

SCOMM

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WORLD SALMON AQUACULTURE

World farmed salmon production reached 145,000 metric tons (t) in 1988 and an estimated 217,000 t in 1989. The latter figure is comparable to the U.S. annual salmon catch (about 250,000 t), and is approaching one-third the size of the world wild salmon catch (about 700,000 t). The rapid expansion of farmed salmon supplies in the late 1980s has led to sharp price decreases. Lower prices have forced some farmers out of business, but at the same time, a large number of farmers first began harvesting salmon on a commercial scale as the 1980s ended. Farmed salmon production could exceed 270,000 t in 1990. Most salmon farmers raise Atlantic salmon, reflecting the fact that farming technology was developed in Europe. The world's largest farmed salmon producer is Norway, accounting for about half of total production in 1988-1989. In early 1990, Norwegian producers for the first time announced plans to freeze significant quantities of salmon for export. The action is intended to protect the huge Norwegian industry by stabilizing fresh salmon prices, but it could also adversely affect frozen salmon exporters in the United States. Apart from Norway, other European countries have also developed major salmon farming industries. Important European Community (EC) producers include the United Kingdom (Scotland) and Ireland. Canada, Japan, and Chile have become major producers of Pacific salmon species in recent years. New Zealand and Australia are still in the early stages of development but could become major salmon producers in the 1990s.

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INTRODUCTION

Salmon aquaculture emerged as a major economic activity during the 1980s. At the beginning of the decade, salmon farming was a novel undertaking. World

production, almost exclusively from Norway and Japan, amounted to only 7,000 tons. The chief difficulties for aquaculturists, as the decade began, were technical. Farmers had to develop profitable methods of raising salmon, while facing the danger that disease, predators, or storms could wipe out their entire stock. As the 1980s ended, the situation was considerably different. World production levels had increased 30-fold, reaching an estimated 217,000 t in 1989 (fig. 1 and appendix 1). Norway was still the largest producer, accounting for over half of the total, but several other nations had developed sizable salmon farming industries (fig. 2). Another group of nations had begun to farm salmon on a commercial scale in the mid-1980s, and

was poised to rapidly expand production as the decade ended. Many of the earlier technical difficulties of salmon farming had been overcome through experience and extensive research.

Figure 1.--World. Farmed Salmon Production, 1980-1990.

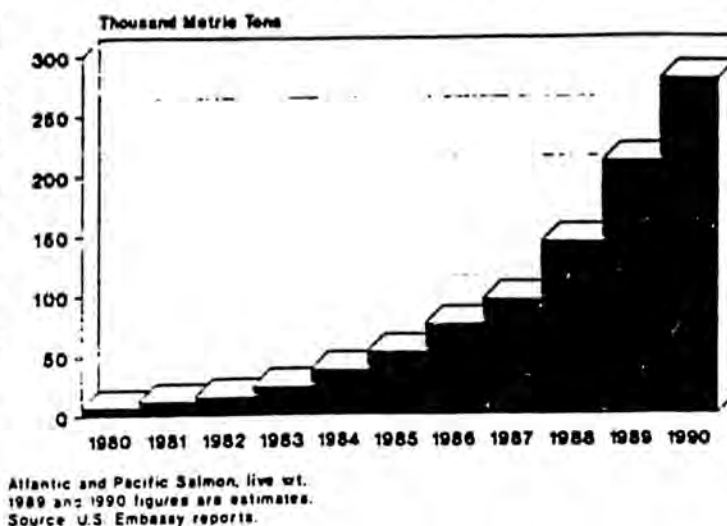
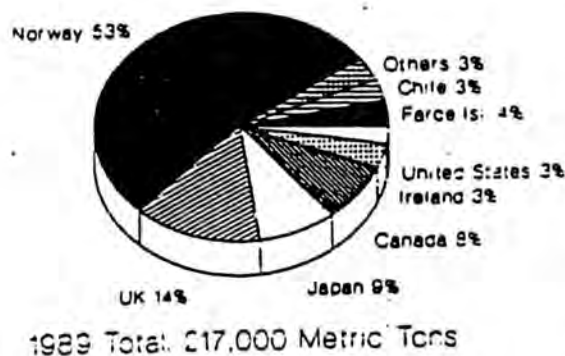


Figure 2.--Farmed Salmon Production by Major Producing Countries, 1989.



Partially Based on Estimates.
Source: U.S. Embassy reports

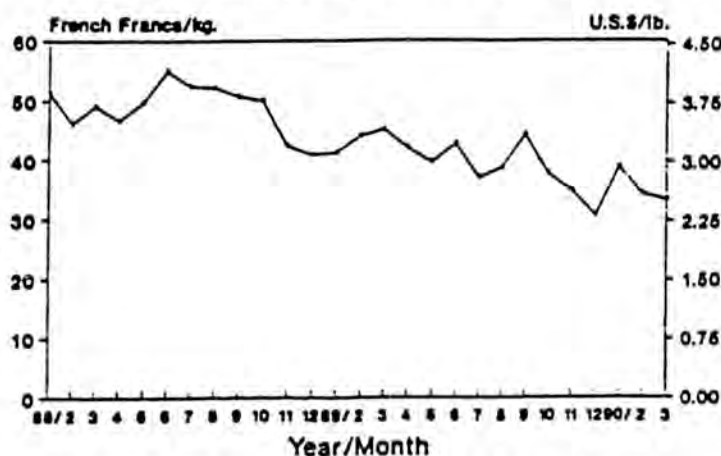
Impressive advances in the production of farmed salmon in the late 1980s have created new difficulties. Early in the decade, farmed salmon was a rarity on world markets, priced as a luxury food. By 1989, however, producer prices for farmed salmon had fallen sharply as exporters placed ever-increasing quantities on the market. For large producing nations, such as Norway, the decline in salmon prices disturbed what had become a major sector of the fishing industry. For salmon farmers in other countries, many of them still paying high start-up costs, falling prices posed a

more serious threat. As the 1990s began, the world's salmon farming industry faced great uncertainty: neither prices nor production levels had stabilized.

Recent Trends

Prices: Fresh salmon prices declined gradually during most of the 1980s as farmed salmon supplies increased. In the UK, for example, fresh salmon prices declined by 30 percent from 1980-1987.^{1/} During 1988-1989 when supplies of farmed salmon surged, steadily declining prices became a major concern for salmon producers. Between January 1988 and December 1989, Norwegian farmed salmon prices fell by 40 percent (from about \$4.00/lb. to \$2.30/lb) in Europe's largest wholesale market near Paris (fig. 3). Prices recovered somewhat in early 1990, but remained well below \$3.00/lb. Lower prices have severely reduced profit margins: one 1987 study estimated farmed salmon production costs in Europe at \$2.00-\$2.50 per pound.^{2/}

Figure 3.--Norwegian Farmed Salmon.
Average Prices, Rungis, France, 1988-90.



Exchange Rate:
6.0 French Francs=U.S.\$1.00
Source: Interfish.

Producer Reaction: In the face of falling prices, salmon farmers appear unwilling to allow market forces to determine the future of their industry. EC

1/ Susan A. Shaw, *Markets in Europe for Selected Aquaculture Species*, 1989, p. 28.

2/ DPA Group Inc., *Cost Production Model for Pen Rearing of Salmon*, 1987. (See Section IV. Sources for complete citations)

producers have alleged that Norwegian salmon farmers are selling at below cost, or "dumping," fresh salmon in the EC market. Norwegians dispute this charge. Even so, Norwegian producers, whose exports have a large impact on fresh salmon markets worldwide, limited the expansion of their fresh salmon exports in 1989, and have indicated that they will limit fresh salmon supplies in 1990 as well.

Technical Issues: Although many technical issues plaguing early salmon farmers have been resolved, others have grown more acute. To compete on world markets, many farmers opted for intensive farming methods, raising salmon under high-density conditions. While these methods permit increased yields, they also place the fish under stress, making them vulnerable to a variety of pathogens, and increasing the chances that one diseased fish will infect others. Unduly stressed salmon have even suffered heart attacks. Researchers have developed many effective vaccines and medications as well as other methods to treat salmon raised under high-density conditions. While these measures are effective, there is some concern among consumers--and therefore among farmers also--about the use of such medical additives in the production of salmon.

Smolts: Concern over the spread of disease has also led many nations to reduce or curtail their imports of salmon eggs and smolts (juvenile salmon). In Iceland, which entered the salmon industry mainly as an exporter of smolts, the disappearance of foreign markets has prompted an expansion of domestic salmon farming. In other nations, the government operates smolt hatcheries to assist farmers. Lately, however, there is a trend toward vertical integration of salmon farms among the larger producers. Some

salmon farmers in Norway, Scotland, and Canada now breed salmon in their own hatcheries.

Environmental Issues: Environmental considerations are closely connected with the technical issues involved in salmon farming. As salmon farms have expanded, becoming an industry rather than a novelty, they have sparked opposition from groups concerned with coastal pollution, the purity of wild salmon stocks, and other ecological issues. Local fishermen sometimes object to the waste excreted by farmed salmon. In Ireland, environmental groups have objected to the installation of salmon farms on scenic stretches of coast which are important for tourism. Because of opposition to the use of coastal sites, many salmon farms are being installed offshore.

Technology: The technology of salmon farming is becoming sophisticated, helping farmers to remain competitive even when they are forced to raise salmon under difficult offshore conditions. Movable floating sea-cages, automated feeding equipment, and waste filtering systems are increasingly common. Norway has led the way in developing technology, but smaller producing countries have also introduced innovations. In France, aquaculturists are attempting to raise salmon in a converted oil tanker.

Ranching: The term "salmon ranching" refers to the practice of releasing juvenile salmon into the ocean for later recapture. While less important than farming as a source of cultured salmon, ranching has recently expanded in several countries. Salmon ranching is not covered in detail in this report, but it is an activity with substantial potential in the 1990s. There are two types of salmon ranching. In the first, widely practiced in Japan, the juvenile salmon released into the ocean

are later caught by coastal fishermen. This method, which increases the existing wild salmon populations, accounts for most of Japan's 150,000 t annual catch of chum salmon.^{3/} Other nations, including Iceland, have also engaged in this kind of salmon ranching. The second type of ranching is more closely related to salmon farming. Instead of allowing the salmon to be caught at sea, ranchers rely on the natural tendency of salmon to return to their river (or in this case, coastal ranch site) of origin. Though ranchers have had mixed success in actually recapturing mature salmon, this method appears to have two potential advantages over conventional farming: production costs could be quite low, since salmon are raised at sea; ranchers may be able to promote their product as being indistinguishable from pure wild salmon.

Notes on this Report

Species: The term "Atlantic salmon" is used in this report to refer to *Salmo salar*, the species raised throughout Europe, with few exceptions. The term "Pacific salmon" refers to a group of related species: coho or silver salmon (*Oncorhynchus kisutch*); chinook or king salmon (*O. tshawytscha*); cherry (*O. masou*); and sockeye or red salmon (*O. nerka*). The species produced in a particular country is (are) identified in the text.

U.S. salmon farming -- Salmon farming in the United States, not covered in this report, yielded an estimated 5,600 t of salmon in 1989, making the United States the eighth largest cultured salmon producer (appendix 1). Farmers in the United States produce both Atlantic and Pacific (mostly chum) salmon.

³ Toshio Tashiro, "Keynote Report: Japan," 1988.

NORWAY

1988 Production: 83,700 t

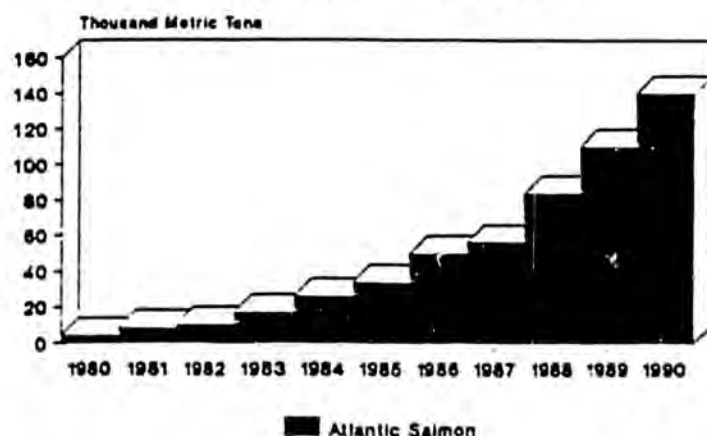
1989 Production: 110,000 t (est.)

Species: Atlantic Salmon



Production: Norway dominates the world farmed salmon industry. In 1989, it produced over half of the world's farmed Atlantic salmon. As the world's pioneer in salmon aquaculture, Norway has enjoyed a spectacular record of success. All sectors within the industry--smolt producers, feed manufacturers, salmon farmers, and salmon exporters--have shared in a remarkable era of growth (fig. 4). This growth has not been achieved without difficulties, however. The sharp Norwegian production increases in recent years--an estimated 115,000 t in 1989 compared with 83,700 t in 1988 and 56,000 t in 1987--have disrupted salmon markets throughout the world. The quantities of salmon reaching commercial size have become difficult for even the skillful Norwegian exporters to market.

Figure 4.--Norway. Farmed Salmon Production, 1980-1990.



Live weight
1988 and 1989 figures are estimates
Source: U.S. Embassy reports.

As production increased, salmon prices declined substantially in 1989 (fig. 3), impairing the profitability of the industry. By late 1989, prices received by Norwegian farmers for large Norwegian salmon had fallen to about \$4.90/kilogram (\$2.22/lb.)--less than half of their 1987 levels. Norwegian salmon farmers were predicting operating losses of as much as \$29 million for 1989.

Norway's production of farmed salmon could have been higher in 1989. Some industry representatives had predicted harvests as high as 150,000 tons. However, when the rapid increase in world supplies of farmed salmon caused prices to decline, Norwegian salmon farmers began to scale back their production estimates. To prevent further price erosion, farmers intentionally limited harvests to 115,000 t--still a record level--instead of the estimated 140,000 t of salmon that were approaching market size.

This self-imposed restraint on 1989 production means that Norwegian farmers carried over substantial "inventories" of penned harvestable salmon, raising the possibility that additional supplies of fresh Norwegian salmon would be brought to market in early 1990. Recognizing the continuing threat to profits, the Norwegian salmon farming industry is taking strong action to shore up prices in the short term and to limit supplies of fresh salmon in

the long term. The Norwegian Fish Farmers Sales Organization (NFFSO) has announced plans to buy and freeze 20,000-40,000 t of salmon. The Organization plans to borrow \$200 million from private banks to finance the freezing plan, and will impose a levy of \$0.75/kg on all exports of fresh salmon in 1990, in order to pay off the loan. Odd Ustad, director of the NFFSO, stated that the combination of the freezing plan and the tax on exports should keep 1990 prices to producers of fresh salmon at about \$6.30/kg (\$2.86/lb.). This action, intended to protect prices in the fresh salmon market, will have an important indirect result: it will significantly increase Norway's involvement in the frozen salmon market, an area in which Norway has played only a limited role in the past.

Farms: There have been about 600 salmon farms operating in Norway since the mid-1980s. Although the number of farms has not increased significantly, potential farming capacity expanded in 1988, when the Norwegian Government permitted fish farmers to increase the size of individual farms from 8,000 cubic meters to 12,000 cubic meters. Smolt production reached a peak of 75 million in 1988, but declined to an estimated 62 million in 1989.

Exports: Norway's exports of farmed salmon have increased tenfold over the past decade, from \$43 million in 1979 to \$486 million in 1988. The EC is the principal market for Norwegian salmon exports (table 1). In 1988, over 60 percent of such exports were sold to EC nations, about 15 percent went to the United States, and 5 percent to Japan. In 1988, the three largest salmon exporters in Norway were the Skaarfish (sales of over \$100 million), Domstein, and Hallvard Leroy companies.

Table 1.--Norway. Exports of Farmed Salmon, by Country of Destination, 1987-1988.

Destination	1987		1988	
	Quantity 1,000 t	Value \$ million	Quantity 1,000 t	Value \$ million
France	11.3	83.6	18.7	130.1
Denmark	7.7	51.8	14.2	92.1
United States	7.8	60.3	9.9	76.5
FRG	4.7	37.9	7.5	56.6
Japan	1.3	10.2	3.0	23.4
Other	9.2	69.8	14.8	107.4
Total	42.0	313.6	68.1	486.1

Units: metric tons (t), U.S. dollars (\$).

Source: U.S. Embassy, Oslo.

According to preliminary reports, Norway exported an estimated 100,000 t of salmon, worth \$585 million, in 1989. As in previous years, the largest markets for farmed salmon exports were in the EC, principally France, Denmark, and the Federal Republic of Germany. Exports to the United States increased in quantity to 11,400 t, but declined in value to \$67 million. Shipments to Japan increased to almost 4,700 tons.

Norway's increasing salmon exports to the EC have become controversial. During 1989, Scottish and Irish salmon farmers alleged that Norwegians were dumping under-priced salmon in the EC market, thereby threatening producers in other countries. In February 1990, the European Commission announced that it would investigate the charges. The EC has never before investigated alleged dumping of a food product, and the criteria for such an investigation may be difficult to establish. Norwegian salmon exporters face similar protests in the United States. U.S. producers of Atlantic salmon filed anti-dumping and countervailing duty complaints against Norway in February 1990.

As their European and U.S. markets have become somewhat problematic, Norwegian salmon farmers have turned increasing attention to the huge Japanese market for salmon, as indicated by the growing share of fresh salmon exports shipped to Japan in 1989. In 1990, Norway may also attempt to sell a significant portion of its frozen salmon production—estimated at 40,000 t—to Japanese importers. However, the U.S. Embassy in Tokyo reported in early 1990 that the Japanese salmon market was oversupplied and that Japanese importers would not accept large quantities of Norwegian frozen salmon unless prices declined significantly. Such a price decline would probably also affect U.S. exports of frozen salmon to Japan.

Outlook: Norwegian salmon farmers faced an uncertain market during late 1989 and early 1990—as evidenced by their decision to delay the harvest of some salmon and to freeze excess quantities as they are harvested. (It is not known whether Norway will continue to freeze salmon in future years.) This uncertainty means that forecasts of Norway's farmed salmon production for 1990 and beyond are extremely tentative. The NFFSO has asked salmon farmers to limit production of both salmon and smolts. Though a 140,000 t salmon harvest is currently being forecast for 1990, market conditions—rather than production capacity—may dictate lower production levels. Continuing annual increases in Norway's farmed salmon production are no longer assured.

FAROE ISLANDS

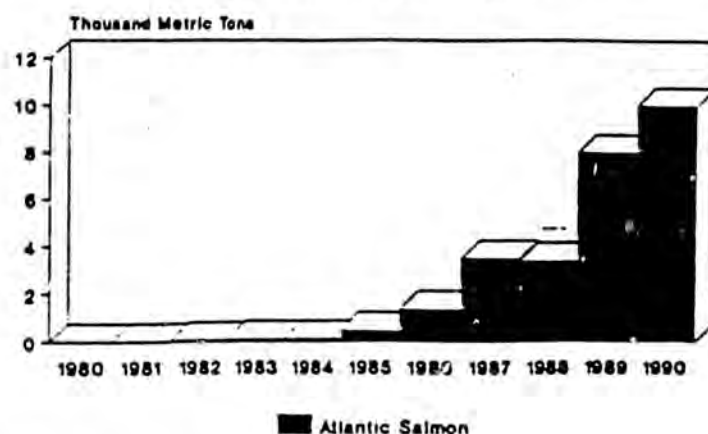
1988 Production: 3,400 t

1989 Production: 8,000 t (est.)

Species: Atlantic Salmon

Production: The Faroe Islands, a self-governing province of the Kingdom of Denmark, has rapidly increased its production of farmed salmon since the mid-1980s (fig. 5). Production first reached 1,000 t in 1986. Harvests have increased since then, but Faroese salmon farmers have also faced setbacks. Losses from fish diseases and algae blooms hurt 1988 production, which reached only 3,400 t instead of the expected 4,200 tons. In addition, many salmon farms were destroyed in late 1988 when severe storms—the worst in 100 years—raged through the Islands, with winds of up to 150 miles per hour. Despite these difficulties, production of farmed Atlantic salmon recovered in 1989 and reached an estimated 8,000 t, more than double the 1988 level.

Figure 5.—Faroe Islands. Farmed Salmon Production, 1980–1990.



Live weight.
1989 and 1990 figures are estimates.
Source: U.S. Embassy reports.



Salmon farming has taken on increasing importance in the Faroe Islands—where catching and processing fish is the mainstay of the economy—because of the downturn in wild fishery catches in recent years. Faroese fishermen invested heavily in highseas trawlers, but have lost their access to traditional distantwater fishing areas off Greenland and Norway.

The Faroese Home-Rule Government supported the start of the salmon farming industry by providing technical assistance and investment loans to fish farmers. Besides providing essential financial support, the Government has also regulated the industry in several ways. The importation of smolts is prohibited in order to protect Faroese salmon from diseases and the number of farms is limited in order to protect the environment.

The Government's prohibition on the import of salmon smolts at first limited the growth of the Faroese salmon farming industry; all smolts had to come from the Government-run hatchery. Salmon farming expanded rapidly after 1984, when the new Government allowed individual farmers to operate their own hatcheries. By 1987, smolt production was estimated at 3 million fish per year.

Farms: There were about 50 salmon

farms in the Faroe Islands in 1989, producing an annual average of 160 t of salmon. Most salmon farmers make use of sea-cages located in narrow fjords, but the Government has encouraged farmers to use offshore cages because of environmental concerns. There were 17 offshore cages operating in 1989.

Exports: The bulk of the farmed salmon produced in the Faroe Islands is exported. In 1987 (the latest year for which export data are available), the Islands exported 82 percent of the cultured salmon produced. The bulk of these exports (95 percent) were shipped to the EC, especially to Denmark (table 2). The United States purchased \$1 million worth of farmed salmon from the Faroe Islands in 1987, but only \$236,000 worth in 1989.

Table 2.--Faroe Islands. Exports of Farmed Salmon by Country of Destination, 1987.

Destination	1987	
	Quantity t	Value \$ 1,000
Denmark	1,061	7,300
France	598	4,700
FRG	542	4,400
Spain	322	2,600
United States	112	1,000
Italy	68	400
Netherlands	47	300
UK	45	300
Belg./Lux.	42	400
Norway	32	300
Others	10	100
Total	2,880	21,800

Units: metric tons (t),

U.S. dollars (\$).

Source: U.S. Embassy, Copenhagen.

Outlook: The conservative Faroe Islands Government elected in 1989 entered office facing a \$1 billion debt. This sum, inherited from former governments that spent heavily for social welfare, makes increased aid to salmon farmers unlikely. Salmon farming is expected to continue expanding at a moderate pace--1990 production is forecast at 10,000 tons.

ICELAND

1988 Production: 1,233 t

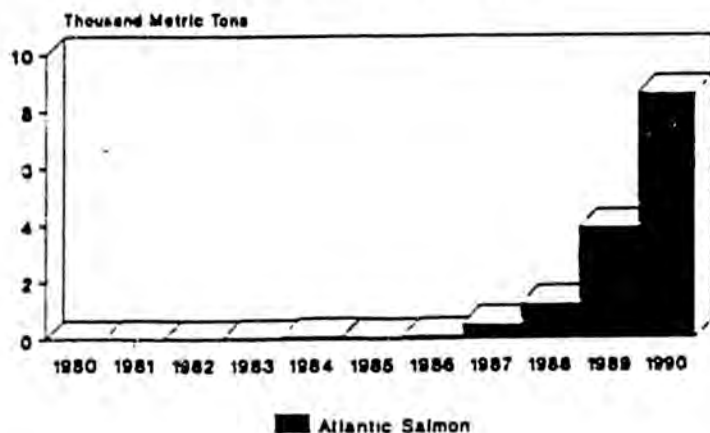
1989 Production: 3,900 t (est.)

Species: Atlantic Salmon



Production: Salmon farming in Iceland first reached commercial scale in 1987, when farmers produced 530 tons. Since then, production has more than doubled each year, to 1,200 t in 1988, and to an estimated 3,900 t in 1989 (fig. 6). Although Iceland does not rival either Norway or the UK as a producer of market-size salmon, the nation has played an important role in the development of the salmon aquaculture industry as an exporter of salmon smolts. The island's geothermal resources were harnessed to provide temperature-controlled water for over 50 hatcheries. Production of smolts for several years exceeded the farming capacity in Iceland, so millions of smolts were exported in the mid-1980s, mostly to Norway and Ireland.

Figure 6.--Iceland. Farmed Salmon Production, 1980-1990.



Live weight.
1989 and 1990 figures are estimates.
Source: U.S. Embassy reports.

In recent years, Iceland has reduced its exports of smolts because foreign markets have largely evaporated, but it has continued to increase smolt production to supply its growing domestic industry. In both 1988 and 1989, over 10 million smolts were raised (compared to 4 million in 1987), none of which were exported, indicating that Icelandic salmon production may exceed 8,000 t in 1990.

Foreign investment and Government assistance have played important roles in the development of Iceland's salmon farming industry. Norwegian companies had invested over \$45 million in Icelandic salmon culture and equipment as of 1987, the latest year for which such data are available. This amount was one-third of total investment in the salmon farming industry. The Icelandic Government has provided additional impetus to salmon farmers by offering low-cost financing. During 1989, as Icelandic salmon farmers began feeling the impact of lower world salmon prices, the Icelandic Prime Minister proposed a Government initiative to address financial problems in the aquaculture sector. Details are not available.

Farms: There were about 60 salmon farms operating in Iceland in 1989, and about 20 salmon ranching enterprises. In recent years, the number of fish farms has not increased rapidly, but culturists have

begun to make greater use of their farms' capacity. They have placed the bulk of the smolts in sea cages, similar to those used by other nations. Because Iceland's bays and inlets are not as well protected as those in Norway or Scotland, some Icelandic farmers have installed land-based farms.

Salmon farmers in Iceland were hard hit in 1989 by the decline of their smolt export markets and the decrease in world salmon prices. At least 10 farms filed for bankruptcy late in the year. One of the failed companies was Islandlax, a joint venture between Iceland's Samband cooperative association and Norway's Noraqua company. The company's owners intended to supply 500,000-700,000 smolts to salmon farms in Norway, but those farms were already fully supplied by Norwegian hatcheries. Because of the difficulty of obtaining credit in Iceland, Islandlax was unable to finance the raising of salmon to market size, and went bankrupt with debts of \$18 million.

Despite such setbacks, many Icelandic farmers are successfully making the transition from production of smolts to production of market-size salmon. Icelandic salmon farmers have emphasized strict standards in their industry, seeking to present their fish on world markets as unsurpassed in quality and free of all chemical additives. Salmon ranching is particularly popular in this context, since it allows farmers to harvest salmon which have matured in the pristine waters surrounding Iceland. Salmon ranching is expected to yield 1,000 t of salmon per year as of the mid-1990s.

Icelandic farmers have benefitted in the past from the technical experience brought in by foreign investors, particularly from Norway, but have lately begun to develop their own technical base.

In 1986, the first class of aquaculturists graduated from Iceland's Agricultural College, and were reported to be in great demand among Icelandic salmon farmers.

Exports: In 1988, Iceland exported 75 percent of its farmed salmon production (table 3). Exports to the United States, Iceland's largest market for farmed salmon, benefit from air transport links which allow salmon harvested in the morning to be on sale in New York by the next morning. Iceland also flies fresh salmon to Europe, where the largest market is France, and has recently added air transport service to Japan. In 1989, preliminary estimates indicated that Iceland exported between 1,500 t and 2,000 t of salmon, thus doubling the quantity of its 1988 exports.

Table 3.--Iceland. Exports of Farmed Salmon by Country of Destination, 1988.

Destination	1988	
	Quantity t	Value \$ 1,000
United States	370.5	2,767
France	232.9	1,344
Switzerland	59.2	531
Japan	53.5	452
FRG	32.6	241
UK	32.0	186
Netherlands	27.8	182
Denmark	8.1	52
Belgium	2.0	11
Spain	0.3	2
Hong Kong	0.2	2
Italy	0.1	1
Sweden	0.1	1
Total	819.4	5,772

Units: metric tons (t).

U.S. dollars (\$).

Source: U.S. Embassy, Reykjavik.

Outlook: As of early 1989, sources in Iceland indicated that production of farmed salmon would continue to increase at a rapid rate, doubling from 3,900 t in 1989 to over 8,000 t in 1990. The rash of salmon farm bankruptcies in late 1989 may slow the production increase somewhat.

SWEDEN

1988 Production: 363 t
1989 Production: 500 t (est.)
Species: Atlantic Salmon

Production: Swedish salmon farming contrasts sharply with salmon aquaculture in Norway, where salmon culturing is a major industry. There are few salmon farms in Sweden (about 15 in 1987); most are small family enterprises on the east coast. About 2 million salmon smolts are raised in Swedish hatcheries each year, but most are released into rivers for stocking purposes rather than raised by farmers. Swedish fishermen catch about 1,000 t of wild salmon in the Baltic each year, and the Government is more concerned about maintaining wild stock levels than about increasing salmon farming. Salmon farms receive no significant Government aid.

Although salmon farming is not a priority in Sweden, several farmers have introduced innovative production methods. In 1986, farmers tested a "Semi-Submersible Offshore Farm" in the North Sea. The capability to produce salmon offshore may be important to the future of aquaculture in Sweden, where concern for protection of coastal areas is strong. Other innovations involve the species being farmed. One Swedish company, Oveds Fish Farm, is successfully producing Arctic char (*Salvelinus alpinus*), which is considered more difficult to raise and potentially more profitable than other members of the salmon family.

FINLAND

1988 Production: 150 t
1989 Production: 170 t (est.)
Species: Atlantic Salmon

Production: Finland's production of farmed salmon is small, hardly reaching commercial levels. Finnish salmon farmers began by producing smolts for export to rapidly expanding Norwegian salmon farms. While its inland waters are ideal for raising smolts, raising adult salmon in Finland has been more difficult because its coastal waters are quite cold. The gulfstream, which warms the coastal waters of both Scotland and Norway, does not reach Finland. Another difficulty for salmon farmers is the low salinity of the Baltic.

In recent years, as exports of salmon smolts to Norway declined--especially when Norway temporarily suspended all smolt imports for fear of disease--farmers have attempted to develop their own salmon farming capacity, despite technical difficulties. Finland has also joined Sweden in releasing salmon smolts into the Baltic in an effort to rebuild wild stocks. In 1986, scientists at the State Central Fish Culture Station in eastern Finland began work on a salmon-ranching project, in which released smolts would return to the hatchery. Finnish farmers have also successfully attempted to raise chum salmon and Arctic char.

UK (SCOTLAND)

1988 Production: 17,951 t

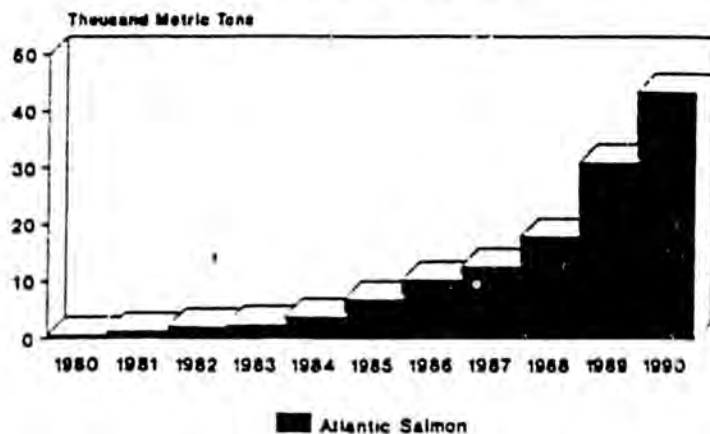
1989 Production: 31,015 t (est.)

Species: Atlantic Salmon



Production: Scotland's production of farmed Atlantic salmon—second only to Norway's—has increased steadily since the mid-1980s (fig. 7). Salmon production expanded from about 18,000 t in 1988 to an estimated 31,000 t in 1989, and is forecast to exceed 43,000 t in 1990. Fish farmers in Scotland have had considerable success overcoming the many technical problems involved in commercial salmon farming. The Scottish industry, however, faces marketing difficulties because of the tremendous growth in farmed salmon supplies to the EC during 1988-89. As salmon exports from Norway have increased, prices throughout the EC have fallen. At two of the largest wholesale fishery markets in Europe (Billingsgate, in London, and Rungis, near Paris) salmon prices fell below those of cod in mid-1989.

Figure 7.--United Kingdom. Farmed Salmon Production, 1980-1990.



Live weight.
1989 and 1990 figures are estimates.
Source: U.S. Embassy reports.

For Scottish salmon farmers, whose product has enjoyed a reputation for high quality and high price, the prospect of lower prices in both domestic and foreign markets is discouraging, but not catastrophic. Although several farms closed in 1989, others opened or expanded. Farmers have continued to introduce more sophisticated production methods. Smolts are vaccinated against diseases, and are often airlifted to farms by helicopter.

Instead of introducing measures to limit the expansion of salmon production, as Norwegian farmers have begun to do recently, Scottish farmers seem to be betting that the market for their salmon will continue to expand. Andrew Gray, the marketing director for the Scottish Salmon Board, states that production will be allowed to expand to 55,000-65,000 t by 1992. Unless world markets expand more than expected, he says, production will not be increased beyond that level.

Farms: Most UK salmon farms are located in northwest Scotland, where bays and islands provide sheltered sites. There are also farms on the east coast, and on the Shetland Islands. In 1988, there were 153 companies operating 258 farms, compared to 126 companies and 196 farms in 1987. The majority of these farms used sea cages, though 14 sites used shore-based tanks or raceways. Of the almost

18,000 t of salmon harvested in 1988, 12,000 t were from smolts received in 1987, and 6,000 t from 1986 smolts. The 22.5 million smolts produced in 1988 were supplied by 90 companies operating 176 sites. Smolt production was expected to reach 28.7 million in 1989, and 33.6 million in 1990.

Many early investments in Scottish aquaculture were made by the Dutch-owned Unilever company, through its Marine Harvest subsidiary. As early as 1986, Marine Harvest had invested \$20 million in Scotland, operating 3 salmon hatcheries, 4 freshwater smolt farms, and 18 salmon culturing farms. By 1988, Marine Harvest produced an estimated 5,500 t of farmed salmon. In 1989, the company expanded its processing plant and expected to harvest 8,000 t of salmon, or about 25 percent of The entire UK production.

Farmers in the Shetland Islands produced a record 8,000 t of salmon in 1989, a 74 percent increase over 1988. The salmon harvest was valued at an estimated \$44 million, \$11 million more than the value of the entire 1989 pelagic and groundfish catch off the Shetlands. Even so, farmers in the Shetlands felt the effects of lower salmon prices on European markets. The value of their record harvest increased only by one-third over 1988 levels.

Exports: Most salmon produced in the UK is consumed domestically. In 1988, UK salmon farmers exported 36 percent of their harvest, with a value of \$52 million (table 4). France was the largest export market, followed by the Netherlands. The United States imported \$4 million worth of farmed salmon from the UK in 1988. Importers in the United States reportedly hold Scottish salmon in high regard, but have recently begun to

resist the higher prices that UK exporters charge. According to some U.S. importers, UK exporters still have to adjust to lower world salmon prices.

In 1989, salmon farmers in the UK increased their exports significantly, when production increased by

Table 4.--United Kingdom, Exports of Farmed Salmon, by Country of Destination, 1988.

Destination	1988	
	Quantity t	Value \$ 1,000
France	4281.0	31,757
Netherlands	648.0	5,889
United States	341.0	4,024
Other	1237.0	10,343
Total	6507.0	52,013

Units: metric tons (t),
U.S. dollars (\$).

Source: U.S. Embassy, London.

14,000 tons. However, the even larger 1989 production increase in Norway (about 26,000 t) boosted supplies of salmon in the EC market. Prices fell sharply. As discussed above (under Norway), Scottish farmers helped persuade the EC Commission to investigate alleged dumping by Norwegian salmon exporters.

Outlook: The rapid increase in Scottish farmed salmon production in recent years has forced farmers to reevaluate their marketing strategy. According to William Crowe, of the Scottish Salmon Growers Association, Scottish farmers have decided to commit themselves to mass production of increasing quantities of salmon for larger markets, instead of continuing to promote their product as the handcrafted "Rolls Royce" of farmed salmon. To market their increased output, Scottish farmers plan to enlarge their overseas markets in the United States and in Japan.

IRELAND

1988 Production: 4,200 t

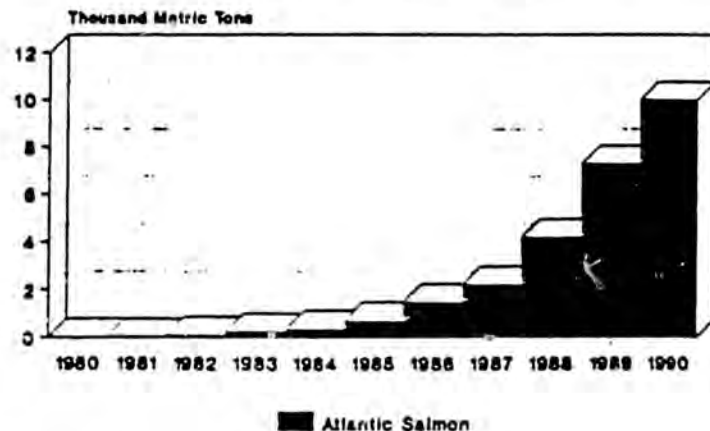
1989 Production: 7,300 t (est.)

Species: Atlantic Salmon

Production: Irish production of farmed salmon has increased markedly each year since the mid-1980s, and is expected to reach 10,000 t in 1990 (Fig. 8). The Irish Salmon Growers Association is developing a two-part strategy for its expanding industry: (1) a quality-assurance program under which each harvested salmon will carry a special gill tag indicating that it has been inspected, and (2) a marketing plan targeted at the United States and Japan. Salmon farms in Ireland received \$5 million in EC aid in 1988. Assistance is also provided by the Government's Irish Sea Fisheries Board, and Udaras Na Gaeltachta—the latter offers aid to Gaelic speaking areas of Ireland.

In 1988, a disease called infectious pancreatic necrosis infected Irish farmed salmon. Farmers estimated that

Figure 8.--Ireland. Farmed Salmon Production, 1980-1990.



Live weight.
1989 and 1990 figures are estimates.
Source: U.S. Embassy reports.



25 percent of their harvest was lost that year because of the disease. The disease was not a problem in 1989.

Farms: There were only 21 salmon farms operating in Ireland in 1988, but interest in salmon farming runs high. The Irish Department of the Marine had over 600 aquaculture applications under review in 1989. However, after several years of rapid expansion, salmon farming in Ireland is facing growing resistance from conservationists, representatives of the tourist industry, and recreational fishermen, all of whom oppose the use picturesque coastal sites for salmon farms and hatcheries.

Because of this resistance, some salmon farms are moving offshore. In 1983, the Irish farmers purchased their first Bridgestone Hi-Seas Cage, manufactured in Japan. By 1989, Irish culturists were operating 28 such cages, becoming the world's largest user. In October 1989, Ireland inaugurated an ambitious 25,000 cubic meter floating salmon farm, said to be able to produce 400 t of salmon per year.

In 1989, there were 25 Irish companies raising smolts at 32 sites, producing an estimated 9.7 million smolts. This was a significant increase from the 6.9 million smolts raised in 1988.

Government licenses are required for freshwater hatcheries, and Government grants are available to finance as much as 65 percent of capital costs.

Exports: Irish farmers exported 2,300 t of salmon, worth over \$16 million, in 1988 (table 5). France was the largest importer of Irish salmon, both because of its relative proximity to Ireland and because French consumers prefer the small (1-2 kg) salmon produced in Ireland. Other EC nations accounted for most of Ireland's exports of farmed salmon, but the United States also imported significant quantities, increasing its imports from 40 t in 1987 to almost 270 t in 1988.

Table 5--Ireland. Exports of Farmed Salmon, by Country of Destination, 1987-1988.

Destination	1987		1988	
	Quantity 1,000 t	Value \$ 1,000	Quantity 1,000 t	Value \$ 1,000
France	1,124	7,206	1,610	10,927
United States	41	411	267	2,345
UK	365	2,238	185	1,238
Netherlands	27	218	128	1,053
Belg./Lux.	63	519	55	433
Spain	75	552	46	316
Japan	17	181	21	141
FRG	9	73	4	52
Switzerland	2	22	2	12
Denmark	0	0	1	6
Others	10	90	0	2
Total	1,733	11,510	2,319	16,525

Units: metric tons (t), U.S. dollars (\$).
Source: U.S. Embassy, Dublin.

Outlook: Irish salmon farmers intend to produce 30,000 t of farmed salmon per year by 1995, but some observers in Ireland are questioning that goal. Decreasing world prices for farmed salmon are a long-term concern. Despite the glut of Norwegian farmed salmon on the market, the Irish Salmon Growers Association maintains that the industry can afford to continue its rapid expansion if it focuses on the large markets in the United States and Japan.

FRANCE

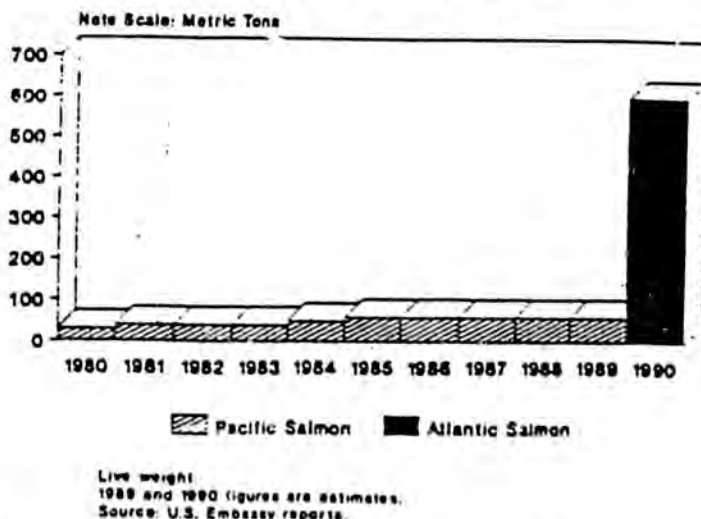
1988 Production: 60 t

1989 Production: 600 t (est.)

Species: Atlantic Salmon and Pacific Salmon

Production: French aquaculturists have emphasized shellfish production (oysters and mussels). Even though it is one of the world's largest salmon importers, France has made no overwhelming effort to become self-sufficient in salmon production, depending instead on imports from North America and more recently from Norway and Scotland. In recent years, farmers in Brittany (northwest France) have succeeded in raising trout on a commercial scale, producing about 500 t per year. Pacific coho salmon have been produced at some of the same farms, but on a much smaller scale (fig. 9). Farmers who have attempted to raise salmon in French waters have reported low survival rates during the summer months, when water temperatures rise. Scientists at the

Figure 9.--France. Farmed Salmon Production, 1980-1990.



National Institute for Agronomy Research (INRA) and the Institut Français pour la Recherche et l'Exploitation de la Mer (IFREMER) are currently investigating the technical aspects of salmon farming in warmer waters, but there is no indication that France will become a major producer of salmon in the foreseeable future.

Farms: The first French farm dedicated exclusively to Atlantic salmon production began operation in mid-1989, when about 230,000 smolts were delivered from Norway to the barge *Ille Sous le Vent*, a converted Portuguese oil tanker. The vessel is the first known conversion of a tanker for use as a salmon farm. The 116-meter long floating farm, equipped with four 4,000-cubic-meter holds, is anchored about 5 kilometers off the north coast of Brittany in Morlaix Bay. Capacity is limited to 500,000 smolts which should yield about 600 t of salmon in 1990. Future harvests from this \$10 million farm are expected to reach 750 t per year. Another converted oil tanker is due to arrive in the Bay in 1990, bringing potential production levels to 1,500 t annually. However, local environmental groups are seeking to limit the expansion of this salmon farming project.

Other French firms are interested in raising farmed salmon as well. In Plouguerneau, the Fermor company plans to establish a salmon farm that will produce 300 t of salmon annually. The Bouygues group plans to establish a 1,000-2,000 t annual capacity farm off Camaret. Six 30-meter diameter cages will be linked to a central tower. If the sea gets too rough, the cages will be lowered to a depth of 20 meters. Overseas, the French Regional Association for the Development of Aquaculture (ARDA) has helped establish Atlantic salmon farms on the islands of St. Pierre and Miquelon, off Canada.

SPAIN

1988 Production: 300 t

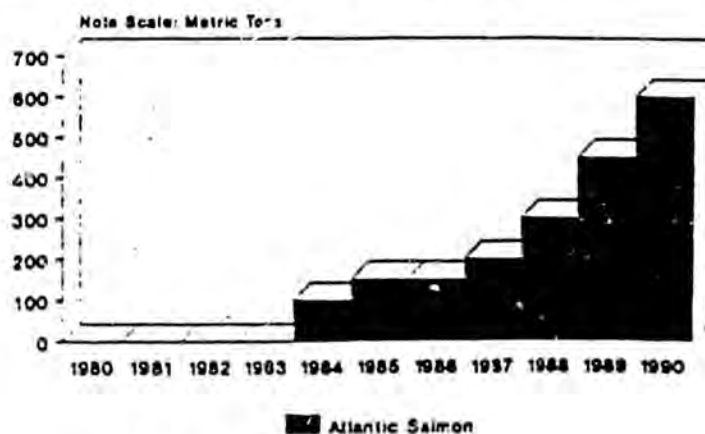
1989 Production: 450 t (est.)

Species: Atlantic Salmon

Production: Spanish salmon farming exists only on a very small scale (fig. 10). In contrast to its large trout farming industry, Spain's salmon farms only produced about 300-500 t per year during 1988-1989. As in France, salmon farmers have faced difficulties because of Spain's relatively warm waters.

Norwegian investors announced plans to establish several salmon farms in northern Spain in 1988. The Norwegians believed that technical difficulties could be overcome, and were interested in gaining access to Spain's growing salmon market. Current information on these farms is not available, but the Spanish market for salmon and trout is indeed expanding. In 1988, salmon and trout imports (aggregated in Spanish trade statistics) increased to 7,300 t, from 4,300 t in 1987.

Figure 10.--Spain. Farmed Salmon Production, 1980-1990.



Live weight.
1989 and 1990 figures are estimates.
Source: U.S. Embassy reports.

CANADA

1988 Production: 9,100 t

1989 Production: 16,700 t (est.)

Species: Atlantic Salmon and
Pacific Salmon



Production: Canadian salmon farmers are forecasting a harvest in excess of 23,000 t in 1990, continuing the rapid increase in production that has occurred since the mid-1980s (fig. 11). In 1985, production on both coasts totaled less than 500 tons. Since then, salmon farming on the Pacific coast (in British Columbia) has expanded to an estimated 14,500 t in 1989, while farming on the Atlantic coast (primarily in the Bay of Fundy between Nova Scotia and New Brunswick) has increased more slowly to about 3,000 tons. The growth of Canadian salmon farming was helped by considerable Norwegian investment.

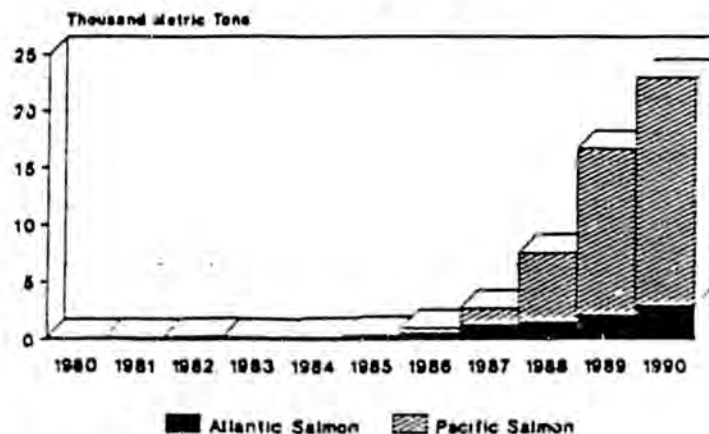
Pacific Region: Salmon farmers in British Columbia (B.C.) raise mostly Pacific species, including chinook (3,850 t in 1988), coho (2,000 t), and chum salmon

(150 t). Chinook farming is expanding in response to consumer preferences in the United States—Canada's largest export market. Chinook production in B.C. is projected to reach 16,500 t in 1990.

Salmon farmers in B.C. were said to have adopted a "gold rush" mentality in the mid-1980s, as farms were established with little regulation or coordination. More recently, however, both Government and private organizations have begun to play an important role in the development of the region's aquaculture industry. The B.C. Salmon Farmers' Association (BCSFA) now represents 95 percent of Pacific salmon farmers and has established well-recognized health and quality standards. The BCSFA also performs marketing studies intended to maximize returns to farmers. A privately funded salmon research institute, Ewos Pacific Research Farm, began investigating nutrition and health issues in mid-1989.

The B.C. Government has moved to supplement these private regulatory and research efforts by forming the B.C. Aquaculture Research and Development Council in 1989. A 1988 "Memorandum of Understanding" between the B.C. Government and the Federal Department of Fisheries and Oceans clarified federal and provincial responsibilities for aquaculture.

Figure 11.—Canada. Farmed Salmon
Production, 1980-1990.



Live Weight.
1989 and 1990 figures are estimates.
Source: U.S. Embassy reports.

Atlantic Region: Salmon farms in Atlantic Canada--producing Atlantic salmon--are centered in the "Scotia-Fundy" region located northeast of Maine. Salmon aquaculture in this region has grown at an orderly pace--in contrast to B.C.--but has also expanded more slowly than predicted. Provincial authorities in Nova Scotia and New Brunswick have adopted a cautious attitude, apparently to prevent overexpansion of the industry. The New Brunswick Government placed a moratorium on the issuance of salmon farm licenses during 1986-88, and has issued only limited numbers of licenses since then. Thus, current production levels (about 3,000 t) are not expected to increase rapidly. Even so, salmon aquaculture in Atlantic Canada was reportedly generating C\$40 million per year in direct sales by 1988.

Salmon farms in Quebec and Newfoundland have so far produced only about 100 t of salmon per year. In an effort to determine whether higher production levels could be achieved in these cold-water areas, researchers recently conducted a 3-year experiment in Newfoundland involving in-cage heating systems and different species of salmon. The commercial feasibility of the experimental farming methods are now being evaluated.

Farms: In 1989, there were 150 active salmon farms in B.C. (200 licenses had been issued), producing an average of 100 t each. The largest concentration of farms is on the west coast of Vancouver Island. Most farmers raise salmon by using smolts from separate Government or private hatcheries, but some farmers are integrating their operations vertically by building hatcheries.

There were about 45 salmon farms operating in Atlantic Canada in 1989,

most of them in the Bay of Fundy. Average annual production per farm in this region is lower than in B.C.--about 65 tons. Many of the farms in Atlantic Canada are quite small; there are only a few large-scale operations. Connors Brothers company, a leading sardine canner, operates a salmon farm and a 400,000 smolt hatchery in New Brunswick, supplies fishmeal to many salmon farmers in the area, and markets salmon for other farmers. The Sea Farms company, a Canada-Norway joint venture, operates 3 hatcheries and 3 farms which are expected to produce 1,000 t of salmon per year by 1990.

Exports: Unlike most other major salmon farming nations, Canada also operates a large wild salmon fishery. Export statistics do not explicitly distinguish between the two sources of salmon. In 1988, exports of fresh salmon from B.C., presumably including most farmed salmon, were shipped mainly to the United States (5,200 t, C\$33.1 million in 1988), followed by Japan (290 t, C\$3.0 million), and the UK (80 t, C\$0.5 million). Corresponding statistics for Atlantic Canada were not readily available. In 1989, the United States imported about \$45 million worth of fresh salmon from Canada, including \$22 million worth of Atlantic salmon (3,000 t), \$12 million worth of sockeye (2,400 t), \$8 million worth of coho (1,900 t), and \$3 million worth of pink salmon (1,700 t).

Outlook: In 1989, Canada's Fisheries and Oceans Minister, Tom Siddon, announced the release of a report entitled "Long Term Production Outlook for the Canadian Aquaculture Industry," prepared by the Price Waterhouse company. The report forecasts a "worst-case" farmed salmon production level of 31,000 t by the year 2000, and a "best-case" level of 66,000 tons.

JAPAN

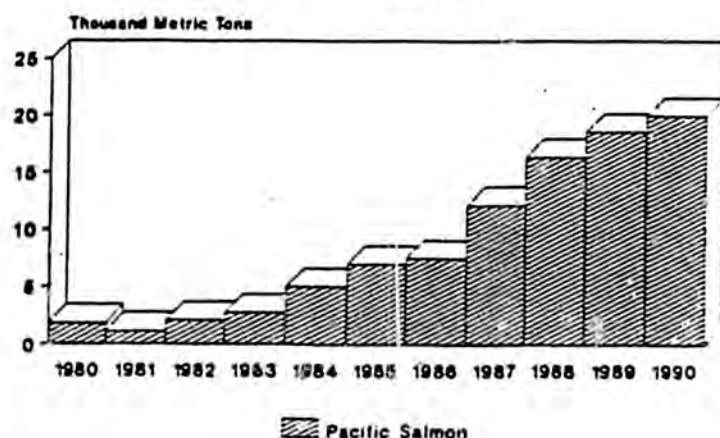
1988 Production: 16,400 t

1989 Production: 18,600 t (est.)

Species: Pacific Salmon

Production: Japan is the world's largest market for salmon, and the largest salmon importer. With its enormous market, Japan has attempted to maintain a high level of self-sufficiency in salmon supplies. As salmon fishing quotas in the North Pacific (established jointly by the Soviet Union and Japan) have been reduced in recent years, Japan has turned to two artificial methods for increasing the supply of salmon. The first method--employed on a small scale since the 1940s--involves hatching and releasing salmon fingerlings, which are then caught several years later off the coast of Japan. This type of salmon ranching yielded 155,000 t of salmon in 1986, a 2.5 percent return rate on the 2 billion fingerlings released in 1982. The second method, coho and chinook salmon aquaculture in sea cages, has not yet

Figure 12.--Japan. Farmed Salmon Production, 1980-1990.



Live weight
1989 and 1990 figures are estimates.
Source: U.S. Embassy reports.



yielded comparable quantities of salmon, but has reached significant levels in recent years (fig. 12).

Japan's farmed salmon production has increased from 5,000 t in 1984 to an estimated 18,600 t in 1989, making Japan the world's third largest producer of cultured salmon and the largest producer of Pacific species. Unlike most other salmon producing countries, Japan apparently does not export any of its growing salmon harvests, and thus has not contributed to the recent rapid growth of farmed salmon supplies on world markets. Nevertheless, Japan's increasing salmon-farming capacity may affect its import requirements, especially for fresh salmon. Production would have to increase dramatically to completely supply Japan's salmon market: in 1989, Japan imported over 135,000 t of fresh, chilled, and frozen salmon (mostly frozen Pacific species).

The Japanese Government has not played a decisive role in the establishment of the salmon farming industry, leaving its development to private companies. Partly for this reason, official information about Japanese salmon farming is limited. A non-Government agency, the Japan Fishery Resources Conservation Association, inspects most shipments of salmon eggs imported into Japan to prevent the spread of whirling disease or

viral hemorrhagic septicemia.

Salmon Farms: Most commercial-scale salmon farms in Japan produce coho salmon; smaller farms produce other species including chinook. There were an estimated 377 coho salmon farms active in Japan in 1989, compared to 326 farms in 1988. Most of these farms (329) are located in Miyagi Prefecture, about 200 miles north of Tokyo. Smolts are supplied by about 130 freshwater farms, using fertilized coho eggs imported primarily from the United States.

Nichimo Fishing Corporation, a major Japanese company, built the first Japanese salmon farm in the early 1970s, prompted by the decline in North Pacific salmon fishing quotas. The company has continued to be the leading producer of coho salmon, and has recently begun to produce cherry salmon, king salmon, and hybrid salmon species, using biotechnology. In addition, the company is attempting to reduce dependence on imported eggs; it has successfully raised salmon from eggs hatched in Japan. Other important salmon farming companies include Nichiro and Taiyo. The Mitsubishi Corporation has recently joined the Niigata Iron and Steel Company and the Hokkaido Prefectural Fish Hatchery in a feasibility study of raising Atlantic salmon.

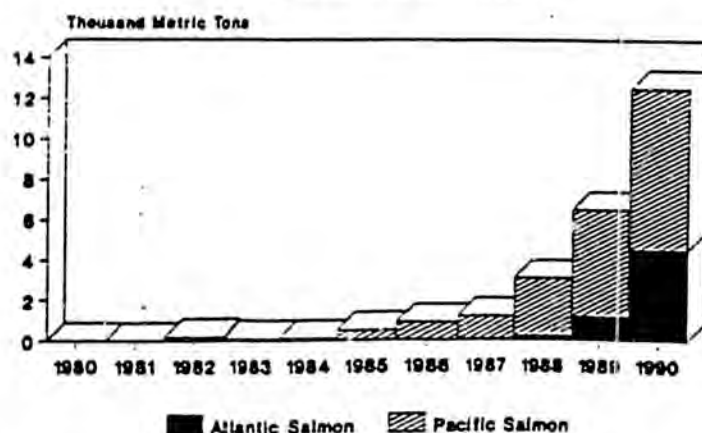
Outlook: Japanese production of farmed Pacific salmon will continue to increase. Coho egg imports from the United States, which largely determine coho salmon production with a 2-3 year lag, increased from 28 million in 1986-87 to 44 million in 1988. If past production rates continue, this level of coho egg imports could yield as much as 30,000 t of salmon in 1990 or 1991.

CHILE

1988 Production:	3,100 t
1989 Production:	6,508 t (est.)
Species:	Atlantic Salmon and Pacific Salmon

Production: Chilean salmon growers expect to harvest over 12,000 t of farmed Atlantic and Pacific salmon in 1990, double the estimated 6,500 t harvested in 1989 (fig. 13). Salmon culture is Chile's fastest growing economic activity. At current growth rates, the salmon culture industry could well become the leading sector of the country's dynamic fishing industry, supplanting Chile's massive fishmeal industry. Salmon farmers initially cultured Pacific cohos, but the involvement of Norwegian and British companies has made possible diversification into Atlantic salmon. Many farmers are also working with Pacific chinooks and sea-farmed trout ("salmon-trout"). Harvests of sockeye and cherry salmon are also planned.

Figure 13.--Chile. Farmed Salmon Production, 1980-1990.



Live Weight.
1989 and 1990 figures are estimates.
Source: U.S. Embassy reports.



Salmon culture is a new industry in Chile. Farmers first harvested more than 1,000 t as late as 1987. Several large foreign companies have subsequently entered the industry, permitting substantial production increases. The participation of major salmon culture companies from Norway, the UK, and Japan has meant an infusion of technology and capital which is enabling the Chilean industry to rapidly evolve from a small-scale operation to an increasingly important sector of the country's fishing industry. 1993 harvests could be close to 30,000 t, equivalent to current UK salmon production levels. Some observers believe that the Chilean industry will eventually rival the massive Norwegian industry. Chilean production costs are generally below those of its major competitors, primarily because of lower feed costs (Chile is a major fishmeal producer).

Farms: The Chilean coast is similar to the Norwegian coast, with large numbers of well-sheltered sites which are ideally suited for salmon farms. Many additional sites are still available along the coast south of Chiloe Island, where the industry is now centered. Farmers are reporting excellent yields with growth rates

exceeding some of the best Scottish and Norwegian operations. (The latitude of Chiloe Island is about 40 degrees, compared with Oslo's latitude of about 60 degrees.) Salmon farmers still rely heavily on imported fertilized salmon eggs, but a small domestic smolt-producing industry is developing. An estimated 25 companies produced salmon smolts in 1989. Salmon farmers in Chile hope to develop a "native species" of disease-resistant farmed salmon.

Exports: Chilean salmon farmers initially marketed their harvests largely fresh in the United States. In 1988-1989, however, exports to Japan increased markedly (table 6 for 1988). In 1989, Chilean exports of frozen salmon to Japan reached 3,970 t, worth \$24 million. Prospects for European sales are unfavorable because of relatively high freight charges to Europe and competition with European producers.

Table 6.--Chile. Exports of Farmed Salmon by Country of Destination, 1986-88.

Destination	1986	1987	1988
	\$ 1,000		
United States	3,237	5,000	9,232
Japan	120	83	7,561
Netherlands	0	57	979
France	6	0	834
Brazil	103	100	259
Argentina	68	107	189
Italy	0	34	136
Belgium	0	25	12
Canada	41	0	0
Others	11	30	398
Total	3,586	5,436	19,600

Units: U.S. dollars (\$).

Source: U.S. Embassy, Santiago.

Outlook: Even in an environment of declining prices, Chilean salmon producers are well-situated to successfully compete because of their low cost structure, high quality standards, species diversification, and successful penetration of both the Japanese and U.S. markets.

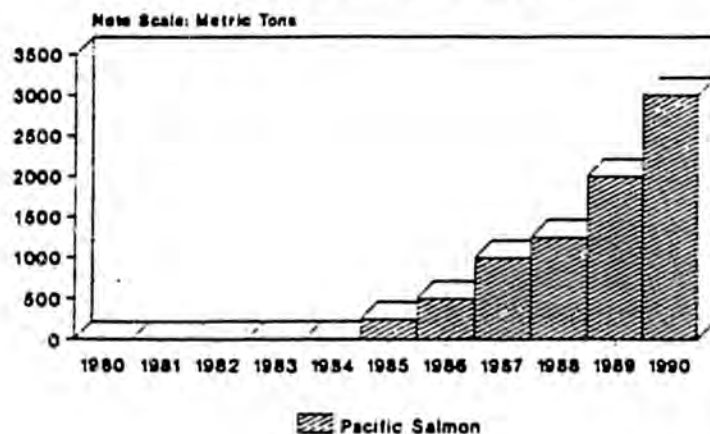
NEW ZEALAND

1988 Production: 1,250 t
 1989 Production: 2,000 t (est.)
 Species: Pacific Salmon



Production: Salmon farming in New Zealand is a relatively new industry. The first salmon farm was established in 1978. Many farmers began to raise salmon on a small scale after first operating other aquaculture ventures such as mussel farms. New Zealand's salmon production has increased rapidly in recent years (fig. 14). While it has yet to become a major producer, New Zealand's salmon output is significant because farmers produce commercial quantities of chinook (king) salmon, a species which is not yet farmed on a large scale anywhere else except in Canada. Exact figures for production by species are not available, but in 1988, New Zealand's salmon farms reportedly had the capacity to produce 2,000 t of chinook salmon per year.

Figure 14.--New Zealand. Farmed Salmon Production, 1980-1990.



Live weight.
 1989 and 1990 figures are estimates.
 Source: U.S. Embassy reports

Farms: There were about 43 salmon aquaculture operations in New Zealand as of early 1988, the latest year for which data are available. Of these, 12 were ocean ranches, 15 were sea-cage farms, 15 were fresh-water pond farms, and 1 was an onshore seawater farm. Most farmers and ranchers raised chinook salmon. At least 9 farms also produced sockeye salmon, but output had not yet reached commercial levels. All farms are licensed by the Government. Eggs are provided primarily by the New Zealand Salmon Company's hatchery, which produces up to 10 million eggs per year.

Salmon farmers in New Zealand have faced both natural and man-made obstacles to expansion. In early 1989, about 600 t (out of a total of 1,400-1,500 t of penned chinook salmon) were lost after an algae bloom struck a group of farms on Stewart Island, the center of the salmon farming industry. On that occasion, farmers were hindered in their efforts to save stocks by a Government regulation restricting salmon farms to Glory Bay, where the algae bloom was most pronounced. After these serious losses, farmers petitioned the Government to relax some of the restrictions placed on salmon farms. However, the control of salmon farming remains a sensitive issue in New Zealand, where protecting the environment is a priority. Ironically, the algae bloom, which destroyed a significant

portion of salmon stocks in early 1989 also heightened concerns that salmon farming had disturbed the natural environment. (Later research, however, has apparently shown that the algae infestation was caused by natural conditions.) Despite the irritation that salmon farmers express concerning strict controls on their industry, Government regulations have played a role in protecting New Zealand's salmon farms from outbreaks of disease. Farms have been briefly quarantined after salmon were discovered to have whirling disease.

Apart from regulatory control, another factor in the slow growth of New Zealand's salmon farming capacity is opposition from native peoples, such as the Maoris, who own prime coastal land. Potential salmon farming ventures have faced long bureaucratic delays as applications for leases are reviewed.

Exports: Most of New Zealand's salmon production is exported to the United States and Japan. In 1986, 75 percent of its exports were sold to the United States, but in recent years the emphasis has shifted overwhelmingly toward Japan. In 1989, New Zealand exported 960 t, worth \$5.6 million to Japan, but only about 1 t to the United States. Most exports are shipped frozen, rather than fresh.

New Zealand's southern-hemisphere location provides is advantageous for salmon exports, because—like Chile—its harvests are available during the northern hemisphere's salmon-culturing off-season (June-August). Furthermore, by producing chinook salmon, New Zealand's farmers have entered a market in which there is limited competition from other salmon farming nations. On the other hand, New Zealand's salmon exporters face the disadvantage of high transport costs.

AUSTRALIA

1988-89 Production: 380 t

1989-90 Production: 2,000 t (est.)

Species: Atlantic Salmon

Production: Salmon farming in Australia began in 1985, when the Tasmanian Government and Norway's Norqua Group established a joint venture (called Tassal Ltd.) to produce Atlantic salmon. That company has become the country's largest producer, and other salmon farms have opened both in Tasmania and in western Australia. The prospects for development of salmon farming in Australia are good because of favorable natural conditions and because of the presence of experienced farmers from both Norway and Scotland. In addition, many salmon farmers in Australia have experience in raising trout, and are thus prepared for some of the difficult technical issues involved in raising salmon. Most farmed salmon in Australia is sold on the domestic market. In 1989, however, Australia exported 280 t, worth \$3 million, to Japan.

Farms: Australian salmon farms are concentrated on the island of Tasmania, south of the mainland, where natural conditions favor rapid growth. In 1987, the latest year for which data are available, there were 26 farms licensed to raise salmon in Tasmania (and 23 farms licensed to grow rainbow trout). The 4 largest farms on the island are operated by the Tassal company, the joint venture with Norway, which has established an integrated operation controlling

production from the smolt stage through harvesting, processing, and marketing.

At least two companies--Marine Industries company, and Australian Seafarms company--have opened salmon farms on the southwest coast of Australia, near Perth. Marine Industries operates tank farms for production of rainbow trout, and was planning to use a similar system for production of salmon. In 1987, that company was forecasting harvests of about 500 t per year by 1992, while Australian Seafarms was forecasting production of 300 t per year by 1991 and 1000 t per year by 1994. Actual production figures for the 2 companies were not available as this report was being prepared.

Sources

General:

U.S. Embassy and Consular Reports.

Fish Farming International, various issues.

Shaw, Susan A., and Adrienne Curry, Markets in Europe for Selected Aquaculture Species, FAO-GLOBEFISH, Rome, July 1989.

Eurofish Report, various issues.

National Marine Fisheries Service, Aquaculture and Capture Fisheries: Impacts in U.S. Seafood Markets, Washington, U.S. Department of Commerce, April 1988.

DPA Group Inc., "Cost Production Model for Pen Rearing of Salmon in Alaska and Other Producing Regions," as cited in Mendez, La Salmonicultura en Chile, 1989.

Australia:

"Fishing for Seafood Profits," Fishing Today, April-May, 1989.

O'Sullivan, David, "Sea-farming Salmon and Trout in Western Australia," Fins, November 6, 1987.

Canada:

Folsom, William, "Canadian Salmon Farming, 1988-89," International Fisheries Report (IFR) 89/99, National Marine Fisheries Service, Washington, December 1989.

Chile:

Mendez, Ricardo, and Clara Muniz, La Salmonicultura en Chile, Fundacion Chile, 1989.

Weidner, Dennis, "The Chilean Salmon Industry, 1989," IFR 90/03, National Marine Fisheries Service, Washington, January 1990.

Ireland:

"Ireland: Schatzinsel für Meereskost," Fischmagazin, Hamburg, September 1989.

Fishing News International, various issues.

Japan:

Tashiro, Yoshio, "Keynote Report: Japan," Proceedings of the JETRO International Forum on Salmon and Trout, Tokyo, 1988.

Anderson, James L., and Yuko Kusakabe, "The Japanese Seafood Market: Salmon," Economic and Commercial Analysis Report No. 21, Published by Market Analysis Group, Canadian Department of Fisheries and Oceans, Ottawa, April 1989.

Norway:

Folsom, William, "Norwegian Salmon Farming, 1988-89," IFR 90/99, National Marine Fisheries Service, Washington, December 1989.

New Zealand:

"New Zealand aiming for top quality," Seafood International, London, January 1988.

UK (Scotland):

Department of Agriculture and Fisheries, "Salmon Farming," (monthly selections from literature on salmon farming), Aberdeen, various months, 1989.

_____, "Report of the DAFS Annual Survey of Fish Farms for 1988, Aberdeen, 1989.

"Der Lachs: Rolls Royce oder BMW?" Fischmagazin, Hamburg, May, 1989.

Seafood Business Leader (February 1990)

Shetland Times, various issues.

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FOR REGIONAL STATISTICS AND MARKET NEWS OFFICES ONLY: Please publish the following summary whenever space is available. Thank you. M. Kravanja.

SUMMARY: "World farmed salmon production reached an estimated 217,000 metric tons (t) in 1989, increasing from 145,000 t in 1988. The yield from the world's salmon farms is comparable to the U.S. annual salmon catch (about 250,000 t), and is approaching one-third the size of the world wild salmon catch (about 700,000 t). Farmed salmon production could exceed 270,000 t in 1990. The rapid expansion of farmed salmon supplies in the late 1980s has led to sharp price decreases. The world's largest farmed salmon producer is Norway, accounting for about half of total production in 1988-1989. In early 1990, Norwegian producers for the first time announced plans to freeze significant quantities (20,000-40,000 t) of salmon for export. This action is intended to protect the huge Norwegian industry by stabilizing fresh salmon prices, but it could also adversely affect frozen salmon exporters in the United States. The Branch of Foreign Fisheries Analysis, Office of International Affairs, has prepared a report describing general trends in salmon farming and the salmon farming industry in Norway and 13 other countries, including the United Kingdom, Canada, Japan, and Chile. U.S. companies can obtain the 27-page report by requesting "World Salmon Aquaculture" (IFR 90/30) from this Statistics and Market News Office, enclosing a large self-addressed envelope with \$1.00 postage."

INDEX: WORLD
Salmon Aquaculture

May 9, 1990

APPENDIX 1. -- WORLD FARMED SALMON PRODUCTION, 1980-89 WITH PROJECTIONS TO 1990.

COUNTRY	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
-- (in Metric Tons, Live Weight) --											
EUROPEAN COMMUNITY:											
France.....	30	40	40	40	50	60	60	60	60	60	600
Ireland.....	21	35	100	257	385	722	1,500	2,232	4,200	7,300	10,000
Spain.....	0	0	0	0	100	150	150	200	300	450	600
United Kingdom...	598	1,333	2,136	2,536	3,912	6,921	10,338	12,721	17,951	31,015	35,000
Sub-total.....	649	1,408	2,276	2,833	4,447	7,853	12,048	15,213	22,511	38,825	46,200
NON-EC EUROPE:											
Faeroe Islands...	0	0	60	105	116	470	1,370	3,500	3,400	8,000	10,000
Finland.....	0	30	30	30	94	100	100	127	150	170	200
Iceland.....	0	20	30	50	107	91	123	530	1,233	3,900	8,600
Norway.....	4,143	8,422	10,266	17,700	25,936	33,796	49,985	56,204	83,700	114,866	150,000
Sweden.....	0	0	10	15	59	81	160	224	363	500	500
Sub-total.....	4,143	8,472	10,396	17,200	26,312	34,538	51,738	60,585	88,846	127,436	169,300
NORTH AMERICA:											
Canada:											
Atlantic.....	11	21	38	68	222	349	646	1,350	3,100	3,150	3,250
Pacific.....	157	176	273	128	107	120	400	1,362	6,000	14,500	20,000
Sub-total....	168	197	311	196	329	469	1,046	2,712	9,100	17,650	23,250
United States:											
Atlantic.....	0	0	0	0	23	68	136	800	1,700	3,200	5,200
Pacific.....	329	873	691	844	1,225	1,752	1,264	1,700	2,000	2,400	2,500
Sub-total....	329	873	691	844	1,248	1,820	1,400	2,500	3,700	5,600	7,700
Total.....	497	1,070	1,002	1,040	1,577	2,289	2,446	5,212	12,800	23,250	30,950
OTHER:											
Chile:											
Atlantic.....	0	1	184	94	109	500	897	1,138	2,900	5,308	8,000
Pacific.....	0	0	0	0	0	0	0	57	200	1,200	4,500
Sub-total....	0	1	184	94	109	500	897	1,195	3,100	6,508	12,500
Japan.....	1,855	1,159	2,122	2,760	5,049	6,990	7,533	12,177	16,400	18,600	20,000
New Zealand.....	0	2	5	10	10	250	500	1,000	1,250	2,000	3,000
Sub-total.....	1,855	1,162	2,311	2,864	5,168	7,740	8,930	14,372	20,750	27,108	35,500
GRAND TOTAL.....	7,144	12,112	15,985	23,937	37,504	52,420	75,162	95,382	144,907	216,619	281,950

SOURCES: U.S. Embassy reports.

UK (Scotland): Department of Agriculture and Fisheries, Edinburgh, for 1988-1990.

Norway: U.S. Embassy, Oslo 5051 dated July 10, 1989, data for 1984-89.

Sweden: "Fiske 1988 - en oversikt, Definitiva uppgifter," Statistiska Meddelanden, J55SM8901, Statistiska centr

NOTE: Excludes data for Australia.

APPENDIX 2. -- WORLD PRODUCTION OF FARMED ATLANTIC AND PACIFIC SALMON, ARRANGED BY SPECIES, 1980-1989
WITH PROJECTIONS TO 1990.

COUNTRY	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
-- (in Metric Tons, Live Weight) --											
ATLANTIC SALMON:											
Canada, Atlantic	11	21	38	68	222	349	646	1,350	3,100	3,150	3,250
Chile.....	0	1	184	94	109	500	897	1138	2900	5308	8000
Faeroe Islands...	0	0	60	105	116	470	1,370	3,500	3,400	8,000	10,000
Finland.....	0	30	30	30	94	100	100	127	150	170	200
France.....	30	40	40	40	50	60	60	60	60	60	600
Iceland.....	0	20	30	50	107	91	123	530	1,233	3,900	8,600
Ireland.....	21	35	100	257	385	722	1,500	2,232	4,200	7,300	10,000
Norway.....	4,143	8,422	10,266	17,000	25,936	33,796	49,985	56,204	83,700	114,866	150,000
Sweden.....	0	0	10	15	59	81	160	224	363	500	500
United Kingdom...	598	1,333	2,136	2,536	3,912	6,921	10,338	12,721	17,951	31,015	35,000
United States....	0	0	0	0	23	68	136	800	1,700	3,200	5,200
Total Atlantic	4,803	9,902	12,894	20,195	31,013	43,158	65,315	78,886	118,757	177,469	231,350
PACIFIC SALMON:											
Canada, Pacific..	157	176	273	128	107	120	400	1,362	6,000	14,500	20,000
Chile.....	0	0	0	0	0	0	0	57	200	1,200	4,500
Japan.....	1,855	1,159	2,122	2,760	5,049	6,990	7,533	12,177	16,400	18,600	20,000
New Zealand.....	0	2	5	10	10	250	500	1,000	1,250	2,000	3,000
Spain.....	0	0	0	0	100	150	150	200	300	450	600
United States....	329	873	691	844	1,225	1,752	1,264	1,700	2,000	2,400	2,500
Total Pacific..	2,341	2,210	3,091	3,742	6,491	9,262	9,847	16,496	26,150	39,150	50,600
GRAND TOTAL.....	7,144	12,112	15,985	23,937	37,504	52,420	75,162	95,382	144,907	216,619	281,950

SOURCES: U.S. Embassy reports.

UK (Scotland): Department of Agriculture and Fisheries, Edinburgh, for 1988-1990.

Norway: U.S. Embassy, Oslo 5051 dated July 10, 1989, data for 1984-89.

Sweden: "Fiske 1988 - en oversikt, Definitiva uppgifter," Statistiska Meddelanden, J55SM8901, Statistiska centr

NOTE: Excludes data for Australia.

Table 13.11. Permitted egg capacities, in millions, of PNP hatcheries within the planning regions, 1991.

REGION	Pink	Chum	Coho	Chinook	Sockeye	Steelhead	Total
SOUTHERN SOUTHEAST							
Association Facilities	0.00	105.80	8.40	5.54	4.00		123.74
Non-Association Facilities	46.00	42.00	0.42	1.40		0.01	89.83
total	46.00	147.80	8.82	6.94	4.00		213.56
NORTHERN SOUTHEAST							
Association Facilities	0.30	136.00	3.55	5.50			145.35
Non-Association Facilities	138.00	251.50	3.25	0.85		0.09	393.69
total	138.30	387.50	6.80	6.35	0.00	0.09	539.04
YAKUTAT (no PNP facilities)							
total	0.00	0.00	0.00	0.00	0.00		0.00
PRINCE WILLIAM SOUND							
Association Facilities	508.00	129.00	4.00	4.00	31.00		676.00
Non-Association Facilities	240.00	28.00	2.00	0.30			270.30
total	748.00	157.00	6.00	4.30	31.00		946.30
COOK INLET							
Association Facilities	10.00	10.00	7.10	4.10	30.00		61.20
total	10.00	10.00	7.10	4.10	30.00		61.20
STATEWIDE TOTALS	942.30	702.30	28.72	21.69	65.00	0.09	1760.10

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