
2001	1 142	2 284	317	1 293	825	991	2.0	4.1	1.2	27.7	56.6
2002	1 212	2 462	350	1 326	863	1 136	2.0	3.8	1.3	28.8	53.9
2003	1 293	2 680	352	1 503	941	1 177	2.1	4.3	1.3	27.2	56.1
2004	1 313	2 895	431	1 775	882	1 120	2.2	4.1	1.3	32.8	61.3
2005	1 591	3 223	487	1 974	1 104	1 248	2.0	4.1	1.1	30.6	61.3
2006	1 391	3 683	500	2 427	891	1 256	2.6	4.9	1.4	36.0	65.9
2007	1 413	3 652	540	2 379	873	1 272	2.6	4.4	1.5	38.2	65.2
Average means cumulative annual rates of variations for each period (%)											
1992-2007	0.2	4.8	16.7	12.4	-2.7	-0.7					
2002-2007	3.1	8.2	9.1	12.4	0.2	2.3					
1997-2002	-2.2	0.4	16.2	7.4	-6.2	-5.3					
1992-1997	-0.3	5.8	25.5	17.5	-2.1	1.1					

Figures corresponding to wild fisheries, calculated deducting aquaculture from total values. All values are in 2006 USD, using the US PPI for all commodities as deflator.

Source: Total exports and aquaculture exports for 2003-2007: Undersecretariat of Fisheries, *Informes Sectoriales*, various volumes. Aquaculture figures for 1990-2002: Fisheries Development Institute .Corrected figures based on original Customs data for the period.

Figure 2.2. Average unit export prices, 1990-2007

(Average prices, 2006 USD per kilo)



Source: SERNAPESCA, *Anuarios Estadísticos*, various volumes

Production structure

Chile's fisheries sector consists of three broad groups: the industrial sector; small-scale or artisanal fishers, including small-scale fish farmers; and aquaculture.

In Chilean terms, artisanal activities are those carried out directly and on a habitual manner by artisanal fishers duly registered in SERNAPESCA's National Registry for Artisanal Fishermen (NRAF) (*Registro Pesquero Artesanal*). They also comprise fishing by fishers' organizations composed only by artisanal fishers. In addition, artisanal activities refer to landings from vessels under 18 meters, with a hold capacity not over 80 m^3 and with a gross registry tonnage not exceeding 50 GRT.[6]

Industrial fishing activities, in turn, are those carried out by individuals or legal persons registered in the National Registry for Industrial Fisheries (NRAF), normally owning bigger fishing vessels and generally associated with processing facilities in land. This category includes factory vessels, for which specific regulations apply. They might either work in the Chilean EEZ or in international waters.

Chilean legislation defines aquaculture as a human activity aiming at the production of living aquatic resources. All parties involved in farming activities also have to register on the National Registry for Aquaculture Concessions and Authorizations (NRACA).

Data from FAO[7] indicate that direct employment in fisheries and aquaculture for 2004 amounted to 118 500 persons, 75 900 of which are related to primary activities, while the rest are engaged in processing. In this second category, 40% of those employed were female workers.

A more recent appraisal by the Undersecretary of Fisheries[8] establishes that direct employment in the fisheries and aquaculture sector at the end of 2007 could be as high as 141 000 individuals, composed of 1 900 industrial fishers; 65 596 artisanal fishers and other small-scale operators; 43 000 laborers in processing plants, and 27 000 in fish farming activities. At least, 30 000 of these posts were assigned to female workers, representing 21% of total employment.

In their 2007 Annual Report, the National Fisheries Association (*Sociedad Nacional de Pesca* or SONAPESCA) estimated that direct and indirect employment generated by fisheries and aquaculture in Chile could well be around 375 000 jobs, of which, over 285 000 are accounted for by the industrial sector. If this is the case, and assuming that an average Chilean family is composed of 3.6 members, it can be inferred that around 1.35 million inhabitants are 'connected' with fisheries or aquaculture in Chile, or about 8% of the total population.[9]

Artisanal sector

At the end of 2007, the NRAF had over 15 000 boats registered and a total of approximately 65 600 fishers and farmers[10]. The South and Extreme South Regions are the areas where the bulk of the fleet capacity exists, reflecting the availability of coastal fishery resources (Table 2.7). Small-scale fishers tend to operate with relatively simple craft (71% of the artisanal fleet), with bigger units less abundant. Table 2.8 provides a breakdown of artisanal fishers by occupation and gender.

Table 2.7. Exports of fishery products, by type of product, 2003-2007

	2006 USD Million					Tonnes				
	2003	2004	2005	2006	2007	2003	2004	2005	2006	2007
Human consumption	**2 116.4**	**2 380.4**	**2 595.3**	**2 996.7**	**2 952.8**	**613 921**	**713 388**	**783 046**	**759 971**	**792 777**
Fresh	587.4	557.7	558.7	657.2	697.8	125 190	125.333	126 145	106.037	116.922
Frozen	1 273.2	1 542.4	1 747.1	2 049.6	1 959.4	396 673	483.689	544 425	552.239	574.203
Canned	181.8	191.5	198.9	197.8	213.4	81 014	91.739	100 156	90.135	92.694
Smoked	36.8	49.6	60.7	70.0	70.7	3 529	5 192	6 261	6.951	6.682
Dried,salted, etc.	37.2	39.2	29.9	22.2	11.6	7 515	7 434	6 059	4.609	2.276
Meals and oils	**458.0**	**406.7**	**509.1**	**558.9**	**565.1**	**628.450**	**548.044**	**753.425**	**581.635**	**560.385**
Fish meal	444.9	385.6	479.3	515.0	514.4	609.274	519.143	708.907	519.498	488.397
Fish oil	13.1	21.1	29.8	43.9	50.7	19.176	28.901	44.518	62.137	71.988
Algae products	**104.4**	**106.3**	**116.9**	**125.5**	**131.9**	**50.635**	**51.626**	**54.402**	**49.216**	**60.018**
Dried algae	31.4	33.5	36.6	32.5	38.4	44.038	44.563	46.889	41.401	51.788
Agar-agar	38.3	36.9	41.0	46.2	44.1	2.433	2.484	2.676	2.308	2.185
Carrageenin	28.6	27.8	30.8	33.8	36.7	3.438	3.597	3.772	3.986	4.528
Alginates	5.8	7.6	7.9	12.0	11.7	677	883	966	1.388	1.367
Other	0.2	0.5	0.5	1.0	1.0	50	99	99	133	149
Live products	**1.2**	**1.4**	**1.4**	**1.8**	**1.8**	**29**	**41**	**54**	**81**	**62**
Other	**0.0**	**-**	**-**	**0.0**	**-**	**5**	**-**	**-**	**32**	**-**
Totals	**2.679,9**	**2 894.8**	**3 222.7**	**3 682.9**	**3 651.6**	**1 293.040**	**1 313.098**	**1 590.928**	**1.390.936**	**1.413.242**
% Hum.cons / Total	**79**	**82.2**	**80.5**	**81.4**	**80.9**	**47.5**	**54.3**	**49.2**	**54.6**	**56.1**

Table 2.7. Exports of fishery products, by type of product, 2003-2007 (cont.)

	USD per kilogram, 2006 USD				
	2003	**2004**	**2005**	**2006**	**2007**
Human consumption	3.4	3.3	3.3	3.9	3.7
Fresh	4.7	4.4	4.4	6.2	6.0
Frozen	3.2	3.2	3.2	3.7	3.4
Canned	2.2	2.1	2.0	2.2	2.3
Smoked	10.4	9.6	9.7	10.1	10.6
Dried,salted, etc.	4.9	5.3	4.9	4.8	5.1
Meals and oils	0.7	0.7	0.7	1.0	1.0
Fish meal	0.7	0.7	0.7	1.0	1.1
Fish oil	0.7	0.7	0.7	0.7	0.7
Algae products	2.1	2.1	2.1	2.5	2.2
Dried algae	0.7	0.8	0.8	0.8	0.7
Agar-agar	15.8	14.8	15.3	20.0	20.2
Carrageenin	8.3	7.7	8.2	8.5	8.1
Alginates	8.6	8.6	8.2	8.6	8.6
Other	5.0	5.0	4.9	7.3	7.0
Live products	41.3	35.2	25.8	22.2	28.8
Other	1.4			0.8	
Totals	2.1	2.2	2.0	2.6	2.6
% Hum.cons / Total	**166**	**151**	**164**	**148**	**144**

Source: Total exports and aquaculture exports for 2003-2007: Undersecretariat of Fisheries, *Informes Sectoriales*, various volumes. Aquaculture figures for 1990-2002: Fisheries Development Institute. Corrected figures based on original Customs data for the period.

Table 2.8. Artisanal vessels, by type of unit and macro-zone

(End of 2007)

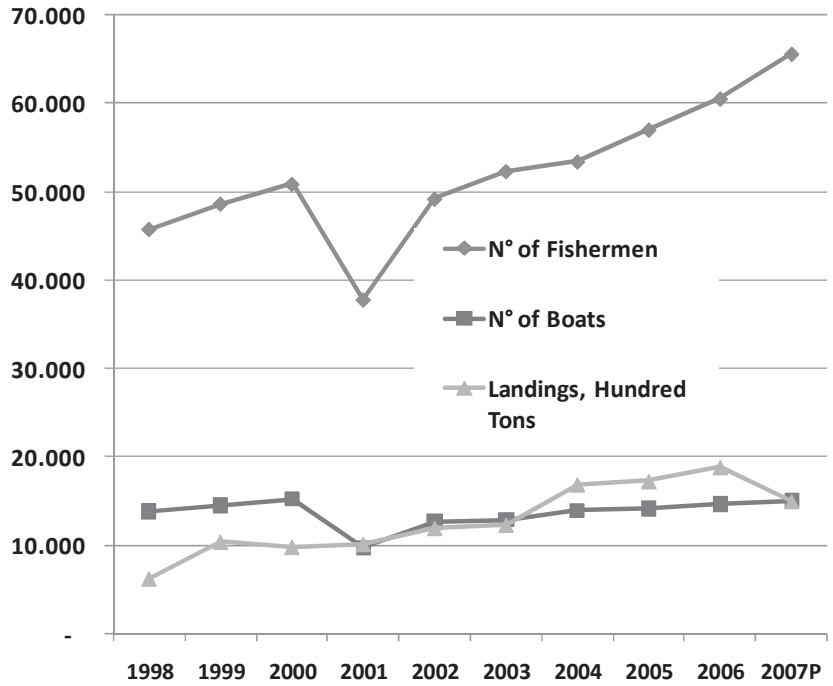
Type of vessel	North	Center	South	Extreme South	Total
Small rowing/sailing boat	323	108	828	95	**1 354**
Small boat with engine	2 385	1 165	4 256	1 498	**9 304**
Boats, LOA< 12mts	186	31	2 111	629	**2 957**
Boats, LOA 12-15mts	123	52	380	151	**706**
Boats, LOA 15-18mts	87	59	488	59	**693**
Totals	**3 104**	**1 415**	**8 063**	**2 432**	**15 014**

North: Regions I to IV, plus XV; *Center*: Regions Vth to VIIth, plus Metropolitan Region; *South*: Regions VIII to X plus Region XIV; *Extreme South*: Regions XI and XII.

Source: SERNAPESCA (2008), *Anuario Estadístico 2007*, Preliminary figures.

The numbers of boats and small-scale fishers[11] have increased between 1998-2007 (Table 2.9 and Figure 2.3). The annual landings per boat increased significantly between 1998 and 2007, while landings per fisher initially increased before eventually stabilising (Figure 2.4).[12]

Figure 2.3. Landings and number of artisanal boats and fishers, 1998-2007



Source: SERNAPESCA, *Anuarios Estadísticos*, various volumes.

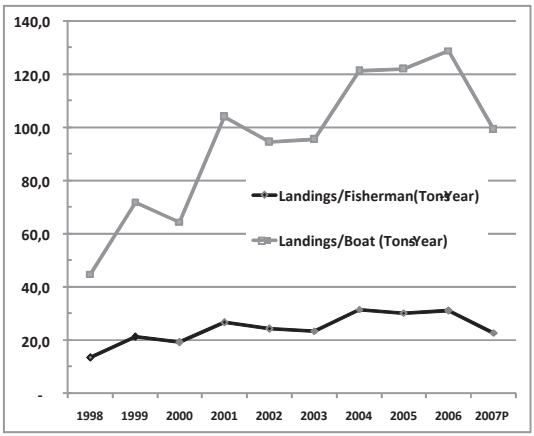
Table 2.9. Artisanal fishers by region
(End of 2007)

Region	Algae collector		Boat owner		Diver		Fishers		Totals (1)
	Female	Male	Female	Male	Female	Male	Female	Male	
XV	12	116	8	216	-	122	19	915	1 102
I	129	342	22	341	1	418	14	823	1 580
II	141	763	27	589	3	758	13	1 411	2 883
III	265	1 085	17	442	2	560	31	1 478	2 968
IV	349	1 285	25	1 064	6	1 282	45	2 756	4 821
V	132	299	16	832	3	573	66	3 667	4 329
VI	188	468	2	65	2	120	8	255	941
VII	131	277	5	323	-	225	34	1 383	1 916
VIII	1 558	901	162	2 245	2	2 047	781	10 779	14 652
IX	47	106	6	156	1	49	39	501	704
XIV	755	447	16	394	8	694	53	1 500	3 078
X	2 228	1 878	99	4 252	18	5 001	1.035	10 894	18 771
XI	7	9	49	968	7	818	318	2 301	2 867
XII	65	64	95	944	-	1 051	177	4 165	4 984
								Grand total	**65 596**

(1): Figures per Region do not add to totals. Totals indicate the actual number of persons involved in these small-scale activities. As one person might be registered under more than one category (Table 11), it could be that the sum of individual figures add up to 86 659, showing that in average, one person is registered in 1,3 activities.

Source: SERNAPESCA, 2008 *Anuario Estadístico 2007*, Preliminary figures

Figure 2.4. Landings per fishers and boat in artisanal fisheries, 1998-2007



Source: SERNAPESCA, Anuarios Estadísticos, various volumes.

Artisanal production has increased by 50% between 2000 and 2007, from 1 to 1.5 million tonnes (Table 10). This increase was primarily in fish (60% increase), mollusks (130%) and algae (35%). Due to a poorer performance of industrial fisheries, they also increased their relative importance, from 20% to 30% of total landings in that period.

Small-scale production is very asymmetric with regard to fisheries, type of boat and levels of activity and income. Bigger fishing units, although less common in this sector, are landing most of the fish captured, while receiving very high incomes, particularly in the pelagic fisheries with Chilean seabass (*bacalao de profundidad*). In contrast, individual fishers, collecting mollusks or algae, or working in small fishing craft are generally less efficient, can earn substantially less, and may even be unable to support themselves or their families in a sustainable manner in many coastal fisheries. Such fishing activities are often complemented by other work, aimed at improving the income of the fishing household. This highlights a potential issue where government support schemes, intended to help the smallest among these artisanal fishers, are complicated by the fact that current legal definitions of these small operators is very broad and also includes the more successful large boat owners.

Table 2.10. Artisanal landings, number of fishers and boats, and productivity figures, 1998-2007[P]

Year	N° Fishers	N° of Boats	Landings (million Tonnes)	Landings per fisherman-year (Tonnes)	Landings per boat-year(Tonnes)
1998	45 764	13 825	0.62	13.5	44.8
1999	48 642	14 453	1.04	21.4	72.0
2000	50 873	15 201	0.98	19.3	64.5
2001	37 777	9 753	1.01	26.9	104 0
2002	49 185	12 632	1.20	24.3	94.6
2003	52 320	12 888	1.23	23.5	95.6
2004	53 410	13 946	1.69	31.7	121 3
2005	57 013	14 179	1.73	30.3	122 0
2006	60 539	14 655	1.89	31.2	128 9
2007P	65 596	15 104	1.50	22.9	99.4

[P] Preliminary data.
Source: SERNAPESCA, *Anuarios Estadísticos*, various volumes

Small-scale operators are organised in cooperatives, syndicates and other cooperative structures. At the end of 2006, there were 492 organisations of this type, 51% of which are found in the Southern part of the country.

During the last decade, small-scale fishers associations have been given exclusive exploitation rights to several sections of the Chilean coastline. This legal scheme, entitled *Areas de Manejo y Explotación de Recursos Bentónicos,* translated as Management Areas for the Exploitation of Benthic Resources (MAEBR), was created in 1991 but is regulated only through Decree N°355 of 1995. MAEBRs are defined as well-delimited coastal areas for which exclusive use rights are granted by SERNAPESCA for four year periods (renewable). They are meant to legally establish small-scale fishers' organizations, aiming at sustainably exploiting the benthic resources available in the area through a proper management plan. In 2007, there were 752 authorized MAEBRs along Chile's coast covering an area of about 115 000 hectares. However, only 204 units were actually operational during 2007, representing 27% of the total registered fishing activities in that year. Production in MAEBRs during 2007 was around 7 000 tonnes, 67% of which relates to mollusks (essentially'loco' and 'macha'); 27% to different

types of algae, and the rest was mainly sea urchin ('erizo') (Tables 2.11 and 2.12).

Under the MAEBR system, artisanal fishers are required to produce yearly management plans, which have to be approved by the State. These plans establish the amount of each resource that will be harvested during a one year period. These production activities are thereafter followed and controlled by consulting firms, which are hired for this particular purpose, and are financed by the fishers' organizations, which in turn receive State support to cover these expenses.

Table 2.11. Catches in Chilean MAEBRs, 2001-2007, thousand tonnes

Year	Total	Algae	Mollusks	Other species
2001	2.091	524	1.530	37
2002	4.180	2.024	2.084	72
2003	6.452	1.875	4.428	149
2004	6.561	1.601	4.288	672
2005	5.510	946	4.191	373
2006	7.581	1542	5.811	228
2007	6.971	1.860	4.684	427

Source : SERNAPESCA, *Anuarios Estadísticos*, Various volumes.

Table 2.12. Artisanal, industrial and aquaculture production, 2000-2007, thousand tonnes

	Thousand tonnes						Percentages of each year's total, per sector					
Year	Algae	Fish	Mollusks	Crustaceans	Other species	Total	Algae	Fish	Mollusks	Crustaceans	Other species	Total
Artisanal sector												
2000	247	596	61	19	58	**981**	25.2	60.7	6.2	1.9	5.9	**100**
2001	234	637	77	19	48	**1 015**	23.1	62.7	7.5	1.9	4.7	**100**
2002	244	825	47	18	61	**1 195**	20.4	69	4	1.5	5.1	**100**
2003	309	800	65	13	44	**1 232**	25.1	65	5.3	1.1	3.6	**100**
2004	391	995	241	15	51	**1 692**	23.1	58.8	14.2	0.9	3	**100**
2005	410	928	336	16	39	**1 729**	23.7	53.7	19.4	1	2.2	**100**
2006	301	1 238	299	15	36	**1 889**	15.9	65.5	15.8	0.8	1.9	**100**
2007P	336	974	140	14	36	**1 501**	22.4	64.9	9.3	0.9	2.4	**100**
Industrial sector												
2000	-	3 548	0	19	-	**3 567**						
2001	-	3 010	0	7	-	**3 017**	-	99.8	0	0.2	-	**100**
2002	-	3 313	1	6	-	**3 320**	-	99.8	0	0.2	-	**100**
2003	-	2 682	1	6	-	**2 689**	-	99.7	0.1	0.2	-	**100**
2004	-	3 611	8	6	-	**3 625**	-	99.6	0.2	0.2	-	**100**
2005	-	2 988	14	6	-	**3 009**	-	99.3	0.5	0.2	-	**100**
2006	-	2 557	8	8	-	**2 572**	-	99.4	0.3	0.3	-	**100**
2007P	-	2 593	41	8	-	**2 642**	-	98.1	1.6	0.3	-	**100**
Aquaculture												
2000	33	343	49	-	0	**425**						
2001	66	505	61	-	-	**632**						
2002	72	483	63	-	-	**617**	11.6	78.2	10.2	-	-	**100**
2003	40	489	79	-	0	**607**	6.6	80.5	12.9	-	0	**100**
2004	20	569	107	-	0	**696**	2.9	81.8	15.3	-	0	**100**
2005	15	614	109	-	-	**739**	2.1	83.1	14.9	-	-	**100**
2006	38	648	150	-	-	**836**	4.6	77.5	17.9	-	-	**100**
2007P	23	664	216	-	0	**904**	2.6	73.5	23.9	-	0	**100**
Total												
2000	281	4 486	110	37	58	**4 972**	5.6	90.2	2.2	0.8	1.2	**100**
2001	300	4 151	138	26	48	**4 663**	6.4	89	3	0.6	1	**100**
2002	316	4 621	111	24	61	**5 133**	6.2	90	2.2	0.5	1.2	**100**
2003	349	3 971	145	19	44	**4 528**	7.7	87.7	3.2	0.4	1	**100**
2004	411	5 176	356	20	51	**6 014**	6.8	86.1	5.9	0.3	0.8	**100**
2005	425	4 531	460	23	39	**5 478**	7.8	82.7	8.4	0.4	0.7	**100**
2006	339	4 443	457	22	36	**5 298**	6.4	83.9	8.6	0.4	0.7	**100**
2007P	360	4 231	397	22	36	**5 046**	7.1	83.9	7.9	0.4	0.7	**100**

Table 2.11. Artisanal, industrial and aquaculture production, 2000-2007, Thousand tones (*cont*)

Percentages of each years total landing per species

Algae	Fish	Mollusks	Crustaceans	Other species	Total
			Artisanal sector		
88.1	13.3	55.5	49.7	100	**19.7**
78.1	15.3	55.3	73.8	100	**21.8**
77.3	17.9	42.5	73.6	100	**23.3**
88.6	20.2	45	69.4	100	**27.2**
95.1	19.2	67.7	72.4	100	**28.1**
96.4	20.5	73.1	71.9	100	**31.6**
88.7	27.9	65.5	65.8	100	**35.7**
93.5	23	35.2	63.8	100	**29.7**
			Industrial sector		
-	79.1	0	50.3	-	**71.7**
-	72.5	0.3	26.2	-	**64.7**
-	71.7	0.9	26.4	-	**64.7**
-	67.5	1	30.6	-	**59.4**
-	69.8	2.3	27.6	-	**60.3**
-	66	3.1	28.1	-	**54.9**
-	57.6	1.7	34.2	-	**48.6**
-	61.3	10.4	36.2	-	**52.3**
			Aquaculture		
11.9	7.6	44.5	-	0	**8.5**
21.9	12.2	44.4	-	-	**13.5**
22.7	10.4	56.6	-	-	**12**
11.4	12.3	54	-	0	**13.4**
4.9	11	30	-	0	**11.6**
3.6	13.6	23.8	-	-	**13.5**
11.3	14.6	32.8	-	-	**15.8**
6.5	15.7	54.5	-	0	**17.9**
			Total		
100	100	100	100	100	**100**
100	100	100	100	100	**100**
100	100	100	100	100	**100**
100	100	100	100	100	**100**
100	100	100	100	100	**100**
100	100	100	100	100	**100**
100	100	100	100	100	**100**
100	100	100	100	100	**100**

Source: Calculations of the study, on figures from SERNAPESCA, various years.

Industrial fisheries

In terms of volume, the main Chilean industrial fishing activities are related to pelagic resources both in the North and Central part of the country. In the Northern part, anchovy is the main species captured, followed by jack mackerel and "caballa" mackerel.[13] However, the largest quantities of mackerel and sardine are caught in Central and Southern Chile. Jack mackerel and 'caballa' mackerel are also caught in increasing volumes outside the Chilean EEZ, a relatively recent development which has required big boats with adequate autonomy and refrigeration capacities.

The rest of the industrial fishing fleet is composed of the operation of several factory vessels, which are allowed to fish only in the extreme south of Chile and in international waters. They are mainly responsible for the landing of several types of southern hakes, conger eels and a part of the very valuable Chilean seabass ('bacalao de profundidad').

These fisheries, combined with the production of common hake in Central Chile and limited amounts of shrimp and prawn constitute the core of what is called 'industrial activities'.

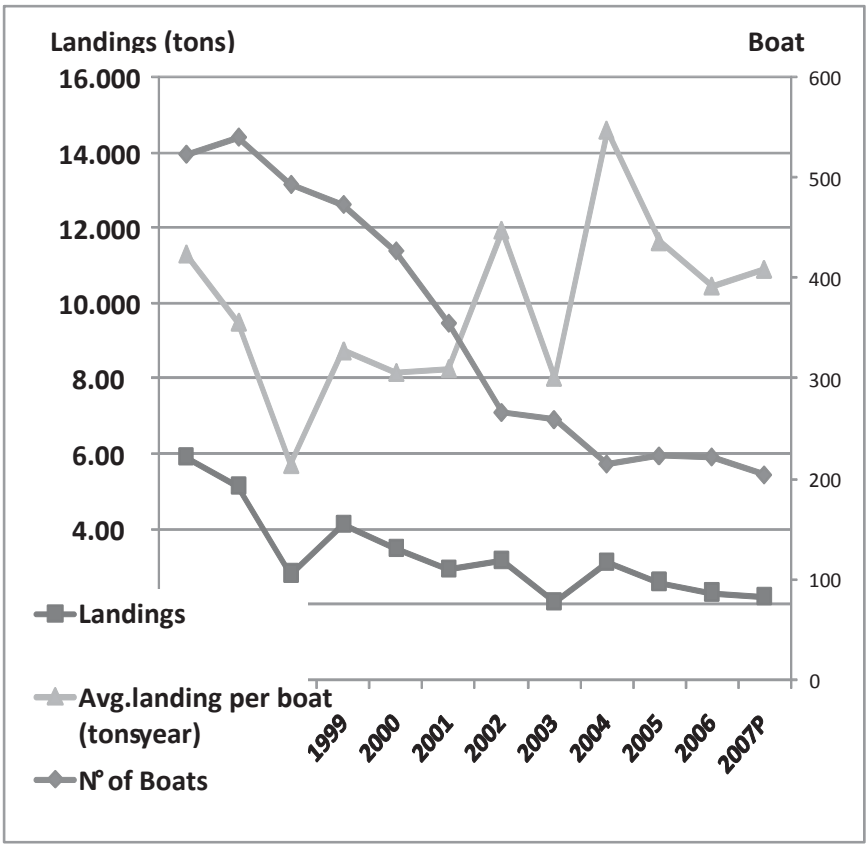
The size of the industrial fleet has declined substantially over the last decade (Table 2.13 and Figure 2.5). The volume of landings has also declined, but at a slower rate, with the result that landings per vessel have grown substantially. This trend has had a noticeable effect on the economic performance of the industrial vessels. It is worth noting that vessels that stop fishing because of the application of different management plans do not receive compensation of any sort.[14] Current government policies do not encompass the use of vessel decommissioning schemes to assist adjustment.

Table 2.13. Catches of 'Loco' and 'Macha' in Chilean MAEBRs, 2001-2007 thousand tonnes

Year	"Loco"		"Macha"	
	MAEBR's landings	% of species Total	MAEBR's landings	% of species Total
2001	806	97%	254	18%
2002	1 132	70%	676	52%
2003	2 191	74%	1 595	7%
2004	2 974	83%	727	38%
2005	3 205	98%	343	22%
2006	3 858	98%	1 229	47%
2007	2 665	78%	1 359	51%

Source : SERNAPESCA, *Anuarios Estadísticos*, various volumes.

Figure 2.5. Industrial fleet vessels and landings, 1996-2007



Does not include factory vessels nor captures made outside the EEZ.

Source : SERNAPESCA, *Anuarios Estadísticos*, Various volumes.

The structure of the industrial fishing fleet in operation during 2007 is presented in Table 2.14. In addition to these vessels, a total of 11 factory vessels registered fishing activities in national waters during 2007, while a further 12 freezer vessels operated in international waters.

Industrial vessels are normally owned by vertically integrated firms, and therefore, most of these boats supply a variety of processing lines owned by the firm, even though occasionally they might supply other processing plants and traders.

Table 2.14. Industrial fleet vessels and landings, 1996-2007

Year	N° of boats	Landings	Avg. landing per boat (tonnes-year)
1996	524	5 933	11 323
1997	541	5 151	9 521
1998	494	2 840	5 749
1999	474	4 150	8 755
2000	428	3 503	8 185
2001	356	2 952	8 292
2002	267	3 192	11 955
2003	260	2 096	8 062
2004	216	3 154	14 602
2005	224	2 609	11 647
2006	223	2 336	10 475
2007P	205	2 318	10 917

Does not include factory vessels nor captures made outside the EEZ.

Source : SERNAPESCA, *Anuarios Estadísticos*, Various volumes.

On several occasions from the 1960s onwards, several industrial fisheries collapsed after repeated growth, overfishing and overinvestment, coupled with relatively poor management and enforcement. The 1960s collapses saw the only occasion where the government intervened to provide financial assistance to 'rescue' investors facing difficulties. The government also bought vessels and processing lines, which were later sold through open biddings or other schemes. After years of trials with different management systems (Chapter 3), practically all the main pelagic and demersal fisheries where the industrial fleets operate have been stabilised, and there does not seem to exist significant excess fishing capacity.

One of the main factors affecting industrial fishing activities these days seems to be a change in distributional patterns of fish stocks, a fact that is reflected in more distant fishing grounds, longer fishing trips and further requirements for more autonomy and good refrigeration.

The volume of landings is not expected to increase in industrial fisheries during the coming years. Therefore, improvements in this sector will mostly be related to better handling of catches, more efficient fishing campaigns and strategies, and a higher portion of landings dedicated to produce fish products for direct human consumption. Indeed, since the early 2000s, at least one big processing plant per year has been built and dedicated to these ends.[15]

Future discussions on industrial fishing in Chile will need to focus on the use of more selective fishing gear, reducing discards in demersal fisheries, and a better control of incidental catches, among other matters. A project is underway in the Chilean Parliament to introduce specific regulations to deal with the issue discards. In addition, Chilean participation in fishing activities in international waters and the regulation of fishing effort in nearby zones outside the local EEZ are under discussion, both within Chile and with other countries having similar concerns in this part of the Pacific Ocean. In 2006, Australia, Chile and New Zealand initiated a process for states to cooperate in the establishment of a new RFMO for the South Pacific (entitled the South Pacific RFMO, or SPRFMO). Chile's interest in participating in the establishment of SPRFMO is driven by the growth and unregulated activity of foreign fleets in the high seas adjacent to Chile, dedicated to fishing for straddling species, particularly jack mackerel. There are now over 20 states, as well as IGOs and NGOs, engaged in the process. The SPRFMO has yet to come into force.

Aquaculture

Fish farming

Commercial fish farming activities are almost exclusively dedicated to salmon and trout farming and account for 74% of volumes harvested by the aquaculture sector in 2007. Turbot represents the only other significant fish farming activity in Chile. Most components of this industry are the property of big industrial corporations, which are usually vertically integrated. Foreign capital is fairly common in this industry as well. The technology applied is competitive on a global level and local production facilities are among the largest in the world.

Marine sites are concentrated in the Xth Region of Chile. However, increasing amounts of farmed fish are being produced further south in the XIth and XIIth Regions. Marine salmon farms were initially established in protected bays and areas, 20-45 meters deep. As the level of production per site grew and annual harvest surpassed the 1 000-3 000 tonnes, farmers started moving to deeper, more exposed and more distant sites, including a

number of areas that were originally neglected because of poor infrastructure.

Average farming capacities per site and total production per firm have grown throughout the years, and today overall output is concentrated on a smaller number of enterprises. Average production per marine site grew about 81% between 2001 and 2007, increasing from 1 013 to 1 835 tonnes. Industry sources indicate that no single producer with an annual production less than 7 000-10 000 can be considered as having a significant chance of being competitive in the coming years.[16]

The number of salmon and trout producers has declined from 47 in 2001 to 32 in 2007. Out of the 32 enterprises, 26 were the property of Chilean companies, while three were owned by Norwegian companies, and the remaining three were owned by Spanish, Japanese and Canadian companies. Chilean companies were responsible for 65% of the total value exported in 2007 (67% in 2001).

Farming on marine sites in Chile can only take place in authorized areas which are included in zones previously approved by and locally named, Aquaculture Authorized Areas, AAA. Approved areas for the Xth and XIth Regions, where most farming activities take place, amount to 860 500 hectares, 10 200 out of which are occupied by salmon farms (1.2% of totals: 2.8% and 0.6% of available space in the Xth and XIth Regions, respectively).[17]

Handling of salmonid eggs and juveniles in fresh water until smolting is carried out very efficiently. Initially, rivers and lakes were used for these purposes. The use of lake water provided a substantial advantage for local producers, as higher average temperatures meant shorter production cycles and lower costs, compared to what was being achieved in other countries. In recent years and still to this day, authorization to grow more fish in lakes has not been granted. Therefore, the need to expand fish production in fresh water has resulted in the construction of very large recirculation facilities. Additionally, hatcheries and juvenile production are increasingly moving to the north of Puerto Montt (capital city of the Xth Region) an almost unthinkable idea only a decade ago, when fresh water resources seemed inexhaustible.

Salmon farmers, as well as scallop and mussel farmers, have developed very active producer associations that represent their interests in national and international fora. Several of these organizations are also involved in research and development activities, and they also engage in training and capacity building at all levels, ranging from production personnel to high ranking executives. Technical seminars throughout the year are widely available, and cover most areas considered of interest by industry members.

Salmon farming activities have been developed in geographic areas that were among the poorest in Chile, at a time where very few work alternatives existed. Nowadays, this industry has become one of the central economic activities in southern Chile and is responsible for reducing population migrations to Argentina and elsewhere in Chile, to the point that currently, the Xth and XIth Regions have to import manpower to satisfy the industry's requirements.

Table 2.15. Profile of industrial fishing fleet in 2007, by region and type of fishing gear

Region	Trawlers	Purse seiners	Gill netters	Long liners	Trap holder
XV	0	55	0	0	0
I	0	72	1	0	0
II	1	55	3	1	0
III	10	0	2	1	0
IV	12	4	1	5	1
V	31	4	2	1	0
VII	1	0	0	1	0
VIII	33	71	0	0	0
XIV	10	23	0	0	1
X	11	0	0	0	1
XI	3	1	0	0	0
Total (*)	**56**	**154**	**3**	**8**	**3**

Figures indicate the number of vessels working on a certain region, with a certain fishing gear. As one boat can work in various regions, and with different fishing gear, totals do not add nor do they coincide with the actual number of vessels, of 205.

Source : SERNAPESCA, (2008) *Anuario Estadístico 2007*,Preliminary figures

Diseases and other environmental problems, particularly in the marine phase of production, have been and continue to be a cause of concern and have seriously damaged salmon farmers' operations and profits (Table 2.15). While a number of mitigation and pro-active initiatives have been developed ('clean production' schemes; various Codes of Practices; integrated geographic information systems, etc.), several challenging issues confront policymakers. These include the level of antibiotic use, sanitary concerns, escapements from farms, environmental impacts below the salmon cages, and proximity between farms.

Currently, sanitary problems are causing a significant production crisis within the industry, severely affecting employment, exports and short term harvesting goals. A new set of improved sanitary protocols is currently under preparation by a newly created Commission appointed by the Ministry of Economy, locally called the 'Salmon Table'.

Table 2.16. Evolution of diseases present in Chilean salmon farms in recent years

Disease	Coho Salmon		Rainbow Trout		Atlantic Salmon	
	6-7 Years ago	Today	6-7 Years ago	Today	6-7 Years ago	Today
Bacterial Kidney Disease	▲	▲	▲	▲	▲	▲
Piscirikettsiosis	▲	▲	▲	▲		▲
Infectious Pancreatic Necrosis		▲	▲	▲	▲	▲
Vibriosis (*V.Ordalii*)						▲
Vibriosis (*V.Anguillarum*)				▲		▲
Ulcerative Vibriosis (% strains)				▲		▲
Streptococosis						▲
Francisellosis						▲
Atypical Furunculosis						▲
Kudoa						▲
Jaundice Syndrome	▲	▲				
Nucleosporidiosis					▲	▲
Flavobacteriosis	▲	▲	▲	▲	▲	▲
Columnaris	▲	▲	▲	▲	▲	▲
Yersiniosis					▲	▲
Saprolegniosis	▲	▲	▲	▲	▲	▲
Sealice (Caligus)		▲	▲	▲	▲	▲
Infectious Salmon Anemia ,ISA	▲ ?	▲				▲
Amoebic Gill Disease						▲

ADL Diagnostics is one of the best known and reputed enterprises dealing with fish pathologies in Chile. The list refers only to 'prevalence', that is, that a certain disease is present, but does not show which ones are the cause of high concerns.

Source: ADL Diagnostics, Chile, Personal communication, November 2008.

A good proportion of the salmon production is sold fresh, and with value added (fillets, steaks, etc.), requiring very sophisticated and efficient processing facilities and logistics, which are currently handled mainly by the large and vertically integrated firms. As already stated, it is a fact that Chilean processing capabilities and the quality of the end products substantially reinforce the desirability of salmon and trout farmed locally, thus favoring further expansion of exports and production.

About 33% of the labor force working in the salmon farming industry adheres to syndicates or unions, a figure that well exceeds the national average of 12%.[18]

Farming of marine fish is still very limited in Chile (salmon and trout are anadromous species), and to date, turbot is the only species produced in commercial quantities. Farming techniques for other marine fish such as local 'lenguado' (flat fish), Southern hake, the introduced 'hirame' (*Paralichthys Olivaceus*) and Atlantic halibut (*Hippoglossus hippoglossus)* are still under development at a pilot level only. Turbot harvests are not likely to grow much in the near future, as there is only one big company working with this crop, and it requires a large capital investment, a high technology and a very good marketing structure. The local level of production limits to the establishment of a well reputed supply center that might be of interest to foreign buyers. Products are likely to primarily enter the fresh and frozen markets, and as a result, adequate logistics and infrastructure are an issue.

In 2004, 38 400 persons were directly employed in the salmon farming industry while indirect jobs were estimated at 15 000.

Mussel farming

Mussel farming has grown dramatically since 1998-1999, following the arrival of Spanish enterprises that introduced new technologies and opened the gateway to exports. Nowadays, mussels are the second major aquaculture product in Chile, farmed production will likely surpass the 200 000 ton mark during 2008 or shortly thereafter, and will continue to expand if market prospects in Europe, the US and other destinations keep growing.

Mussel farming is currently handled by small, medium-size and big producers, most of whom sell at farm-gate to big processing plants that have a significant surplus capacity, a situation which is likely to persist for several years. Processing lines are the property of big companies, most of which have only recently started to farm their own mussels. They are likely to continue buying from small and medium-size producers in the short and medium term.

In 2007, there were 30 processing plants in operation, of which 21 owned by Chilean companies. Seven plants have Spanish owners, one plant has mixed Italian-Spanish owners, while the last one belonged to an Icelandic company.[19]

At the end of April 2008, there were 890 farming concessions granted in the Xth Region, with a total area of about 8 000 hectares.[20] This Region accounts for practically all the mussels farmed in Chile.

The similarity of Chilean mussel with its equivalent product grown in Galicia, Spain, facilitates enormously the marketing of this product in Europe, currently its main market. Due to logistic problems and associated costs, Chilean mussels compete at their best when frozen, and therefore have to rely on the development of these particular markets to continue expanding sales.

Mussel producers are already crowding the best production areas, and still depend on natural seed. The first issue has meant that production cycles have started to get longer, while the availability of natural seed might become a constraint for future expansion at some stage. Red tides are a continuous and recurrent threat in Southern Chile, and even though studies to mitigate their effect are constantly being undertaken, it is likely that red tides will keep appearing in mussel production areas during the coming years.

Scallop farming

In contrast, scallop farmers have limited site availability in the center-north part of Chile, where this crop is primarily grown. Annual production is restricted to a limited number of relatively well protected coastal areas, with depths of up to 50-60 meters. Local producers rely heavily on the collection of natural seeds, as hatchery output is still limited and meant mainly to complement wild seed availability.

Farms are mostly medium-size units, with only a few showing larger capacities. This affects the profitability and long-term sustainability of this industry. Scallop farmers sell most of their product to France, and compete with Peru as well as with scallops from other origins. The Peruvian wild harvest and farmed production of scallop is much larger than that of Chile, and also has lower costs and competitive advantages. In Chile, the property and size structure of this industry does not generate enough surplus to invest much further in research and development so as to improve production efficiency and competitiveness.

Abalone farming

Abalone production is still limited but bound to expand dramatically to 1 500-2 000 tonnes in the coming decade. Technology is still a limiting factor, particularly with respect to artificial feeding and the economics of

production with sea water pumped in-land. Production units are still relatively small, but bound to grow and become economically attractive in the medium turn.

Local production will probably evolve both in southern and northern Chile, related mainly to medium to big size enterprises. Requiring a production cycle of three years or more, abalones are not likely to become an interesting stand-alone farming venture for many operators. Therefore, in the medium term, abalone farms are likely to be a part of other farming facilities, probably dealing as well with mussels, scallops and/or salmon and trout. The majority of locally produced abalones is bound to be sold either live, fresh or frozen, a fact that requires solid and demanding logistic capabilities and facilities.

In the 1990s, red abalone was the first exotic species for which a formal environmental impact report was requested and approved in Chile. As a result of this process, farming in open marine sites is only authorized on a relatively narrow space in Southern Chile, close to Chiloe Island. The farming of abalone in northern marine sites was only recently authorized, but in this case there was a requirement imposed in terms of allowing the farming of only male or, alternatively female abalones per site. This requirement has prevented investments along these lines, as a system to determine the sex of juveniles is not yet available at a reasonable cost.

Algae and small-scale farming

To date, commercial macro algae production is almost exclusively restricted to gracilaria algae, largely in the hands of small-scale farmers, primarily located in southern Chile. This crop has shown many ups and downs throughout the years, and its future is still uncertain due to the high level of market volatility. The technology for this crop is well known and not considered a limiting factor, as is the context around natural environmental conditions and the availability of sites.

A normal farm can be as small as 0.5-1 hectares in size. Buyers of farmed algae are limited in numbers, and exercise significant monopsony power on prices, a fact which severely affects this crop's sustainability.

At the end of 2004, there were around 840 small-scale active farms, permanently employing about 4 400 persons and another 1 800 on a part-time or seasonal basis.[21] The farms occupied 2 700 hectares, representing 14% of total area used by fish farming in that year, while over 86% of these farms were located in the Xth Region. Generally speaking, small-scale farmers usually work on land of less than six hectares. The vast majority farm one species only and are not vertically integrated.

Small-scale farmers specialize in the production of species such as algae and mollusks (mainly gracilaria and mussels), where no artificial diets are necessary. Exactly the opposite occurs with industrial farms.

As opposed to other countries, small-scale farming in Chile is not a subsistence activity. Local farmers preferably sell their crops at farm gate, for further processing or for exports. The total production value of this sector was estimated to be USD 6,5-10 million in 2004.[22]

Notes

1. See the Annex for name equivalences. Hake is equivalent to' Merluza común'; Shrimps, to 'Camarones'; Prawns to 'Langostinos' and Jack mackerel to 'Jurel'. As translations to English vary from source to source, on several occasions Spanish names are used with their scientific equivalent located in the Annex.
2. Although at least 75 different species of fish are landed in total.
3. A closer look at export volumes indicate that during the last fifteen years there are two different periods. Between 1992 and 1998 volumes decrease at an annual rate of 9.1%, while between 1998 and 2007 they increase at 1.8% per year. The same applies with values, which diminish at 2.8% per annum in the former period, while they augment at 0.8% per year thereafter.
4. Reviewing FAO's FISHSTAT data for 1984-2006 it is apparent that average values per kilo (in constant USD) for most aquaculture products have sharply diminished along the years, a fact probably related to production increases.
5. Currently, local salmon farmers are facing a serious sanitary crisis, which will have severe effects on production and production structures. Therefore, new sanitary regulations will most probably be enforced in the coming months , and they will have economic effects, yet to be evaluated.
6. GRT : Gross registry tonnage, represents the total internal volume of a vessel, with some exemptions for non-productive spaces such as crew quarters. 1 gross register ton is equal to a volume of 100 cubic feet (2.83 M3), which volume, if filled with water, would weigh around 2,800 kg or 2.8 tonnes.
7. FAO, *Fishery and Aquaculture Country Profile*, www.fao.org/fishery/countrysector/FI-CP_CL/es, October 2008
8. Personal communication, October 2008
9. SONAPESCA, 2008, Annual Report 2007*,* Santiago.

10. This figure of 65 600 fishers differs slightly from that of 69.000 mentioned at the end of paragraph 2.5, as they were obtained from different sources. The 'Instituto Nacional de Estadística' (National Statistics Institute) is currently undertaking a national census on manpower in Chilean fisheries, and these results should help clarify this matter by the end of 2009 or early 2010.

11. Small-scale fishers refers to all categories of workers shown in Table 12.

12. SERNAPESCA states that 49% of those production units reported landings at least once during 2007. This fact can be, rather arbitrarily, interpreted by saying that reporting is not as "massive" or accurate as desirable. This fact may coincide with previous comments regarding inaccuracies of statistics available for local seafood consumption.

13. "Caballa" is the local common name for mackerel

14. The crisis of the anchovy fishery and fish meal industry of the 1960's, which partly resulted from unduly optimistic fishing plans backed mostly by the Government, is the only recorded time where official financial help was granted to industrial activities.

15. SONAPESCA (2008), Annual Report *2007*, Santiago.

16. Personal communications, October 2008

17. Salmon Chile, 2007 *Informe Económico Salmonicultura 2006*.

18. Salmon Chile, 2007, Table 17.

19. AQUA Magazine, personal communication.

20. Undersecretary of Fisheries, October 2008, www.subpesca.cl/carto_acuic3.htm

21. GESAM Consultores, 2005 Diagnóstico de la acuicultura de pequeña escala en Chile, Final Reports (documentos separados) , Phases 1 and 2, Project FIP 2004-26 , Santiago, Chile.

22. Wurmann C., 2008 *Problemática y Desafíos de la Producción Chilena de Bivalvos en Pequeña Escala,* in *Estado Actual y Manejo de Moluscos Bivalvos y su Proyección Futura: Factores que afectan sus Sustentabilidad en Latinoamérica, A.Lovatelli et.al. Editors,* FAO.