



II

*S*eafood Products in Canada and Abroad: Industry Structure and Recent Developments

Despite the overharvesting of numerous fish stocks in various regions of the world, the fisheries and the seafood industry are experiencing a period of sustained commercial expansion. One only has to attend any international trade fair to realize the surprising vitality of this industry and the host of products from around the world. According to the United Nations Food and Agriculture Organization (FAO) world catches of fish and shellfish (aquaculture included) set an unprecedented record of 100 million tonnes in 1992. Production rose to 122 million tonnes in 1997, mainly as a result of increased aquaculture production, but dropped to 117 million tonnes in 1998. Growth in fish supply will probably continue to slow down for some years, mainly because of the levelling off or reduction in maritime fish landings and a slowdown in the growth of aquaculture production compared to the early 1990s.²⁶ However, demand for seafood products should continue to keep pace not only as a result of the rise in the standard of living and the population growth but also because of other factors relating to industrial organization and technological applications. As Jean Chaussade explains in his book *La mer nourricière: enjeu du XXI^e siècle*, demand mirrors supply as much as supply mirrors demand.²⁷

■ The Origin and Use of Primary Supply

We should first clearly identify the various types of supply and their origins. The capture fisheries include maritime and inland (or fresh-water) fisheries, while aquaculture fisheries produce fish that are farmed or raised in marine environments (salt water) or inland waterways (fresh water, rivers, and brackish water). Table 3 illustrates these

26. The slowdown was caused by the overharvesting of a number of large fish stocks in Nordic countries, particularly northern cod stocks, and the negative effects of El Niño on Peruvian and Chilean fisheries, and by the collapse of the Soviet Union, which had the world's largest capture fishery.

27. See Jean Chaussade, *La mer nourricière: enjeu du XXI^e siècle* [Nourishment from the sea: 21st century issues] (Institut de géographie de l'Université de Nantes, 1994).

Table 3
World Fisheries Production by Source of Supply,
1990–97

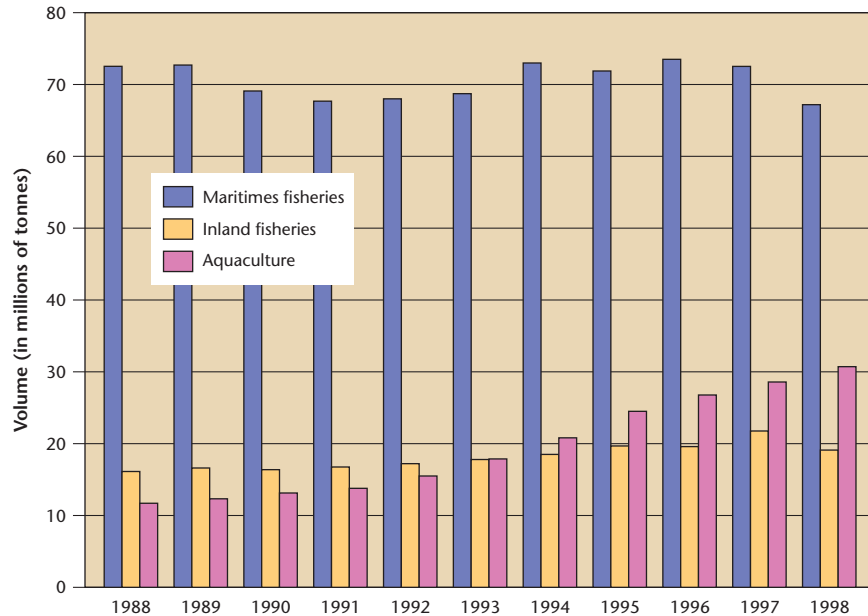
	Production (in millions of tonnes)					
	1990	1992	1994	1995	1996	1997
Inland fisheries						
Aquaculture	8.17	9.39	12.11	13.86	15.61	17.13
Capture	6.59	6.25	6.91	7.38	7.55	7.70
Total inland fisheries	14.76	15.64	19.02	21.24	23.16	24.83
Maritime fisheries						
Aquaculture	4.96	6.13	8.67	10.42	10.78	11.14
Capture	79.29	79.95	85.77	85.62	87.07	86.03
Total maritime fisheries	84.25	86.08	94.44	96.04	97.85	97.17
Total aquaculture	13.13	15.52	20.77	24.28	26.38	28.27
Total capture	85.88	86.20	92.68	93.00	94.63	93.73
World total	99.01	101.72	113.45	117.28	121.01	122.00

Source: FAO, World Review of Fisheries and Aquaculture, 1998.

distinctions and shows an assessment of the various sources of supply for most of the 1990s.

As we can see, primary fish supplies come mainly from the capture, or wild, fisheries. The maritime capture fisheries reached a record production of 87 million tonnes in 1996, but by then the rate of growth in fisheries production was in decline. In the 1950s and 1960s, world production in the maritime fisheries increased 6 percent per year, on average, and doubled between 1950 and 1961 from 17 million to 35 million tonnes. It doubled again over the next two decades, reaching 68 million tonnes in 1983. During the next ten years, however, the average rate of growth fell to 1.5 percent and then to 0.6 percent in 1995–96. But by then aquaculture production was on the rise and buoying the level of primary supply, as shown in figure 3. With the exception of China, where aquaculture production is replacing the capture fisheries (maritime and inland), the capture fisheries dominate, with 87 percent of primary fisheries production in 1998. This is illustrated in table 4, which combines traditional supply (the capture fisheries) with aquaculture production and shows that

Figure 3
Change in World Supply — the Capture Fisheries and Aquaculture, 1988–98



Source: FAO, FISH DATABASE; compiled by the author.

the thirty-five top fish and seafood-producing countries account for 90 percent of world fisheries and aquaculture production.

Half of world fish and seafood production in 1998 came from five countries: China (38.0 million tonnes), Japan (5.9 million tonnes), India (5.5 million tonnes), the United States (5.2 million tonnes), and the Russian Federation (4.5 million tonnes). Indonesia, Peru, Chile, Thailand, and Norway each produced between 3.3 million and 4.4 million tonnes. In total, those top-ten producers accounted for two-thirds (66.8 percent) of total world fisheries production in 1998. Twenty-three countries recorded primary production of at least one million tonnes, with Canada ranking twenty-third.

In recent years, the volume of fisheries products sold fresh increased not only in absolute value but also as a percentage of fish sold in all forms (see table 5). In 1997, approximately 35 percent of all fish was sold fresh, compared to 20 percent in 1986 and 25 percent in 1993. The volume of frozen fish also went up, both in developed and developing countries, as did the supply of fish fillets, frozen shrimp,

Table 4
Main Producing Countries — Fish and Seafood, 1998
(Production over 500,000 Tonnes)

Rank	Country	Capture	Aquaculture	Total Production		Cumulative Total (%)
				(tonnes)	(%)	
1	China (mainland)	17,235,086	20,795,367	38,030,453	32.5	32.5
2	Japan	5,139,000	765,000	5,904,000	5.0	37.6
3	India	3,700,000	1,800,000	5,500,000	4.7	42.3
4	United States	4,713,303	438,331	5,151,634	4.4	46.7
5	Russian Federation	4,454,759	63,195	4,517,954	3.9	50.5
6	Indonesia	3,698,850	696,880	4,395,730	3.8	54.3
7	Peru	4,338,437	7,732	4,346,169	3.7	58.0
8	Chile	3,265,306	293,044	3,558,350	3.0	61.0
9	Thailand	2,912,203	575,901	3,488,104	3.0	64.0
10	Norway	2,850,445	408,862	3,259,307	2.8	66.8
11	South Korea	2,026,934	327,462	2,354,396	2.0	68.8
12	Philippines	1,827,971	311,933	2,139,904	1.8	70.6
13	Iceland	1,681,951	3,868	1,685,819	1.4	72.1
14	Viet Nam	1,130,660	537,870	1,668,530	1.4	73.5
15	Denmark	1,557,335	42,368	1,599,703	1.4	74.9
16	Bangladesh	839,141	665,000	1,504,141	1.3	76.2
17	Spain	1,102,075	315,477	1,417,552	1.2	77.4

18	China (Taiwan)	1,076,288	240,435	1,316,723	1.1	78.5
19	Malaysia	1,172,922	103,360	1,276,282	1.1	79.6
20	Mexico	1,181,402	40,989	1,222,391	1.0	80.6
21	Argentina	1,128,823	1,334	1,130,157	1.0	81.6
22	Great Britain	919,905	137,421	1,057,326	0.9	82.5
23	Canada	957,737	90,626	1,048,363	0.9	83.4
24	Myanmar	850,000	100,000	950,000	0.8	84.2
25	Brazil	760,000	80,000	840,000	0.7	84.9
26	France	535,653	300,000	835,653	0.7	85.6
27	Morocco	708,332	2,101	710,433	0.6	86.2
28	New Zealand	599,856	73,250	673,106	0.6	86.8
29	Netherlands	536,626	120,024	656,650	0.6	87.4
30	Pakistan	596,980	24,079	621,059	0.5	87.9
31	South Africa	560,000	5,301	565,301	0.5	88.4
32	Italy	315,593	246,625	562,218	0.5	88.9
33	Turkey	487,200	56,700	543,900	0.5	89.3
34	Venezuela	506,177	10,670	516,847	0.4	89.8
35	Egypt	365,580	139,389	504,969	0.4	90.2
Subtotal (35 countries)		75,732,530	29,820,594	105,553,124	90.2	90.2
Other countries		10,577,321	870,830	11,448,151	9.8	–
World total		86,309,851	30,691,424	117,001,275	100.0	100.0

Source: FAO, products database; compiled by the author.

Table 5
World Utilization of Fisheries and Aquaculture Products,
1993–97

Utilization	1993 (%)	1994 (%)	1995 (%)	1996 (%)	1997 (%)
Sold fresh	25.3	25.8	29.5	32.2	35.1
Frozen	24.8	23.6	23.3	22.8	22.2
Canned	12.2	11.1	10.9	10.3	9.2
In-brine, salted, dried	9.8	9.8	10.0	9.6	10.0
Processed into meal or oil	26.1	27.9	24.7	23.5	22.0
Miscellaneous	2.0	2.0	2.0	2.0	2.0
Total	100.0	100.0	100.0	100.0	100.0

Source: FAO, *The State of World Fisheries and Aquaculture*, 1999.

and ready-to-serve fish and fish in other convenience foods. Canned and frozen products, on the other hand, seem to be losing their share. We should point out that the distinction between fresh-chilled products and frozen products is often difficult to draw. It is clear, however, that new processing and preservation technologies are resulting in a wider range of fresh and chilled products. Also, the supply of in-brine, salted, and dried products is increasing. Again, there is some interesting diversification taking place involving products that increasingly contain farmed products and shellfish meat. It is interesting to note in passing that approximately one-quarter of total world fish production is used in animal feed.

■ The Growing Importance of Aquaculture

Aquaculture has exploded in the last two decades, to the extent that it is now radically altering the international seafood trade. This has not happened by chance. Greater access to new technology, particularly in the area of marine biology, has resulted in faster and more effectively controlled breeding; that and the expansion of markets for seafood products are primary factors in the industry's vitality. There are also many other reasons for these developments. With the stagnation and, in some cases, the decline of the capture fisheries, attractive markets are opening up for the aquaculture industry. Also, storage and distribution methods have improved, which have not only boosted import-export flow but also spurred retail sales. As well, the

integration and modernization of distribution-marketing channels and the globalization of quality standards give consumers access to a growing variety of quality products at affordable prices.

Stimulated by new technologies and supported by numerous governments who see it as a “natural” addition to traditional and declining fisheries (or, in the case of developing countries, as a way to attract foreign currency), aquaculture has become one of the most prolific segments of the food industries, so much so that for fifteen years, aquaculture products have literally sustained the growth of the world seafood trade. A number of farmed products, in particular shrimp, Atlantic salmon, whitefish such as tilapia, as well as some molluscs (oysters, scallops, and soft-shell clams), have rapidly taken their place on the international seafood market; their volume reached 23 million tonnes in 1997, i.e., three times the volume sold in 1976.²⁸

Equally significant is the change in the percentage of world fisheries production entering import-export channels, from 30 percent in 1986 to 38 percent in 1997, a significant proportion given that only 10 percent of global beef production reaches international markets.²⁹ The potential of aquaculture has been amply demonstrated by the rapid expansion of the sector, which has increased annually by 10 percent since 1984. By comparison, the rate of growth in animal meat production was only 3 percent per year on average, and capture fisheries production has increased by only 1.6 percent per year.

Aquaculture production more than doubled from 1990 to 1997, increasing from 13 to 28 million tonnes and driving up its market value from US\$25 billion to over US\$45 billion. And that does not include farmed seaweed (7.2 million tonnes, with a value of US\$5 billion); a growing percentage of that production is being used to manufacture industrial, pharmaceutical, and cosmetic products. Overall, the volume of aquaculture products rose from 12 percent of total production in 1988 to 26 percent in 1998. Remarkably, over one-quarter of seafood products intended for human consumption are now produced by the aquaculture industry.³⁰

Asian countries continue to dominate world aquaculture production, including China, which produced two-thirds (67 percent) of the world volume in 1997 (see table 6). However, given the relatively low

28. FAO, GLOBEFISH, *Fishery Products, Production, and Trade* (1999).

29. *Ibid.*

30. FAO, *News and Highlights: International Aquaculture Meeting Plans for the Future* (April 2000).

Table 6
Aquaculture Production by Country, 1988–97

Country	1988	1990	1992	1994	1996	1997
Volume (in tonnes)						
Mainland China	5,630,454	6,482,402	8,256,487	12,966,795	17,714,570	19,315,623
India	893,330	1,012,121	1,388,644	1,527,796	1,783,482	1,776,450
Japan	806,754	804,293	818,330	781,027	829,354	806,534
Indonesia	414,597	499,824	550,368	597,522	733,088	754,610
Thailand	220,416	291,719	370,974	509,800	551,431	575,901
Bangladesh	175,261	194,278	257,395	319,820	449,648	512,738
Viet Nam	152,617	160,076	167,899	217,056	402,500	480,000
United States	357,614	315,448	413,531	390,781	393,331	438,331
South Korea	457,057	376,683	375,507	342,785	358,003	392,427
Norway	89,987	150,028	137,387	218,457	321,542	366,281
Philippines	343,059	379,940	386,876	387,588	349,442	330,443
France	227,534	256,647	250,202	280,867	285,659	287,547
Chile	9,240	32,447	68,474	117,960	217,903	272,346
Taiwan	294,345	333,514	250,286	281,686	262,403	257,530
Canada	21,461	36,462	46,885	53,582	71,191	82,000
Other countries	1,606,504	1,758,260	1,738,105	1,797,326	2,041,328	2,159,653
World total	11,700,230	13,084,142	15,477,350	20,790,848	26,746,875	28,808,414

	Value (in thousands of US\$)						
Mainland China	7,277,932	8,217,345	9,921,877	13,394,364	18,412,032	20,509,595	
India	1,023,411	1,600,284	1,597,459	2,078,217	2,057,442	1,975,418	
Japan	3,102,173	2,885,464	3,347,587	4,105,608	3,894,477	3,525,432	
Indonesia	946,107	1,477,273	1,812,355	1,823,180	2,164,986	2,224,782	
Thailand	507,538	775,801	1,169,849	1,852,667	1,812,243	1,783,038	
Bangladesh	366,402	467,064	569,498	831,681	1,223,371	1,370,199	
Viet Nam	290,997	389,614	461,598	589,017	936,100	1,112,400	
United States	525,344	535,227	629,454	701,350	736,423	771,183	
South Korea	318,548	398,311	619,311	602,612	678,231	913,141	
Norway	516,878	773,205	655,761	848,912	994,635	1,043,824	
Philippines	695,982	812,974	952,094	1,284,922	1,205,544	898,324	
France	480,326	527,594	563,357	640,546	604,315	634,097	
Chile	48,911	152,705	268,258	453,424	787,102	918,652	
Taiwan	1,195,668	1,248,505	1,160,998	1,262,379	1,178,113	945,523	
Canada	85,635	167,961	215,214	217,266	259,149	278,646	
Other countries	3,833,259	4,319,931	4,924,703	5,377,437	5,998,466	6,564,213	
World total	21,215,111	24,749,258	28,869,373	36,063,582	42,942,629	45,468,467	

Source: FAO, aquaculture production database; compiled by the author.

Table 7
Main Aquatic Species Farmed Worldwide, 1988–97

Species	1988	1990	1995	1997
Volume (in tonnes)				
Carp, barbel, and other cyprinoids	5,306,759	5,740,879	10,518,668	13,272,968
Shrimp	576,453	671,997	951,593	941,814
Salmon, trout, smelt	436,390	586,195	944,683	1,222,255
Including Atlantic salmon	112,377	225,492	465,286	638,951
Oysters	1,331,402	1,251,982	3,049,373	3,085,118
Clams, softshell, ark	531,423	629,766	1,766,284	1,948,979
Misc. freshwater fish	758,651	1,009,641	1,685,829	1,994,039
Scorpionfish, redfish, conger eel	55,314	72,111	182,742	250,952
Sea scallops	305,444	340,698	1,153,428	1,269,033
Horse mackerel, mullet, saury	193,711	189,776	213,812	183,210
Tilapia and other cichlids	308,234	396,366	711,048	945,723
Eels	98,109	171,923	187,943	233,073
Other species	1,798,340	2,022,808	3,118,729	3,461,250
Including blue mussels	415,846	365,665	357,650	401,147
Grand total	11,700,230	13,084,142	24,484,132	28,808,414

Value (in thousands of US\$)					
Carp, barbel, and other cyprinoids	6,726,473	7,879,579	11,247,465	14,281,091	
Shrimp	3,849,758	4,208,247	6,272,285	6,074,984	
Salmon, trout, smelt	2,010,951	2,626,140	3,677,126	4,198,416	
Including Atlantic salmon	694,478	1,195,104	1,782,584	2,113,288	
Oysters	1,491,105	1,582,118	3,370,691	3,290,957	
Clams, softshell, ark	741,277	906,059	2,327,234	2,536,770	
Misc. freshwater fish	1,078,645	1,482,076	2,102,129	2,484,045	
Scorpionfish, redfish, conger eel	587,840	724,472	1,840,708	2,134,928	
Sea Scallops	531,450	547,169	1,646,392	1,766,676	
Horse mackerel, mullet, saury	1,118,532	989,751	1,418,204	1,337,453	
Tilapia and other cichlids	383,356	558,654	1,016,725	1,299,772	
Eels	1,043,883	1,030,843	1,366,184	1,108,035	
Other species	1,651,841	2,214,150	3,795,646	4,955,340	
Including blue mussels	280,014	298,863	224,396	25,420	
Grand total	21,215,111	24,749,258	40,080,789	45,468,467	

Source: FAO, aquaculture production database; compiled by the author.

value of carp and seaweed, which form the bulk of its aquaculture production, China accounts for only 45 percent of the value of the industry's world production. On the other hand, Japan contributes only 3 percent to world aquaculture production, but that amount represents 7.8 percent of its value, the reason being that it farms large volumes of species that have a high commercial value, such as young male salmon, oysters, and sea scallops. As a result, the value of Japan's aquaculture production ranks it second in the world. The same is true for Indonesia and Thailand, where shrimp production predominates, and Norway, where salmonid production, particularly Atlantic salmon, helps raise the value of its aquaculture production.

Two of the ten main aquatic species farmed are plants. Apart from seaweed and other aquatic plants, various types of carp (silver, weed, common, marbled, and mrigal) dominate by far in tonnage and value. Shrimp, salmon, and oysters are the other three main species because of their high unit value (see table 7).

Among farmed products, shrimp and salmon are probably the most actively traded seafood internationally. Raised mainly in a tropical environment, shrimp, which is exported to developed countries, makes a significant contribution to the economies of some Asian and Latin American countries. The other high-value species, Atlantic salmon, which is not among the top ten in aquaculture production, is farmed in cold climates, where much of what is produced is consumed. Although a few industrialized countries, such as Japan, Norway, and the United States, are among the main producers, aquaculture is most intense in low-income, food-deficient countries. Some farmed whitefish, such as tilapia and catfish, and some types of carp are increasingly common in import-export channels. In the United States, those species have the potential to replace capture groundfish, including cod, which has become more rare and thus more expensive. In Europe, hoki, catfish, and tilapia have not been completely accepted as substitutes for groundfish, which has resulted in higher prices on the continent for other fish such as cod.

As we have seen, Canada rates as a secondary player in the capture fisheries (ranking twenty-first globally) and accounts for only a tiny percentage of world aquaculture production. Canada's share of world primary fish and seafood production fell from 1.7 percent in 1990, before moratoriums on some groundfish stocks were imposed, to 0.9 percent in 1997, dropping from twelfth place in 1990 to twenty-third place in 1998. That decline can be partly explained by sharp drops in groundfish supply and by the strong expansion of world

aquaculture, particularly in Asian countries. Nevertheless, Canada has managed to stay among the top exporting countries, although it has dropped in rank — from third in 1990 to sixth in 1997. We will see how the Canadian fishery has been able to maintain its position in a more open and increasingly competitive international market. First, however, let us look at changes in primary supply, which in large part shapes the industry as a whole.

■ **Primary Supply in Eastern Canada: Development and Structure**

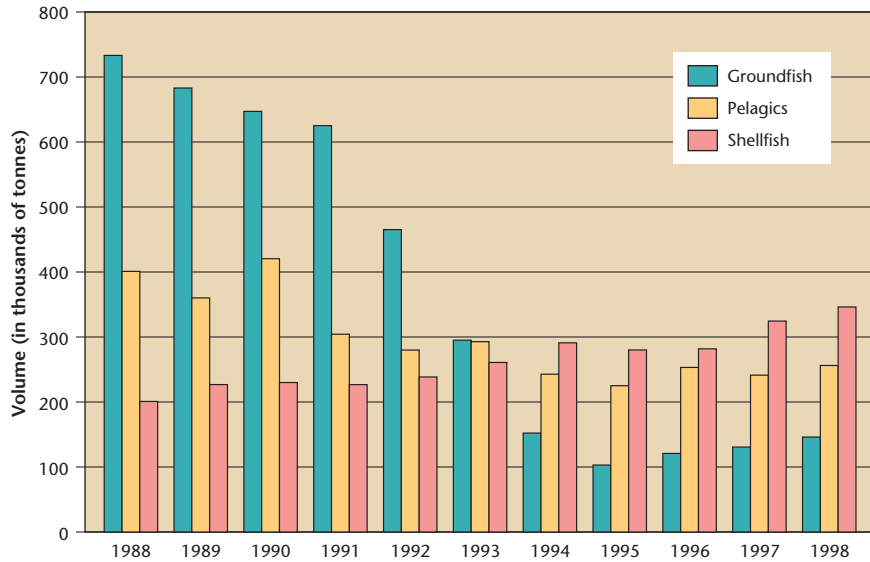
The Traditional Fisheries Sector

In eastern Canada, the supply of seafood comes primarily from the capture, or wild, fisheries. Canadian catches, particularly groundfish, gradually increased after the implementation of the 200-mile EEZ, peaking at 1,334,000 tonnes in 1988 (i.e., 55 percent of landings in eastern Canada), but the value of landings came mostly from shellfish, i.e., approximately 68 percent. The situation has changed considerably since then, however, as shown in figures 4 and 5.

From 733,300 tonnes in 1988, groundfish landings had fell to only 103,600 tonnes in 1995, depriving producers in the Atlantic regions of the raw material essential to their operations. There was some recovery beginning in 1996, but groundfish landings reached only 146,700 tonnes in 1998, i.e., only 20 percent of their 1988 volume.

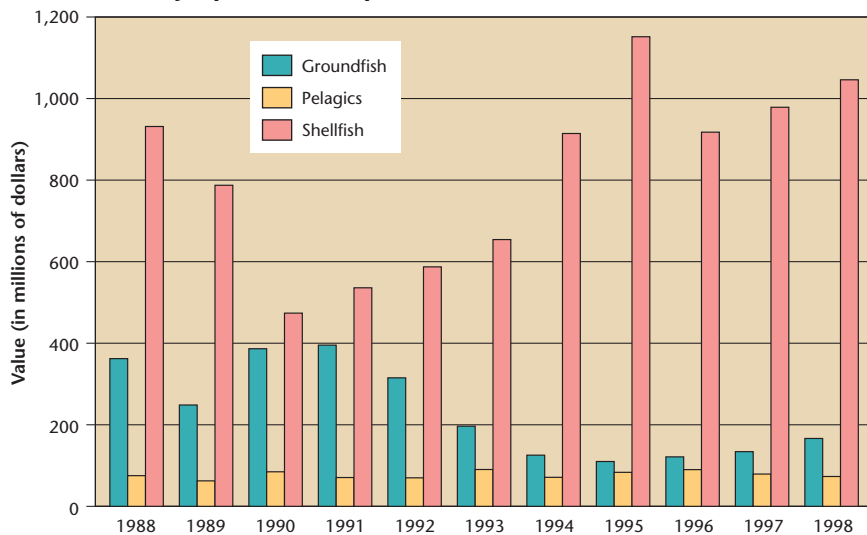
During that time, production of molluscs and crustaceans (mainly lobster, snow crab, Northern shrimp, and, to a lesser extent, scallops) was rising steadily. Dockside volumes for molluscs and crustaceans rose from 200,400 tonnes in 1988 to over 346,000 tonnes in 1998. This growth is all the more important because it involves mainly species with a high market value. However, their value-added processing poses a problem because of the strong demand for fresh seafood and the complex and, above all, costly nature of processing these types of species from an industrial standpoint. Capture levels for pelagic fish fluctuate from year to year as a result of weather conditions and economic factors. Herring, capelin, and squid are the main species marketed in this group. The problem, however, is that the average unit value of pelagic fish is relatively low; in fact its actual value has fallen over the last ten years. As we will see later, only herring roe, destined mainly for the lucrative Japanese market, has a high market value.

Figure 4
Change in Volume of Fish and Seafood Landings,
by Species Group, Eastern Canada, 1988–98



Source: Department of Fisheries and Oceans Canada, annual statistics on commercial fisheries and aquaculture; compiled by the author.

Figure 5
Change in Value of Fish and Seafood Landings,
by Species Group, Eastern Canada, 1988–98



Source: Department of Fisheries and Oceans Canada, annual statistics on commercial fisheries and aquaculture; compiled by the author.

To varying degrees, each of the five provinces bordering on the Atlantic and the Gulf of St. Lawrence has been tested by changes in eastern Canada's maritime fisheries over the past ten years. Without going into detail, we will discuss two basic points. First, the groundfish crisis has affected not just Newfoundland and Labrador, although that province has been hardest hit because it depended much more than the other provinces on groundfish stocks from the continental shelf. The drop in Newfoundland landings was greater in absolute and relative terms than anywhere else (see table 8).

Outside Newfoundland, the groundfish-processing industry in the other four provinces of eastern Canada has also suffered and continues to be deprived of an essential resource. Processors in Nova Scotia watched their local groundfish supply plummet from 260,000 tonnes in 1988 to under 78,000 tonnes in 1995; in Quebec, from 55,700 to 3,400 tonnes; in New Brunswick from 20,000 to approximately 1,300 tonnes; and in Prince Edward Island (redfish in particular), from 14,400 to 1,300 tonnes. Nevertheless, the fishing industry in those provinces was less affected by the groundfish crisis than in Newfoundland. In the Maritimes and to a lesser degree in Quebec, the industry could still count on a supply of other fairly lucrative species, such as lobster, snow crab, and scallops.

The other important point to be discussed is the restructuring of the primary fishing industry, particularly in Newfoundland but elsewhere as well. Table 9 shows that restructuring had a major impact on shellfish harvesting and that one species, lobster, accounts for one-third of the value of landings on the East Coast. From 24 percent of total landings in 1990, the value of lobster catches rose to 33.7 percent in 1998. This increase is remarkable given that lobster catches fell by approximately 16 percent during the same period; however, firm lobster prices were mainly responsible for its steady performance. The average price paid to lobster fishers increased from \$4.85/kilogram in 1990 to \$10.25/kilogram in 1995, and for the most part has continued to rise since. Northern shrimp production has also risen sharply in recent years. Dockside volumes in eastern Canada soared from 37,000 tonnes in 1990 to over 115,000 tonnes in 1998. The increase was strongest in Newfoundland, where volumes were up 52,000 tonnes, and in Nova Scotia, where they grew by 20,000 tonnes. The result is that Northern shrimp production accounted for 7.8 to 21.1 percent of the total value of landings during that period.

One species that made an important contribution to maintaining a firm foundation for the Atlantic Canadian fisheries is snow crab.

Table 8
Fish and Seafood Landings in Eastern Canada, by Province and by Species Group,
1988, 1995, and 1998

Species	Volume (in tonnes)			Value (in thousands of dollars)		
	1988	1995	1998	1988	1995	1998
Newfoundland						
Groundfish	383,200	19,590	52,575	167,200	16,671	57,710
Pelagic fish	135,400	24,943	62,172	37,000	5,532	16,596
Molluscs & crustaceans	39,700	91,384	150,748	82,800	313,680	336,424
All species	558,300	135,917	265,495	287,000	335,883	410,730
Nova Scotia						
Groundfish	259,900	77,753	85,445	164,300	85,452	98,515
Pelagic fish	136,600	77,217	85,222	34,500	48,332	32,602
Molluscs & crustaceans	97,100	100,326	111,705	237,100	376,638	408,147
All species	493,600	255,296	282,372	435,900	510,422	539,264
New Brunswick						
Groundfish	20,100	1,563	1,688	9,200	1,882	2,124
Pelagic fish	105,900	97,327	76,045	19,700	20,365	14,002
Molluscs & crustaceans	25,400	33,290	26,087	89,200	185,848	113,048
All species	151,400	132,180	103,820	118,100	208,095	129,174

Prince Edward Island						
Groundfish	14,400	1,297	818	4,900	877	786
Pelagic fish	13,000	15,604	24,171	3,500	4,824	7,280
Molluscs & crustaceans	15,400	20,953	23,506	57,900	108,116	102,217
All species	42,800	37,854	48,495	66,300	113,817	110,283
Quebec						
Groundfish	55,700	3,391	6,177	26,900	5,315	8,570
Pelagic fish	9,700	10,359	9,181	4,900	4,294	2,878
Molluscs & crustaceans	22,800	33,997	33,999	67,300	167,640	87,071
All species	88,200	47,747	49,357	99,100	177,249	98,519
Eastern Canada						
Groundfish	733,300	103,594	146,703	362,786	110,197	167,705
Pelagic fish	400,600	225,450	256,791	75,772	83,347	73,358
Molluscs & crustaceans	200,400	279,950	346,045	930,963	1,151,922	1,046,907
All species	1,334,300	608,994	749,539	1,369,521	1,345,466	1,287,970

Source: Department of Fisheries and Oceans Canada, annual statistics on commercial fisheries and aquaculture; compiled by the author.

Table 9
Value and Volume of Fish and Seafood Landings,
by Species, Eastern Canada, 1990 and 1998

Species	Volume of Landings (in tonnes)		Value of Landings (in thousands of dollars)		Percentage of Total Landing Value	
	1990	1998	1990	1998	1990	1998
Cod	395,266	36,806	242,919	55,928	25.5	4.3
Redfish	81,450	27,142	22,701	14,424	2.4	1.1
Flatfish	63,665	13,619	36,254	15,656	3.8	1.2
Pollock	38,386	15,092	20,219	13,149	2.1	1.0
Haddock	22,148	11,721	24,216	20,686	2.5	1.6
Turbot	19,602	13,091	16,552	19,446	1.7	1.5
Hake	15,185	19,992	7,607	15,596	0.8	1.2
Halibut	2,415	1,268	10,820	8,346	1.1	0.6
Other groundfish	9,556	7,972	5,391	4,474	0.6	0.3
Groundfish	647,673	146,703	386,679	167,705	40.5	13.0
Herring	260,272	187,723	37,503	28,666	3.9	2.2
Capelin	126,917	40,784	17,379	12,032	1.8	0.9
Mackerel	21,790	17,157	6,210	8,747	0.7	0.7
Alewife	7,912	6,771	2,093	1,840	0.2	0.1
Smelt	1,081	813	843	880	0.1	0.1
Salmon	688	2	3,077	8	0.3	0.0

	471	690	7,158	9,824	0.8	0.8
Tuna	471	690	7,158	9,824	0.8	0.8
Other pelagic fish	2,638	2,851	10,364	11,361	1.1	0.9
Pelagic fish	421,769	256,791	84,627	73,358	8.9	5.7
Scallops	83,277	61,728	86,950	92,832	9.1	7.2
Clams, quahogs	22,666	28,730	18,265	37,827	1.9	2.9
Squid	5,589	1,314	2,769	1,298	0.3	0.1
Mussels	2,912	8,238	4,375	10,090	0.5	0.8
Oysters	2,639	1,471	4,987	3,327	0.5	0.3
Molluscs	117,083	101,481	117,346	145,374	12.3	11.2
Lobster	47,857	40,085	232,217	435,686	24.3	33.7
Shrimp	37,279	115,630	74,174	273,753	7.8	21.1
Snow crab	26,177	75,194	49,469	174,184	5.2	13.5
Crab (other)	864	8,615	321	6,282	0.0	0.5
Crustaceans	112,177	239,524	356,181	889,905	37.3	68.7
Various ^a	42,940	28,911	8,560	6,466	0.9	0.5
Other molluscs and crustaceans	786	1,738	507	4,685	0.1	0.4
Sea urchin	-	3,302	-	6,943	0.0	0.5
Grand total	1,342,428	778,450	953,900	1,294,436	100.0	100.0

Source: Department of Fisheries and Oceans Canada, annual statistics on commercial fisheries and aquaculture; compiled by the author.

^a Marine plants (seaweed) and seal (value only).

Although cyclically more unstable and subject to the volatile Japanese market, snow crab production has grown steadily in eastern Canada since 1990, from 26,000 to 75,000 tonnes in 1998. Like shrimp, the snow crab fishery has benefited Newfoundland more than the rest of eastern Canada: its fishers have captured 85 percent of additional crab volumes on the Atlantic coast. This rather lucrative fishery, and the Northern shrimp fishery, has contributed extensively to revitalizing the fishing industry in Newfoundland. No fewer than 3,300 fishers granted licenses under the Enterprise Allocation program have turned to snow crab fishing in Newfoundland, and they operate approximately forty crabbing grounds, most located in the eastern areas (3K and 3L), but also in northern (2J) and southern areas (3Ps) and even on the narrow west coast shelf (4R).³¹ According to scientists, the decline in cod stocks hastened the revival of crab stocks because cod prey on crab.

An important aspect of this new fishery in Newfoundland is that this type of crab lends itself to processing and thus has led to more processing plant jobs. Unlike neighbouring provinces, which rely primarily on the Japanese market to sell crab sections, the principal market for Newfoundland crab is the United States (\$281 million in 1999, which represents 74 percent of provincial crab exports), followed by China (\$45 million), Japan (\$39 million), Thailand (\$10 million), and a few other countries in Asia and Europe. The value of Newfoundland snow crab exports in 1999 (\$379 million) was one and a half times higher than snow crab exports from the other four Atlantic provinces combined (\$222 million),³² an impressive achievement in a province hit hard by the depletion of groundfish stocks.

In summary, the expansion of the shrimp and in particular the snow crab fisheries together with firm lobster prices, alone have supported the East Coast fishing industry for the last ten years. Also important are regional supplies of scallops (southwestern Nova Scotia), herring (sardines in southwestern New Brunswick, herring roe in a number of areas, particularly in northeastern New Brunswick, and smoked herring in southeastern New Brunswick), groundfish (approximately 146,000 tonnes landed in eastern Canada in 1998, including 85,000 tonnes in Nova Scotia, a significant amount), and growing supplies of other species including mussels (close to 10,000 tonnes), clams and other shellfish (30,500 tonnes), and more recently

31. According to *The 1999 Newfoundland and Labrador Seafood Industry — Year in Review*.

32. Compiled by the author from Industry Canada's STRATEGIS database.

rock crab (8,600 tonnes) and sea urchin (3,300 tonnes). The harvesting of species which until now have been underutilized or ignored, such as rock crab and sea urchin, show a change in attitude by fishers and processors, who must now make use of all available species. Of course aquaculture has also contributed to the regional fishery, as the following section explains.

The Aquaculture Sector: Expansion and Diversification

Although Canada is one of the world's top fish exporters (sixth in 1998), it ranks only twenty-third in fisheries production (the capture fisheries). Canada's estimated aquaculture production in 1998 was 92,000 tonnes: i.e., 0.3 percent of world volume and 0.6 percent of world value — far behind Asian countries, which dominate in both areas. Although Canada ranks twenty-second in aquaculture production, the average unit value of its aquaculture products is particularly high, placing it fourth in that category behind Japan, Chile, and Thailand.

Canada has only recently established a viable aquaculture industry. Progress has been rapid, however, particularly in salmon and mussel farming, and there is intense activity in the commercial production of a growing number of species. Canada's aquaculture production rose from 21,500 tonnes to over 113,000 tonnes between 1988 and 1999 and from Can.\$105 million to Can.\$558 million in value. The percentage of aquaculture products has continued to rise, and today they account for 9.5 percent of the tonnage of fish and seafood landings, but 27 percent of the value of traditional fisheries production. This increase is particularly evident for farmed fish, e.g., Atlantic salmon, production of which increased from 3,400 tonnes in 1988 to 72,300 tonnes in 1999 (\$34 million to \$452 million). Diversification is also underway, particularly in the area of shellfish farming.

Despite these encouraging signs, the true value of the aquaculture industry's contribution to the economy of coastal areas is not always recognized. This is the case with Canada's East Coast, although events in recent years have led to a greater recognition of the industry's potential. It is true that aquaculture is only in the embryonic stage in several coastal areas, and interindustry links have not been clearly established. Nevertheless, its contribution is extremely significant, all the more so given that the industry is an answer to the decline of traditional resources at the same time as it helps to diversify regional employment.

Although Canada's eastern provinces account for 70 to 80 percent of the value of the traditional fisheries in Canada, they represent a more modest percentage of aquaculture production, i.e., between 40 and 50 percent. Production is growing steadily, however, rising from 9,000 tonnes in 1988 to 16,000 tonnes in 1990, and reaching 51,800 tonnes in 1999 for a value of \$230.5 million (see table 10).

Farmed salmon alone represents 70 percent of the value of aquaculture production. However, the industry is relatively diversified, both sectorally and geographically. Trout, mussel, and oyster farming are already well established in eastern Canada, and a growing number of licences are being issued for farming new species, such as clams, green sea urchin, scallops, cod, haddock, turbot, halibut, Arctic char, and so on.³³

Aquaculture production of bivalves rose from 6,400 tonnes in 1990 to 17,700 tonnes in 1998, and their market value increased from \$10.4 million to \$25.7 million. Such growth is remarkable, especially considering that production of this kind is still affected by the traditionalism of the fisheries. This is particularly true in the oyster sector, where most licence holders limit themselves to harvesting, and many leases remain effectively nonproductive. In Prince Edward Island, for example, only one hundred of five hundred leaseholders are commercially active.³⁴ That ratio is even lower in New Brunswick, where no more than thirty of the nearly four hundred licence holders operate commercially.³⁵ According to scientists, there are approximately eighteen hundred oyster leases in the Maritimes covering nearly 5,000 hectares; if all leases were harvested to capacity and if all viable, unused sites were farmed, annual oyster production would be in the order of 125,000 tonnes,³⁶ a long way from the 2,600 tonnes reported in 1998 by oyster producers in the Maritimes.

The rapid development of the aquaculture sector is even more evident when compared to the traditional fisheries. Aquaculture production in eastern Canada represents a growing percentage of the total volume of fisheries production, rising from 1.2 percent in 1990

33. For complete and detailed coverage of aquaculture in eastern Canada, see Andrew Boghen, ed., *Cold-Water Aquaculture in Atlantic Canada* (Moncton: Canadian Institute for Research on Regional Development, 1995).

34. According to *Aquaculture Industry Profile and Labour Market Analysis*, report prepared for the Canadian Aquaculture Industry Alliance, p. 17.

35. Information obtained from discussions with various industry stakeholders.

36. According to R. E. Lavoie, "Culture of the American Oyster," in Boghen, ed. *Cold-Water Aquaculture in Atlantic Canada*, 192.

Table 10
Aquaculture Production in Eastern Canada, by Species Group and by Province, 1999

	Newfound- land	Nova Scotia	Prince Edward Island	New Brunswick	Quebec	Eastern Canada	
						1999	1990
Volume (in tonnes)							
Fish	2,487	4,715	82	22,550	1,084	30,918	9,798
Seafood	1,700	1,762	16,313	951	142	20,868	6,405
• Atlantic salmon	399	791	-	22,000	-	23,190	7,835
• Mussels	1,700	945	13,890	665	139	17,339	3,598
• Trout	2,088	3,924	-	550	1,084	7,646	1,873
• Oysters	-	776	2,423	286	1	3,486	2,698
• Other	-	41	82	-	2	125	199
Total	4,187	6,477	16,395	23,501	1,226	51,786	16,203
Value (in thousands of dollars)							
Fish	13,944	24,374	786	156,100	4,303	199,507	88,059
Seafood	3,800	3,509	21,920	1,586	174	30,989	10,362
• Atlantic salmon	2,462	7,022	-	150,000	-	159,484	74,641
• Mussels	3,800	1,485	16,845	798	167	23,095	13,418
• Trout	11,482	17,352	-	6,100	-	34,934	3,964
• Oysters	-	1,815	5,075	788	3	7,681	5,262
• Other	-	209	786	-	4,307	5,302	1,626
Total	17,744	27,883	22,706	157,686	4,477	230,496	98,911

Sources: Department of Fisheries and Oceans Canada, annual statistics on commercial fisheries and aquaculture; for Quebec figures, P. Lauzier, *Cahier sur la production aquicole* (Spring 2000).

to over 5 percent in recent years (see table 11). Not an impressive figure, it is true. Worldwide, the percentage of aquaculture products across the industry has grown steadily, and today it accounts for 12 percent of the capture fisheries production. Nevertheless, in terms of value rather than volume, Atlantic Canada performs very well, with aquaculture representing 13 to 15 percent of the value of traditional fishery landings.

Table 11
Aquaculture vs. Traditional Production – Fish and Seafood,
Eastern Canada, 1990–98

	Aquaculture Production as a % of Traditional Landings			Value of Aquaculture Production as a % of Traditional Landings		
	Fish	Seafood	All Species	Fish	Seafood	All Species
1990	0.9	2.8	1.2	18.8	2.2	10.5
1992	1.7	2.7	1.9	25.9	1.4	11.1
1994	3.7	3.3	3.5	56.1	1.3	11.1
1996	5.3	4.4	4.9	66.6	1.9	14.0
1997	6.2	4.2	5.2	76.7	1.9	15.3
1998	5.1	5.1	5.1	60.1	2.4	13.2

Source: Compiled by the author using data from the Department of Fisheries and Oceans Canada.